

KAPLAN

# 8 Practice Tests for the New SAT<sup>®</sup> 2016

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- Master the test with realistic practice and in-depth question review
- 1,200+ practice questions
- Detailed answer explanations with expert strategic advice
- Practice for every question type

**HIGHER SCORE GUARANTEED\***

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# SAT PRACTICE TEST 1 ANSWER SHEET

Remove (or photocopy) this answer sheet and use it to complete the test. See the answer key following the test when finished.

Start with number 1 for each section. If a section has fewer questions than answer spaces, leave the extra spaces blank.

## SECTION

1

- |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| 1. (A) (B) (C) (D)  | 14. (A) (B) (C) (D) | 27. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 2. (A) (B) (C) (D)  | 15. (A) (B) (C) (D) | 28. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 3. (A) (B) (C) (D)  | 16. (A) (B) (C) (D) | 29. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D)  | 17. (A) (B) (C) (D) | 30. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D)  | 18. (A) (B) (C) (D) | 31. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D)  | 19. (A) (B) (C) (D) | 32. (A) (B) (C) (D) | 45. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D)  | 20. (A) (B) (C) (D) | 33. (A) (B) (C) (D) | 46. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D)  | 21. (A) (B) (C) (D) | 34. (A) (B) (C) (D) | 47. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D)  | 22. (A) (B) (C) (D) | 35. (A) (B) (C) (D) | 48. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 23. (A) (B) (C) (D) | 36. (A) (B) (C) (D) | 49. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 24. (A) (B) (C) (D) | 37. (A) (B) (C) (D) | 50. (A) (B) (C) (D) |
| 12. (A) (B) (C) (D) | 25. (A) (B) (C) (D) | 38. (A) (B) (C) (D) | 51. (A) (B) (C) (D) |
| 13. (A) (B) (C) (D) | 26. (A) (B) (C) (D) | 39. (A) (B) (C) (D) | 52. (A) (B) (C) (D) |

# right in  
Section 1
# wrong in  
Section 1

## SECTION

2

- |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| 1. (A) (B) (C) (D)  | 12. (A) (B) (C) (D) | 23. (A) (B) (C) (D) | 34. (A) (B) (C) (D) |
| 2. (A) (B) (C) (D)  | 13. (A) (B) (C) (D) | 24. (A) (B) (C) (D) | 35. (A) (B) (C) (D) |
| 3. (A) (B) (C) (D)  | 14. (A) (B) (C) (D) | 25. (A) (B) (C) (D) | 36. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D)  | 15. (A) (B) (C) (D) | 26. (A) (B) (C) (D) | 37. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D)  | 16. (A) (B) (C) (D) | 27. (A) (B) (C) (D) | 38. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D)  | 17. (A) (B) (C) (D) | 28. (A) (B) (C) (D) | 39. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D)  | 18. (A) (B) (C) (D) | 29. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D)  | 19. (A) (B) (C) (D) | 30. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D)  | 20. (A) (B) (C) (D) | 31. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 21. (A) (B) (C) (D) | 32. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 22. (A) (B) (C) (D) | 33. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |

# right in  
Section 2
# wrong in  
Section 2

SECTION 3

3

- 1. (A) (B) (C) (D)
- 2. (A) (B) (C) (D)
- 3. (A) (B) (C) (D)
- 4. (A) (B) (C) (D)

- 5. (A) (B) (C) (D)
- 6. (A) (B) (C) (D)
- 7. (A) (B) (C) (D)
- 8. (A) (B) (C) (D)

- 9. (A) (B) (C) (D)
- 10. (A) (B) (C) (D)
- 11. (A) (B) (C) (D)
- 12. (A) (B) (C) (D)

- 13. (A) (B) (C) (D)
- 14. (A) (B) (C) (D)
- 15. (A) (B) (C) (D)

# right in Section 3

# wrong in Section 3

16.

	7	7	
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1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
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7	7	7	7
8	8	8	8
9	9	9	9

17.

	7	7	
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2	2	2	2
3	3	3	3
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7	7	7	7
8	8	8	8
9	9	9	9

18.

	7	7	
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3	3	3	3
4	4	4	4
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7	7	7	7
8	8	8	8
9	9	9	9

19.

	7	7	
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

20.

	7	7	
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

SECTION 4

4

- 1. (A) (B) (C) (D)
- 2. (A) (B) (C) (D)
- 3. (A) (B) (C) (D)
- 4. (A) (B) (C) (D)
- 5. (A) (B) (C) (D)
- 6. (A) (B) (C) (D)
- 7. (A) (B) (C) (D)
- 8. (A) (B) (C) (D)

- 9. (A) (B) (C) (D)
- 10. (A) (B) (C) (D)
- 11. (A) (B) (C) (D)
- 12. (A) (B) (C) (D)
- 13. (A) (B) (C) (D)
- 14. (A) (B) (C) (D)
- 15. (A) (B) (C) (D)
- 16. (A) (B) (C) (D)

- 17. (A) (B) (C) (D)
- 18. (A) (B) (C) (D)
- 19. (A) (B) (C) (D)
- 20. (A) (B) (C) (D)
- 21. (A) (B) (C) (D)
- 22. (A) (B) (C) (D)
- 23. (A) (B) (C) (D)
- 24. (A) (B) (C) (D)

- 25. (A) (B) (C) (D)
- 26. (A) (B) (C) (D)
- 27. (A) (B) (C) (D)
- 28. (A) (B) (C) (D)
- 29. (A) (B) (C) (D)
- 30. (A) (B) (C) (D)

# right in Section 4

# wrong in Section 4

31.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

32.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

33.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

34.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

35.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

36.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

37.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

38.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

# MATH TEST

25 Minutes—20 Questions

## NO-CALCULATOR SECTION

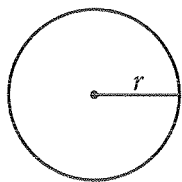
Turn to Section 3 of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding oval on the answer sheet. You may use any available space for scratch work.

Notes:

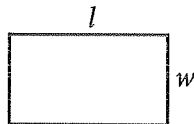
1. Calculator use is NOT permitted.
2. All numbers used are real numbers.
3. All figures used are necessary to solving the problems that they accompany. All figures are drawn to scale EXCEPT when it is stated that a specific figure is not drawn to scale.
4. Unless stated otherwise, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$ , for which  $f(x)$  is a real number.

Information:

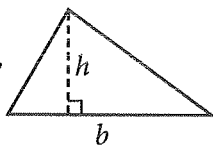


$$A = \pi r^2$$

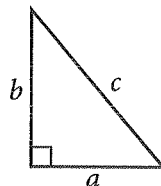
$$C = 2\pi r$$



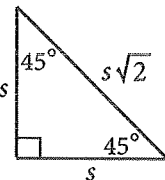
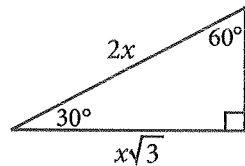
$$A = lw$$



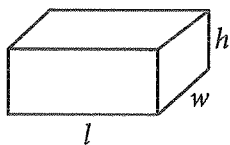
$$A = \frac{1}{2}bh$$



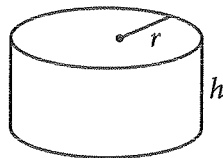
$$c^2 = a^2 + b^2$$



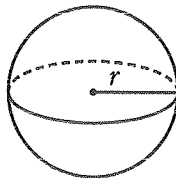
Special Right Triangles



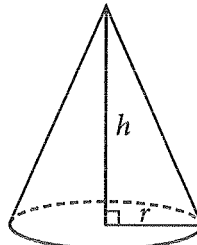
$$V = lwh$$



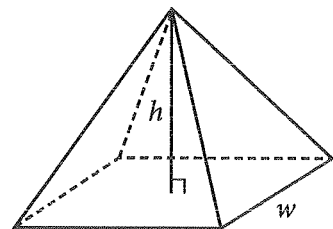
$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



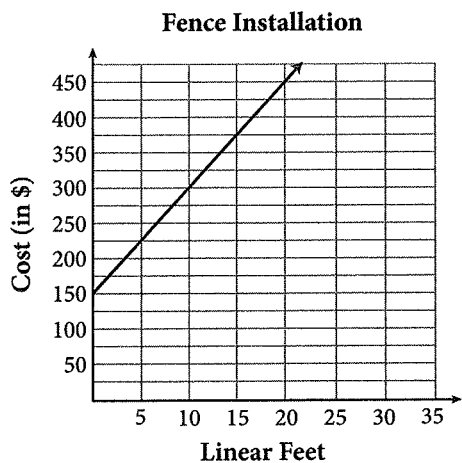
$$V = \frac{1}{3}lwh$$

The sum of the degree measures of the angles in a triangle is 180.

The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is  $2\pi$ .

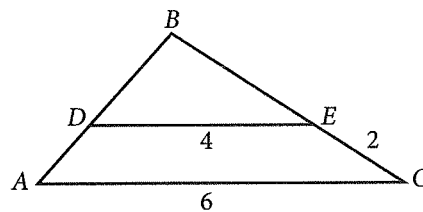
GO ON TO THE NEXT PAGE



- The graph shows the cost of installing a vinyl privacy fence. The company charges a flat installation fee plus a cost per linear foot of fencing. Based on the graph, how much does one linear foot of this particular vinyl fence cost?
  - A) \$5
  - B) \$15
  - C) \$75
  - D) \$150

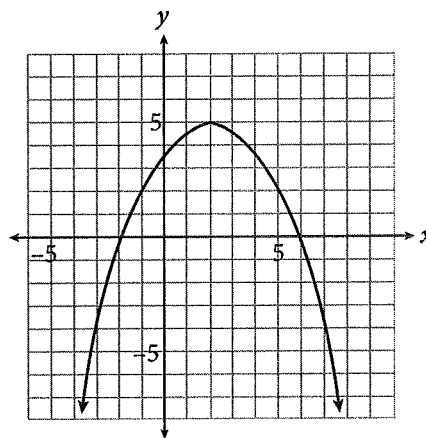
$$\frac{24x^4 + 36x^3 - 12x^2}{12x^2}$$

- Which of the following expressions is equivalent to the expression shown above?
  - A)  $2x^2 + 3x$
  - B)  $24x^4 + 36x^3$
  - C)  $2x^2 + 3x - 1$
  - D)  $24x^4 + 36x^3 - 1$

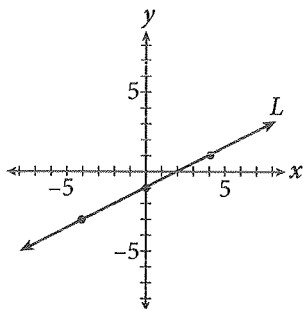


Note: Figure not drawn to scale.

- In the figure shown,  $\triangle ABC \sim \triangle DBE$ . What is the length of  $\overline{BE}$ ?
  - A) 3.5
  - B) 3.75
  - C) 4
  - D) 4.5



- Which of the following represents the function shown?
  - A)  $f(x) = -\frac{1}{3}(x-2)^2 + 5$
  - B)  $f(x) = -\frac{1}{3}(x+2)^2 + 5$
  - C)  $f(x) = \frac{1}{3}(x+2)^2 + 5$
  - D)  $f(x) = 3(x-2)^2 + 5$



5. If line  $L$  shown here is reflected over the  $x$ -axis, what is the slope of the new line?
- A)  $-2$   
 B)  $-\frac{1}{2}$   
 C)  $\frac{1}{2}$   
 D)  $2$
6. If  $p = 4x^3 + x - 2$ ,  $q = x^2 - 1$ , and  $r = 3x - 5$ , then what is  $2p - (q + r)$ ?
- A)  $7x^3 - x + 2$   
 B)  $8x^3 - x^2 - x + 2$   
 C)  $8x^3 - x^2 - x - 10$   
 D)  $8x^3 - x^2 + 5x - 8$
7. Which of the following are the roots of the equation  $2x^2 + 4x - 3 = 0$ ?
- A)  $\frac{-2 \pm \sqrt{10}}{2}$   
 B)  $-2 \pm \sqrt{5}$   
 C)  $-1 \pm \sqrt{10}$   
 D)  $-1 \pm 2\sqrt{10}$
8. If  $g(x) = 3x - 5$  and  $h(x) = \frac{7x + 10}{4}$ , at what point does the graph of  $g(x)$  intersect the graph of  $h(x)$ ?
- A)  $(-2, -11)$   
 B)  $(2, 1)$   
 C)  $(3, 4)$   
 D)  $(6, 13)$
9. If  $x = k^{-\frac{1}{3}}$ , where  $x > 0$  and  $k > 0$ , which of the following equations gives  $k$  in terms of  $x$ ?
- A)  $k = \frac{1}{x^3}$   
 B)  $k = \frac{1}{\sqrt[3]{x}}$   
 C)  $k = -\sqrt[3]{x}$   
 D)  $k = -x^3$
- $4x - (10 - 2x) = c(3x - 5)$
10. If the equation shown has infinitely many solutions, and  $c$  is a constant, what is the value of  $c$ ?
- A)  $-2$   
 B)  $-\frac{2}{3}$   
 C)  $\frac{2}{3}$   
 D)  $2$
11. If  $0 < 1 - \frac{a}{3} \leq \frac{1}{2}$ , which of the following is not a possible value of  $a$ ?
- A)  $1.5$   
 B)  $2$   
 C)  $2.5$   
 D)  $3$

$$\begin{cases} y - \frac{2}{k}x \leq 0 \\ \frac{1}{k}x - \frac{1}{2}y \leq -1 \end{cases}$$

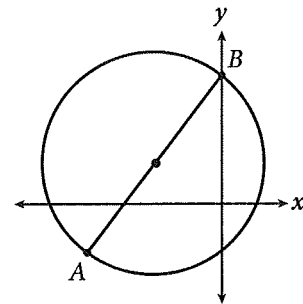
12. If the system of inequalities shown has no solution, what is the value of  $k$ ?

- A) 1  
 B) 2  
 C) There is no value of  $k$  that results in no solution.  
 D) There are infinitely many values of  $k$  that result in no solution.

$$\frac{4x}{x-7} + \frac{2x}{2x-14} = \frac{70}{2(x-7)}$$

13. What value(s) of  $x$  satisfy the equation above?

- A) 0  
 B) 7  
 C) No solution  
 D) Any value such that  $x \neq 7$



14. The circle shown is given by the equation  $x^2 + y^2 + 6x - 4y = 12$ . What is the shortest distance from  $A$  to  $B$ ?

- A) 5  
 B) 10  
 C)  $4\sqrt{3}$   
 D) 24

15. If  $g$  is a function defined over the set of all real numbers and  $g(x-1) = 3x^2 + 5x - 7$ , then which of the following defines  $g(x)$ ?

- A)  $g(x) = 3x^2 - x - 9$   
 B)  $g(x) = 3x^2 + 5x + 1$   
 C)  $g(x) = 3x^2 + 11x + 1$   
 D)  $g(x) = 3x^2 + 11x - 6$

**Directions:** For questions 16-20, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
4. Some problems may have more than one correct answer. In such cases, grid only one answer.
5. **Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $\frac{7}{2}$ .  
(If  $3\frac{1}{2}$  is entered into the grid as 

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)
6. **Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Answer:  $\frac{7}{12}$

Write answer in boxes. →

7	/	1	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Grid in result. →

Answer: 2.5

2	.	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

← Decimal point

Answer: 201

Either position is correct.

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

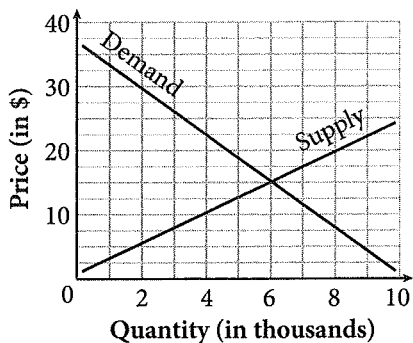
Acceptable ways to grid  $\frac{2}{3}$  are:

2	/	3
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2	2	2
3	3	3
4	4	4
5	5	5
6	6	6

.	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

.	6	6	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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6	6	6	6



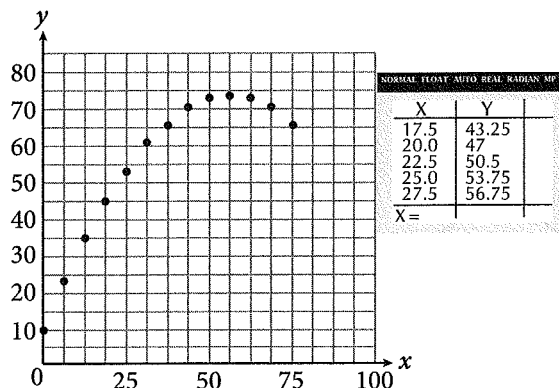


16. Retail businesses strive to price their products so that they sell as many as possible without losing money. Economic equilibrium is the price point at which the supply for a product is equal to the demand for that product. The graph above models this scenario. According to the graph, at what price in dollars will supply equal demand for this particular product?
17. Once an insect reaches its larval stage, its mass increases linearly for a short period of time and then slows down as it prepares to enter pupation. Suppose the larva of a certain species has an initial mass of 10 grams and grows linearly from  $t = 0$  to  $t = 48$  hours of its larval stage. If after 48 hours, the mass of the larva is 14 grams, what was its mass in grams at  $t = 6$  hours?

$x$	$f(x)$
-1	-2
0	0
1	2
2	4
3	6

$x$	$g(x)$
-2	3
-1	2
0	1
1	-1
2	-2

18. Several values for the functions  $f(x)$  and  $g(x)$  are shown in the tables. What is the value of  $f(g(-1))$ ?
19. If  $(4 + 3i)(1 - 2i) = a + bi$ , then what is the value of  $a$ ? (Note that  $i = \sqrt{-1}$ .)



20. The maximum value of the data shown in the scatterplot occurs at  $x = 56.25$ . If the data is modeled using a quadratic regression and the correlation coefficient is 1.0, then what is the  $y$ -value when  $x = 90$ ?

# MATH TEST

55 Minutes—38 Questions

## CALCULATOR SECTION

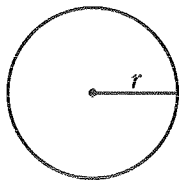
Turn to Section 4 of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding oval on the answer sheet. You may use any available space for scratch work.

Notes:

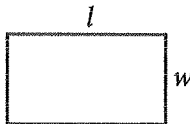
1. Calculator use is permitted.
2. All numbers used are real numbers.
3. All figures used are necessary to solving the problems that they accompany. All figures are drawn to scale EXCEPT when it is stated that a specific figure is not drawn to scale.
4. Unless stated otherwise, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$ , for which  $f(x)$  is a real number.

Information:

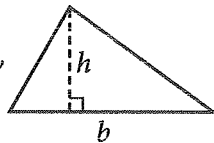


$$A = \pi r^2$$

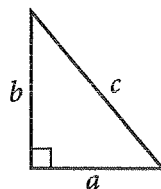
$$C = 2\pi r$$



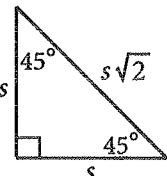
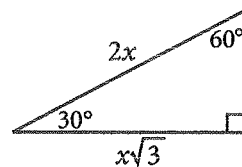
$$A = lw$$



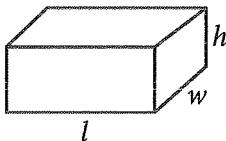
$$A = \frac{1}{2}bh$$



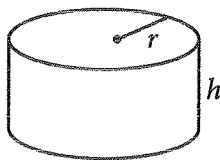
$$c^2 = a^2 + b^2$$



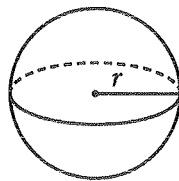
Special Right Triangles



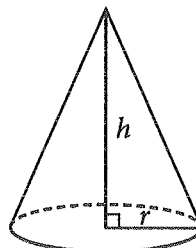
$$V = lwh$$



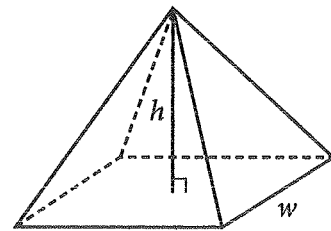
$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



$$V = \frac{1}{3}lwh$$

The sum of the degree measures of the angles in a triangle is 180.

The number of degrees of arc in a circle is 360.

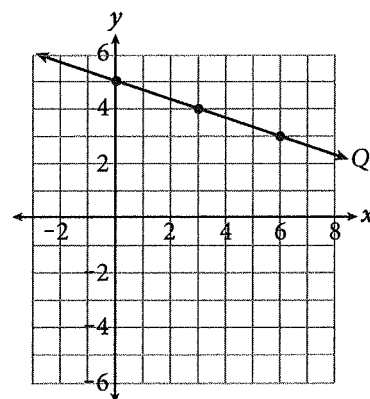
The number of radians of arc in a circle is  $2\pi$ .

1. The U.S. Centers for Disease Control recommends that adults engage in 2.5 hours per week of vigorous exercise. A local health society conducts a survey to see if people are meeting this goal. They ask 100 people with gym memberships how many minutes of exercise they engage in per week. After analyzing the data, the health society finds that the average respondent exercises 142 minutes per week, but the margin of error was approximately 36 minutes. The society wants to lower this margin of error. Using which of the following samples instead would do so?

- A) 50 people with gym memberships  
 B) 50 people randomly selected from the entire adult population  
 C) 100 people with gym memberships, but from a variety of gyms  
 D) 200 people randomly selected from the entire adult population

2. As a general rule, businesses strive to maximize revenue and minimize expenses. An office supply company decides to try to cut expenses by utilizing the most cost-effective shipping method. The company determines that the cheapest option is to ship boxes of ballpoint pens and mechanical pencils with a total weight of no more than 20 pounds. If each pencil weighs 0.2 ounces and each pen weighs 0.3 ounces, which inequality represents the possible number of ballpoint pens,  $b$ , and mechanical pencils,  $m$ , the company could ship in a box and be as cost-effective as possible?

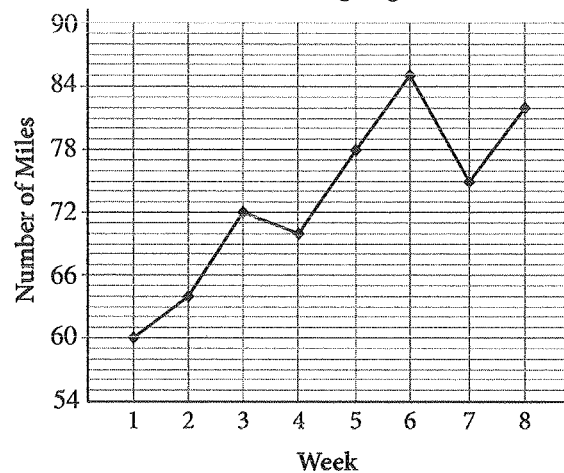
- A)  $0.3b + 0.2m < 20$   
 B)  $0.3b + 0.2m \leq 20$   
 C)  $\frac{b}{0.3} + \frac{m}{0.2} < 20$   
 D)  $\frac{b}{0.3} + \frac{m}{0.2} \leq 20$



3. Where will line  $Q$  shown in the graph intersect the  $x$ -axis?
- A) 13  
 B) 14  
 C) 15  
 D) 16
4. The function  $f(x)$  is defined as  $f(x) = 2g(x)$ , where  $g(x) = x + 5$ . What is the value of  $f(3)$ ?
- A) -4  
 B) 6  
 C) 8  
 D) 16
5. A printing company uses a color laser printer that can print 18 pages per minute (ppm) when printing on thick cardstock paper. One of the company's best sellers on the Internet is business cards, which are sold in boxes of 225 cards. The cards are printed 10 per page, then cut and boxed. If a real estate company has 12 full-time agents and orders two boxes of cards per agent, how many minutes should it take to print the cards, assuming the printer runs continuously?
- A) 15  
 B) 20  
 C) 30  
 D) 45

6. If  $0.002 \leq x \leq 0.2$  and  $5 \leq y \leq 25$ , what is the maximum value of  $\frac{x}{y}$ ?
- A) 0.04  
 B) 0.4  
 C) 4  
 D) 40
7. Following a study of children in the United States under three years old, the American Academy of Pediatrics stated that there is a positive correlation between the amount of time spent watching television and the likelihood of developing an attention deficit disorder. Which of the following is an appropriate conclusion to draw from this statement?
- A) There is an association between television time and attention disorders for American children under three years old.  
 B) There is an association between television time and attention disorders for all children under three years old.  
 C) An increase in attention disorders is caused by an increase in television time for American children under three years old.  
 D) An increase in attention disorders is caused by an increase in television time for all children under three years old.

Training Log

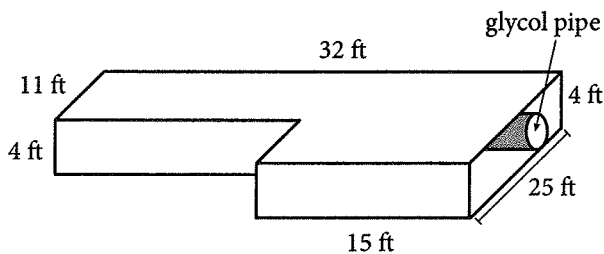


8. A bicyclist is training for the Liège-Bastogne-Liège, one of Europe's oldest road bicycle races. The line graph above shows the number of miles she biked each week for eight weeks. According to the graph, what was the greatest change (in absolute value) in the weekly number of miles she biked between two consecutive weeks?
- A) 7  
 B) 8  
 C) 9  
 D) 10
9. If a line that passes through the coordinates  $(a - 1, 2a)$  and  $(a, 6)$  has a slope of 5, what is the value of  $a$ ?
- A) -2  
 B)  $-\frac{1}{2}$   
 C)  $\frac{1}{2}$   
 D) 2

10. An occupational health organization published a study showing an increase in the number of injuries that resulted from elderly people falling in the bathtub. In response to this increase, a medical supply company decided to drop its price on bathtub lifts from \$450 to \$375, hoping to still break even on the lifts. The company breaks even when its total revenue (income from selling  $n$  bathtub lifts) is equal to its total cost of producing the lifts. If the cost  $C$ , in dollars, of producing the lifts is  $C = 225n + 3,150$ , how many more of the lifts does the company need to sell at the new price to break even than at the old price?
- A) 7  
 B) 12  
 C) 14  
 D) 21

Questions 11 and 12 refer to the following information.

A zoo is building a penguin exhibit. It will consist of an underwater area and a land area. The land area is made of thick sheets of ice. An outline of the total space covered by the ice is shown below. A pipe 2 feet in diameter runs the full length of the exhibit under the ice. A substance known as ice-cold glycol continuously runs through the pipe to keep the ice frozen.



11. About how many cubic feet of water are needed to create the ice portion of the exhibit?
- A) 1,850  
 B) 2,150  
 C) 2,450  
 D) 3,100
12. The zoo is planning to hire a company to fill the space with water. The company plans to use two 4-inch hoses that can each pump 60 gallons of water per minute. About how long should it take to fill the space? (There are 7.48 gallons of water in 1 cubic foot of ice.)
- A) 1 hour  
 B) 1 hour, 30 minutes  
 C) 1 hour, 55 minutes  
 D) 2 hours, 15 minutes

13. Which of the following quadratic equations has no solution?

- A)  $0 = -2(x - 5)^2 + 3$   
 B)  $0 = -2(x - 5)(x + 3)$   
 C)  $0 = 2(x - 5)^2 + 3$   
 D)  $0 = 2(x + 5)(x + 3)$

Questions 14 and 15 refer to the following information.

Three airplanes depart from three different airports at 8:30 AM, all travelling to Chicago O'Hare International Airport (ORD). The distances the planes must travel are recorded in the following table.

From	Distance to Chicago (ORD)
Kansas City (MCI)	402
Boston (BOS)	864
Miami (MIA)	1,200

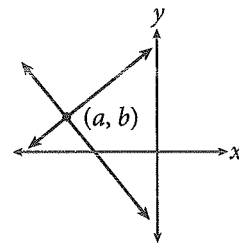
14. The plane traveling from Boston traveled at an average speed of 360 mph. The plane traveling from Kansas City arrived at 10:34 AM. How many minutes before the plane from Boston arrived did the plane from Kansas City arrive?
- A) 20  
 B) 28  
 C) 42  
 D) 144

15. For the first  $\frac{1}{4}$  of the trip, the plane from Miami flew through heavy winds and dense cloud cover at an average speed of 200 mph. For the remaining portion of the trip, the weather was ideal, and the plane flew at an average speed of 450 mph. Due to a backlog of planes at ORD, it was forced to circle overhead in a holding pattern for 25 minutes before landing. At what time did the plane from Miami land in Chicago?

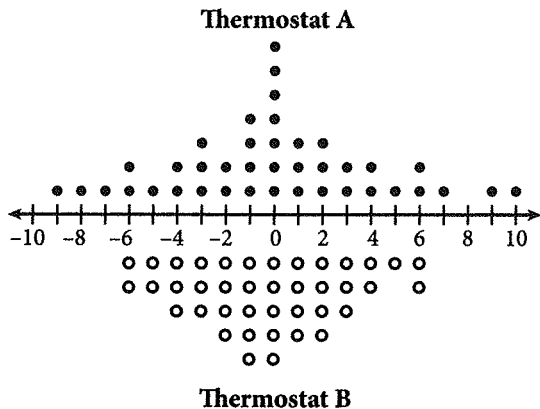
- A) 12:00 PM  
 B) 12:25 PM  
 C) 12:50 PM  
 D) 1:15 PM

16. If  $h(t) = \sqrt{t^2 + 9}$  for all real values of  $t$ , which of the following is not in the range of  $h(t)$ ?

- A) 1  
 B) 3  
 C) 9  
 D) 10



17. If  $(a, b)$  represents the solution to the system of equations shown in the graph and  $a = -3b$ , then which of the following could be the value of  $a + b$ ?
- A)  $-9$   
 B)  $0$   
 C)  $3$   
 D)  $6$



18. A car manufacturer tested two types of thermostats to determine which one it wanted to use in a new model of car. The more consistently the thermostat engages the engine's cooling fan, the better the cooling system performs over the long run. The double dot plot above shows the test results, given the following conditions:

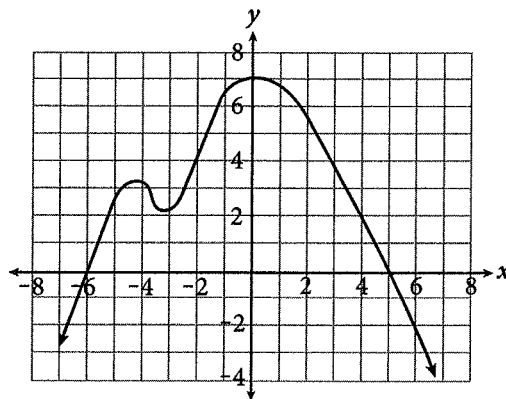
- Zero indicates that the cooling fan engaged at exactly the temperature at which the thermostat was set (the target temperature).
- Negative numbers indicate that the fan engaged below the target temperature.
- Positive numbers indicate that the fan engaged above the target temperature.
- The safe range for the fan to engage is 10 degrees above or below the target temperature.

Which of the following best states which thermostat the car manufacturer is likely to choose and why?

- A) Thermostat A because the median of the data is 0, and the range is greater than that of Thermostat B
- B) Thermostat B because the median of the data is 0, and the range is less than that of Thermostat A
- C) Thermostat A because the mode of the data is 0, which indicates a more consistent thermostat
- D) Thermostat B because the data is bimodal (has two modes), which indicates a more consistent thermostat

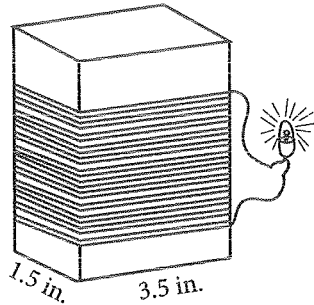
19. If  $p$  and  $q$  represent the zeros of a quadratic function and  $p + q = -3$ , which of the following could be the factored form of  $f(x)$ ?

- A)  $f(x) = (x - 3)(x + 3)$
- B)  $f(x) = (x - 4)(x + 1)$
- C)  $f(x) = (x - 1)(x + 4)$
- D)  $f(x) = (x - 6)(x + 3)$

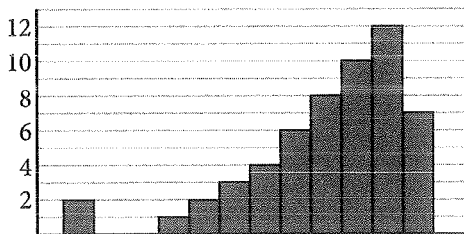


20. The figure above shows the graph of  $p(x) - 4$ . What is the value of  $p(0)$ ?

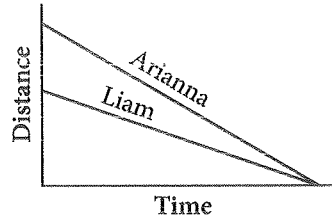
- A) 3
- B) 4
- C) 7
- D) 11



21. Geraldine is making a simple AC electric generator for a science project using copper wire, cardboard, a nail, and magnets. The first step in building the generator is wrapping the wire around and around a rectangular prism made from the cardboard and connecting it to a small lightbulb, as shown in the figure. If Geraldine has 18 feet of wire and needs to leave 3 inches on each end to connect to the lightbulb, how many times can she wrap the wire around the cardboard prism?
- A) 21  
B) 28  
C) 35  
D) 42



22. Which of the following best describes the data represented by the figure shown?
- A) Skewed to the left with two outliers  
B) Skewed to the left with an outlier of 2  
C) Skewed to the right with two outliers  
D) Skewed to the right with an outlier of 2



23. Arianna and her brother Liam both walk home from school each day, but they go to different schools. The figure shows their trip home on Monday. Based on the graph, which of the following statements is true?
- A) It took Liam longer to walk home because his school is farther away.  
B) It took Arianna longer to walk home because her school is farther away.  
C) Arianna and Liam walked home at the same rate.  
D) Arianna walked home at a faster rate than Liam.
24. If line  $L$  passes through the points  $(-4, -8)$  and  $(8, 1)$ , which of the following points does line  $L$  not pass through?
- A)  $(0, -5)$   
B)  $(4, -1)$   
C)  $(12, 4)$   
D)  $(16, 7)$

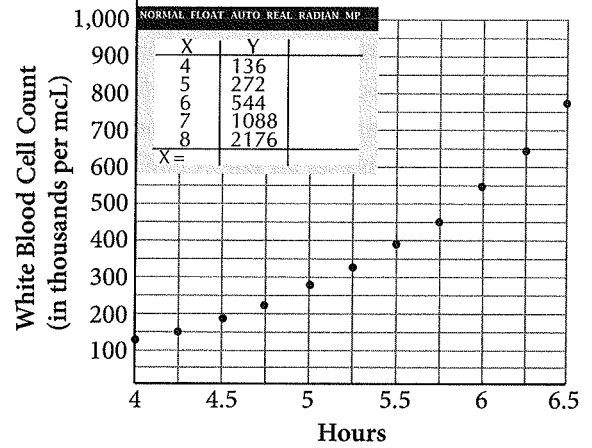


	Unemployed	Employed	Totals
Female Degree	12	188	200
Female No Degree	44	156	200
Male Degree	23	177	200
Male No Degree	41	159	200
Totals	120	680	800

25. The table above shows the results of a sociological study identifying the number of males and females with and without college degrees who were unemployed or employed at the time of the study. If one person from the study is chosen at random, what is the probability that that person is an employed person with a college degree?

- A)  $\frac{73}{160}$   
 B)  $\frac{10}{17}$   
 C)  $\frac{17}{20}$   
 D)  $\frac{73}{80}$

Infected Patient



26. Typically, when people contract an infectious disease, their immune system immediately begins to produce extra white blood cells to fight the disease. The scatterplot shows the white blood cells reproducing in an infected patient, along with several values found when modeling the data using a graphing calculator. According to this model, how many white blood cells per microliter of blood did the patient have before he contracted the disease?
- A) 3,400  
 B) 8,500  
 C) 10,000  
 D) 13,600

27. A rodeo is building a circular arena. The arena will have a total area of  $64\pi$  square yards and can either be left open for rodeo competitions or divided into 12 equal sections through the center for auctions. When holding auctions, the rodeo has an average of 4 bulls and 8 horses for sale. A bull cannot be placed in a section directly beside another section containing a bull, and all edges of these sections must be reinforced with strong steel to keep the bulls from getting out. Which of the following represents how much steel in yards the rodeo will need to reinforce the four bull sections?
- A)  $32\pi$   
 B)  $64\pi$   
 C)  $32 + \frac{16\pi}{3}$   
 D)  $64 + \frac{16\pi}{3}$
28. Lena bought a saltwater fish tank that holds 400 gallons of water. She started filling the tank on Friday, but then stopped after putting only 70 gallons of water in the tank. On Saturday, she bought a bigger hose and began filling the tank again. It took her 1 hour and 50 minutes on Saturday to completely fill the tank. Which equation represents the number of gallons of water in the fish tank on Saturday, given the amount of time in minutes that Lena spent filling the tank?
- A)  $y = 3x + 70$   
 B)  $y = 3x + 330$   
 C)  $y = 70x + 330$   
 D)  $y = 110x + 70$
29. A self-storage company has three sizes of storage units. The ratio of small to medium units is 3:5. The ratio of medium to large units is 3:2. The company analyzes its business model and current consumer demand and determines that it can benefit from utilizing larger economies of scale. In other words, it decides to grow its business based on current economic conditions and plans to build a second, larger self-storage building. The company's research indicates that the new market would benefit from having only two sizes of storage units, small and large, in the same ratio as its current facility. What ratio of small to large units should it use?
- A) 1:1  
 B) 3:2  
 C) 5:3  
 D) 9:10

$$\frac{1}{x} + \frac{3}{x} = \frac{1}{7}$$

30. The equation shown above represents the following scenario: A chemical laboratory uses two air purifiers to clean the air of contaminants emitted while working with hazardous materials. One is an older model, and the other is a new model that is considerably more energy efficient. The new model can clean the air of contaminants three times as quickly as the older model. Working together, the two air purifiers can clean the air in the lab in 7 hours. Which of the following describes what the term  $\frac{1}{x}$  in the equation represents?
- A) The portion of the air the new model can clean in 1 hour  
 B) The portion of the air the older model can clean in 1 hour  
 C) The time it takes the older model to clean the air by itself  
 D) The time it takes the older model to clean  $\frac{1}{7}$  of the air by itself

**Directions:** For questions 31-38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $\frac{7}{2}$ .  
(If  $3\frac{1}{2}$  is entered into the grid as 

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Answer:  $\frac{7}{12}$

Write answer in boxes. →

7	/	1	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Grid in result. →

Answer: 2.5

2	.	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

← Decimal point

Answer: 201  
Either position is correct.

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

2	0	1
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<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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2	2	2
3	3	3
4	4	4

Acceptable ways to grid  $\frac{2}{3}$  are:

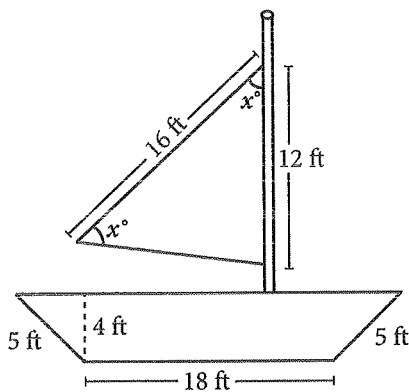
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4	4	4
5	5	5
6	6	6

.	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

.	6	6	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

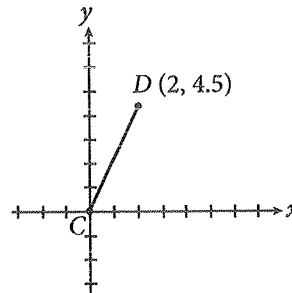
$$\frac{1}{3}(90x - 12) = \frac{1}{2}(8x + 10)$$

31. What is the solution to the equation shown?
32. If  $n^{\frac{5}{2}} = 32$ , what is the value of  $n$ ?
33. When a thrift store gets used furniture in good condition to sell, it researches the original price and then marks the used piece down by 40% of that price. On the first day of each of the following months, the price is marked down an additional 15% until it is sold or it reaches 30% of its original price. Suppose the store gets a piece of used furniture on January 15th. If the piece of furniture costs \$1,848 new, and it is sold on March 10th of the same year, what is the final selling price, not including tax? Round your answer to the nearest whole dollar.



Note: Figure not drawn to scale.

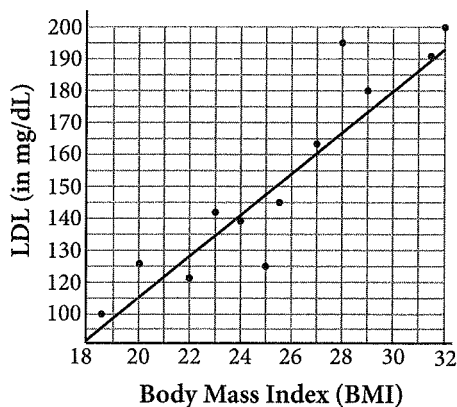
34. Many sailboat manufacturers sell kits that include instructions and all the materials needed to build a simple sailboat. The figure shows the finished dimensions of a sailboat from such a kit. The instructions indicate that  $\cos x^\circ = b$ , but do not give the value of  $b$ . What is the value of  $b$ ?



35. In the figure shown, line  $B$  (not shown) is parallel to  $\overline{CD}$  and passes through the point  $(0, -1)$ . If line  $B$  also passes through the point  $(2, y)$ , what is the value of  $y$ ?
36. Recycling of certain metals has been a common practice dating back to preindustrial times. For example, there is evidence of scrap bronze and silver being collected and melted down for reuse in a number of European countries. Today, there are recycling companies and even curbside collection bins for recycling. As a general rule, recycling companies pay for metals by weight. Suppose a person brings in 3 pounds of copper and receives \$8.64, and 24 ounces of nickel and receives \$10.08. If another person brings in equal weights of copper and nickel, what fractional portion of the money would he receive from the copper?

Questions 37 and 38 refer to the following information.

Body mass index, or BMI, is one of several measures used by doctors to determine a person's health as indicated by weight and height. Low-density lipoprotein, or LDL cholesterol, known as the "bad" cholesterol, is another health indicator and consists of fat proteins that clog arteries. Following are the results of a study showing the relationship between BMI and LDL for 12 individuals and the line of best fit for the data.



37. How many of the 12 people have an actual LDL that differs by 10 or more mg/dL from the LDL predicted by the line of best fit?
38. A doctor's patient has a BMI of 25 and an LDL level of 160. The doctor wants to calculate the percent error of this patient's data compared to that predicted by the line of best fit. Suppose the doctor uses the points (20, 110) and (30, 180), which lie on the line of best fit, to model the equation. Based on this model, what is the percent error? Round to the nearest tenth of a percent and ignore the percent sign when entering your answer.

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS SECTION ONLY. DO NOT TURN TO ANY OTHER SECTION IN THE TEST.

**STOP**

**MATH—NO CALCULATOR**

1. B	6. B	11. D	16. 15
2. C	7. A	12. D	17. 10.5 or $21/2$
3. C	8. D	13. C	18. 4
4. A	9. A	14. B	19. 10
5. B	10. D	15. C	20. 50.5

**MATH—CALCULATOR**

1. D	11. B	21. A	31. $9/26$ or .346
2. B	12. D	22. A	32. 4
3. C	13. C	23. D	33. 801
4. D	14. A	24. B	34. $2/3$ or .666 or .667
5. C	15. B	25. A	35. 3.5 or $7/2$
6. A	16. A	26. B	36. $3/10$
7. A	17. A	27. D	37. 3
8. D	18. B	28. A	38. 9.4
9. C	19. C	29. D	
10. A	20. D	30. A	

**Getting to the Answer:** Choice (C) is correct. By leaving out the phrase “though she is losing her summer,” this answer choice conveys the intended meaning of the sentence with logic and concise language.

**44. B**

**Difficulty:** Hard

**Category:** Writing & Language / Quantitative

**Strategic Advice:** Make sure you understand the information conveyed by the graphic’s labels before you attempt to choose the correct answer.

**Getting to the Answer:** The passage tells you that Kelli’s chosen field is oil and energy, represented by the bar on the far right of the graphic. Choice (B) is the correct answer, as it matches the information that the graphic provides about the number of oil and energy interns per 1,000 hires noted in the y-axis.

## MATH TEST: NO-CALCULATOR SECTION

**1. B**

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** In a real-world scenario, the slope of a line represents a unit rate and the y-intercept represents a flat fee or a starting amount.

**Getting to the Answer:** The cost of one linear foot is the same as the unit rate (the cost per linear foot), which is represented by the slope of the line. Use the grid-lines and the axis labels to count the rise and the run from the y-intercept of the line (0, 150) to the next point that hits an intersection of two grid-lines. Pay careful attention to how the grid-lines are marked (by 5s on the x-axis and by 25s on the y-axis). The line rises 75 units and runs 5 units, so the slope is  $\frac{75}{5} = 15$  dollars per linear foot of fence. Note that you could also use the slope formula and two points from the graph to find the unit rate.

**2. C**

**Difficulty:** Easy

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Don’t be tempted—you can’t simply cancel one term when a polynomial is divided by a monomial. Instead, find the greatest common factor of *both* the numerator and the denominator. Factor out the GCF from the numerator and from the denominator, and then you can cancel it.

**Getting to the Answer:** The GCF is  $12x^2$ .

$$\begin{aligned} & \frac{24x^4 + 36x^3 - 12x^2}{12x^2} \\ &= \frac{\cancel{12x^2} (2x^2 + 3x - 1)}{\cancel{12x^2}} \\ &= 2x^2 + 3x - 1 \end{aligned}$$

## 3. C

Difficulty: Easy

Category: Additional Topics in Math / Geometry

**Strategic Advice:** Corresponding sides of similar triangles are proportional, so write a proportion (paying careful attention to the order of the sides) using the sides that you know and the side that you're looking for. Then, solve the proportion for the missing side.

**Getting to the Answer:** Call the missing side  $x$ . Write a proportion using words first, and then fill in the lengths of the sides that you know:

$$\begin{aligned} \frac{\text{right side small } \Delta}{\text{base of small } \Delta} &= \frac{\text{right side large } \Delta}{\text{base of large } \Delta} \\ \frac{x}{4} &= \frac{2+x}{6} \\ 6x &= 4(2+x) \\ 6x &= 8+4x \\ 2x &= 8 \\ x &= 4 \end{aligned}$$

The length of  $\overline{BE}$  is 4.

## 4. A

Difficulty: Easy

Category: Passport to Advanced Math / Quadratics

**Strategic Advice:** Recognizing the different forms of a quadratic equation can save valuable time on Test Day. Each of the answer choices is given in vertex form, so start by matching the vertex of the parabola in the graph to the correct equation.

**Getting to the Answer:** When a quadratic equation is written in vertex form,  $y = a(x - h)^2 + k$ , the vertex is  $(h, k)$ . The vertex of the parabola in the graph is  $(2, 5)$ ; therefore, the equation should look like  $y = a(x - 2)^2 + 5$ . This means you can eliminate B and C. To choose between (A) and D, consider the value of  $a$ . The parabola in the graph opens downward, so  $a$  must be negative. This means (A) is correct.

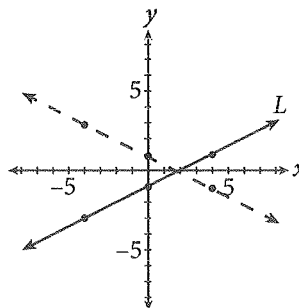
## 5. B

Difficulty: Medium

Category: Heart of Algebra / Linear Equations

**Strategic Advice:** You can approach this question conceptually or concretely. Drawing a quick sketch is most likely the safest approach.

**Getting to the Answer:** Line  $L$  shown in the graph rises from left to right, so it has a positive slope. Once reflected over the  $x$ -axis, it will fall from left to right, so the new line will have a negative slope. This means you can eliminate C and D. Now, draw a quick sketch of the reflected line on the coordinate plane in your test booklet and count the rise (or fall) and the run from one point to the next.



The reflected line falls 2 units and runs 4 units, so the slope is  $-\frac{2}{4}$ , which reduces to  $-\frac{1}{2}$ .

## 6. B

Difficulty: Medium

Category: Passport to Advanced Math / Exponents

**Strategic Advice:** Attention to detail is the key to answering this question correctly. You simply need to combine like terms, being careful to distribute negative signs where appropriate.

**Getting to the Answer:** Break the calculation into steps: Find  $2p$ , find  $q + r$ , and then subtract the results. Arranging the terms in descending order will help keep them organized.



$$2p = 2(4x^3 + x - 2) = 8x^3 + 2x - 4$$

$$q + r = x^2 - 1 + 3x - 5 = x^2 + 3x - 6$$

$$\begin{aligned} 2p - (q + r) &= 8x^3 + 2x - 4 - (x^2 + 3x - 6) \\ &= 8x^3 + 2x - 4 - x^2 - 3x + 6 \\ &= 8x^3 - x^2 + 2x - 3x - 4 + 6 \\ &= 8x^3 - x^2 - x + 2 \end{aligned}$$

**7. A****Difficulty:** Medium**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** The roots of an equation are the same as its solutions. Take a peek at the answer choices—they contain radicals, which tells you that the equation can't be factored. Instead, either complete the square or solve the equation using the quadratic formula, whichever you are most comfortable using.

**Getting to the Answer:** The equation is already written in the form  $y = ax^2 + bx + c$  and the coefficients are fairly small, so using the quadratic formula is probably the quickest method. Jot down the values that you'll need:  $a = 2$ ,  $b = 4$ , and  $c = -3$ . Then, substitute these values into the quadratic formula and simplify:

$$\begin{aligned} x &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\ &= \frac{-(4) \pm \sqrt{(4)^2 - 4(2)(-3)}}{2(2)} \\ &= \frac{-4 \pm \sqrt{16 + 24}}{4} \\ &= \frac{-4 \pm \sqrt{40}}{4} \end{aligned}$$

This is not one of the answer choices, so simplify the radical. To do this, look for a perfect square that divides into 40 and take its square root.

$$\begin{aligned} x &= \frac{-4 \pm \sqrt{4 \times 10}}{4} \\ &= \frac{-4 \pm 2\sqrt{10}}{4} \\ &= \frac{-2 \pm \sqrt{10}}{2} \end{aligned}$$

Be careful—you can't simplify the answer any further because you cannot divide the square root of 10 by 2.

**8. D****Difficulty:** Medium**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Although this question asks where the *graphs* of the functions intersect, it is not necessary to actually graph them. Understanding the connection between graphing the equations and the algebra behind the graphs will save valuable time on Test Day.

**Getting to the Answer:** Two graphs intersect at the point where they have the same  $x$ -value and the same  $y$ -value. The notations  $g(x)$  and  $h(x)$  can both be interpreted as "the  $y$ -value at a given value of  $x$ ," so set  $g(x)$  equal to  $h(x)$  and solve for  $x$ . Then plug this value into either function to find the corresponding  $y$ -value. Don't let the fraction intimidate you—you can write  $g(x)$  as a fraction over 1 and use cross-multiplication.

$$\begin{aligned} \frac{3x - 5}{1} &= \frac{7x + 10}{4} \\ 4(3x - 5) &= 7x + 10 \\ 12x - 20 &= 7x + 10 \\ 5x &= 30 \\ x &= 6 \end{aligned}$$

$$\begin{aligned}g(x) &= 3x - 5 \\g(6) &= 3(6) - 5 \\&= 18 - 5 \\&= 13\end{aligned}$$

The graphs of the functions will intersect at (6, 13).

**9. A**

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** When you write an equation *in terms of* a specific variable, you are simply solving the equation for that variable. In this question, you'll need to relate fractional exponents to radicals and understand how to use negative exponents. Be careful—you're not just rewriting the equation, you're solving it for  $k$ .

**Getting to the Answer:** Raising a quantity to the one-third power is the same as taking its cube root. Applying a negative exponent to a quantity is the same as writing its reciprocal. Rewrite the equation using these properties and then solve for  $k$  using inverse operations. Note that the inverse of taking a cube root of a quantity is cubing the quantity.

$$\begin{aligned}x &= k^{-\frac{1}{3}} \\x &= \frac{1}{\sqrt[3]{k}} \\(x)^3 &= \left(\frac{1}{\sqrt[3]{k}}\right)^3 \\x^3 &= \frac{1}{k} \\kx^3 &= 1 \\k &= \frac{1}{x^3}\end{aligned}$$

**10. D**

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** There are two variables and only one equation, so you can't actually solve the equation for  $c$ . Instead, recall that an equation has infinitely many solutions when the left side is identical to the right side. When this happens, everything cancels out and you get the equation  $0 = 0$ , which is always true.

**Getting to the Answer:** Start by simplifying the left side of the equation. Don't forget to distribute the negative sign to both terms inside the parentheses.

$$\begin{aligned}4x - (10 - 2x) &= c(3x - 5) \\4x - 10 + 2x &= c(3x - 5) \\6x - 10 &= c(3x - 5)\end{aligned}$$

Next, quickly compare the left side of the equation to the right side. Rather than distributing the  $c$ , notice that if  $c$  were 2, then both sides of the equation would equal  $6x - 10$ , and it would have infinitely many solutions. Therefore,  $c$  is 2.

**11. D**

**Difficulty:** Medium

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Choose the best strategy to answer the question. Here, the fractions make it look more complicated than it really is, so start by clearing the fractions by multiplying everything by the least common denominator, 6.

**Getting to the Answer:** You don't need to separate this compound inequality into pieces. Just remember, whatever you do to one piece, you must do to all three pieces. Don't forget to flip the inequality symbols if you multiply or divide by a negative number.

$$\begin{aligned}
 0 < 1 - \frac{a}{3} &\leq \frac{1}{2} \\
 6(0) < 6\left(1 - \frac{a}{3}\right) &\leq 6\left(\frac{1}{2}\right) \\
 0 < 6 - 2a &\leq 3 \\
 -6 < -2a &\leq -3 \\
 3 > a &\geq \frac{3}{2} \\
 1.5 &\leq a < 3
 \end{aligned}$$

Now, read the inequality symbols carefully. The value of  $a$  is between 1.5 and 3, including 1.5, but *not* including 3, so (D) is the correct answer.

**12. D**

**Difficulty:** Hard

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Some questions cannot be answered using brute force, but rather by understanding how equations and graphs are related. The only way a system of inequalities can have no solution is if the graph consists of two parallel lines with shading in opposite directions so that there is no overlap.

**Getting to the Answer:** Start by writing each equation in slope-intercept form to help you envision what the graphs will look like. You'll need to multiply the second equation by  $-2$ , so don't forget to flip the inequality symbol.

$$y - \frac{2}{k}x \leq 0 \rightarrow y \leq \frac{2}{k}x$$

$$\frac{1}{k}x - \frac{1}{2}y \leq -1 \rightarrow -\frac{1}{2}y \leq -\frac{1}{k}x - 1 \rightarrow y \geq \frac{2}{k}x + 2$$

Now, think about the graphs. The first equation has a slope of  $\frac{2}{k}$ , a  $y$ -intercept of 0, and is shaded below the line. The second equation also has a slope of  $\frac{2}{k}$ , but it has a  $y$ -intercept of 2 and is shaded above

the line. This means that no matter what value of  $k$  is used (other than 0), the two lines are parallel and shaded in opposite directions, and thus there are infinitely many values of  $k$  that produce a system with no solution.

**13. C**

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** When solving a rational equation, start by getting a common denominator. Then, you can set the numerators equal and solve for the variable. Don't forget, however: If the answer produces zero in any denominator, then it is not a valid answer.

**Getting to the Answer:** The denominators are almost the same already; you just need to multiply the top and bottom of the first term by 2, factor the denominator of the second term, and you'll be ready to solve the equation.

$$\begin{aligned}
 \frac{2}{2} \left( \frac{4x}{x-7} \right) + \frac{2x}{2x-14} &= \frac{70}{2(x-7)} \\
 \frac{8x}{2(x-7)} + \frac{2x}{2(x-7)} &= \frac{70}{2(x-7)}
 \end{aligned}$$

Now that the denominators are all the same, you can solve the equation represented by the numerators.

$$8x + 2x = 70$$

$$10x = 70$$

$$x = 7$$

Be careful—this isn't the correct answer. Because there are variables in the denominator, you must check the solution to make sure it isn't extraneous, or in other words, doesn't cause a 0 in the denominator of any term. Unfortunately, if  $x = 7$ , then all of the denominators are zero (and division by zero is not possible), so the equation has no solution.

## 14. B

**Difficulty:** Hard**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** Being able to convert equations to different forms is a valuable skill to master. For example, when the equation of a circle is written in the form  $(x - h)^2 + (y - k)^2 = r^2$ , you can easily find the center and the radius of the circle.

**Getting to the Answer:** The shortest distance from  $A$  to  $B$  is through the center of the circle, along the diameter, which is twice the radius, so you need to find  $r$ . To do this, complete the square for the  $x$ -terms and for the  $y$ -terms. Start by reordering the terms. Then, take the coefficient of the  $x$ -term and divide it by 2, square it, and add the result to the two terms with  $x$ -variables. Do the same with the  $y$ -term. Remember, you must also add these amounts to the other side of the equation. This creates a perfect square of  $x$ -terms and  $y$ -terms, and the equation will look more like a circle.

$$x^2 + y^2 + 6x - 4y = 12$$

$$x^2 + 6x + y^2 - 4y = 12$$

$$(x^2 + 6x + 9) + (y^2 - 4y + 4) = 12 + 9 + 4$$

$$(x + 3)^2 + (y - 2)^2 = 25$$

This means that the radius of the circle is  $\sqrt{25} = 5$ , so the diameter is 10, which is also the distance from  $A$  to  $B$ . Note that you can do a quick check of your work by looking at the center; according to the equation, the center is  $(-3, 2)$ , which appears to match the location of the center on the graph.

## 15. C

**Difficulty:** Hard**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** The key to answering this question is in having a conceptual understanding of function notation. Here, the input  $(x - 1)$  has already been substituted and simplified in the given function. Your job is to determine what the function would have looked like had  $x$  been the input.

**Getting to the Answer:** To keep things organized, let  $u = x - 1$ , the old input. This means  $x = u + 1$ . Substitute this into  $g$  and simplify:

$$\begin{aligned} g(u) &= 3(u + 1)^2 + 5(u + 1) - 7 \\ &= 3(u^2 + 2u + 1) + 5u + 5 - 7 \\ &= 3u^2 + 6u + 3 + 5u + 5 - 7 \\ &= 3u^2 + 11u + 1 \end{aligned}$$

This means  $g(u) = 3u^2 + 11u + 1$ .

When working with function notation, you evaluate the function by substituting a given input value for the variable in the parentheses. Here, if the input value is  $x$ , then  $g(x) = 3x^2 + 11x + 1$ .

## 16. 15

**Difficulty:** Easy**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Sometimes, being able to interpret a graph that models a real-world scenario is enough to answer a question. Just be sure to read the axis labels carefully.

**Getting to the Answer:** The equilibrium price occurs when the supply and demand are equal. Graphically, this means where the two lines intersect. The lines intersect at the point  $(6, 15)$ . You can see from the axis labels that price is plotted along the  $y$ -axis, so the equilibrium price is \$15.

## 17. 10.5 or 21/2

**Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** The key word in this question is *linear*. In a real-world scenario that involves a constant rate of change, you almost always need to find the slope and the initial amount so you can write an equation. The question states that the initial mass of the larva was 10 grams, so all you need to do is find the slope.

**Getting to the Answer:** Write the information given in the question as ordered pairs (time, mass) so you can find the slope. At  $t = 0$ , the larva has a mass of 10 grams, so one pair is  $(0, 10)$ . After 48 hours, the larva has a mass of 14 grams, so a second pair is  $(48, 14)$ . Now, use the slope formula:

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{14 - 10}{48 - 0} \\ &= \frac{4}{48} = \frac{1}{12} \end{aligned}$$

The equation is  $y = \frac{1}{12}x + 10$ , where  $y$  represents the mass of the larva after  $x$  hours. Substitute 6 for  $x$  to find the mass after 6 hours:  $\frac{1}{12}(6) + 10 = \frac{6}{12} + 10 = 10.5$  grams.

**18. 4**

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** The notation  $(f(g(x)))$  indicates a composition of two functions which is read “ $f$  of  $g$  of  $x$ .” It means that the output when  $x$  is substituted in  $g(x)$  becomes the input for  $f(x)$ .

**Getting to the Answer:** First, use the table on the right to find that  $g(-1)$  is 2. This is your new input. Now, use the table on the left to find  $f(2)$ , which is 4.

**19. 10**

**Difficulty:** Medium

**Category:** Additional Topics in Math / Imaginary Numbers

**Strategic Advice:** Multiply the two complex numbers just as you would two binomials (using FOIL). Then, combine like terms. The question tells you that  $i = \sqrt{-1}$ . If you square both sides of the equation, this is the same as  $i^2 = -1$ , which is a more useful fact.

**Getting to the Answer:**

$$\begin{aligned} (4 + 3i)(1 - 2i) &= 4(1 - 2i) + 3i(1 - 2i) \\ &= 4 - 8i + 3i - 6i^2 \\ &= 4 - 5i - 6(-1) \\ &= 4 - 5i + 6 \\ &= 10 - 5i \end{aligned}$$

The question asks for  $a$  in  $a + bi$ , so the correct answer is 10.

**20. 50.5**

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Scatterplots

**Strategic Advice:** This question requires a conceptual understanding of modeling data and properties of quadratic functions. When a regression model has a correlation coefficient of 1, it means that the model exactly fits the data. This tells you that you can use what you know about quadratic functions to answer the question.

**Getting to the Answer:** The graph of a quadratic function is symmetric with respect to its axis of symmetry. The axis of symmetry occurs at the  $x$ -value of the vertex, which also happens to be where the maximum (or minimum) of the function occurs. The question tells you this value—it’s  $x = 56.25$ . Because  $x = 90$  is 33.75 ( $90 - 56.25 = 33.75$ ) units to the right of the axis of symmetry, you know that the  $y$ -value will be the same as the point that is 33.75 units to the left of the axis of symmetry. This occurs at  $x = 56.25 - 33.75 = 22.5$ . Read the  $y$ -value from the graphing calculator screenshot to find the answer, which is 50.5.

## MATH TEST: CALCULATOR SECTION

1. D

**Difficulty:** Easy

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** A larger sample size is always likely to result in a lower margin of error, so you can immediately eliminate A and B.

**Getting to the Answer:** To reduce the margin of error, the society should use a larger sample size selected from a better representation of the population. The target population is *all* adults, not just those that have gym memberships. Using only adults with gym memberships is likely to skew the results because these respondents probably exercise considerably more than people who do not have gym memberships. This means (D) is correct.

2. B

**Difficulty:** Easy

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Think about this question conceptually. The box cannot weigh more than 20 pounds, so start there. If the box cannot weigh *more than* 20 pounds, this means it can weigh 20 pounds *or less*, so the right half of the inequality you are looking for is  $\leq 20$ . This means you can eliminate A and C.

**Getting to the Answer:** Again, think about the question. A box is made up of ballpoint pens,  $b$ , and mechanical pencils,  $m$ . Each pen weighs 0.3 ounces, and each pencil weighs 0.2 ounces. The total weight of the box would be the number of pens,  $b$ , multiplied by their weight, 0.3, added to the number of pencils,  $m$ , multiplied by their weight, 0.2. So the inequality is  $0.3b + 0.2m \leq 20$ .

3. C

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Finding an  $x$ -intercept is easy when you know the equation of the line—it's the value of  $x$  when  $y$  is 0.

**Getting to the Answer:** Everything you need to write the equation is shown on the graph. The  $y$ -intercept is 5 and the line falls 1 unit and runs 3 units from one point to the next, so the slope is  $-\frac{1}{3}$ . This means the equation of the line, in slope-intercept form, is  $y = -\frac{1}{3}x + 5$ . Now, set the equation equal to zero and solve for  $x$ :

$$0 = -\frac{1}{3}x + 5$$

$$\frac{1}{3}x = 5$$

$$x = 15$$

Line Q will intercept the  $x$ -axis at 15.

4. D

**Difficulty:** Easy

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Understanding function notation will earn you valuable points on Test Day. When you see an expression such as  $f(x)$ , it means to substitute the given value for  $x$  in the function's equation. When there is more than one function involved, pay careful attention to which function should be evaluated first.

**Getting to the Answer:** You are looking for the value of  $f(x)$  at  $x = 3$ . Because  $f(x)$  is defined in terms of  $g(x)$ , evaluate  $g(3)$  first by substituting 3 for  $x$  in the expression  $x + 5$ .

$$g(3) = 3 + 5 = 8$$

$$f(3) = 2g(3) = 2(8) = 16$$

5. C

**Difficulty:** Easy**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages**Strategic Advice:** Pay careful attention to the units. As you read the question, decide how and when you will need to convert units.**Getting to the Answer:** Work backward—you need to know how many pages of cards will be printed. To find this number, you first need to know how many cards will be printed. So, start with the number of agents (which tells you the number of boxes) and multiply by the number of cards per box:

$$12 \cancel{\text{agents}} \times \frac{2 \cancel{\text{boxes}}}{1 \cancel{\text{agent}}} \times \frac{225 \text{ cards}}{1 \cancel{\text{box}}} = 5,400 \text{ cards}$$

Next, use the information about *pages* to finish the calculations:

$$5,400 \cancel{\text{cards}} \times \frac{1 \cancel{\text{page}}}{10 \cancel{\text{cards}}} \times \frac{1 \text{ minute}}{18 \cancel{\text{pages}}} = 30 \text{ minutes}$$

6. A

**Difficulty:** Medium**Category:** Heart of Algebra / Inequalities**Strategic Advice:** The question is asking about  $\frac{x}{y}$ , so think about how fractions work. Larger numerators result in larger values  $\left(\frac{3}{2}, \text{ for example, is greater than } \frac{1}{2}\right)$ , and smaller denominators result in larger values  $\left(\frac{1}{2}, \text{ for example, is greater than } \frac{1}{4}\right)$ .**Getting to the Answer:** The largest possible value of  $\frac{x}{y}$  is found by choosing the largest possible value for  $x$  and the smallest possible value for  $y$ :  $\frac{0.2}{5} = 0.04$ .

7. A

**Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Statistics and Probability**Strategic Advice:** Results from a study can only be generalized to the population from which the sample was taken. Also, keep in mind that positive correlations do not prove causation.**Getting to the Answer:** The study was conducted by the American Academy of Pediatrics on children in the United States under three, so the sample is American children under three, which means conclusions can only be drawn about *this* population. Also, because correlations do not prove causation, the only conclusion that can be drawn is that there is an association between television time and attention disorders for American children under three years old.

8. D

**Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Statistics and Probability**Strategic Advice:** The greatest change (in absolute value) in miles ridden per week could be an increase or a decrease. Try organizing the changes in a table (or a simple list).**Getting to the Answer:** Make a list to show the changes in miles ridden per week between each pair of consecutive weeks. You don't have to worry about whether the change is positive or negative, so to keep things simple, always subtract the smaller number from the larger number. Save yourself some time by skipping weeks that clearly have smaller changes, such as between weeks 1 and 2 and between weeks 3 and 4.

$$\text{Weeks 2-3: } 72 - 64 = 8$$

$$\text{Weeks 4-5: } 78 - 70 = 8$$

$$\text{Weeks 5-6: } 85 - 78 = 7$$

$$\text{Weeks 6-7: } 85 - 75 = 10$$

$$\text{Weeks 7-8: } 82 - 75 = 7$$

Of the differences, the greatest is from week 6 to week 7, which is a change of 10 miles, making (D) correct.

9. C

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Given two points (even when the coordinates are variables), the slope of the line is  $\frac{y_2 - y_1}{x_2 - x_1}$ .

**Getting to the Answer:** You are given a numerical value for the slope and a pair of coordinate points with variables. To find the value of  $a$ , plug the points into the slope formula, and then solve for  $a$ .

$$\begin{aligned} \text{Slope} &= \frac{y_2 - y_1}{x_2 - x_1} \\ 5 &= \frac{6 - 2a}{a - (a - 1)} \\ 5 &= \frac{6 - 2a}{1} \\ 5 &= 6 - 2a \\ -1 &= -2a \\ \frac{1}{2} &= a \end{aligned}$$

10. A

**Difficulty:** Hard

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Questions about breaking even usually involve creating a system of equations (one for cost and one for revenue), setting the equations equal to each other, and solving for the variable.

**Getting to the Answer:** Create a system of equations at each price point using  $n$  for the number of bathtub lifts. Then solve each system. Note that the cost equation will be the same for both systems, and it is already given to you in the question.

$$\text{Old price: } C = 225n + 3,150; R = 450n$$

$$C = R$$

$$225n + 3,150 = 450n$$

$$3,150 = 225n$$

$$14 = n$$

$$\text{New price: } C = 225n + 3,150; R = 375n$$

$$C = R$$

$$225n + 3,150 = 375n$$

$$3,150 = 150n$$

$$21 = n$$

At the old price, the company needed to sell 14 lifts to break even. At the new price, it needs to sell 21 lifts, so it needs to sell  $21 - 14 = 7$  more lifts at the new price to break even.

11. B

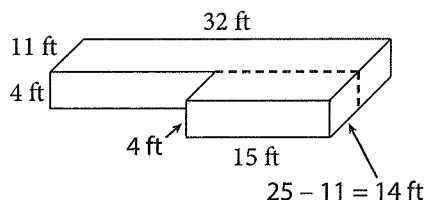
**Difficulty:** Medium

**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** The amount of water needed to create the ice portion of the exhibit is another way of saying the *volume* of the ice. So, you need to find the volume of the entire space and then subtract the volume of the cylinder that runs through the ice. The volume of a rectangular prism is given by  $V = l \times w \times h$ , and the volume of a cylinder equals the area of its base times its height, or  $\pi r^2 h$ .



**Getting to the Answer:** To determine the volume of the ice, start by decomposing the figure into two rectangular prisms and adding their volumes. You can decompose the figure left to right or front to back. Front to back, it looks like the following figure:



The prism in the back has a volume of  $32 \times 11 \times 4 = 1,408$  cubic ft. The prism in the front has a length of 15 ft and a height of 4 ft, but the width is missing. Find the missing width by subtracting 11 from 25, which is 14 ft. So, the volume of the prism in the front is  $15 \times 14 \times 4 = 840$  cubic ft. The total volume of the prisms is  $1,408 + 840 = 2,248$  cubic ft. Be careful—that's not the answer. You still need to find the amount of space taken up by the glycol pipe and subtract it. The diameter of the pipe is 2 ft, so its radius is 1 foot, and the height (or the length in this question) is 32 ft, so the volume is  $\pi(1)^2(32) \approx 100.53$  cubic ft. This means the amount of ice needed is  $2,248 - 100.53 = 2,147.47$ , or about 2,150 cubic ft.

## 12. D

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Let the units in this question guide you to the answer. You'll also need to use the answer you found in the previous question, which is often the case in questions that are grouped together.

**Getting to the Answer:** The company will use two hoses, each of which pumps at a rate of 60 gallons per minute, so the rate is actually 120 gallons per minute. Convert the volume you found earlier from cubic feet to gallons, and then use the rate to find the time.

$$2,150 \cancel{\text{ft}^3} \times \frac{7.48 \cancel{\text{gal}}}{1 \cancel{\text{ft}^3}} \times \frac{1 \text{ min}}{120 \cancel{\text{gal}}} = 134 \text{ minutes}$$

The answers are given in hours and minutes, so write 134 minutes as 2 hours and 14 minutes, or about 2 hours and 15 minutes.

## 13. C

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** Making connections between equations and their graphs will save valuable time on this question. The graph of every quadratic equation is a parabola, which may or may not cross the  $x$ -axis, depending on where its vertex is and which way it opens. Don't forget—if the equation is written in vertex form,  $y = a(x - h)^2 + k$ , then the vertex is  $(h, k)$ , and the value of  $a$  tells you which way the parabola opens.

**Getting to the Answer:** The graph of an equation that has *no solution* does not cross the  $x$ -axis, so try to envision the graph of each of the answer choices. When a quadratic is written in factored form, the factors tell you the  $x$ -intercepts, which means every quadratic equation that can be written in factored form (over the set of real numbers) must have solutions. This means you can eliminate B and D. Now, imagine the graph of the equation in A: The vertex is  $(5, 3)$  and  $a$  is negative, so the parabola opens downward and consequently must cross the  $x$ -axis. This means you can eliminate A, and (C) must be correct. The graph of the equation in (C) has a vertex of  $(5, 3)$  and opens up, so it does not cross the  $x$ -axis and, therefore, has no solution.

You could also graph each of the answer choices in your graphing calculator, but this is not the most time-efficient way to answer the question.

**14. A****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages**Strategic Advice:** Questions that involve distance, rate, and time can almost always be solved using the formula  $\text{Distance} = \text{rate} \times \text{time}$ .**Getting to the Answer:** Use the speed, or rate, of the plane from Boston, 360 mph, and its distance from Chicago, 864 mi, to determine when it arrived. You don't know the time, so call it  $t$ .

$$\text{Distance} = \text{rate} \times \text{time}$$

$$864 = 360t$$

$$2.4 = t$$

This means it took 2.4 hours for the plane to arrive. This is more than 2 full hours, so multiply 2.4 by 60 to find the number of minutes it took:  $60 \times 2.4 = 144$  minutes. Now determine how long it took the plane from Kansas City. It left at 8:30 AM and arrived at 10:34 AM, so it took 2 hours and 4 minutes, or 124 minutes. This means the plane from Kansas City arrived  $144 - 124 = 20$  minutes before the plane from Boston.

**15. B****Difficulty:** Hard**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages**Strategic Advice:** Break the question into short steps (first part of trip, second part of trip, circling overhead). Before selecting an answer, make sure you included the results of each step in your calculations.**Getting to the Answer:** To get started, you'll need to find the distance for each part of the trip—the question only tells you the total distance. Then, use

the formula  $\text{Distance} = \text{rate} \times \text{time}$  to find how long the plane flew at 200 mph and then how long it flew at 450 mph.

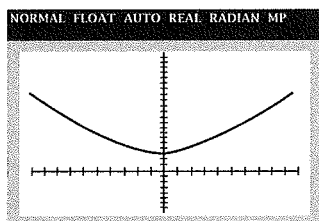
$$\begin{aligned} \text{First part of trip: } \frac{1}{4} \times 1,200 &= 300 \text{ mi} \\ 300 &= 200t \\ t &= \frac{300}{200} = 1.5 \text{ hours} \\ 1.5 \times 60 &= 90 \text{ minutes} \end{aligned}$$

$$\begin{aligned} \text{Second part of trip: } \frac{3}{4} \times 1,200 &= 900 \text{ mi} \\ 900 &= 450t \\ t &= \frac{900}{450} = 2 \text{ hours} \\ 2 \times 60 &= 120 \text{ minutes} \end{aligned}$$

This means the plane flew for a total of  $90 + 120 = 210$  minutes. Next, add the time the plane circled overhead:  $210 + 25 = 235$  minutes. The total trip took 235 minutes (3 hours and 55 minutes), which means the plane landed at  $8:30 + 3 \text{ hours} = 11:30 + 55 \text{ minutes} = 12:25 \text{ PM}$ .

**16. A****Difficulty:** Medium**Category:** Passport to Advanced Math / Functions**Strategic Advice:** The range of a function is the set of possible outputs, or  $y$ -values on a graph.**Getting to the Answer:** For all real values of any number  $t$ , the value of  $t^2$  cannot be negative. This means the smallest possible value of  $t^2$  is 0 and, consequently, the smallest possible value of  $h(t)$  is  $h(0) = \sqrt{0^2 + 9} = \sqrt{9} = 3$ . Thus, the number 1 is not in the range of the function.

You could also graph the function in your graphing calculator and examine the possible  $y$ -values. The graph follows here:



Notice that the lowest point on the graph is  $(0, 3)$ , which tells you that the range of the function is  $h(t) \geq 3$ .

**17. A**

**Difficulty:** Medium

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Graphically, the solution to a system of equations is the point or points where the graphs intersect. Whenever a graph with no grid-lines or axis labels is shown, you are usually interested primarily in the sign of the coordinates of a point, not the actual values.

**Getting to the Answer:** The graphs intersect in Quadrant 2 of the coordinate plane, so the  $x$ -value of the point of intersection (or  $a$ ) is negative, and the  $y$ -value (or  $b$ ) is positive. The question states that  $a = -3b$ , so you can eliminate B right away—the coordinates would have to be equal if their sum was 0. Now try Picking Numbers. Let  $b = 1$ , which means  $a = -3$  and the sum of  $a + b$  is  $-2$ , which is not one of the answer choices. Try another pair: If  $b = 2$ , then  $a = -6$ , and the sum is  $-4$ . This is still not one of the answer choices, but you should see a pattern—the  $x$ -coordinate will always overpower the  $y$ -coordinate, resulting in a negative sum, so the correct answer must be (A).

**18. B**

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** When comparing two data sets for consistency, consider both the data center (mean or median) and the spread (standard deviation or range).

**Getting to the Answer:** Each set of data has a median of 0, and Thermostat A also has a mode of 0. Both of these measures indicate good test results. However, Thermostat A has a greater range of data. If the company chooses this thermostat, the cooling fan is likely to engage anywhere from  $-9$  degrees below the target temperature to 10 degrees above the target temperature. Although this is within the safe temperature range, it is not as consistent as Thermostat B, which engaged the fan within 6 degrees on either side of the target temperature. This means (B) is correct.

**19. C**

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** When a quadratic function is written in factored form, you can find its zeros by setting each factor equal to 0 and solving for the variable. Knowing this will save valuable time on Test Day.

**Getting to the Answer:** Each of the answer choices is written in factored form, so mentally solve each one by asking yourself what number would make each factor equal to 0. Then find the sum of the results:

Choice A:  $3 + (-3) \neq -3$ . Eliminate.

Choice B:  $4 + (-1) \neq -3$ . Eliminate.

Choice C:  $1 + (-4) = -3$ , so (C) is correct.

Choice D:  $6 + (-3) \neq -3$ . Eliminate.

**20. D**

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** A constant added or subtracted inside a function will shift the function left or right, while a constant added or subtracted from the outside will shift the function up or down.

**Getting to the Answer:** Be careful—you're looking for the value of  $p(0)$ , but the graph shows  $p(x) - 4$ , which means the original graph has been shifted down 4 units. You'll need to find the  $y$ -value of the graph when  $x = 0$ , then add 4 to get back up to the original function. The graph passes through the point  $(0, 7)$ , so  $p(0) - 4 = 7$ . Add 4 to both sides of the equation to get  $p(0) = 7 + 4 = 11$ .

21. A

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Sometimes writing an equation is the quickest route to answering a question. Assign a variable to the unknown, write the equation in words, and then translate from English into math.

**Getting to the Answer:** The unknown in this question is the number of times Geraldine can wrap the wire around the prism. Call this  $n$ . Now, write an equation in words: Total amount of wire equals distance around the prism times the number of wraps plus the extra on the ends. To fill in the numbers, you'll need to make a few calculations. Because the dimensions of the prism are given in inches, convert the amount of wire to inches as well:  $18 \text{ ft} = 18 \times 12 = 216$  inches. Next, figure out the distance around the prism using the picture. Don't forget, you have to go all the way around:  $1.5 + 3.5 + 1.5 + 3.5 = 10$  inches. Finally, read the question again to determine that the *extra on the ends* is  $3 + 3 = 6$  inches. Now you're ready to translate from English into math to write your equation, and then solve it.

$$216 = 10n + 6$$

$$210 = 10n$$

$$21 = n$$

Geraldine can wrap the wire around the prism 21 times.

22. A

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** A data set is *skewed to the left* if the tail (the part that gets smaller and smaller) is longer on the left, and it is *skewed to the right* if the tail is longer on the right. An *outlier* is a data point that is set apart from the rest of the data.

**Getting to the Answer:** The tail of the data shown in the graph is longer on the left side, so the data is skewed to the left. This means you can eliminate C and D. The first bar on the left side of the graph clearly represents outliers, since it is set apart from the rest of the data. To choose between (A) and B, recall that in a histogram, the heights of the bars tell you *how many* data points fit in the given category. The height of the bar is 2, so the data has two outliers, which means (A) is correct.

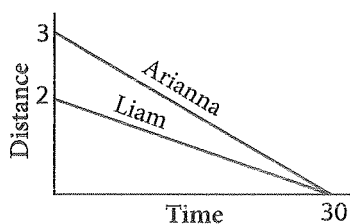
23. D

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Try adding numbers to the graph.

**Getting to the Answer:** Add reasonable numbers to the graph to help you answer the question. An example follows:



Use the numbers to help you evaluate each statement. It took Liam and Arianna each 30 minutes to walk home, so A and B are incorrect. Arianna walked 3 miles in 30 minutes, while Liam only walked 2 miles in 30 minutes; their rates are not the same, so C is also incorrect. This means (D) must be true. Arianna started out farther away than Liam, so she must have walked at a faster rate to arrive at home in the same amount of time.

**24. B****Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** The slopes between sets of points that lie on the same line are equal. You can find the slope between points using the slope formula or by looking for patterns.

**Getting to the Answer:** Before immediately jumping to the slope formula, take a peek at the answer choices—all the  $x$ -coordinates of the points are multiples of 4, so looking for a pattern is the quickest way to answer this question. It may help to put all the points in a table (including those given in the question stem), with the  $x$ -coordinates arranged from smallest to largest, and then see which point doesn't fit the pattern.

$x$	$y$
-4	-8
0	-5
4	-1
8	1
12	4
16	7

Notice that all the  $x$ -coordinates increase by 4, while most of the  $y$ -coordinates increase by 3. For the slope between each pair of points to be equal, the  $y$ -coordinate at  $x = 4$  would need to be  $-2$ , not  $-1$ , so the point given in (B) does not lie on the line.

**25. A****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** Identify which pieces of information from the table you need. The question asks for the probability that a randomly chosen person from the study is employed and has a college degree, so you need the total of both females and males with college degrees who are employed compared to all the participants in the study.

**Getting to the Answer:** There are 188 employed females with a college degree and 177 employed males with a college degree for a total of 365 employed people with a college degree out of 800 participants, so the probability is  $\frac{365}{800}$ , which reduces to  $\frac{73}{160}$ .

**26. B****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** Translate from English into math: The number of cells in the original sample means the value of the function at 0 hours, or  $f(0)$ . The first  $x$ -value on the graph is 4, not 0, so you'll need to use the values shown in the calculator screenshot to write an equation for the model.

**Getting to the Answer:** Notice that the  $y$ -values in the calculator screenshot double as the  $x$ -values increase by 1. This means that the model is an exponential growth function of the form  $f(x) = f(0) \cdot 2^x$ . Choose a point from the calculator screenshot such as (4, 136), substitute the values into the function, and solve for  $f(0)$ :

$$136 = f(0) \cdot (2)^4$$

$$136 = f(0) \cdot 16$$

$$\frac{136}{16} = f(0)$$

$$8.5 = f(0)$$

The y-axis title tells you that the numbers are given in thousands, so there were 8,500 white blood cells per microliter in the original sample.

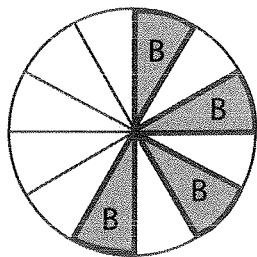
You could also work backward from the calculator screenshot by dividing by 2 four times (from 4 hours to 3 hours, 3 hours to 2 hours, 2 hours to 1 hour, and 1 hour to before the patient contracted the disease). The result is  $136 \div 2^4 = 136 \div 16 = 8.5$ , which in thousands is 8,500.

27. D

**Difficulty:** Hard

**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** Drawing a sketch is the key to answering this question.



Notice that two radii and an arc form each section, so the amount of steel needed for one section is the length of the radius times 2, plus the length of the outer arc. Once you know this, you can simply multiply by 4.

**Getting to the Answer:** You are given the total area, which means you can find the radius by substituting  $64\pi$  for  $A$  in the area formula,  $A = \pi r^2$ .

$$64\pi = \pi r^2$$

$$64 = r^2$$

$$8 = r$$

For auctions, the arena is divided into 12 equal sections through the center, so divide 360 by 12 to find that the central angle measure for each section is  $30^\circ$ . Now use the arc length formula:

$$\begin{aligned} \frac{n^\circ}{360^\circ} \times 2\pi r &= \frac{30^\circ}{360^\circ} \times 2\pi(8) \\ &= \frac{1}{12} \times 16\pi \\ &= \frac{4\pi}{3} \end{aligned}$$

The amount of steel needed for one section is  $8 + 8 + \frac{4\pi}{3} = 16 + \frac{4\pi}{3}$ , so the amount needed for all four sections is  $4 \left( 16 + \frac{4\pi}{3} \right) = 64 + \frac{16\pi}{3}$ .

28. A

**Difficulty:** Hard

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** To write the equation of a line, you need two things—the starting amount ( $y$ -intercept) and the rate of change (slope). Substitute these values into slope-intercept form of a line ( $y = mx + b$ ), and you have your equation.

**Getting to the Answer:** The initial amount of water in the tank on Saturday is 70 gallons, so you already know  $b$ . To find  $m$ , you'll need to use the information given in the question to write two data points.

The amount of water in the tank *depends* on how long Lena has been filling it, so the number of gallons is the dependent variable and time is the independent variable. This tells you that the data points should be written in the form (time, gallons). At time = 0 on Saturday, the number of gallons is 70, so the data point is (0, 70). After 1 hour and 50 minutes, which is  $60 + 50 = 110$  minutes, the tank is full (400 gallons), so another data point is (110, 400). Now, use the slope formula to find that the rate of change is  $\frac{400 - 70}{110 - 0} = \frac{330}{110} = 3$  gallons per minute. Substituting  $m$  and  $b$  into slope-intercept form results in the equation  $y = 3x + 70$ , so (A) is correct.

**29. D****Difficulty:** Hard**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages**Strategic Advice:** Read the question, organizing important information as you go. You need to find the ratio of small units to large units. You're given two ratios: small to medium and medium to large.**Getting to the Answer:** Both of the given ratios contain medium size units, but the medium amounts (5 and 3) are not identical. To directly compare them, find a common multiple (15). Multiply each ratio by the factor that will make the number of medium units equal to 15.

$$\text{small to medium: } (3:5) \times (3:3) = 9:15$$

$$\text{medium to large: } (3:2) \times (5:5) = 15:10$$

Now that the number of medium units needed is the same in both ratios, you can merge the two ratios to compare small to large directly: 9:15:10. Therefore, the proper ratio of small units to large units is 9:10.

**30. A****Difficulty:** Hard**Category:** Passport to Advanced Math / Exponents**Strategic Advice:** Think of the rate given in the question in terms of the constant term you see on the right-hand side of the equation. Working together, the two air purifiers can clean the air in 7 hours. This is equivalent to saying that they can clean  $\frac{1}{7}$  of the air in 1 hour.**Getting to the Answer:** If  $\frac{1}{7}$  is the portion of the air the two purifiers can clean *together* in 1 hour, then each term on the left side of the equation represents the portion that each purifier can clean*individually* in one hour. Since the new model is 3 times as fast as the older model,  $\frac{3}{x}$  represents the portion of the air the new model can clean in 1 hour, and  $\frac{1}{x}$  represents the portion of the air the older model can clean in 1 hour.**31. 9/26 or .346****Difficulty:** Easy**Category:** Heart of Algebra / Linear Equations**Strategic Advice:** Choose the best strategy to answer the question. Distribute the fractions because the numbers inside each set of parentheses are evenly divisible by the denominators of the fractions by which they are being multiplied.**Getting to the Answer:**

$$\frac{1}{3}(90x - 12) = \frac{1}{2}(8x + 10)$$

$$30x - 4 = 4x + 5$$

$$26x = 9$$

$$x = \frac{9}{26}$$

**32. 4****Difficulty:** Medium**Category:** Passport to Advanced Math / Exponents**Strategic Advice:** When solving any type of equation, you should always think of inverse operations. The inverse of raising a quantity to the  $\frac{5}{2}$  power is raising it to the  $\frac{2}{5}$  power.**Getting to the Answer:** Eliminate the exponent using inverse operations and then go from there.

$$n^{\frac{5}{2}} = 32$$

$$\left(n^{\frac{5}{2}}\right)^{\frac{2}{5}} = (32)^{\frac{2}{5}}$$

$$n = 32^{\frac{2}{5}}$$

Now, you have two choices—you can enter this value into your calculator as  $32^{2/5}$  or you can evaluate the number using rules of exponents:

$$32^{\frac{2}{5}} = (\sqrt[5]{32})^2 = 2^2 = 4$$

**33. 801****Difficulty:** Hard**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages**Strategic Advice:** Draw a chart or diagram detailing the various price reductions for each 30-day period.**Getting to the Answer:** You'll need to make several calculations, so don't round until the final answer.

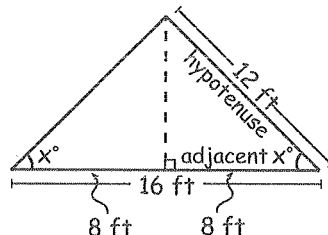
Date	% of Most Recent Price	Resulting Price
Jan. 15	$100 - 40\% = 60\%$	$\$1,848 \times 0.6 = \$1,108.80$
Feb. 1	$100 - 15\% = 85\%$	$\$1,108.80 \times 0.85 = \$942.48$
March 1	$100 - 25\% = 75\%$	$\$942.48 \times 0.75 = \$706.86$

You can stop here because the item was sold on March 10th. Before gridding in your answer, check that \$801 is not less than 30% of the original price:  $0.30 \times \$1,848 = \$554.40$ . It's not, so the final selling price, rounded to the nearest whole dollar, was \$801.

**34.  $\frac{2}{3}$  or .666 or .667****Difficulty:** Hard**Category:** Additional Topics in Math / Trigonometry

**Strategic Advice:** Trig functions usually apply to right triangles, so draw in the altitude of the triangle to get a better picture of which parts of the triangle are useful. Then use the identity  $\cos x = \frac{\text{adj}}{\text{hyp}}$ .

**Getting to the Answer:** Two angles of the triangle have equal measures, so the triangle is isosceles, which means that drawing an altitude from the top to the base will bisect the base, resulting in two smaller right triangles as shown here:



Now, use the identity  $\cos x^\circ = \frac{\text{adjacent}}{\text{hypotenuse}} = \frac{8}{12}$ , so

$$b = \frac{8}{12}, \text{ which can be simplified to } \frac{2}{3}.$$

**35. 3.5 or  $\frac{7}{2}$** **Difficulty:** Hard**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Remember that parallel lines have the same slope. Use the slope formula  $m = \frac{y_2 - y_1}{x_2 - x_1}$  to find the slope of  $\overline{CD}$ .

**Getting to the Answer:**  $\overline{CD}$  passes through the points (0, 0) and (2, 4.5), so its slope is  $\frac{4.5 - 0}{2 - 0} = 2.25$ . Line  $B$  has the same slope and passes through (0, -1), so you can use the slope formula again to find the  $y$ -coordinate of the given point, (2,  $y$ ).

$$2.25 = \frac{y - (-1)}{2 - 0}$$

$$2.25 = \frac{y + 1}{2}$$

$$4.5 = y + 1$$

$$3.5 = y$$

The  $y$ -coordinate of the point is 3.5.



**36. 3/10****Difficulty:** Hard**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages**Strategic Advice:** Whenever rates are given in different units, start by converting to the same units. In most cases, converting to the smaller unit avoids fractions and decimals.**Getting to the Answer:** Start with nickel because the weight is already in ounces:  $\$10.08 \div 24 = \$0.42$  per ounce. Now find the per-ounce rate for copper. There are 16 ounces in one pound, so three pounds is 48 ounces:  $\$8.64 \div 48 = \$0.18$  per ounce. So, if a person were to bring in equal amounts of each, he would receive \$0.18 per ounce of copper and \$0.42 per ounce of nickel. To find the fractional portion he would receive from the copper, set up a comparison between the amount received for copper and the total amount received,  $\$0.18 + \$0.42 = \$0.60$ . The portion of the total amount he receives from copper would be  $\frac{0.18}{0.60}$ , which reduces to  $\frac{3}{10}$ .**37. 3****Difficulty:** Easy**Category:** Problem Solving and Data Analysis / Scatterplots**Strategic Advice:** This question takes just a bit of patience and careful reading and interpretation of the graph.**Getting to the Answer:** Each grid-line along the vertical axis represents 5 units, so look for points that are at least two grid-lines away from the line of best fit. The people who have BMIs of 20, 25, and 28 have LDLs that are 10 or more mg/dL greater than the LDLs predicted by the line of best fit. This represents 3 people.**38. 9.4****Difficulty:** Hard**Category:** Problem Solving and Data Analysis / Scatterplots**Strategic Advice:** Percent error shows the deviation of an actual value from an expected value. The formula for percent error is  $\frac{|\text{Expected value} - \text{Actual value}|}{\text{Actual value}}$ .

To find the expected value, you'll need to find the equation of the line of best fit using the data points given in the question.

**Getting to the Answer:** First, determine the equation of the line of best fit. The slope is

$$m = \frac{180 - 110}{30 - 20}$$

$$m = \frac{70}{10}$$

$$m = 7$$

So far, the equation looks like  $y = 7x + b$ . Next, use either of the two points to find  $b$ :

$$y = 7x + b$$

$$110 = 7(20) + b$$

$$110 = 140 + b$$

$$-30 = b$$

The equation is  $y = 7x - 30$ , so the expected value for a person with a BMI of 25 is  $7(25) - 30 = 145$ .

The doctor's patient had an LDL of 160, so the percent error is

$$\frac{|145 - 160|}{160} = \frac{15}{160} = 0.09375$$

Be sure to follow directions. Rounded to the nearest tenth of a percent, the correct answer is 9.4.

# SAT PRACTICE TEST 2 ANSWER SHEET

Remove (or photocopy) this answer sheet and use it to complete the test. See the answer key following the test when finished.

Start with number 1 for each section. If a section has fewer questions than answer spaces, leave the extra spaces blank.

SECTION

**1**

- |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| 1. (A) (B) (C) (D)  | 14. (A) (B) (C) (D) | 27. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 2. (A) (B) (C) (D)  | 15. (A) (B) (C) (D) | 28. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 3. (A) (B) (C) (D)  | 16. (A) (B) (C) (D) | 29. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D)  | 17. (A) (B) (C) (D) | 30. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D)  | 18. (A) (B) (C) (D) | 31. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D)  | 19. (A) (B) (C) (D) | 32. (A) (B) (C) (D) | 45. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D)  | 20. (A) (B) (C) (D) | 33. (A) (B) (C) (D) | 46. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D)  | 21. (A) (B) (C) (D) | 34. (A) (B) (C) (D) | 47. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D)  | 22. (A) (B) (C) (D) | 35. (A) (B) (C) (D) | 48. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 23. (A) (B) (C) (D) | 36. (A) (B) (C) (D) | 49. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 24. (A) (B) (C) (D) | 37. (A) (B) (C) (D) | 50. (A) (B) (C) (D) |
| 12. (A) (B) (C) (D) | 25. (A) (B) (C) (D) | 38. (A) (B) (C) (D) | 51. (A) (B) (C) (D) |
| 13. (A) (B) (C) (D) | 26. (A) (B) (C) (D) | 39. (A) (B) (C) (D) | 52. (A) (B) (C) (D) |

# right in Section 1

# wrong in Section 1

SECTION

**2**

- |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| 1. (A) (B) (C) (D)  | 12. (A) (B) (C) (D) | 23. (A) (B) (C) (D) | 34. (A) (B) (C) (D) |
| 2. (A) (B) (C) (D)  | 13. (A) (B) (C) (D) | 24. (A) (B) (C) (D) | 35. (A) (B) (C) (D) |
| 3. (A) (B) (C) (D)  | 14. (A) (B) (C) (D) | 25. (A) (B) (C) (D) | 36. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D)  | 15. (A) (B) (C) (D) | 26. (A) (B) (C) (D) | 37. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D)  | 16. (A) (B) (C) (D) | 27. (A) (B) (C) (D) | 38. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D)  | 17. (A) (B) (C) (D) | 28. (A) (B) (C) (D) | 39. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D)  | 18. (A) (B) (C) (D) | 29. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D)  | 19. (A) (B) (C) (D) | 30. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D)  | 20. (A) (B) (C) (D) | 31. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 21. (A) (B) (C) (D) | 32. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 22. (A) (B) (C) (D) | 33. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |

# right in Section 2

# wrong in Section 2

SECTION 3

3

1. (A) (B) (C) (D)      5. (A) (B) (C) (D)      9. (A) (B) (C) (D)      13. (A) (B) (C) (D)  
 2. (A) (B) (C) (D)      6. (A) (B) (C) (D)      10. (A) (B) (C) (D)      14. (A) (B) (C) (D)  
 3. (A) (B) (C) (D)      7. (A) (B) (C) (D)      11. (A) (B) (C) (D)      15. (A) (B) (C) (D)  
 4. (A) (B) (C) (D)      8. (A) (B) (C) (D)      12. (A) (B) (C) (D)

16.

7	7		
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0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

17.

7	7		
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

18.

7	7		
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0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

19.

7	7		
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0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

20.

7	7		
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0	0	0	0
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

# right in Section 3

# wrong in Section 3

SECTION 4

4

1. (A) (B) (C) (D)      9. (A) (B) (C) (D)      17. (A) (B) (C) (D)      25. (A) (B) (C) (D)  
 2. (A) (B) (C) (D)      10. (A) (B) (C) (D)      18. (A) (B) (C) (D)      26. (A) (B) (C) (D)  
 3. (A) (B) (C) (D)      11. (A) (B) (C) (D)      19. (A) (B) (C) (D)      27. (A) (B) (C) (D)  
 4. (A) (B) (C) (D)      12. (A) (B) (C) (D)      20. (A) (B) (C) (D)      28. (A) (B) (C) (D)  
 5. (A) (B) (C) (D)      13. (A) (B) (C) (D)      21. (A) (B) (C) (D)      29. (A) (B) (C) (D)  
 6. (A) (B) (C) (D)      14. (A) (B) (C) (D)      22. (A) (B) (C) (D)      30. (A) (B) (C) (D)  
 7. (A) (B) (C) (D)      15. (A) (B) (C) (D)      23. (A) (B) (C) (D)  
 8. (A) (B) (C) (D)      16. (A) (B) (C) (D)      24. (A) (B) (C) (D)

31.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

32.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

33.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

34.

7	7		
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0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

35.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	6	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

36.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	6	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

37.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

38.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

# right in Section 4

# wrong in Section 4

# MATH TEST

25 Minutes—20 Questions

## NO-CALCULATOR SECTION

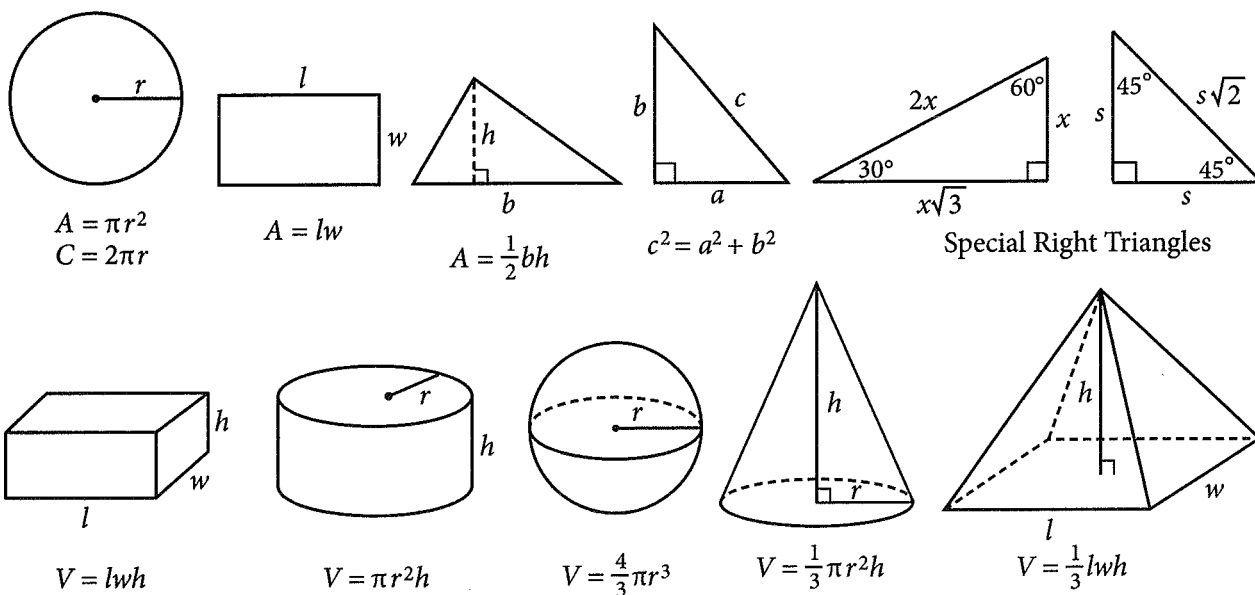
Turn to Section 3 of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding oval on the answer sheet. You may use any available space for scratch work.

Notes:

1. Calculator use is NOT permitted.
2. All numbers used are real numbers.
3. All figures used are necessary to solving the problems that they accompany. All figures are drawn to scale EXCEPT when it is stated that a specific figure is not drawn to scale.
4. Unless stated otherwise, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$ , for which  $f(x)$  is a real number.

Information:



The sum of the degree measures of the angles in a triangle is 180.

The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is  $2\pi$ .

Number of Runs	Total Number of People Who Have Ridden the Swings
2	28
3	42
5	70

1. The giant swings in an amusement park are run only when completely full to maintain a fairly even distribution of weight. The number of times the swings have been run, along with a cumulative rider count, is recorded in the table above. Based on the information, how many people will have ridden the giant swings when they have been run eight times?
- A) 98  
B) 112  
C) 140  
D) 224
2. Which of the following expressions is equivalent to  $a^{\frac{2}{6}}$ ?
- A)  $\sqrt[3]{a}$   
B)  $\sqrt{3a}$   
C)  $\frac{a}{3}$   
D)  $\frac{2}{a^6}$
3. A publishing company ships books to schools, some of which are hardback textbooks and some of which are paperback workbooks. Each shipping box can hold a maximum of 20 textbooks or 64 workbooks. Each textbook takes up 192 cubic inches of space, and each workbook takes up 60 cubic inches of space. One box can hold a maximum of 3,840 cubic inches. The shipping department is packing a box containing both types of books. Which of the following systems of inequalities can the department use to determine how many textbooks,  $t$ , and workbooks,  $w$ , can be shipped in one box?
- A) 
$$\begin{cases} t \leq 20 \\ w \leq 64 \\ 60t + 192w \leq 3,840 \end{cases}$$
- B) 
$$\begin{cases} t \geq 20 \\ w \geq 64 \\ 192t + 60w \geq 3,840 \end{cases}$$
- C) 
$$\begin{cases} t \leq 20 \\ w \leq 64 \\ 192t + 60w \leq 3,840 \end{cases}$$
- D) 
$$\begin{cases} t \leq 192 \\ w \leq 60 \\ 20t + 64w \leq 3,840 \end{cases}$$
4. A nutritionist is studying the effects of nutritional supplements on athletes. She uses the function  $P_i(a)$  to represent the results of her study, where  $a$  represents the number of athletes who participated in the study, and  $P_i$  represents the number of athletes who experienced increased performance while using the supplements over a given period of time. Which of the following lists could represent a portion of the domain for the nutritionist's function?
- A)  $\{\dots-100, -75, -50, -25, 0, 25, 50, 75, 100\dots\}$   
B)  $\{-100, -75, -50, -25, 0, 25, 50, 75, 100\}$   
C)  $\{0, 2.5, 5, 7.5, 10, 12.5, 15\dots\}$   
D)  $\{0, 15, 30, 45, 60, 75\dots\}$

5. Which of the following does not represent a linear relationship?

A) 

<b>x</b>	-1	-4	-7	-10	-13
<b>y</b>	8	6	4	2	0

B) 

<b>x</b>	-3	-1	1	3	5
<b>y</b>	5	3	1	-1	-3

C) 

<b>x</b>	1	2	3	4	5
<b>y</b>	-5	-5	-5	-5	-5

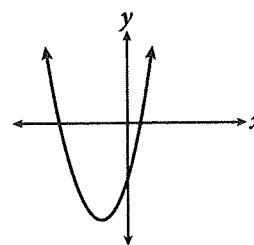
D) 

<b>x</b>	-2	-1	0	1	2
<b>y</b>	4	1	0	1	4

$$\begin{cases} Ax - 2y = 18 \\ Bx + 6y = 26 \end{cases}$$

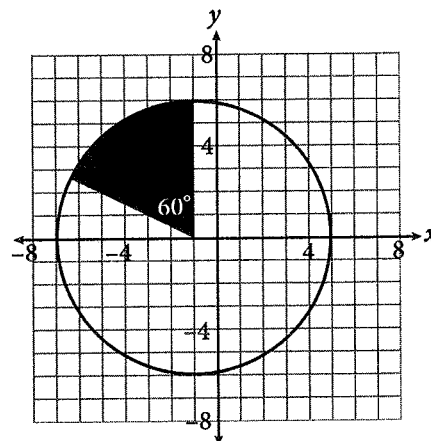
6. If the graphs of the lines in the system of equations above intersect at  $(4, -1)$ , what is the value of  $\frac{B}{A}$ ?

- A)  $-3$
- B)  $-\frac{1}{3}$
- C)  $\frac{1}{2}$
- D)  $2$



7. Which of the following equations could represent the graph in the figure?

- A)  $y = x^2 - 4x - 4$
- B)  $y = x^2 + 4x - 4$
- C)  $y = x^2 - 8x + 16$
- D)  $y = x^2 + 8x + 16$

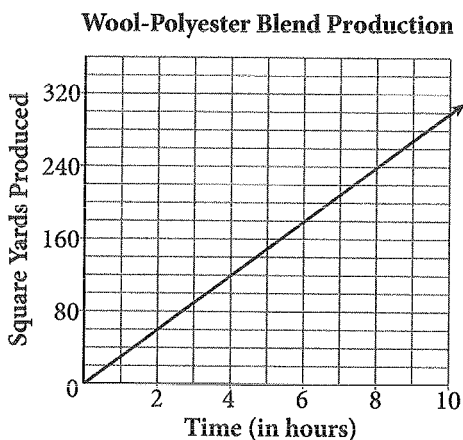


8. What is the area of the shaded sector of the circle shown in the figure above?

- A)  $2\pi$
- B)  $6\pi$
- C)  $12\pi$
- D)  $36\pi$

9. Which of the following expressions has the same value as  $\sqrt{0.25} \times \sqrt{2}$ ?

- A)  $\frac{\sqrt{2}}{4}$
- B)  $\frac{1}{2}$
- C)  $\frac{\sqrt[3]{2}}{2}$
- D)  $\frac{\sqrt{2}}{2}$

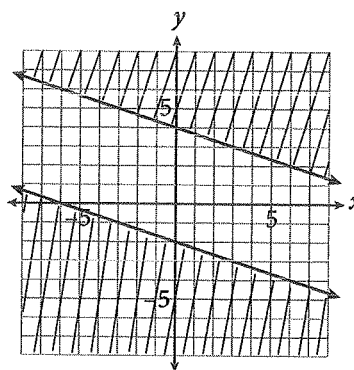


10. The figure above shows the rate at which a textile machine can produce a wool-polyester blend fabric. To produce a 100% polyester fabric, the same machine can produce 40 square yards per hour. Given that the company needs to fill an order for 2,400 square yards of each type of fabric, which of the following statements is true?

- A) It will take half as long to make the blended fabric as the 100% polyester fabric.
- B) It will take twice as long to make the blended fabric as the 100% polyester fabric.
- C) It will take 20 more hours to make the blended fabric than the 100% polyester fabric.
- D) It will take 20 fewer hours to make the blended fabric than the 100% polyester fabric.

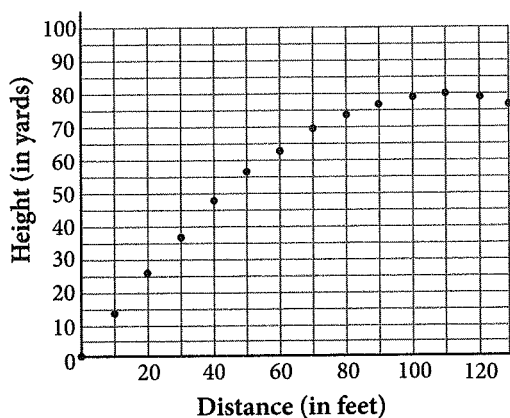
11. Given the polynomial  $6x^4 + 2x^2 - 8x - c$ , where  $c$  is a constant, for what value of  $c$  will  $\frac{6x^4 + 2x^2 - 8x - c}{x + 2}$  have no remainder?

- A) -120
- B) -60
- C) 60
- D) 120



12. Which of the following systems of inequalities could be represented by the graph shown?

- A)  $\begin{cases} 3x - y \geq 4 \\ 3x - y \leq -2 \end{cases}$
- B)  $\begin{cases} 3x + y \geq 4 \\ 3x + y \leq -2 \end{cases}$
- C)  $\begin{cases} x - 3y \geq 12 \\ x - 3y \leq -6 \end{cases}$
- D)  $\begin{cases} x + 3y \geq 12 \\ x + 3y \leq -6 \end{cases}$

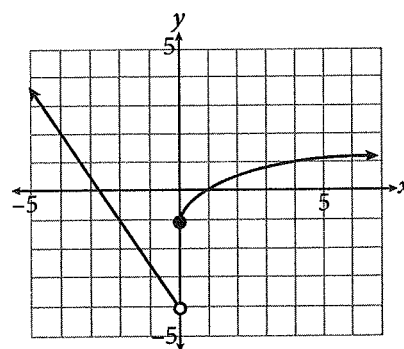


13. The figure above shows part of the path of a planned roller coaster hill. What is the sum, in feet, of the vertical height and the horizontal distance that the roller coaster will travel while on this particular hill?

- A) 220
- B) 300
- C) 460
- D) 900

14. Which of the following expressions is equivalent to the complex number  $\frac{2}{i+6} + (2+5i)$ ? (Note that  $\sqrt{-1} = i$ .)

- A)  $\frac{32i+9}{i+6}$
- B)  $\frac{34i+7}{i+6}$
- C)  $\frac{32i+19}{i+6}$
- D)  $\frac{37i+14}{i+6}$



15. Which of the following piecewise functions could have been used to generate the graph above?

A)  $g(x) = \begin{cases} -\frac{3}{2}x - 4, & \text{if } x < 0 \\ \sqrt{x} - 1, & \text{if } x \geq 0 \end{cases}$

B)  $g(x) = \begin{cases} -\frac{3}{2}x - 4, & \text{if } x < 0 \\ \sqrt{x-1}, & \text{if } x \geq 0 \end{cases}$

C)  $g(x) = \begin{cases} -\frac{3}{2}x - 4, & \text{if } x < 0 \\ \sqrt{x+1}, & \text{if } x > 0 \end{cases}$

D)  $g(x) = \begin{cases} -\frac{2}{3}x - 4, & \text{if } x < 0 \\ \sqrt{x} + 1, & \text{if } x \geq 0 \end{cases}$



**Directions:** For questions 16-20, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $\frac{7}{2}$ .

(If  $3\frac{1}{2}$  is entered into the grid as 

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)

- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Answer:  $\frac{7}{12}$

Write answer in boxes. →

7	/	1	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Grid in result. →

Answer: 2.5

2	.	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

← Decimal point

Answer: 201  
Either position is correct.

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

Acceptable ways to grid  $\frac{2}{3}$  are:

2	/	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6

.	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

.	6	6	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

16. If  $0.2x + 1.8 = 3 - 0.6x$ , what is the value of  $x$ ?

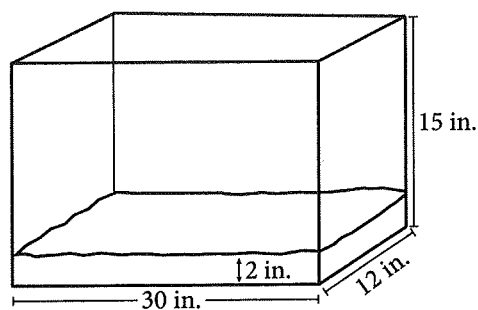
Equation 1	
$x$	$y$
5	-8
4	-5
3	-2
2	1

Equation 2	
$x$	$y$
-8	3
-6	4
-4	5
-2	6

17. The tables above represent data points for two linear equations. If the two equations form a system, what is the  $x$ -coordinate of the solution to that system?

$$18 - \frac{(3x)^{\frac{1}{2}}}{2} = 15$$

18. What value of  $x$  satisfies the equation above?



19. The figure above shows a fish tank with sand in the bottom. If the water level is to be 3 inches below the top, how many cubic inches of water are needed to fill the tank?
20. If  $g(x) = 2x^3 - 5x^2 + 4x + 6$ , and  $P$  is the point on the graph of  $g(x)$  that has an  $x$ -coordinate of 1, then what is the  $y$ -coordinate of the corresponding point on the graph of  $g(x - 3) + 4$ ?

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS SECTION ONLY. DO NOT TURN TO ANY OTHER SECTION IN THE TEST.

**STOP**

# MATH TEST

55 Minutes—38 Questions

## CALCULATOR SECTION

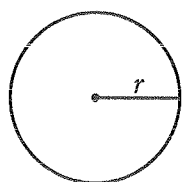
Turn to Section 4 of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding oval on the answer sheet. You may use any available space for scratch work.

Notes:

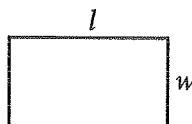
1. Calculator use is permitted.
2. All numbers used are real numbers.
3. All figures used are necessary to solving the problems that they accompany. All figures are drawn to scale EXCEPT when it is stated that a specific figure is not drawn to scale.
4. Unless stated otherwise, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$ , for which  $f(x)$  is a real number.

Information:

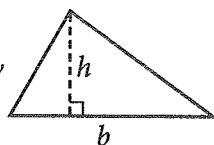


$$A = \pi r^2$$

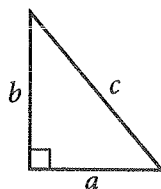
$$C = 2\pi r$$



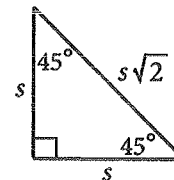
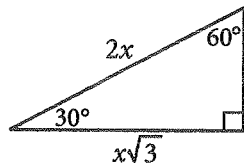
$$A = lw$$



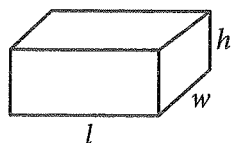
$$A = \frac{1}{2}bh$$



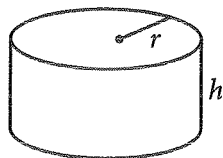
$$c^2 = a^2 + b^2$$



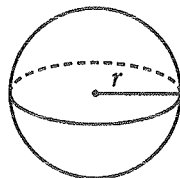
Special Right Triangles



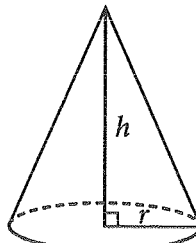
$$V = lwh$$



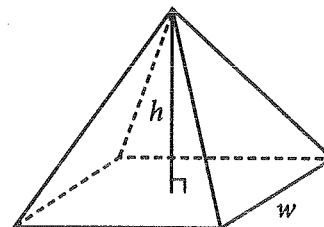
$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



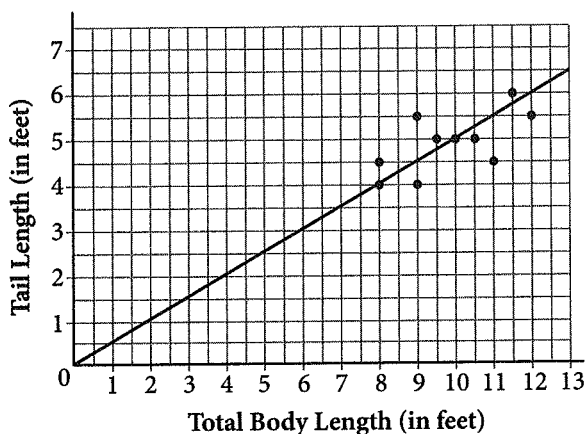
$$V = \frac{1}{3}lwh$$

The sum of the degree measures of the angles in a triangle is 180.

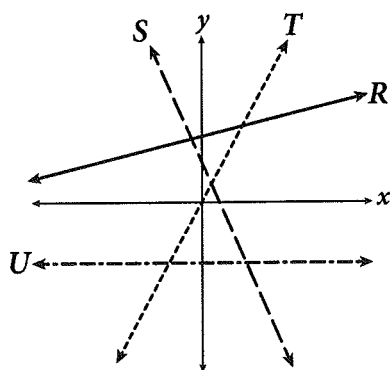
The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is  $2\pi$ .

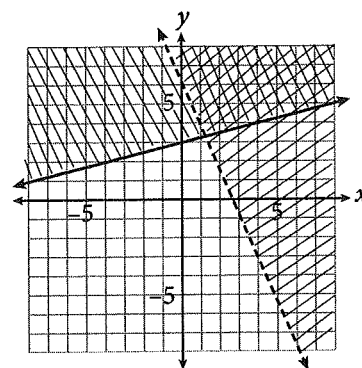
GO ON TO THE NEXT PAGE 



- The Florida Department of Wildlife caught and tagged 10 adult female alligators as part of an effort to protect this endangered species. They took various measurements and readings related to body size and health. The total body length is plotted against the tail length in the scatterplot shown above, along with a line of best fit. Which of the following equations best models the data?
  - $y = 0.5x$
  - $y = 2x$
  - $y = 0.4x + 1$
  - $y = 0.6x - 1$



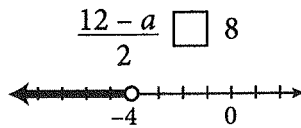
- Which of the following lists correctly orders the lines in the figure above according to their slopes, from least to greatest?
  - R, T, S, U
  - S, U, R, T
  - S, R, U, T
  - U, S, R, T



- Which of the following is a solution to the system of inequalities shown in the figure above?
  - $(-5, 2)$
  - $(-2, 5)$
  - $(2, 5)$
  - $(5, 2)$
- The American political system is largely a two-party system. In fact, only six candidates who were not associated with either the Republican or the Democratic Party have been elected governor in any state since 1990. In one such election, the ratio of votes received for the Independent candidate to the Democratic candidate to the Republican candidate was approximately 19:18:13. If 510,000 votes were cast in the election, how many more votes were cast for the Independent candidate than for the Republican candidate?
  - 6,000
  - 10,200
  - 61,200
  - 193,800

Selection Method	Number of States
Election	22
Gubernatorial appointment	11
Legislative appointment	2
Missouri Plan	15

5. There are four ways in which state judges are selected for their positions. One is by election, another is appointment by the governor (usually with the confirmation by the state legislature), and a third is appointment by the state legislature. The final way is a hybrid of the last two, called the Missouri Plan, in which a nonpartisan legislative committee recommends a list of candidates and the governor chooses from this list. The table above shows the number of states that engage in each process for the highest court of the state, usually called the state Supreme Court. What percent of states select judges using the Missouri Plan?
- A) 17%  
 B) 30%  
 C) 33%  
 D) 43%
6. A botanist collects and models some data and is able to determine that the number of germinated seeds of a certain plant is linearly correlated to the amount of rainfall during the previous month, according to the equation  $s = 28.5r + 83$ . In this equation,  $s$  is the number of seeds germinated, and  $r$  is the amount of rainfall in inches. In a certain geographic region that the botanist is studying, 197 seeds germinated. Approximately how many inches of rainfall did that area receive during the previous month?
- A) 3.1  
 B) 4  
 C) 7  
 D) 9.8
7. A dendrologist (a botanist who studies trees exclusively) is examining the way in which a certain tree sheds its leaves. He tracks the number of leaves shed each day over the period of a month, starting when the first leaf is shed. He organizes the data in a scatterplot and sees that the data can be modeled using an exponential function. He determines the exponential model to be  $f(x) = 6(1.92)^x$ , where  $x$  is the number of days after the tree began to shed its leaves. What does the value 1.92 in the function tell the dendrologist?
- A) The number of leaves shed almost doubles each day.  
 B) The number of leaves shed almost doubles every six days.  
 C) The number of leaves left on the tree is reduced by about 92% each day.  
 D) The number of leaves left on the tree is reduced by about 92% every six days.



8. Which inequality symbol would make the above statement true?
- A)  $\leq$   
 B)  $\geq$   
 C)  $<$   
 D)  $>$

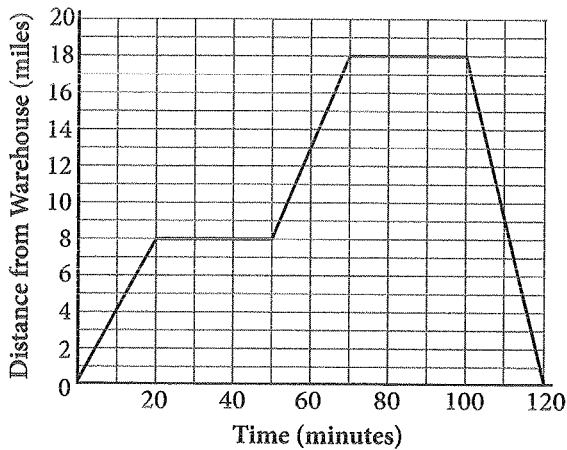
Price per Pencil	Projected Number of Units Sold
\$0.20	150,000
\$0.25	135,000
\$0.30	120,000
\$0.35	105,000
\$0.40	90,000
\$0.45	75,000

9. Generally, the price of an item is a good indicator of how many units of that item will be sold. The lower the price, the more units will be sold. A marketing department develops a table showing various price points and the projected number of units sold at that price point. Which of the following represents the linear relationship shown in the table, where  $x$  is the price and  $y$  is the number of units sold?
- A)  $y = 0.03x + 150,000$   
 B)  $y = 300,000x + 75,000$   
 C)  $y = -300,000x + 90,000$   
 D)  $y = -300,000x + 210,000$

10. A mailing supply store sells small shipping boxes in packs of 8 or 20. If the store has 61 packs in stock totaling 800 small shipping boxes, how many packs have 20 boxes in them, assuming all the packs are full?
- A) 26  
 B) 32  
 C) 35  
 D) 40
11. Given that  $\sqrt{-1} = i$ , which of the following is equivalent to the sum  $i^{125} + i^{125}$ ?
- A)  $i^{14}$   
 B)  $i^{250}$   
 C)  $2i^{45}$   
 D)  $2i^{250}$

$$-\frac{9}{2}x^{10} - \frac{3}{2}x^9 + \frac{15}{2}x^8$$

12. Which of the following is equivalent to the expression above?
- A)  $-\frac{3}{2}x^8(3x^2 + x - 5)$   
 B)  $-\frac{1}{2}x^8(9x^2 + 3x - 5)$   
 C)  $\frac{3}{2}x^8(-3x^2 + x + 5)$   
 D)  $3x^8(-3x^2 - x + 5)$



13. The graph above shows a delivery truck's distance from the company's warehouse over a two-hour period, during which time the delivery people made two deliveries and then returned to the warehouse. Based on the graph, which of the following statements could be true?
- A) Each delivery took 30 minutes to complete, not including driving time.
  - B) The location of the second delivery was about 70 miles from the warehouse.
  - C) The truck traveled about 18 miles from the time it left the warehouse until it returned.
  - D) The second delivery was about 18 miles farther from the warehouse than the first delivery.

Questions 14 and 15 refer to the following information.

Plants are capable of cross-pollinating with related but different plants. This creates a hybrid plant. Sometimes, a hybrid plant is superior to the two different plants from which it was derived. This is known as “hybrid vigor.” Scientists can examine the DNA of a plant to see if it is a hybrid. This can be valuable information because if the plant appears superior, it would be beneficial to develop more of these hybrids. An agricultural scientist examines an orchard that has several types of apple trees and orange trees to see which ones are hybrids. Some of the information she collected is shown in the table below.

	Apple Trees	Orange Trees	Total
Hybrid			402
Non-hybrid		118	
Total			628

14. Based on the data, if 45% of the apple trees are not hybrids, how many apple trees are hybrids?
- A) 50  
 B) 132  
 C) 226  
 D) 240
15. The scientist wants to study the orange trees to check for hybrid vigor. If she chooses one orange tree at random, what is the probability that it will be a hybrid?
- A)  $\frac{59}{194}$   
 B)  $\frac{135}{314}$   
 C)  $\frac{97}{157}$   
 D)  $\frac{135}{194}$



$$\left(5x^4 - \frac{1}{4}x^3 + 3x\right) \div \frac{1}{2}x$$

16. What is the result of dividing the two expressions above?

- A)  $\frac{5}{2}x^3 - \frac{1}{8}x^2 + \frac{3}{2}$   
 B)  $\frac{5}{2}x^3 - 2x^2 + \frac{3}{2}x$   
 C)  $10x^3 - \frac{1}{2}x^2 + 6$   
 D)  $10x^3 - \frac{1}{8}x^2 + 6x$

$x$	$y$
-1	7
0	5
1	3
2	1

17. If graphed, the ordered pairs in the table above would form a line. Where would this line intersect the  $x$ -axis?

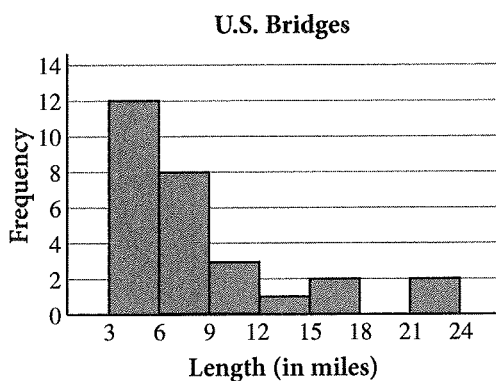
- A)  $-2\frac{1}{2}$   
 B)  $-\frac{1}{2}$   
 C)  $2\frac{1}{2}$   
 D) 5

18. Mount Fuji in Japan was first climbed by a monk in 663 AD and subsequently became a Japanese religious site for hundreds of years. It is now a popular tourist site. When ascending the mountain, tourists drive part of the distance and climb the rest of the way. Suppose a tourist drove to an elevation of 2,390 meters and from that point climbed to the top of the mountain, and then descended back to the car taking the same route. If it took her a total of 7 hours to climb up and back down, and she climbed at an average rate of 264 vertical meters per hour going up and twice that going down, approximately how tall is Mount Fuji?

- A) 1,386 meters  
 B) 2,772 meters  
 C) 3,776 meters  
 D) 5,172 meters

$$\begin{cases} y = 3x \\ -3x^2 + 2y^2 = 180 \end{cases}$$

19. If  $(x, y)$  is a solution to the system of equations above, what is the value of  $x^2$ ?
- A) 12  
 B) 20  
 C) 60  
 D) 144
20. If  $M = 3x^2 + 9x - 4$  and  $N = 5x^2 - 12$ , then what is  $2(M - N)$ ?
- A)  $-2x^2 + 9x + 8$   
 B)  $-4x^2 + 18x - 32$   
 C)  $-4x^2 + 18x + 16$   
 D)  $8x^2 + 9x - 16$

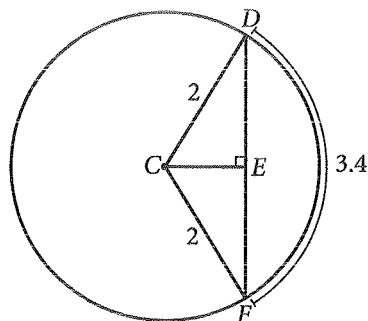


21. The Lake Pontchartrain Causeway Bridge in Louisiana is the longest bridge in the United States, at 23.83 miles long. The histogram above shows the distribution of the lengths, in miles, of 28 of the longest bridges in the United States, including Lake Pontchartrain Causeway Bridge. Which of the following could be the median length of the 28 bridges represented in the histogram?
- A) 5.9  
B) 7.9  
C) 9.2  
D) 9.9
22. In the United States, the original full retirement age was 65. The retirement age has since been pushed to 66 and will soon move to 67, as life expectancies go up. The Social Security Administration periodically conducts studies regarding retirement age. One such study focused on whether or not retiring early lowers a person's life expectancy. The study found a weak positive correlation between retirement age and life expectancy. If data from the study were graphed in a scatterplot, which of the following statements would be true?
- A) The slope of the line of best fit would be a large positive number.  
B) The slope of the line of best fit would be a negative number close to 0.  
C) The data points would follow, but not closely, an increasing line of best fit.  
D) The data points would be closely gathered around an increasing line of best fit.
23. A student is doing a scale drawing of a woolly mammoth on a piece of poster board for her presentation on the last ice age. She was surprised to find that the woolly mammoth, reaching a height of only about 10 feet, 6 inches, was actually smaller than today's African elephant. Even more surprising is the fact that the woolly mammoth's tusks averaged 11.5 feet in length. If the student draws the mammoth 14 inches tall on her poster, approximately how many inches long should she make the tusks?
- A) 12.78  
B) 15.0  
C) 15.33  
D) 16.1
24. Johanna picked 3 pounds of strawberries at a "pick-your-own" patch. At this particular patch, the cost is \$1.50 for the pail and \$3.99 per pound of strawberries picked. If a linear equation is created to represent the situation and written in the form  $y = mx + b$ , which piece of the equation would the value 13.47 in this scenario most likely represent?
- A)  $b$   
B)  $m$   
C)  $x$   
D)  $y$

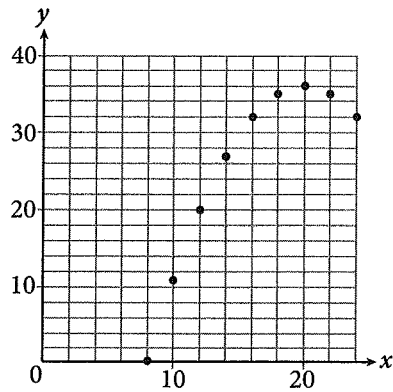
25. In an effort to decrease reliance on fossil fuels, some energy producers have started to utilize renewable resources. One such power plant uses solar panels to create solar energy during the day and then shifts to natural gas at night or when there is cloud cover. One particularly bright morning, the company increases the amount of its power typically generated by solar panels by 60%. During a cloudy spell, it decreases the amount by 30%, and then when the sun comes back out, it increases the amount again by 75% before shutting the panels down for the night. What is the net percent increase of this company's reliance on solar panels during that day?

- A) 75%  
 B) 96%  
 C) 105%  
 D) 165%
26. Zoos use various methods for determining how to feed different animals. Sometimes they use age, weight, or, usually in the case of snakes, length. If a snake that is 2 feet, 6 inches long receives 12 grams of frog mash per feeding, how many grams should a snake that is 1 meter in length get? (Use the approximate conversion 1 foot = 0.3 meters.)

- A) 5  
 B) 13  
 C) 14.5  
 D) 16



27. Which of the following gives the length of chord  $DF$  in the figure above?
- A)  $2\cos(1.7)$   
 B)  $2\sin(1.7)$   
 C)  $4\cos(0.85)$   
 D)  $4\sin(0.85)$
28. If  $y = 12 - x$  and  $\frac{3y}{4} + 11 = \frac{-x}{2}$ , what is the value of  $\frac{x}{5} + \frac{y}{4}$ ?
- A)  $-1$   
 B)  $\frac{19}{4}$   
 C)  $\frac{75}{4}$   
 D) 33



29. If a quadratic equation is used to model the data shown in the scatterplot above, and the model fits the data exactly, which of the following is a solution to the quadratic equation?

A) 28  
B) 32  
C) 34  
D) 36

30. If  $h$  is a function defined over the set of all real numbers and  $h(x - 4) = 6x^2 + 2x + 10$ , then which of the following defines  $h(x)$ ?

A)  $h(x) = 6x^2 - 2x + 114$   
B)  $h(x) = 6x^2 - 46x + 98$   
C)  $h(x) = 6x^2 + 2x + 98$   
D)  $h(x) = 6x^2 + 50x + 114$

**Directions:** For questions 31-38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
4. Some problems may have more than one correct answer. In such cases, grid only one answer.
5. **Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $\frac{7}{2}$ .

(If  $3\frac{1}{2}$  is entered into the grid as 

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)

6. **Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Answer:  $\frac{7}{12}$

Write answer in boxes. →

7	/	1	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Grid in result. →

Answer: 2.5

2	.	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

← Decimal point

Answer: 201  
Either position is correct.

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1
2	2	2
3	3	3
4	4	4

2	0	1
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<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1
2	2	2
3	3	3

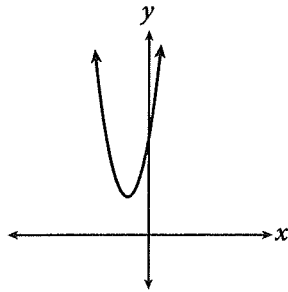
Acceptable ways to grid  $\frac{2}{3}$  are:

2	/	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6

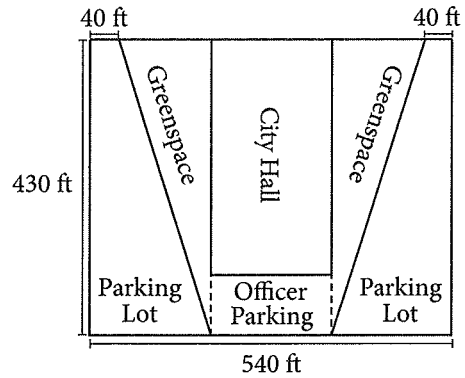
.	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

.	6	6	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

31. The Bar Exam is a test given in each state to determine whether or not a law school graduate is competent to practice law. The American Bar Association surveyed 3,000 law school graduates across the country who passed the bar exam in 2000. Of those surveyed, 720 were not practicing law in 2012. If 55,200 graduates passed the bar in 2000, about how many of them were practicing law in 2012, assuming the sample was a good representation of the population of law school graduates who passed the bar in 2000? Round to the nearest thousand and enter your answer in terms of thousands. (For example, enter 18,000 as 18.)
32. In recent years, car manufacturers have started producing hybrid vehicles, which run on both electricity and gasoline, resulting in a significantly higher gas mileage. Suppose the odometer of a hybrid car, which shows how many miles the car has traveled, reads 4,386 miles. If the car averages 48 miles to the gallon of gas and currently has 12 gallons in the tank, what should the odometer reading be when the tank is empty?



33. If the equation of the graph shown above is  $y = 2(x + 3)^2 + 10$ , what is the  $y$ -intercept of the graph?

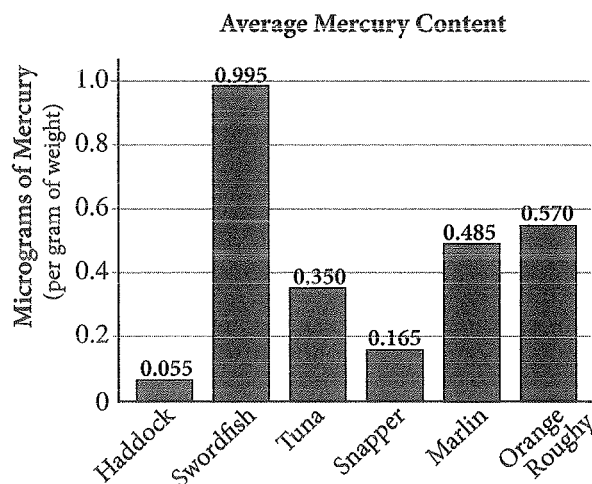


34. Many cities try to work “greenspaces” into their city planning because living plants help filter the city’s air, reducing the effects of pollution. The figure above shows the plans for a new greenspace around City Hall, which will be created by converting portions of the existing parking lots. If the width of each parking lot is the same as the width of the City Hall building, how many thousands of square feet of greenspace will there be after the conversion? Round to the nearest thousand and enter your answer in terms of thousands. (For example, enter 14,000 as 14.)
35. Rasha volunteers at a charity that helps feed the homeless. He collects donations and then uses the money to buy food for care packages. This week, he collected \$145. Each care package will include canned vegetables and bags of rice in the ratio 3:1. The cans cost \$0.89 each, and the bags of rice cost \$3.49 each. Using the given ratio, what is the maximum number of complete vegetable/rice care packages Rasha can make?

36. A subway car on the New York City subway travels at an average speed of 17.4 miles per hour. Train cars on the Chicago L travel at an average speed that is 30% faster than that of the NYC subway. The DC Metro travels at an average speed that is 30% faster than that of the Chicago L. Marc rode the NYC subway from one stop to another and it took 6 minutes; Lizzie rode the Chicago L from one stop to another and it took 4.8 minutes; and Darius rode the DC Metro, which took 3.6 minutes between stops. How many miles did the person who traveled the shortest distance between stops travel? Round to the nearest tenth of a mile.

Questions 37 and 38 refer to the following information.

Mercury is a naturally occurring metal that can be harmful to humans. The current recommendation is for humans to take in no more than 0.1 microgram for every kilogram of their weight per day. Fish generally carry high levels of mercury, although certain fish have higher mercury content than others. Fish, however, are healthy sources of many other nutrients, so nutritionists recommend keeping them in the human diet. The figure below shows the average mercury content of several types of fish.



37. If a person weighs 82 kilograms, how many grams of snapper can he safely consume per day? Round your answer to the nearest gram.
38. Suppose in a week, a person regularly eats one portion of each type of the fish shown in the bar graph, except the fish with the highest mercury content. What is this person's average daily mercury consumption, in micrograms, assuming a portion size of 100 grams? Round your answer to the nearest microgram.

**ANSWER KEY****READING TEST**

1. C	14. C	27. B	40. A
2. D	15. C	28. B	41. C
3. B	16. D	29. A	42. D
4. C	17. A	30. D	43. C
5. C	18. C	31. C	44. A
6. A	19. D	32. C	45. A
7. B	20. B	33. B	46. B
8. D	21. A	34. B	47. C
9. B	22. B	35. C	48. B
10. B	23. C	36. C	49. A
11. C	24. C	37. A	50. C
12. D	25. D	38. B	51. D
13. A	26. C	39. C	52. C

**WRITING AND LANGUAGE TEST**

1. C	12. A	23. A	34. D
2. B	13. B	24. B	35. C
3. C	14. C	25. D	36. D
4. D	15. A	26. B	37. B
5. C	16. D	27. C	38. B
6. C	17. B	28. B	39. B
7. B	18. C	29. A	40. C
8. A	19. A	30. C	41. B
9. B	20. B	31. D	42. C
10. D	21. D	32. C	43. B
11. A	22. A	33. D	44. D



**MATH—NO CALCULATOR**

1. B	6. D	11. D	16. $\frac{3}{2}$ or 1.5
2. A	7. B	12. D	17. 0
3. C	8. B	13. C	18. 12
4. D	9. D	14. A	19. 3600
5. D	10. C	15. A	20. 11

**MATH—CALCULATOR**

1. A	11. C	21. B	31. 42
2. B	12. A	22. C	32. 4962
3. C	13. A	23. C	33. 28
4. C	14. B	24. D	34. 60
5. B	15. D	25. B	35. 23
6. B	16. C	26. D	36. 1.7
7. A	17. C	27. D	37. 50
8. D	18. C	28. A	38. 23
9. D	19. A	29. B	
10. A	20. C	30. D	

**Strategic Advice:** Two complete thoughts should be two separate sentences. Be careful of inappropriate transition words.

**Getting to the Answer:** A period and a capital letter will divide the two complete thoughts correctly. Choice (B) is the correct answer.

42. C

**Difficulty:** Easy

**Category:** Writing & Language / Organization

**Strategic Advice:** Look for the relationship between this sentence and the previous one. This will help you choose the appropriate transition word.

**Getting to the Answer:** Choice (C) shows the relationship between the two sentences by emphasizing that some people were affected by the gluten pill.

43. B

**Difficulty:** Easy

**Category:** Writing & Language / Sentence Formation

**Strategic Advice:** Verbs that have the same level of importance in a sentence must be in parallel form. Check to see if this is true here.

**Getting to the Answer:** Choice (B) is the correct answer. The verb “does” is in the singular present tense, and so is “benefits.”

44. D

**Difficulty:** Easy

**Category:** Writing & Language / Effective Language Use

**Strategic Advice:** The context of the sentence suggests the word that would have the best fit.

**Getting to the Answer:** “Suspected” reflects the idea that this is what doctors and researchers thought was true at first. Choice (D) is correct.

## MATH TEST: NO-CALCULATOR SECTION

1. B

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Determine from the table the number of people who ride the swings on a single run (the unit rate, or slope). Then, multiply this number by 8.

**Getting to the Answer:** If 28 people have ridden the swings after it has been run 2 times, this means  $28 \div 2 = 14$  people ride the swings each time. Therefore, when the swings have been run 8 times,  $14 \times 8 = 112$  people will have ridden them.

2. A

**Difficulty:** Easy

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** A variable with a fraction exponent can be written as a radical expression by writing the numerator of the fraction as the power of the radicand and the denominator as the degree (also called the index) of the root. For example,  $x^{\frac{2}{3}} = \sqrt[3]{x^2}$ .

**Getting to the Answer:** Start by reducing the fraction in the exponent:  $\frac{2}{6} = \frac{1}{3}$ . The variable  $a$  is being raised to the  $\frac{1}{3}$  power, so rewrite the term as a radical expression with a 3 as the degree of the root and 1 as the power to which  $a$  is being raised.

$$a^{\frac{2}{6}} = a^{\frac{1}{3}} = \sqrt[3]{a^1} = \sqrt[3]{a}$$

3. C

**Difficulty:** Easy

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Use the Kaplan Method for Translating English into Math. The clue “holds a maximum” means it can hold exactly that much or less, so use the symbol  $\leq$ . This means you can eliminate B.

**Getting to the Answer:** The box can hold a maximum of 20 textbooks, so the first inequality is  $t \leq 20$ . The box can hold a maximum of 64 workbooks, so the second inequality is  $w \leq 64$  (eliminate D). The third inequality deals with the size of each book. The box can fit  $t$  textbooks multiplied by the size of the textbook, 192 cubic inches, and  $w$  workbooks multiplied by the size of the workbook, 60 cubic inches. The box can fit a maximum of 3,840 cubic inches total, so the last inequality is  $192t + 60w \leq 3,840$ .

4. D

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** The domain of a function represents the possible values of  $x$ , or the input values. In this function,  $x$  is represented by  $a$ , which is the number of athletes who participated in the study.

**Getting to the Answer:** This is a real-world scenario, so you cannot simply use rules of functions to determine the domain. Because there cannot be a negative number of athletes or a fraction of an athlete, the list in (D) is the only one that could represent a portion of the function's domain.

5. D

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Check to see whether the change in the  $y$ -values compared with the change in the  $x$ -values is constant for each pair of values.

**Getting to the Answer:** The table in (D) does not represent a linear relationship because the  $x$ -values change by +1 each time, while the  $y$ -values change by -3, then -1, then +1, then +3. A linear relationship has a constant rate of change, which means it is either always increasing or always decreasing by the same amount. This data clearly changes direction and is therefore not linear.

6. D

**Difficulty:** Medium

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** If the graphs intersect at  $(4, -1)$ , then the solution to the system is  $x = 4$  and  $y = -1$ . This means you can substitute these values into both equations and go from there.

**Getting to the Answer:** Substitute the values of  $x$  and  $y$  into each equation and solve for  $A$  and  $B$ . Then, divide  $B$  by  $A$ .

$$\begin{array}{rcl} Ax - 2y = 18 & & Bx + 6y = 26 \\ A(4) - 2(-1) = 18 & & B(4) + 6(-1) = 26 \\ 4A + 2 = 18 & & 4B - 6 = 26 \\ 4A = 16 & & 4B = 32 \\ A = 4 & & B = 8 \end{array}$$

Therefore,  $\frac{B}{A} = \frac{8}{4} = 2$ .

7. B

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** Factoring the quadratic equations could give you information about the  $x$ -intercepts, but upon inspection,  $A$  and  $(B)$  can't be factored. As an alternate strategy, find the axis of symmetry using the formula  $x = -\frac{b}{2a}$  (the quadratic formula without the radical part) to determine in which quadrant the vertex lies. You are looking for an equation whose graph has its vertex in the third quadrant.

**Getting to the Answer:** Choice (B) is correct because  $x = -\frac{(4)}{2(1)} = -\frac{4}{2} = -2$ , and when  $-2$  is substituted into the equation  $y = (-2)^2 + 4(-2) - 4 = -8$ , it puts the vertex at  $(-2, -8)$ , which is in the third quadrant and matches the graph.

**8. B****Difficulty:** Medium**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** The area of a sector is equal to the area of the circle times the fraction of the circle represented by the sector.

**Getting to the Answer:** Start by finding the area of the whole circle: The diameter of the circle extends along the  $x$ -axis from  $-7$  to  $5$ , which is  $12$  units, which means the radius is  $6$ . Substitute this into the area formula:

$$\begin{aligned} A &= \pi r^2 \\ A &= \pi(6)^2 \\ A &= 36\pi \end{aligned}$$

There are  $360$  degrees in a whole circle, so the fraction of the circle represented by the sector is  $\frac{60}{360} = \frac{1}{6}$ . The area of the sector is  $\frac{1}{6} \times 36\pi = 6\pi$  square units.

**9. D****Difficulty:** Medium**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Use the rules for radicals to simplify the product. Don't actually try to find the value of each answer choice.

**Getting to the Answer:** When two radical expressions with the same degree root are multiplied, you can multiply the numbers under the radicals, leaving the product inside. The root stays the same. Writing  $0.25$  as  $\frac{1}{4}$  may make finding the product easier:

$$\sqrt{0.25} \times \sqrt{2} = \sqrt{\frac{1}{4} \times 2} = \sqrt{\frac{1}{2}} = \frac{1}{\sqrt{2}}$$

leave a radical in the denominator (and this is not one of the answer choices), so rewrite the expression by multiplying the top and bottom by  $\sqrt{2}$  to

$$\text{get } \frac{1}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{2}}{2}.$$

**10. C****Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Start by finding the rate at which the blended fabric is produced according to the graph. To do this, find the slope by picking two points and using the formula  $m = \frac{y_2 - y_1}{x_2 - x_1}$ . Pay careful attention to how the grid-lines are labeled.

**Getting to the Answer:** Using the points  $(0, 0)$  and  $(2, 60)$ , the slope is  $m = \frac{60 - 0}{2 - 0} = \frac{60}{2} = 30$ , which means the machine produces  $30$  square yards of the blended fabric per hour. The question states that the machine can produce the  $100\%$  polyester fabric at a rate of  $40$  square yards per hour. Now, determine how long it would take the machine to produce  $2,400$  yards of each fabric:

$$\text{Blended: } 2,400 \div 30 = 80 \text{ hours}$$

$$100\% \text{ polyester: } 2,400 \div 40 = 60 \text{ hours}$$

This means it will take  $20$  more hours to make the blended fabric than the  $100\%$  polyester fabric, which matches (C).

**11. D****Difficulty:** Hard**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Don't bother with trial and error; it will take far too long. Use polynomial long division and your reasoning skills instead.

**Getting to the Answer:** Use long division to divide the two expressions. Don't forget to fill in  $0$  as a placeholder for the missing  $x^3$  term.

$$\begin{array}{r}
 6x^3 - 12x^2 + 26x - 60 \\
 x + 2 \overline{) 6x^4 + 0x^3 + 2x^2 - 8x - c} \\
 \underline{-(6x^4 + 12x^3)} \\
 -12x^3 + 2x^2 - 8x - c \\
 \underline{-(-12x^3 - 24x^2)} \\
 26x^2 - 8x - c \\
 \underline{-(26x^2 + 52x)} \\
 -60x - c \\
 \underline{-(-60x - 120)} \\
 -c + 120
 \end{array}$$

To make sure there is no remainder,  $c$  would have to be 120.

**12. D****Difficulty:** Hard**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** The system in the graph shows shading on opposite sides of two parallel lines, which means there is no solution to the system. This means you're looking for two equations with the same slope, different  $y$ -intercepts, and different inequality symbols.

**Getting to the Answer:** The equations are all given in standard form ( $Ax + By = C$ ). It would be very time-intensive to convert all four systems to slope-intercept form, so look for ways to eliminate choices more quickly. Each line in the graph falls 1 unit and runs 3 units, so you need to find two lines that have a slope of  $-\frac{1}{3}$ . Use the trick  $m = \frac{-A}{B}$  to quickly determine the slopes. The lines in A have a slope of

$\frac{-3}{-1} = 3$ , so eliminate A; the lines in B have a slope of

$\frac{-3}{1} = -3$ , so eliminate B; the lines in C have a slope of

$\frac{-1}{-3} = \frac{1}{3}$ , so eliminate C (pay attention to the sign).

This means (D) must be correct. The lines in (D) have a slope of  $\frac{-1}{3} = -\frac{1}{3}$ , which matches the graph. You

don't have to check the shading because none of the other slopes were a match.

**13. C****Difficulty:** Hard**Category:** Passport to Advanced Math / Scatterplots

**Strategic Advice:** Make sure you read the axis labels and the question carefully. You'll also need to rely on your knowledge of quadratic equations.

**Getting to the Answer:** The question asks for the sum of the vertical height and the horizontal distance that the roller coaster will travel above ground. The data points follow a parabolic (U-shaped) path, which means you can use properties of quadratic equations to find the solution. The vertical height is fairly straightforward—the vertex of the parabola is located at (110, 80), so the vertical height that the roller coaster reaches is 80 yards (notice the units). To find the horizontal distance, think about symmetry. Because the vertex occurs at a distance of 110 feet, the total horizontal distance that the roller coaster will travel is twice that, or 220 feet. Convert 80 yards to feet and add the result to 220 to arrive at the correct answer,  $80 \times 3 = 240$  and  $240 + 220 = 460$  feet.

**14. A****Difficulty:** Hard**Category:** Additional Topics in Math / Imaginary Numbers

**Strategic Advice:** Fractions with complex numbers are no different from any other fraction. You must find a common denominator before adding them.

**Getting to the Answer:** Find a common denominator by multiplying the second term by  $i + 6$ . You're given that  $\sqrt{-1} = i$ , but a more useful fact is that  $i^2 = -1$ , so be sure to make this substitution as you go. Once you have found the common denominator, you can simply add like terms.

$$\begin{aligned} \frac{2}{i+6} + (2+5i) &= \frac{2}{i+6} + \frac{2+5i}{1} \\ &= \frac{2}{i+6} + \frac{2+5i}{1} \left( \frac{i+6}{i+6} \right) \\ &= \frac{2}{i+6} + \frac{2i+12+5(-1)+30i}{i+6} \\ &= \frac{2}{i+6} + \frac{32i+7}{i+6} \\ &= \frac{32i+9}{i+6} \end{aligned}$$

**15. A****Difficulty:** Hard**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Graphing piecewise functions can be tricky. Try describing the graph in words first and then find the matching function. Use words like “to the left of” (which translates as *less than*) and “to the right of” (which translates as *greater than*).

**Getting to the Answer:** First, notice that both pieces of the graph either start or stop at 0, but one has a closed dot and the other has an open dot. This means you can eliminate C right away because the inequality symbol in both equations would lead to open dots on the graph. To choose among the remaining answers, think about parent functions and transformations. To the left of  $x = 0$ , the graph is a line with a slope of  $-\frac{3}{2}$  and a  $y$ -intercept of  $-4$ , so

you can eliminate D because the slope of the line is incorrect. Now, look to the right of  $x = 0$ —the graph is a square root function that has been moved down 1 unit, so its equation is  $y = \sqrt{x} - 1$ . This means (A) is correct. (The square root portion of C would have been moved to the left 1 unit rather than down 1.)

**16. 3/2 or 1.5****Difficulty:** Easy**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Don’t waste time trying to combine decimal numbers. Instead, multiply all of the numbers in the equation by 10 to get rid of the decimals. The resulting equation is much easier to solve.

**Getting to the Answer:** Multiplying each term in the equation by 10 moves the decimal one place to the right, which eliminates all the decimals.

$$\begin{aligned} 10(0.2x + 1.8) &= 3 - 0.6x \\ 2x + 18 &= 3 - 0.6x \\ 8x &= 12 \\ x &= \frac{12}{8} = \frac{3}{2} \end{aligned}$$

**17. 0****Difficulty:** Medium**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** The solution to the system is the point that both tables will have in common, but the tables, as given, do not share any points. You could use the data to write the equation of each line and then solve the system, but this would use up valuable time on Test Day. Instead, whenever data is presented in a table, look for patterns that can be extended.

**Getting to the Answer:** In the table on the left, the  $x$ -values decrease by 1 each time and the  $y$ -values increase by 3. In the table on the right, the  $x$ -values increase by 2 each time and the  $y$ -values increase by 1. Use these patterns to continue the tables.

Equation 1	
$x$	$y$
5	-8
4	-5
3	-2
2	1
1	4
0	7

Equation 2	
$x$	$y$
-8	3
-6	4
-4	5
-2	6
0	7
2	8

The point  $(0, 7)$  satisfies both equations, so the  $x$ -coordinate of the solution to the system is 0.

**18. 12**

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Solving an equation that has a fractional exponent can be very intimidating, so rewrite that part of the equation using a radical instead. Then, solve the equation the same way you would any other: Isolate the variable using inverse operations, one step at a time.

**Getting to the Answer:** After rewriting the equation using a radical, start by subtracting 18 from both sides. Next, multiply both sides of the equation by  $-2$ . Then, square both sides to remove the radical. Finally, divide both sides by 3.

$$\begin{aligned} 18 - \frac{(3x)^2}{2} &= 15 \\ 18 - \frac{\sqrt{3x}}{2} &= 15 \\ -\frac{\sqrt{3x}}{2} &= -3 \\ \sqrt{3x} &= 6 \\ 3x &= 36 \\ x &= 12 \end{aligned}$$

**19. 3600**

**Difficulty:** Medium

**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** Determine the dimensions of the tank in which there will be water. Then, use the formula for finding the volume of a rectangular prism: Volume = length  $\times$  width  $\times$  height.

**Getting to the Answer:** The tank is 30 inches long, 15 inches tall, and 12 inches wide. The sand and the space left at the top of the tank do not affect the length or the width, only the height of the water. There are 2 inches of sand in the bottom and

3 inches of space left at the top, which means the height of the water is  $15 - 2 - 3 = 10$  inches. Use the formula Volume =  $l \times w \times h = 30 \times 12 \times 10$ . To multiply the numbers without a calculator, multiply  $3 \times 1 \times 12 = 36$  and then add two zeros to get 3,600 cubic inches of water.

**20. 11**

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** This question is, for the most part, conceptual. Start by finding the  $y$ -coordinate of  $P$  in the original equation. Then, perform the transformation on the coordinates (rather than the function) to save yourself valuable time.

**Getting to the Answer:** Substitute 1 for  $x$  in the original equation. Graphically, the resulting value of  $g(1)$  is the  $y$ -coordinate of the point.

$$\begin{aligned} g(x) &= 2x^3 - 5x^2 + 4x + 6 \\ &= 2(1)^3 - 5(1)^2 + 4(1) + 6 \\ &= 2 - 5 + 4 + 6 \\ &= 7 \end{aligned}$$

The point on the graph of  $g(x)$  is  $(1, 7)$ . Now, the question asks for the  $y$ -coordinate of the corresponding point on the transformed graph. When performing transformations, the operations grouped with the  $x$  are performed on the  $x$ -coordinate, and the operations *not* grouped with the  $x$  are performed on the  $y$ -coordinate. So, add 4 to 7 to find that the  $y$ -coordinate of the point on the transformed graph is 11.

## MATH TEST: CALCULATOR SECTION

**1. A**

**Difficulty:** Easy

**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** Don't get bogged down in the contextual information in this question. You're looking for the equation that best matches the line drawn through the data points.

**Getting to the Answer:** The best-fit line begins at the origin, which means the  $y$ -intercept is 0 (the  $b$  in the equation  $y = mx + b$ ), so you can eliminate C and D. Now, find the slope of the line. Between (0, 0) and (8, 4), the line rises 4 units and runs 8 units, so the slope is  $\frac{4}{8} = \frac{1}{2}$ , which is equivalent to 0.5. This means (A) is correct.

## 2. B

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** A horizontal line has a slope of 0. Lines that slant downward from left to right have a negative slope, and lines that slant upward from left to right have a positive slope.

**Getting to the Answer:** Only one line has a negative slope,  $S$ , so it should come first in the list. This means you can eliminate A and D. Next comes the horizontal line with a slope of 0, which is line  $U$ . You can now eliminate C, which means (B) must be correct. To confirm (which isn't absolutely necessary), there are two lines with positive slopes:  $R$  and  $T$ . Line  $T$  has a steeper slant than line  $R$ , which means line  $T$  has a greater slope; therefore, the correct ordering is  $S, U, R, T$ .

## 3. C

**Difficulty:** Easy

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Algebraically, the solution to a system of inequalities is an ordered pair that satisfies *both* inequalities. Graphically, this means the ordered pair falls within the intersection (overlap) of the two shaded regions.

**Getting to the Answer:** The point (2, 5) lies within the intersection of the two shaded regions, so it is a solution to the system. None of the other points lie within the intersection.

## 4. C

**Difficulty:** Easy

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Don't let the three-way ratio confuse you. You can answer this question just like any other ratio question. Before selecting your answer, make sure you answered the right question (how many *more* votes for the Independent candidate than for the Republican candidate).

**Getting to the Answer:** Set up an equation using parts: 19 parts of the vote were cast for the Independent candidate, 18 parts for the Democrat, and 13 parts for the Republican. You don't know how big a part is, so call it  $x$ . Now, write and solve an equation:

$$\begin{aligned} 19x + 18x + 13x &= 510,000 \\ 50x &= 510,000 \\ x &= 10,200 \end{aligned}$$

This means each part is equal to 10,200 votes. Now, you could multiply 19 by this number and 13 by this number, and then subtract. Or, you could recognize that the Independent received  $19 - 13 = 6$  more parts of the vote than the Republican, or  $6(10,200) = 61,200$  more votes.

## 5. B

**Difficulty:** Easy

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Don't spend too much time reviewing the context of the question. Focus on the last couple of sentences, which tell you what you're looking for.



**Getting to the Answer:** You need to find the percent of states that use the Missouri Plan. There are 15 states that use the Missouri Plan and 50 states total, so use the formula Whole  $\times$  percent = part. The whole is 50, the percent is unknown so call it  $x$ , and the part is 15, resulting in the equation  $50x = 15$ . Use division to find that  $x$  is  $15 \div 50 = 0.3 = 30\%$ .

## 6. B

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Don't let all the science confuse you. The way in which the variables are defined tells you exactly what to do.

**Getting to the Answer:** All you need to do is substitute 197 (number of seeds) for  $s$  and solve for  $r$  (rainfall) using inverse operations.

$$197 = 28.5r + 83$$

$$114 = 28.5r$$

$$4 = r$$

## 7. A

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** The dendrologist uses an exponential function to model the data. When an exponential equation is written in the form of  $f(x) = ab^x$ ,  $a$  is the starting amount and  $b$  is the rate of growth or decay.

**Getting to the Answer:** Read the question carefully. The dendrologist is studying the number of leaves shed, not the number of leaves left on the tree, so you can eliminate C and D. Remember,  $a$  is the starting amount, not the unit of time, so it can't represent the number of days, which means you can also eliminate B. Choice (A) is correct because 1.92 is  $b$  in the equation, which represents the growth rate, so it tells the dendrologist that the number of leaves shed almost doubles (192% is very close to 200%) each day.

## 8. D

**Difficulty:** Medium

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** There is an open dot on the number line, which means the sign must be  $<$  or  $>$ , so you can eliminate A and B.

**Getting to the Answer:** To decide between C and (D), you don't even need to solve the equation. Instead, look at the shading. The graph is shaded to the left, which means the graph shows  $a < -4$ . However, there is a negative sign in front of the  $a$  term, so the inequality will be reversed at some point in the solution, which means the original inequality sign must have been  $>$ . The correct answer is (D). You can check your answer by solving the inequality using the sign you chose. If you chose correctly, your answer should match the graph.

## 9. D

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Take a quick peek at the answer choices. The equations are given in slope-intercept form, so start by finding the slope.

**Getting to the Answer:** Find the slope by substituting two pairs of values from the table (try to pick easy ones, if possible) into the slope formula,  $m = \frac{y_2 - y_1}{x_2 - x_1}$ . Keep in mind that the projected number of units sold depends on the price, so the price is the independent variable ( $x$ ) and the projected number is the dependent variable ( $y$ ). Using the points (0.2, 150,000) and (0.4, 90,000), the slope is

$$m = \frac{150,000 - 90,000}{0.2 - 0.4}$$

$$m = \frac{60,000}{-0.2}$$

$$m = -300,000$$

This means you can eliminate A and B because the slope is not correct. Don't let B fool you—the projected number of units sold goes down as the price goes up, so there is an inverse relationship, which means the slope must be negative. To choose between C and (D), you could find the  $y$ -intercept of the line, but this is a fairly time-intensive process. Instead, choose any pair of values from the table, such as (0.2, 150,000), and substitute into C and (D) only. Choice (D) is correct because  $150,000 = -300,000(0.2) + 210,000$  is a true statement.

**10. A****Difficulty:** Medium**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Create a system of linear equations where  $e$  represents the number of packs with 8 boxes and  $t$  represents the number of packs with 20 boxes. Before selecting your final answer, make sure you answered the right question (the number of packs that have 20 boxes).

**Getting to the Answer:** The first equation should represent the total number of packs,  $e + t = 61$ . The second equation should represent the total number of boxes. Because  $e$  represents packs with 8 boxes and  $t$  represents packs with 20 boxes, the second equation should be  $8e + 20t = 800$ . Now, solve the system using substitution. Solve the first equation to find that  $e = 61 - t$ . Then, substitute the result into the second equation:

$$\begin{aligned} 8e + 20t &= 800 \\ 8(61 - t) + 20t &= 800 \\ 488 - 8t + 20t &= 800 \\ 488 + 12t &= 800 \\ 12t &= 312 \\ t &= 26 \end{aligned}$$

We assigned the variable  $t$  to the number of packs with 20 boxes, so 26 packs have 20 boxes. This is what the question asks for, so you don't need to find the value of  $e$ .

**11. C****Difficulty:** Medium**Category:** Additional Topics in Math / Imaginary Numbers

**Strategic Advice:** To evaluate a high power of  $i$ , look for patterns and use the definition  $\sqrt{-1} = i$ , which, when written in a more useful form, is  $i^2 = -1$ .

**Getting to the Answer:** Write out enough powers of  $i$  for you to see the pattern:

$$\begin{aligned} i^1 &= i \\ i^2 &= -1 \text{ (definition)} \\ i^3 &= i \times i^2 = i \times -1 = -i \\ i^4 &= i^2 \times i^2 = -1 \times -1 = 1 \\ i^5 &= i^4 \times i = 1 \times i = i \\ i^6 &= i^4 \times i^2 = 1 \times -1 = -1 \\ i^7 &= i^6 \times i = -1 \times i = -i \\ i^8 &= i^4 \times i^4 = 1 \times 1 = 1 \end{aligned}$$

Notice that the pattern ( $i, -1, -i, 1, i, -1, -i, 1$ ) repeats on a cycle of 4. To evaluate  $i^{125}$ , divide 125 by 4. The result is 31, remainder 1, which means 31 full cycles and then back to  $i^1$ . This means  $i^{125}$  is equivalent to  $i^1$ , which is  $i$ . Because  $i + i = 2i$ , you are looking for the answer choice that is also equivalent to  $2i$ . Choices (C) and D look tempting (because of the 2), so start with them: (C) is correct because  $45 \div 4 = 11$ , remainder 1, which means  $i^{45}$  is equivalent to  $i$  and  $2i^{45}$  is equal to  $2i$ .

**12. A****Difficulty:** Medium**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Find the greatest common factor (GCF) that can be divided out of all of the terms in the expression. You need to find the greatest number and the variable to the highest power that each term has in common. To make finding the GCF easier, ignore the 2s in the denominators until you've decided on a GCF and then put the 2 back in.

**Getting to the Answer:** The greatest number that 9, 3, and 15 have in common is 3, so the GCF (with the 2 back in the denominator) is  $\frac{3}{2}$ . All terms in the expression have at least  $x^8$ , so you can also factor out  $x^8$  from each term.

$$\begin{aligned} &-\frac{9}{2}x^{10}-\frac{3}{2}x^9+\frac{15}{2}x^8 \\ &=\frac{3}{2}x^8(-3x^2-x+5) \end{aligned}$$

Unfortunately, this isn't one of the answer choices. However, in (A),  $-\frac{3}{2}$  has been factored out, and all of the signs of the terms are reversed. This answer is equivalent to the one found above and is therefore correct.

### 13. A

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Pay careful attention to the axis labels as you read the answer choices. Time is graphed on the  $x$ -axis, and distance is graphed on the  $y$ -axis.

**Getting to the Answer:** Compare each answer choice to the graph, eliminating false statements as you go.

Choice (A): The truck is stopped when it is making a delivery. This means its distance is not changing, and the graph should be flat. Both flat sections of the graph span 30 minutes (20 to 50 and 70 to 100), so each delivery took 30 minutes. Choice (A) is correct. If you're confident in your answer, move on to the next question. If not, you can quickly check the other answer choices to be sure.

Choice B: The second delivery starts at (70, 18), which means it was about 18 miles away from the warehouse, not 70.

Choice C: When the truck arrived at the first delivery, it was about 8 miles from the warehouse, and when

it was at the second delivery, it was about 18 miles from the warehouse. Then, it had to travel 18 miles back to the warehouse, so it traveled a total of 36 miles, not 18.

Choice D: The second delivery took place 18 miles from the warehouse, and the first delivery took place 8 miles from the warehouse, which means the second delivery was about 10 miles farther from the warehouse, not 18.

### 14. B

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** Start by filling in any cells in the table that you can, using the information provided in the table itself (kind of like a sudoku puzzle).

**Getting to the Answer:** Because there are 628 trees total and 402 are hybrids, you know that  $628 - 402 = 226$  are not hybrids. Then, because 118 orange trees are not hybrids, you know that  $226 - 118 = 108$  apple trees are not hybrids. Now, you've reached the point at which the table can't help you anymore. So, look at the question. It says that 45% of the apple trees are not hybrids. Use the formula  $\text{Percent} \times \text{whole} = \text{part}$  to arrive at the equation  $0.45w = 108$ . Then, solve for  $w$  by dividing:  $108 \div 0.45 = 240$ , which tells you there are 240 apple trees in total. This means there are  $240 - 108 = 132$  apple trees that are hybrids.

### 15. D

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** Start by completing the rest of the table. Use the information you found in the previous question.

**Getting to the Answer:** Because there are 402 hybrids in total, there are  $402 - 132 = 270$  orange

trees that are hybrids, which means there are  $270 + 118 = 388$  orange trees in total. Now, find the probability that if the scientist selects one orange tree, it will be a hybrid. There are 388 orange trees total, and of those, 270 are hybrids, so the probability of picking a hybrid is  $\frac{270}{388} = \frac{135}{194}$ .

**16. C****Difficulty:** Medium**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Division and factoring are interchangeable, so think of factoring out the  $x$ . Then, instead of dividing by  $\frac{1}{2}$ , you can multiply by its reciprocal, 2. Using these two strategies will make solving a question like this considerably easier.

**Getting to the Answer:** First, divide (factor) out the  $x$  by subtracting 1 from each exponent: The result is  $\left(5x^4 - \frac{1}{4}x^3 + 3x\right) \div x = 5x^3 - \frac{1}{4}x^2 + 3$ . Now, multiply each term by 2 to get this:

$$\begin{aligned} 5x^3 - \frac{1}{4}x^2 + 3 \div \frac{1}{2} &= 2\left(5x^3 - \frac{1}{4}x^2 + 3\right) \\ &= 10x^3 - \frac{1}{2}x^2 + 6 \end{aligned}$$

**17. C****Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Be careful—the 0 in the table is an  $x$ -value, which means it shows the  $y$ -intercept, not the  $x$ -intercept. You are looking for the point at which  $y = 0$ .

**Getting to the Answer:** You could use two of the points in the table and the slope formula to find the equation of the line, then substitute 0 for  $y$  and solve for  $x$ . However, this would use up valuable time. Instead, look for a pattern in the table. If you continue the pattern, the next ordered pair would be  $(3, -1)$ ,

which would mean the line has dropped below the  $x$ -axis. This means the graph of the line crosses the  $x$ -axis somewhere between the  $x$ -values of 2 and 3. The only answer choice that is between 2 and 3 is (C).

**18. C****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** There are a few ways to answer this question, but the quickest way is to average the tourist's climb rate over the 7 hours.

**Getting to the Answer:** The distance going up and back down is the same (because she uses the same route), so find the average of the tourist's speed over both the ascent and the descent. She climbed 264 meters per hour going up and twice that, 528 meters per hour, going back down, so her average climb rate was  $264 + 528 = 792 \div 2 = 396$  meters per hour. It took her 7 hours. Use the formula Distance = rate  $\times$  time to find the distance:

$$\begin{aligned} \text{Distance} &= 396 \times 7 \\ \text{Distance} &= 2,772 \end{aligned}$$

But remember, this amount represents both up and down the mountain, so divide by 2 to find that the vertical distance between the point where she started climbing and the top of the mountain is 1,386 meters. Be careful—this is not the answer! The question asks how tall Mount Fuji is, so don't forget to add the vertical distance she drove, 2,390 meters, to get  $2,390 + 1,386 = 3,776$  meters.

**19. A****Difficulty:** Medium**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** Even though one of the equations in this system isn't linear, you can still solve the system using substitution.

**Getting to the Answer:** You already know that  $y$  is equal to  $3x$ , so substitute  $3x$  for  $y$  in the second equation. Don't forget that when you square  $3x$ , you must square both the coefficient and the variable.

$$\begin{aligned} -3x^2 + 2y^2 &= 180 \\ -3x^2 + 2(3x)^2 &= 180 \\ -3x^2 + 2(9x^2) &= 180 \\ -3x^2 + 18x^2 &= 180 \\ 15x^2 &= 180 \\ x^2 &= 12 \end{aligned}$$

The question asks for the value of  $x^2$ , not  $x$ , so there is no need to take the square root of 12 to find the value of  $x$ . The answer is (A).

## 20. C

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Adding polynomials is typically safer than subtracting them, because you may forget to distribute the negative sign when subtracting more than one term.

**Getting to the Answer:** To find  $M - N$ , multiply each term of  $N$  by  $-1$  and then add the two polynomials by combining like terms.

$$\begin{aligned} -1N &= -5x^2 + 12 \\ M + (-N) &= 3x^2 + 9x - 4 - 5x^2 + 12 \\ &= -2x^2 + 9x + 8 \end{aligned}$$

Don't forget to multiply the resulting expression by 2 to get  $2(-2x^2 + 9x + 8) = -4x^2 + 18x + 16$ .

## 21. B

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** The *median* of a data set is the middle value when the data points are arranged from least to greatest (or greatest to least). When

there is an even number of data points, the median is the average of the two middle values.

**Getting to the Answer:** The histogram represents the lengths of 28 bridges, so the median length is the average of the 14th and 15th longest bridges. Because the number of bridges that are less than 6 miles long is 12, and the number of bridges that are less than 9 miles long is  $12 + 8 + 20$ , the median length of the 28 bridges must be between 6 and 9 miles (because 14 and 15 lie between 12 and 20). Of the choices given, only (B) matches this criterion.

## 22. C

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** It's a good idea to get comfortable with the vocabulary used in statistics questions. *Correlation* simply means relationship. The word *weak* refers to the strength of the relationship, which has no effect on slope, but rather on how closely the data points follow the line of best fit.

**Getting to the Answer:** Be careful not to confuse slope and strength. Simply because a data set shows a weak correlation does not mean the slope will be close to zero. The data can still be gathered around a steep line of best fit. So, you can eliminate A and B. Also, keep in mind that the terms *weak* and *positive* are not related but rather are two independent descriptors of the correlation. So, the fact that the rate of change is positive has nothing to do with the strength of the correlation. In a weak correlation, the data points will follow the line of best fit, but not as closely as in a strong correlation, which means (C) is correct.

## 23. C

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Pay careful attention to the units. You need to convert all of the dimensions to inches and then find the scale factor.

**Getting to the Answer:** There are 12 inches in one foot, so the height of the woolly mammoth was  $10 \times 12 = 120 + 6 = 126$  inches. The tusk length was 11.5 feet, or  $11.5 \times 12 = 138$  inches. The student plans to draw the mammoth 14 inches tall, so find the scale factor of the two heights by writing them as a fraction:  $\frac{14}{126} = \frac{1}{9}$ . This means the scale factor is  $\frac{1}{9}$ . Multiply this by the length of the real mammoth's tusks to find the scaled length:  $138 \times \frac{1}{9} = \frac{138}{9} = 15\frac{1}{3}$ . This means the student should make the tusks 15.33 inches long.

#### 24. D

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** When a real-world scenario is modeled using a linear equation,  $b$  is a flat fee or starting amount,  $m$  is a unit rate,  $x$  represents the number of units, and  $y$  represents a total amount.

**Getting to the Answer:** Write the equation in words first, adding the variables as you go. The total cost,  $y$ , is equal to the cost per pound,  $m$ , multiplied by the number of pounds,  $x$ , and added to the cost of the pail,  $b$ . You can eliminate A and B because  $b$  is 1.50 (the cost of the pail) and  $m$  is 3.99 (the cost per pound). You can also eliminate C because Johanna picks 3 pounds, so  $x$  is 3. Choice (D) is correct because the total cost of picking 3 pounds is  $3.99(3) + 1.50 = 13.47$ . This means 13.47 most likely represents the total cost,  $y$ .

#### 25. B

**Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Start by determining what the question is asking. You need to find the net percent change in the power reliance on solar panels over the course of a day. To do this, you need to know how much the solar panels were relied on at the beginning of the day and how much at the end (neither of which is given).

**Getting to the Answer:** Whenever you aren't given a concrete starting point, pick one yourself. The best number to use when dealing with percents is 100. First, find how much power was derived from the solar panels after the first increase:  $100 \times 0.6 = 60$ . So, the company increased power from the solar panels to  $100 + 60 = 160$ . Next, find the amount after the decrease:  $160 \times 0.3 = 48$ , so the solar panels then provided  $160 - 48 = 112$  units of power. Finally, find the amount after the last increase:  $112 \times 0.75 = 84$ , so the plant ended the day at  $112 + 84 = 196$ , which is  $196 - 100 = 96$  more than it started the day with. To find the percent change, use the formula  $\text{Percent change} = \frac{\text{amount of change}}{\text{original amount}}$

to get  $\frac{96}{100} = 0.96 = 96\%$ .

#### 26. D

**Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** A question like this requires a simple proportion. However, you need to convert the units so they are the same. You can convert feet to meters or meters to feet—it doesn't matter which you choose, as long as the lengths end up in the same unit of measure.

**Getting to the Answer:** Because the conversion given at the end of the question is feet to meters, convert the first snake length to meters by multiplying it by 0.3. Remember, 2 feet, 6 inches is the same as 2.5 feet:  $2.5 \text{ feet} \times 0.3 \text{ meters per foot} = 0.75 \text{ meters}$ . Now, set up a proportion and solve. Let  $g$  be the number of grams of feed needed for a

snake that is 1 meter long. Write the proportion in words first to keep the pieces organized:

$$\frac{\text{length of 1st snake}}{\text{food for 1st snake}} = \frac{\text{length of 2nd snake}}{\text{food for 2nd snake}}$$

$$\frac{0.75}{12} = \frac{1}{g}$$

$$0.75g = 12$$

$$g = 16$$

A snake that is 1 meter long should receive 16 grams of frog mash.

27. D

**Difficulty:** Hard

**Category:** Additional Topics in Math / Trigonometry

**Strategic Advice:** This is a very difficult question involving arc length given in radians and answer choices that involve trig functions. If you're not familiar with these topics, you should guess and move on to the next question. (Don't forget—there is no penalty for wrong answers on the new SAT!)

**Getting to the Answer:** Take a peek at the answer choices—the angles of the trig functions are given in radians, rather than degrees (you know this because there is no degree symbol). This means you'll need to use the radian formula for finding arc length:  $arcL = \theta \times r$ , where  $\theta$  is the central angle of the arc in radians and  $r$  is the radius of the circle. This will allow you to determine the measure of the central angle, half of which becomes one of the angles of a right triangle ( $CDE$ , for example). You know both the arc length (3.4) and the radius (2), so solve for the central angle.

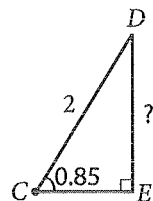
$$arcL = \theta \times r$$

$$3.4 = \theta \times 2$$

$$1.7 = \theta$$

This means that  $\angle DCF$  has a measure of 1.7 radians, and consequently,  $\angle DCE$  has a measure of half that, or 0.85 radians. Add this measure to the triangle, or

draw a quick right triangle off to the side like the one below:



Now, if you can find the length of side  $DE$ , you can double it to find the length of chord  $DF$ . Side  $DE$  is opposite the angle measure that you found and you know the hypotenuse of the triangle; so, use the ratio

$\sin x = \frac{\text{opposite}}{\text{hypotenuse}}$  to find the length of side  $DE$ :

$$\sin(0.85) = \frac{DE}{2}$$

$$2\sin(0.85) = DE$$

Multiply by 2 to find that  $DF = 2 \times 2\sin(0.85) = 4\sin(0.85)$ . Keep in mind that multiplying the angle (inside the parentheses) is not the same as multiplying the whole quantity by 2.

28. A

**Difficulty:** Hard

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Don't let all the fractions intimidate you. There are two equations and two variables, so solve this system the same way you would solve any other system of equations.

**Getting to the Answer:** The first equation is already solved perfectly for  $y$ , so use substitution. To make the second equation easier to work with, multiply it by 4 to clear the fractions (even though you may have noticed the tempting 4 in the denominator of the desired expression).

$$\begin{aligned}
 4\left(\frac{3y}{4} + 11\right) &= \frac{-x}{2} \\
 3y + 44 &= -2x \\
 3(12 - x) + 44 &= -2x \\
 36 - 3x + 44 &= -2x \\
 80 - 3x &= -2x \\
 80 &= x
 \end{aligned}$$

Next, substitute 80 for  $x$  into the first equation and solve for  $y$ .

$$\begin{aligned}
 y &= 12 - 80 \\
 y &= -68
 \end{aligned}$$

Finally, substitute the values you found into the expression in the question,  $\frac{x}{5} + \frac{y}{4}$ .

$$\frac{80}{5} + \frac{(-68)}{4} = 16 + (-17) = -1$$

**29. B****Difficulty:** Hard**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** This question requires a conceptual understanding of modeling data and properties of quadratic equations. You also need to recall that a *solution* to an equation is the same as the  $x$ -intercept of the equation's graph.

**Getting to the Answer:** The graph of a quadratic equation is symmetric with respect to its axis of symmetry. The axis of symmetry occurs at the  $x$ -value of the vertex, which according to the graph is 20. You can also see from the graph that one of the  $x$ -intercepts is  $x = 8$ . This means that 8 is a solution to the quadratic equation. Unfortunately, 8 isn't one of the answer choices. However, because the graph of a quadratic equation is symmetric, the other solution ( $x$ -intercept) must be the same distance from the vertex as 8 is, which is  $20 - 8 = 12$  units. Therefore, the other solution to the equation is  $x = 20 + 12 = 32$ .

**30. D****Difficulty:** Hard**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** The key to answering this question is in having a conceptual understanding of function notation. Here, the input  $(x - 4)$  has already been substituted and simplified in the given function. Your job is to determine what the function would have looked like had  $x$  been the input instead.

**Getting to the Answer:** To keep things organized, let  $u = x - 4$ , the old input. This means  $x = u + 4$ . Substitute this into  $h(x - 4)$  and simplify:

$$\begin{aligned}
 h(x - 4) &= 6x^2 + 2x + 10 \\
 h(u) &= 6(u + 4)^2 + 2(u + 4) + 10 \\
 &= 6(u^2 + 8u + 16) + 2u + 8 + 10 \\
 &= 6u^2 + 48u + 96 + 2u + 8 + 10 \\
 &= 6u^2 + 50u + 114
 \end{aligned}$$

This means  $h(u) = 6u^2 + 50u + 114$ .

When working with function notation, you evaluate the function by substituting a given input value for the variable in the parentheses. Here, if the input value is  $x$ , then  $h(x) = 6x^2 + 50x + 114$ .

**31. 42****Difficulty:** Easy**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** When a sample is a good representation of a population, you can apply the results of a study to the entire population.

**Getting to the Answer:** Start by finding the percent of the graduates who were surveyed that were not practicing law:  $720$  out of  $3,000 = 720 \div 3,000 = 0.24$ , or  $24\%$ . The question asks about the number of graduates who *were* practicing law in 2012, so subtract from  $100\%$  to find that  $76\%$  of the graduates *were* practicing law in 2012. Apply this percentage to the whole population of graduates from 2000 who passed the bar:  $55,200 \times 0.76 = 41,952$ . Now, follow directions carefully—round to the nearest thousand ( $42,000$ ) and enter your answer as the number of thousands, which is 42.



32. 4962

Difficulty: Easy

Category: Heart of Algebra / Linear Equations

**Strategic Advice:** Create a linear equation to keep the information straight. The total number of miles driven by the car is equal to the miles per gallon times the number of gallons in the tank added to the existing number of miles on the odometer.

**Getting to the Answer:** The equation is  $y = 48x + 4,386$ . You are given the  $x$ -value, 12 gallons, so simply substitute it for  $x$  and solve for  $y$ .

$$y = 48(12) + 4,386$$

$$y = 576 + 4,386$$

$$y = 4,962$$

33. 28

Difficulty: Medium

Category: Passport to Advanced Math / Quadratics

**Strategic Advice:** Graphically, a  $y$ -intercept is in the form  $(0, y)$ , so the  $y$ -intercept of the graph is the value of  $y$  when 0 is substituted for  $x$  in the equation.

**Getting to the Answer:** Don't forget to follow the correct order of operations as you simplify the expression.

$$y = 2(0 + 3)^2 + 10$$

$$= 2(3)^2 + 10$$

$$= 2(9) + 10$$

$$= 18 + 10$$

$$= 28$$

34. 60

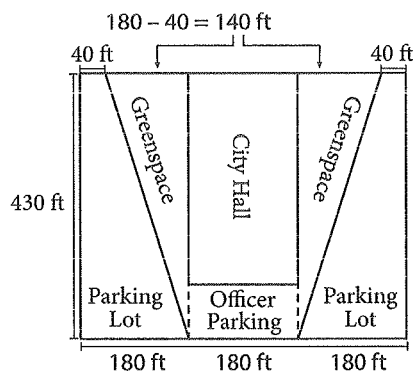
Difficulty: Medium

Category: Additional Topics in Math / Geometry

**Strategic Advice:** Whenever a question asks about the amount of space something covers (here, the greenspace), you are looking for area. In this question, the area that you're looking for takes on the shape of a right triangle (actually, two of them), so

use the formula  $A = \frac{1}{2}bh$ .

**Getting to the Answer:** The key to answering this question is in labeling the diagram. The calculations are very straightforward once you have the correct dimensions of the triangles. You're given that the width of each parking lot is equal to the width of the City Hall building, so each parking lot is  $540 \div 3 = 180$  feet wide. This means the base of each triangle (at the top of the diagram) is  $180 - 40 = 140$  feet. The height of each triangle is the same as the length of the parking lot, which is 430 feet.



You now have all the numbers you need. The area of each triangle is  $\frac{1}{2}(140)(430) = 30,100$ , so both triangles together result in a greenspace that covers 60,200 square feet. Rounded to the nearest thousand, this is 60,000, which should be gridded in as 60.

35. 23

Difficulty: Medium

Category: Heart of Algebra / Inequalities

**Strategic Advice:** When a question asks about a maximum (or minimum) amount, it usually means you need to create and solve an inequality.

**Getting to the Answer:** Write the inequality in words first. The cost of 3 cans of vegetables plus the cost of 1 bag of rice, all multiplied by the number of care packages Rasha makes, must be less than or equal to the amount of money he collected, \$145. Because you are not asked to differentiate between cans and rice, they can be represented by the same variable. Just don't forget to multiply the cost of

1 can by 3 first ( $\$0.89 \times 3 = \$2.67$ ). Let  $p$  represent the number of care packages:

$$\begin{aligned}(2.67 + 3.49)p &\leq 145 \\ 6.16p &\leq 145 \\ p &\leq 23.54\end{aligned}$$

Be careful, the question asks for *complete* care packages, so he can make only 23.

### 36. 1.7

**Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Questions that involve distance, rate, and time can almost always be solved using the formula Distance = rate  $\times$  time. Just make sure the rate and the time involve compatible units.

**Getting to the Answer:** For each of the three rail systems, you know how long the person traveled and their rate (after you adjust for the 30%). Use the formula to find the distance for each one. But be careful—the rates are given in miles per hour, which means you must use hours, not minutes, for the times.

*New York City Subway:*

$$\text{Time} = 6 \text{ minutes} = 0.1 \text{ hours}$$

$$\text{Rate} = 17.4 \text{ mph}$$

$$\text{Distance} = 17.4 \times 0.1 = 1.74 \text{ miles}$$

*Chicago L:*

$$\text{Time} = 4.8 \text{ minutes} = 0.08 \text{ hours}$$

$$\text{Rate} = 1.3(17.4) = 22.62 \text{ mph}$$

$$\text{Distance} = 22.62 \times 0.075 = 1.8096 \text{ miles}$$

*DC Metro:*

$$\text{Time} = 3.6 \text{ minutes} = 0.06 \text{ hours}$$

$$\text{Rate} = 1.3(22.62) = 29.406 \text{ mph}$$

$$\text{Distance} = 29.406 \times 0.05 = 1.76436 \text{ miles}$$

Marc traveled the shortest distance between stops at about 1.7 miles.

### 37. 50

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** The key to answering a question like this is in reading the labels on the graph carefully. You do not need to convert grams to micrograms or vice versa. They are simply the units for mercury content.

**Getting to the Answer:** Start by determining how many micrograms of mercury a person who weighs 82 kilograms can consume:  $82 \times 0.1 = 8.2$  micrograms. Next, find *snapper* on the bar graph and determine how many micrograms it contains (per gram of weight): 0.165. Divide the number of micrograms the person can consume, 8.2, by the number in each gram of snapper to arrive at  $8.2 \div 0.165 = 49.697$ , or about 50 grams.

### 38. 23

**Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** There is a lot of information to sort through in a question like this. Make a plan and carry out the plan one step at a time. Don't try to keep all the calculations in your calculator; jot them down as you work through each step.

**Getting to the Answer:** Multiply the average portion size (100 grams) by each mercury content shown in the bar graph. Don't forget to remove the swordfish, because it has the highest mercury content. Then, find the average—but be careful, you're finding an average over 7 days (the number of days in a week), not 5 (the number of portions the person consumes).

$$\text{Haddock: } 0.055 \times 100 = 5.5$$

$$\text{Tuna: } 0.350 \times 100 = 35$$

$$\text{Snapper: } 0.165 \times 100 = 16.5$$

Marlin:  $0.485 \times 100 = 48.5$

Orange Roughy:  $0.570 \times 10 = 5.7$

The total is 162.5 micrograms, which means the average daily consumption over the whole week is  $162.5 \div 7 = 23.214$ , or about 23 micrograms. (Note that unless this person weighs 230 kg, which is a little over 500 pounds, then they are consuming way too much mercury per day.)

# SAT PRACTICE TEST 3 ANSWER SHEET

Remove (or photocopy) this answer sheet and use it to complete the test. See the answer key following the test when finished.

Start with number 1 for each section. If a section has fewer questions than answer spaces, leave the extra spaces blank.

## SECTION

1

- |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| 1. (A) (B) (C) (D)  | 14. (A) (B) (C) (D) | 27. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 2. (A) (B) (C) (D)  | 15. (A) (B) (C) (D) | 28. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 3. (A) (B) (C) (D)  | 16. (A) (B) (C) (D) | 29. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D)  | 17. (A) (B) (C) (D) | 30. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D)  | 18. (A) (B) (C) (D) | 31. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D)  | 19. (A) (B) (C) (D) | 32. (A) (B) (C) (D) | 45. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D)  | 20. (A) (B) (C) (D) | 33. (A) (B) (C) (D) | 46. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D)  | 21. (A) (B) (C) (D) | 34. (A) (B) (C) (D) | 47. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D)  | 22. (A) (B) (C) (D) | 35. (A) (B) (C) (D) | 48. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 23. (A) (B) (C) (D) | 36. (A) (B) (C) (D) | 49. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 24. (A) (B) (C) (D) | 37. (A) (B) (C) (D) | 50. (A) (B) (C) (D) |
| 12. (A) (B) (C) (D) | 25. (A) (B) (C) (D) | 38. (A) (B) (C) (D) | 51. (A) (B) (C) (D) |
| 13. (A) (B) (C) (D) | 26. (A) (B) (C) (D) | 39. (A) (B) (C) (D) | 52. (A) (B) (C) (D) |

  
 # right in  
 Section 1

  
 # wrong in  
 Section 1

## SECTION

2

- |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| 1. (A) (B) (C) (D)  | 12. (A) (B) (C) (D) | 23. (A) (B) (C) (D) | 34. (A) (B) (C) (D) |
| 2. (A) (B) (C) (D)  | 13. (A) (B) (C) (D) | 24. (A) (B) (C) (D) | 35. (A) (B) (C) (D) |
| 3. (A) (B) (C) (D)  | 14. (A) (B) (C) (D) | 25. (A) (B) (C) (D) | 36. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D)  | 15. (A) (B) (C) (D) | 26. (A) (B) (C) (D) | 37. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D)  | 16. (A) (B) (C) (D) | 27. (A) (B) (C) (D) | 38. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D)  | 17. (A) (B) (C) (D) | 28. (A) (B) (C) (D) | 39. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D)  | 18. (A) (B) (C) (D) | 29. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D)  | 19. (A) (B) (C) (D) | 30. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D)  | 20. (A) (B) (C) (D) | 31. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 21. (A) (B) (C) (D) | 32. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 22. (A) (B) (C) (D) | 33. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |

  
 # right in  
 Section 2

  
 # wrong in  
 Section 2

SECTION

3

1. (A) (B) (C) (D)      5. (A) (B) (C) (D)      9. (A) (B) (C) (D)      13. (A) (B) (C) (D)  
 2. (A) (B) (C) (D)      6. (A) (B) (C) (D)      10. (A) (B) (C) (D)      14. (A) (B) (C) (D)  
 3. (A) (B) (C) (D)      7. (A) (B) (C) (D)      11. (A) (B) (C) (D)      15. (A) (B) (C) (D)  
 4. (A) (B) (C) (D)      8. (A) (B) (C) (D)      12. (A) (B) (C) (D)

16.

7	7		
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6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

17.

7	7		
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0	0	0	0
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3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

18.

7	7		
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0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

19.

7	7		
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0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

20.

7	7		
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0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

# right in Section 3

# wrong in Section 3

SECTION

4

1. (A) (B) (C) (D)      9. (A) (B) (C) (D)      17. (A) (B) (C) (D)      25. (A) (B) (C) (D)  
 2. (A) (B) (C) (D)      10. (A) (B) (C) (D)      18. (A) (B) (C) (D)      26. (A) (B) (C) (D)  
 3. (A) (B) (C) (D)      11. (A) (B) (C) (D)      19. (A) (B) (C) (D)      27. (A) (B) (C) (D)  
 4. (A) (B) (C) (D)      12. (A) (B) (C) (D)      20. (A) (B) (C) (D)      28. (A) (B) (C) (D)  
 5. (A) (B) (C) (D)      13. (A) (B) (C) (D)      21. (A) (B) (C) (D)      29. (A) (B) (C) (D)  
 6. (A) (B) (C) (D)      14. (A) (B) (C) (D)      22. (A) (B) (C) (D)      30. (A) (B) (C) (D)  
 7. (A) (B) (C) (D)      15. (A) (B) (C) (D)      23. (A) (B) (C) (D)  
 8. (A) (B) (C) (D)      16. (A) (B) (C) (D)      24. (A) (B) (C) (D)

31.

7	7		
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1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

32.

7	7		
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0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

33.

7	7		
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0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

34.

7	7		
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0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

35.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

36.

7	7		
.	.	.	.
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

37.

7	7		
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0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

38.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

# right in Section 4

# wrong in Section 4

# MATH TEST

25 Minutes—20 Questions

## NO-CALCULATOR SECTION

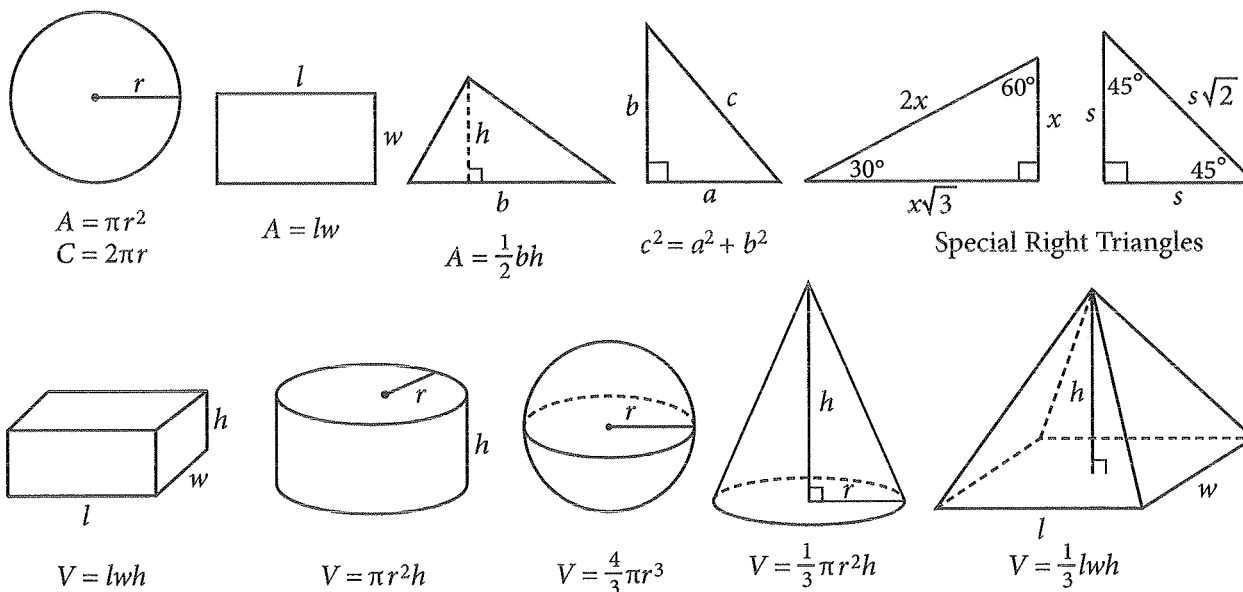
Turn to Section 3 of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding oval on the answer sheet. You may use any available space for scratch work.

Notes:

1. Calculator use is NOT permitted.
2. All numbers used are real numbers.
3. All figures used are necessary to solving the problems that they accompany. All figures are drawn to scale EXCEPT when it is stated that a specific figure is not drawn to scale.
4. Unless stated otherwise, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$ , for which  $f(x)$  is a real number.


Information:



The sum of the degree measures of the angles in a triangle is 180.

The number of degrees of arc in a circle is 360.

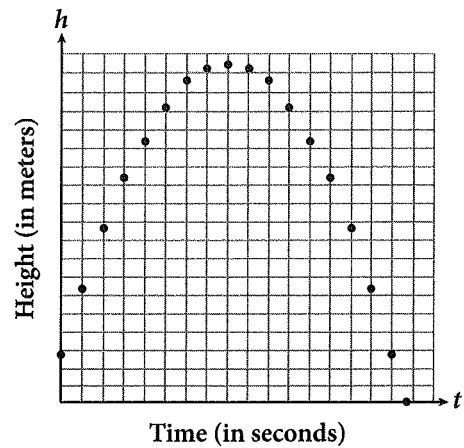
The number of radians of arc in a circle is  $2\pi$ .

GO ON TO THE NEXT PAGE 

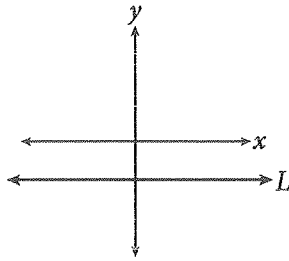
1. Tread depth is a measurement between the top of the rubber on a tire and the bottom of its deepest groove. The average tread depth on a new standard tire is  $\frac{10}{32}$  inches. In most states, a tire is considered legally worn out, and therefore unsafe, when the tread depth reaches  $\frac{2}{32}$  inches. Which inequality represents the range of safe tread depths  $d$  for a standard car tire?

- A)  $\frac{2}{32} > d \leq \frac{10}{32}$   
 B)  $\frac{2}{32} < d \geq \frac{10}{32}$   
 C)  $\frac{2}{32} < d \leq \frac{10}{32}$   
 D)  $\frac{2}{32} > d \geq \frac{10}{32}$

2. If  $x^2 - 8x = 48$  and  $x < 0$ , what is the value of  $x + 10$ ?
- A)  $-2$   
 B)  $4$   
 C)  $6$   
 D)  $8$



3. A physics class is using simulation software to study water bottle rockets before attempting to build one for the National Physics Competition. Their first simulation is of a rocket without a parachute launched from the roof of the gymnasium. The scatterplot shows the approximate path of the rocket. The software program generates the equation  $h = -4.9t^2 + 39.2t + 14$  to model the data, where  $h$  is the height in meters of the rocket  $t$  seconds after it was launched. What does the number 14 most likely represent in this equation?
- A) The number of seconds the rocket was in the air  
 B) The height of the gymnasium from which the rocket was launched  
 C) The number of seconds that it took the rocket to reach its maximum height  
 D) The maximum height of the rocket



4. Line  $L$  shown in the graph could be the graph of which equation?
- A)  $x + y = -2$   
 B)  $x + y = 0$   
 C)  $x + y - 2 = x$   
 D)  $x + y + 2 = x$

$$\begin{cases} 2x + 5y = 8 \\ x + 3y = 3 \end{cases}$$

5. If  $(x, y)$  is a solution to the system of equations above, what is the value of  $y^2$ ?
- A) 4  
 B) 9  
 C) 25  
 D) 81
6. An alloy is a metal made by mixing and melting two or more metals together. After the metals are mixed, the alloy must be cooled slowly to avoid crystallization. Suppose a metallurgist heats a mixture of metals to a temperature of  $2,500^\circ\text{F}$  and then removes the resulting alloy from the furnace. The alloy will then cool at a constant rate of  $40^\circ\text{F}$  every 15 minutes until it reaches room temperature. Which of the following functions represents the temperature  $T$  of the alloy  $h$  hours after it was removed from the furnace until it reaches room temperature?
- A)  $T(h) = -15h + 2,500$   
 B)  $T(h) = -40h + 2,500$   
 C)  $T(h) = -160h + 2,500$   
 D)  $T(h) = -600h + 2,500$

7. If  $\frac{3}{a-1} = \frac{12}{w}$ , such that  $a \neq 1$  and  $w \neq 0$ , what is  $w$  in terms of  $a$ ?

- A)  $4a - 4$   
 B)  $4a - 12$   
 C)  $12a - 4$   
 D)  $\frac{1}{4}a + 1$

$$\frac{4 - (1 - 3n)}{36} = \frac{2(n - 3) + 7}{12}$$

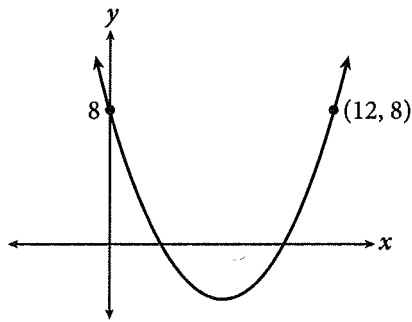
8. In the equation above, what is the value of  $n$ ?
- A) 0  
 B) 2  
 C) 3  
 D) There is no value of  $n$  that satisfies the equation.
9. Which of the following functions has a domain of  $x \geq 2$ ?
- A)  $f(x) = -x^2 + 2$   
 B)  $g(x) = -\sqrt{x - 2}$   
 C)  $h(x) = -\sqrt{x} + 2$   
 D)  $k(x) = -|x - 2|$
10. If  $\frac{1}{6}x - \frac{1}{2}y = 3$ , what is the value of  $x - 3y$ ?
- A) 6  
 B) 12  
 C) 18  
 D) 36
11. If  $x$  is an angle such that  $0 < x < 90^\circ$ , which of the following statements is not always true?
- A)  $\cos(x) > 0$   
 B)  $\cos(-x) > 0$   
 C)  $\cos(x + 90^\circ) < 0$   
 D)  $\cos(2x) < 0$



$$\begin{cases} ax + y = -5 \\ -\frac{1}{3}x - 2y = -1 \end{cases}$$

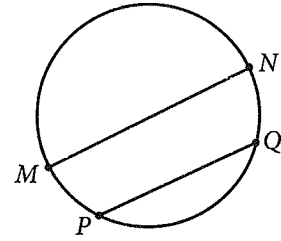
12. If the system of linear equations above has no solution, and  $a$  is a constant, what is the value of  $a$ ?

- A)  $-\frac{1}{3}$   
 B)  $-\frac{1}{6}$   
 C)  $\frac{1}{6}$   
 D)  $\frac{1}{3}$



13. The range of the parabola shown in the graph is  $y \geq -4$ . If the equation  $y = ax^2 + bx + c$  is used to represent the graph, what is the value of  $a$ ?

- A)  $\frac{1}{3}$   
 B)  $\frac{2}{3}$   
 C)  $\frac{3}{2}$   
 D) 3



14. The circle shown has a radius of  $r$  centimeters. If chord  $PQ$  is parallel to diameter  $MN$ , and the length of chord  $PQ$  is  $\frac{3}{4}$  of the length of the diameter, what is the distance in centimeters between  $\overline{MN}$  and  $\overline{PQ}$  in terms of  $r$ ?

- A)  $\frac{\sqrt{7}}{4}r$   
 B)  $\frac{\sqrt{3}}{2}r$   
 C)  $\frac{1}{4}\pi r$   
 D)  $\frac{3}{4}\pi r$

15. Which of the following represents  $16^{\frac{3}{2}}$  as an integer?

- A) 4  
 B) 12  
 C) 48  
 D) 64

**Directions:** For questions 16-20, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $\frac{7}{2}$ .  
(If  $3\frac{1}{2}$  is entered into the grid as 

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Answer:  $\frac{7}{12}$

Write answer in boxes. →

7	/	1	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	
1	1	<input type="radio"/>	1
2	2	2	<input type="radio"/>
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
<input type="radio"/>	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Grid in result. →

Answer: 2.5

← Decimal point

2	.	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	<input type="radio"/>	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

Answer: 201

Either position is correct.

	2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	<input type="radio"/>	0	
1	1	1	<input type="radio"/>
2	<input type="radio"/>	2	2
3	3	3	3
4	4	4	4

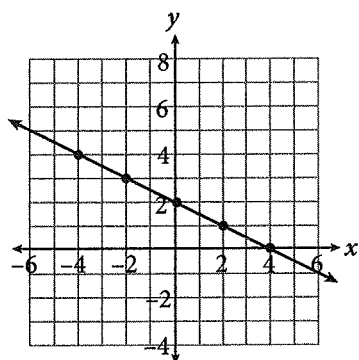
2	0	1	
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	0	0
1	1	<input type="radio"/>	1
2	<input type="radio"/>	2	2
3	3	3	3

Acceptable ways to grid  $\frac{2}{3}$  are:

2	/	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	<input type="radio"/>	2
3	3	<input type="radio"/>
4	4	4
5	5	5
6	6	6

.	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

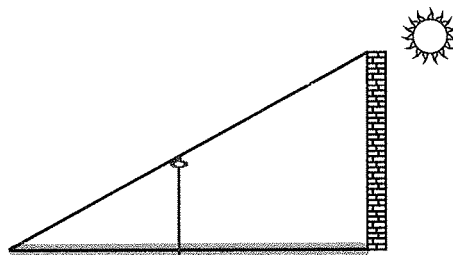
.	6	6	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	<input type="radio"/>	<input type="radio"/>	6



16. If the equation that represents the graph shown above is written in standard form,  $Ax + By = C$ , and  $A = 6$ , what is the value of  $B$ ?
17. If  $\frac{1}{3} \leq 2 - \frac{d}{6} \leq \frac{5}{4}$ , what is the minimum possible value of  $d$ ?

$$g(x) = \begin{cases} x^2 - 1, & \text{if } x \leq 0 \\ \frac{x^2}{3} + 1, & \text{if } 0 < x \leq 3 \\ 5x + 3, & \text{if } x > 3 \end{cases}$$

18. For the piecewise-defined function  $g(x)$  shown above, what is the value of  $g(2)$ ?



Note: Figure not drawn to scale.

19. A toy saber is stuck at a right angle into the ground 4 inches deep. It casts a shadow that is 4 feet long. The brick wall casts a shadow three times that long. If the wall is 7 feet 6 inches tall, how many inches long is the toy saber?
20. What is one possible solution to the rational equation  $\frac{x}{x-1} - \frac{2}{x} = \frac{1}{x-1}$ ?

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS SECTION ONLY. DO NOT TURN TO ANY OTHER SECTION IN THE TEST.

**STOP**

# MATH TEST

55 Minutes—38 Questions

## CALCULATOR SECTION

Turn to Section 4 of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding oval on the answer sheet. You may use any available space for scratch work.

Notes:

1. Calculator use is permitted.
2. All numbers used are real numbers.
3. All figures used are necessary to solving the problems that they accompany. All figures are drawn to scale EXCEPT when it is stated that a specific figure is not drawn to scale.
4. Unless stated otherwise, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$ , for which  $f(x)$  is a real number.

Information:

$A = \pi r^2$   
 $C = 2\pi r$

$A = lw$

$A = \frac{1}{2}bh$

$c^2 = a^2 + b^2$

Special Right Triangles

$V = lwh$

$V = \pi r^2h$

$V = \frac{4}{3}\pi r^3$

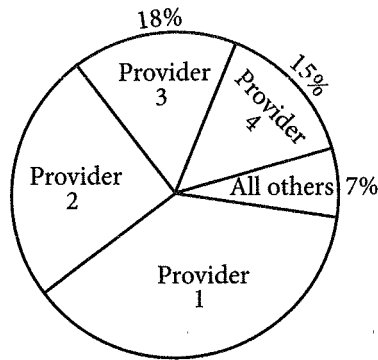
$V = \frac{1}{3}\pi r^2h$

$V = \frac{1}{3}lwh$

The sum of the degree measures of the angles in a triangle is 180.

The number of degrees of arc in a circle is 360.

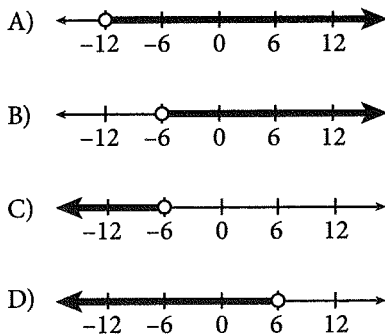
The number of radians of arc in a circle is  $2\pi$ .



- A company's market share is the percent of consumers who utilize the services or buy the products of that company. The pie chart above shows the different market shares of cable providers in a certain region. If the ratio of the market shares of Provider 1 to Provider 2 is 3:2, what is Provider 1's market share?

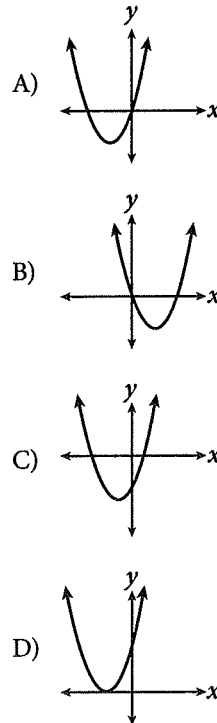
A) 24%  
 B) 30%  
 C) 36%  
 D) 42%

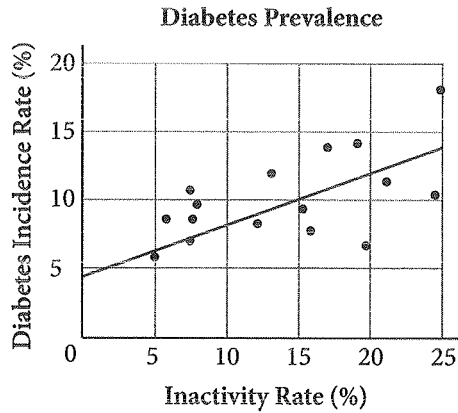
- Which of the following number lines represents the solution to the inequality  $3x + 29 > 5 - x$ ?



- Water is vital to human health. An average person should consume approximately 2.5 ounces of water per hour. However, because of the salt in it, seawater actually dehydrates the human body and should not be consumed. This is why boats must carry a supply of fresh water when embarking on long trips. Suppose a sailboat is traveling at an average speed of 4 nautical miles per hour with 3 people on board and the trip is 232 nautical miles. What is the minimum number of ounces of water the boat should stock before leaving?

A) 69.6  
 B) 145  
 C) 435  
 D) 1,113.6
- If  $a = 0$  and  $b < 0$ , then which of the following could be the graph of  $f(x) = (x - a)(x - b)$ ?





5. Increased physical activity has been linked to a lower incidence rate of diabetes. The scatterplot above shows the relationship between the percent of people in a certain country whose daily activity qualifies them as “inactive” and the incidence rate of diabetes in that country. The line of best fit for the data is also shown. Which of the following best represents the meaning of the  $y$ -intercept of the line of best fit in the context of this question?
- A) The predicted incidence rate of diabetes when the entire country is considered active
- B) The predicted incidence rate of diabetes when the entire country is considered inactive
- C) The predicted percent of people who will be active when the incidence rate of diabetes is 0%
- D) The predicted percent of people who will be inactive when the incidence rate of diabetes is 0%
6. At the grocery store, Gigi buys apples, a magazine, and a gallon of milk. The apples are priced per pound. In her state, there is no sales tax on food. If the total cost of her items is given by the function  $C(p) = 1.89p + 1.07(3.99) + 4.49$ , then the term  $1.07(3.99)$  most likely represents
- A) the cost of one gallon of milk.
- B) the per-pound cost of the apples.
- C) the cost of the magazine, including tax.
- D) the cost of the magazine, not including tax.
7. When a homeowner hires a contractor to renovate a bathroom, the homeowner is charged for both labor and materials. By law, the contractor can charge sales tax on the materials, but not on the labor. If the contractor quotes the homeowner \$3,000 for materials and \$40 per hour for labor, and sales tax in the homeowner’s state is 5.5%, which equation represents the total cost for the bathroom renovation if it takes the contractor  $h$  hours to complete the job?
- A)  $c = (40h + 3,000)(1.055)$
- B)  $c = 1.055(40 + 3,000)h$
- C)  $c = 40h(1.055) + 3,000$
- D)  $c = 40h + 1.055(3,000)$

8. A picture-framing shop sells ready-made frames and also does custom framing using different kinds and widths of wood or metal. The shop has a three-day sale. During the sale, for an 11-inch  $\times$  14-inch frame, a ready-made frame costs \$12 and a custom frame costs \$30. Over the course of the three days, the shop sells ninety-two 11  $\times$  14 frames and collects \$1,788. Solving which system of equations would yield the number of 11  $\times$  14 ready-made frames  $r$  and the number of 11  $\times$  14 custom frames  $c$  that the shop sold during the three-day sale?

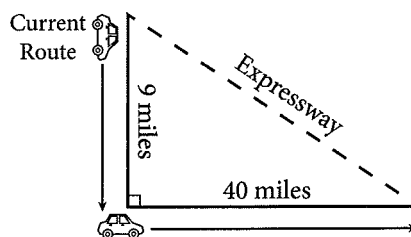
- A)  $\begin{cases} r + c = 92 \\ 12r + 30c = \frac{1,788}{3} \end{cases}$
- B)  $\begin{cases} r + c = 1,788 \\ 12r + 30c = 92 \times 3 \end{cases}$
- C)  $\begin{cases} r + c = 1,788 \\ 12r + 30c = 92 \end{cases}$
- D)  $\begin{cases} r + c = 92 \\ 12r + 30c = 1,788 \end{cases}$

City	Cost per Square Foot
Detroit	\$62.45
Atlanta	\$74.19
New York City	\$288.58
San Francisco	\$420.99

9. In real estate, location is often the number one determinant of home prices. The table above shows the average price per square foot of houses in four cities. Assuming an average home size of 1,500 to 2,000 square feet, which inequality represents how much more in dollars a house in New York City would cost than in Detroit?

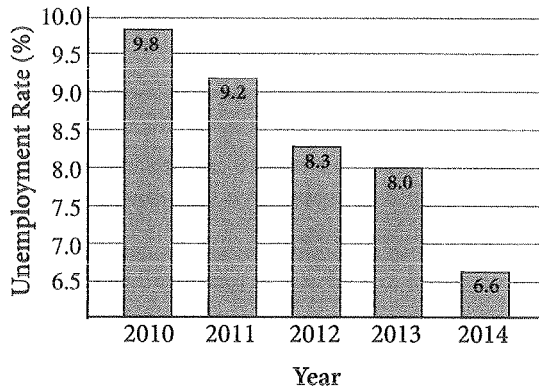
- A)  $x \geq 226.13$
- B)  $62.45 \leq x \leq 288.58$
- C)  $93,675 \leq x \leq 432,870$
- D)  $339,195 \leq x \leq 452,260$

10. If  $5n - 3(n - 1) = \frac{1}{2}(4n + 16) - 5$ , what is the value of  $n$ ?
- A)  $n = 1$
  - B)  $n = 3$
  - C) There is no value of  $n$  for which the equation is true.
  - D) There are infinitely many values of  $n$  for which the equation is true.



Note: Figure not drawn to scale.

11. The figure above shows the route that Max currently takes to work and back home every day. The city is planning to build an expressway that would cross through the city to help alleviate commuter traffic. Assuming an average gas consumption of 20 miles per gallon and a 5-day workweek, how many gallons of gas will Max save per week by taking the expressway to and from work each day instead of using his current route?
- A) 2
  - B) 4
  - C) 8
  - D) 10.25



12. The bar graph shows the percent of the U.S. population that was unemployed as of January 1 on each of the years shown. A governmental agency wants to use the 5-year mean of the data to estimate how many people were unemployed in a certain geographic area between 2010 and 2014. If the total adult population of the area was 250,000, approximately how many adults were unemployed in that area during the indicated time period?

- A) 16,950
- B) 20,150
- C) 20,950
- D) 104,750

13. Which of the following expressions is equivalent to

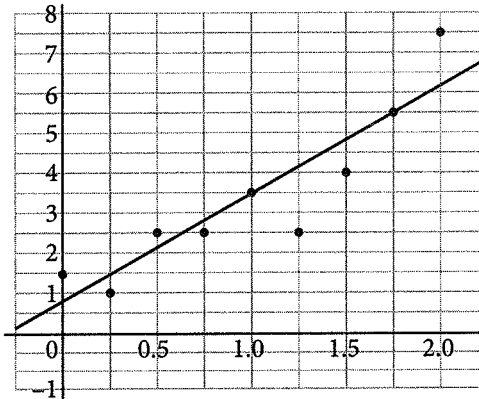
$$(36x^4y^7)^{\frac{1}{2}}?$$

- A)  $\frac{36x^4y^7}{2}$
- B)  $6xy^2\sqrt{y}$
- C)  $6x^2y^3\sqrt{y}$
- D)  $(36x^4y^7)^{-2}$



Questions 14 and 15 refer to the following information.

Use the data in the scatterplot and the line of best fit shown to answer the following questions.



14. Which of the following values most accurately reflects the average rate of change of the data based on the line of best fit?
- A)  $\frac{3}{8}$   
 B)  $\frac{3}{4}$   
 C)  $\frac{4}{3}$   
 D)  $\frac{8}{3}$
15. According to the graph, the data has been modeled using a line of best fit. Another researcher thinks that an exponential model may be a better fit. The table below shows the researcher's results after using a graphing calculator to perform a linear regression and an exponential regression on the data.

LinReg	ExpReg
$y = ax + b$	$y = a \times b^x$
$a = 2.7$	$a = 1.251327$
$b = .68888889$	$b = 2.299749$
$r^2 = .81876039$	$r^2 = .84304281$
$r = .9048538$	$r = .9181736$

Which of the following best explains which regression model is a better fit and why?

- A) A linear model is a much better fit because its value of  $a$  is considerably higher.  
 B) A linear model is a slightly better fit because its value of  $r$  is slightly smaller.  
 C) An exponential model is a much better fit because its value of  $a$  is much closer to 1.  
 D) An exponential model is a slightly better fit because its value of  $r$  is slightly closer to 1.

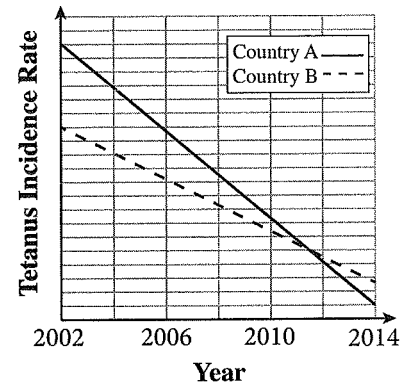
16. Which of the following are solutions to the quadratic equation  $(x - 2)^2 = \frac{16}{25}$ ?
- A)  $x = \pm\sqrt{\frac{4}{5}}$   
 B)  $x = -\frac{4}{5}, x = \frac{4}{5}$   
 C)  $x = \frac{6}{5}, x = \frac{14}{5}$   
 D)  $x = \frac{14}{5}, x = -\frac{14}{5}$
17. If the slope of a line is  $-\frac{5}{2}$  and a point on the line is  $(2, -1)$ , which of the following is the  $y$ -intercept of the line?
- A)  $-6$   
 B)  $-\frac{1}{2}$   
 C)  $4$   
 D)  $6$
18. The Consumer Price Index (CPI) is a weighted average of the cost of certain categories of goods and services in the United States. It is one of the most widely used measures of inflation. According to the U.S. Census Bureau, the CPI was 130.7 in 1990 and was 218.1 in 2010. If the CPI continues to experience the same percent increase over the next 20 years, approximately what will the CPI be in 2030?
- A) 145.8  
 B) 305.5  
 C) 363.9  
 D) 408.7
19. Given the function  $f(x) = \frac{1}{4}x - 2$ , what domain value corresponds to a range value of  $-\frac{5}{3}$ ?
- A)  $-\frac{29}{12}$   
 B)  $\frac{4}{3}$   
 C)  $\frac{7}{3}$   
 D)  $\frac{29}{12}$

$$T = 2\pi\sqrt{\frac{m}{k}}$$

20. When a spring is pressed tightly between two objects, it remains still. When one or both of those objects is disturbed, the spring starts to move. The equation above can be used to find the time period  $T$  in which a mass  $m$ , attached to a spring, makes a single oscillation (going all the way down and then back up). The variable  $k$  is a constant. Which of the following equations could be used to find the mass of the object?

- A)  $m = \frac{2\pi k}{T^2}$   
 B)  $m = \frac{kT^2}{4\pi^2}$   
 C)  $m = \frac{T^2}{4\pi^2 k}$   
 D)  $m = \sqrt{\frac{T}{2\pi k}}$

21. An educational polling company wants to determine whether parents of high school-age children believe using an electronic tablet in the classroom will improve student learning. To do this, the company conducted a survey by sending 50,000 text messages across the entire United States to randomly selected phones with text-messaging capabilities. For every text that the company sent, it received a response to the survey. Which of the following best explains why this random sample is unlikely to be a good representative sample of parents' opinions on the use of tablets in the classroom?
- A) Most parents don't care about this issue, and their attitude is likely to skew the results.
- B) Surveys conducted via text messaging are illegal and therefore are not considered reliable.
- C) There is no way to verify whether the responders to the survey were parents of high school age-children.
- D) The survey was biased because parents who own a cell phone probably also have a tablet and would want their children to learn how to use it.
22. A company that makes shoelaces has two machines, both of which run 24 hours a day. The first machine can produce 36,000 shoelaces per day. The second machine can produce 28,800 shoelaces per day. How many more shoelaces can the first machine make than the second machine in 8 minutes?
- A) 5
- B) 40
- C) 160
- D) 200



23. Tetanus is an infection of the body's nervous system. It is usually contracted by cutting oneself on a rusty metal object. In 2002, Country A started requiring students to have tetanus shots before entering public school. That same year, Country B started providing the vaccine free of charge to school-age children but has not required that they get it. The graph above shows the incidence rate of tetanus in these two countries starting in 2002. Which of the following statements is true?
- A) Country A's vaccine requirement had a greater impact on the incidence rate than did Country B's free vaccines.
- B) Country B's free vaccines had a greater impact on the incidence rate than did Country A's vaccine requirement.
- C) Country A's vaccine requirement had about the same impact on the incidence rate as did Country B's free vaccines.
- D) Because the countries started with different incidence rates, it is impossible to determine which country's actions had a greater impact.

24. A college professor with several hundred students has office hours between classes to provide extra help when needed. His classes on Monday are from 9:00 AM to 10:45 AM and 2:30 PM to 3:45 PM. It takes him 5 minutes to walk from the classroom to his office, and he takes a lunch break from 12:00 PM to 1:00 PM. On a particular Monday, he plans to grade tests, which have all multiple-choice questions. If each test consists of 50 questions and it takes him 4 seconds to mark each question right or wrong, how many complete tests can he mark during his office hours if no students come for help? Assume that he does not take the time to add up the scores until after his afternoon class.

- A) 46  
B) 47  
C) 54  
D) 55

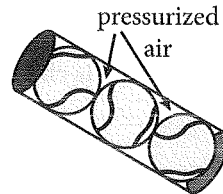
25. An optician charges \$125 for an eye examination, frames, and clear glass lenses, but \$197 for an eye examination, frames, and tinted glass lenses. If the tinted lenses cost three times as much as the clear lenses, how much do the clear glass lenses cost?

- A) \$24  
B) \$36  
C) \$48  
D) \$72

Registered to Vote?	1	2	3	4	5	Total
Yes	112	104	228	487	163	1,094
No	28	76	48	158	54	364
Total	140	180	276	645	217	1,458

26. An incumbent state senator (currently in office and running for an additional term) conducts a survey to see how favorably the people in her district view her. In the survey, responses of 1 or 2 represent an unfavorable view, a response of 3 is a neutral view, and responses of 4 or 5 are favorable. The results of the survey are recorded in the table. If one registered voter is chosen at random to attend a town hall meeting, what is the probability that the voter does not view the senator unfavorably?

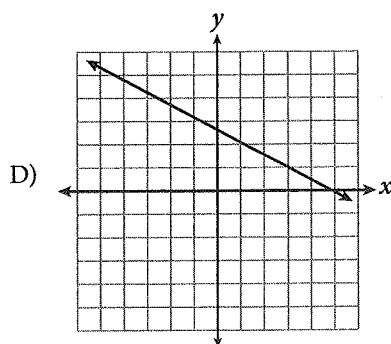
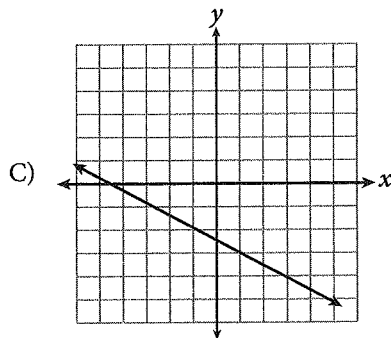
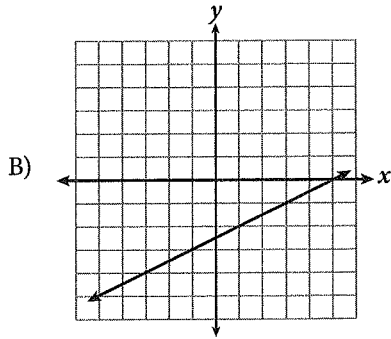
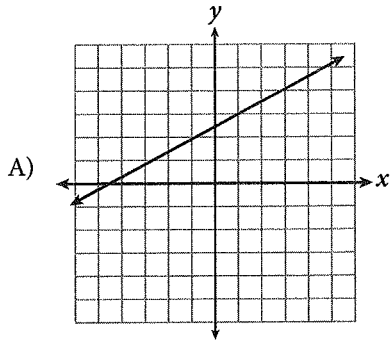
- A) 40.6%  
B) 59.4%  
C) 78.1%  
D) 80.3%



27. Higher-quality tennis balls are typically packaged in cylindrical cans, as shown above, which are pressurized with air to keep them fresh. If the can and the tennis balls have the same diameter, 2.6 inches, what is the volume in cubic inches of the air inside the can around the tennis balls? Assume that each tennis ball is tangent to the next and that the top and bottom tennis balls are tangent to the top and bottom of the can.

- A)  $4.4\pi$   
B)  $8.1\pi$   
C)  $10.3\pi$   
D)  $29.3\pi$

28. If  $h$  is a rational number such that  $-1 < h < 0$ , which of the following could be the graph of the equation  $y = hy + hx + x - 4$ ?



29. A scientist weighed a 1.0 cubic foot piece of granite and found that it weighed 168 pounds. The average density of Earth's inner core is approximately  $12.8 \text{ g/cm}^3$ . How much denser, in  $\text{g/cm}^3$ , is Earth's inner core than the piece of granite? Use any of the following conversions:

- 12 inches = 1 foot
- 16 ounces = 1 pound
- 1 inch = 2.54 cm
- 1 ounce = 28.35 grams

- A) 2.7  
 B) 10.1  
 C) 15.55  
 D) 28.35

$$\frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$

30. In electronic circuits, resistors are often paired to manage the flow of the electrical current. To find the total resistance of a pair of parallel resistors, electricians use the formula shown above, where  $R_1$  is the resistance of the first resistor and  $R_2$  is the resistance of the second resistor. Which of the following is another way to represent this formula?

- A)  $\frac{R_1 R_2}{R_1 + R_2}$   
 B)  $\frac{R_1 + R_2}{R_1 R_2}$   
 C)  $\frac{1}{R_2} - \frac{1}{R_1}$   
 D)  $R_1 + R_2$

**Directions:** For questions 31-38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $\frac{7}{2}$ .  
(If  $3\frac{1}{2}$  is entered into the grid as 

3	1	/	2
○	○	○	○

, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Answer:  $\frac{7}{12}$

Write answer in boxes. →

7	/	1	2
○	○	○	○
○	○	○	○
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Grid in result. →

Answer: 2.5

2	.	5
○	○	○
○	○	○
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

← Decimal point

Answer: 201

Either position is correct.

2	0	1
○	○	○
○	○	○
1	1	1
2	2	2
3	3	3
4	4	4

2	0	1
○	○	○
○	○	○
1	1	1
2	2	2
3	3	3

Acceptable ways to grid  $\frac{2}{3}$  are:

2	/	3
○	○	○
○	○	○
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6

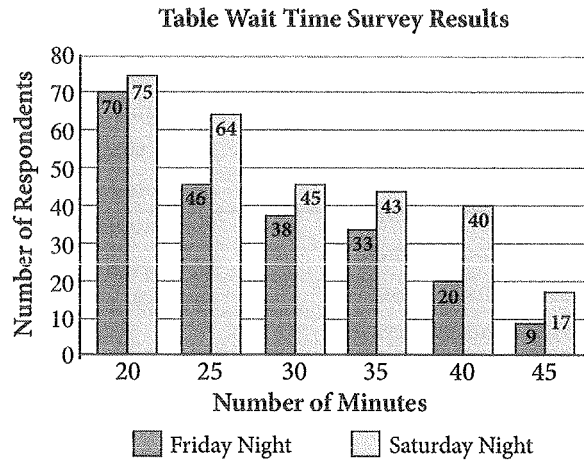
.	6	6	6
○	○	○	○
○	○	○	○
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

.	6	6	7
○	○	○	○
○	○	○	○
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

31. According to the U.S. Department of Agriculture, the linear equation  $f = -3.7t + 872$  estimates the number of acres of farmland  $f$  in the United States  $t$  years after 2010, where  $f$  is given in millions of acres. Based on this equation, at the start of what year will the amount of farmland be below 800 million acres?
32. If  $g(x) = x^2 + 2x + 9$ , what is  $g(5) - g(-1)$ ?
33. A North Carolina agricultural supply company is hoping to expand its services to three counties in rural Virginia. According to its research, there is a total of approximately 1,200 farms in these three counties. The company sends out surveys to a sample of 200 randomly selected farmers in the counties and finds that 120 are not satisfied with their current supply company. Based on other market research, the company is confident that it will be able to acquire 75% of the dissatisfied customers. Based on this information and the results of the sample survey, about how many customers should the company be able to acquire in these three counties?
- $$\frac{4 + \sqrt{-16}}{2 + \sqrt{-4}}$$
34. Use the definition  $\sqrt{-1} = i$  to write the expression above in simplest form.
35. Sometimes, companies will buy stock in businesses owned by one or more of their competitors in order to gain some control over the competing companies. Suppose Company X buys stock in two of its competitors. The first competitor is a small regional company. Five hundred shares of its stock cost \$25,000 less than half as much as 500 shares of the other competitor, which is a large national company. Together, Company X pays \$155,000 for all the stock. How many more thousands of dollars did Company X spend on acquiring the stock of the national competitor than the regional one? Enter your answer in thousands of dollars. (For example, enter \$15,000 as 15.)
36. The Mackinac Bridge in Michigan is one of the longest suspension bridges in the Western Hemisphere, spanning approximately 1.63 miles from one end to the other. It has several pieces that are connected by anchorages (large blocks to which the suspension cables are attached). The longest piece is 3,800 feet long. In a scale drawing on a poster board, the length of the bridge is 28 inches. How many inches long should the longest piece be? Round your answer to the nearest tenth of an inch. (There are 5,280 feet in 1 mile.)

Questions 37 and 38 refer to the following information.

A restaurant sent out surveys to determine how long customers are willing to wait for a table on Friday night versus Saturday night. Participants randomly received either a Friday night or a Saturday night survey. Results are shown in the bar graph below.



37. If a customer is chosen at random from all of the survey respondents, what is the probability that the customer is willing to wait at least 30 minutes for a table?
38. On average, how many minutes longer are customers willing to wait for a table on Saturday night than on Friday night? Round your answer to the nearest whole minute.



**ANSWER KEY****READING TEST**

1. A	14. A	27. C	40. C
2. B	15. D	28. C	41. D
3. C	16. D	29. A	42. B
4. A	17. A	30. B	43. D
5. D	18. C	31. C	44. D
6. C	19. B	32. C	45. B
7. D	20. A	33. D	46. C
8. A	21. A	34. A	47. A
9. D	22. C	35. C	48. B
10. A	23. D	36. B	49. C
11. D	24. C	37. D	50. A
12. A	25. D	38. C	51. A
13. B	26. D	39. A	52. C

**WRITING AND LANGUAGE TEST**

1. D	12. D	23. A	34. D
2. A	13. B	24. D	35. D
3. B	14. A	25. C	36. B
4. A	15. A	26. A	37. B
5. A	16. B	27. C	38. C
6. C	17. D	28. C	39. D
7. B	18. C	29. D	40. D
8. C	19. A	30. B	41. C
9. B	20. D	31. A	42. A
10. D	21. D	32. B	43. B
11. D	22. A	33. B	44. B

**MATH—NO CALCULATOR**

1. C	6. C	11. D	16. 12
2. C	7. A	12. C	17. $9/2$ or 4.5
3. B	8. A	13. A	18. $7/3$ or 2.33
4. D	9. B	14. A	19. 34
5. A	10. C	15. D	20. 2

**MATH—CALCULATOR**

1. C	11. B	21. C	31. 2030
2. B	12. C	22. B	32. 36
3. C	13. C	23. A	33. 540
4. A	14. D	24. A	34. 2
5. A	15. D	25. B	35. 85
6. C	16. C	26. D	36. 12.4
7. D	17. C	27. A	37. .49
8. D	18. C	28. B	38. 1
9. D	19. B	29. B	
10. D	20. B	30. A	

## MATH TEST: NO-CALCULATOR SECTION

1. C

**Difficulty:** Easy

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** When matching a real-world scenario to an inequality, try writing the inequality in words first, and then translate from English into math.

**Getting to the Answer:** On a new tire, the tread depth is  $\frac{10}{32}$  inches. As the car is driven, the tread wears down, or is *less* over time, so the depth is always less than or equal to  $\frac{10}{32}$ . You can express this as  $d \leq \frac{10}{32}$ , which means you can eliminate B and D. For safety reasons, the tread depth must be *more* than  $\frac{2}{32}$  inches. You can express this as  $d > \frac{2}{32}$ . Because the answer choices are written with the number first, turn the inequality around—but don't forget to keep the open end of the symbol pointed at  $d$ . The result is  $\frac{2}{32} < d$ . This means (C) is correct.

2. C

**Difficulty:** Easy

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** There are a number of ways to solve quadratic equations. When the coefficient of  $x^2$  is 1, the quickest way is usually to factor, if possible. You could also use the quadratic formula or completing the square.

**Getting to the Answer:** To answer this question, first rewrite the equation in standard form,  $x^2 - 8x - 48 = 0$ , and then factor to arrive at  $(x - 12)(x + 4) = 0$ . Using the Zero-Product property to solve for  $x$  results in  $x = 12$  and  $x = -4$ . It is given that  $x < 0$ , so  $x$  must equal  $-4$ . This means that  $x + 10$  is equal to  $-4 + 10 = 6$ .

3. B

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** When a quadratic equation is written in standard form,  $y = ax^2 + bx + c$ , the value of  $c$  is the  $y$ -intercept of the equation's graph. This is because substituting 0 for  $x$  results in  $y = a(0)^2 + b(0) + c = c$ .

**Getting to the Answer:** In a real-world scenario, the  $y$ -intercept represents an initial amount. In this question, height is what is being measured, so the  $y$ -intercept represents the initial height of the bottle rocket. Because the rocket was fired from the roof of the gymnasium, the height of the gymnasium must be 14 meters, making (B) correct.

4. D

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Horizontal and vertical lines have special forms. A horizontal line has a slope of 0 and an equation that always looks like  $y = b$ , where  $b$  is a constant. A vertical line has an undefined slope and always looks like  $x = b$ .

**Getting to the Answer:** Line  $L$  shown in the graph is horizontal, so you are looking for an equation that once simplified (or written in  $y = mx + b$  form) looks like  $y = b$ . In other words, all the  $x$ -terms must cancel out. In addition, because the line is below the  $x$ -axis,  $b$  must be a negative number. Check each answer choice to see if it takes on the desired form. Choice A  $\rightarrow y = -x - 2$ , so eliminate it. Choice B  $\rightarrow y = -x$ , so eliminate it. Choice C  $\rightarrow y = 2$ , which is in the correct form, but 2 is positive and the graph would be above the  $x$ -axis, so eliminate it. This means (D) must be correct—subtracting  $x$  and 2 from both sides of the equation results in  $y = -2$ , which could be the equation of line  $L$ .

**5. A****Difficulty:** Medium**Category:** Heart of Algebra / Systems of Linear Equations**Strategic Advice:** When solving a system of linear equations, always check to see if you can cancel out one of the variables by multiplying either of the equations by a fairly small number and then adding the equations. Before you choose an answer, check that you answered the right question (the value of  $y^2$ ).**Getting to the Answer:** Multiply the bottom equation by  $-2$  and then combine the equations to eliminate the terms that have  $x$ 's in them.

$$\begin{array}{r} 2x + 5y = 8 \rightarrow \cancel{2}x + 5y = 8 \\ -2[x + 3y = 3] \rightarrow \underline{-2x - 6y = -6} \\ \hline -y = 2 \\ y = -2 \end{array}$$

The question asks for the value of  $y^2$ , so you don't need to find the value of  $x$ . Simply square the value of  $y$  and you're done:  $(-2)^2 = 4$ .

**6. C****Difficulty:** Medium**Category:** Passport to Advanced Math / Functions**Strategic Advice:** Take a quick peek at the answer choices—but only to get an idea of how the functions look. They are all linear equations, so apply what you know about the slope-intercept form of a line to choose the correct function.**Getting to the Answer:** In a real-world scenario, the slope of a line represents a rate of change (how fast the alloy cools) and the  $y$ -intercept represents a starting amount (the initial temperature of the alloy). Be careful—the rate is given in minutes while the question asks for a function in terms of hours. There are four 15-minute intervals in an hour, so the cooling rate per hour is  $-40(4) = -160$  degrees. (The rate is negative because as the alloy cools, the temperature

drops.) Look back at the answer choices—(C) is the only one that has a slope of  $-160$ , so (C) is correct.

**7. A****Difficulty:** Medium**Category:** Passport to Advanced Math / Exponents**Strategic Advice:** Whenever an equation involves two fractional expressions set equal to each other, you can cross-multiply to solve. As you work through the algebra, don't skip steps. This will keep you from forgetting to distribute numbers and/or negative signs.**Getting to the Answer:**

$$\frac{3}{a-1} = \frac{12}{w}$$

$$3(w) = 12(a-1)$$

$$3w = 12a - 12$$

$$\frac{\cancel{3}w}{\cancel{3}} = \frac{12a}{3} - \frac{12}{3}$$

$$w = 4a - 4$$

**8. A****Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations**Strategic Advice:** Choose the best strategy to answer the question—cross-multiplying in this question (without a calculator) will create large numbers and possibly lead to errors. Instead, start by simplifying the numerators and then multiply both sides of the equation by the least common denominator, 36.

**Getting to the Answer:**

$$\begin{aligned} \frac{4 - (1 - 3n)}{36} &= \frac{2(n - 3) + 7}{12} \\ \frac{4 - 1 + 3n}{36} &= \frac{2n - 6 + 7}{12} \\ \frac{3 + 3n}{36} &= \frac{2n + 1}{12} \\ \cancel{36} \times \left[ \frac{3 + 3n}{\cancel{36}} \right] &= \left[ \frac{2n + 1}{\cancel{12}} \right] \times \cancel{36} \\ 3 + 3n &= 3(2n + 1) \\ 3 + 3n &= 6n + 3 \\ 0 &= 3n \\ 0 &= n \end{aligned}$$

Don't be fooled—this does not mean that there is no solution. The value of  $n$  just happens to be 0. If the variable had been in the denominator of either of the expressions, you would need to check that the solution is valid, but it wasn't, so the correct answer is (A).

**9. B****Difficulty:** Medium**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** The domain of a function is the set of  $x$ -values (inputs) for which the function is defined. Of all the parent functions, the only ones that have a *restricted* domain (a domain that is not all real numbers) are the square root function (because the square root of a negative number is imaginary) and the rational function (because you cannot divide by 0).

**Getting to the Answer:** The domain in the question is restricted to numbers greater than or equal to 2, so you can immediately eliminate A and D—the domain of a quadratic function and an absolute function is all real numbers. To choose between (B) and C, you can draw a quick sketch or think about how transformations affect the domain of each function. The domain of the parent function  $f(x) = \sqrt{x}$  is  $x \geq 0$  (nonnegative numbers). In (B),

the parent function is reflected vertically across the horizontal axis (which doesn't change the domain) and then shifted to the right 2 (making the domain  $x \geq 2$ ), so (B) is correct. Note that in C, the function is reflected across the horizontal axis and then shifted *up* 2 units, which adds 2 to the *range* of the function, not the domain.

**10. C****Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Only one equation is given, and it has two variables. This means that you don't have enough information to solve for either variable. Instead, look for the relationship between the variable terms in the equation and those in the expression that you are trying to find,  $x - 3y$ .

**Getting to the Answer:** The expression that you're looking for doesn't have fractions, so clear the fractions in the equation by multiplying both sides by 6. Don't forget to distribute the 6 to both terms on the left side of the equation.

$$\begin{aligned} \frac{1}{6}x - \frac{1}{2}y &= 3 \\ 6\left(\frac{1}{6}x - \frac{1}{2}y\right) &= 6(3) \\ x - 3y &= 18 \end{aligned}$$

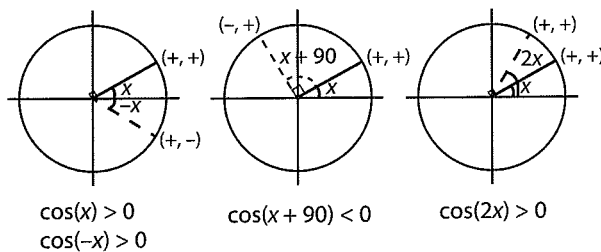
This yields the expression that you are looking for,  $x - 3y$ , so no further work is required—just read the value on the right-hand side of the equation. The answer is 18, which is (C).

**11. D****Difficulty:** Hard**Category:** Additional Topics in Math / Trigonometry

**Strategic Advice:** When a trig question involves signs (+ and -) rather than numbers, using your knowledge of how the *unit circle* works will get you to the answer. Before you begin analyzing the answer choices, translate the inequality symbols to signs ( $> 0$  means +, and  $< 0$  means -).

**Getting to the Answer:** Draw a quick sketch of a unit circle and add the angle  $x$ . Because  $0 < x < 90^\circ$ , you can draw the angle anywhere in the first quadrant. Drawing a small angle is usually the safest way to go.

Then, sketch in each of the angles described in the answers. Keep in mind that the cosine of the angle is equal to the  $x$ -coordinate of the point where the angle hits the unit circle, so it's positive in Quadrants I and IV and negative in Quadrants II and III.



After sketching in each of the angles, compare them with the answer choices. The only one that is not always true is (D). When the angle is small, twice the angle still lands in Quadrant I, so the cosine is still positive (and therefore  $> 0$ , not  $< 0$ ). Note that had you drawn a larger angle in Quadrant I, such as a  $60^\circ$  angle,  $2x$  would have landed in Quadrant II, in which case the cosine would have been negative. However, the question asks for the statement that is not *always* true, so you must consider both large and small angles in Quadrant I.

## 12. C

**Difficulty:** Hard

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Graphically, a system of linear equations that has no solution indicates two parallel lines or, in other words, two lines that have the same slope. So, write each of the equations in slope-intercept form ( $y = mx + b$ ) and set their slopes ( $m$ ) equal to each other to solve for  $a$ . Before finding the slopes, multiply the bottom equation by  $-3$  to make it easier to manipulate.

**Getting to the Answer:**

$$ax + y = -5 \rightarrow y = -ax - 5$$

$$-3\left(-\frac{1}{3}x - 2y = -1\right) \rightarrow x + 6y = 3 \rightarrow y = -\frac{1}{6}x + \frac{1}{2}$$

The slope of the first line is  $-a$ , and the slope of the second line is  $-\frac{1}{6}$ . Setting them equal and solving for  $a$  results in  $-a = -\frac{1}{6}$  or  $a = \frac{1}{6}$ .

## 13. A

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** To write the equation of a parabola, you need two things—the vertex and one other point. In this question, you already have a point, but you'll need to reason logically to find the vertex. Use these two facts: The vertex of a parabola lies on its axis of symmetry, and the range of a quadratic equation depends on the  $y$ -coordinate of the vertex.

**Getting to the Answer:** The vertex of the parabola shown must lie on its axis of symmetry, which is halfway between the two points  $(0, 8)$  and  $(12, 8)$ . This means the  $x$ -coordinate of the vertex is halfway between 0 and 12, which is 6. To find the  $y$ -coordinate of the vertex, look at the range:  $y \geq -4$  means that the minimum value of the graph, and hence the  $y$ -coordinate of the vertex, is  $-4$ . Now, use the vertex  $(6, -4)$  to set up a quadratic equation in vertex form:  $y = a(x - h)^2 + k$ . The result is  $y = a(x - 6)^2 - 4$ . Plug in either of the given points for  $x$  and  $y$  to find the value of  $a$ . Using  $(0, 8)$ , the result is:

$$y = a(x - 6)^2 - 4$$

$$8 = a(0 - 6)^2 - 4$$

$$8 = 36a - 4$$

$$12 = 36a$$

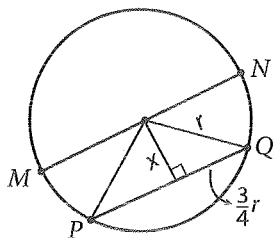
$$a = \frac{12}{36} = \frac{1}{3}$$

14. A

**Difficulty:** Hard**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** Drawing in a radius or two is usually a good way to start a circle question, especially when there doesn't seem to be a lot of information given. This question asks about the distance between the chord and the diameter, so start by drawing that in. Then, see if drawing a radius will help.

**Getting to the Answer:** After you've drawn in anything that you think might help you answer the question, go back and label wherever possible. The radius has length  $r$ , so add that to the diagram. The chord is  $\frac{3}{4}$  as long as the diameter, which means half the chord is  $\frac{3}{4}$  as long as the radius, so add that to the diagram. You are looking for the distance between the chord and the diameter, so call that  $x$ .



You now have a right triangle with enough labels to use the Pythagorean theorem.

$$a^2 + b^2 = c^2$$

$$x^2 + \left(\frac{3}{4}r\right)^2 = r^2$$

$$x^2 + \frac{9}{16}r^2 = r^2$$

$$x^2 = \frac{16}{16}r^2 - \frac{9}{16}r^2$$

$$x^2 = \frac{7}{16}r^2$$

$$x = \sqrt{\frac{7}{16}r^2} = \frac{\sqrt{7}}{4}r$$

15. D

**Difficulty:** Hard**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Because this is a non-calculator question, you need to rewrite the exponent in a way that makes it easier to evaluate. Unit fractions, as exponents, are easy to evaluate because they can be rewritten as radicals.

**Getting to the Answer:** Use the rules of exponents to rewrite  $\frac{3}{2}$  as a unit fraction raised to a power. Then write the expression in radical form and simplify.

$$\begin{aligned} 16^{\frac{3}{2}} &= (16^{\frac{1}{2}})^3 \\ &= (\sqrt{16})^3 \\ &= 4^3 \\ &= 4 \times 4 \times 4 \\ &= 64 \end{aligned}$$

16. 12

**Difficulty:** Easy**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** The two things you can glean from the equation of a line are its slope and its y-intercept. In this question, you're given information about  $A$  and asked about  $B$ . Try writing the equation in slope-intercept form to see how  $A$  and  $B$  are related. Then look at the graph and see what you can add to this relationship.

**Getting to the Answer:** Start by writing the equation in slope-intercept form,  $y = mx + b$ .

$$Ax + By = C$$

$$By = -Ax + C$$

$$y = -\frac{A}{B}x + \frac{C}{B}$$

So, together  $A$  and  $B$  (specifically  $A$  over  $B$ ) define the slope of the line. Look at the graph: Reading from left to right, the line falls 1 unit for every 2 units

that it runs to the right, so the slope is  $-\frac{1}{2}$ . Don't forget—the question tells you that  $A = 6$ , so set the slope equal to  $-\frac{6}{B}$  and solve for  $B$ :

$$\begin{aligned} -\frac{1}{2} &= -\frac{6}{B} \\ B &= 12 \end{aligned}$$

**17. 9/2 or 4.5****Difficulty:** Medium**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Choose the best strategy to answer the question. Here, the fractions make it look more complicated than it really is, so start by clearing the fractions by multiplying everything by 12.

**Getting to the Answer:** You don't need to separate this compound inequality into pieces. Just remember, whatever you do to one piece, you must do to all three pieces, and don't forget to reverse the inequality symbols if you multiply or divide by a negative number.

$$\begin{aligned} \frac{1}{3} \leq 2 - \frac{d}{6} &\leq \frac{5}{4} \\ 12\left(\frac{1}{3}\right) \leq 12\left(2 - \frac{d}{6}\right) &\leq 12\left(\frac{5}{4}\right) \\ 4 \leq 24 - 2d &\leq 15 \\ -20 \leq -2d &\leq -9 \\ 10 \geq d &\geq \frac{9}{2} \end{aligned}$$

The question asks for the minimum possible value of  $d$ , so turn the inequality around so that smaller numbers are written first:  $\frac{9}{2} \leq d \leq 10$ , making the minimum value  $\frac{9}{2}$ , or 4.5.

**18. 7/3 or 2.33****Difficulty:** Medium**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Piecewise defined functions look intimidating, but they are usually very simple functions—they're just written in pieces. Your job is to figure out which piece of the function you need to use to answer the question.

**Getting to the Answer:** The right-hand side of each piece of the function tells you what part of the domain (which  $x$ -values) goes with that particular function. In this function, only values of  $x$  that are less than zero go with the top function, values of  $x$  between 0 and 3 go with the middle function, and values of  $x$  that are greater than 3 go with the bottom function. Because 2 is between 0 and 3, plug it into the middle function and simplify:

$$\begin{aligned} g(2) &= \frac{(2)^2}{3} + 1 \\ &= \frac{4}{3} + 1 \\ &= \frac{4}{3} + \frac{3}{3} = \frac{7}{3} \end{aligned}$$

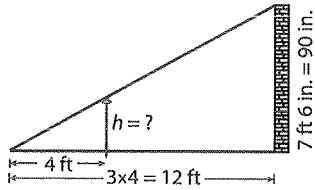
**19. 34****Difficulty:** Hard**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** Drawing on the diagram is a great strategy to get started on a question like this. There are two right triangles—the smaller one formed by the saber, the path of the sun's rays, and the ground; and the larger one formed by the brick wall, the path of the sun's rays, and the ground. The two triangles share one angle (the small angle on the left side), and each has a 90-degree angle (where the saber and the brick wall each meet the ground), making the third pair of corresponding angles also congruent. This means the triangles are similar by AAA, and the sides of the triangles are proportional.

**Getting to the Answer:** Add information from the question to the diagram. You'll need to convert the height of the wall to inches because the question asks for the length of the saber in inches. (You could also convert the base lengths to inches, but it is not



necessary because you can compare feet to feet in that ratio.)



Now that you have a more detailed drawing, set up and solve a proportion:

$$\frac{\text{base of small triangle}}{\text{base of large triangle}} = \frac{\text{length of saber (in inches)}}{\text{height of wall (in inches)}}$$

$$\begin{aligned}\frac{4}{12} &= \frac{h}{90} \\ 4(90) &= 12h \\ 360 &= 12h \\ 30 &= h\end{aligned}$$

Don't forget to add the 4 inches that are stuck in the ground to find that the length of the saber is  $30 + 4 = 34$  inches.

## 20. 2

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Solving a rational equation takes patience and a good deal of algebraic manipulation. You'll need to find a common denominator and multiply both sides of the equation by that denominator. The next steps will depend on what kind of equation results from the first steps.

**Getting to the Answer:** Start by multiplying both sides of the equation (all three terms) by the common denominator, which is  $x(x + 1)$ . Try to write neatly, especially when canceling terms, so you don't lose track of anything.

$$\begin{aligned}x(x-1)\left(\frac{x}{x-1}\right) - \cancel{x}(x-1)\left(\frac{2}{\cancel{x}}\right) &= x(x-1)\left(\frac{1}{x-1}\right) \\ x(x) - 2(x-1) &= x(1) \\ x^2 - 2x + 2 &= x\end{aligned}$$

The resulting equation is quadratic, so set it equal to zero and either try to factor it or use the quadratic formula to solve it.

$$\begin{aligned}x^2 - 2x + 2 &= x \\ x^2 - 3x + 2 &= 0 \\ (x-1)(x-2) &= 0 \\ x-1=0 \text{ or } x-2=0 \\ x=1 \text{ or } x=2\end{aligned}$$

Be careful here—whenever there is a variable in the denominator of an equation, you must check to make sure that the solutions do not result in division by zero. The solution  $x = 1$  *does* result in division by 0, so it is invalid. That means the only correct solution is  $x = 2$ .

**MATH TEST: CALCULATOR SECTION****1. C****Difficulty:** Easy**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages**Strategic Advice:** Break the question into steps. Before you can use the ratio, you need to find the percent of the market that utilizes Provider 1 and Provider 2.**Getting to the Answer:** The ratio given in the question is 3:2, so write this as 3 parts (Provider 1) and 2 parts (Provider 2). You don't know how big a part is, so call it  $x$ . This means that  $3x + 2x =$  the percent of consumers that utilize Provider 1 and Provider 2 for cable services, which is 100% – all the other providers:  $100 - (18 + 15 + 7) = 100 - 40 = 60$ .

$$3x + 2x = 60$$

$$5x = 60$$

$$x = 12$$

Each part has a value of 12 and three parts use Provider 1, so Provider 1's market share is  $3 \times 12 = 36\%$ .**2. B****Difficulty:** Easy**Category:** Heart of Algebra / Inequalities**Strategic Advice:** Solve the inequality using inverse operations. Then compare your answer with each of the number lines shown. Remember, on a number line, numbers to the right are greater than numbers to the left.**Getting to the Answer:**

$$3x + 29 > 5 - x$$

$$4x + 29 > 5$$

$$4x > -24$$

$$x > -6$$

There should be an open dot at  $-6$ , with shading to the right, so (B) is correct. Don't be fooled by C. You only reverse the inequality symbol when you multiply or divide by a negative number, not when the answer is negative.**3. C****Difficulty:** Easy**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages**Strategic Advice:** This is a question about rates, so pay careful attention to the units. As you read the question, decide if and when you will need to convert units.**Getting to the Answer:** First determine how long it will take the boat to complete the trip. Set up and solve a proportion:

$$\frac{4 \text{ nautical miles}}{1 \text{ hour}} = \frac{232 \text{ nautical miles}}{x \text{ hours}}$$

$$4x = 232$$

$$x = 58$$

The question asks for the total number of ounces of water needed. The recommended rate of consumption is given in ounces per hour, and you now know the number of hours that it will take the boat to complete the trip. Multiply the number of total hours by the number of ounces needed per hour:  $58 \times 2.5 = 145$ . Be careful—this isn't the answer. Remember, there are 3 people on board. This is the amount 1 person needs to consume during the trip, so multiply by 3 to get  $145 \times 3 = 435$  ounces.**4. A****Difficulty:** Medium**Category:** Passport to Advanced Math / Quadratics**Strategic Advice:** If  $a = 0$ , then one factor must be  $(a - 0)$ , which means  $x = 0$  is a root. This means the graph must cross through the origin, so you can eliminate C and D right away.

**Getting to the Answer:** Look at the remaining two choices, (A) and B. The question states that  $b < 0$ . This means  $b$  is negative, which means the other  $x$ -intercept must fall to the left of the  $y$ -axis, so (A) is correct.

Because this question is in the calculator section of the test, you could also use the Picking Numbers strategy. Choose a value for  $b$  (that is less than 0), such as  $-2$ , and graph the equation  $y = (x - 0)(x - (-2))$  to see what the graph looks like.

### 5. A

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** You don't need to know the  $y$ -intercept to answer the question, so don't waste valuable time trying to find it. Instead, use the labels on the axes to determine the meaning of the  $y$ -intercept.

**Getting to the Answer:** The  $y$ -intercept is the point at which  $x = 0$ . In this real-world scenario, the percent of people who are considered inactive is graphed on the  $x$ -axis, so the  $y$ -intercept occurs when 0% of the country is inactive. Now, look carefully at the way the answer choices are worded. Choice (A) is correct because it says the entire country is *active*, which is the same as saying 0% are inactive. Choice B says the entire country is *inactive*, which means 100% is inactive (not 0% inactive).

### 6. C

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** In a real-world scenario, a one-time fee does not depend on the variable and is therefore a constant. A unit rate, however, is always multiplied by the independent variable.

**Getting to the Answer:** The total cost consists of the gallon of milk (a constant), the per-pound cost of the apples (which depends on the number of pounds), and the cost of the magazine (which is the only taxed item). The constant in the equation is 4.49 and is, therefore, the cost of the gallon of milk; 1.89 is being multiplied by  $p$  (the number of pounds), so \$1.89 must be the per-pound cost of the apples. That leaves the remaining term,  $1.07(3.99)$ , which must be the cost of the magazine (\$3.99) plus a 7% sales tax.

### 7. D

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Organize information as you read the question; the total cost includes the labor cost, the cost of the materials, and the 5.5% tax on the *materials only*.

**Getting to the Answer:** If the contractor works  $h$  hours, the labor cost of the renovation is the per-hour rate (\$40) multiplied by the number of hours ( $h$ ) or  $40h$ . To this amount, add the \$3,000 for materials, which are taxed at a rate of 5.5% and should therefore be multiplied by 1.055. The total cost is given by the equation  $c = 40h + 1.055(3,000)$ , which is (D).

### 8. D

**Difficulty:** Medium

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** One equation should represent the total *number* of frames, while the other equation should represent the *revenue* from the frames.

**Getting to the Answer:** The number of custom frames  $c$  plus the number of ready-made frames  $r$  equals the total number of frames sold, 92. Therefore, one equation is  $c + r = 92$ . This means you can eliminate B and C. Now write the revenue equation: Revenue per custom frame ( $30c$ ) plus revenue per ready-made frame ( $12r$ ) equals the total amount collected (1,788). The revenue equation

is  $30c + 12r = 1,788$ . Don't let A fool you. The question says nothing about the revenue *per day* of the sale, so there is no reason to divide by 3. Choice (D) is correct.

**9. D**

**Difficulty:** Medium

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** The best way to answer this question is to pretend you are a homebuyer. How much more per square foot would your house cost in New York than Detroit? If the house was 1,500 square feet, how much more would this be? If the house was 2,000 square feet, how much more would this be?

**Getting to the Answer:** Based on the data in the table, a house would cost  $\$288.58 - \$62.45 = \$226.13$  more per square foot in New York than in Detroit. If the house was 1,500 square feet, it would cost  $1,500(226.13) = \$339,195$  more. If the house was 2,000 square feet, it would cost  $2,000(226.13) = \$452,260$  more. So, the house would cost somewhere between  $\$339,195$  and  $\$452,260$  more, which can be expressed as the compound inequality  $339,195 \leq x \leq 452,260$ .

**10. D**

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Use the distributive property to simplify each of the terms that contain parentheses. You don't need to clear the fractions on the right-hand side, because you can easily take half of  $4n$  and half of 16. Once you arrive at the simplified equation, make sure you understand what the result is telling you.

**Getting to the Answer:**

$$\begin{aligned} 5n - 3(n - 1) &= \frac{1}{2}(4n + 16) - 5 \\ 5n - 3n + 3 &= 2n + 8 - 5 \\ 2n + 3 &= 2n + 3 \\ 3 &= 3 \end{aligned}$$

All of the variable terms cancel out, and the resulting numerical statement is true (3 always equals 3), so there are infinitely many solutions, or in other words, there are infinitely many values of  $n$  for which the equation is true.

**11. B**

**Difficulty:** Medium

**Category:** Additional Topics / Geometry

**Strategic Advice:** It will save valuable time on Test Day if you can recognize the Pythagorean triple in this problem. If not, just use the Pythagorean theorem to find the length of the expressway.

**Getting to the Answer:** The roads form a right triangle with the expressway as the hypotenuse. The two legs are Max's current route. He travels on one road for 9 miles and the other for 40. You might recognize this as a Pythagorean triple: 9, 40, 41. Even if you don't, you can always use the Pythagorean theorem to solve for the length of the hypotenuse.

$$\begin{aligned} a^2 + b^2 &= c^2 \\ (9)^2 + (40)^2 &= c^2 \\ 81 + 1,600 &= c^2 \\ 1,681 &= c^2 \\ 41 &= c \end{aligned}$$

Now that you know the length of the expressway, it's time to analyze what the question is actually asking.

The question asks how much gas he will save given that his car gets 20 miles per gallon. His current *round-trip* route is  $2(9 + 40) = 2(49) = 98$  miles, which will use  $98 \div 20 = 4.9$  gallons of gas per day, which is equal to  $5(4.9) = 24.5$  gallons per workweek. The *round-trip* expressway route is  $2(41) = 82$  miles, which will use  $82 \div 20 = 4.1$  gallons of gas per day, which is equal to  $5(4.1) = 20.5$  gallons per workweek. Thus, he will save  $24.5 - 20.5 = 4$  gallons of gas per week by taking the expressway.

12. C

**Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Statistics and Probability**Strategic Advice:** The mean of a set of numbers is the same as the average, which is the sum of the numbers divided by the amount of numbers.**Getting to the Answer:** Use the graph to find the sum of the unemployment rates over all 5 years:  $9.8 + 9.2 + 8.3 + 8 + 6.6 = 41.9$ . Now, divide by the number of years to calculate the mean:  $41.9 \div 5 = 8.38$ . Read the axis labels carefully. The unemployment rate is given as a percent, so write 8.38 as 0.0838. If there were 250,000 people in the geographic area, then approximately  $250,000 \times 0.0838 = 20,950$  people were unemployed during the indicated time period.

13. C

**Difficulty:** Medium**Category:** Passport to Advanced Math / Exponents**Strategic Advice:** To make the expression look more familiar, rewrite the fraction exponent as a radical. Then, find the largest perfect square for each factor and take its square root (which allows you to bring the square roots outside the radical).**Getting to the Answer:**

$$\begin{aligned} & (36x^4y^7)^{\frac{1}{2}} \\ &= \sqrt{36x^4y^7} \\ &= \sqrt{(6^2)(x^2)^2(y^3)^2y} \\ &= 6x^2y^3\sqrt{y} \end{aligned}$$

You could also use prime factorization and look for pairs of factors that are the same in order to bring them outside the radical.

14. D

**Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Scatterplots**Strategic Advice:** The average rate of change is the same as the slope of the line of best fit. Look for two points that lie on the line (or as close as possible to the line) and then find the slope using the slope formula,  $m = \frac{y_2 - y_1}{x_2 - x_1}$ . Pay careful attention to how the axes are labeled to make sure you write the points accurately.**Getting to the Answer:** Using the points (1, 3.5) and (1.75, 5.5), the average rate of change is  $\frac{5.5 - 3.5}{1.75 - 1} = \frac{2}{0.75} = 2.\bar{6}$  or  $\frac{8}{3}$ .

15. D

**Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Scatterplots**Strategic Advice:** Performing a regression on a graphing calculator (or using computer software) tells you the approximate equation that could be used to model the data and how well the model fits the data. The *fit* is indicated by the correlation coefficient,  $r$ . The closer this number is to 1 (a 100% fit), the more accurately the model describes the data.**Getting to the Answer:** You can eliminate A and C right away because they do not involve the correlation coefficient,  $r$ . To choose between B and (D), look at the value of  $r$  to find that 0.9181736 is slightly closer to 1 than 0.9048538. This means the exponential model is a slightly better fit than the linear model.

16. C

**Difficulty:** Medium**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** Taking the square root is the inverse operation of squaring, and both sides of the equation are already perfect squares, so take their square roots. Then solve the resulting equations. Remember, there will be two equations to solve.

**Getting to the Answer:**

$$\begin{aligned}(x-2)^2 &= \frac{16}{25} \\ \sqrt{(x-2)^2} &= \sqrt{\frac{16}{25}} \\ x-2 &= \pm \frac{\sqrt{16}}{\sqrt{25}} \\ x &= 2 \pm \frac{4}{5}\end{aligned}$$

Now, simplify each equation:  $x = 2 - \frac{4}{5} = \frac{10}{5} - \frac{4}{5} = \frac{6}{5}$   
and  $x = 2 + \frac{4}{5} = \frac{10}{5} + \frac{4}{5} = \frac{14}{5}$ .

**17. C**

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** When you know the slope and one point on a line, you can use  $y = mx + b$  to write the equation. Substitute the slope for  $m$  and the coordinates of the point for  $x$  and  $y$ . Then solve for  $b$ , which gives you the  $y$ -intercept of the line.

**Getting to the Answer:** The slope is given as  $-\frac{5}{2}$ , so substitute this for  $m$ . The point is given as  $(2, -1)$ , so  $x = 2$  and  $y = -1$ . Now, find  $b$ .

$$\begin{aligned}y &= mx + b \\ -1 &= -\frac{5}{2}(2) + b \\ -1 &= -5 + b \\ 4 &= b\end{aligned}$$

The  $y$ -intercept of the line is 4.

You could also very carefully graph the line using the given point and the slope. Start at  $(2, -1)$  and move toward the  $y$ -axis by rising 5 and running to

the left 2 (because the slope is negative). You should land at the point  $(0, 4)$ .

**18. C**

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Find the percent increase using the formula,  $\% \text{ Change} = \frac{\text{amount of change}}{\text{original amount}}$ . Then apply the same percent increase to the 2010 CPI to find the expected value in 2030.

**Getting to the Answer:** The amount of increase is  $218.1 - 130.7 = 87.4$ , so the percent increase is  $87.4 \div 130.7 = 0.6687$ , or 66.87% over 20 years. If the total percent increase over the next 20 years is the same, the CPI will be about  $218.1 \times 1.6687 = 363.9$ .

**19. B**

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Don't answer this question too quickly—you may be tempted to substitute  $-\frac{5}{3}$  for  $x$ , but  $-\frac{5}{3}$  is the output (range), not the input (domain).

**Getting to the Answer:** The given range value is an output value, so substitute  $-\frac{5}{3}$  for  $f(x)$  and use inverse operations to solve for  $x$ , which gives you the corresponding domain value. Start by multiplying the equation by the greatest common multiple of 3 and 4, which is 12, in order to clear the fractions.

$$\begin{aligned}-\frac{5}{3} &= \frac{1}{4}x - 2 \\ (12)\left(-\frac{5}{3}\right) &= (12)\frac{1}{4}x - 2(12) \\ -20 &= 3x - 24 \\ 4 &= 3x \\ \frac{4}{3} &= x\end{aligned}$$

## 20. B

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Don't spend too much time reading the scientific explanation of the equation. Focus on the question at the very end—it's just asking you to solve the equation for  $m$ .

**Getting to the Answer:** First, square both sides of the equation to get  $m$  out from under the radical. Then, divide both sides by  $4\pi^2$ . Finally, multiply both sides by  $k$ .

$$T = 2\pi\sqrt{\frac{m}{k}}$$

$$T^2 = (2\pi)^2\left(\frac{m}{k}\right)$$

$$T^2 = 4\pi^2\left(\frac{m}{k}\right)$$

$$\frac{T^2}{4\pi^2} = \frac{m}{k}$$

$$\frac{kT^2}{4\pi^2} = m$$

## 21. C

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** A good representative sample is not only random, but also a good representation of the population in question. Here, the population in question is parents of high school-age children.

**Getting to the Answer:** Not everyone with a cell phone is a parent of high school-age children. For example, single and married people who don't have children are likely to make up at least a portion of the random texts sent out by the polling company. This means that, despite being randomly selected, the sample is unlikely to be a good representative sample. (Note that D also sounds reasonable, but the question asks for the best explanation that specifically addresses why the sample is unlikely to be a *good representative sample*.)

## 22. B

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Let the units in this question, as in most rate questions, guide you to the answer.

**Getting to the Answer:** The rate at which each machine can produce is given per day, but the question asks about the number of shoelaces each machine can produce in 8 minutes, so convert shoelaces per day to shoelaces per minute and multiply by 8. Then find the difference.

*Machine 1:*

$$\frac{36,000 \text{ laces}}{\text{day}} \times \frac{1 \text{ day}}{24 \text{ hr}} \times \frac{1 \text{ hr}}{60 \text{ min}} \times 8 \text{ min} = 200 \text{ laces}$$

*Machine 2:*

$$\frac{28,800 \text{ laces}}{\text{day}} \times \frac{1 \text{ day}}{24 \text{ hr}} \times \frac{1 \text{ hr}}{60 \text{ min}} \times 8 \text{ min} = 160 \text{ laces}$$

The first machine can produce  $200 - 160 = 40$  more shoelaces in 8 minutes.

**23. A****Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Compare the differences in the two lines to the statements in the answer choices. Pay careful attention to which line represents each country.

**Getting to the Answer:** The lines both have different  $y$ -intercepts and different slopes. The dashed line (Country B) starts lower and has a more gradual slope, while the solid line (Country A) starts higher and has a steeper slope. This means that, even though the incidence rate was initially higher, Country A's vaccine requirement had a greater impact on the incidence rate than Country B's free vaccines. You can also think about it logically: The incidence rate in Country A started higher and ended lower than in Country B, which means there was a greater change.

**24. A****Difficulty:** Hard**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** This question has a lot of information, so break the question into short steps. First, calculate the amount of time the professor will spend in office hours. Then, determine how many questions he can grade in that time, paying careful attention to units as you go.

**Getting to the Answer:** Start by finding the time between classes. There are 3 hours and 45 minutes between classes. Now, subtract 10 minutes (5 minutes each way) for walking to and from the classroom, which leaves 3 hours and 35 minutes. Next, subtract the hour the professor takes for lunch, leaving 2 hours and 35 minutes, to grade papers. Now comes the tricky part. The question gives you the rate at which he can grade papers per second, so you need to convert the hours and minutes to seconds. There are 60 minutes in 1 hour, so 2 hours and 35 minutes is 155 minutes. There are 60 seconds in

1 minute, so the number of seconds the professor has to grade papers is 9,300. Now divide this by 4 to see how many questions he can grade: 2,325. The question asks how many complete tests he can grade, and there are 50 questions per test, so divide by 50 to get 46.5, which means he can completely grade 46 tests (he doesn't have time to finish the 47th test).

**25. B****Difficulty:** Hard**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** The trick to answering a question like this is figuring out what accounts for the difference in the prices.

**Getting to the Answer:** In each case, the examination and the frames are the same; the difference in the cost must be due to the difference in the cost of the lenses. Because tinted lenses cost three times as much as clear lenses, the *difference* in cost must be twice the cost of the clear lenses.

$$\begin{aligned} \text{Difference in cost} &= \text{cost of tinted} - \text{cost of clear} \\ &= 3(\text{cost of clear}) - \text{cost of clear} \\ &= 2(\text{cost of clear}) \end{aligned}$$

The difference in cost is  $\$197 - \$125 = \$72$ . Because this is twice the cost of the clear lenses, the clear lenses must cost  $\$72 \div 2 = \$36$ .

**26. D****Difficulty:** Hard**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** Whenever a question involves a two-way table, read carefully to see which rows and/or columns you need to focus on. Here, the politician is only targeting registered voters for the town hall meeting, so focus on the "Yes" row in the table.



**Getting to the Answer:** The question asks for the probability that the registered voter chosen will not view the senator *unfavorably*. This means the voter's view is either *neutral* or *favorable*, so look at columns 3, 4, and 5. Add the numbers together to get  $228 + 487 + 163 = 878$ . The probability that you're looking for is the quotient of this number divided by the total number of registered voters:  $878 \div 1,094 = 0.8025$ , or approximately 80.3%.

**27. A**

**Difficulty:** Hard

**Category:** Additional Topics / Geometry

**Strategic Advice:** Don't forget to refer to the formula page on Test Day. The can is a cylinder and a tennis ball is a sphere, so you'll need to use both equations.

**Getting to the Answer:** Make a plan before you start plugging values into the formulas: The volume of the air is equal to the volume of the can minus the volume of the three tennis balls. For both formulas, you will need the radius. The diameters of the cylinder and the balls are the same, 2.6, but you need the radius, so divide by 2 to get  $2.6 \div 2 = 1.3$ . For the cylinder you also need the height. Because there are 3 tennis balls and the top and bottom balls are tangent to the top and bottom of the can, the height is simply the diameter multiplied by 3, which is  $2.6 \times 3 = 7.8$ . Now you're ready to use the formulas. A quick peek at the answer choices will tell you that you don't need to simplify completely.

First, find the volume of the whole can:

$$V = \pi r^2 h$$

$$V = \pi(1.3)^2(7.8)$$

$$V = \pi(1.69)(7.8)$$

$$V = 13.182\pi$$

Next, find the volume of three tennis balls:

$$V = 3\left(\frac{4}{3}\pi r^3\right)$$

$$V = 3\left(\frac{4}{3}\pi(1.3)^3\right)$$

$$V = 4\pi(2.197)$$

$$V = 8.788\pi$$

Finally, subtract to get  $13.182\pi - 8.788\pi = 4.394\pi$ , or about  $4.4\pi$  cubic inches of air.

**28. B**

**Difficulty:** Hard

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** None of the variables in the equation has an exponent greater than 1, so the equation is linear. Most of what we know about lines revolves around slope and y-intercepts, so start by rearranging the equation to look like  $y = mx + b$ .

**Getting to the Answer:**

$$y = hy + hx + x - 4$$

$$y - hy = hx + x - 4$$

$$y(1-h) = x(h+1) - 4$$

$$y = \frac{(h+1)}{(1-h)}x - \frac{4}{1-h}$$

Once rewritten, you have a linear equation with a slope of  $\frac{h+1}{1-h}$  and a y-intercept of  $-\frac{4}{1-h}$ . It is given in the question that  $-1 < h < 0$  (or a negative fraction greater than  $-1$ ), so the quantity  $h + 1$  is positive and the quantity  $1 - h$  is also positive, resulting in a positive slope and a negative y-intercept. Only (B) satisfies these conditions.

**29. B**

**Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Let the units in this question guide you to the correct answer. Set up unit conversions so that the units you don't want will cancel out. Your goal is to find the density of the piece of granite so you can compare it to the density of Earth's inner core. You don't need a definition of *density*—you can see from the units that you need to convert to  $\text{g}/\text{cm}^3$ , which tells you to divide the weight of the granite by the volume.

**Getting to the Answer:** You're not given a conversion from feet to centimeters or pounds to grams, so you'll need to convert 168 pounds per cubic foot to ounces per cubic inch, and then to grams per cubic centimeter. Try not to round too much as you work—rather, wait until the very end if possible.

$$\begin{aligned} \frac{168 \text{ lb}}{1 \text{ ft}^3} &\times \frac{1 \text{ ft}}{12 \text{ in.}} \times \frac{1 \text{ ft}}{12 \text{ in.}} \times \frac{1 \text{ ft}}{12 \text{ in.}} = \frac{168 \text{ lb}}{1,728 \text{ in.}^3} \\ &= \frac{168 \cancel{\text{ lb}}}{1,728 \text{ in.}^3} \times \frac{16 \text{ oz}}{1 \cancel{\text{ lb}}} = \frac{2,688 \text{ oz}}{1,728 \text{ in.}^3} \\ &= \frac{2,688 \text{ oz}}{1,728 \cancel{\text{ in.}^3}} \times \frac{1 \cancel{\text{ in.}} \times 1 \cancel{\text{ in.}} \times 1 \cancel{\text{ in.}}}{2.54 \text{ cm} \times 2.54 \text{ cm} \times 2.54 \text{ cm}} \\ &= \frac{2,688 \text{ oz}}{28,316.85 \text{ cm}^3} \\ &= \frac{2,688 \cancel{\text{ oz}}}{28,316.85 \text{ cm}^3} \times \frac{28.35 \text{ g}}{1 \cancel{\text{ oz}}} = \frac{76,204.8 \text{ g}}{28,316.85 \text{ cm}^3} \approx 2.7 \text{ g}/\text{cm}^3 \end{aligned}$$

But wait—that's not the final answer. Subtract this amount from 12.8 to find that Earth's inner core is  $12.8 - 2.7 = 10.1 \text{ g}/\text{cm}^3$  denser than the piece of granite.

### 30. A

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Simplifying a complex rational expression requires planning and patience. Here, you need to write the denominator of the big expression as a single fraction, and then you can simply "flip it" to adjust for the "1 over."

**Getting to the Answer:** Start by writing  $\frac{1}{R_1} + \frac{1}{R_2}$  as a single term. To do this, find the common denominator and write each piece of the sum in terms of that denominator. The common denominator is  $R_1R_2$ .

$$\begin{aligned} \frac{1}{R_1} + \frac{1}{R_2} &= \frac{R_2}{R_2} \left( \frac{1}{R_1} \right) + \frac{R_1}{R_1} \left( \frac{1}{R_2} \right) \\ &= \frac{R_2}{R_1R_2} + \frac{R_1}{R_1R_2} \\ &= \frac{R_1 + R_2}{R_1R_2} \end{aligned}$$

But remember, this fraction is the denominator under 1, so you need to write the reciprocal (flip it); the correct expression is  $\frac{R_1R_2}{R_1 + R_2}$ .

### 31. 2030

**Difficulty:** Easy

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Some questions require both mathematical calculations and logic. Think carefully before you grid in your answer to any question that asks, "In what year...?"

**Getting to the Answer:** You want the cropland to be below, or less than 800, so set up and solve an inequality:

$$\begin{aligned} f &< 800 \\ -3.7t + 872 &< 800 \\ -3.7t &< -72 \\ t &> 19.46 \end{aligned}$$

Here's the tricky part—should you round? To decide, plug 19 and 20, one at a time, into the original equation and simplify:

When  $t = 19$ ,  $f = -3.7(19) + 872 = 801.7$ , which is not below 800.

This means  $t = 20$ , but be careful—that is not the answer! The question states that  $t$  represents the number of years after 2010, so the correct answer is  $2010 + 20 = 2030$ .

**32. 36****Difficulty:** Easy**Category:** Passport to Advanced Math / Functions**Strategic Advice:** When evaluating a function, substitute the value inside the parentheses for  $x$  in the equation.**Getting to the Answer:** Evaluate the function at  $x = 5$  and at  $x = -1$ . Then subtract the second output from the first. Note that this is not the same as first subtracting  $5 - (-1)$  and then evaluating the function at  $x = 6$ .

$$f(5) = (5)^2 + 2(5) + 9 = 25 + 10 + 9 = 44$$

$$f(-1) = (-1)^2 + 2(-1) + 9 = 1 - 2 + 9 = 8$$

$$f(5) - f(-1) = 44 - 8 = 36$$

**33. 540****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages**Strategic Advice:** Work through this question one step at a time. Start by using the sample survey to find the percentage of farmers who are not satisfied with their current supply company.**Getting to the Answer:** According to the sample survey,  $\frac{120}{200} = 0.6$  (or 60%) of the farmers are not satisfied with their current supply company. Multiply the total number of farms in the population (the three counties) to find that  $1,200 \times 0.6 = 720$  farmers are not satisfied. The company is confident that it can acquire 75% of these customers, or  $720 \times 0.75 = 540$  customers.**34. 2****Difficulty:** Medium**Category:** Additional Topics / Imaginary Numbers**Strategic Advice:** Because  $\sqrt{-1} = i$ , rewrite each number under the radical as a product of  $-1$  and itself. Then take the square root of each. If possible, cancel any factors that are common to the numerator and the denominator.**Getting to the Answer:**

$$\begin{aligned} \frac{4 + \sqrt{-16}}{2 + \sqrt{-4}} &= \frac{4 + \sqrt{16 \times (-1)}}{2 + \sqrt{4 \times (-1)}} \\ &= \frac{4 + 4i}{2 + 2i} \\ &= \frac{2(2 + 2i)}{\cancel{2 + 2i}} \\ &= 2 \end{aligned}$$

**35. 85****Difficulty:** Medium**Category:** Heart of Algebra / Systems of Linear Equations**Strategic Advice:** Write a system of equations with  $r =$  the cost of the regional competitor's stock in thousands of dollars (so you don't have to deal with all the zeros) and  $n =$  the cost of the national competitor's stock in thousands of dollars. Before entering your final answer, check that you answered the right question (how much more the national competitor's stock cost).**Getting to the Answer:** Translate English into math to write the two equations: The regional competitor's stock cost 25 thousand dollars less than half as much as the national competitor's stock, so  $r = \frac{1}{2}n - 25$ . Together, both stock acquisitions cost 155 thousand dollars, so  $r + n = 155$ .

The system of equations is:

$$\begin{cases} r + n = 155 \\ r = \frac{n}{2} - 25 \end{cases}$$

The bottom equation is already solved for  $r$ , so substitute  $r = \frac{n}{2} - 25$  into the top equation for  $r$  and solve for  $n$ . To make the numbers easier to work with, multiply each term by 2 to clear the fractions:

$$\begin{aligned}\frac{n}{2} - 25 + n &= 155 \\ n - 50 + 2n &= 310 \\ 3n &= 360 \\ n &= 120\end{aligned}$$

The national competitor's stock cost 120 thousand dollars, so the regional competitor's cost  $(120 \div 2) - 25 = 60 - 25 = 35$  thousand dollars. This means the national competitor's stock cost  $120 - 35 = 85$  thousand dollars more than the regional competitor's stock.

### 36. 12.4

**Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Pay careful attention to the units. You need to convert the length of the whole bridge to feet and then set up and solve a proportion.

**Getting to the Answer:** You don't need to convert all of the dimensions to inches, even though the answer asks for inches. The ratio will be the same. But you do need to convert the length of the bridge, given in miles, to feet, because the length of the longest piece of the bridge is given in feet:  $1.63 \text{ miles} \times 5,280 \text{ feet} = 8,606.4 \text{ feet}$ . Now, set up a proportion and solve for the unknown. Use words first to help you keep the dimensions in the right places:

$$\begin{aligned}\frac{\text{actual longest piece}}{\text{actual total length}} &= \frac{\text{drawing longest piece}}{\text{drawing total length}} \\ \frac{3,800}{8,606.4} &= \frac{x}{28} \\ 106,400 &= 8,606.4x \\ 12.36 &\approx x\end{aligned}$$

The length of the longest piece in the drawing should be 12.4 inches long.

### 37. .49

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** Identify the parts of the bar graph that you will need to answer this question. You need to find a probability, which is always given by the number of favorable outcomes (willing to wait at least 30 minutes) divided by the total number of outcomes (all the responses to the survey).

**Getting to the Answer:** First, total the number of customers willing to wait 30 minutes or more. Be careful—the question doesn't specify Friday or Saturday, so use both days:

$$38 + 45 + 33 + 43 + 20 + 40 + 9 + 17 = 245$$

Now, find the total number of people who responded to the survey. You don't need to start over—just add the previous sum to the number of people willing to wait *less than* 30 minutes:

$$245 + 70 + 75 + 46 + 64 = 500$$

This means the probability that someone will be willing to wait more than 30 minutes is  $\frac{245}{500} = \frac{49}{100}$ .

This fraction won't fit in the answer grid, so enter your answer as a decimal, .49.

### 38. 1

**Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** Think about what the bar graph shows: times customers are willing to wait on Friday and Saturday. The question asks *on average* how much *longer* customers are willing to wait. So, you will need to find a weighted average for each day.

**Getting to the Answer:** Start with Friday. Multiply each wait time by the height of the bar (the number of people willing to wait for that amount of time on that night):

$$20 \times 70 = 1,400$$

$$25 \times 46 = 1,150$$

$$30 \times 38 = 1,140$$

$$35 \times 33 = 1,155$$

$$40 \times 20 = 800$$

$$45 \times 9 = 405$$

Next, add the results to get 6,050, and then divide by the total number of people who took the Friday survey ( $70 + 46 + 38 + 33 + 20 + 9 = 216$ ):  $6,050 \div 216 = 28.0$  minutes. This is the average amount of time people are willing to wait for a table on Friday night. Now, do the same thing for Saturday.

$$20 \times 75 = 1,500$$

$$25 \times 64 = 1,600$$

$$30 \times 45 = 1,350$$

$$35 \times 43 = 1,505$$

$$40 \times 40 = 1,600$$

$$45 \times 17 = 765$$

Add the results, 8,320, and divide by the number of people ( $75 + 64 + 45 + 43 + 40 + 17 = 284$ ) to get  $8,320 \div 284 = 29.3$  minutes. So, people are willing to wait  $29.3 - 28.0 = 1.3$  minutes longer on Saturday than Friday. Don't forget to follow directions—1.3 rounded to the nearest whole minute is 1 minute.

# SAT PRACTICE TEST 4 ANSWER SHEET

Remove (or photocopy) this answer sheet and use it to complete the test. See the answer key following the test when finished.

Start with number 1 for each section. If a section has fewer questions than answer spaces, leave the extra spaces blank.

## SECTION

# 1

- |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| 1. (A) (B) (C) (D)  | 14. (A) (B) (C) (D) | 27. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 2. (A) (B) (C) (D)  | 15. (A) (B) (C) (D) | 28. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 3. (A) (B) (C) (D)  | 16. (A) (B) (C) (D) | 29. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D)  | 17. (A) (B) (C) (D) | 30. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D)  | 18. (A) (B) (C) (D) | 31. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D)  | 19. (A) (B) (C) (D) | 32. (A) (B) (C) (D) | 45. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D)  | 20. (A) (B) (C) (D) | 33. (A) (B) (C) (D) | 46. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D)  | 21. (A) (B) (C) (D) | 34. (A) (B) (C) (D) | 47. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D)  | 22. (A) (B) (C) (D) | 35. (A) (B) (C) (D) | 48. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 23. (A) (B) (C) (D) | 36. (A) (B) (C) (D) | 49. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 24. (A) (B) (C) (D) | 37. (A) (B) (C) (D) | 50. (A) (B) (C) (D) |
| 12. (A) (B) (C) (D) | 25. (A) (B) (C) (D) | 38. (A) (B) (C) (D) | 51. (A) (B) (C) (D) |
| 13. (A) (B) (C) (D) | 26. (A) (B) (C) (D) | 39. (A) (B) (C) (D) | 52. (A) (B) (C) (D) |

# right in  
Section 1

# wrong in  
Section 1

## SECTION

# 2

- |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| 1. (A) (B) (C) (D)  | 12. (A) (B) (C) (D) | 23. (A) (B) (C) (D) | 34. (A) (B) (C) (D) |
| 2. (A) (B) (C) (D)  | 13. (A) (B) (C) (D) | 24. (A) (B) (C) (D) | 35. (A) (B) (C) (D) |
| 3. (A) (B) (C) (D)  | 14. (A) (B) (C) (D) | 25. (A) (B) (C) (D) | 36. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D)  | 15. (A) (B) (C) (D) | 26. (A) (B) (C) (D) | 37. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D)  | 16. (A) (B) (C) (D) | 27. (A) (B) (C) (D) | 38. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D)  | 17. (A) (B) (C) (D) | 28. (A) (B) (C) (D) | 39. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D)  | 18. (A) (B) (C) (D) | 29. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D)  | 19. (A) (B) (C) (D) | 30. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D)  | 20. (A) (B) (C) (D) | 31. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 21. (A) (B) (C) (D) | 32. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 22. (A) (B) (C) (D) | 33. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |

# right in  
Section 2

# wrong in  
Section 2

SECTION 3

3

- 1. (A) (B) (C) (D)
- 2. (A) (B) (C) (D)
- 3. (A) (B) (C) (D)
- 4. (A) (B) (C) (D)

- 5. (A) (B) (C) (D)
- 6. (A) (B) (C) (D)
- 7. (A) (B) (C) (D)
- 8. (A) (B) (C) (D)

- 9. (A) (B) (C) (D)
- 10. (A) (B) (C) (D)
- 11. (A) (B) (C) (D)
- 12. (A) (B) (C) (D)

- 13. (A) (B) (C) (D)
- 14. (A) (B) (C) (D)
- 15. (A) (B) (C) (D)

# right in Section 3

# wrong in Section 3

16.

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4	4	4	4
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7	7	7	7
8	8	8	8
9	9	9	9

17.

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7	7	7	7
8	8	8	8
9	9	9	9

18.

	7	7	
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3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

19.

	7	7	
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

20.

	7	7	
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4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

SECTION 4

4

- 1. (A) (B) (C) (D)
- 2. (A) (B) (C) (D)
- 3. (A) (B) (C) (D)
- 4. (A) (B) (C) (D)
- 5. (A) (B) (C) (D)
- 6. (A) (B) (C) (D)
- 7. (A) (B) (C) (D)
- 8. (A) (B) (C) (D)

- 9. (A) (B) (C) (D)
- 10. (A) (B) (C) (D)
- 11. (A) (B) (C) (D)
- 12. (A) (B) (C) (D)
- 13. (A) (B) (C) (D)
- 14. (A) (B) (C) (D)
- 15. (A) (B) (C) (D)
- 16. (A) (B) (C) (D)

- 17. (A) (B) (C) (D)
- 18. (A) (B) (C) (D)
- 19. (A) (B) (C) (D)
- 20. (A) (B) (C) (D)
- 21. (A) (B) (C) (D)
- 22. (A) (B) (C) (D)
- 23. (A) (B) (C) (D)
- 24. (A) (B) (C) (D)

- 25. (A) (B) (C) (D)
- 26. (A) (B) (C) (D)
- 27. (A) (B) (C) (D)
- 28. (A) (B) (C) (D)
- 29. (A) (B) (C) (D)
- 30. (A) (B) (C) (D)

# right in Section 4

# wrong in Section 4

31.

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3	3	3	3
4	4	4	4
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6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

32.

	7	7	
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

33.

	7	7	
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1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

34.

	7	7	
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

35.

	7	7	
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

36.

	7	7	
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

37.

	7	7	
	0	0	0
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

38.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

# MATH TEST

25 Minutes—20 Questions

## NO-CALCULATOR SECTION

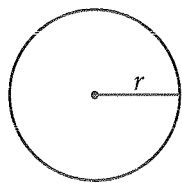
Turn to Section 3 of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding oval on the answer sheet. You may use any available space for scratch work.

Notes:

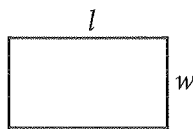
1. Calculator use is NOT permitted.
2. All numbers used are real numbers.
3. All figures used are necessary to solving the problems that they accompany. All figures are drawn to scale EXCEPT when it is stated that a specific figure is not drawn to scale.
4. Unless stated otherwise, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$ , for which  $f(x)$  is a real number.

Information:

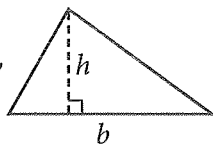


$$A = \pi r^2$$

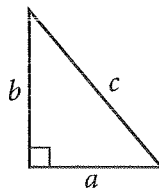
$$C = 2\pi r$$



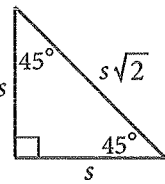
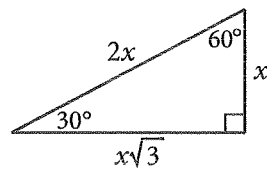
$$A = lw$$



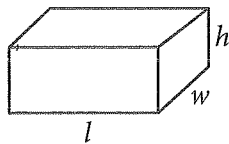
$$A = \frac{1}{2}bh$$



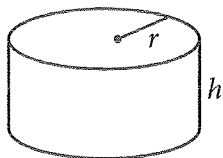
$$c^2 = a^2 + b^2$$



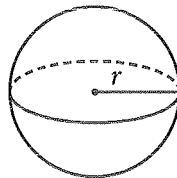
Special Right Triangles



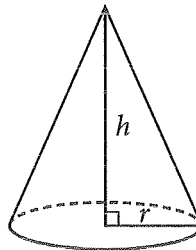
$$V = lwh$$



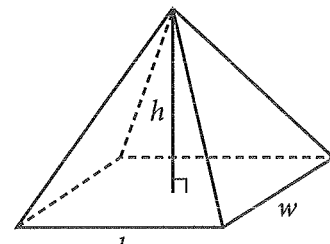
$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$




$$V = \frac{1}{3}lwh$$

The sum of the degree measures of the angles in a triangle is 180.

The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is  $2\pi$ .

GO ON TO THE NEXT PAGE 



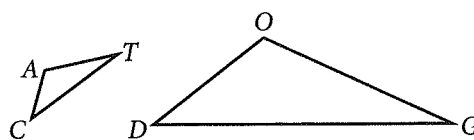
$$a = \frac{b-3}{c}$$

1. In a certain board game, where playing involves a specific number of cards and a specific number of players, three cards are removed from the deck and kept in an envelope, while the rest of the cards are distributed equally among the players. The scenario can be represented by the equation given above. What does the variable  $c$  represent in this scenario?

- A) The number of players
- B) The number of cards left over
- C) The number of cards in the deck
- D) The number of cards dealt to each player

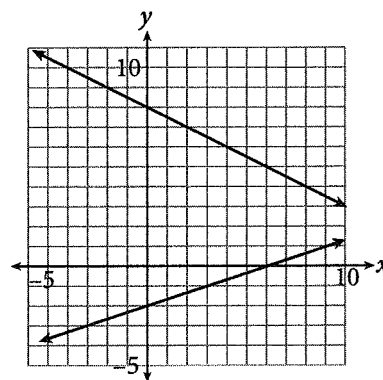
2. A hospital hosts an annual charity drive in which volunteers sell first aid kits to raise money for the pediatric ward. The hospital ordered too many kits last year, so it already has some to start this year's drive with. The project manager estimates, based on last year's sales, that the hospital needs to order an additional 50 boxes of kits. The function  $k(b) = 12b + 32$ , where  $b$  is the number of boxes ordered, represents the number of kits the hospital will have after the order arrives. When the project manager places the order, she is told that the company has changed the number of kits per box to 8. How many more boxes will she need to order to end up with the same number of kits that she had originally planned for?

- A) 25
- B) 32
- C) 75
- D) 200



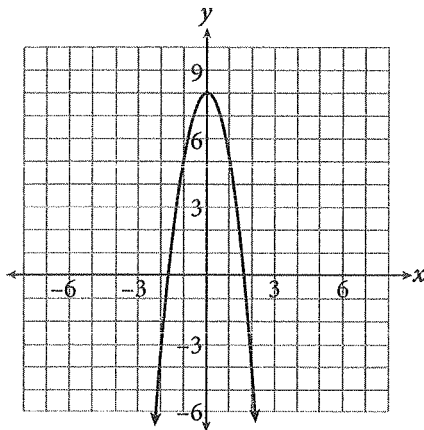
Note: Figure not drawn to scale.

3. If  $\triangle CAT$  shown above is similar to  $\triangle DOG$ , and the ratio of the length of  $\overline{TC}$  to  $\overline{GD}$  is 2:7, which of the following ratios must also be equal to 2:7?
- A)  $\overline{CA}:\overline{DG}$
  - B)  $m\angle C : m\angle D$
  - C) area of  $\triangle CAT$ :area of  $\triangle DOG$
  - D) perimeter of  $\triangle CAT$ :perimeter of  $\triangle DOG$
4. Which of the following expressions is equivalent to  $\sqrt{16x^9y^6}$ ?
- A)  $4x^2y^3$
  - B)  $4x^3y^2$
  - C)  $4xy\sqrt{xy}$
  - D)  $4x^4y^3\sqrt{x}$



5. What is the solution to the system of equations shown in the graph?
- A) (11, 1.5)
  - B) (12, 2)
  - C) (13, 2.5)
  - D) (14, 2.75)

6. The value of  $7x^2 + 3$  is how much more than the value of  $7x^2 - 9$ ?
- A) 6  
 B) 12  
 C)  $7x^2 - 6$   
 D)  $7x^2 + 12$

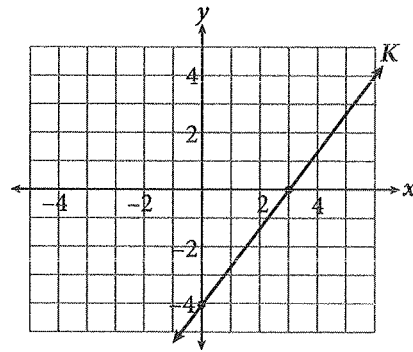


7. Vadim graphs the equation  $y = -3x^2 + 8$ , which is shown in the figure above. He realizes, however, that he miscalculated and should have graphed  $y = -\frac{1}{3}x^2 + 8$ . How will this affect his graph?
- A) It will change the  $y$ -intercept.  
 B) It will make the parabola open in the opposite direction.  
 C) It will make the parabola cross the  $x$ -axis closer to the origin.  
 D) It will make the parabola cross the  $x$ -axis farther from the origin.

8. Which value of  $x$  makes the equation  $\frac{9}{4}\left(x - \frac{7}{3}\right) = 5$  true?
- A)  $-\frac{1}{9}$   
 B)  $\frac{41}{9}$   
 C)  $\frac{163}{12}$   
 D)  $\frac{67}{3}$

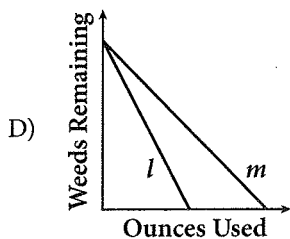
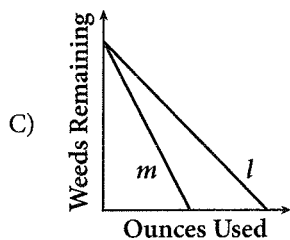
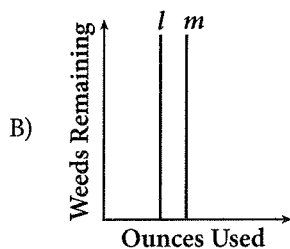
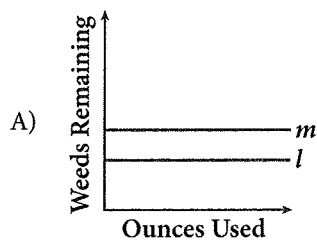
9. An egg farmer packs his eggs in standard 12-hole cartons and then packs the cartons in large shipping boxes. The number of boxes needed,  $b$ , to transport  $c$  cartons of eggs can be found using the function  $b(c) = \frac{c}{40}$ . If the carton-packing machine can pack a maximum of 4,000 cartons per day, and it does not pack partial boxes, what is the range of the function in this context?

- A) All integers from 0 to 100  
 B) All integers from 0 to 4,000  
 C) All integers greater than or equal to 40  
 D) All integers greater than or equal to 100



10. Where will the graph of  $y = \frac{4}{3}x + 8$  intersect line  $K$  shown above?
- A)  $(-3, 4)$   
 B)  $(9, 20)$   
 C) The graphs will never intersect.  
 D) It is not possible to determine where the graphs will intersect because the  $y$ -intercept of the given line does not fit on the coordinate plane.

11. Some herbicides are more effective at killing weeds than others, relative to the amount of the herbicide needed to produce results. Which graph could represent the effectiveness of a more-effective herbicide,  $m$ , and a less-effective herbicide,  $l$ ?

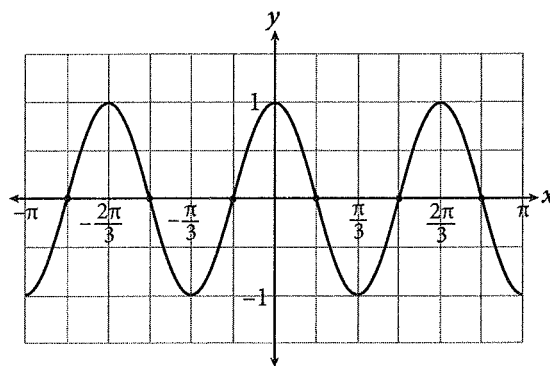


12. Which of the following values satisfies the inequalities  $t - \frac{3}{4} > \frac{3}{2}$  and  $\frac{t}{4} - \frac{1}{3} < \frac{5}{12}$ ?

- A) 1.75
- B) 2.25
- C) 2.75
- D) 3.25

13. If  $p(x)$  is a polynomial function that has a simple zero at  $x = 4$  and a double zero at  $x = -\frac{1}{3}$ , which of the following could be the factored form of  $p(x)$ ?

- A)  $p(x) = (x - 4)(x + 3)^2$
- B)  $p(x) = (x - 4)(3x + 1)^2$
- C)  $p(x) = 2(x - 4)(x + 3)$
- D)  $p(x) = 2(x - 4)(3x + 1)$



14. The graph of  $g(x) = \cos(3x)$  is shown above. Which of the following lists represents the values of  $x$  for which  $g(x) = 0$ ?

- A)  $-180^\circ, -120^\circ, -60^\circ, 60^\circ, 120^\circ, 180^\circ$
- B)  $-165^\circ, -105^\circ, -45^\circ, 45^\circ, 105^\circ, 165^\circ$
- C)  $-150^\circ, -90^\circ, -30^\circ, 30^\circ, 90^\circ, 120^\circ$
- D)  $-120^\circ, -80^\circ, -40^\circ, 40^\circ, 80^\circ, 120^\circ$

15. Water from rivers and streams is often unsafe to drink because of sediments and contaminants. One primitive way that water has been filtered in the past (and is still occasionally employed by avid campers and survivalists) is to use a charcoal filter, through which the water is allowed to trickle. Suppose three campers make three charcoal filters. The first two campers make their filters using water bottles, each of which can filter enough water for all three campers in 8 hours. The third filter is made from a two-liter soda bottle and can filter the same amount of water in 4 hours. How long will it take the three filters working together to filter enough water for all three campers?
- A)  $\frac{1}{2}$  hour  
B) 1 hour  
C)  $1\frac{1}{2}$  hours  
D) 2 hours

**Directions:** For questions 16-20, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
4. Some problems may have more than one correct answer. In such cases, grid only one answer.
5. **Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $\frac{7}{2}$ .

(If  $3\frac{1}{2}$  is entered into the grid as 

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)

6. **Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Answer:  $\frac{7}{12}$

Write answer in boxes. →

7	/	1	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
<input type="radio"/>	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Grid in result. →

Answer: 2.5

2	.	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

← Decimal point

Answer: 201  
Either position is correct.

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1
2	2	2
3	3	3
4	4	4

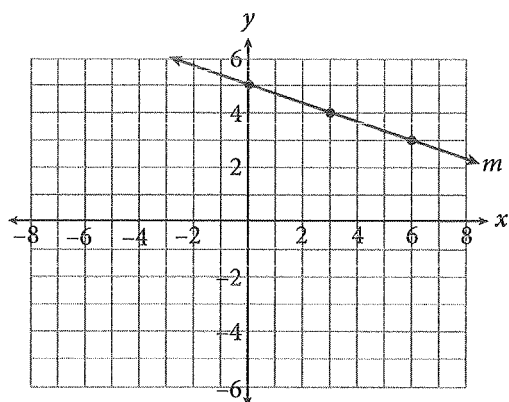
2	0	1	
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4

Acceptable ways to grid  $\frac{2}{3}$  are:

2	/	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6

.	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

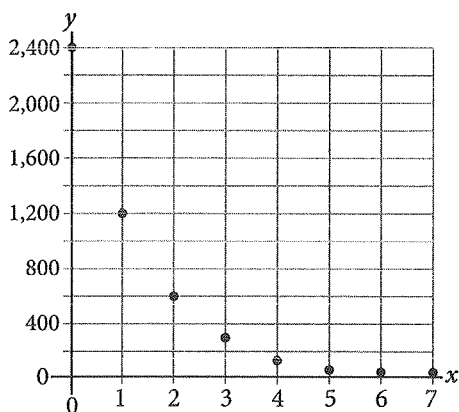
.	6	6	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6



16. If line  $m$  shown above is reflected over the  $x$ -axis, what is the slope of the new line?

$$0 \leq \frac{1-k}{2} < \frac{7}{8}$$

17. If  $k$  lies within the solution set of the inequality shown above, what is the maximum possible value of  $k$ ?



18. If an exponential function of the form  $h(x) = a(b)^x$  is used to model the data shown in the graph above, what is the value of  $b$ ?

19. What is the value of the complex number  $\frac{1}{4}i^{42} + i^{60}$ ?

20. In medicine, when a drug is administered in pill form, it takes time for the concentration in the bloodstream to build up, particularly for pain medications. Suppose for a certain pain medication, the function  $C(t) = \frac{1.5t}{t^2 + 4}$  is used to model the concentration, where  $t$  is the time in hours after the patient takes the pill. For this particular medication, the concentration reaches a maximum level of 0.375 about two hours after it is administered and then begins to decrease. If the patient isn't allowed to eat or drink until the concentration drops back down to 0.3, how many hours after taking the pill must the patient wait before eating or drinking?

# MATH TEST

55 Minutes—38 Questions

## CALCULATOR SECTION

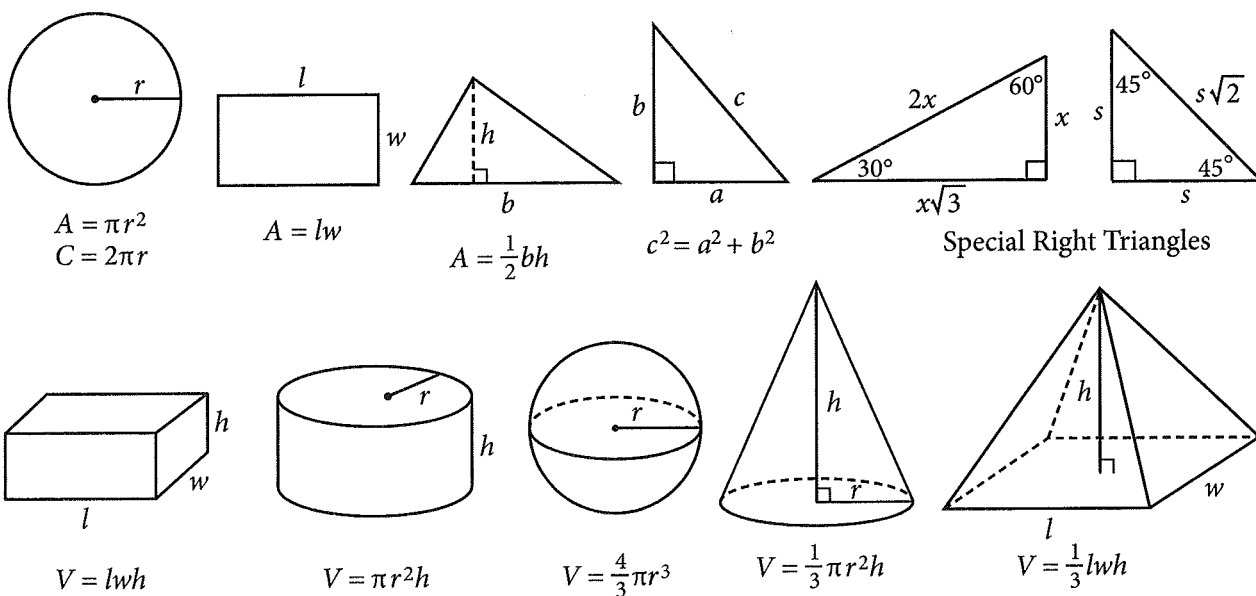
Turn to Section 4 of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding oval on the answer sheet. You may use any available space for scratch work.

Notes:

1. Calculator use is permitted.
2. All numbers used are real numbers.
3. All figures used are necessary to solving the problems that they accompany. All figures are drawn to scale EXCEPT when it is stated that a specific figure is not drawn to scale.
4. Unless stated otherwise, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$ , for which  $f(x)$  is a real number.

Information:



The sum of the degree measures of the angles in a triangle is 180.

The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is  $2\pi$ .

GO ON TO THE NEXT PAGE 

Rating Score	1	2	3	4	5
Frequency	0	4	6	8	2

1. In a market where approximately 44% of all book purchases are made online, customer reviews are extremely important from a sales and marketing perspective. Early reviews are most important, as they help or hinder a book's momentum in the marketplace. The frequency table shown above gives the first 20 customer ratings for a certain book sold online. What is the mean rating for this book?
- A) 3  
B) 3.4  
C) 3.7  
D) 4
2. Hardwood trees take much longer to grow than softwood trees. Once harvested, however, hardwood is much stronger and more durable. Because of its higher density, a piece of hardwood that is the same size as a piece of softwood weighs considerably more. A lumberyard ships both kinds of wood to home improvement stores. The cost  $C$ , in dollars, to ship a pallet of wood weighing  $p$  pounds can be found using the equation  $C = 6.5p + 16$ . What is the cost difference to ship a pallet of hardwood weighing 170 pounds versus a pallet of softwood weighing 80 pounds?
- A) \$90  
B) \$325  
C) \$585  
D) \$715
3. The First Transcontinental Railroad, which was 1,907 miles long, was completed in 1869 to connect the West Coast of the United States to the existing rail system that ran from the Missouri River to the East Coast. During the early years after building the railroad, dangerous conditions and mechanical problems could delay the train significantly. For a person traveling from one end of the First Transcontinental Railroad to the other, which inequality represents all possible values of  $t$ , where  $t$  is the time it took to complete the journey, if the train traveled at an average speed of  $m$  miles per hour?
- A)  $t \leq \frac{m}{1,907}$   
B)  $t \leq \frac{1,907}{m}$   
C)  $t \leq 1,907m$   
D)  $t \leq 1,907 + m$

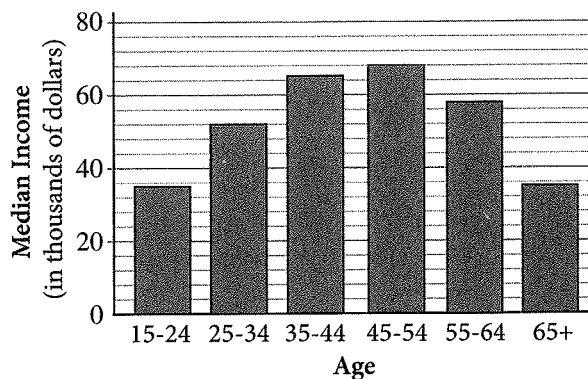
$$\frac{3x+7}{x-2} = 16$$

4. Which value of  $x$  satisfies the equation given above?
- A)  $\frac{9}{19}$   
B)  $\frac{9}{13}$   
C) 2  
D) 3

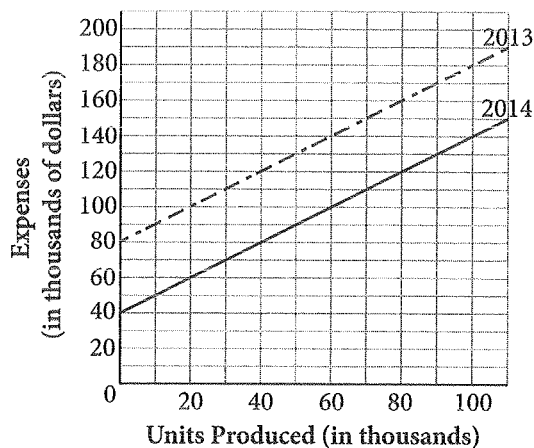


	Bargain	High-End
Price (per sq. ft)	\$1.89	\$5.49
Rating	2.8	8.2
Life Expectancy	5 years	

5. The table above shows the price per square foot, the average customer rating (out of 10), and the life expectancy (before needing replacement) of the bargain version and the high-end version of carpet at a flooring warehouse. If the ratio of the life expectancies is roughly the same as the ratios of the prices and the ratings, about how many years can the high-end carpet be expected to last?
- A) 10  
 B) 12  
 C) 15  
 D) 18



6. The bar graph shows median household incomes in a certain geographic region according to the age of the highest earner in the household. When presenting the data, the researcher decides to exclude the first age bracket (15-24), because it includes minors, which will likely skew the results because most minors do not have full-time jobs. The researcher also decides to exclude the last age bracket (65+) because it includes retirees, which is again likely to skew the results for the same reason. Which of the following statements most likely describes how this will affect the data overall?
- A) It will significantly change the median, but not the mean.  
 B) It will significantly change the mean, but not the median.  
 C) It will significantly change both the mean and the median.  
 D) There will be no significant change to either the mean or the median.
7. If the graph of  $y = mx + b$  passes through quadrants I, III, and IV on a coordinate plane, which of the following must be true about  $m$  and  $b$ ?
- A)  $m < 0, b < 0$   
 B)  $m < 0, b > 0$   
 C)  $m > 0, b < 0$   
 D)  $m > 0, b > 0$

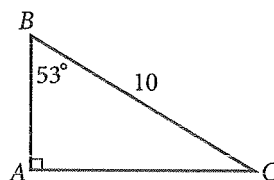


8. Manufacturing companies typically have a number of fixed costs (such as rent, machinery, insurance, etc.), which do not depend on output, and variable costs (such as wages, utilities, materials, etc.), which vary with output, usually at a constant rate. The graph shows a company's costs for manufacturing a particular product over the course of two years. Which of the following could explain the difference between the 2013 and 2014 costs?
- A) The company reduced its fixed costs by 50%.
- B) The company reduced its variable costs by 50%.
- C) The company reduced the number of units produced by 50%.
- D) The company reduced its fixed costs, variable costs, and the number of units produced by 50%.

$$\begin{cases} y = \frac{1}{4}x - 3 \\ y = -\frac{5}{2}x + 8 \end{cases}$$

9. Which of the following is the  $y$ -coordinate of the solution to the system of equations given above?
- A) -8
- B) -2
- C) 2
- D) 4

10. Premature babies are typically born underweight and are cared for in a neonatal intensive care unit (NICU). At a certain NICU, the mean weight of all the male babies is 4 pounds, and the mean weight of all the female babies is 3.6 pounds. Which of the following must be true about the mean weight  $w$  of the combined group of male and female babies at this NICU?
- A)  $w = 3.8$
- B)  $w > 3.8$
- C)  $w < 3.8$
- D)  $3.6 < w < 4$



11. Based on the figure above, what is the approximate length of side  $AB$ ?
- A) 6
- B) 7.2
- C) 8
- D) 8.5
12. When most people buy a house, they take out a mortgage to cover at least part of the cost of the home and then pay the loan back over time. The most common kind of mortgage is a 30-year loan. A couple buys a home and takes out a 30-year loan in the amount of \$220,000 (called the principal). They decide they want to pay it off early to save money on interest. They set a goal of reducing the principal amount of the loan to \$170,000 in four years. Suppose during the first two years of their four-year timeline, the couple pays down the loan by 10%. By what percent do they need to pay down the rest of the loan to reach their overall goal?
- A) 10%
- B) 14%
- C) 18%
- D) 20%

$x$	1	2	3	4	5	6
$f(x)$	3.5	0	-2.5	-4	-4.5	-4

13. The table above shows several points through which the graph of a quadratic function  $f(x)$  passes. One of the  $x$ -intercepts for the graph is given in the table. What is the other  $x$ -intercept for the graph?
- A)  $(-2, 0)$   
 B)  $(5, 0)$   
 C)  $(8, 0)$   
 D)  $(10, 0)$

**Questions 14 and 15 refer to the following information.**

A college cafeteria received a petition from students to offer healthier meat, vegetarian, and vegan dishes. In response to the petition, the cafeteria conducted an analysis of its existing menu to determine the current state of those options. The results are summarized in the table below. The analyst used a sliding scale based on the nutrient levels compared against calorie, sugar, and sodium counts to determine the health score, a score of 1 being the least healthy and 5 being the healthiest.

Health Score	Meat Dishes	Vegetarian Dishes	Vegan Dishes
1	3	1	1
2	4	3	1
3	8	5	4
4	5	4	2
5	0	1	0

14. What fraction of the vegetarian and vegan dishes has a health score of 3 or higher?
- A)  $\frac{1}{4}$   
 B)  $\frac{8}{21}$   
 C)  $\frac{8}{11}$   
 D)  $\frac{11}{21}$
15. If a student chooses a dish at random for lunch one day, what is the probability that it will be a meat dish with a health score of at least 4?
- A)  $\frac{5}{42}$   
 B)  $\frac{5}{22}$   
 C)  $\frac{1}{4}$   
 D)  $\frac{13}{42}$

$$r = \sqrt[4]{\frac{8kl}{\pi R}}$$

16. Ideally, blood should flow smoothly through the arteries in our bodies. When there are problems, or as a natural part of aging, there is an increased amount of resistance to blood flow. *Viscosity* is a term used to describe the thickness or stickiness of the blood and is directly related to this resistance, as are the radius and the length of the artery through which the blood flows. The formula given above relates the radius ( $r$ ) of an artery to the viscosity ( $k$ ), resistance ( $R$ ), and length ( $l$ ) of that artery. Which of the following represents the viscosity in terms of the other variables?

A)  $k = \frac{r^4 \pi R}{8l}$

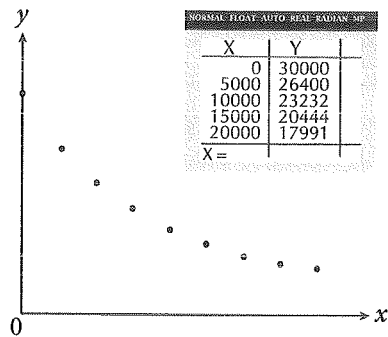
B)  $k = \sqrt[4]{\frac{8l}{\pi R r}}$

C)  $k = \frac{1}{2} r \pi R l$

D)  $k = \left( \frac{8l}{\pi R r} \right)^4$

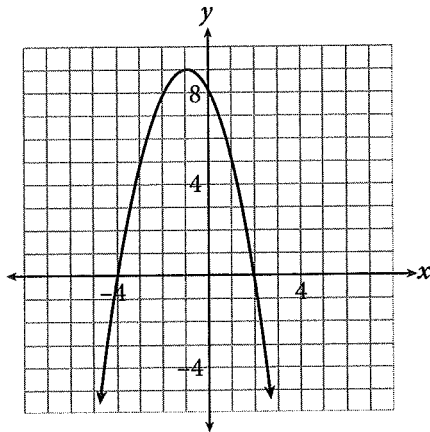
17. Two muffins and a carton of milk cost \$3.35. If five muffins and a carton of milk cost \$5.60, what is the cost of two cartons of milk?

- A) \$0.75  
 B) \$1.50  
 C) \$1.85  
 D) \$3.70

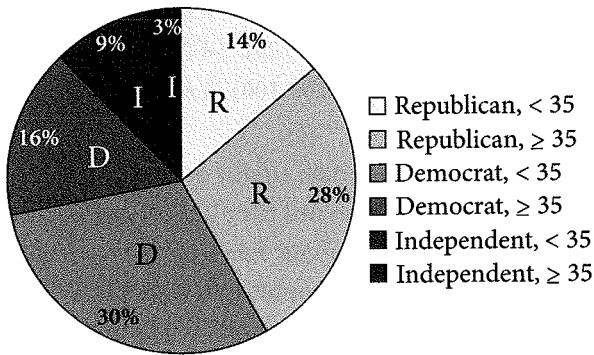


18. The calculator screenshot above shows the  $x$ - and  $y$ -values for the first few data points shown in the scatterplot, which can be modeled using an exponential function. Which of the following scenarios could be represented by this function?

- A) The resale value of a car is cut in half for every 3,600 miles driven.  
 B) The resale value of a car decreases by \$5,000 for every 3,600 miles driven.  
 C) The resale value of a car decreases by \$3,600 for every 5,000 miles driven.  
 D) The resale value of a car decreases by approximately 12% for every 5,000 miles driven.

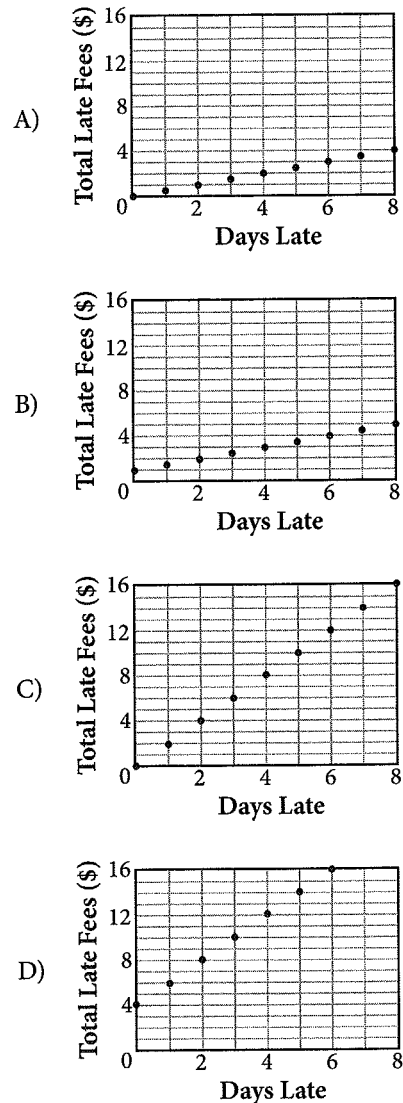


19. The graph of the function  $f(x) = -x^2 - 2x + 8$  is shown in the figure above. For what values of  $x$  does  $f(x) = 5$ ?
- A) -4 and 2
  - B) -3 and 1
  - C) -1 and 9
  - D) 5 and 8



20. The pie chart above shows the distribution of registered voters in a certain district in Illinois by party and by age. If there are 8,640 voters in the district, what is the ratio of Republicans to Independents?
- A) 3:1
  - B) 7:2
  - C) 22:3
  - D) 23:6

21. A DVD rental kiosk dispenses movies for \$1 for a 24-hour rental. After the initial rental period has expired, customers are charged a \$0.50 late fee for every 24 hours that the movie is returned late. If a customer rents four movies at one time, which of the following graphs represents the total possible charges in late fees, assuming he returns all the movies together?



22. There are many ways to defrost a turkey. One way is to let it thaw slowly in the refrigerator, at a thaw rate of about 4 pounds per day. Another way is to submerge the turkey in cold water, which thaws it at a rate of 1 pound per 30 minutes. Approximately how many more ounces of turkey can the cold-water method thaw in 2 hours than the refrigerator method? (1 pound = 16 ounces)
- A) 16  
B) 27  
C) 32  
D) 59
23. A freight train operator knows that on a 200-mile trip, if the freight cars are not fully loaded, she can save 1 hour of travel time by increasing her normal speed by 10 miles per hour. What is her normal speed in miles per hour?
- A) 40  
B) 45  
C) 55  
D) 60
24. A cable company offers movie rental packages. If you join the Movie Fan club, you get 10 movies for \$20 and each movie after that costs \$2.50. If you join the Movie Super Fan club, you get unlimited movies for a year for \$75. How many movies would a person need to rent for each package to cost the same amount over a one-year period?
- A) 22  
B) 30  
C) 32  
D) 57
25. Many wholesale businesses charge customers less per item when they buy those items in bulk. Suppose a baseball cap distributor charges \$6 per cap for the first 25 caps the customer purchases, \$5 per cap for the next 75 purchased, and \$4 per cap for all additional caps over 100. Which of the following piecewise functions represents this scenario, where  $C$  represents the total cost and  $n$  represents the number of caps purchased?
- A)  $C(n) = \begin{cases} 6n, & \text{if } n \leq 25 \\ 5n, & \text{if } 25 < n \leq 100 \\ 4n, & \text{if } n > 100 \end{cases}$
- B)  $C(n) = \begin{cases} 6n, & \text{if } n < 25 \\ 5n, & \text{if } 25 \leq n < 100 \\ 4n, & \text{if } n \geq 100 \end{cases}$
- C)  $C(n) = \begin{cases} 6n, & \text{if } n \leq 25 \\ 150 + 5(n - 25), & \text{if } 25 < n \leq 100 \\ 500 + 4(n - 100), & \text{if } n > 100 \end{cases}$
- D)  $C(n) = \begin{cases} 6n, & \text{if } n \leq 25 \\ 150 + 5(n - 25), & \text{if } 25 < n \leq 100 \\ 525 + 4(n - 100), & \text{if } n > 100 \end{cases}$
26. The decline of a certain animal species' population, currently estimated to be 22,000, can be modeled by the quadratic function  $p(x) = -0.5x^2 + 22,000$ , where  $x$  is the number of years after 2015. Based on only this information, and assuming no intervention to change the path of the population, which of the following statements must be true?
- A) This species will be extinct by the end of the year 2225.
- B) The animal population for this species is decreasing at a constant rate.
- C) In approximately 100 years, the animal population for this species will be about half what it was in 2015.
- D) The animal population will increase or decrease from the initial 2015 level, depending on the year after 2015.

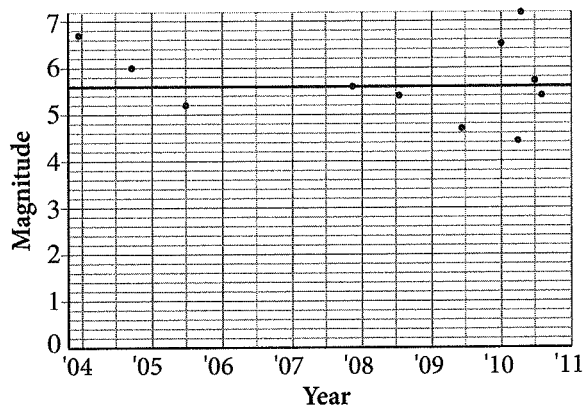
27. In geology, the water table is the level below which the ground is saturated with water. Wells must be dug below this point to bring water up into the well. Except in cases of severe flooding, the water level in a well does not rise above the water table. Suppose a cylindrical well is 6 feet wide and 60 feet deep in an area where the water table is 40 feet below ground level. Assuming no unusual circumstances, what is the volume in cubic feet of the water in the well at any given time?

- A)  $180\pi$
- B)  $360\pi$
- C)  $540\pi$
- D)  $720\pi$

28. Ramon graphed a line that has a slope of  $-2$ . The line he graphed passes through the point  $(3, 5)$ . If Ramon doubles the slope of his line and then shifts it down 1 unit, through which point will the line pass?

- A)  $(3, -2)$
- B)  $(3, 9)$
- C)  $(6, 4)$
- D)  $(10, 2)$

**California Earthquakes, 2003-2010**



29. Earthquakes occur when energy is released from deep inside the earth, causing friction between the tectonic plates of the earth's crust. The magnitude, or intensity, of the earthquake is measured on the Richter scale. The scatterplot above shows the earthquakes experienced by California between December 2003 and December 2010. The line of best fit, which has a slope of 0, is a fairly good indicator in California. Approximately what percent of the earthquakes in California during this time period differed by 1 point or more on the Richter scale from the magnitude predicted by the line of best fit?

- A) 22%
- B) 27%
- C) 33%
- D) 36%

30. If the equation  $\frac{2}{9}x^2 + \frac{8}{3}x - 7 = 3$  has solutions  $x_1$  and  $x_2$ , what is the product of  $x_1$  and  $x_2$ ?

- A)  $-45$
- B)  $-15$
- C)  $-5$
- D)  $3$

**Directions:** For questions 31-38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $\frac{7}{2}$ .

(If  $3\frac{1}{2}$  is entered into the grid as 

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)

- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Answer:  $\frac{7}{12}$

Write answer in boxes. →

7	/	1	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Grid in result. →

Answer: 2.5

2	.	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

← Decimal point

Answer: 201  
Either position is correct.

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

Acceptable ways to grid  $\frac{2}{3}$  are:

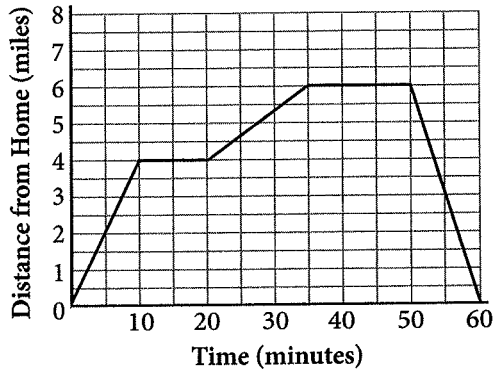
2	/	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6

.	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

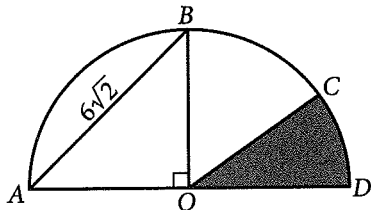
.	6	6	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6



31. If  $-10 < 14 - 2p < 6$ , what is the greatest possible integer value of  $7 - p$ ?

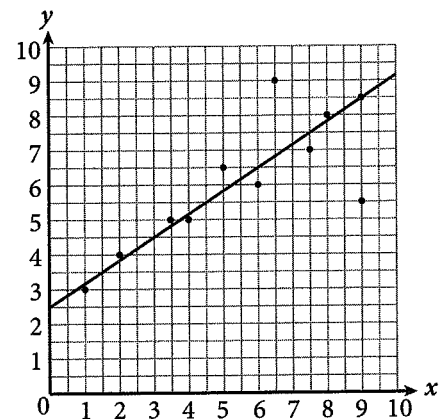


32. The graph above shows Umberto's distance from home over a one-hour period, during which time he first went to the bank, then went to the post office, and then returned home. How many minutes did Umberto spend at the bank and at the post office combined?
33. Selena is taking a 90-minute test that consists of 50 multiple-choice questions and 30 true-false questions. If she completes 48 questions in 50 minutes, how many seconds per question does she have on average to answer each of the remaining questions?



34. If  $\overline{AD}$  is a diameter of the circle shown above, and the arc length of  $CD$  is  $\pi$ , what is the area of the shaded region? Use 3.14 to approximate  $\pi$  and round your answer to the nearest tenth.

35. A bag valve mask is used to resuscitate patients who have stopped breathing. It consists primarily of a bag attached to a mask. The mask is fitted to the patient's nose and mouth. Squeezing the bag pushes air through the mask and into the patient's lungs. For sanitary reasons, most of these masks are disposable. Suppose a hospital's mask supplier sells them in boxes of 48 or 144, and the supplier has 35 boxes in stock. If the supplier has 2,832 total masks in stock, how many masks would the hospital receive if it ordered all of the boxes of 144 that the supplier has in stock?

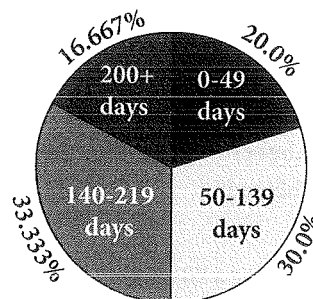


36. Patricia collected data for a school project, plotted the information on a scatterplot (shown above), and drew the line of best fit. In reviewing her notes, she realized that one of her data points was wrong, so she eliminated that point and redrew the line of best fit. If the new  $y$ -intercept of her line is 2 and the slope is steeper than before, what was the  $y$ -value of the point she eliminated?

**Questions 37 and 38 refer to the following information.**

A company sponsors a health program for its employees by partnering with a local gym. If employees pay for a yearlong membership at this gym, then for every day the employee uses his or her swipe card to enter the gym (and work out), the company reimburses the employee 0.2% of the cost of the \$220 membership. Additionally, any employee who goes to the gym more than 60% of the days in the year gets one bonus paid day off of work. The company uses a 365-day year.

37. If 246 employees participate in the program and they each go to the gym an average of 84 days per year, how much money in membership reimbursements will the company pay out? Round your answer to the nearest whole dollar.
38. Giving employees additional paid time off also costs the company money because it is paying the salary of an employee who is not actually doing any work on that day. The pie graph below shows gym usage for the 246 employees who participated in the health program.



If the average salary of workers who participated was \$14.90 per hour and one day off equals 8 hours, how much did the health program day-off benefit cost the company? Round your answer to the nearest whole dollar.

**ANSWER KEY****READING TEST**

1. B	14. A	27. C	40. D
2. A	15. B	28. A	41. D
3. D	16. A	29. B	42. B
4. B	17. C	30. A	43. A
5. D	18. D	31. D	44. D
6. B	19. B	32. A	45. C
7. D	20. A	33. C	46. B
8. A	21. C	34. B	47. A
9. C	22. B	35. C	48. B
10. C	23. C	36. D	49. D
11. A	24. B	37. A	50. D
12. C	25. A	38. B	51. C
13. B	26. C	39. D	52. A

**WRITING AND LANGUAGE TEST**

1. D	12. A	23. B	34. B
2. B	13. D	24. A	35. A
3. C	14. B	25. C	36. B
4. C	15. C	26. D	37. C
5. B	16. A	27. B	38. A
6. D	17. D	28. C	39. D
7. D	18. C	29. B	40. B
8. B	19. D	30. A	41. C
9. C	20. B	31. B	42. D
10. C	21. D	32. A	43. B
11. A	22. B	33. D	44. A

**MATH—NO CALCULATOR**

1. A	6. B	11. C	16. $\frac{1}{3}$ or .333
2. A	7. D	12. C	17. 1
3. D	8. B	13. B	18. $\frac{1}{2}$ or .5
4. D	9. A	14. C	19. $\frac{3}{4}$ or .75
5. B	10. C	15. D	20. 4

**MATH—CALCULATOR**

1. B	11. A	21. C	31. 2
2. C	12. B	22. D	32. 25
3. B	13. C	23. A	33. 75
4. D	14. C	24. C	34. 9.4
5. C	15. A	25. D	35. 1728
6. D	16. A	26. A	36. 5.5
7. C	17. D	27. A	37. 9092
8. A	18. D	28. A	38. 4887
9. B	19. B	29. B	
10. D	20. B	30. A	

## MATH TEST: NO-CALCULATOR SECTION

1. A

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Think about the words in the scenario and the operations they describe.

**Getting to the Answer:** In the scenario, there are a specified number of cards in the deck, from which 3 are removed, or subtracted. This means  $b$  must represent the initial number of cards in the deck, from which the remaining cards ( $b - 3$ ) are distributed, or divided, equally among the players. This means  $c$  must represent the number of players among whom the cards are divided, making (A) correct. Although it is not asked for in the question, the result of performing all the operations ( $a$ ) represents the number of cards each player receives.

2. A

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Start by determining what each part of the function given represents.

**Getting to the Answer:** The function represents the number of kits the hospital will have, so  $k(b)$  is the total number of kits. The question tells you that  $b$  is the number of boxes ordered, which you also know to be 50. Because  $b$  is multiplied by 12, this must be the number of kits per box. Finally, 32 is simply added to the equation, which must mean it represents the kits left over from last year's charity drive. Now, look at the question. It states that the company has changed the number of kits per box to 8. Evaluate the original function at  $b = 50$  to see how many kits the hospital would have had:  $k(50) = 12(50) + 32 = 632$ .

Now, substitute this for  $k(b)$  in the new function, replacing the 12 with the 8, and solve for  $b$ :

$$632 = 8b + 32$$

$$600 = 8b$$

$$75 = b$$

Be careful—this is not the answer. She needs to order  $75 - 50 = 25$  more boxes than she would have had to order at 12 kits per box.

3. D

**Difficulty:** Medium

**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** Corresponding sides of similar triangles are proportional, and corresponding angles are congruent.

**Getting to the Answer:** You can eliminate B immediately because corresponding angles of similar triangles are congruent, so they are always in a 1:1 ratio. You can also eliminate A because side  $CA$  does not correspond to side  $DG$  ( $CA$  corresponds to  $DO$ ), so you cannot say that they will be in the same ratio. Because the side lengths are proportional, when you add the lengths of all the side lengths (the perimeter), this number will be in the same proportion, so (D) is correct. You can check this by assigning numbers that are in the ratio 2:7 and finding the perimeter of each triangle:

$$TC = 2 \text{ and } GD = 7$$

$$CA = 4 \text{ and } DO = 14$$

$$AT = 6 \text{ and } OG = 21$$

$$\text{Perimeter of triangle } CAT = 2 + 4 + 6 = 12$$

$$\text{Perimeter of triangle } DOG = 7 + 14 + 21 = 42$$

$$12:42 = 2:7$$

4. D

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Whenever simplifying a square root, look for the largest perfect square of each factor. Bring the square root of the perfect squares outside the radical.

**Getting to the Answer:**

$$\begin{aligned} & \sqrt{16x^9y^6} \\ &= \sqrt{(4)^2 \cdot (x^4)^2 \cdot x \cdot (y^3)^2} \\ &= 4x^4y^3\sqrt{x} \end{aligned}$$

**5. B**

**Difficulty:** Medium

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Don't try to extend the graphs in a question like this. The answers are very close together, and it would be easy to make a mistake. Instead, think algebraically—the solution to a system of equations is the ordered pair that satisfies both equations. Thus, you need to find the equation of each line and solve the system using substitution.

**Getting to the Answer:** Start with the top line. Its  $y$ -intercept is 8, and it falls 1 unit for every 2 units it runs, so its slope is  $-\frac{1}{2}$ , making the equation  $y = -\frac{1}{2}x + 8$ . The bottom line has a  $y$ -intercept of  $-2$ , and it rises 1 unit for every 3 units it runs, so its slope is  $\frac{1}{3}$ , making its equation  $y = \frac{1}{3}x - 2$ .

Set the two equations equal to one another. Multiply everything by the common denominator, 6, to clear the fractions. Then perform inverse operations to solve for  $x$ :

$$\begin{aligned} \frac{1}{3}x - 2 &= -\frac{1}{2}x + 8 \\ 2x - 12 &= -3x + 48 \\ 5x &= 60 \\ x &= 12 \end{aligned}$$

You do not need to substitute 12 for  $x$  and solve for  $y$  because there is only one answer with an  $x$ -coordinate of 12, which means (B) must be correct.

**6. B**

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** When you find the language confusing, try to put it in concrete terms. If you wanted to know how much more 8 was than 5, what would you do? You would subtract  $8 - 5 = 3$  more. So you need to subtract these two algebraic expressions.

**Getting to the Answer:** Don't forget to distribute the negative when simplifying the difference:

$$(7x^2 + 3) - (7x^2 - 9) = 7x^2 + 3 - 7x^2 + 9 = 12$$

**7. D**

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** Don't waste time trying to graph the second equation. Instead, think about the question conceptually. The magnitude of the coefficient of  $x^2$  (not the sign) determines how wide or narrow the graph is.

**Getting to the Answer:** Changing the coefficient of  $x^2$  from  $-3$  to  $-\frac{1}{3}$  will make the graph narrower or wider (in this case, wider), which means the only things that will change are the  $x$ -intercepts. This means you can eliminate A and B. To choose between C and (D), recall that fraction coefficients (between 0 and 1) result in wider graphs, so the  $x$ -intercepts will spread out and therefore be farther from the origin.

**8. B**

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** This question has multiple fractions, so start by clearing the  $\frac{9}{4}$  by multiplying both sides of the equation by its reciprocal,  $\frac{4}{9}$ .

**Getting to the Answer:** You might have to repeat this process to eliminate any remaining fractions.

$$\begin{aligned}\frac{9}{4}\left(x - \frac{7}{3}\right) &= 5 \\ \frac{4}{9}\left[\frac{9}{4}\left(x - \frac{7}{3}\right)\right] &= \frac{4}{9}(5) \\ x - \frac{7}{3} &= \frac{20}{9}\end{aligned}$$

There are still a couple of fractions in the equation, so multiply by the common denominator this time, which is 9.

$$\begin{aligned}9\left(x - \frac{7}{3}\right) &= 9\left(\frac{20}{9}\right) \\ 9x - 21 &= 20 \\ 9x &= 41 \\ x &= \frac{41}{9}\end{aligned}$$

9. A

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** The range of a function is the set of possible values of  $y$ , or output values.

**Getting to the Answer:** Think about the scenario—if  $c$  represents the maximum number of crates (which is 4,000), then the range can certainly never be greater than this, so eliminate C and D. Now you need to think about the meaning of *range*—range refers to  $y$ -values, not  $x$ -values, so substitute 4,000 for  $c$  (which represents  $x$  in this scenario) to find that the  $y$ -values must fall between 0 and 100. The range consists only of integers because the question states that the machine does not pack partial boxes.

10. C

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** You cannot graph the given equation on the grid, so find the equation of line  $K$  shown in the graph and go from there.

**Getting to the Answer:** Line  $K$  intersects the  $y$ -axis at  $-4$ . From there, it rises 4 units and runs 3 units to the next point, making its equation  $y = \frac{4}{3}x - 4$ .

Now, you could set this equation equal to the one in the question and solve for  $x$ , or you could recognize that the two lines have the same slope but different  $y$ -intercepts, which means they are parallel lines and will never intersect.

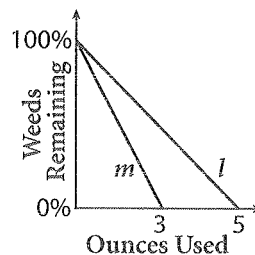
11. C

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Sometimes, the best way to answer a conceptual question, particularly one that involves graphs without number labels, is to add your own numbers to the graph. Then you can try to make sense of the axis labels and the numbers you added.

**Getting to the Answer:** Add reasonable numbers to each graph that make sense for that graph. (C) is correct because logically, a more-effective herbicide requires fewer ounces to eliminate all of the weeds. In the sample graph below, the more effective herbicide (which is  $m$ ) only takes 3 ounces to achieve 0% weeds remaining, while the less effective one (which is  $l$ ) takes 5 ounces to produce the same results.



12. C

**Difficulty:** Medium

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Although the answer choices are given in decimal form, don't convert the fractions in the inequalities to decimals—this will create very messy calculations.

**Getting to the Answer:** Solve each inequality for  $t$  by first clearing all the fractions.

$$\begin{array}{ll} \text{First inequality:} & \text{Second inequality:} \\ 4\left(t - \frac{3}{4}\right) > 4\left(\frac{3}{2}\right) & 12\left(\frac{t}{4} - \frac{1}{3}\right) < 12\left(\frac{5}{12}\right) \\ 4t - 3 > 6 & 3t - 4 < 5 \\ 4t > 9 & 3t < 9 \\ t > \frac{9}{4} & t < 3 \end{array}$$

Now, because the answer choices are given in decimal form, convert  $\frac{9}{4} = 2\frac{1}{4} = 2.25$ . The correct answer is greater (but not equal) to 2.25 and less than 3. The only answer that falls within this range is 2.75, making (C) correct.

### 13. B

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** A *double zero* occurs in a polynomial when a factor is repeated, or in other words, squared. For example, the factor  $(x - a)$  produces a simple zero at  $x = a$ , while  $(x - b)^2$  produces a double zero at  $x = b$ .

**Getting to the Answer:** The polynomial has a simple zero at  $x = 4$ , which corresponds to a factor of  $(x - 4)$ , and all of the answers include this factor. The double zero at  $x = -\frac{1}{3}$  results from a repeated (squared) factor, so you can eliminate C and D. To choose between A and (B), set each factor equal to 0 and then use inverse operations to solve for  $x$  (mentally if possible). The polynomial in A has zeroes at 4 and  $-3$  (not  $-\frac{1}{3}$ ), so you can eliminate A. Choice (B) is correct because it has a double zero when

$$\begin{aligned} 3x + 1 &= 0 \\ 3x &= -1 \\ x &= -\frac{1}{3} \end{aligned}$$

### 14. C

**Difficulty:** Hard

**Category:** Additional Topics in Math / Trigonometry

**Strategic Advice:** You don't need to know a lot of trig to answer this question. You will, however, need to know how to convert radians to degrees (multiply the radians by  $\frac{180^\circ}{\pi}$ ).

**Getting to the Answer:** Recall that  $g(x) = 0$  means "crosses the  $x$ -axis," regardless of the type of function involved, which means you are looking for the  $x$ -intercepts. Study the graph carefully: The function crosses the  $x$ -axis six times, halfway between each of the labeled grid-lines. Rather than finding the points using the radians given in the graph, convert the radians to degrees and then

determine the halfway points:  $-\pi\left(\frac{180^\circ}{\pi}\right) = -180^\circ$ ,

$\left(-\frac{2\pi}{3}\right)\left(\frac{180^\circ}{\pi}\right) = -120^\circ$ ,  $\left(-\frac{\pi}{3}\right)\left(\frac{180^\circ}{\pi}\right) = -60^\circ$ , and so

on. Take a minute now to find the halfway points because chances are that you don't have to do all the conversions. Halfway between  $-180^\circ$  and  $-120^\circ$  is  $-150^\circ$ . Stop—that's all you need to know. The leftmost  $x$ -intercept is at  $-150^\circ$ , which means (C) must be correct. If you want to check another value just to be sure, halfway between  $-120^\circ$  and  $-60^\circ$  is  $-90^\circ$ , which is the second value in (C), confirming that it is correct.

### 15. D

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Determine the rate at which each filter cleans the water supply. Then add them together to get the combined rate.

**Getting to the Answer:** You're told that either of the two water-bottle-sized filters can filter the whole supply in 8 hours. This means one of these filters works at a rate of  $\frac{1}{8}$  of the supply per hour. Likewise, the larger filter's rate is  $\frac{1}{4}$  of the supply per hour. Add them all together, set them equal to  $\frac{1}{t}$  (the rate for the entire task), and solve for  $t$ .



$$\begin{aligned} \frac{1}{8} + \frac{1}{8} + \frac{1}{4} &= \frac{1}{t} \\ t\left(\frac{1}{8} + \frac{1}{8} + \frac{1}{4}\right) &= t\left(\frac{1}{t}\right) \\ \frac{t}{8} + \frac{t}{8} + \frac{t}{4} &= 1 \\ \frac{2t}{8} + \frac{t}{4} &= 1 \\ \frac{2t}{8} + \frac{2t}{8} &= 1 \\ \frac{4t}{8} &= 1 \\ 4t &= 8 \\ t &= 2 \end{aligned}$$

Therefore, working together, it would take all three filters 2 hours to filter the entire water supply.

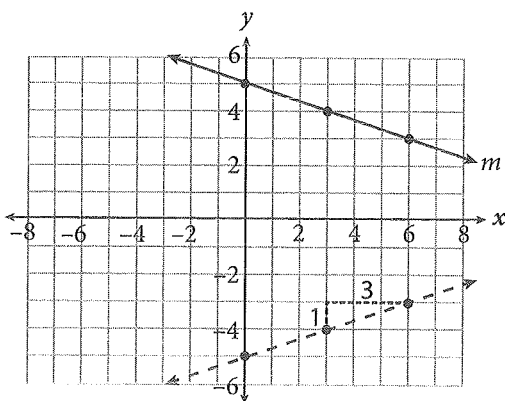
**16. 1/3 or .333**

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** When a grid is provided for you, take the time to draw a sketch on the grid.

**Getting to the Answer:** Sketch the reflection on the grid:



Use your sketch to count the vertical change and the horizontal change from one point to the next. Remember—slope is *rise over run*. The slope of the reflected line is  $\frac{1}{3}$ . Grid this in as 1/3 or .333.

**17. 1**

**Difficulty:** Medium

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Whenever expressions involve fractions, you can clear the fractions by multiplying each term in the expression by the least common denominator. Don't forget—when working with inequalities, if you multiply or divide by a negative number, you must flip the inequality symbol(s).

**Getting to the Answer:** The inequality in this question is a compound inequality, but you don't need to break it into parts. Just be sure that anything you do to one piece of the inequality, you do to all three pieces. Start by multiplying everything by 8 to clear the fractions.

$$\begin{aligned} 0 &\leq \frac{1-k}{2} < \frac{7}{8} \\ 8(0) &\leq 8\left(\frac{1-k}{2}\right) < 8\left(\frac{7}{8}\right) \\ 0 &\leq 4(1-k) < 7 \\ 0 &\leq 4 - 4k < 7 \\ -4 &\leq -4k < 3 \\ \frac{-4}{-4} &\geq \frac{-4k}{-4} > \frac{3}{-4} \\ 1 &\geq k > -\frac{3}{4} \end{aligned}$$

Turn the inequality around so the numbers are increasing from left to right:  $-\frac{3}{4} < k \leq 1$ . This tells you that  $k$  is less than or equal to 1, making 1 the maximum possible value of  $k$ .

**18. 1/2 or .5**

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Jot down the first few points and look for a pattern.

**Getting to the Answer:** The points are (0, 2,400), (1, 1,200), (2, 600), (3, 300), and so on. This means each  $y$ -value is half the previous value, so  $b$ , which is the decay rate, is  $\frac{1}{2}$ . Grid this in as 1/2 or .5.

**19. 3/4 or .75**

**Difficulty:** Hard

**Category:** Additional Topics in Math / Imaginary Numbers

**Strategic Advice:** To evaluate a high power of  $i$ , look for patterns and use the definition  $\sqrt{-1}=i$ , which can be written in a more useful form as  $i^2=-1$ .

**Getting to the Answer:** Write out enough powers of  $i$  that allow you to see the pattern:

$$i^1 = i$$

$$i^2 = -1 \text{ (definition)}$$

$$i^3 = i \times i^2 = i \times -1 = -i$$

$$i^4 = i^2 \times i^2 = -1 \times -1 = 1$$

$$i^5 = i^4 \times i = 1 \times i = i$$

$$i^6 = i^4 \times i^2 = 1 \times -1 = -1$$

$$i^7 = i^6 \times i = -1 \times i = -i$$

$$i^8 = i^4 \times i^4 = 1 \times 1 = 1$$

Notice that the pattern ( $i, -1, -i, 1, i, -1, -i, 1$ ) repeats on a cycle of 4. To evaluate  $i^{42}$ , divide 42 by 4. The result is 10, remainder 2, which means 10 full cycles, and then back to  $i^2$ . This means  $i^{42}$  is equivalent to  $i^2$ , which is  $-1$ . Do the same for  $i^{60}$ :  $60 \div 4 = 15$ , remainder 0, which means stop on the 4th cycle to find that  $i^{60} = 1$ . Make these substitutions in the original equation:

$$\frac{1}{4}i^{42} + i^{60} = \frac{1}{4}(-1) + 1 = -\frac{1}{4} + 1 = \frac{3}{4}$$

Grid in the answer as 3/4 or .75.

**20. 4**

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Sometimes in a real-world scenario, you need to think logically to get a mental picture of what is happening. Think about the concentration of the medicine—it starts at 0, increases to a maximum of 0.375, and then decreases again as it begins to wear off. This means the concentration is 0.3 two times—once before it hits the max and once after. In this case, you're looking for the second occurrence.

**Getting to the Answer:** Set the function equal to 0.3 and solve for  $t$ . Don't stress out about the decimals—as soon as you have the equation in some kind of standard form, you can move the decimals to get rid of them.

$$0.3 = \frac{1.5t}{t^2 + 4}$$

$$0.3(t^2 + 4) = 1.5t$$

$$0.3t^2 + 1.2 = 1.5t$$

To make the equation easier to work with, move the decimal one place to the right in each term. The result is a fairly nice quadratic equation. Move everything to the left side, factor out a 3, and go from there.

$$3t^2 + 12 = 15t$$

$$3t^2 - 15t + 12 = 0$$

$$3(t^2 - 5t + 4) = 0$$

$$3(t-1)(t-4) = 0$$

$$t = 1 \text{ and } t = 4$$

Don't forget, you're looking for the second occurrence of a 0.3 concentration (after the medicine has started to wear off), so the correct answer is 4 hours.

## MATH TEST: CALCULATOR SECTION

1. B

**Difficulty:** Easy

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** The mean rating means the average score given. To find the average, multiply each score by the number of times it occurs (the frequency). Then, add the results and divide by the total number of scores, 20.

**Getting to the Answer:** The sum of the ratings is  $(2 \times 4) + (3 \times 6) + (4 \times 8) + (5 \times 2) = 8 + 18 + 32 + 10 = 68$ .

Divide by the number of ratings to find that the mean is  $68 \div 20 = 3.4$ .

2. C

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** There is a lot of information in this question. Focus on the question in the last couple of sentences.

**Getting to the Answer:** Find the difference in the costs of shipping each type of wood by substituting the two values given for  $p$  and then subtracting.

$$C = 6.5p + 16$$

$$C(\text{hardwood}) = 6.5(170) + 16 = 1,121$$

$$C(\text{softwood}) = 6.5(80) + 16 = 536$$

$$\$1,121 - \$536 = \$585$$

3. B

**Difficulty:** Easy

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Use the formula Distance = rate  $\times$  time and solve for time. Then, substitute the value

given for distance, 1,907. Remember,  $m$  is the rate in this scenario.

**Getting to the Answer:** All of the inequality symbols are the same, so look for the inequality with the proper relationship among distance, rate, and time.

$$d = r \times t$$

$$\frac{d}{r} = t$$

$$t = \frac{1,907}{m}$$

Choice (B) is correct.

4. D

**Difficulty:** Easy

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Don't let this rational equation intimidate you. Rather than finding a common denominator, move the 16 to the other side of the equation, write it over 1, and use cross-multiplication. Don't forget to check that your solution doesn't cause the denominator to be 0. If it does, then it's an invalid solution.

**Getting to the Answer:** After moving the 16, cross-multiply and then solve for  $x$  using inverse operations.

$$\frac{3x+7}{x-2} - 16 = 0$$

$$\frac{3x+7}{x-2} = \frac{16}{1}$$

$$3x+7 = 16(x-2)$$

$$3x+7 = 16x-32$$

$$3x+39 = 16x$$

$$39 = 13x$$

$$3 = x$$

When substituted into the denominator of the original equation, 3 does not cause division by 0, so it is a valid solution.

**5. C****Difficulty:** Easy**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages**Strategic Advice:** Find the ratios of the first two categories and then apply either one to the third.**Getting to the Answer:** Write out the ratios of the prices and the ratings: 1.89 to 5.49 and 2.8 to 8.2.

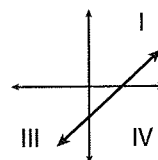
Set up a proportion with the life expectancy and either ratio. Let  $e$  be the unknown life expectancy of the high-end carpet.

$$\begin{aligned}\frac{1.89}{5.49} &= \frac{5}{e} \\ 1.89e &= 27.45 \\ e &= 14.52\end{aligned}$$

You can check your answer using the other ratio:

$$\begin{aligned}\frac{2.8}{8.2} &= \frac{5}{e} \\ 2.8e &= 41 \\ e &= 14.64\end{aligned}$$

The high-end carpeting can be expected to last about 15 years.

**6. D****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Statistics and Probability**Strategic Advice:** The mean is the average of the data, while the median is the midpoint. When the shape of the data is symmetric, the mean is approximately equal to the median.**Getting to the Answer:** The two age brackets that are being removed contain the same amount of data and are on opposite sides of the center of the data, so there will be no significant change to either the mean or the median.**7. C****Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations**Strategic Advice:** Draw a quick sketch of the line described and compare it to the answer choices. Don't forget, the quadrants start with I in the upper right corner and move counterclockwise.**Getting to the Answer:** A sample sketch follows:

Notice that the line is increasing, so the slope is positive ( $m > 0$ ). This means you can eliminate A and B. The line crosses the  $y$ -axis below the origin, so  $b$  is negative ( $b < 0$ ), which means (C) is correct.

**8. A****Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations**Strategic Advice:** This question is very conceptual. You need to understand what each part of the graph represents. The  $y$ -intercept represents the fixed costs, while the slope (the per-unit cost) represents the variable costs.**Getting to the Answer:** Compare the two lines. The second line (2014) has a lower  $y$ -intercept than the first (2013), which means the company reduced its fixed costs. You don't need to worry about the 50% because all the answer choices involve this same amount. You can eliminate B and C because they don't mention fixed costs. To determine whether the variable costs changed, look at the slopes. The lines are parallel, so the slope did not change, which means the variable costs did not change. Therefore, the company only reduced its fixed costs, and (A) is correct.

## 9. B

**Difficulty:** Medium

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** This system is set up perfectly to solve using substitution because both equations are already solved for  $y$ .

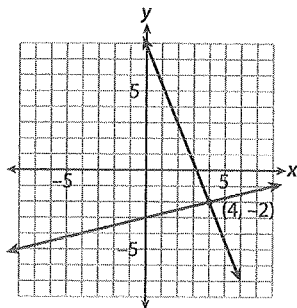
**Getting to the Answer:** Set both  $x$  expressions equal to one another and solve. Multiply the whole equation by 4 first, to get rid of the fractions.

$$\begin{aligned}\frac{1}{4}x - 3 &= -\frac{5}{2}x + 8 \\ 1x - 12 &= -10x + 32 \\ 11x &= 44 \\ x &= 4\end{aligned}$$

The question asks for the  $y$ -coordinate of the solution, so substitute 4 for  $x$  in either equation and solve for  $y$ .

$$\begin{aligned}y &= \frac{1}{4}(4) - 3 \\ y &= 1 - 3 \\ y &= -2\end{aligned}$$

As an alternate method, because the equations are already in slope-intercept form, you could graph both equations in your calculator and find the point of intersection, which is  $(4, -2)$ .



## 10. D

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** To calculate the combined mean weight, you would need to know how many male babies and how many female babies there are in their respective groups, which is not provided in the question.

**Getting to the Answer:** Because the mean weights are different and you do not know how many male or how many female babies there are in the NICU, you need to reason logically to arrive at the correct answer. The mean weight of the female babies is lower than that of the male babies, so the combined mean cannot be greater than or equal to that of the male babies. Similarly, the mean weight of the male babies is greater than that of the female babies, so the combined mean cannot be less than or equal to the mean weight of the female babies. In other words, the combined mean weight must fall somewhere between the two means, making (D) correct.

## 11. A

**Difficulty:** Medium

**Category:** Additional Topics in Math / Trigonometry

**Strategic Advice:**  $ABC$  is a right triangle. You know the length of one side and the measure of one of the acute angles, which means you can use SOH CAH TOA.

**Getting to the Answer:** You know the length of the hypotenuse (10) and you're looking for the length of the side adjacent to (touching) the  $53^\circ$  angle, so use cosine. Set up a trigonometric ratio and solve for the length of  $AB$ . Make sure your calculator is set to degree mode.

$$\begin{aligned}\cos(53^\circ) &= \frac{\text{adjacent}}{\text{hypotenuse}} \\ \cos(53^\circ) &= \frac{AB}{10} \\ 10(0.601815) &= AB \\ 6.01815 &= AB\end{aligned}$$

The length of  $AB$  is approximately 6.

**12. B****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages**Strategic Advice:** A question like this requires planning. Start by figuring out how much of the loan the couple has already paid down and how much they still have left to meet their goal.**Getting to the Answer:** If they have reduced the principal amount by 10%, they have paid the loan down to  $100 - 10 = 90\%$  of its original value. Use the formula  $\text{Percent} \times \text{whole} = \text{part}$  to get  $\$220,000 \times 0.9 = \$198,000$  remaining on the principal. So, after two years, the value of the loan is  $\$198,000$ , which means the couple still have  $\$198,000 - \$170,000 = \$28,000$  of the principal loan amount left to pay off to reach their goal. Now, determine what percent of the remaining whole this constitutes using the same formula again. The percent is unknown this time, so call it  $p$ :

$$p \times 198,000 = 28,000$$

$$p = 28,000 \div 198,000 = 0.1414 = 14.14\%$$

Therefore, the couple needs to pay down approximately 14% of the current principal amount to reach their goal.

**13. C****Difficulty:** Medium**Category:** Passport to Advanced Math / Quadratics**Strategic Advice:** This question is much simpler than it looks. Don't waste time trying to find the equation of the quadratic. Rather, think about properties of parabolas, in particular, symmetry.**Getting to the Answer:** The graph of a parabola is symmetric with respect to its axis of symmetry (the imaginary vertical line that passes through the  $x$ -coordinate of the vertex). This means that each  $x$ -intercept must be the same distance from the vertex. Take a careful look at the values in the table.The  $y$ -values start at 3.5, decrease to a minimum value of  $-4.5$ , and then turn around. The points on each side of the minimum have the same  $y$ -values ( $-4$ ), which means you've found the vertex,  $(5, -4.5)$ . The  $x$ -intercept given in the table is  $(2, 0)$ , which is 3 horizontal units to the left of 5. Therefore, the other  $x$ -intercept must be 3 horizontal units to the right of 5, which is  $(8, 0)$ .**14. C****Difficulty:** Easy**Category:** Problem Solving and Data Analysis / Statistics and Probability**Strategic Advice:** This question is all about reading the table carefully and identifying the pieces of information that you need.**Getting to the Answer:** The question asks about vegetarian and vegan dishes, so you are only concerned with those two columns. Find the total number of vegetarian and vegan dishes:  $1 + 3 + 5 + 4 + 1 + 1 + 1 + 4 + 2 + 0 = 22$ . The question wants to know which fraction of these dishes has a health score of 3 or higher, so now look at those 3 rows of the last 2 columns and add those amounts:  $5 + 4 + 1 + 4 + 2 + 0 = 16$ . Now, write a fraction that represents 16 out of 22 and reduce:  $\frac{16}{22} = \frac{8}{11}$ .**15. A****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Statistics and Probability**Strategic Advice:** Sometimes, rewording a probability question makes it clearer, particularly when there is a lot of information given in a table.**Getting to the Answer:** Reword the question: Find the probability that the student randomly chooses a dish that is both meat *and* has a health score of at least 4. This tells you that you are only interested in the combinations meat/4 and meat/5. The probability of randomly selecting one of these

two combinations is (number of meat/4 + number of meat/5) divided by (number of all dishes). Now read the table and do the math. To save a bit of time, recall that you already found the total number of vegetarian and vegan dishes (22) in the previous question, so all you need to do is add the meat dishes:

$$p = \frac{5+0}{3+4+8+5+22}$$

$$= \frac{5}{42}$$

**16. A****Difficulty:** Medium**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Don't worry too much about the scientific information. All you really need to know is that  $k$  is the viscosity, which means you're solving the equation for  $k$ .

**Getting to the Answer:** The inverse of taking a fourth root is raising to the fourth power, so start by raising both sides of the equation to the fourth power to remove the radical, and then go from there.

$$(r)^4 = \left( \sqrt[4]{\frac{8kl}{\pi R}} \right)^4$$

$$r^4 = \frac{8kl}{\pi R}$$

$$r^4 \pi R = 8kl$$

$$\frac{r^4 \pi R}{8l} = k$$

**17. D****Difficulty:** Medium**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Write a system of equations with  $m$  = the number of muffins and  $c$  = the number of cartons of milk. Before you choose your answer,

make sure you answered the right question (the cost of two cartons of milk).

**Getting to the Answer:** Translate from English into math to write the two equations: The first statement is translated as  $2m + c = \$3.35$  and the second as  $5m + c = \$5.60$ . The system is

$$\begin{cases} 2m + c = 3.35 \\ 5m + c = 5.60 \end{cases}$$

You could solve the system using substitution, but elimination is quicker in this question, because subtracting the second equation from the first eliminates  $c$ , and you can solve for  $m$ :

$$2m + c = 3.35$$

$$-(5m + c = 5.60)$$

$$-3m = -2.25$$

$$m = 0.75$$

Substitute this value for  $m$  in the first equation, and solve for  $c$ :

$$2(0.75) + c = 3.35$$

$$1.5 + c = 3.35$$

$$c = 1.85$$

So two cartons of milk would cost  $2 \times \$1.85 = \$3.70$ .

**18. D****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** You are told that the function is exponential, which means the  $y$ -values are *not* changing by a constant amount (which is supported by the values in the calculator screenshot).

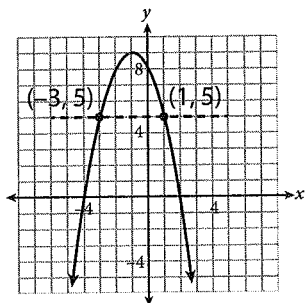
**Getting to the Answer:** You can immediately eliminate B and C because these describe linear functions (the value decreases by a constant amount each time). To choose between A and (D), think logically about how the graph would be labeled (if it had labels). The value of a car *depends* on how many

miles it has been driven, so *value* would be plotted along the  $y$ -axis, and *miles driven* would be plotted along the  $x$ -axis. Now, apply this to the values in the calculator screenshot. The miles driven ( $x$ ) increase by 5,000 each time, and for every 5,000-mile increase, the value of the car drops. This means (D) is correct. To check this answer, you can multiply each  $y$ -value in the table by  $100 - 12 = 88\%$ , or 0.88, to see if the values are in fact decreasing by 12% each time (which they are).

**19. B****Difficulty:** Medium**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** This question is very straightforward if you understand the language of functions. Although you could set the second equation equal to 0 and solve for  $x$ , the solution can be found simply by looking at the graph.

**Getting to the Answer:** The statement  $f(x) = 5$  means to find the  $x$ -values on the graph when  $y$  is 5. To do this, draw a horizontal line across the graph at  $y = 5$  and read the  $x$ -coordinates of the points where the line intersects the parabola.



The function  $y = -x^2 - 2x + 8$  has  $x$ -values of  $-3$  and  $1$  when  $y = 5$ .

**20. B****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Sometimes, a question includes information that is not needed, making it appear more complicated than it really is. In this question, the number of actual voters in the district has nothing to do with the ratio that you're looking for.

**Getting to the Answer:** Because the figures in the pie chart are given as percentages, the ratio will be the same no matter how many voters there are in the district. All you need to do is compare Republicans to Independents. The question does not specify an age range, so add both together for each. The district consists of  $14 + 28 = 42$  parts Republican and  $9 + 3 = 12$  parts Independent, so the ratio is 42:12, which reduces to 7:2.

**21. C****Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Be very careful that you understand what the question is asking. The question wants to know about total late fees, not the total charges and not the late fees per movie.

**Getting to the Answer:** Think about the question conceptually before you examine the graphs. The question asks about late fees *only*, not total charges. If the movies are returned on time, or 0 days late, the late fees will be \$0, so the graph must start at the origin. Eliminate B and D. Next, the question asks about *total* late fees for all four movies. The late fee is \$0.50 per movie per day, so the late fee for all four movies is  $4 \times \$0.5 = \$2$  per day. This means (C) must be correct because the points increase at a rate of \$2 per day. (Note that A shows the possible late fees for returning one movie late.)

**22. D****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages



**Strategic Advice:** Let the units in this question guide you to the solution. The thawing rates of the different methods are given in pounds, but one is given in pounds per day and the other in pounds per 30 minutes. The question asks about the number of ounces each method can thaw in 2 hours, so convert pounds per day and pounds per 30 minutes to ounces per hour.

**Getting to the Answer:** Start by converting pounds to ounces. There are 16 ounces in 1 pound, so 4 pounds is 64 ounces and 1 pound is 16 ounces. Now, use the factor-label method to incorporate the time conversions.

*Refrigerator Method:*

$$\frac{64 \text{ oz}}{1 \text{ day}} \times \frac{1 \text{ day}}{24 \text{ hrs}} \times 2 \text{ hrs} = 5.33 \text{ oz}$$

*Cold Water Method:*

$$\frac{16 \text{ oz}}{30 \text{ min}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times 2 \text{ hrs} = 64 \text{ oz}$$

In 2 hours, the cold water method can thaw approximately  $64 - 5.33 = 58.67$  or about 59 more ounces.

### 23. A

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** When a question concerns distance, rate, and time, organizing the information in a table is usually very helpful.

**Getting to the Answer:** Use the equation Distance = rate  $\times$  time.

	Distance	Rate	Time
Normal Trip	200	$r$	$t$
Faster Trip	200	$r + 10$	$t - 1$

Now, set up a system of equations:  $200 = rt$  and  $200 = (r + 10)(t - 1)$ . Solve the system by solving

the first equation for  $r$  and substituting the result into the second equation; the first equation is  $200 = rt \rightarrow r = \frac{200}{t}$ . *Tip:* Go ahead and FOIL the factors in the second equation before substituting the value of  $r$ .

$$200 = (r + 10)(t - 1)$$

$$200 = rt + 10t - r - 10$$

$$200 = \left(\frac{200}{t}\right)t + 10t - \frac{200}{t} - 10$$

$$\cancel{200} = \cancel{200} + 10t - \frac{200}{t} - 10$$

$$0 = 10t - \frac{200}{t} - 10$$

Now, factor out a 10, find a common denominator, and you'll wind up with a fairly nice quadratic equation to solve.

$$0 = 10\left(t - \frac{20}{t} - 1\right)$$

$$0 = \frac{t^2 - 20 - t}{t}$$

$$0 = t^2 - t - 20$$

$$0 = (t - 5)(t + 4)$$

The two solutions are  $t = 5$  and  $t = -4$ . Time can't be negative, so  $t = 5$ . Substitute this back into the first equation (because the question asks about her original speed) and solve for  $r$ . Her normal speed is  $\frac{200}{5} = 40$  miles per hour.

### 24. C

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** When a question asks for a number that results in the *same* amount of something, it usually means writing an equation with one expression set equal to the other.

**Getting to the Answer:** Let  $m$  represent the number of movie rentals. The Movie Super Fan package costs \$75 for unlimited rentals, so write 75 on one side of the equal sign. The other package costs \$2.50 per

rental (not including the first 10 rentals), or  $2.5(m - 10)$ , plus a flat \$20 fee for those first 10 rentals, so write  $2.5(m - 10) + 20$  on the other side of the equal sign. Simplify the right-hand side of the equation and then use inverse operations to solve for  $m$ .

$$75 = 2.5(m - 10) + 20$$

$$75 = 2.5m - 25 + 20$$

$$80 = 2.5m$$

$$32 = m$$

Renting 32 movies would result in equal package costs, so (C) is correct. Note that this is one of those rare occasions when you could work backward from the answer choices (even though it may use up valuable time). Try 32 in the scenario: The first 10 movies are free, so you must pay for 22 at a cost of \$2.50 each, making the total cost of the Movie Fan package  $\$20 + 22(\$2.50) = \$75$ .

### 25. D

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Don't let the format of the answer choices intimidate you. Use the Kaplan Method for Translating English into Math to systematically eliminate wrong answers.

**Getting to the Answer:** Let  $n$  be the number of caps ordered. The supplier charges \$6 per cap for up to and including 25 caps, so the first inequality should be the cost of the cap multiplied by the number ordered, or  $6n$ , given that  $n \leq 25$ . You can eliminate B because it does not include 25 in the "if" statement. The distributor then charges \$5 per cap for the next 75 caps, which means  $n$  is greater than 25, but less than or equal to  $25 + 75 = 100$ . The cost of the total order would be the cost of the first 25 caps ( $6 \times 25 = 150$ ) added to the amount of the next set of caps, which is \$5 times the number ordered minus the first 25 ordered (because they are at the \$6 price point), or  $150 + 5(n - 25)$ , so you can now eliminate A. For the final price point, the

inequality is simply any order of caps greater than 100, or  $n > 100$ . The cost equation is the cost of the first 25 caps (150) plus the cost of the next 75 caps ( $75 \times 5 = 375$ ) plus the cost of the final set of caps, \$4 multiplied by the number ordered, minus the first 100 ordered (because they are at either the \$5 or \$6 price points), or  $150 + 375 + 4(n - 100) = 525 + 4(n - 100)$ , making (D) correct.

### 26. A

**Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** One of the keys to doing well on Test Day is knowing when (and how) to use your calculator and when it would be quicker to solve something conceptually or by hand. You might try graphing the equation in your calculator, but finding a good viewing window may be very time-consuming. Instead, think about what you know about quadratic functions and how to evaluate them.

**Getting to the Answer:** Skim through the answer choices to see which ones are easiest to eliminate. The question states that the function is quadratic; therefore, the population cannot be decreasing at a *constant* rate (or the function would be linear), so eliminate B. A quick examination of the equation tells you that the parabola opens downward ( $-0.5x^2$ ) and its vertex has been shifted up 22,000 units to  $(0, 22,000)$ . Because  $x = 0$  represents 2015, for all years after 2015 (to the right of 0), the graph will always be decreasing, which means you can eliminate D. The other two choices involve actual numbers, so go back to A. The year 2225 is 210 years after 2015, so the statement translates as "at  $x = 210$ ,  $p(x) = 0$  (or less theoretically depending on the month of the year)," or more specifically that  $p(210) = 0$ . Substitute 210 for  $x$  in the equation and see what happens (this is where your calculator is needed):  $p(210) = -0.5(210)^2 + 22,000 = -50$ . The population can't be negative, but this tells you that by the end of the year 2225, there will be no more of this species, meaning it will be extinct, so (A) is correct.

**27. A****Difficulty:** Hard**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** Use the formula for finding the volume of a cylinder,  $V = \pi r^2 h$ . Check the formula page rather than trying to recall it from memory. Don't forget to use the radius, not the diameter, which is given.

**Getting to the Answer:** The well is 6 feet wide; this is its diameter, so  $r = 3$ . The height of the well is 60 feet, but the water table is 40 feet below ground level, which means only  $60 - 40 = 20$  feet of the well is below the water table and thus has water in it, so  $h = 20$ .

$$V = \pi(3)^2(20)$$

$$V = \pi(9)(20)$$

$$V = 180\pi$$

**28. A****Difficulty:** Hard**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** You do not have enough information to answer this question using rules of transformations. Instead, you'll need to write the equation of the original line, then follow the criteria given to change the equation and find the point.

**Getting to the Answer:** You already know the slope of the original line ( $m = -2$ ), but you need the  $y$ -intercept. You also know a point through which the line passes. Plug the  $x$ - and  $y$ -values of this point into slope-intercept form of a line, and solve for  $b$ .

$$5 = -2(3) + b$$

$$5 = -6 + b$$

$$11 = b$$

The equation of the original line is  $y = -2x + 11$ . If Ramon doubles the slope, it goes from  $-2$  to  $2(-2) = -4$ . If he shifts the line down one unit, the  $y$ -intercept

becomes  $11 - 1 = 10$ , so the equation of the new line is  $y = -4x + 10$ . Graph the line in your graphing calculator and see that it passes through the point  $(3, -2)$ . You could also plug the  $x$ - and  $y$ -values of the points in the answer choices into the new equation to see which one results in a true statement, but this could take more time depending on which choice is correct on Test Day.

**29. B****Difficulty:** Hard**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** Being able to read information from an infographic is an important skill that will earn you points on Test Day.

**Getting to the Answer:** Examine the graph, including the axis labels and numbering. On the vertical axis, there are 5 parts to each 1 unit, which means each grid-line represents 0.2 points on the Richter scale. So you are looking for points that are 5 or more grid-lines away from the line of best fit. There are 3 points that meet this criterion (one before 2004 and two between 2010 and 2011). Now, count the total number of data points: There are 11, and  $3 \div 11 = .2727$ , or about 27 percent.

Note that you could also do the math to find that the magnitude predicted by the line of best fit is 5.6, so you're looking for points with a  $y$ -value of 4.6 or lower and 6.6 or greater.

**30. A****Difficulty:** Hard**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** This is a quadratic equation, so you need one side to equal 0 and then, best-case scenario, you'll be able to factor. If not, you can rely on the quadratic formula.

**Getting to the Answer:** First, subtract 3 from both sides of the equation. Then multiply everything by 9 to clear the fractions.

$$\begin{aligned}\frac{2}{9}x^2 + \frac{8}{3}x - 7 &= 3 \\ \frac{2}{9}x^2 + \frac{8}{3}x - 10 &= 0 \\ 9\left(\frac{2}{9}x^2 + \frac{8}{3}x - 10\right) &= 9(0) \\ 2x^2 + 24x - 90 &= 0\end{aligned}$$

Each number in the equation is divisible by 2, so factor out a 2 and go from there.

$$\begin{aligned}2x^2 + 24x - 90 &= 0 \\ 2(x^2 + 12x - 45) &= 0 \\ 2(x + 15)(x - 3) &= 0\end{aligned}$$

The solutions are  $-15$  and  $3$ , but be careful! The question asks for the product of the solutions, so the correct answer is  $(-15)(3) = -45$ .

### 31. 2

**Difficulty:** Easy

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** When a question asks for the value of an expression, rather than the value of the variable alone, try to determine how the desired expression is related to what is given in the question.

**Getting to the Answer:** Notice that  $7 - p$  is half of  $14 - 2p$ . This means you can cut all parts of the inequality in half to arrive at the correct answer.

$$\begin{aligned}\frac{-10}{2} < \frac{14 - 2p}{2} < \frac{6}{2} \\ -5 < 7 - p < 3\end{aligned}$$

There is no need to solve for  $p$  because the question asks about  $7 - p$ . The inequality ( $<$ ) doesn't include 3, so the greatest possible integer value of  $7 - p$  is 2.

### 32. 25

**Difficulty:** Easy

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Pay careful attention to the axis labels as you read the answer choices. Time is graphed on the  $x$ -axis and distance is graphed on the  $y$ -axis. Try to visualize what is happening as Umberto runs his errands.

**Getting to the Answer:** Umberto was inside the bank and inside the post office when time was passing, but his distance was not changing (because he was stopped). This means you're looking for the portions of the graph where the line is horizontal (because distance is graphed on the vertical axis and you want no vertical change). This occurs from  $(10, 4)$  to  $(20, 4)$  and from  $(35, 6)$  to  $(50, 6)$ . This means he spent 10 minutes in the bank and 15 minutes in the post office, for a total of 25 minutes in both.

### 33. 75

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Pay careful attention to the units in a question like this. Here, the rate is given in minutes, but the question asks for the answer in seconds.

**Getting to the Answer:** The test consists of a total of  $50 + 30 = 80$  questions. Selena has already answered 48 of the 80 questions. This means she has  $80 - 48 = 32$  questions left. She has used up 50 of the 90 minutes, leaving 40 minutes to complete the test. To find the amount of time per question she has left, divide the remaining time by the number of questions remaining:  $40 \text{ minutes} \div 32 \text{ questions} = 1.25 \text{ minutes per question}$ . Don't forget to change your answer to seconds. There are 60 seconds in 1 minute, so multiply  $1.25 \times 60$  to find that she has 75 seconds per question.

## 34. 9.4

**Difficulty:** Hard**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** This question requires logical thinking, knowledge of special right triangles, and knowing how to find arc length. It's a challenging question, so if you're pushed for time, skip it and come back later.

**Getting to the Answer:** Finding the area of a sector of a circle (the shaded region) requires knowing the degree measure of the corresponding interior angle. Given that information, your first step is to find the area of the entire circle. Then you'll find the proportional amount represented by the sector. To find the area of a circle, the only thing you need is the radius. The radius is not shown in the figure, so you will have to think about special right triangles. In the figure, triangle  $ABO$  is formed by 2 radii and a  $90^\circ$  angle. This means the triangle must be a 45-45-90 triangle, and therefore its side lengths are in the ratio  $1:1:\sqrt{2}$ . The hypotenuse is given as  $6\sqrt{2}$ , so the side lengths of the triangle, and therefore the radius of the circle, must be 6, and the area of the entire circle is  $A = \pi r^2 = \pi(6)^2 = 36\pi$ . Now you need to find the portion of the circle represented by the shaded region by finding the measure of the angle inside the sector and dividing by 360. You'll need to use the given arc length,  $\pi$ , and the formula for finding arc length (arc length =  $\theta r$ , where  $\theta$  is the interior angle and  $r$  is the length of the radius):

$$\pi = \theta(6)$$

$$\frac{\pi}{6} = \theta$$

If you know your unit circle, you know this corresponds to  $30^\circ$ . If you don't recall this fact, then you can convert radians to degrees by multiplying the radian measure by  $\frac{180}{\pi}$  to get  $\frac{\pi}{6} \times \frac{180}{\pi} = \frac{180}{6} = 30$ .

This means the shaded region makes up  $\frac{30}{360} = \frac{1}{12}$  of the total area of the circle, so divide the total area

by 12 to get  $36\pi \div 12 = 3\pi$ . The question tells you to approximate  $\pi$  using 3.14 and to round to the nearest tenth, so the final answer is 9.4.

## 35. 1728

**Difficulty:** Hard**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** You can tell from the length of the question that you can simply skim the first couple of sentences. You also need to make sure you answer the right question (how many masks the hospital would receive if it ordered all of the boxes of 144 the supplier has in stock).

**Getting to the Answer:** Create a system of linear equations where  $x$  represents the number of boxes with 48 masks and  $y$  represents the number of boxes with 144 masks. The first equation should represent the total number of boxes,  $x + y = 35$ . The second equation should represent the total number of masks. Because  $x$  represents boxes with 48 masks and  $y$  represents boxes with 144 masks, the second equation is  $48x + 144y = 2,832$ . Now solve the system using substitution. Solve the first equation for either variable; then substitute the result into the second equation:

$$x + y = 35$$

$$x = 35 - y$$

$$48(35 - y) + 144y = 2,832$$

$$1,680 - 48y + 144y = 2,832$$

$$96y = 1,152$$

$$y = 12$$

So 12 boxes have 144 masks. Because the question asks about boxes of 144, you don't need to find the value of  $x$ —but you're not done yet. The question asks how many masks the hospital would receive if it buys all of the boxes of 144 the supplier has, not the number of boxes. The hospital would receive  $12 \times 144 = 1,728$  masks.

**36. 5.5****Difficulty:** Hard**Category:** Problem Solving and Data Analysis / Scatterplots**Strategic Advice:** Actually, there is nothing to calculate in a question like this. The answer must be the  $y$ -value of one of the points already on the graph, so you just need to think about how the graph will look after Patricia removes the erroneous point.**Getting to the Answer:** The  $y$ -intercept of the line in the graph is 2.5. Once Patricia removes the point, it is 2, which means the line is adjusted downward. The slope of the line, however, is steeper, which means the change in  $y$ -values will be greater compared to the change in  $x$ -values. Sketch this new line on the graph. After drawing the new line, you can see that the line still fits the data, except for point (9, 5.5), which has now become an extreme outlier. This must have been the point Patricia eliminated, so grid in 5.5.**37. 9092****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages**Strategic Advice:** Break this problem into short steps to keep all of the information organized.**Getting to the Answer:** *Step one:* Determine how many days total the company needs to make reimbursements for by multiplying the number of employees by the average number of days they each go to the gym:  $246 \times 84 = 20,664$ .*Step two:* Determine the amount of money the company must reimburse per day by multiplying the daily reimbursement rate, 0.2% by the cost of the membership:  $\$220 \times 0.002 = \$0.44$ .*Step three:* Find the total amount the company must pay in reimbursements by multiplying the total number of days for which it must make reimbursements by the amount it must pay per day:  $20,664 \times \$0.44 = \$9,092.16 = \$9,092$ .**38. 4887****Difficulty:** Hard**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages**Strategic Advice:** Again, break the question into short steps so that your calculations don't get jumbled up.**Getting to the Answer:** *Step one:* Determine how many days an employee needed to visit the gym to earn the bonus day off by multiplying the number of days in the year, 365, by 60%. The result is 219, but the question says *more than* 60% of the days, so an employee must have gone 220 days to qualify for the bonus day off.*Step two:* Determine how many employees qualified for this benefit by looking to see what percent (according to the pie graph) went to the gym the required number of days. Then, multiply this number by the number of employees who participated in the health program:  $246 \times 0.16667 = 41$  employees.*Step three:* Find the total number of hours for which the company must pay for the days off:  $41 \times 8 = 328$  hours.*Step four:* Calculate the total cost of this benefit by multiplying by the average hourly rate:  $328 \times \$14.90 = \$4,887.2$ , which rounded to the nearest whole dollar is \$4,887.

# SAT PRACTICE TEST 5 ANSWER SHEET

Remove (or photocopy) this answer sheet and use it to complete the test. See the answer key following the test when finished.

Start with number 1 for each section. If a section has fewer questions than answer spaces, leave the extra spaces blank.

## SECTION

1

- |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| 1. (A) (B) (C) (D)  | 14. (A) (B) (C) (D) | 27. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 2. (A) (B) (C) (D)  | 15. (A) (B) (C) (D) | 28. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 3. (A) (B) (C) (D)  | 16. (A) (B) (C) (D) | 29. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D)  | 17. (A) (B) (C) (D) | 30. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D)  | 18. (A) (B) (C) (D) | 31. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D)  | 19. (A) (B) (C) (D) | 32. (A) (B) (C) (D) | 45. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D)  | 20. (A) (B) (C) (D) | 33. (A) (B) (C) (D) | 46. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D)  | 21. (A) (B) (C) (D) | 34. (A) (B) (C) (D) | 47. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D)  | 22. (A) (B) (C) (D) | 35. (A) (B) (C) (D) | 48. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 23. (A) (B) (C) (D) | 36. (A) (B) (C) (D) | 49. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 24. (A) (B) (C) (D) | 37. (A) (B) (C) (D) | 50. (A) (B) (C) (D) |
| 12. (A) (B) (C) (D) | 25. (A) (B) (C) (D) | 38. (A) (B) (C) (D) | 51. (A) (B) (C) (D) |
| 13. (A) (B) (C) (D) | 26. (A) (B) (C) (D) | 39. (A) (B) (C) (D) | 52. (A) (B) (C) (D) |

  
 # right in  
Section 1

  
 # wrong in  
Section 1

## SECTION

2

- |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| 1. (A) (B) (C) (D)  | 12. (A) (B) (C) (D) | 23. (A) (B) (C) (D) | 34. (A) (B) (C) (D) |
| 2. (A) (B) (C) (D)  | 13. (A) (B) (C) (D) | 24. (A) (B) (C) (D) | 35. (A) (B) (C) (D) |
| 3. (A) (B) (C) (D)  | 14. (A) (B) (C) (D) | 25. (A) (B) (C) (D) | 36. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D)  | 15. (A) (B) (C) (D) | 26. (A) (B) (C) (D) | 37. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D)  | 16. (A) (B) (C) (D) | 27. (A) (B) (C) (D) | 38. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D)  | 17. (A) (B) (C) (D) | 28. (A) (B) (C) (D) | 39. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D)  | 18. (A) (B) (C) (D) | 29. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D)  | 19. (A) (B) (C) (D) | 30. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D)  | 20. (A) (B) (C) (D) | 31. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 21. (A) (B) (C) (D) | 32. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 22. (A) (B) (C) (D) | 33. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |

  
 # right in  
Section 2

  
 # wrong in  
Section 2

SECTION 3

1. (A) (B) (C) (D)      5. (A) (B) (C) (D)      9. (A) (B) (C) (D)      13. (A) (B) (C) (D)  
 2. (A) (B) (C) (D)      6. (A) (B) (C) (D)      10. (A) (B) (C) (D)      14. (A) (B) (C) (D)  
 3. (A) (B) (C) (D)      7. (A) (B) (C) (D)      11. (A) (B) (C) (D)      15. (A) (B) (C) (D)  
 4. (A) (B) (C) (D)      8. (A) (B) (C) (D)      12. (A) (B) (C) (D)

16.

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4	4	4	4
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7	7	7	7
8	8	8	8
9	9	9	9

17.

	7	7	
	0	0	0
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

18.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

19.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

20.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

# right in Section 3

# wrong in Section 3

SECTION 4

1. (A) (B) (C) (D)      9. (A) (B) (C) (D)      17. (A) (B) (C) (D)      25. (A) (B) (C) (D)  
 2. (A) (B) (C) (D)      10. (A) (B) (C) (D)      18. (A) (B) (C) (D)      26. (A) (B) (C) (D)  
 3. (A) (B) (C) (D)      11. (A) (B) (C) (D)      19. (A) (B) (C) (D)      27. (A) (B) (C) (D)  
 4. (A) (B) (C) (D)      12. (A) (B) (C) (D)      20. (A) (B) (C) (D)      28. (A) (B) (C) (D)  
 5. (A) (B) (C) (D)      13. (A) (B) (C) (D)      21. (A) (B) (C) (D)      29. (A) (B) (C) (D)  
 6. (A) (B) (C) (D)      14. (A) (B) (C) (D)      22. (A) (B) (C) (D)      30. (A) (B) (C) (D)  
 7. (A) (B) (C) (D)      15. (A) (B) (C) (D)      23. (A) (B) (C) (D)  
 8. (A) (B) (C) (D)      16. (A) (B) (C) (D)      24. (A) (B) (C) (D)

31.

	7	7	
	0	0	0
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

32.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

33.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

34.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

35.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

36.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

37.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

38.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

# right in Section 4

# wrong in Section 4



# MATH TEST

25 Minutes—20 Questions

## NO-CALCULATOR SECTION

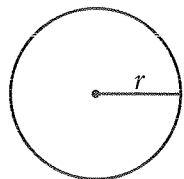
Turn to Section 3 of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding oval on the answer sheet. You may use any available space for scratch work.

Notes:

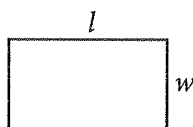
1. Calculator use is NOT permitted.
2. All numbers used are real numbers.
3. All figures used are necessary to solving the problems that they accompany. All figures are drawn to scale EXCEPT when it is stated that a specific figure is not drawn to scale.
4. Unless stated otherwise, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$ , for which  $f(x)$  is a real number.

Information:

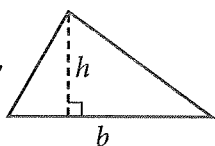


$$A = \pi r^2$$

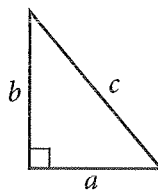
$$C = 2\pi r$$



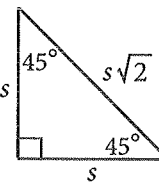
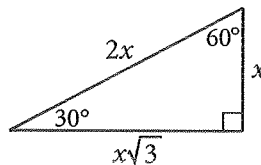
$$A = lw$$



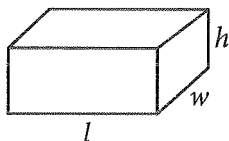
$$A = \frac{1}{2}bh$$



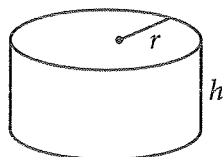
$$c^2 = a^2 + b^2$$



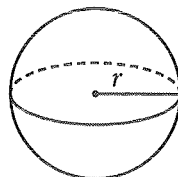
Special Right Triangles



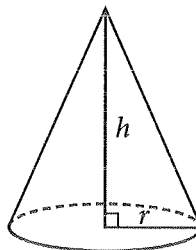
$$V = lwh$$



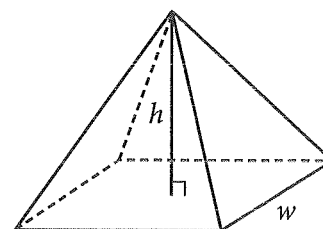
$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



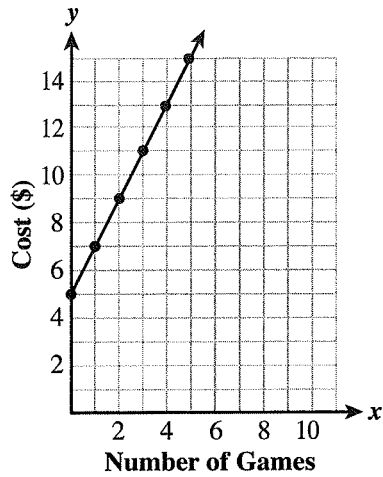
$$V = \frac{1}{3}lwh$$

The sum of the degree measures of the angles in a triangle is 180.

The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is  $2\pi$ .

GO ON TO THE NEXT PAGE



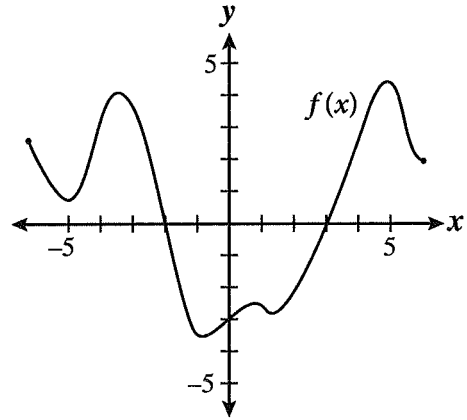
1. The graph above shows the amount that a new, high-tech video arcade charges its customers. What could the  $y$ -intercept of this graph represent?
- A) The cost of playing 5 games  
 B) The cost per game, which is \$5  
 C) The entrance fee to enter the arcade  
 D) The number of games that are played

$$\frac{3x}{x+5} \div \frac{6}{4x+20}$$

2. Which of the following is equivalent to the expression above, given that  $x \neq -5$ ?
- A)  $2x$   
 B)  $\frac{x}{2}$   
 C)  $\frac{9x}{2}$   
 D)  $2x + 4$

$$(x+3)^2 + (y+1)^2 = 25$$

3. The graph of the equation above is a circle. What is the area, in square units, of the circle?
- A)  $4\pi$   
 B)  $5\pi$   
 C)  $16\pi$   
 D)  $25\pi$



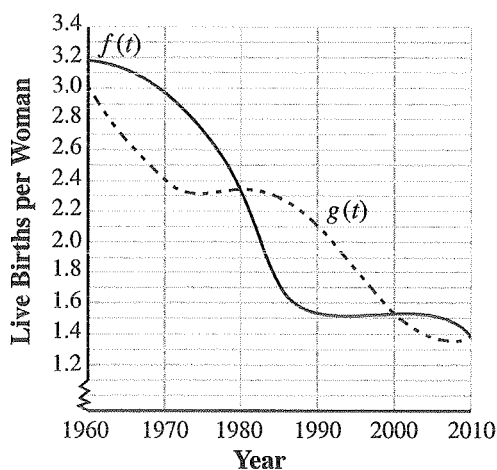
4. The figure above shows the graph of  $f(x)$ . For which value(s) of  $x$  does  $f(x)$  equal 0?
- A) 3 only  
 B)  $-3$  only  
 C)  $-2$  and 3  
 D)  $-3$ ,  $-2$ , and 3

$$\frac{4(d+3)-9}{8} = \frac{10-(2-d)}{6}$$

5. In the equation above, what is the value of  $d$ ?

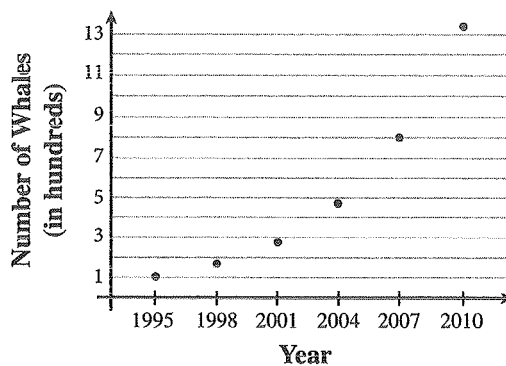
- A)  $\frac{23}{16}$   
 B)  $\frac{23}{8}$   
 C)  $\frac{25}{8}$   
 D)  $\frac{25}{4}$

Total Fertility Rate, 1960-2010

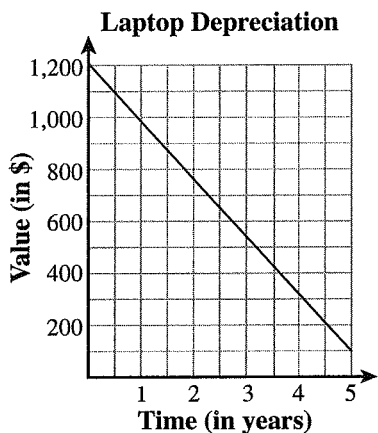


Source: Data from Eurostat.

6. One indicator of a declining economy is a continued decline in birth rates. In 2010, birth rates in Europe were at an all-time low, with the average number of children that a woman has in her lifetime at well below two. In the figure above,  $f(t)$  represents birth rates for Portugal between 1960 and 2010, and  $g(t)$  represents birth rates in Slovakia for the same time period. For which value(s) of  $t$  is  $f(t) > g(t)$ ?
- A)  $1960 < t < 1980$  only  
 B)  $1980 < t < 2000$  only  
 C)  $1960 < t < 1980$  and  $1990 < t < 2000$   
 D)  $1960 < t < 1980$  and  $2000 < t < 2010$



7. The blue whale is the largest creature in the world and has been found in every ocean in the world. A marine biologist surveyed the blue whale population in Monterey Bay, off the coast of California, every three years between 1995 and 2010. The figure above shows her results. If  $w$  is the number of blue whales present in Monterey Bay and  $t$  is the number of years since the study began in 1995, which of the following equations best represents the blue whale population of Monterey Bay?
- A)  $w = 100 + 2t$   
 B)  $w = 100 + \frac{t^2}{4}$   
 C)  $w = 100 \times 2^t$   
 D)  $w = 100 \times 2^{\frac{t}{4}}$

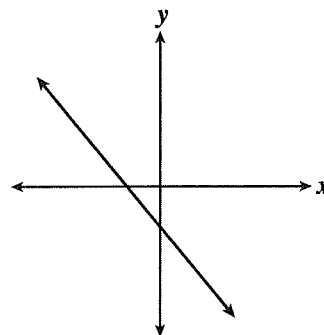


8. The figure above shows the straight-line depreciation of a laptop computer over the first five years of its use. According to the figure, what is the average rate of change in dollars per year of the value of the computer over the five-year period?

- A) -1,100
- B) -220
- C) -100
- D) 100

9. What is the coefficient of  $x^2$  when  $6x^2 - \frac{2}{5}x + 1$  is multiplied by  $10x + \frac{1}{3}$ ?

- A) -4
- B) -2
- C) 2
- D) 4



10. The graph above could represent which of the following equations?

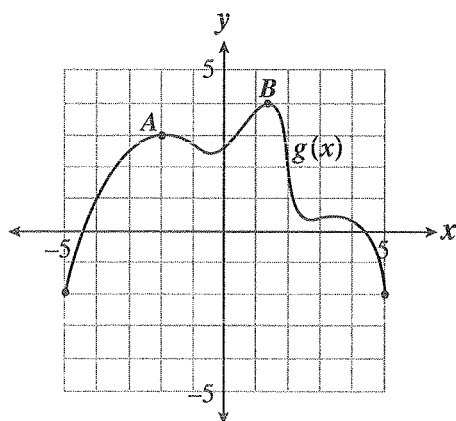
- A)  $-6x - 4y = 5$
- B)  $-6x - 4y = -5$
- C)  $-6x + 4y = 5$
- D)  $-6x + 4y = -5$

$$\begin{cases} \frac{3}{4}x - \frac{1}{2}y = 12 \\ kx - 2y = 22 \end{cases}$$

11. If the system of linear equations above has no solution, and  $k$  is a constant, what is the value of  $k$ ?

- A)  $-\frac{4}{3}$
- B)  $-\frac{3}{4}$
- C) 3
- D) 4

12. In Delray Beach, Florida, you can take a luxury golf cart ride around downtown. The driver charges \$4 for the first  $\frac{1}{4}$  mile, plus \$1.50 for each additional  $\frac{1}{2}$  mile. Which inequality represents the number of miles,  $m$ , that you could ride and pay no more than \$10?
- A)  $3.25 + 1.5m \leq 10$   
 B)  $3.25 + 3m \leq 10$   
 C)  $4 + 1.5m \leq 10$   
 D)  $4 + 3m \leq 10$



13. The graph of  $g(x)$  is shown in the figure above. If  $h(x) = -g(x) + 1$ , which of the following statements is true?
- A) The range of  $h(x)$  is  $-3 \leq y \leq 3$ .  
 B) The minimum value of  $h(x)$  is  $-4$ .  
 C) The coordinates of point A on the function  $h(x)$  are  $(2, 4)$ .  
 D) The graph of  $h(x)$  is increasing between  $x = -5$  and  $x = -2$ .

14. If  $a + bi$  represents the complex number that results from multiplying  $3 + 2i$  times  $5 - i$ , what is the value of  $a$ ?
- A) 2  
 B) 13  
 C) 15  
 D) 17

$$\frac{1}{x} + \frac{4}{x} = \frac{1}{72}$$

15. In order to create safe drinking water, cities and towns use water treatment facilities to remove contaminants from surface water and groundwater. Suppose a town has a treatment plant but decides to build a second, more efficient facility. The new treatment plant can filter the water in the reservoir four times as quickly as the older facility. Working together, the two facilities can filter all the water in the reservoir in 72 hours. The equation above represents the scenario. Which of the following describes what the term  $\frac{1}{x}$  represents?
- A) The portion of the water the older treatment plant can filter in 1 hour  
 B) The time it takes the older treatment plant to filter the water in the reservoir  
 C) The time it takes the older treatment plant to filter  $\frac{1}{72}$  of the water in the reservoir  
 D) The portion of the water the new treatment plant can filter in 4 hours

**Directions:** For questions 16-20, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $\frac{7}{2}$ .

(If  $3\frac{1}{2}$  is entered into the grid as 

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)

- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Answer:  $\frac{7}{12}$

7	/	1	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Answer: 2.5

2	.	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

← Decimal point

Write answer in boxes. →

Grid in result. →

Answer: 201  
Either position is correct.

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

2	0	1	
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4

Acceptable ways to grid  $\frac{2}{3}$  are:

2	/	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6

.	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

.	6	6	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

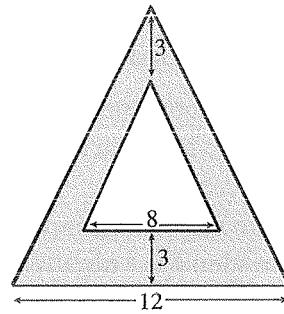
16. If  $\frac{1}{4}x = 5 - \frac{1}{2}y$ , what is the value of  $x + 2y$ ?

$$\begin{cases} x + 3y \leq 18 \\ 2x - 3y \leq 9 \end{cases}$$

17. If  $(a, b)$  is a point in the solution region for the system of inequalities shown above and  $a = 6$ , what is the minimum possible value for  $b$ ?

$$\frac{\sqrt{x} \cdot x^{\frac{5}{6}} \cdot x}{\sqrt[3]{x}}$$

18. If  $x^n$  is the simplified form of the expression above, what is the value of  $n$ ?



Note: Figure not drawn to scale.

19. In the figure above, the area of the shaded region is 52 square units. What is the height of the larger triangle?
20. If  $y = ax^2 + bx + c$  passes through the points  $(-3, 10)$ ,  $(0, 1)$ , and  $(2, 15)$ , what is the value of  $a + b + c$ ?

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS SECTION ONLY. DO NOT TURN TO ANY OTHER SECTION IN THE TEST.

**STOP**

# MATH TEST

55 Minutes—38 Questions

## CALCULATOR SECTION

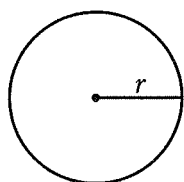
Turn to Section 4 of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding oval on the answer sheet. You may use any available space for scratch work.

Notes:

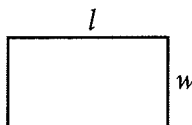
1. Calculator use is permitted.
2. All numbers used are real numbers.
3. All figures used are necessary to solving the problems that they accompany. All figures are drawn to scale EXCEPT when it is stated that a specific figure is not drawn to scale.
4. Unless stated otherwise, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$ , for which  $f(x)$  is a real number.

Information:

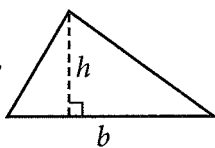


$$A = \pi r^2$$

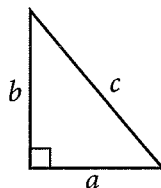
$$C = 2\pi r$$



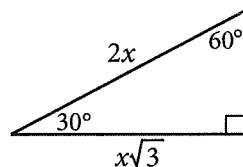
$$A = lw$$



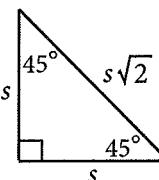
$$A = \frac{1}{2}bh$$



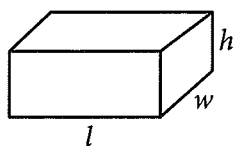
$$c^2 = a^2 + b^2$$



$$x\sqrt{3}$$



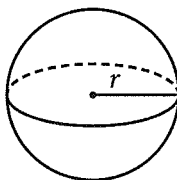
Special Right Triangles



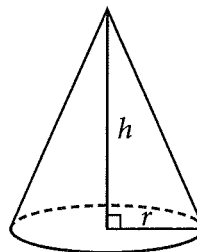
$$V = lwh$$



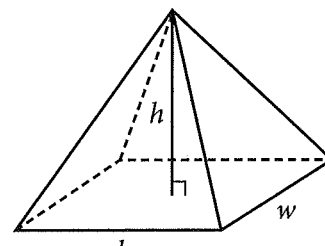
$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



$$V = \frac{1}{3}lwh$$

The sum of the degree measures of the angles in a triangle is 180.

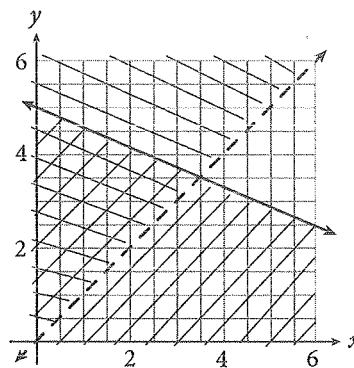
The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is  $2\pi$ .

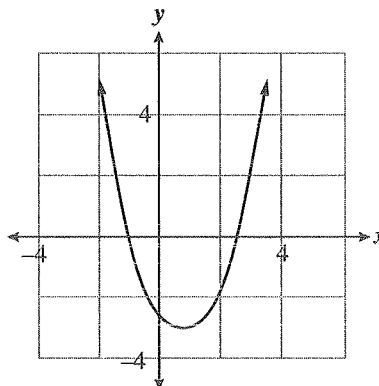
GO ON TO THE NEXT PAGE 



1. Oceans, seas, and bays represent about 96.5% of Earth's water, including the water found in our atmosphere. If the volume of the water contained in oceans, seas, and bays is about 321,000,000 cubic miles, which of the following best represents the approximate volume, in cubic miles, of all the world's water?
- A) 308,160,000  
 B) 309,765,000  
 C) 332,642,000  
 D) 334,375,000
2. An electrician charges a one-time site visit fee to evaluate a potential job. If the electrician accepts the job, he charges an hourly rate plus the cost of any materials needed to complete the job. The electrician also charges for tax, but only on the cost of the materials. If the total cost of completing a job that takes  $h$  hours is given by the function  $C(h) = 45h + 1.06(82.5) + 75$ , then the term  $1.06(82.5)$  represents
- A) the hourly rate.  
 B) the site visit fee.  
 C) the cost of the materials, including tax.  
 D) the cost of the materials, not including tax.



3. The figure above shows the solution set for the system  $\begin{cases} y > x \\ y \leq -\frac{3}{7}x + 5 \end{cases}$ . Which of the following is not a solution to the system?
- A) (0, 3)  
 B) (1, 2)  
 C) (2, 4)  
 D) (3, 3)

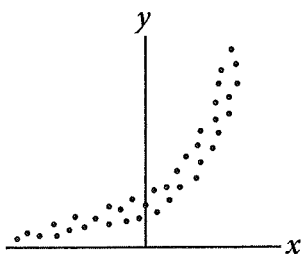


4. Each of the following quadratic equations represents the graph shown above. Which equation reveals the exact values of the  $x$ -intercepts of the graph?
- A)  $y = \frac{1}{2}(2x - 5)(x + 1)$   
 B)  $y = x^2 - \frac{3}{2}x - \frac{5}{2}$   
 C)  $y + \frac{49}{16} = \left(x - \frac{3}{4}\right)^2$   
 D)  $y = \left(x - \frac{3}{4}\right)^2 - \frac{49}{16}$

National Government Concerns

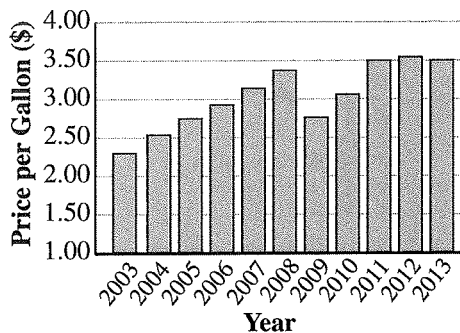


5. Margo surveyed all the students in the government classes at her school to see what they thought should be the most important concern of a national government. The results of the survey are shown in the figure above. If the ratio of students who answered “Foreign Policy” to those who answered “Environment” was 5:3, what percentage of the students answered “Environment”?
- A) 16%  
 B) 21%  
 C) 24%  
 D) 35%



6. Which of the following best describes the type of association shown in the scatterplot above?
- A) linear, positive  
 B) linear, negative  
 C) exponential, positive  
 D) exponential, negative

Average Annual Gas Prices

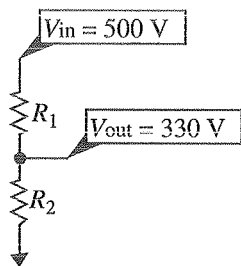


Data from U.S. Energy Information Administration.

7. The figure above shows the average annual gas prices in the United States from 2003 to 2013. Based on the information shown, which of the following conclusions is valid?
- A) A gallon of gas cost more in 2008 than in 2013.  
 B) The price more than doubled between 2003 and 2013.  
 C) The drop in price from 2008 to 2009 was more than \$1.00 per gallon.  
 D) The overall change in price was greater between 2003 and 2008 than it was between 2008 and 2013.

$$\begin{cases} -2x + 5y = 1 \\ 7x - 10y = -11 \end{cases}$$

8. If  $(x, y)$  is a solution to the system of equations above, what is the sum of  $x$  and  $y$ ?
- A)  $\frac{137}{30}$   
 B)  $-4$   
 C)  $-\frac{10}{3}$   
 D)  $-3$



9. A voltage divider is a simple circuit that converts a large voltage into a smaller one. The figure above shows a voltage divider that consists of two resistors that together have a total resistance of 294 ohms. To produce the desired voltage of 330 volts,  $R_2$  must be 6 ohms less than twice  $R_1$ . Solving which of the following systems of equations gives the individual resistances for  $R_1$  and  $R_2$ ?
- A)  $\begin{cases} R_2 = 2R_1 - 6 \\ R_1 + R_2 = 294 \end{cases}$
- B)  $\begin{cases} R_1 = 2R_2 + 6 \\ R_1 + R_2 = 294 \end{cases}$
- C)  $\begin{cases} R_2 = 2R_1 - 6 \\ R_1 + R_2 = \frac{294}{330} \end{cases}$
- D)  $\begin{cases} R_1 = 2R_2 + 6 \\ R_1 + R_2 = 330(294) \end{cases}$
10. If  $\frac{2}{5}(5x) + 2(x-1) = 4(x+1) - 2$ , what is the value of  $x$ ?
- A)  $x = -2$
- B)  $x = 2$
- C) There is no value of  $x$  for which the equation is true.
- D) There are infinitely many values of  $x$  for which the equation is true.
11. Crude oil is being transferred from a full rectangular storage container with dimensions 4 meters by 9 meters by 10 meters into a cylindrical transportation container that has a diameter of 6 meters. What is the minimum possible length for a transportation container that will hold all of the oil?
- A)  $40\pi$
- B)  $\frac{40}{\pi}$
- C)  $60\pi$
- D)  $\frac{120}{\pi}$
12. The percent increase from 5 to 12 is equal to the percent increase from 12 to what number?
- A) 16.8
- B) 19.0
- C) 26.6
- D) 28.8

$$b = \frac{L}{4\pi d^2}$$

13. The brightness of a celestial body, like a star, decreases as you move away from it. In contrast, the luminosity of a celestial body is a constant number that represents its intrinsic brightness. The inverse square law, shown above, is used to find the brightness,  $b$ , of a celestial body when you know its luminosity,  $L$ , and the distance,  $d$ , in meters to the body. Which equation shows the distance to a celestial body, given its brightness and luminosity?
- A)  $d = \frac{1}{2}\sqrt{\frac{L}{\pi b}}$
- B)  $d = \sqrt{\frac{L}{2\pi b}}$
- C)  $d = \frac{\sqrt{L}}{2\pi b}$
- D)  $d = \frac{L}{2\sqrt{\pi b}}$

Questions 14 and 15 refer to the following information.

Each month, the Bureau of Labor Statistics conducts a survey called the Current Population Survey (CPS) to measure unemployment in the United States. Across the country, about 60,000 households are included in the survey sample. These households are grouped by geographic region. A summary of the January 2014 survey results for male respondents in one geographic region is shown in the table below.

Age Group	Employed	Unemployed	Not in the Labor Force	Total
16 to 19	8	5	10	23
20 to 24	26	7	23	56
25 to 34	142	11	28	157
35 to 44	144	8	32	164
45 to 54	66	6	26	98
Over 54	65	7	36	152
<b>Total</b>	451	44	155	650

14. According to the data in the table, for which age group did the smallest percentage of men report that they were unemployed in January 2014?
- A) 20 to 24 years  
 B) 35 to 44 years  
 C) 45 to 54 years  
 D) Over 54 years
15. If one unemployed man from this sample is chosen at random for a follow-up survey, what is the probability that he will be between the ages of 45 and 54?
- A) 6.0%  
 B) 13.6%  
 C) 15.1%  
 D) 44.9%

16. Which of the following are solutions to the quadratic equation  $(x-1)^2 = \frac{4}{9}$ ?

A)  $x = -\frac{5}{3}, x = \frac{5}{3}$

B)  $x = \frac{1}{3}, x = \frac{5}{3}$

C)  $x = \frac{5}{9}, x = \frac{13}{9}$

D)  $x = 1 \pm \sqrt{\frac{2}{3}}$

17. Damien is throwing darts. He has a total of 6 darts to throw. He gets 5 points for each dart that lands in a blue ring and 10 points for each dart that lands in a red ring. If  $x$  of his darts land in a blue ring and the rest land in a red ring, which expression represents his total score?

A)  $10x$

B)  $10x + 5$

C)  $5x + 30$

D)  $60 - 5x$

18. Red tide is a form of harmful algae that releases toxins as it breaks down in the environment. A marine biologist is testing a new spray, composed of clay and water, hoping to kill the red tide that almost completely covers a beach in southern Florida. He applies the spray to a representative sample of 200 square feet of the beach. By the end of the week, 184 square feet of the beach is free of the red tide. Based on these results, and assuming the same general conditions, how much of the 10,000-square-foot beach would still be covered by red tide if the spray had been used on the entire area?

A) 800 sq ft

B) 920 sq ft

C) 8,000 sq ft

D) 9,200 sq ft

$$\begin{cases} y = \frac{1}{2}x - 2 \\ y = -x^2 + 1 \end{cases}$$

19. If  $(a, b)$  is a solution to the system of equations above, which of the following could be the value of  $b$ ?

A)  $-3$

B)  $-2$

C)  $1$

D)  $2$

20. Given the function  $g(x) = \frac{2}{3}x + 7$ , what domain value corresponds to a range value of 3?

A)  $-6$

B)  $-2$

C)  $6$

D)  $9$

21. A landscaper buys a new commercial-grade lawn mower that costs \$2,800. Based on past experience, he expects it to last about 8 years, and then he can sell it for scrap metal with a salvage value of about \$240. Assuming the value of the lawn mower depreciates at a constant rate, which equation could be used to find its approximate value after  $x$  years, given that  $x < 8$ ?

A)  $y = -8x + 2,560$

B)  $y = -240x + 2,800$

C)  $y = -320x + 2,800$

D)  $y = 240x - 2,560$

22. A microbiologist is studying the effects of a new antibiotic on a culture of 20,000 bacteria. When the antibiotic is added to the culture, the number of bacteria is reduced by half every hour. What kind of function best models the number of bacteria remaining in the culture after the antibiotic is added?

- A) A linear function  
 B) A quadratic function  
 C) A polynomial function  
 D) An exponential function

23. An airline company purchased two new airplanes. One can travel at speeds of up to 600 miles per hour and the other at speeds of up to 720 miles per hour. How many more miles can the faster airplane travel in 12 seconds than the slower airplane?

- A)  $\frac{1}{30}$   
 B)  $\frac{2}{5}$   
 C) 2  
 D) 30

State	Minimum Wage per Hour
Idaho	\$7.25
Montana	\$7.90
Oregon	\$9.10
Washington	\$9.32

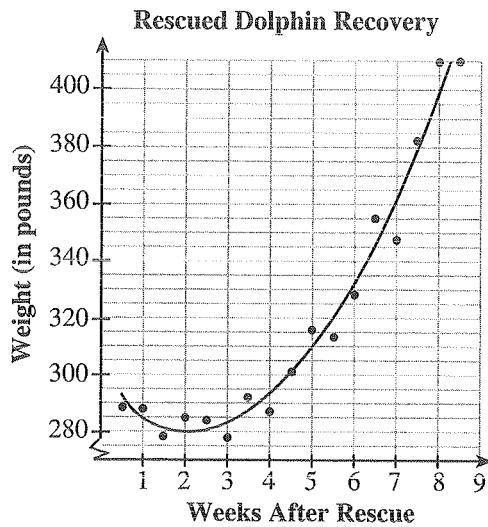
24. The table above shows the 2014 minimum wages for several states that share a border. Assuming an average workweek of between 35 and 40 hours, which inequality represents how much more a worker who earns minimum wage can earn per week in Oregon than in Idaho?

- A)  $x \geq 1.85$   
 B)  $7.25 \leq x \leq 9.10$   
 C)  $64.75 \leq x \leq 74$   
 D)  $253.75 \leq x \leq 364$

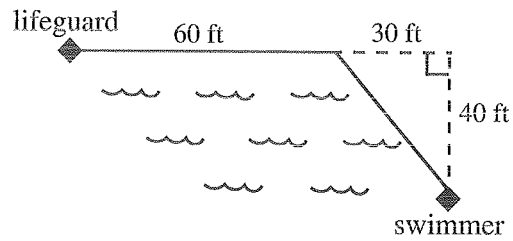
25. In the United States, the maintenance and construction of airports, transit systems, and major roads is largely funded through a federal excise tax on gasoline. Based on the 2011 statistics given below, how much did the average household pay per year in federal gasoline taxes?

- The federal gasoline tax rate was 18.4 cents per gallon.
- The average motor vehicle was driven approximately 11,340 miles per year.
- The national average fuel economy for noncommercial vehicles was 21.4 miles per gallon.
- The average American household owned 1.75 vehicles.

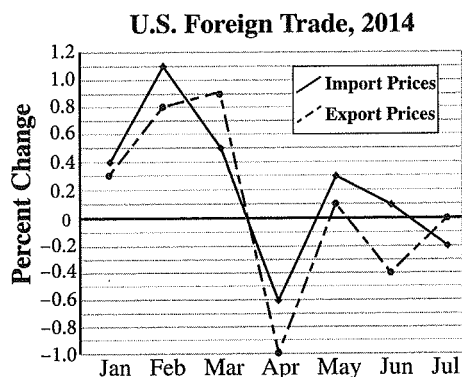
- A) \$55.73  
 B) \$68.91  
 C) \$97.52  
 D) \$170.63



26. Following the catastrophic oil spill in the Gulf of Mexico in April of 2010, more than 900 bottlenose dolphins were found dead or stranded in the oil spill area. The figure above shows the weight of a rescued dolphin during its recovery. Based on the quadratic model fit to the data shown, which of the following is the closest to the average rate of change in the dolphin's weight between week 2 and week 8 of its recovery?
- A) 4 pounds per week
  - B) 16 pounds per week
  - C) 20 pounds per week
  - D) 40 pounds per week



27. As shown in the figure above, a lifeguard sees a struggling swimmer who is 40 feet from the beach. The lifeguard runs 60 feet along the edge of the water at a speed of 12 feet per second. He pauses for 1 second to locate the swimmer again, and then dives into the water and swims along a diagonal path to the swimmer at a speed of 5 feet per second. How many seconds go by between the time the lifeguard sees the struggling swimmer and the time he reaches the swimmer?
- A) 16
  - B) 22
  - C) 50
  - D) 56
28. What was the initial amount of gasoline in a fuel trailer, in gallons, if there are now  $x$  gallons,  $y$  gallons were pumped into a storage tank, and then 50 gallons were added to the trailer?
- A)  $x + y + 50$
  - B)  $x + y - 50$
  - C)  $y - x + 50$
  - D)  $x - y - 50$



29. The figure above shows the net change, as a percentage, for U.S. import and export prices from January to July 2014 as reported by the Bureau of Labor Statistics. For example, U.S. import prices declined 0.2 percent in July while export prices remained unchanged for that month. Based on this information, which of the following statements is true for the time period shown in the figure?

- A) On average, export prices increased more than import prices.
- B) Import prices showed an increase more often than export prices.
- C) Import prices showed the greatest change between two consecutive months.
- D) From January to July, import prices showed a greater overall decrease than export prices.

$$\frac{3.86}{x} + \frac{180.2}{10x} + \frac{42.2}{5x}$$

30. The Ironman Triathlon originated in Hawaii in 1978. The format of the Ironman has not changed since then: It consists of a 3.86-km swim, a 180.2-km bicycle ride, and a 42.2-km run, all raced in that order and without a break. Suppose an athlete bikes 10 times as fast as he swims and runs 5 times as fast as he swims. The variable  $x$  in the expression above represents the rate at which the athlete swims, and the whole expression represents the number of hours that it takes him to complete the race. If it takes him 16.2 hours to complete the race, how many kilometers did he swim in 1 hour?

- A) 0.85
- B) 1.01
- C) 1.17
- D) 1.87



**Directions:** For questions 31-38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $\frac{7}{2}$ .

(If  $3\frac{1}{2}$  is entered into the grid as 

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)

- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Answer:  $\frac{7}{12}$

7	/	1	2
<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	2	2	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	3	3	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	4	4	4
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	5	5	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	7	7	7
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	8	8	8
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	9	9	9

Write answer in boxes. →

← Fraction line

Grid in result. →

Answer: 2.5

2	.	5
<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	2	2
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	3	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	4	4
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	5	5
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	7	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	8	8
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	9	9

← Decimal point

Answer: 201  
Either position is correct.

2	0	1
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	2	2
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	3	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	4	4

2	0	1
<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	2	2
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	3	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	4	4

Acceptable ways to grid  $\frac{2}{3}$  are:

2	/	3
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	2	2
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	3	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	4	4
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	5	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	6	6

.	6	6	6
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	2	2	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	3	3	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	4	4	4
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	5	5	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	6	6	6

.	6	6	7
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	2	2	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	3	3	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	4	4	4
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	5	5	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	6	6	6

31. What value of  $x$  satisfies the equation

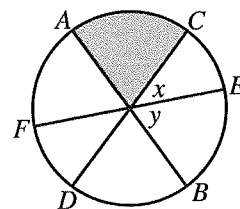
$$\frac{2}{3}(5x + 7) = 8x ?$$

32. Some doctors base the dosage of a drug to be given to a patient on the patient's body surface area (BSA). The most commonly used formula for

calculating BSA is  $BSA = \sqrt{\frac{wh}{3,600}}$ , where

$w$  is the patient's weight (in kg),  $h$  is the patient's height (in cm), and BSA is measured in square meters. How tall (in cm) is a patient who weighs 150 kg and has a BSA of  $2\sqrt{2}$  m<sup>2</sup>?

33. A college math professor informs her students that rather than curving final grades, she will replace each student's lowest test score with the next to lowest test score, and then re-average the test grades. If Leeza has test scores of 86, 92, 81, 64, and 83, by how many points does her final test average change based on the professor's policy?



34. In the figure above,  $\overline{AB}$ ,  $\overline{CD}$ , and  $\overline{EF}$  are diameters of the circle. If  $y = 2x - 12$ , and the shaded area is  $\frac{1}{5}$  of the circle, what is the value of  $x$ ?

35. If the slope of a line is  $-\frac{7}{4}$  and a point on the line is (4, 7), what is the  $y$ -intercept of the line?

36. Rory left home and drove straight to the airport at an average speed of 45 miles per hour. He returned home along the same route, but traffic slowed him down and he only averaged 30 miles per hour on the return trip. If his total travel time was 2 hours and 30 minutes, how far is it, in miles, from Rory's house to the airport?

Questions 37 and 38 refer to the following information.

**Chemical Makeup of One Mole of Chloroform**

Element	Number of Moles	Mass per Mole (grams)
Carbon	1	12.011
Hydrogen	1	1.008
Chlorine	3	35.453

A chemical solvent is a substance that dissolves another to form a solution. For example, water is a solvent for sugar. Unfortunately, many chemical solvents are hazardous to the environment. One eco-friendly chemical solvent is chloroform, also known as trichloromethane (CHCl<sub>3</sub>). The table above shows the chemical makeup of one mole of chloroform.

37. Carbon makes up what percent of the mass of one mole of chloroform? Round your answer to the nearest whole percent and ignore the percent sign when entering your answer.

38. If a chemist starts with 1,000 grams of chloroform and uses 522.5 grams, how many moles of chlorine are left?

**IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS SECTION ONLY. DO NOT TURN TO ANY OTHER SECTION IN THE TEST.**

**STOP**

**ANSWER KEY****READING TEST**

1. A	14. B	27. D	40. A
2. B	15. D	28. C	41. B
3. C	16. C	29. C	42. D
4. C	17. A	30. B	43. A
5. A	18. D	31. D	44. B
6. C	19. C	32. B	45. A
7. D	20. C	33. B	46. B
8. A	21. C	34. C	47. D
9. D	22. B	35. D	48. D
10. A	23. D	36. B	49. A
11. A	24. C	37. D	50. C
12. D	25. A	38. A	51. D
13. D	26. A	39. B	52. C

**WRITING AND LANGUAGE TEST**

1. C	12. B	23. C	34. B
2. D	13. B	24. B	35. A
3. B	14. B	25. D	36. C
4. C	15. A	26. B	37. C
5. A	16. A	27. B	38. B
6. C	17. C	28. C	39. C
7. B	18. A	29. B	40. B
8. D	19. B	30. C	41. A
9. C	20. C	31. B	42. D
10. C	21. D	32. D	43. D
11. A	22. D	33. A	44. C

**MATH—NO CALCULATOR**

- |      |       |       |        |
|------|-------|-------|--------|
| 1. C | 6. D  | 11. C | 16. 20 |
| 2. A | 7. D  | 12. B | 17. 1  |
| 3. D | 8. B  | 13. A | 18. 2  |
| 4. C | 9. B  | 14. D | 19. 14 |
| 5. B | 10. A | 15. A | 20. 6  |

**MATH—CALCULATOR**

- |       |       |       |         |
|-------|-------|-------|---------|
| 1. C  | 11. B | 21. C | 31. 1   |
| 2. C  | 12. D | 22. D | 32. 192 |
| 3. D  | 13. A | 23. B | 33. 3.4 |
| 4. A  | 14. D | 24. C | 34. 40  |
| 5. B  | 15. B | 25. D | 35. 14  |
| 6. C  | 16. B | 26. C | 36. 45  |
| 7. D  | 17. D | 27. A | 37. 10  |
| 8. B  | 18. A | 28. B | 38. 12  |
| 9. A  | 19. A | 29. B |         |
| 10. C | 20. A | 30. D |         |

44. C

**Difficulty:** Hard**Category:** Writing & Language / Organization

**Strategic Advice:** Examine the entire paragraph. Decide whether the sentence provides more information about a topic mentioned in one of the other sentences.

**Getting to the Answer:** This sentence provides more information related to sentence 1, "The Montreal Protocol is a living document"; it describes how the document is "living." Choice (C) is the correct answer.

## MATH TEST: NO-CALCULATOR SECTION

1. C

**Difficulty:** Easy**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** To determine what the  $y$ -intercept could mean in the context of a word problem, examine the labels on the graph and note what each axis represents.

**Getting to the Answer:** According to the labels, the  $y$ -axis represents cost, and the  $x$ -axis represents the number of games played. The  $y$ -intercept,  $(0, 5)$ , has an  $x$ -value of 0, which means 0 games were played, yet there is still a cost of \$5. The cost must represent a flat fee that is charged before any games are played, such as an entrance fee to enter the arcade.

2. A

**Difficulty:** Easy**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** To divide one rational expression by another, multiply the first expression by the reciprocal (the flip) of the second expression.

**Getting to the Answer:** Rewrite the division as multiplication, factor any factorable expressions, and then simplify if possible.

$$\begin{aligned} \frac{3x}{x+5} \div \frac{6}{4x+20} &= \frac{3x}{x+5} \cdot \frac{4x+20}{6} \\ &= \frac{3x}{\cancel{x+5}} \cdot \frac{4\cancel{(x+5)}}{6} \\ &= \frac{12x}{6} \\ &= 2x \end{aligned}$$

Note that the question also states that  $x \neq -5$ . This doesn't affect your answer—it is simply stated because the denominators of rational expressions cannot equal 0.

3. D

**Difficulty:** Easy**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** When the equation of a circle is written in the form  $(x - h)^2 + (y - k)^2 = r^2$ , the point  $(h, k)$  represents the center of the circle on a coordinate plane, and  $r$  represents the length of the radius.

**Getting to the Answer:** To find the area of a circle, use the formula,  $A = \pi r^2$ . In the equation given in the question,  $r^2$  is the constant on the right-hand side (25)—you don't even need to solve for  $r$  because the area formula involves  $r^2$ , not  $r$ . So, the area is  $\pi(25)$  or  $25\pi$ .

4. C

**Difficulty:** Easy**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** When using function notation,  $f(x)$  is simply another way of saying  $y$ , so this question is asking you to find the values of  $x$  for which  $y = 0$ , or in other words, where the graph crosses the  $x$ -axis.

**Getting to the Answer:** The graph crosses the  $x$ -axis at the points  $(-2, 0)$  and  $(3, 0)$ , so the values of  $x$  for which  $f(x) = 0$  are  $-2$  and  $3$ .

5. B

**Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Choose the best strategy to answer the question. You could start by cross-multiplying to get rid of the denominators, but simplifying the numerators first will make the calculations easier.

**Getting to the Answer:**

$$\begin{aligned}\frac{4(d+3)-9}{8} &= \frac{10-(2-d)}{6} \\ \frac{4d+12-9}{8} &= \frac{10-2+d}{6} \\ \frac{4d+3}{8} &= \frac{8+d}{6} \\ 6(4d+3) &= 8(8+d) \\ 24d+18 &= 64+8d \\ 16d &= 46 \\ d &= \frac{46}{16} = \frac{23}{8}\end{aligned}$$

6. D

**Difficulty:** Medium**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** This is a crossover question, so quickly skim the first couple of sentences. Then look for the relevant information in the last couple of sentences. It may also help to circle the portions of the graph that meet the given requirement.

**Getting to the Answer:** Because *greater* means *higher* on a graph, the statement  $f(t) > g(t)$  translates to "Where is  $f(t)$  above  $g(t)$ ?" The solid curve represents  $f$  and the dashed curve represents  $g$ , so  $f > g$  between the years 1960 and 1980 and again between the years 2000 and 2010. Look for these time intervals in the answer choices:  $1960 < t < 1980$  and  $2000 < t < 2010$ .

7. D

**Difficulty:** Medium**Category:** Passport to Advanced Math / Scatterplots

**Strategic Advice:** Use the shape of the data to predict the type of equation that might be used as a model. Then, use specific values from the graph to choose the correct equation.

**Getting to the Answer:** According to the graph, the population of the whales grew slowly at first and then more quickly. This means that an exponential model is probably the best fit, so you can eliminate A (linear) and B (quadratic). The remaining equations are both exponential, so choose a data point and see which equation is the closest fit. Be careful—the vertical axis represents *hundreds* of whales, and the question states that  $t$  represents the number of years since the study began, so  $t = 0$  for 1995,  $t = 3$  for 1998, and so on. If you use the data for 1995, which is the point (0, 100), the results are the same for both equations, so choose a different point. Using the data for 2007,  $t = 2007 - 1995 = 12$ , and the number of whales was 800. Substitute these values into C and D to see which one is true. Choice C is not true because  $800 \neq 100 \times 2^{12}$ . Choice (D) is correct because  $800 = 100 \times 2^{\frac{12}{4}} = 100 \times 2^3 = 100 \times 8$  is true.

8. B

**Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Average rate of change is the same as slope, so use the slope formula.

**Getting to the Answer:** To find the average rate of change over the 5-year period, find the slope between the starting point (0, 1,200) and the ending point (5, 100).

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{100 - 1,200}{5 - 0} = \frac{-1,100}{5} = -220$$

The average rate of change is negative because the laptop decreases in value over time.

Note: Because the question involves *straight-line* depreciation, you could have used any two points on the graph to find the slope. As a general rule, however, you should use the endpoints of the given time interval.

**9. B****Difficulty:** Medium**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** When multiplying polynomials, carefully multiply each term in the first factor by each term in the second factor. This question doesn't ask for the entire product, so check to make sure you answered the right question (the coefficient of  $x^2$ ).

**Getting to the Answer:**

$$\begin{aligned} & \left(6x^2 - \frac{2}{5}x + 1\right)\left(10x + \frac{1}{3}\right) \\ &= 6x^2\left(10x + \frac{1}{3}\right) - \frac{2}{5}x\left(10x + \frac{1}{3}\right) + 1\left(10x + \frac{1}{3}\right) \\ &= 60x^3 + \underline{2x^2} - 4x^2 - \frac{2}{15}x + 10x + \frac{1}{3} \end{aligned}$$

The coefficient of  $x^2$  is  $2 + (-4) = -2$ .

**10. A****Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Notice that there are no grid-lines and no numbers on the axes. This is a great clue that the numbers in the equations don't actually matter.

**Getting to the Answer:** The line is decreasing, so the slope ( $m$ ) is negative. The line crosses the  $y$ -axis below 0, so the  $y$ -intercept ( $b$ ) is also negative. Put each answer choice in slope-intercept form, one at a time, and examine the signs of  $m$  and  $b$ . Begin with A:

$$\begin{aligned} -6x - 4y &= 5 \\ -4y &= 6x + 5 \\ y &= \frac{6x}{-4} + \frac{5}{-4} \\ y &= -\frac{3}{2}x - \frac{5}{4} \end{aligned}$$

You don't need to check any of the other equations. Choice (A) has a negative slope and a negative  $y$ -intercept, so it is the correct equation.

**11. C****Difficulty:** Hard**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Graphically, a system of linear equations that has no solution indicates two parallel lines or, in other words, two lines that have the same slope. So, write each of the equations in slope-intercept form ( $y = mx + b$ ) and set their slopes ( $m$ ) equal to each other to solve for  $k$ . Before finding the slopes, multiply the top equation by 4 to make it easier to manipulate.

**Getting to the Answer:**

$$\begin{aligned} 4\left(\frac{3}{4}x - \frac{1}{2}y = 12\right) &\rightarrow 3x - 2y = 48 \rightarrow y = \frac{3}{2}x - 24 \\ kx - 2y = 22 &\rightarrow -2y = -kx + 22 \rightarrow y = \frac{k}{2}x - 11 \end{aligned}$$

The slope of the first line is  $\frac{3}{2}$ , and the slope of the second line is  $\frac{k}{2}$ . Set them equal and solve for  $k$ .

$$\begin{aligned} \frac{3}{2} &= \frac{k}{2} \\ 2(3) &= 2(k) \\ 6 &= 2k \\ 3 &= k \end{aligned}$$

12. B

**Difficulty:** Hard

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Pay careful attention to units, particularly when a question involves rates. The \$4.00 for the first  $\frac{1}{4}$  mile is a flat fee. Before you write the inequality, you need to find the per-mile rate for the remaining miles.

**Getting to the Answer:** The driver charges \$4.00 for the first  $\frac{1}{4}$  mile, which is a flat fee, so write 4.

The additional charge is \$1.50 per  $\frac{1}{2}$  mile, or 1.50 times 2 = \$3.00 per mile. The number of miles after the first  $\frac{1}{4}$  mile is  $m - \frac{1}{4}$ , so the cost of the trip, not including the first  $\frac{1}{4}$  mile, is  $3\left(m - \frac{1}{4}\right)$ . This means

the cost of the whole trip is  $4 + 3\left(m - \frac{1}{4}\right)$ . The clue “no more than \$10” means that much or less, so use the symbol  $\leq$ . The inequality is  $4 + 3\left(m - \frac{1}{4}\right) \leq 10$ , which simplifies to  $3.25 + 3m \leq 10$ .

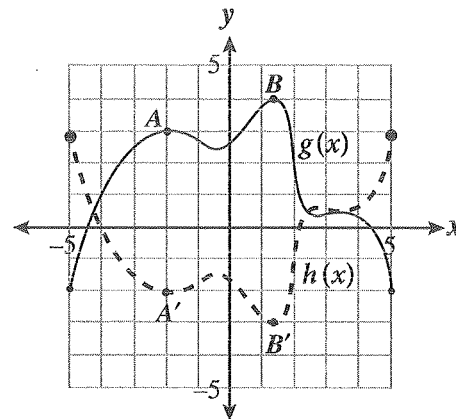
13. A

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Think about how the transformations affect the graph of  $g(x)$  and draw a sketch of  $h(x)$  on the same grid. Compare the new graph to each of the answer choices until you find one that is true.

**Getting to the Answer:** The graph of  $h(x) = -g(x) + 1$  is a vertical reflection of  $g(x)$ , over the  $x$ -axis, that is then shifted up 1 unit. The graph looks like the dashed line in the following graph:



Now, compare the dashed line to each of the answer choices: the range of  $h(x)$  is the set of  $y$ -values from lowest to highest (based on the dashed line). The lowest point occurs at point  $B'$  and has a  $y$ -value of  $-3$ ; the highest value occurs at both ends of the graph and is 3, so the range is  $-3 \leq y \leq 3$ . This means (A) is correct and you can move on to the next question. Don't waste valuable time checking the other answer choices unless you are not sure about the range. (Choice B: The minimum value of  $h(x)$  is  $-3$ , not  $-4$ . Choice C: The coordinates of point  $A$  on  $h(x)$  are  $(-2, -2)$ , not  $(2, 4)$ . Choice D: The graph of  $h(x)$  is decreasing, not increasing, between  $x = -5$  and  $x = -2$ .)

14. D

**Difficulty:** Medium

**Category:** Additional Topics in Math / Imaginary Numbers

**Strategic Advice:** Multiply the two complex numbers just as you would two binomials (using FOIL). Then, combine like terms and use the definition  $i^2 = -1$  to simplify the result.



**Getting to the Answer:**

$$\begin{aligned}
 (3+2i)(5-i) &= 3(5-i) + 2i(5-i) \\
 &= 15 - 3i + 10i - 2i^2 \\
 &= 15 + 7i - 2(-1) \\
 &= 15 + 7i + 2 \\
 &= 17 + 7i
 \end{aligned}$$

The question asks for  $a$  in  $a + bi$ , so the correct answer is 17.

**15. A****Difficulty:** Hard**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Think of the rate given in the question in terms of the constant term you see on the right-hand side of the equation. Working together, the two treatment plants can filter the water in 72 hours. This is equivalent to saying that they can filter  $\frac{1}{72}$  of the water in 1 hour.

**Getting to the Answer:** If  $\frac{1}{72}$  is the portion of the water the two treatment plants can filter *together*, then each term on the left side of the equation represents the portion that each plant can filter *individually* in 1 hour. Because the new facility is 4 times as fast as the older facility,  $\frac{4}{x}$  represents the portion of the water the new plant can filter in 1 hour, and  $\frac{1}{x}$  represents the portion of the water the older plant can filter in 1 hour.

**16. 20****Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Only one equation is given, and it has two variables. This means that you don't have enough information to solve for either variable. Instead, look for the relationship between the variable terms in the equation and those in the expression that you are trying to find,  $x + 2y$ .

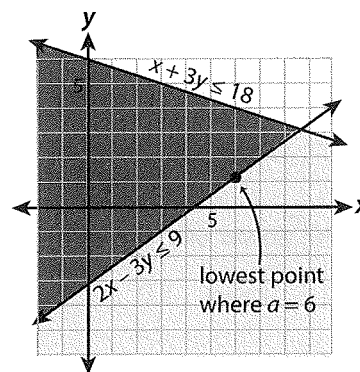
**Getting to the Answer:** First, move the  $y$ -term to the left side of the equation to make it look more like the expression you are trying to find. The expression doesn't have fractions, so clear the fractions in the equation by multiplying both sides by 4. This yields the expression that you are looking for,  $x + 2y$ , so no further work is required—just read the value on the right-hand side of the equation. The answer is 20.

$$\begin{aligned}
 \frac{1}{4}x &= 5 - \frac{1}{2}y \\
 \frac{1}{4}x + \frac{1}{2}y &= 5 \\
 4\left(\frac{1}{4}x + \frac{1}{2}y\right) &= 4(5) \\
 x + 2y &= 20
 \end{aligned}$$

**17. 1****Difficulty:** Medium**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** This question is extremely difficult to answer unless you draw a sketch. It doesn't have to be perfect—you just need to get an idea of where the solution region is. Don't forget to flip the inequality symbol when you graph the second equation.

**Getting to the Answer:** Sketch the system.



If  $(a, b)$  is a solution to the system, then  $a$  is the  $x$ -coordinate of any point in the darkest shaded region and  $b$  is the corresponding  $y$ -coordinate. When  $a = 6$ , the minimum possible value for  $b$  lies

on the lower boundary line,  $2x - 3y \leq 9$ . It looks like the  $y$ -coordinate is 1, but to be sure, substitute  $x = 6$  into the equation and solve for  $y$ . You can use  $=$  in the equation, instead of the inequality symbol, because you are finding a point on the boundary line.

$$\begin{aligned} 2x - 3y &= 9 \\ 2(6) - 3y &= 9 \\ 12 - 3y &= 9 \\ -3y &= -3 \\ y &= 1 \end{aligned}$$

18. 2

**Difficulty:** Hard**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Rewrite the radicals as fraction exponents:  $\sqrt{x} = x^{\frac{1}{2}}$  and  $\sqrt[3]{x} = x^{\frac{1}{3}}$ .

**Getting to the Answer:** Write each factor in the expression in exponential form. Then use the rules of exponents to simplify the expression. Add the exponents of the factors that are being multiplied and subtract the exponent of the factor that is being divided:

$$\begin{aligned} \frac{\sqrt{x} \cdot x^{\frac{5}{6}} \cdot x}{\sqrt[3]{x}} &= \frac{x^{\frac{1}{2}} \cdot x^{\frac{5}{6}} \cdot x^1}{x^{\frac{1}{3}}} \\ &= x^{\frac{1}{2} + \frac{5}{6} + 1 - \frac{1}{3}} \\ &= x^{\frac{3}{6} + \frac{5}{6} + \frac{6}{6} - \frac{2}{6}} \\ &= x^{\frac{12}{6}} = x^2 \end{aligned}$$

Because  $n$  is the power of  $x$ , the value of  $n$  is 2.

19. 14

**Difficulty:** Hard**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** The shaded region is the area of the larger triangle minus the area of the smaller triangle. Set up and solve an equation using the information from the figure. Before you grid in your answer, check that you answered the right question (height of larger triangle).

**Getting to the Answer:** You don't know the height of the smaller triangle, so call it  $h$ . You do know the area of the shaded region—it's 52 square units.

Larger triangle: base = 12; height =  $h + 3 + 3$

Smaller triangle: base = 8; height =  $h$

Shaded area = large area – small area

$$\begin{aligned} 52 &= \left[ \left( \frac{1}{2} \right) (12)(h+6) \right] - \left[ \left( \frac{1}{2} \right) (8)(h) \right] \\ 52 &= 6(h+6) - 4h \\ 52 &= 6h + 36 - 4h \\ 52 &= 2h + 36 \\ 16 &= 2h \\ 8 &= h \end{aligned}$$

The question asks for the height of the *larger* triangle, so the correct answer is  $8 + 3 + 3 = 14$ .

20. 6

**Difficulty:** Hard**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** The highest power of  $x$  in the equation is 2, so the function is quadratic. Writing quadratic equations can be tricky and time-consuming. If you know the roots, you can use factors to write the equation. If you don't know the roots, you need to create a system of equations to find the coefficients of the variable terms.

**Getting to the Answer:** You don't know the roots of this equation, so start with the point that has the easiest values to work with, (0, 1), and substitute them into the equation  $y = ax^2 + bx + c$ .

$$1 = a(0)^2 + b(0) + c$$

$$1 = c$$

Now your equation looks like  $y = ax^2 + bx + 1$ . Next, use the other two points to create a system of two equations in two variables.

$$(-3, 10) \rightarrow 10 = a(-3)^2 + b(-3) + 1 \rightarrow 9 = 9a - 3b$$

$$(2, 15) \rightarrow 15 = a(2)^2 + b(2) + 1 \rightarrow 14 = 4a + 2b$$

You now have a system of equations to solve. None of the variables has a coefficient of 1, so use elimination to solve the system. If you multiply the top equation by 2 and the bottom equation by 3, the  $b$ -terms will eliminate each other.

$$2[9a - 3b = 9] \rightarrow 18a - 6b = 18$$

$$3[4a + 2b = 14] \rightarrow \underline{12a + 6b = 42}$$

$$30a = 60$$

$$a = 2$$

Now, find  $b$  by substituting  $a = 2$  into either of the original equations. Using the top equation, you get:

$$9(2) - 3b = 9$$

$$18 - 3b = 9$$

$$-3b = -9$$

$$b = 3$$

The value of  $a + b + c$  is  $2 + 3 + 1 = 6$ .

## MATH TEST: CALCULATOR SECTION

### 1. C

**Difficulty:** Easy

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** You can use the formula

$$\text{Percent} = \frac{\text{Part}}{\text{Whole}} \times 100\% \text{ whenever you know two}$$

out of the three quantities.

**Getting to the Answer:** The clue "all" tells you that the "whole" is what you don't know. The percent is 96.5, and the part is 321,000,000.

$$96.5 = \frac{321,000,000}{w} \times 100\%$$

$$96.5w = 32,100,000,000$$

$$w = \frac{32,100,000,000}{96.5}$$

$$w = 332,642,487$$

The answer choices are rounded to the nearest thousand, so the answer is 332,642,000.

### 2. C

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** A *one-time* fee does not depend on the variable and is therefore a constant. A unit rate, however, is always multiplied by the independent variable.

**Getting to the Answer:** The total cost consists of the site visit fee (a constant), an hourly cost (which depends on the number of hours), and the cost of the materials (which are taxed). The constant in the equation is 75 and is therefore the site visit fee; 45 is being multiplied by  $h$  (the number of hours), so \$45 must be the hourly rate. That leaves the remaining term,  $1.06(82.5)$ , which must be the cost of the materials (\$82.50) plus a 6% tax.

## 3. D

**Difficulty:** Easy

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** The intersection (overlap) of the two shaded regions is the solution to the system of inequalities. Check each point to see whether it lies in the region with the darkest shading. Don't forget to check that you answered the right question—you are looking for the point that is *not* a solution to the system.

**Getting to the Answer:** Each of the first three points clearly lies in the overlap. The point (3, 3) looks like it lies on the dashed line, which means it is *not* included in the solution. To check this, plug (3, 3) into the easier inequality:  $3 \not> 3$  (3 is equal to itself, not greater than itself), so (D) is correct.

## 4. A

**Difficulty:** Easy

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** Quadratic equations can be written in several forms, each of which reveals something special about the graph. For example, the vertex form of a quadratic equation gives the minimum or maximum value of the function, while the standard form reveals the  $y$ -intercept.

**Getting to the Answer:** The factored form of a quadratic equation reveals the solutions to the equation, which graphically represent the  $x$ -intercepts. Choice (A) is the only equation written in this form and therefore must be correct. You can set each factor equal to 0 and solve to find that the  $x$ -intercepts of the graph are  $x = \frac{5}{2}$  and  $x = -1$ .

## 5. B

**Difficulty:** Easy

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Break the question into steps. Before you can use the ratio, you need to find the percent of the students who answered either "Foreign Policy" or "Environment."

**Getting to the Answer:** The ratio given in the question is 5:3, so write this as 5 parts "Foreign Policy" and 3 parts "Environment." You don't know how big a *part* is, so call it  $x$ . This means that  $5x + 3x =$  the percent of the students who answered either "Foreign Policy" or "Environment," which is 100% – all the other answers:

$$\begin{aligned} 100 - (16 + 14 + 9 + 5) &= 100 - 44 = 56 \\ 5x + 3x &= 56 \\ 8x &= 56 \\ x &= 7 \end{aligned}$$

Each part has a value of 7, and 3 parts answered "Environment," so the correct percentage is  $3(7) = 21\%$ .

## 6. C

**Difficulty:** Easy

**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** Examine both the shape and the direction of the data to pick the best description of the association.

**Getting to the Answer:** A data set that has a linear association follows the path of a straight line; a data set that is exponential follows a path that is similar to linear data, but with a curve to it because the rate of increase (or decrease) changes over time. This data set has a curve to it, so "exponential" describes the association better than "linear." This means you can eliminate A and B. A positive association between two variables is one in which higher values of one variable correspond to higher values of the other variable, and vice versa. In other words, as the  $x$ -values of the data points go up, so do the  $y$ -values. This is indeed the case for this data set, so (C) is correct.

**7. D****Difficulty:** Easy**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** Your only choice for this question is to compare each statement to the figure. Don't waste time trying to figure out the exact value for each bar—an estimate is good enough to determine whether each statement is true.

**Getting to the Answer:** Choice A is incorrect because the price in 2008 was slightly less (not more) than \$3.50, while the price in 2013 was right around \$3.50. Choice B is incorrect because the price in 2003 was more than \$2.00, and the price in 2013 was not more than twice that (\$4.00). Choice C is incorrect because the price in 2008 was about \$3.25 and the price in 2009 was about \$2.75—this is not a difference of more than \$1.00. This means (D) must be correct. You don't have to check it—just move on. (Between 2003 and 2008, the change in price was about  $\$3.40 - \$2.30 = \$1.10$ ; between 2008 and 2013, the change in price was only about  $\$3.50 - \$3.40 = \$0.10$ ; the change in price was greater between 2003 and 2008.)

**8. B****Difficulty:** Medium**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Because none of the variable terms has a coefficient of 1, solve the system of equations using elimination by addition (combining the equations). Before you choose an answer, check that you answered the right question (the sum of  $x$  and  $y$ ).

**Getting to the Answer:** Multiply the top equation by 2 to eliminate the terms that have  $y$ 's in them.

$$\begin{array}{r} 2[-2x + 5y = 1] \rightarrow -4x + 10y = 2 \\ 7x - 10y = -11 \rightarrow \underline{7x - 10y = -11} \\ \hline 3x \qquad = -9 \\ x \qquad = -3 \end{array}$$

Now, substitute the result into either of the original equations and simplify to find  $y$ :

$$\begin{array}{r} -2x + 5y = 1 \\ -2(-3) + 5y = 1 \\ 6 + 5y = 1 \\ 5y = -5 \\ y = -1 \end{array}$$

The question asks for the *sum*, so add  $x$  and  $y$  to get  $-3 + (-1) = -4$ .

**9. A****Difficulty:** Medium**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Take a quick peek at the answers just to see what variables are being used, but don't study the equations. Instead, write your own system using the same variables as given in the answer choices.

**Getting to the Answer:** One of the equations in the system should represent the sum of the two resistors ( $R_1 + R_2$ ), which is equal to 294. This means you can eliminate C and D. The second equation needs to satisfy the condition that  $R_2$  is 6 less than twice  $R_1$ , or  $R_2 = 2R_1 - 6$ . This means (A) is correct.

**10. C****Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Use the distributive property to simplify each of the terms that contains parentheses. Then use inverse operations to solve for  $x$ .

**Getting to the Answer:**

$$\begin{aligned} \frac{2}{5}(3x) + 2(x-1) &= 4(x+1) - 2 \\ 2x + 2x - 2 &= 4x + 4 - 2 \\ 4x - 2 &= 4x + 2 \\ -2 &\neq 2 \end{aligned}$$

All of the variable terms cancel out, and the resulting numerical statement is false (because negative 2 does not equal positive 2), so there is no solution to the equation. Put another way, there is no value of  $x$  for which the equation is true.

**11. B****Difficulty:** Medium**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** Think about this question logically before you start writing things down—after it's transferred, the volume of the oil in the cylindrical container will be the same volume as the rectangular container, so you need to set the two volumes equal and solve for  $h$ .

**Getting to the Answer:** The volume of the rectangular container is  $4 \times 9 \times 10$ , or 360 cubic meters. The volume of a cylinder equals the area of its base times its height, or  $\pi r^2 h$ . Because the diameter is 6 meters, the radius,  $r$ , is half that, or 3 meters. Now we're ready to set up an equation and solve for  $h$  (which is the height of the cylinder or, in this case, the length of the transportation container):

Volume of oil = Volume of rectangular container

$$\begin{aligned} \pi(3)^2 h &= 360 \\ 9\pi h &= 360 \\ h &= \frac{360}{9\pi} = \frac{40}{\pi} \end{aligned}$$

**12. D****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Even though this question uses the word *percent*, you are never asked to find the actual percent itself. Set this question up as a proportion to get the answer more quickly. Remember, percent change equals amount of change divided by the original amount.

**Getting to the Answer:**

$$\begin{aligned} \frac{12-5}{5} &= \frac{x-12}{12} \\ \frac{7}{5} &= \frac{x-12}{12} \\ 12(7) &= 5(x-12) \\ 84 &= 5x - 60 \\ 144 &= 5x \\ 28.8 &= x \end{aligned}$$

**13. A****Difficulty:** Medium**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Don't spend too much time reading the scientific explanation of the equation. Focus on the question at the very end—it's just asking you to solve the equation for  $d$ .

**Getting to the Answer:** First, cross-multiply to get rid of the denominator. Then, divide both sides of the equation by  $4\pi b$  to isolate  $d^2$ . Finally, take the square root of both sides to find  $d$ .

$$\begin{aligned}
 b(4\pi d^2) &= L \\
 \frac{b(4\pi d^2)}{4\pi b} &= \frac{L}{4\pi b} \\
 d^2 &= \frac{L}{4\pi b} \\
 \sqrt{d^2} &= \sqrt{\frac{L}{4\pi b}} \\
 d &= \sqrt{\frac{L}{4\pi b}}
 \end{aligned}$$

Unfortunately, this is not one of the answer choices, so you'll need to simplify further. You can take the square root of 4 (it's 2), but be careful—it's in the denominator of the fraction, so it comes out of the square root as  $\frac{1}{2}$ .

The simplified equation is  $d = \frac{1}{2} \sqrt{\frac{L}{\pi b}}$ .

#### 14. D

**Difficulty:** Easy

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** You do not need to use all of the information presented in the table to find the answer. Read the question carefully to make sure you use only what you need.

**Getting to the Answer:** To calculate the percentage of men in each age group who reported being unemployed in January 2014, divide the number in *that* age group who were unemployed by the total number in *that* age group. There are six age groups but only four answer choices, so don't waste time on the age groups that aren't represented. Choice (D) is correct because  $7 \div 152 \approx 0.046 = 4.6\%$ , which is a lower percentage than that for any other age group (20 to 24 = 12.5%; 35 to 44 = 4.9%; 45 to 54 = 6.1%).

#### 15. B

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** The follow-up survey targets only those respondents who said they were unemployed, so focus on that column in the table.

**Getting to the Answer:** There were 6 respondents out of 44 unemployed males who were between the ages of 45 and 54, so the probability is  $\frac{6}{44} = 0.136$ , or about 13.6%.

#### 16. B

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** Taking the square root is the inverse operation of squaring, and both sides of the equation are already perfect squares, so take their square roots. Then solve the resulting equations. Remember, there will be two equations to solve.

**Getting to the Answer:**

$$\begin{aligned}
 (x-1)^2 &= \frac{4}{9} \\
 \sqrt{(x-1)^2} &= \sqrt{\frac{4}{9}} \\
 x-1 &= \pm \frac{\sqrt{4}}{\sqrt{9}} \\
 x &= 1 \pm \frac{2}{3}
 \end{aligned}$$

Now, simplify each equation:  $x = 1 + \frac{2}{3} = \frac{3}{3} + \frac{2}{3} = \frac{5}{3}$

and  $x = 1 - \frac{2}{3} = \frac{3}{3} - \frac{2}{3} = \frac{1}{3}$ .

#### 17. D

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** The key to answering this question is to determine how many darts land in each color ring. If there are 6 darts total and  $x$  land in a blue ring, the rest, or  $6 - x$ , must land in a red ring.

**Getting to the Answer:** Write the expression in words first: points per blue ring (5) times number of darts in blue ring ( $x$ ), plus points per red ring (10) times number of darts in red ring ( $6 - x$ ). Now, translate the words into numbers, variables, and operations:  $5x + 10(6 - x)$ . This is not one of the answer choices, so simplify the expression by distributing the 10 and then combining like terms:  $5x + 10(6 - x) = 5x + 60 - 10x = 60 - 5x$ .

18. A

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** This is a science crossover question. Read the first two sentences quickly—they are simply describing the context of the question. The last two sentences pose the question, so read those more carefully.

**Getting to the Answer:** In the sample, 184 out of 200 square feet were free of red tide after applying the spray. This is  $\frac{184}{200} = 0.92 = 92\%$  of the area. For the whole beach,  $0.92(10,000) = 9,200$  square feet should be free of the red tide. Be careful—this is *not* the answer. The question asks how much of the beach would still be covered by red tide, so subtract to get  $10,000 - 9,200 = 800$  square feet.

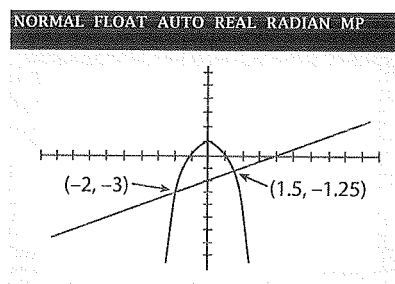
19. A

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** The solution to a system of equations is the point(s) where their graphs intersect. You can solve the system algebraically by setting the equations equal to each other, or you can solve it graphically using your calculator. Use whichever method gets you to the answer more quickly.

**Getting to the Answer:** Both equations are given in calculator-friendly format ( $y = \dots$ ), so graphing them is probably the more efficient approach. The graph looks like:



The solution point in the question is given as  $(a, b)$ , so  $b$  represents the  $y$ -coordinate of the solution. The  $y$ -coordinates of the points of intersection are  $-3$  and  $-1.25$ , so choice (A) is correct.

20. A

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Don't answer this question too quickly—you may be tempted to substitute 3 for  $x$ , but 3 is the output (range), not the input (domain).

**Getting to the Answer:** The given range value is an output value, so substitute 3 for  $g(x)$  and use inverse operations to solve for  $x$ , which is the corresponding domain value.

$$g(x) = \frac{2}{3}x + 7$$

$$3 = \frac{2}{3}x + 7$$

$$-4 = \frac{2}{3}x$$

$$-12 = 2x$$

$$-6 = x$$

You could also graph the function and find the value of  $x$  (the domain value) for which the value of  $y$  (the range value) is 3. The point on the graph is  $(-6, 3)$ .



**21. C****Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Don't peek at the answers. Write your own equation using the initial cost and the rate of change in the value of the lawn mower. Remember—when something changes at a constant rate, it can be represented by a linear equation.

**Getting to the Answer:** When a linear equation in the form  $y = mx + b$  is used to model a real-world scenario,  $m$  represents the constant rate of change, and  $b$  represents the starting amount. Here, the starting amount is easy—it's the purchase price, \$2,800. To find the rate of change, think of the initial cost as the value at 0 years, or the point (0, 2,800), and the salvage amount as the value at 8 years, or the point (8, 240). Substitute these points into the slope formula to find that  $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{240 - 2,800}{8 - 0} = \frac{-2,560}{8} = -320$ , so the equation is  $y = -320x + 2,800$ .

**22. D****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Functions

**Strategic Advice:** Determine whether the change in the number of bacteria is a common difference (linear function) or a common ratio (exponential function) or if the number of bacteria changes direction (quadratic or polynomial function).

**Getting to the Answer:** The question tells you that the number of bacteria is reduced by half every hour after the antibiotic is applied. The microbiologist started with 20,000, so after one hour, there are 10,000 left, or  $20,000 \times \frac{1}{2}$ . After 2 hours, there are 5,000 left, or  $20,000 \times \frac{1}{2} \times \frac{1}{2}$ , and so on. The change in the number of bacteria is a common ratio  $\left(\frac{1}{2}\right)$ ,

so the best model is an exponential function of the form  $y = a\left(\frac{1}{2}\right)^x$ . In this scenario,  $a$  is 20,000.

**23. B****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Let the units in this question guide you to the solution. The speeds of the airplanes are given in miles per hour, but the question asks about the number of miles each airplane can travel in 12 seconds, so convert miles per hour to miles per second.

**Getting to the Answer:***Slower airplane:*

$$\frac{600 \text{ mi}}{\text{hr}} \times \frac{1 \text{ hr}}{60 \text{ min}} \times \frac{1 \text{ min}}{60 \text{ sec}} \times 12 \text{ sec} = 2 \text{ mi}$$

*Faster airplane:*

$$\frac{720 \text{ mi}}{\text{hr}} \times \frac{1 \text{ hr}}{60 \text{ min}} \times \frac{1 \text{ min}}{60 \text{ sec}} \times 12 \text{ sec} = 2.4 \text{ mi}$$

The faster plane can travel  $2.4 - 2 = 0.4$  miles farther, which is the same as  $\frac{2}{5}$  miles.

**24. C****Difficulty:** Medium**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** The best way to answer this question is to pretend you are the worker. How much more would you earn for one hour in Oregon than in Idaho? If you worked 35 hours per week, how much more would this be? If you worked 40 hours per week, how much more would this be?

**Getting to the Answer:** Based on the data in the table, a worker would earn  $\$9.10 - \$7.25 = \$1.85$  more for one hour of work in Oregon than in Idaho.

If he worked 35 hours per week, he would earn  $35(1.85) = \$64.75$  more. If he worked 40 hours per week, he would earn  $40(1.85) = \$74$  more. So, the worker would earn somewhere between  $\$64.75$  and  $\$74$  more per week, which can be expressed as the compound inequality  $64.75 \leq x \leq 74$ .

25. D

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** This is another question where the units can help you find the answer. Use the number of vehicles owned to find the total number of miles driven to find the total number of gallons of gas used to find the total tax paid. Phew!

**Getting to the Answer:**

$$1.75 \cancel{\text{ vehicles}} \times \frac{11,340 \text{ miles}}{\cancel{\text{ vehicle}}} = 19,845 \text{ miles}$$

$$19,845 \cancel{\text{ miles}} \times \frac{1 \text{ gallon of gas}}{21.4 \cancel{\text{ miles}}} = 927.336 \text{ gallons}$$

$$927.336 \cancel{\text{ gallons}} \times \frac{\$0.184}{\cancel{\text{ gallon}}} = \$170.63$$

26. C

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** The average rate of change of a function over a given interval, from  $a$  to  $b$ , compares the change in the outputs,  $f(b) - f(a)$ , to the change in the inputs,  $b - a$ . In other words, it is the slope of the line that connects the endpoints of the interval, so you can use the slope formula.

**Getting to the Answer:** Look at the quadratic model, not the data points, to find that the endpoints of the given interval, week 2 to week 8, are (2, 280) and (8, 400). The average rate of change is

$$\frac{400 - 280}{8 - 2} = \frac{120}{6} = 20.$$

On average, the dolphin's weight increased by 20 pounds per week.

27. A

**Difficulty:** Hard

**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** In this question, information is given in both the diagram and the text. You need to relate the text to the diagram, one piece of information at a time, to calculate how long the lifeguard ran along the beach and how long he swam. Before you find the swim time, you need to know how far he swam.

**Getting to the Answer:** Whenever you see a right triangle symbol in a diagram, you should think Pythagorean theorem or, in this question, special right triangles. All multiples of 3-4-5 triangles are right triangles, so the length of the lifeguard's swim is the hypotenuse of a 30-40-50 triangle, or 50 feet. Add this number to the diagram. Now calculate the times using the distances and the speeds given. Don't forget the 1 second that the lifeguard paused.

$$\text{Run time} = 60 \cancel{\text{ ft}} \times \frac{1 \text{ sec}}{12 \cancel{\text{ ft}}} = \frac{60}{12} = 5 \text{ sec}$$

$$\text{Pause time} = 1 \text{ sec}$$

$$\text{Swim time} = 50 \cancel{\text{ ft}} \times \frac{1 \text{ sec}}{5 \cancel{\text{ ft}}} = \frac{50}{5} = 10 \text{ sec}$$

$$\text{Total time} = 5 + 1 + 10 = 16 \text{ seconds}$$

28. B

**Difficulty:** Hard

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Write an equation in words first and then translate from English to math. Finally, rearrange your equation to find what you're interested in, which is the initial amount of gasoline.

**Getting to the Answer:** Call the initial amount  $A$ . After you've written your equation, solve for  $A$ .

Amount now ( $x$ ) = Initial amount ( $A$ ) minus  $y$ , plus 50

$$x = A - y + 50$$

$$x + y - 50 = A$$

The initial amount was  $x + y - 50$  gallons. Note that you could also use Picking Numbers to answer this question.

### 29. B

**Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** When a question involves reading data from a graph, it is sometimes better to skip an answer choice if it involves long calculations. Skim the answer choices for this question—A involves finding two averages, each of which is composed of 7 data values. Skip this choice for now.

**Getting to the Answer:** Start with (B). Be careful—you are not looking for places where the line segments are increasing. The  $y$ -axis already represents the change in prices, so you are simply counting the number of positive values for the imports (5) and for the exports (4). There are more for the imports, so (B) is correct and you don't need to check any of the other statements. Move on to the next question.

### 30. D

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** The key to answering this question is deciding what you're trying to find. The question tells you that  $x$  represents the athlete's swim rate, and you are looking for the number of kilometers he swam in one hour—these are the same thing. If you find  $x$  (in kilometers per hour), you will know how many kilometers he swam in one hour.

**Getting to the Answer:** Set the equation equal to the total time, 16.2, and solve for  $x$ . To do this, write the variable terms over a common denominator,  $10x$ , and combine them into a single term. Then cross-multiply and go from there.

$$16.2 = \frac{10\left(\frac{3.86}{x}\right) + \frac{180.2}{10x} + \frac{2\left(\frac{42.2}{5x}\right)}{10x}$$

$$16.2 = \frac{38.6}{10x} + \frac{180.2}{10x} + \frac{84.4}{10x}$$

$$16.2 = \frac{303.2}{10x}$$

$$10x(16.2) = 303.2$$

$$162x = 303.2$$

$$x = \frac{303.2}{162} \approx 1.87$$

### 31. 1

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Choose the best strategy to answer the question. If you distribute the  $\frac{2}{3}$ , it creates messy calculations. Instead, clear the fraction by multiplying both sides of the equation by 3. Then use the distributive property and inverse operations to solve for  $x$ .

**Getting to the Answer:**

$$\frac{2}{3}(5x + 7) = 8x$$

$$\cancel{3} \cdot \frac{2}{\cancel{3}}(5x + 7) = 3 \cdot 8x$$

$$2(5x + 7) = 24x$$

$$10x + 14 = 24x$$

$$14 = 14x$$

$$1 = x$$

### 32. 192

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** This looks like a word problem, but don't let it intimidate you. Once you read it, you'll see that it boils down to substituting a few given values for the variables and solving the equation.

**Getting to the Answer:** Before you start substituting values, quickly check that the units given match the units required to use the equation—they

do, so proceed. The patient's weight ( $w$ ) is 150 and the patient's BSA is  $2\sqrt{2}$ , so the equation becomes  $2\sqrt{2} = \sqrt{\frac{150h}{3,600}}$ . The only variable left in the equation is  $h$ , and you are trying to find the patient's height, so you're ready to solve the equation. To do this, square both sides of the equation and then continue using inverse operations. Be careful when you square the left side—you must square both the 2 and the root 2.

$$\begin{aligned} 2\sqrt{2} &= \sqrt{\frac{150h}{3,600}} \\ (2\sqrt{2})^2 &= \left(\sqrt{\frac{150h}{3,600}}\right)^2 \\ 2^2(\sqrt{2})^2 &= \frac{150h}{3,600} \\ 4(2) &= \frac{150h}{3,600} \\ 28,800 &= 150h \\ 192 &= h \end{aligned}$$

**33. 3.4****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** The test average is the same as the mean of the data. The *mean* is the sum of all the values divided by the number of values. Break the question into short steps to keep your calculations organized. Before gridding in your answer, make sure you answered the right question (how much the final test average changes).

**Getting to the Answer:***Step 1:* Find the original test average:

$$\frac{86 + 92 + 81 + 64 + 83}{5} = \frac{406}{5} = 81.2.$$

*Step 2:* Find the average of the tests after replacing the lowest score (64) with the next to lowest score (81):

$$\frac{86 + 92 + 81 + 81 + 83}{5} = \frac{423}{5} = 84.6.$$

*Step 3:* Subtract the original average from the new average:  $84.6 - 81.2 = 3.4$ .**34. 40****Difficulty:** Hard**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** Because  $\overline{AB}$ ,  $\overline{CD}$ , and  $\overline{EF}$  are diameters, the sum of  $x$ ,  $y$ , and the interior angle of the shaded region is 180 degrees. The question tells you that the shaded region is  $\frac{1}{5}$  of the circle, so the interior angle must equal  $\frac{1}{5}$  of the degrees in the whole circle, or  $\frac{1}{5}$  of 360.

**Getting to the Answer:** Use what you know about  $y$  (that it is equal to  $2x - 12$ ) and what you know about the shaded region (that it is  $\frac{1}{5}$  of 360 degrees) to write and solve an equation.

$$x + y + \frac{1}{5}(360) = 180$$

$$x + (2x - 12) + 72 = 180$$

$$3x + 60 = 180$$

$$3x = 120$$

$$x = 40$$

**35. 14****Difficulty:** Hard**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** When you know the slope and one point on a line, you can use  $y = mx + b$  to write the equation. Substitute the slope for  $m$  and the coordinates of the point for  $x$  and  $y$  and then solve for  $b$ , the  $y$ -intercept of the line.

**Getting to the Answer:** The slope is given as  $-\frac{7}{4}$ , so substitute this for  $m$ . The point is given as (4, 7), so  $x = 4$  and  $y = 7$ . Now, find  $b$ :

$$y = mx + b$$

$$7 = -\frac{7}{4}(4) + b$$

$$7 = -7 + b$$

$$14 = b$$

The  $y$ -intercept of the line is 14.

You could also very carefully graph the line using the given point and the slope. Start at (4, 7) and move toward the  $y$ -axis by rising 7 and running *to the left* 4 (because the slope is negative). You should land at the point (0, 14).

### 36. 45

**Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Make a chart that represents rate, time, and distance and fill in what you know. Then use your table to solve for distance. If it took Rory  $t$  hours to get to the airport, and the total trip took 2 hours and 30 minutes (or 2.5 hours), how long (in terms of  $t$ ) did the return trip take?

**Getting to the Answer:**

	Rate	Time	Distance
To airport	45 mph	$t$	$d$
Back to home	30 mph	$2.5 - t$	$d$

Now use the formula  $d = r \times t$  for both parts of the trip:  $d = 45t$  and  $d = 30(2.5 - t)$ . Because both are equal to  $d$ , you can set them equal to each other and solve for  $t$ :

$$45t = 30(2.5 - t)$$

$$45t = 75 - 30t$$

$$75t = 75$$

$$t = 1$$

Now plug back in to solve for  $d$ :

$$d = 45t$$

$$d = 45(1)$$

$$d = 45$$

### 37. 10

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** You don't need to know chemistry to answer this question. All the information you need is in the table. Use the formula

$$\text{Percent} = \frac{\text{Part}}{\text{Whole}} \times 100\%$$

**Getting to the Answer:** To use the formula, find the part of the mass represented by the carbon; there is 1 mole of carbon, and it has a mass of 12.011 grams. Next, find the whole mass of the mole of chloroform; 1 mole carbon (12.011 g) + 1 mole hydrogen (1.008 g) + 3 moles chlorine ( $3 \times 35.453 = 106.359$  g) =  $12.011 + 1.008 + 106.359 = 119.378$ . Now use the formula:

$$\begin{aligned} \text{Percent} &= \frac{12.011}{119.378} \times 100\% \\ &= 0.10053 \times 100\% \\ &= 10.053\% \end{aligned}$$

Before you grid in your answer, make sure you follow the directions—round to the nearest whole percent, which is 10.

### 38. 12

**Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** This part of the question contains several steps. Think about the units given in the question and how you can use what you know to find what you need.

**Getting to the Answer:** Start with grams of chloroform; the chemist starts with 1,000 and uses 522.5, so there are  $1,000 - 522.5 = 477.5$  grams left. From the previous question, you know that 1 mole of chloroform has a mass of 119.378 grams, so there are  $477.5 \div 119.378 = 3.999$ , or about 4 moles of chloroform left. Be careful—you're not finished yet. The question asks for the number of moles of *chlorine*, not chloroform. According to the table, each mole of chloroform contains 3 moles of chlorine, so there are  $4 \times 3 = 12$  moles of chlorine left.

# SAT PRACTICE TEST 6 ANSWER SHEET

Remove (or photocopy) this answer sheet and use it to complete the test. See the answer key following the test when finished.

Start with number 1 for each section. If a section has fewer questions than answer spaces, leave the extra spaces blank.

## SECTION

1

- |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| 1. (A) (B) (C) (D)  | 14. (A) (B) (C) (D) | 27. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 2. (A) (B) (C) (D)  | 15. (A) (B) (C) (D) | 28. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 3. (A) (B) (C) (D)  | 16. (A) (B) (C) (D) | 29. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D)  | 17. (A) (B) (C) (D) | 30. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D)  | 18. (A) (B) (C) (D) | 31. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D)  | 19. (A) (B) (C) (D) | 32. (A) (B) (C) (D) | 45. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D)  | 20. (A) (B) (C) (D) | 33. (A) (B) (C) (D) | 46. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D)  | 21. (A) (B) (C) (D) | 34. (A) (B) (C) (D) | 47. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D)  | 22. (A) (B) (C) (D) | 35. (A) (B) (C) (D) | 48. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 23. (A) (B) (C) (D) | 36. (A) (B) (C) (D) | 49. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 24. (A) (B) (C) (D) | 37. (A) (B) (C) (D) | 50. (A) (B) (C) (D) |
| 12. (A) (B) (C) (D) | 25. (A) (B) (C) (D) | 38. (A) (B) (C) (D) | 51. (A) (B) (C) (D) |
| 13. (A) (B) (C) (D) | 26. (A) (B) (C) (D) | 39. (A) (B) (C) (D) | 52. (A) (B) (C) (D) |

  
 # right in  
Section 1

  
 # wrong in  
Section 1

## SECTION

2

- |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| 1. (A) (B) (C) (D)  | 12. (A) (B) (C) (D) | 23. (A) (B) (C) (D) | 34. (A) (B) (C) (D) |
| 2. (A) (B) (C) (D)  | 13. (A) (B) (C) (D) | 24. (A) (B) (C) (D) | 35. (A) (B) (C) (D) |
| 3. (A) (B) (C) (D)  | 14. (A) (B) (C) (D) | 25. (A) (B) (C) (D) | 36. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D)  | 15. (A) (B) (C) (D) | 26. (A) (B) (C) (D) | 37. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D)  | 16. (A) (B) (C) (D) | 27. (A) (B) (C) (D) | 38. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D)  | 17. (A) (B) (C) (D) | 28. (A) (B) (C) (D) | 39. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D)  | 18. (A) (B) (C) (D) | 29. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D)  | 19. (A) (B) (C) (D) | 30. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D)  | 20. (A) (B) (C) (D) | 31. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 21. (A) (B) (C) (D) | 32. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 22. (A) (B) (C) (D) | 33. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |

  
 # right in  
Section 2

  
 # wrong in  
Section 2

SECTION 3

3

- 1. (A) (B) (C) (D)
- 2. (A) (B) (C) (D)
- 3. (A) (B) (C) (D)
- 4. (A) (B) (C) (D)

- 5. (A) (B) (C) (D)
- 6. (A) (B) (C) (D)
- 7. (A) (B) (C) (D)
- 8. (A) (B) (C) (D)

- 9. (A) (B) (C) (D)
- 10. (A) (B) (C) (D)
- 11. (A) (B) (C) (D)
- 12. (A) (B) (C) (D)

- 13. (A) (B) (C) (D)
- 14. (A) (B) (C) (D)
- 15. (A) (B) (C) (D)

# right in Section 3

# wrong in Section 3

16.

	7	7	
	0	0	0
	1	1	1
	2	2	2
	3	3	3
	4	4	4
	5	5	5
	6	6	6
	7	7	7
	8	8	8
	9	9	9

17.

	7	7	
	0	0	0
	1	1	1
	2	2	2
	3	3	3
	4	4	4
	5	5	5
	6	6	6
	7	7	7
	8	8	8
	9	9	9

18.

	7	7	
	0	0	0
	1	1	1
	2	2	2
	3	3	3
	4	4	4
	5	5	5
	6	6	6
	7	7	7
	8	8	8
	9	9	9

19.

	7	7	
	0	0	0
	1	1	1
	2	2	2
	3	3	3
	4	4	4
	5	5	5
	6	6	6
	7	7	7
	8	8	8
	9	9	9

20.

	7	7	
	0	0	0
	1	1	1
	2	2	2
	3	3	3
	4	4	4
	5	5	5
	6	6	6
	7	7	7
	8	8	8
	9	9	9

SECTION 4

4

- 1. (A) (B) (C) (D)
- 2. (A) (B) (C) (D)
- 3. (A) (B) (C) (D)
- 4. (A) (B) (C) (D)
- 5. (A) (B) (C) (D)
- 6. (A) (B) (C) (D)
- 7. (A) (B) (C) (D)
- 8. (A) (B) (C) (D)

- 9. (A) (B) (C) (D)
- 10. (A) (B) (C) (D)
- 11. (A) (B) (C) (D)
- 12. (A) (B) (C) (D)
- 13. (A) (B) (C) (D)
- 14. (A) (B) (C) (D)
- 15. (A) (B) (C) (D)
- 16. (A) (B) (C) (D)

- 17. (A) (B) (C) (D)
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- 23. (A) (B) (C) (D)
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- 25. (A) (B) (C) (D)
- 26. (A) (B) (C) (D)
- 27. (A) (B) (C) (D)
- 28. (A) (B) (C) (D)
- 29. (A) (B) (C) (D)
- 30. (A) (B) (C) (D)

# right in Section 4

# wrong in Section 4

31.

	7	7	
	0	0	0
	1	1	1
	2	2	2
	3	3	3
	4	4	4
	5	5	5
	6	6	6
	7	7	7
	8	8	8
	9	9	9

32.

	7	7	
	0	0	0
	1	1	1
	2	2	2
	3	3	3
	4	4	4
	5	5	5
	6	6	6
	7	7	7
	8	8	8
	9	9	9

33.

	7	7	
	0	0	0
	1	1	1
	2	2	2
	3	3	3
	4	4	4
	5	5	5
	6	6	6
	7	7	7
	8	8	8
	9	9	9

34.

	7	7	
	0	0	0
	1	1	1
	2	2	2
	3	3	3
	4	4	4
	5	5	5
	6	6	6
	7	7	7
	8	8	8
	9	9	9

35.

	7	7	
	0	0	0
	1	1	1
	2	2	2
	3	3	3
	4	4	4
	5	5	5
	6	6	6
	7	7	7
	8	8	8
	9	9	9

36.

	7	7	
	0	0	0
	1	1	1
	2	2	2
	3	3	3
	4	4	4
	5	5	5
	6	6	6
	7	7	7
	8	8	8
	9	9	9

37.

	7	7	
	0	0	0
	1	1	1
	2	2	2
	3	3	3
	4	4	4
	5	5	5
	6	6	6
	7	7	7
	8	8	8
	9	9	9

38.

	7	7	
	0	0	0
	1	1	1
	2	2	2
	3	3	3
	4	4	4
	5	5	5
	6	6	6
	7	7	7
	8	8	8
	9	9	9

## MATH TEST

25 Minutes—20 Questions

### NO-CALCULATOR SECTION

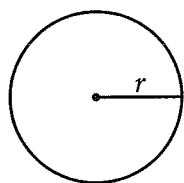
Turn to Section 3 of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding oval on the answer sheet. You may use any available space for scratch work.

Notes:

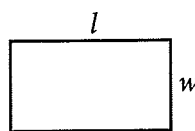
1. Calculator use is NOT permitted.
2. All numbers used are real numbers.
3. All figures used are necessary to solving the problems that they accompany. All figures are drawn to scale EXCEPT when it is stated that a specific figure is not drawn to scale.
4. Unless stated otherwise, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$ , for which  $f(x)$  is a real number.

Information:

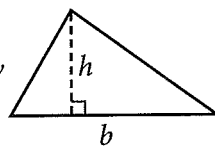


$$A = \pi r^2$$

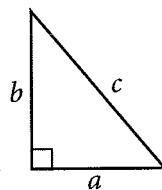
$$C = 2\pi r$$



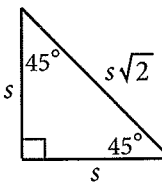
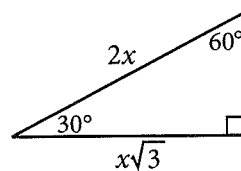
$$A = lw$$



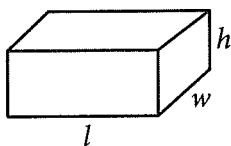
$$A = \frac{1}{2}bh$$



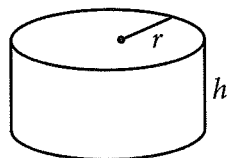
$$c^2 = a^2 + b^2$$



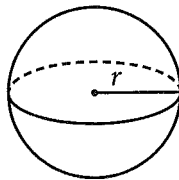
Special Right Triangles



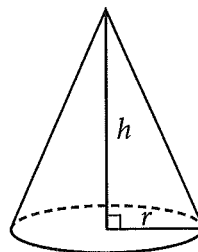
$$V = lwh$$



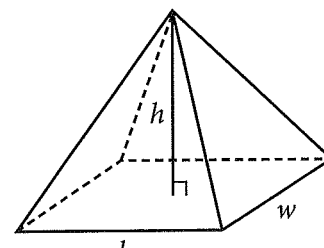
$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



$$V = \frac{1}{3}lwh$$

The sum of the degree measures of the angles in a triangle is 180.

The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is  $2\pi$ .

GO ON TO THE NEXT PAGE

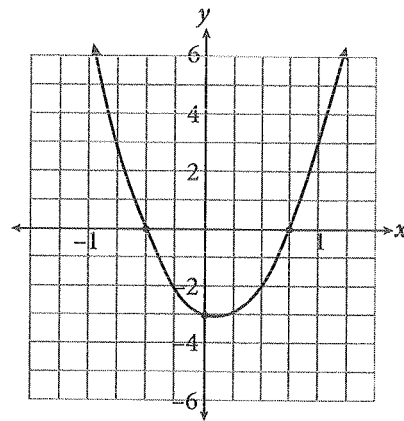


1. A biologist develops the equation  $y = 20.942x + 127$  to predict the regrowth of a certain species of plant  $x$  months after a natural disaster occurred. Which of the following describes what the number 20.942 represents in this equation?

- A) The estimated number of the plants after  $x$  months
- B) The estimated monthly increase in the number of the plants
- C) The estimated monthly decrease in the number of the plants
- D) The estimated number of the plants that survived the natural disaster

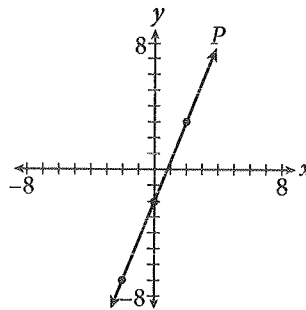
2. Which of the following expressions is equivalent to  $25x^2 - \frac{4}{9}$ ?

- A)  $\sqrt{5x - \frac{2}{3}}$
- B)  $x\left(5x - \frac{2}{3}\right)$
- C)  $\left(5x + \frac{2}{3}\right)\left(5x - \frac{2}{3}\right)$
- D)  $\left(25x + \frac{2}{3}\right)\left(25x - \frac{2}{3}\right)$



3. Which of the following could be the factored form of the equation graphed in the figure shown?

- A)  $y = (2x + 1)(4x - 3)$
- B)  $y = (x + 2)(x - 3)$
- C)  $y = \left(x - \frac{1}{2}\right)\left(x + \frac{3}{4}\right)$
- D)  $y = \frac{1}{2}(x + 1)(x - 3)$



4. Line  $P$  is shown in the coordinate plane here. If line  $Q$  (not shown) is the result of translating line  $P$  left 4 units and down 3 units, then what is the slope of line  $Q$ ?

- A)  $-\frac{4}{3}$
- B)  $-1$
- C)  $\frac{4}{3}$
- D)  $\frac{5}{2}$

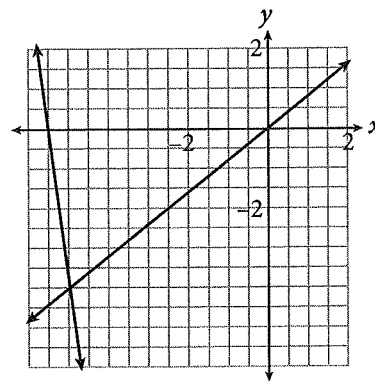
$$a = \frac{v_f - v_i}{t}$$

5. Acceleration is the rate at which the velocity of an object changes with respect to time, or in other words, how much an object is speeding up or slowing down. The average acceleration of an object can be found using the formula shown above, where  $t$  is the time over which the acceleration is being measured,  $v_f$  is the final velocity, and  $v_i$  is the initial velocity. Which of the following represents  $t$  in terms of the other variables?

- A)  $t = \frac{a}{v_f - v_i}$   
 B)  $t = \frac{v_f - v_i}{a}$   
 C)  $t = a(v_f - v_i)$   
 D)  $t = \frac{1}{a(v_f - v_i)}$

6. Which of the following equations could represent a parabola that has a minimum value of  $-5$  and whose axis of symmetry is the line  $x = 1$ ?

- A)  $y = (x - 5)^2 + 1$   
 B)  $y = (x + 5)^2 + 1$   
 C)  $y = (x - 1)^2 - 5$   
 D)  $y = (x + 1)^2 - 5$



7. If  $(A, B)$  is the solution to the system of equations shown in the graph above, what is the value of  $A + B$ ?

- A)  $-18$   
 B)  $-9$   
 C)  $1$   
 D)  $5.5$

8. If  $A = x^2 + 4x + 9$  and  $B = x^3 + 6x - 2$ , what is  $3A + B$ ?

- A)  $4x^2 + 18x + 25$   
 B)  $x^3 + x^2 + 10x + 7$   
 C)  $x^3 + 3x^2 + 18x + 25$   
 D)  $3x^3 + 3x^2 + 30x + 29$

9. How many real values of  $x$  satisfy the quadratic equation  $9x^2 - 12x + 4 = 0$ ?

- A)  $0$   
 B)  $1$   
 C)  $2$   
 D)  $4$

10. Which of the following represents the solution set for the inequality  $\frac{3}{5}\left(x + \frac{2}{7}\right) > -6$ ?

- A)  $x > -\frac{72}{7}$   
 B)  $x > -\frac{216}{35}$   
 C)  $x > -\frac{136}{35}$   
 D)  $x > -\frac{18}{7}$

11. Acetaminophen is one of the most common drugs given to children and one of the most difficult to give correctly because it's sold in several different forms and different concentrations. For example, the old concentration given by dropper was 90 mg of acetaminophen per 1 ml of liquid, while the new concentration given by syringe is 160 mg per 5 ml. Several dosages are shown in the table below.

Infant Acetaminophen Dosages			
Age	0–3 mo	4–11 mo	12–23 mo
Dropper	0.5 ml	1.0 ml	1.5 ml
Syringe	1.25 ml	2.5 ml	3.75 ml

Which linear function represents the relationship between the amount of liquid in the dropper,  $d$ , and the amount of liquid in the syringe,  $s$ ?

- A)  $s = 0.4d$   
 B)  $s = 1.25d$   
 C)  $s = 2d$   
 D)  $s = 2.5d$
12. Which of the following equations, when graphed on a coordinate plane, will not cross the  $y$ -axis?
- A)  $0.5(4x + y) = y - 9$   
 B)  $2(x + 7) - x = 4(y + 3)$   
 C)  $0.25(8y + 4x) - 7 = -2(-y + 1)$   
 D)  $6x - 2(3y + x) = 10 - 3y$

$$\begin{cases} Hx + 2y = -8 \\ Kx - 5y = -13 \end{cases}$$

13. If the solution to the system of equations shown above is  $(2, -1)$ , what is the value of  $\frac{K}{H}$ ?
- A)  $-3$   
 B)  $-\frac{1}{3}$   
 C)  $\frac{1}{3}$   
 D)  $3$
14. It is given that  $\sin A = k$ , where  $A$  is an angle measured in radians and  $\pi < A < \frac{3\pi}{2}$ . If  $\sin B = k$ , which of the following could be the value of  $B$ ?
- A)  $A - \pi$   
 B)  $\pi + A$   
 C)  $2\pi - A$   
 D)  $3\pi - A$
15. Which of the following is equivalent to the expression  $\left(\frac{\frac{1}{x^2}}{x^{-2}}\right)^2$ ?

- A)  $x^2$   
 B)  $\left(\frac{x^2}{x}\right)^{\frac{1}{2}}$   
 C)  $\left(\frac{(x^2)(x^{\frac{1}{3}})}{x^4}\right)^3$   
 D)  $\left(\frac{(x^3)(x^4)}{x^{-3}}\right)^{\frac{1}{2}}$

**Directions:** For questions 16-20, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $\frac{7}{2}$ .

(If  $3\frac{1}{2}$  is entered into the grid as 

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)

- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Answer:  $\frac{7}{12}$

7	/	1	2
<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Write answer in boxes. →

← Fraction line

Grid in result. →

Answer: 2.5

2	.	5
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

← Decimal point

Answer: 201

Either position is correct.

2	0	1
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

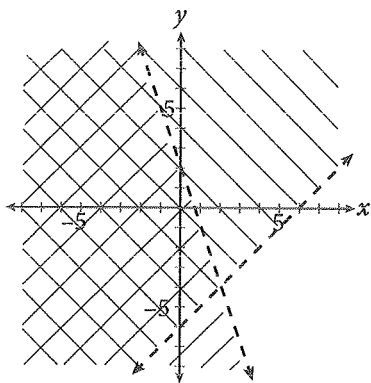
2	0	1
<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

Acceptable ways to grid  $\frac{2}{3}$  are:

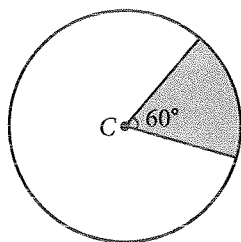
2	/	3
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6

.	6	6	6
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

.	6	6	7
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6



16. The figure above shows the solution for the system of inequalities  $\begin{cases} y < -3x + 2 \\ y > x - 6 \end{cases}$ . Suppose  $(a, b)$  is a solution to the system. If  $a = 0$ , what is the greatest possible integer value of  $b$ ?
17. Given the function  $f(x) = \frac{2}{3}x - 5$ , what input value corresponds to an output of 3?



18. If the area of the shaded sector in circle  $C$  shown above is  $6\pi$  square units, what is the diameter of the circle?
19. If a circle is given by the equation  $x^2 + y^2 + 10x - 4y = 20$ , what is its diameter?
20. In economics, the law of demand states that as the price of a commodity rises, the demand for that commodity goes down. A company determines that the monthly demand for a certain item that it sells can be modeled by the function  $q(p) = -2p + 34$ , where  $q$  represents the quantity sold in hundreds and  $p$  represents the selling price in dollars. It costs \$7 to produce this item. How much more per month in profits can the company expect to earn by selling the item at \$12 instead of \$10? (Profit = sales - costs)

# MATH TEST

55 Minutes—38 Questions

## CALCULATOR SECTION

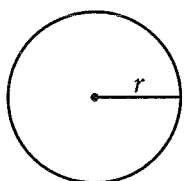
Turn to Section 4 of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding oval on the answer sheet. You may use any available space for scratch work.

Notes:

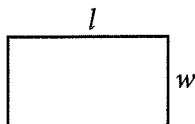
1. Calculator use is permitted.
2. All numbers used are real numbers.
3. All figures used are necessary to solving the problems that they accompany. All figures are drawn to scale EXCEPT when it is stated that a specific figure is not drawn to scale.
4. Unless stated otherwise, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$ , for which  $f(x)$  is a real number.

Information:

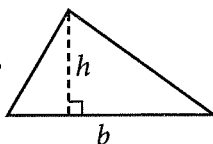


$$A = \pi r^2$$

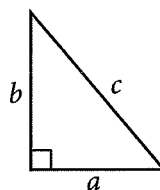
$$C = 2\pi r$$



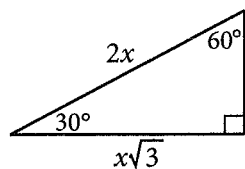
$$A = lw$$



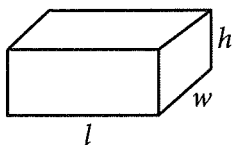
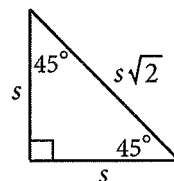
$$A = \frac{1}{2}bh$$



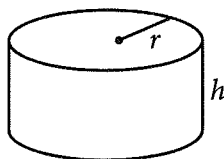
$$c^2 = a^2 + b^2$$



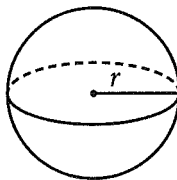
Special Right Triangles



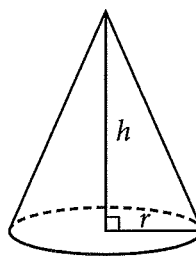
$$V = lwh$$



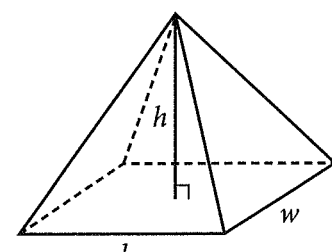
$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



$$V = \frac{1}{3}lwh$$

The sum of the degree measures of the angles in a triangle is 180.

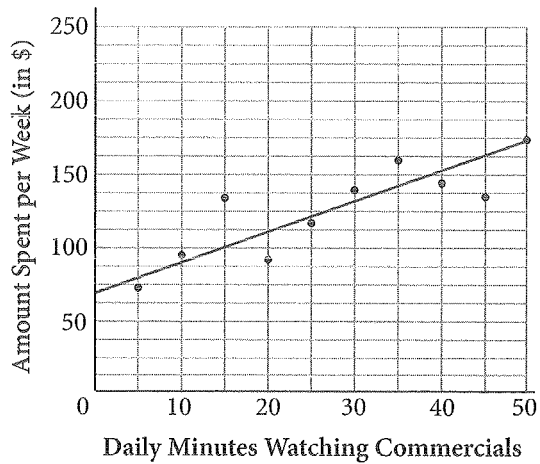
The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is  $2\pi$ .

GO ON TO THE NEXT PAGE

1. The USDA recommends that adult females consume 75 mg of ascorbic acid, also known as vitamin C, each day. Because smoking inhibits vitamin absorption, smokers are encouraged to consume an additional 35 mg daily. If one grapefruit contains 40 mg of vitamin C and one serving of spinach contains 10 mg, which of the following inequalities represents the possible intake of grapefruit  $g$  and spinach  $s$  that a smoking female could consume to meet or surpass the USDA's recommended amount of vitamin C?

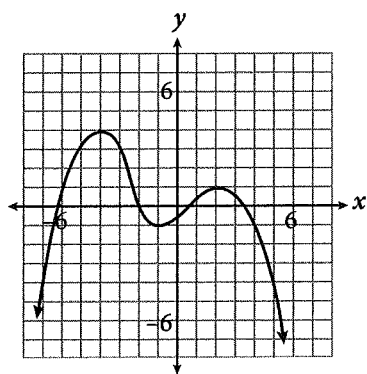
- A)  $40g + 10s \geq 75$   
 B)  $40g + 10s \geq 110$   
 C)  $40g + 10s > 110$   
 D)  $\frac{40}{g} + \frac{10}{s} \geq 110$



2. The scatterplot above shows the relationship between the amount of time spent watching commercials each day and the amount of money spent each week on brand name grocery products for 10 consumers. The line of best fit for the data is also shown. Which of the following best represents the meaning of the slope of the line of best fit in the context of this question?
- A) The predicted amount of time spent watching commercials when a person spends 0 dollars on brand name products  
 B) The predicted amount of money spent on brand name products when a person spends 0 minutes watching commercials  
 C) The predicted increase in time spent watching commercials for every dollar increase in money spent on brand name products  
 D) The predicted increase in money spent on brand name products for every one-minute increase in time spent watching commercials

3. There are very few states in the United States that require public schools to pay sales tax on their purchases. For this reason, many schools pay for student portraits and then the parents reimburse the school. Parents can choose between the basic package for \$29.50 and the deluxe package for \$44.50. If 182 parents ordered packages and the school's total bill was \$6,509, which of the following systems of equations could be used to find the number of parents who ordered a basic package,  $b$ , and the number who ordered a deluxe package,  $d$ , assuming no parent ordered more than one package?

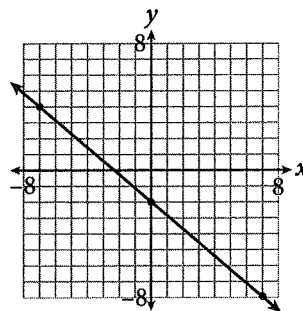
- A) 
$$\begin{cases} b + d = 6,509 \\ 29.5b + 44.5d = 182 \end{cases}$$
- B) 
$$\begin{cases} b + d = 182 \\ 29.5b + 44.5d = 6,509 \end{cases}$$
- C) 
$$\begin{cases} 2(b + d) = 182 \\ 29.5b + 44.5d = 6,509 \end{cases}$$
- D) 
$$\begin{cases} b + d = 182 \\ 29.5b + 44.5d = \frac{6,509}{2} \end{cases}$$



4. The graph of a polynomial function  $p(x)$  is shown above. For what values of  $x$  does  $p(x) = -4$ ?
- A) -1  
 B) 4  
 C) -7 and 5  
 D) -7, 4, and 5

5. If  $4x + 3 = 19$ , what is the value of  $4x - 3$ ?

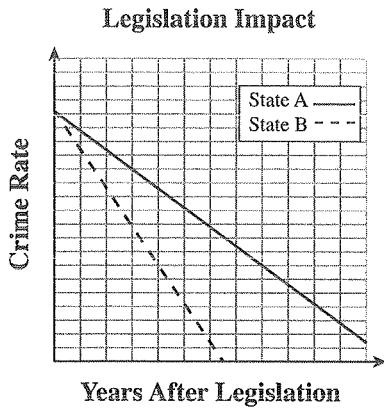
- A) -19  
 B) 4  
 C) 13  
 D) 19



6. What is the slope of the line shown in the graph?

- A) -2  
 B)  $-\frac{7}{6}$   
 C)  $-\frac{6}{7}$   
 D) 2





7. Most crimes in the United States are governed by state law rather than federal. Suppose two states passed laws that raised the penalty for committing armed robbery. The figure above represents the crime rate for armed robbery in both states after the laws were passed. Based on the graph, which of the following statements is true?
- A) State A's law had a more positive impact on the crime rate for armed robbery.  
 B) State B's law had a more positive impact on the crime rate for armed robbery.  
 C) The laws in both states had the same impact on the crime rate for armed robbery.  
 D) Without axis labels, it is not possible to determine which state's law had a bigger impact.
8. On average, for every 2,500 cans of colored paint a home improvement chain mixes, exactly 40 are the wrong color (defective). At this rate, how many cans of paint were mixed during a period in which exactly 128 were defective?
- A) 5,200  
 B) 7,500  
 C) 8,000  
 D) 64,000
9. According to the American Association of University Women, the mean age of men who have a college degree at their first marriage is 29.9 years. The mean age of women with a college degree at their first marriage is 28.4 years. Which of the following must be true about the combined mean age  $m$  of all people with college degrees at their first marriage?
- A)  $m = 29.15$   
 B)  $m > 29.15$   
 C)  $m < 29.15$   
 D)  $28.4 < m < 29.9$
10. When scuba divers ascend from deep water, they must either rise slowly or take safety breaks to avoid nitrogen buildup in their lungs. The length of time a diver should take to ascend is directly proportional to how many feet she needs to ascend. If a scuba diver can safely ascend 165 feet in 5.5 minutes, then how many feet can she ascend in 90 seconds?
- A) 45  
 B) 60  
 C) 75  
 D) 90
11. The chief financial officer of a shoe company calculates that the cost  $C$  of producing  $p$  pairs of a certain shoe is  $C = 17p + 1,890$ . The marketing department wants to sell the shoe for \$35 per pair. The shoe company will make a profit only if the total revenue from selling  $p$  pairs is greater than the total cost of producing  $p$  pairs. Which of the following inequalities gives the number of pairs of shoes  $p$  that the company needs to sell in order to make a profit?
- A)  $p < 54$   
 B)  $p > 54$   
 C)  $p < 105$   
 D)  $p > 105$

12. The human body has a very limited ability to store carbohydrates, which is why it is important for athletes to consume them during long training sessions or competitions. It is recommended that athletes consume approximately 3 calories per minute in situations like these. How many calories would an athlete biking a 74-mile race need to consume, assuming he bikes at an average speed of 9.25 miles per hour during the race?

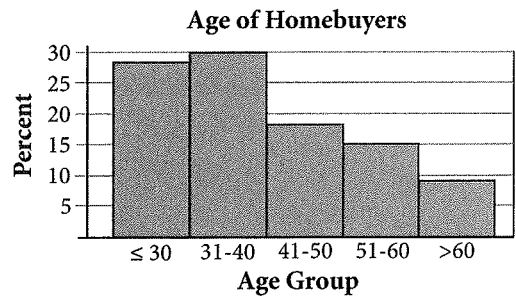
- A) 480  
 B) 1,440  
 C) 1,665  
 D) 2,053.5

$x$	3	-1	-5	-7
$y$	0	14	28	?

13. If the values in the table represent a linear relationship, what is the missing value?
- A) 21  
 B) 30  
 C) 35  
 D) 42

Questions 14 and 15 refer to the following information.

The figure shows the age distribution of homebuyers and the percent of the market each age range makes up in a particular geographic region.



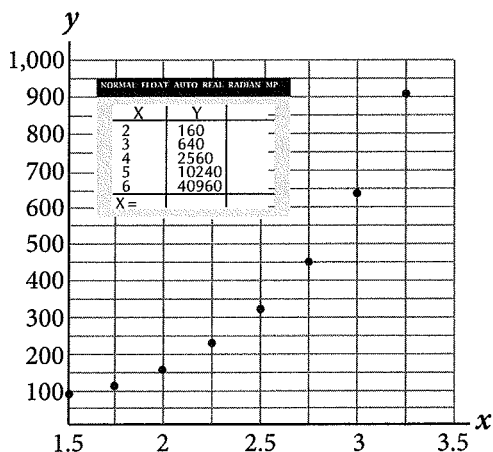
14. A new real estate agent is deciding which age group she should market toward in order to get the most clients. Which of the following measures of the data would be best for her to use when making this decision?
- A) Mean  
 B) Mode  
 C) Range  
 D) Median
15. Based on the information in the figure, which of the following statements is true?
- A) The shape of the data is skewed to the right, so the mean age of homebuyers is greater than the median.
- B) The shape of the data is skewed to the left, so the median age of homebuyers is greater than the mean.
- C) The shape of the data is fairly symmetric, so the mean age of homebuyers is approximately equal to the median.
- D) The data has no clear shape, so it is impossible to make a reliable statement comparing the mean and the median.

16. A railway company normally charges \$35 round trip from the suburbs of a city into downtown. The company also offers a deal for commuters who use the train frequently to commute from their homes in the suburbs to their jobs in the city. Commuters can purchase a discount card for \$900, after which they only have to pay \$12.50 per round trip. How many round trips,  $t$ , must a commuter make in order for the discount card to be a better deal?
- A)  $t < 40$   
 B)  $t > 40$   
 C)  $t < 72$   
 D)  $t > 72$
17. Most people save money before going on vacation. Suppose Etienne saved \$800 to spend during vacation, 20 percent of which he uses to pay for gas. If he budgets 25 percent of the remaining money for food, allots \$300 for the hotel, and spends the rest of the money on entertainment, what percentage of the original \$800 did he spend on entertainment?
- A) 14.5%  
 B) 17.5%  
 C) 22.5%  
 D) 28.5%
18. A microbiologist placed a bacteria sample containing approximately 2,000 microbes in a petri dish. For the first 7 days, the number of microbes in the dish tripled every 24 hours. If  $n$  represents the number of microbes after  $h$  hours, then which of the following equations is the best model for the data during the 7-day period?
- A)  $n = 2,000(3)^{\frac{h}{24}}$   
 B)  $n = 2,000(3)^{24h}$   
 C)  $n = \frac{h}{24} \times 2,000$   
 D)  $n = 24h \times 2,000$

	For	Against	Undecided	Total
1L	32	16	10	58
2L	24	12	28	64
3L	17	25	13	55
Total	73	53	51	177

19. A survey is conducted regarding a proposed change in the attendance policy at a law school. The table above categorizes the results of the survey by year of the student (1L, 2L, or 3L) and whether they are for, against, or undecided about the new policy. What fraction of all 1Ls and 2Ls are against the new policy?
- A)  $\frac{14}{61}$   
 B)  $\frac{24}{61}$   
 C)  $\frac{28}{53}$   
 D)  $\frac{28}{177}$

20. Which of the following expressions is equivalent to  $(6 + 5i)^3$ ? (Note:  $i = \sqrt{-1}$ )
- A)  $11 + 60i$   
 B)  $216 - 125i$   
 C)  $-234 + 415i$   
 D)  $-3,479 + 1,320i$

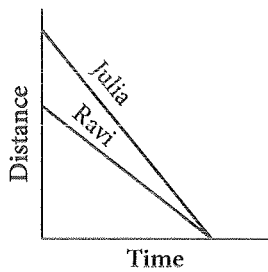


21. If an exponential function is used to model the data shown in the figure, and it is written in the form  $f(x) = f(0)(1 + r)^x$ , what would be the value of  $r$ ?
- A) 2  
 B) 3  
 C) 4  
 D) 5

22. The Great Pyramid of Giza, built in the 26th century BC just outside of Cairo, Egypt, had an original height of 480 feet, 8 inches, before some of the stones in which it was encased fell away. Inside the pyramid is a 53.75-foot passage, called the Dead End Shaft, which archeologists have yet to discover the purpose of. Suppose a museum is building a scale model of the pyramid for patrons to explore. Because of the museum's ceiling height, they can only make the pyramid 71 feet, 6 inches tall. About how long should the museum's Dead End Shaft be?
- A) 8 feet  
 B) 12 feet  
 C) 30 feet  
 D) 96 feet

$$\frac{-x^2 - 10x + 24}{2 - x}$$

23. Which of the following is equivalent to the expression above, given that  $x \neq 2$ ?
- A)  $-x - 12$   
 B)  $x - 12$   
 C)  $12 - x$   
 D)  $x + 12$
24. Ethanol is an alcohol commonly added to gasoline to reduce the use of fossil fuels. A commonly used ratio of ethanol to gasoline is 1:4. Another less common and more experimental additive is methanol, with a typical ratio of methanol to gasoline being 1:9. A fuel producer wants to see what happens to cost and fuel efficiency when a combination of ethanol and methanol are used. In order to keep the ratio of gasoline to total additive the same, what ratio of ethanol to methanol should the company use?
- A) 1:1  
 B) 4:9  
 C) 9:4  
 D) 36:9



25. Julia and Ravi are meeting at a museum. The figure above represents the drives from their homes to the museum. Based on the figure, which of the following statements is true?
- A) Julia drove to the museum at a faster speed than Ravi.
- B) Julia and Ravi drove to the museum at about the same speed.
- C) It took Ravi longer to arrive at the museum because his home is farther away.
- D) It took Julia longer to arrive at the museum because her home is farther away.
26. If the graph of the function  $g(x)$  passes through the point  $(8, -3)$ , then through which point does the graph of  $-g(x - 4) - 6$  pass?
- A)  $(-12, -9)$
- B)  $(-12, -3)$
- C)  $(4, -3)$
- D)  $(12, -3)$
27. If  $f(x) = x - 1$ ,  $g(x) = x^3$ , and  $x \leq 0$ , which of the following could not be in the range of  $f(g(x))$ ?
- A)  $-27$
- B)  $-3$
- C)  $-1$
- D)  $1$
28. Given the equation  $y = -3(x - 5)^2 + 8$ , which of the following statements is not true?
- A) The  $y$ -intercept is  $(0, 8)$ .
- B) The axis of symmetry is  $x = 5$ .
- C) The vertex is  $(5, 8)$ .
- D) The parabola opens downward.
29. Every weekend for 48 hours, a law firm backs up all client files by scanning and uploading them to a secure remote server. On average, the size of each client file is 2.5 gigabytes. The law firm's computer can upload the scans at a rate of 5.25 megabytes per second. What is the maximum number of client files the law firm can back up each weekend? (1 gigabyte = 1,000 megabytes)
- A) 362
- B) 363
- C) 476
- D) 477
30. Main Street and 2nd Street run parallel to each other. Both are one-way streets. Main Street runs north, and 2nd Street runs south. The city is planning to build a new road, also one-way, that runs toward the southeast and cuts through both streets at an angle. Traffic turning off of Main Street would have to make a  $125^\circ$  turn onto the new road. What angle would traffic turning off of 2nd Street have to make turning onto the new road?
- A)  $55^\circ$
- B)  $65^\circ$
- C)  $125^\circ$
- D)  $235^\circ$

**Directions:** For questions 31-38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $\frac{7}{2}$ .  
(If  $3\frac{1}{2}$  is entered into the grid as 

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Answer:  $\frac{7}{12}$

7	/	1	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
<input checked="" type="radio"/>	7	7	7
8	8	8	8
9	9	9	9

Write answer in boxes. →

← Fraction line

Grid in result. →

Answer: 2.5

2	.	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

← Decimal point

Answer: 201  
Either position is correct.

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
1	1	1
2	2	2
3	3	3
4	4	4

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
1	1	1
2	2	2
3	3	3
4	4	4

Acceptable ways to grid  $\frac{2}{3}$  are:

2	/	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6

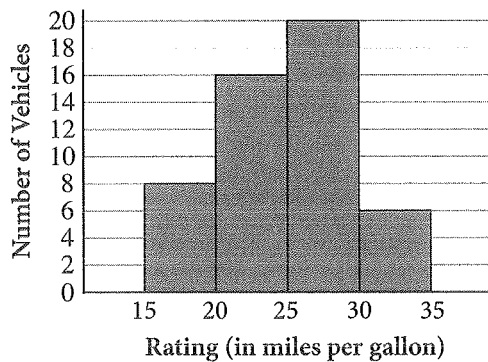
.	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

.	6	6	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

$$\frac{4h - (21 - 8h)}{3} = \frac{15 + 6(h - 1)}{2}$$

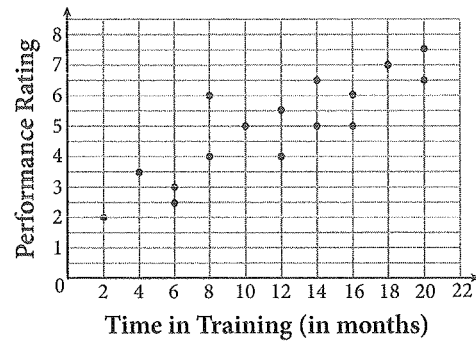
31. What is the value of  $h$  in the equation above?
32. A company is buying two warehouses near their production plants in two states, New York and Georgia. As is always the case in the real estate market, the geographic location plays a major role in the price of the property. Consequently, the warehouse in New York costs \$30,000 less than four times the Georgia warehouse. Together, the two warehouses cost the company \$445,000. How many more thousand dollars does the New York property cost than the Georgia property?

**Fuel Efficiency Ratings**



33. The histogram above shows the number of vehicles that a car rental agency currently has available to rent, categorized by fuel efficiency ratings. If a customer randomly selects one of the available cars, what is the probability that he will get a car that has a fuel efficiency rating of at least 25 miles per gallon? Enter your answer as a decimal number.
34. The volume of a rectangular shipping crate being loaded onto a barge for international shipment across the Panama Canal is 10,290 cubic feet. If the length to width to height ratio of the crate is 3:5:2 (in that order), what is the length of the crate in feet?

**Regional Manager Job Performance**



35. A company conducted a study comparing the overall job performance of its regional managers with the length of time each one spent in the company's management-training program. The scatterplot above shows the results of the study. What is the length of the time spent in training, in months, of the manager represented by the data point that is the greatest distance from the line of best fit (not shown)?
36. If  $(2^{32})^{(2^{32})} = 2^{(2^x)}$ , what is the value of  $x$ ?

**Questions 37 and 38 refer to the following information.**

Three cars all arrive at the same destination at 4:00 PM. The first car traveled 144 miles mostly by highway. The second car traveled 85 miles mainly on rural two-lane roads. The third car traveled 25 miles primarily on busy city streets.

37. The first car traveled at an average speed of 64 mph. The second car started its drive at 2:18 PM. How many minutes had the first car already been traveling before the second car started its drive?
38. The third car encountered heavy traffic for the first 60% of its trip and only averaged 15 mph. Then traffic stopped due to an accident, and the car did not move for 20 minutes. After the accident was cleared, the car averaged 30 mph for the remainder of the trip. At what time in the afternoon did the third car start its trip? Use only digits for your answer. (For example, enter 1:25 PM as 125.)

**ANSWER KEY****READING TEST**

1. C	14. A	27. A	40. D
2. A	15. D	28. C	41. C
3. D	16. B	29. D	42. A
4. B	17. C	30. B	43. A
5. B	18. B	31. C	44. C
6. A	19. B	32. A	45. A
7. D	20. D	33. A	46. B
8. D	21. D	34. A	47. B
9. C	22. D	35. B	48. B
10. C	23. A	36. D	49. D
11. C	24. C	37. C	50. C
12. A	25. B	38. C	51. A
13. D	26. A	39. B	52. D

**WRITING AND LANGUAGE TEST**

1. B	12. B	23. D	34. A
2. D	13. C	24. B	35. C
3. C	14. C	25. A	36. D
4. C	15. D	26. A	37. C
5. B	16. A	27. C	38. B
6. B	17. B	28. D	39. B
7. B	18. D	29. C	40. D
8. B	19. D	30. B	41. C
9. A	20. B	31. C	42. D
10. C	21. D	32. D	43. A
11. A	22. C	33. A	44. B



**MATH—NO CALCULATOR**

1. B	6. C	11. D	16. 1
2. C	7. B	12. C	17. 12
3. A	8. C	13. D	18. 12
4. D	9. B	14. D	19. 14
5. B	10. A	15. D	20. 800

**MATH—CALCULATOR**

1. B	11. D	21. B	31. 11.5 or $23/2$ or $69/6$
2. D	12. B	22. A	32. 255
3. B	13. C	23. D	33. .52
4. C	14. B	24. C	34. 21
5. C	15. A	25. A	35. 8
6. C	16. B	26. D	36. 37
7. B	17. C	27. D	37. 33
8. C	18. A	28. A	38. 220
9. D	19. A	29. A	
10. A	20. C	30. A	

## ANSWERS AND EXPLANATIONS

### READING TEST

#### *Walden*

1. C

**Difficulty:** Medium

**Category:** Reading / Detail

**Strategic Advice:** Reread the entire paragraph to assess the intention of the sentence in question, and determine which answer choice best shows the author's reason for including this sentence.

**Getting to the Answer:** The author's previous statements in the paragraph directly relate to the idea that the conscious endeavors described are the very activities that will reawaken people; therefore, (C) is correct.

2. A

**Difficulty:** Hard

**Category:** Reading / Vocab-in-Context

**Strategic Advice:** Read the complete sentence for context clues, and determine which answer choice's definition best serves the idea presented.

**Getting to the Answer:** The sentence suggests the author wants to live actively and "suck out all the marrow of life" (line 39) rather than live in a resigned, accepting manner; thus, (A) is correct because it best describes how the author does not wish to live.

3. D

**Difficulty:** Medium

**Category:** Reading / Inference

**Strategic Advice:** The first paragraph of a passage often contains clues to the author's beliefs and opinions. Read the first paragraph expressly for the purpose of determining the author's views.

**Getting to the Answer:** The author suggests that most people are only awake enough for physical labor, some for intellectual discussions, and very few for a higher calling. This implies that he feels most people are not working toward their fullest potential, so (D) is correct.

4. B

**Difficulty:** Hard

**Category:** Reading / Command of Evidence

**Strategic Advice:** Choose the quote from the passage that best supports the correct answer of the previous question.

**Getting to the Answer:** Choice (B) is the correct answer not just because it shows the author's belief that most people are not truly awake, but also because it shows that the author thinks most people spend their lives pursuing goals beneath their human potential.

5. B

**Difficulty:** Easy

**Category:** Reading / Global

**Strategic Advice:** Read the entire passage to determine the author's central idea about society. Then choose the answer choice that correctly reflects this.

**Getting to the Answer:** Throughout the passage, the author frequently mentions that our society focuses on mundane labor and details and that we shun a life of conscious endeavors; therefore, (B) is the correct answer.

6. A

**Difficulty:** Medium

**Category:** Reading / Inference

**Strategic Advice:** Because the author's views on religion are not explicitly stated, you must make inferences by examining details in the entire passage.

undefined but important terms, (A) is the correct answer.

**44. B**

**Difficulty:** Medium

**Category:** Writing & Language / Punctuation

**Strategic Advice:** Review the sentence to assess which answer choice offers the correct use of plural punctuation to convey the proper sense of possession.

**Getting to the Answer:** The possessive plural of “Cones” refers to both sisters owning something, and requires an apostrophe after the “s” with no additional letters or punctuation. Choice (B) is correct.

## MATH TEST: NO-CALCULATOR SECTION

**1. B**

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Look at the structure of the equation. It is written in the form  $y = mx + b$ . In a real-world scenario,  $m$  is the rate of change and  $b$  is the initial amount.

**Getting to the Answer:** The question is asking about 20.942, which is  $m$  in the equation, and therefore represents a rate of change. The variable  $x$  represents number of months. The value of  $m$  is positive, so it represents the estimated monthly increase in the number of the plants after the natural disaster occurred.

**2. C**

**Difficulty:** Easy

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** Use the structure of the expression to factor it. Notice that both terms are perfect squares.

**Getting to the Answer:** The expression is a difference of two squares, so write each term as a quantity squared and then use the rule  $a^2 - b^2 = (a + b)(a - b)$ .

$$\begin{aligned} 25x^2 - \frac{4}{9} &= (5x)^2 - \left(\frac{2}{3}\right)^2 \\ &= \left(5x + \frac{2}{3}\right)\left(5x - \frac{2}{3}\right) \end{aligned}$$

**3. A**

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** Factored form of a quadratic equation reveals the roots, or  $x$ -intercepts, of the equation, so start by identifying the  $x$ -intercepts on the graph.

**Getting to the Answer:** An  $x$ -intercept is an  $x$ -value that corresponds to a  $y$ -value of 0. Read the axis labels carefully—each grid-line represents  $\frac{1}{4}$ , so the  $x$ -intercepts of the graph, and therefore the roots of the equation, are  $x = -\frac{1}{2}$  and  $x = \frac{3}{4}$ . This means you are looking for factors that when solved result in these values of  $x$ . Choice (A) is correct because  $2x + 1$  gives you  $x = -\frac{1}{2}$  and  $4x - 3$  gives you  $x = \frac{3}{4}$ .

**4. D**

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Don't jump right into translating the line. Think about how the translation would affect the slope—it wouldn't. Translating the line moves all the points by the same amount, so the slope doesn't change.

**Getting to the Answer:** Find the slope of line  $P$  by counting the rise and the run from one point to the next, and you'll have your answer. From the

y-intercept  $(0, -2)$ , the line rises 5 units and runs 2 units to the point  $(2, 3)$ , so the slope is  $\frac{5}{2}$ .

5. B

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** This question looks complicated, but really just amounts to solving the equation for  $t$  using a couple of inverse operations.

**Getting to the Answer:** Multiply both sides of the equation by  $t$  to get it out of the denominator, and then divide both sides by  $a$ .

$$\begin{aligned} a &= \frac{v_f - v_i}{t} \\ t \left( a = \frac{v_f - v_i}{t} \right) & \cancel{t} \\ ta &= v_f - v_i \\ t &= \frac{v_f - v_i}{a} \end{aligned}$$

6. C

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** Imagine the graph of a parabola. The minimum value is the  $y$ -coordinate of its vertex, and the axis of symmetry also passes through the vertex. Use these properties to identify the vertex, and then use it to write the equation of the parabola in vertex form,  $y = a(x - h)^2 + k$ , where  $(h, k)$  is the vertex.

**Getting to the Answer:** If the minimum of the parabola is  $-5$ , then the vertex of the parabola looks like  $(x, -5)$ . The axis of symmetry,  $x = 1$ , tells you the  $x$ -coordinate—it's 1. That means  $(h, k)$  is  $(1, -5)$ , and the equation of the parabola looks like  $y = a(x - 1)^2 - 5$ . The value of  $a$  in each of the answer choices is 1, so (C) is correct.

7. B

**Difficulty:** Medium

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** The solution to a system of linear equations shown graphically is the point where the lines intersect. Read the axis labels carefully. Each grid-line represents  $\frac{1}{2}$ .

**Getting to the Answer:** The two lines intersect at the point  $(-5, -4)$ , so  $A + B = -5 + (-4) = -9$ .

8. C

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** When adding or subtracting polynomial expressions, simply combine like terms (terms that have the same variable part). Pay careful attention to the exponents. To keep things organized, arrange the terms in descending order before you combine them.

**Getting to the Answer:** Substitute the given expressions for  $A$  and  $B$  into  $3A + B$ . Distribute the 3 to each term of  $A$  and then combine like terms. Be careful—the first term of  $B$  is  $x^3$ , not  $x^2$ , so these cannot be combined.

$$\begin{aligned} & 3(x^2 + 4x + 9) + (x^3 + 6x - 2) \\ &= 3x^2 + 12x + 27 + x^3 + 6x - 2 \\ &= x^3 + 3x^2 + 12x + 6x + 27 - 2 \\ &= x^3 + 3x^2 + 18x + 25 \end{aligned}$$

9. B

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** A quadratic equation can have zero, one, or two real solutions. There are several ways to determine exactly how many. You could graph the equation and see how many times it crosses the  $x$ -axis; you could calculate the discriminant (the value

under the square root in the quadratic formula); or you could try to factor the equation. Use whichever method gets you to the answer the quickest.

**Getting to the Answer:** Notice that the first and last terms in the equation are perfect squares—this is a hint that it could be a perfect square trinomial, which it is. The factored form of the equation is  $(3x - 2)(3x - 2)$ . Both factors are the same, so there is only one real value,  $x = \frac{2}{3}$ , that satisfies the equation.

**10. A**

**Difficulty:** Medium

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** When an equation or an inequality involves fractions, there are a number of ways to approach it. You could distribute the fractions or you could clear the fractions by multiplying both sides by the lowest common denominator. In this question, clearing one fraction at a time will prevent having to work with messy fractions and large numbers.

**Getting to the Answer:** Solve the inequality one step at a time. First, multiply everything by 5, and then divide by 3—this will clear the first fraction:

$$\begin{aligned} 5 \cdot \left[ \frac{3}{5} \left( x + \frac{2}{7} \right) > -6 \right] \cdot 5 \\ 3 \left( x + \frac{2}{7} \right) > -30 \\ \frac{3 \left( x + \frac{2}{7} \right)}{3} > \frac{-30}{3} \\ x + \frac{2}{7} > -10 \end{aligned}$$

Now, multiply everything by 7 and go from there:

$$\begin{aligned} 7 \cdot \left[ x + \frac{2}{7} > -10 \right] \cdot 7 \\ 7x + 2 > -70 \\ 7x > -72 \\ x > -\frac{72}{7} \end{aligned}$$

**11. D**

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Don't let all the contextual information confuse you. The question at the end tells you that you are looking for the linear relationship between the pairs of numbers in the last two rows of the table. This amounts to writing an equation in the form  $y = mx + b$ .

**Getting to the Answer:** Take a peek at the answers—none of the equations have a  $y$ -intercept, so all you need to do is write the equation  $y = mx$ , or in this case,  $s = md$ . To find  $m$ , use any two ordered pairs from the table and the slope formula. Be careful— $d$  represents  $x$  in the equation, so the drop-per amounts should be written first in the ordered pairs. Using  $(0.5, 1.25)$  and  $(1.0, 2.5)$ , the slope is:

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{2.5 - 1.25}{1.0 - 0.5} \\ &= \frac{1.25}{0.5} \\ &= 2.5 \end{aligned}$$

This means the equation is  $s = 2.5d$ .

## 12. C

**Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Think conceptually before you start simplifying the equations. The only type of line that does not cross the  $y$ -axis is a vertical line (because it runs parallel to the axis). All vertical lines take the form  $x = a$ . In other words, a vertical line does not have a  $y$  term.

**Getting to the Answer:** You don't have to completely simplify every equation to answer this question, nor do you need to graph any of the equations. Eliminate equations that will clearly have a  $y$  term once simplified. You don't need to worry about the  $x$  terms or the constants.

**Choice A:** Although it may appear that the  $y$  terms will cancel, you must first distribute 0.5. The result is  $0.5y$  on the left side of the equation and  $y$  on the right, which do not cancel, so eliminate A.

**Choice B:** No  $y$  terms on the left, but  $4y$  on the right, so eliminate B.

**Choice (C):**  $0.25(8y) = 2y$  on the left, and  $-2(-y) = 2y$  on the right, which do indeed cancel, so (C) is correct.

You don't need to waste time checking D—just move on to the next question. (**Choice D:**  $-6y$  on the left and  $-3y$  on the right, which do not cancel.)

## 13. D

**Difficulty:** Hard**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Typically, solving a system of equations means finding the values of  $x$  and  $y$  that satisfy both equations simultaneously. In this question, you already know that. The question may look complicated, but don't let it intimidate you. Because the solution to the system satisfies both equations, you can substitute 2 and  $-1$ , for  $x$  and  $y$  respectively,

and then solve for  $H$  and  $K$ . Before selecting your answer, check that you found what the question was asking for (the value of  $\frac{K}{H}$ ).

**Getting to the Answer:** Substitute the values of  $x$  and  $y$  into each equation and solve for  $H$  and  $K$ . Then, divide  $K$  by  $H$ .

$$Hx + 2y = -8$$

$$H(2) + 2(-1) = -8$$

$$2H - 2 = -8$$

$$2H = -6$$

$$H = -3$$

$$Kx - 5y = -13$$

$$K(2) - 5(-1) = -13$$

$$2K + 5 = -13$$

$$2K = -18$$

$$K = -9$$

$$\text{So, } \frac{K}{H} = \frac{-9}{-3} = 3.$$

## 14. D

**Difficulty:** Hard**Category:** Additional Topics in Math / Trigonometry

**Strategic Advice:** Try to determine how angles  $A$  and  $B$  are related, based on their corresponding sine values. Then, determine the quadrant in which angle  $B$  must lie, given the parameters of angle  $A$   $\left(\pi < A < \frac{3\pi}{2}\right)$ .

**Getting to the Answer:** If an angle with measure  $A$  such that  $\pi < A < \frac{3\pi}{2}$  is drawn on a unit circle, its terminal side will fall in Quadrant III, and  $\sin A = k$  will be a negative value (because sine represents the  $y$ -value of the point that intersects the unit circle). If  $\sin B = k$  also (and  $k$  is negative), then the terminal side of  $B$  must land in either of Quadrants III or IV (because sine is negative in those quadrants). Choose an easy radian measure (in Quadrant III) for

angle  $A$ , such as  $\frac{5\pi}{4}$ . Try each answer choice to see which one results in an angle that lies in the third or fourth quadrant:

*Choice A:*  $\frac{5\pi}{4} - \pi = \frac{5\pi}{4} - \frac{4\pi}{4} = \frac{\pi}{4}$ , which is in Quadrant I, so eliminate A.

*Choice B:*  $\pi + \frac{5\pi}{4} = \frac{4\pi}{4} + \frac{5\pi}{4} = \frac{9\pi}{4}$ , which is in Quadrant I (because it is the same as  $\frac{\pi}{4}$  rotated one full circle), so eliminate B.

*Choice C:*  $2\pi - \frac{5\pi}{4} = \frac{8\pi}{4} - \frac{5\pi}{4} = \frac{3\pi}{4}$ , which is in Quadrant II, so eliminate C.

*Choice (D):*  $3\pi - \frac{5\pi}{4} = \frac{12\pi}{4} - \frac{5\pi}{4} = \frac{7\pi}{4}$ , which is in Quadrant IV, so (D) is correct.

### 15. D

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Being able to fluently use the rules of exponents will come in handy on Test Day. For this question, use these rules: when you raise a power to a power, you multiply the exponents, and when you divide with exponents, you subtract them.

**Getting to the Answer:** Distribute the 2 outside the parentheses to the exponent in the numerator and in the denominator:

$$\left(\frac{x^{\frac{1}{2}}}{x^{-2}}\right)^2 = \frac{x^{\frac{1}{2} \cdot 2}}{x^{-2 \cdot 2}} = \frac{x^1}{x^{-4}}$$

Now, subtract the exponents:

$$\frac{x}{x^{-4}} = x^{1-(-4)} = x^{1+4} = x^5$$

Unfortunately,  $x^5$  is not one of the answer choices, so look for an answer choice that is also equivalent to  $x^5$ . You can eliminate A right away, and the exponents in B look too small, so start with C, which simplifies to  $\frac{x^7}{x^{12}} = \frac{1}{x^5}$  and is therefore not correct.

Choice (D) is correct because:

$$\left(\frac{(x^3)(x^4)}{x^{-3}}\right)^{\frac{1}{2}} = \left(\frac{x^7}{x^{-3}}\right)^{\frac{1}{2}} = (x^{7-(-3)})^{\frac{1}{2}} = (x^{10})^{\frac{1}{2}} = x^5.$$

### 16. 1

**Difficulty:** Medium

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** If  $(a, b)$  is a solution to the system, then  $a$  is the  $x$ -coordinate of any point in the region where the shading overlaps and  $b$  is the corresponding  $y$ -coordinate.

**Getting to the Answer:** When  $a = 0$  (or  $x = 0$ ), the maximum possible value for  $b$  lies on the upper boundary line,  $y < -3x + 2$ . (You can tell which boundary line is the upper line by looking at the  $y$ -intercept.) The point on the boundary line is  $(0, 2)$ , but the boundary line is dashed (because the inequality is strictly less than), so you cannot include  $(0, 2)$  in the solution set. This means 1 is the greatest possible integer value for  $b$  when  $a = 0$ .

### 17. 12

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Understanding the language of functions will come in very handy on Test Day. For any function  $f(x)$ , the  $x$  is the input value, and the output is the result after plugging in the input and simplifying.

**Getting to the Answer:** The question tells you that the *output* is 3 (not the input), so set the equation equal to 3 and solve for  $x$ .

$$3 = \frac{2}{3}x - 5$$

$$8 = \frac{2}{3}x$$

$$3 \cdot 8 = \cancel{3} \cdot \frac{2}{\cancel{3}}x$$

$$24 = 2x$$

$$12 = x$$

18. 12

**Difficulty:** Medium**Category:** Additional Topics in Math / Geometry**Strategic Advice:** Use the relationship

$\frac{\text{area of sector}}{\text{area of circle}} = \frac{\text{central angle}}{360^\circ}$  to answer this ques-

tion. To help you remember this relationship, just

think  $\frac{\text{partial area}}{\text{whole area}} = \frac{\text{partial angle}}{\text{whole angle}}$ .

**Getting to the Answer:** The unknown in this question is the diameter of the circle, which is twice the radius. You can find the radius of the circle by first finding the area of the whole circle, and then by using the area equation,  $A = \pi r^2$ . You have everything you need to find the area of the circle. Because this is a no-calculator question, you can bet that numbers will simplify nicely.

$$\frac{\text{area of sector}}{\text{area of circle}} = \frac{\text{central angle}}{360^\circ}$$

$$\frac{6\pi}{A} = \frac{60}{360}$$

$$\frac{6\pi}{A} = \frac{1}{6}$$

$$A = 36\pi$$

Now, solve for  $r$  using  $A = \pi r^2$ :

$$36\pi = \pi r^2$$

$$36 = r^2$$

$$\pm 6 = r$$

The radius can't be negative, so it must be 6, which means the diameter of the circle is twice that, or 12.

19. 14

**Difficulty:** Hard**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** When the equation of a circle is in the form  $(x - h)^2 + (y - k)^2 = r^2$ , the  $r$  represents the length of the radius. To get the equation into this form, complete the squares.

**Getting to the Answer:** You already have an  $x^2$  and a  $y^2$  in the given equation and the coefficients of  $x$  and  $y$  are even, so completing the square is fairly straightforward—there are just a lot of steps. Start by grouping the  $x$ s and  $y$ s together. Then, take the coefficient of the  $x$ -term and divide it by 2, square it, and add it to the two terms with  $x$ -variables. Do the same with the  $y$ -term. Don't forget to add these amounts to the other side of the equation as well. This creates a perfect square of  $x$ -terms and  $y$ -terms, so take the square root of each.

$$x^2 + y^2 + 10x - 4y = 20$$

$$x^2 + 10x + y^2 - 4y = 20$$

$$(x^2 + 10x + 25) + (y^2 - 4y + 4) = 20 + 25 + 4$$

$$(x + 5)^2 + (y - 2)^2 = 49$$

The equation tells you that  $r^2 = 49$ , which means that the radius is 7 and the diameter is twice that, or 14.

20. 800

**Difficulty:** Hard**Domain:** Passport to Advanced Math / Functions

**Strategic Advice:** You don't need to take an economics class to understand this question. Think about it logically and in terms of function notation. You need to find the quantity sold (use the function for that), and then the profits (use logic for that). The calculations are fairly simple, but there are a lot of them, so try organizing them in a table.



**Getting to the Answer:** Find the quantity that the company can expect to sell at each price using the demand function. Don't forget that the quantity is given in hundreds. Then, find the total sales, the total costs, and the total profits using simple multiplication.

Price	\$12	\$10
Quantity	$q(12) = -2(12) + 34$	$q(10) = -2(10) + 34$
	$= -24 + 34$	$= -20 + 34$
	$= 10$	$= 14$
	$10(100) = 1,000$	$14(100) = 1,400$
Sales	$1,000(12) = \$12,000$	$1,400(10) = \$14,000$
Costs	$1,000(7) = \$7,000$	$1,400(7) = \$9,800$
Profits	\$5,000	\$4,200

The company will earn  $\$5,000 - \$4,200 = \$800$  more per month.

## MATH TEST: CALCULATOR SECTION

### 1. B

**Difficulty:** Easy

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** When trying to match an inequality to a real-world scenario, you need to examine the numbers, the variables, and the inequality symbol.

**Getting to the Answer:** The question asks how much is needed to *meet or surpass* the recommended amount, which is another way of saying *greater than or equal to*, so you can eliminate C. Adult females should consume 75 mg of vitamin C, and smokers should consume an additional 35 mg, so the total amount that a smoking female should consume is  $75 + 35 = 110$  mg. This means the right-hand side of the equation should be  $\geq 110$ , and you can eliminate A. To choose between (B) and D, think in concrete terms. *Multiplying* (not dividing) the number of mg in each grapefruit or serving of

spinach yields the total amount of vitamin C in each, so (B) is correct.

### 2. D

**Difficulty:** Easy

**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** You don't need to know the slope of the line of best fit to answer the question, so don't waste valuable time trying to find it. Instead, use the labels on the axes to determine the meaning of the slope.

**Getting to the Answer:** On a graph, slope means the change in the  $y$ -values (rise) compared to the change in the  $x$ -values (run). In a real-world scenario, this is the same as the unit rate. In this context, the rise is the amount of money spent, and the run is the number of minutes watching commercials. Thus, the unit rate, or slope, represents the predicted increase in money spent on brand name products for every one-minute increase in time spent watching commercials.

### 3. B

**Difficulty:** Easy

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Whenever a question gives you information about a total number of items and a total cost of those items, you should write one equation that represents the total number (here, the number of packages) and a second equation that represents the total cost (here, the cost of the portraits).

**Getting to the Answer:** The number of parents who ordered basic packages plus the number who ordered deluxe packages equals the total number of parents (182), so one equation is  $b + d = 182$ . This means you can eliminate A and C. Now write the cost equation: cost per basic package (29.5) times

number ordered ( $b$ ) plus cost per deluxe package (44.5) times number ordered ( $d$ ) equals the total bill (\$6,509). The cost equation is  $29.5b + 44.5d = 6,509$ . Together, these two equations form the system in (B). Don't let D fool you—there are two choices of packages, but this does not impact the total amount of the school's bill.

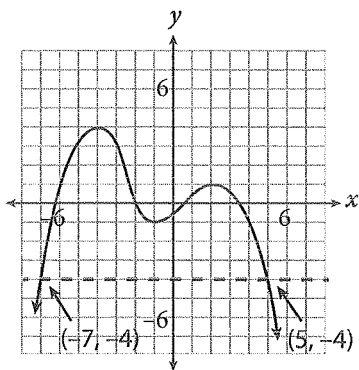
4. C

**Difficulty:** Easy

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Understanding the language of functions will make answering this question very simple. Another way of saying “For what values of  $x$  does  $f(x) = -4$ ?” is “What is the  $x$ -value when  $y = -4$ ?”

**Getting to the Answer:** Draw a line across the graph at  $y = -4$  and find the  $x$ -coordinates of any points that hit your line.



The line hits the graph at  $x = -7$  and at  $x = 5$ .

5. C

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Don't let this fairly simple question fool you. Just because 3 and  $-3$  are opposites, this does not mean the value on the right-hand side of the equals sign will be the opposite of 19.

**Getting to the Answer:** Solve for  $x$ , then substitute that value into the second equation for  $x$  and simplify.

$$\begin{aligned} 4x + 3 &= 19 \\ 4x &= 16 \\ x &= 4 \end{aligned}$$

Thus,  $4x - 3 = 4(4) - 3 = 16 - 3 = 13$ .

You might also recognize that  $4x - 3$  is 6 less than  $4x + 3$ , so you can simply subtract 6 from 19 to arrive at 13.

6. C

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** To find the slope of a line from its graph, either count the rise and the run from one point to the next, or choose two points that lie on the line and substitute them into the slope formula,  $m = \frac{y_2 - y_1}{x_2 - x_1}$ . Use whichever method gets you to the answer the quickest. Pay careful attention to negative signs.

**Getting to the Answer:** Using the points  $(0, -2)$  and  $(7, -8)$ , the slope is:

$$\begin{aligned} m &= \frac{-8 - (-2)}{7 - 0} \\ &= \frac{-6}{7} \\ &= -\frac{6}{7} \end{aligned}$$

7. B

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Compare the differences in the two lines to the statements in the answer choices. Pay careful attention to which line represents each state. Be careful—this is a real-world scenario, and

the word “positive” does not refer to the slope of the lines.

**Getting to the Answer:** The key difference between the lines in the graph is their slopes. The dashed line (State B) has a steeper negative slope, while the solid line (State A) has a more gradual slope. This means that the crime rate for armed robbery in State B decreased at a faster rate than in State A. Because, in the real world, a positive impact means fewer crimes, State B’s law had a more positive impact on the crime rate for armed robbery.

### 8. C

**Difficulty:** Easy

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** When ratios involve large numbers, simplify if possible to make the calculations easier.

**Getting to the Answer:** Let  $p$  equal the number of cans of paint mixed. Set up a proportion and solve for  $p$ . Try writing the proportion in words first.

$$\frac{4 \cancel{\text{ defective}}}{2,50 \cancel{\text{ mixed}}} = \frac{128 \cancel{\text{ defective}}}{p \cancel{\text{ mixed}}}$$

$$\frac{4}{250} = \frac{128}{p}$$

$$4p = 32,000$$

$$p = 8,000$$

### 9. D

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** In order to calculate the combined mean age, you would need to know how many men and how many women there are in their respective groups, which is not provided in the question.

**Getting to the Answer:** Because the mean ages are different and you do not know how many men or women have college degrees and get married, you need to reason logically to arrive at the correct answer. The mean age of the women is lower than that of the men, so the combined mean cannot be greater than or equal to that of the men. Similarly, the mean age of the men is greater than that of the women, so the combined mean cannot be less than or equal to the mean age of the women. In other words, the combined mean age must fall somewhere between the two means, making (D) correct.

### 10. A

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** To answer a question that says “directly proportional,” set two ratios equal to each other and solve for the missing amount. Don’t forget—match the units in the numerators and in the denominators on both sides.

**Getting to the Answer:** Let  $f$  equal the number of feet that the diver can safely ascend in 90 seconds. Set up a proportion and solve for  $f$ . Because the first rate is given in terms of minutes, write 90 seconds as 1.5 minutes.

$$\frac{165 \text{ feet}}{5.5 \text{ minutes}} = \frac{f \text{ feet}}{1.5 \text{ minutes}}$$

$$1.5(165) = 5.5(f)$$

$$247.5 = 5.5f$$

$$45 = f$$

### 11. D

**Difficulty:** Medium

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** You could graph the cost function ( $y = 17p + 1,890$ ) and the revenue function ( $y = 35x$ ) and try to determine where the revenue function is greater (higher on the graph). However,

the numbers are quite large and this may prove to be very time-consuming. Instead, create and solve an inequality comparing revenue and cost.

**Getting to the Answer:** If the revenue from a single pair of shoes is \$35, then the total revenue from  $p$  pairs is  $35p$ . If revenue must be greater than cost, then the inequality must be  $35p > 17p + 1,890$ . Now, solve for  $p$  using inverse operations:

$$\begin{aligned} 35p &> 17p + 1,890 \\ 18p &> 1,890 \\ p &> 105 \end{aligned}$$

**12. B**

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** This is a question about rates, so pay careful attention to the units. As you read the question, decide how and when you will need to convert units.

**Getting to the Answer:** First, determine how long it will take the athlete to complete the race. Set up a proportion.

$$\begin{aligned} \frac{9.25 \text{ miles}}{1 \text{ hour}} &= \frac{74 \text{ miles}}{x \text{ hours}} \\ 9.25x &= 74 \\ x &= 8 \end{aligned}$$

The question asks for the total number of calories needed. The recommended rate of consumption is given in calories per minute, and you now know the number of hours that it will take the athlete to complete the race. So, you could convert the number of hours to minutes ( $8 \times 60$  minutes = 480 minutes) and then multiply this by 3 (the calorie per minute rate given) to find that the athlete should consume  $480 \times 3 = 1,440$  calories. Or, you could also convert the given rate (3 calories per minute) to a per-hour rate ( $3 \times 60 = 180$  calories per hour) and then multiply this by the number of hours it will take the athlete to finish the race ( $180 \times 8 = 1,440$  calories).

**13. C**

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** The rate of change (or slope) of a linear relationship is constant, so find the rate and apply it to the missing value. You could also look for a pattern in the table.

**Getting to the Answer:** Choose any two points (preferably ones with the nicest numbers) from the table, and substitute them into the slope formula. Using the points (3, 0) and (-1, 14), the slope is  $\frac{14-0}{-1-3} = \frac{14}{-4} = \frac{7}{-2}$ . This means that for every

2 units the  $x$ -value decreases, the  $y$ -value increases by 7, and the decrease from  $x = -5$  to  $x = -7$  happens to be  $-2$ . So, increase the  $y$ -value by 7 one time:  $28 + 7 = 35$ .

**14. B**

**Difficulty:** Easy

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** Think about what the question is asking. The real estate agent wants to figure out which measure of the data (mean, mode, range, or median) is going to be most useful.

**Getting to the Answer:** The *mode* of a data set tells you the data point, or in this case the age range, that occurs most often. If the real estate agent markets to the age range that represents the mode, she will be marketing to the largest group of clients possible.

**15. A**

**Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** Some data sets have a *head*, where many data points are clustered in one area,

and one or two *tails*, where the number of data points slowly decreases to 0. Examining the tail will help you describe the shape of the data set. A data set is *skewed* in the direction of its longest tail.

**Getting to the Answer:** The graph in this question has its tail on the right side, so the data is skewed to the right. When data is skewed to the right, the mean is greater than the median because the mean is more sensitive to the higher data values in the tail than is the median, so (A) is correct. If you're not sure about the mean/median part, read the rest of the answer choices—none of them describes the data as skewed to the right, so you can eliminate all of them.

**16. B**

**Difficulty:** Medium

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Translate from English into math to help you create an inequality. Then solve your inequality.

**Getting to the Answer:** The question states that  $t$  represents the number of round trips. The cost of one round trip without the discount card is \$35 per trip, or  $35t$ . If a commuter purchases the discount card, round trips would equal the cost of the card plus \$12.50 per trip, or  $900 + 12.5t$ . Combine these into an inequality, remembering which way the inequality symbol should be oriented. You want the cost with the discount card to be less than (<) the cost without the card, so the inequality is  $900 + 12.5t < 35t$ . Now, solve for  $t$ :

$$\begin{aligned} 900 + 12.5t &< 35t \\ 900 &< 22.5t \\ 40 &< t \end{aligned}$$

Turn the inequality around to find that  $t > 40$ , which means a commuter must make more than 40 trips for the discount card to be a better deal, which is (B).

**17. C**

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** When you see a complex percent question on Test Day, stay calm and work toward the solution one step at a time.

**Getting to the Answer:** Etienne starts with \$800. He spends 20% of \$800, or  $0.2(\$800) = \$160$ , on gas. He has  $\$800 - \$160 = \$640$  left over. He budgets 25% of \$640, or  $0.25(\$640) = \$160$ , for food and allots \$300 for the hotel. Because he spends all the remaining money on entertainment, he spends  $\$640 - \$160 - \$300 = \$180$  on entertainment. Divide this amount by the original amount to find the percent he spent on entertainment:  $\frac{180}{800} = 0.225 = 22.5\%$ .

**18. A**

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Scatterplots

**Strategic Advice:** When the dependent variable in a relationship increases by a scale factor, like doubling, tripling, etc., there is an exponential relationship between the variables which can be written in the form  $y = a(b)^x$ , where  $a$  is the initial amount,  $b$  is the scale factor, and  $x$  is time.

**Getting to the Answer:** The question states that the number of microbes tripled every 24 hours, so the relationship is exponential. This means you can eliminate C and D right away. Choices (A) and B are written in the form  $y = a(b)^x$ , with the initial amount equal to 2,000 and the scale factor equal to 3, so you can't eliminate either one at first glance. To choose between them, try an easy number for  $h$  (like 24) in each equation to see which one matches the information given in the question. In the first equation,  $n = 2,000(3)^{\frac{24}{24}} = 2,000 \times (3)^1 = 6,000$ , which is 2,000 tripled, so (A) is correct.

19. A

**Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** When working with two-way tables, always read the question carefully, identifying which pieces of information you need. Here, you need to focus on the “Against” column and the “1L” and “2L” rows. To stay organized, it may help to circle these pieces of information in the table.

**Getting to the Answer:** There are 58 1Ls and 64 2Ls in the survey sample, for a total of  $58 + 64 = 122$  1Ls and 2Ls. There are 16 1Ls and 12 2Ls against the policy, for a total of  $16 + 12 = 28$ . This means that 28 out of the 122 1Ls and 2Ls are against the new policy. Written as a fraction, this is  $\frac{28}{122}$ , which reduces to  $\frac{14}{61}$ .

20. C

**Difficulty:** Medium**Category:** Additional Topics in Math / Imaginary Numbers

**Strategic Advice:** You will not be expected to raise a complex number like the one in this question to the third power by hand. That’s a clue that you should be able to use your calculator.

**Getting to the Answer:** The definition of  $i$  has been programmed into all graphing calculators, so you can perform basic operations on complex numbers using the calculator (in the Calculator Section of the test). Enter the expression as follows:  $(6 + 5i)^3$ . On the TI83/84 calculators, you can find  $i$  on the button with the decimal point. After entering the expression, the calculator should return  $-234 + 415i$ , which is (C).

You could, however, expand the number by hand, by writing it as  $(6 + 5i)(6 + 5i)(6 + 5i)$  and carefully multiplying it all out.

21. B

**Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** When an exponential function is written in the form  $f(x) = f(0)(1 + r)^x$ , the quantity  $(1 + r)$  represents the growth rate or the decay rate depending on whether the  $y$ -values are increasing or decreasing.

**Getting to the Answer:** The  $y$ -values are increasing in this graph, so  $r$  represents a growth rate. Because the data is modeled using an exponential function (not a linear function), the rate is not the same as the slope. Look at the  $y$ -values in the calculator screenshot—they are quadrupling as the  $x$ -values increase by 1. In the equation, this means that  $(1 + r) = 4$ . Solve this equation to find that  $r = 3$ .

22. A

**Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Pay careful attention to the units. You need to convert all of the dimensions to inches and then set up and solve a proportion.

**Getting to the Answer:** There are 12 inches in one foot, so the real pyramid’s height was  $(480 \times 12) + 8 = 5,760 + 8 = 5,768$  inches; the length of the passage in the real pyramid is  $53.75 \times 12 = 645$  inches; the museum’s pyramid height will be 71 feet, 6 inches, or 858 inches; and the length of the museum’s passage is unknown. Set up a proportion and solve for the unknown. Use words first to help you keep the measurements in the right places:

$$\frac{\text{real passage length}}{\text{real height}} = \frac{\text{museum passage length}}{\text{museum height}}$$

$$\frac{645}{5,768} = \frac{x}{858}$$

$$553,410 = 5,768x$$

$$95.94 = x$$

The museum should make its passage about 96 inches, or  $96 \div 12 = 8$  feet long.

**23. D****Difficulty:** Hard**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** You could use polynomial long division to answer this question, or you could try to factor the numerator and see if any terms cancel. It is very tricky to factor a quadratic equation with a negative coefficient on  $x^2$ , so start by factoring  $-1$  out of both the numerator and the denominator.

**Getting to the Answer:** To factor the resulting quadratic in the numerator, you need to find two numbers whose product is  $-24$  and whose sum is  $10$ . The numbers are  $-2$  and  $+12$ .

$$\begin{aligned} \frac{-x^2 - 10x + 24}{2 - x} &= \frac{\cancel{-1}(x^2 + 10x - 24)}{\cancel{-1}(x - 2)} \\ &= \frac{(x - 2)(x + 12)}{x - 2} \\ &= x + 12 \end{aligned}$$

**24. C****Difficulty:** Hard**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** You're given two ratios: ethanol to gasoline and methanol to gasoline. Your job is to "merge" them so you can directly compare ethanol to methanol.

**Getting to the Answer:** Both of the given ratios contain gasoline, but the gasoline amounts (4 and 9) are not identical. To directly compare them, find a common multiple (36). Multiply each ratio by the factor that will make the number of parts of gasoline equal to 36 in each:

$$\text{Ethanol to Gasoline: } (1:4) \times (9:9) = 9:36$$

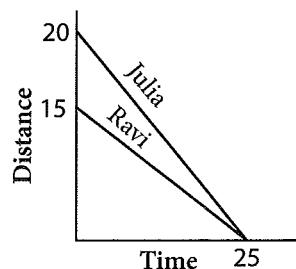
$$\text{Methanol to Gasoline: } (1:9) \times (4:4) = 4:36$$

Now that the number of parts of gasoline needed is the same in both ratios, you can merge the two ratios to compare ethanol to methanol directly:  $9:36:4$ . So the proper ratio of ethanol to methanol is  $9:4$ .

**25. A****Difficulty:** Hard**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Sometimes, adding numbers to a graph will help you answer a question.

**Getting to the Answer:** Add reasonable numbers to the graph such as the ones shown in the following example:



Use the numbers to help you evaluate each statement. It took Julia and Ravi each 25 minutes to drive to the museum, so you can eliminate C and D. Julia drove 20 miles in 25 minutes, while Ravi only drove 15 miles in 25 minutes; their rates are not the same, so B is not correct. This means (A) must be correct. Julia starts out farther away than Ravi, so Julia must have driven at a faster speed than Ravi to arrive at the museum in the same amount of time.

**26. D****Difficulty:** Hard**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Transformations that are grouped with the  $x$  in a function shift the graph horizontally and therefore affect the  $x$ -coordinates of points on the graph. Transformations that are not grouped with the  $x$  shift the graph vertically and therefore affect the  $y$ -coordinates of points on the graph.

Remember, horizontal shifts are always backward of what they look like.

**Getting to the Answer:** Perform each transformation on the coordinates of the point, one at a time, following the same order of operations that you use when simplifying arithmetic expressions. Start with  $(x - 4)$ . This shifts the graph right 4 units, so add 4 to the  $x$ -coordinate of the given point:  $(8, -3) \rightarrow (8 + 4, -3) = (12, -3)$ . Next, apply the negative in front of  $g$ , which is not grouped with the  $x$ , so it makes the  $y$ -coordinate the opposite of what it was:  $(12, -3) \rightarrow (12, 3)$ . Finally, the  $-6$  is not grouped with  $x$ , so subtract 6 from the  $y$ -coordinate:  $(12, 3) \rightarrow (12, 3 - 6) = (12, -3)$ . Therefore, (D) is correct. You could also plot the point on a coordinate plane, perform the transformations (right 4, reflect vertically over the  $x$ -axis, and then down 6), and find the resulting point.

## 27. D

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Sometimes, a question requires thought rather than brute force. Here, you need to understand that when dealing with compositions, the range of the inner function becomes the domain of the outer function, which in turn produces the range of the composition.

**Getting to the Answer:** In the composition  $f(g(x))$ , the function  $g(x) = x^3$  is the inner function. Because the question states that  $x$  is either zero or a negative number ( $x \leq 0$ ), every value of  $x$ , when substituted into this function, will result in zero or a negative number (because a negative number raised to an odd power is always negative). This means that the largest possible range value for  $g(x)$  is 0, and consequently that the largest possible domain value for  $f(x)$  is also 0. Substituting 0 for  $x$  in  $f(x)$  results in  $-1$ , which is the largest possible range value for the composition. Because  $1 > -1$ , it is not in the range of  $f(g(x))$ , so (D) is correct.

## 28. A

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** To answer this question, you need to recall nearly everything you've learned about quadratic graphs. The equation is given in vertex form ( $y = a(x - h)^2 + k$ ), which reveals the vertex  $(h, k)$ , the direction in which the parabola opens (upward when  $a > 0$  and downward when  $a < 0$ ), the axis of symmetry ( $x = h$ ), and the minimum/maximum value of the function ( $k$ ).

**Getting to the Answer:** Start by comparing each answer choice to the equation,  $y = -3(x - 5)^2 + 8$ . The only choice that you cannot immediately compare is (A), because vertex form does not readily reveal the  $y$ -intercept, so start with B. Don't forget, you are looking for the statement that is not true. Choice B: The axis of symmetry is given by  $x = h$ , and  $h$  is 5, so this statement is true and therefore not correct. Choice C: The vertex is given by  $(h, k)$ , so the vertex is indeed  $(5, 8)$  and this choice is not correct. Choice D: The value of  $a$  is  $-3$ , which indicates that the parabola opens downward, so this choice is also incorrect. That means (A) must be the correct answer. To confirm, you could substitute 0 for  $x$  in the equation to find the  $y$ -intercept.

$$\begin{aligned} y &= -3(x - 5)^2 + 8 \\ &= -3(0 - 5)^2 + 8 \\ &= -3(-5)^2 + 8 \\ &= -3(25) + 8 \\ &= -75 + 8 \\ &= -67 \end{aligned}$$

The  $y$ -intercept is  $(0, -67)$ , not  $(0, 8)$ , so the statement is not true and therefore the correct answer.

## 29. A

**Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages



**Strategic Advice:** Don't let all the technical words in this question overwhelm you. Solve it step-by-step, examining the units as you go. Notice that some of the numbers in the answer choices are just 1 apart, so think carefully before selecting your answer.

**Getting to the Answer:** *Step 1:* Determine the number of megabytes the computer can upload in 1 weekend (48 hours):

$$\frac{5.25 \text{ megabytes}}{1 \text{ sec}} \times \frac{60 \text{ sec}}{1 \text{ min}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times 48 \text{ hr} \\ = 907,200 \text{ megabytes}$$

*Step 2:* Convert this amount to gigabytes (because the information about the scans is given in gigabytes, not megabytes):

$$907,200 \text{ megabytes} \times \frac{1 \text{ gigabyte}}{1,000 \text{ megabytes}} \\ = 907.2 \text{ gigabytes}$$

*Step 3:* Each client file is about 2.5 gigabytes in size, so divide this number by 2.5 to determine how many client files the computer can upload to the remote server:  $907.2 \div 2.5 = 362.88$  files. Remember, you should round this number down to 362, because the question asks for the maximum number the computer can upload, and it cannot complete the 363rd scan in the time allowed.

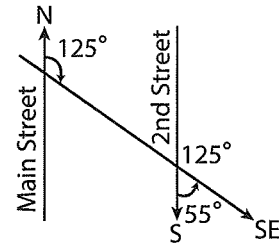
**30. A**

**Difficulty:** Hard

**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** This question does not provide a graphic, so sketch a quick diagram of the information presented. Be sure to show the direction of traffic for each street.

**Getting to the Answer:** The question describes two parallel streets, cut by a transversal. Start with that, and then add all the details.



Traffic traveling north on Main Street must make a  $125^\circ$  turn onto the new road. This is the angle between where the traffic was originally headed and where it is headed after it makes the turn. Traffic on 2nd Street is traveling south, the opposite direction. As shown in the diagram, the angle that the southbound traffic would make is supplementary to the corresponding angle made by the northbound traffic. When two parallel lines are cut by a transversal, corresponding angles are congruent, which means that cars turning off of 2nd Street will make a  $180 - 125 = 55^\circ$  turn onto the new road.

**31. 11.5 or 23/2 or 69/6**

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Simplify the numerators, then cross-multiply and solve using inverse operations.

**Getting to the Answer:** Simplify each numerator. Then, cross-multiply. Finally, isolate the variable using inverse operations.

$$\frac{4h - (21 - 8h)}{3} = \frac{15 + 6(h - 1)}{2} \\ \frac{4h - 21 + 8h}{3} = \frac{15 + 6h - 6}{2} \\ \frac{12h - 21}{3} = \frac{6h + 9}{2} \\ 2(12h - 21) = 3(6h + 9) \\ 24h - 42 = 18h + 27 \\ 6h = 69 \\ h = \frac{69}{6} = \frac{23}{2} = 11.5$$

32. 255

**Difficulty:** Medium**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Write a system of equations with  $N$  = the cost of the New York property in thousands of dollars (so you don't have to deal with all the zeros) and  $G$  = the cost of the Georgia property in thousands of dollars. Before entering your final answer, check that you answered the right question (how much *more* the New York property costs).

**Getting to the Answer:** Translate English into math to write the two equations: the New York property costs 30 thousand dollars less than four times the cost of the Georgia property, so  $N = 4G - 30$ ; together, the two properties cost 445 thousand dollars, so  $N + G = 445$ .

The system of equations is:

$$\begin{cases} N = 4G - 30 \\ N + G = 445 \end{cases}$$

The top equation is already solved for  $N$ , so substitute  $4G - 30$  into the second equation for  $N$  and solve for  $G$ :

$$\begin{aligned} 4G - 30 + G &= 445 \\ 5G - 30 &= 445 \\ 5G &= 475 \\ G &= 95 \end{aligned}$$

The Georgia property costs 95 thousand dollars, so the New York property costs  $4(95) - 30 = 350$  thousand dollars. This means the New York property costs  $350 - 95 = 255$  thousand more dollars than the Georgia property.

33. .52

**Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** The probability that an event will occur is the number of desired outcomes (number of available cars that have a rating of at least 25 mpg) divided by the number of total possible outcomes (total number of cars).

**Getting to the Answer:** "At least" means that much or greater, so find the number of cars represented by the two bars to the right of 25 in the histogram:  $20 + 6 = 26$  cars. Now find the total number of available cars:  $8 + 16 + 20 + 6 = 50$ . Finally, divide to find the indicated probability:  $\frac{26}{50} = 0.52$ .

34. 21

**Difficulty:** Medium**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** Use the formula for finding the volume of a rectangular solid,  $V = lwh$ , to write an equation. Because the dimensions are given as the ratio 3:5:2, let the length, width, and height be represented by  $3x$ ,  $5x$ , and  $2x$ .

**Getting to the Answer:** Substitute the expressions into the formula and solve for  $x$ .

$$\begin{aligned} 10,290 &= (3x)(5x)(2x) \\ 10,290 &= 30x^3 \\ 343 &= x^3 \\ 7 &= x \end{aligned}$$

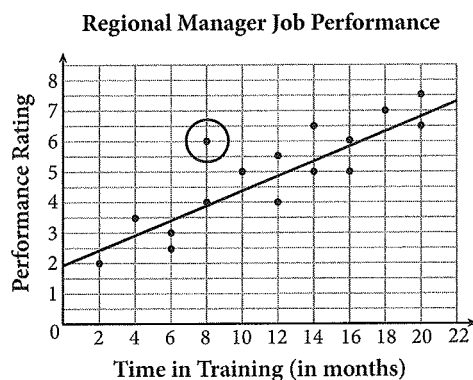
The length was represented by  $3x$ , so multiply to find that the length is  $3(7) = 21$  feet.

35. 8

**Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** Draw the line of best fit so that approximately half the data points fall above the line and half fall below it.

**Getting to the Answer:** The line of best fit is shown as follows:



Look for the point that is farthest from the line you drew, which is (8, 6). Because time is plotted along the horizontal axis, this point represents a manager who spent 8 months in the training program.

**36. 37****Difficulty:** Hard**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Although this question is in the calculator portion of the test, you get an overflow error if you try to use your calculator. This is because the numbers are simply too large. You'll need to rely on the rules of exponents to answer this question.

**Getting to the Answer:** When a power is raised to a power, multiply the exponents. You want to be able to add the exponents later, so the bases need to be the same, and you'll need to recognize that 32 is the same as 2 raised to the 5th power.

$$\begin{aligned} & (2^{32})^{(2^{32})} \\ &= 2^{(32 \cdot 2^{32})} \\ &= 2^{(2^5 \cdot 2^{32})} \end{aligned}$$

Now that the two bases in the exponent are the same, you can add their exponents.

$$\begin{aligned} &= 2^{(2^{5+32})} \\ &= 2^{(2^{37})} \end{aligned}$$

Therefore,  $x = 37$ .

**37. 33****Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Questions that involve distance, rate, and time can almost always be solved using the formula  $\text{Distance} = \text{rate} \times \text{time}$ .

**Getting to the Answer:** Use the speed, or rate, of the first car (64 mph) and its distance from the destination (144 mi) to determine how long it traveled. You don't know the time, so call it  $t$ .

$$\begin{aligned} \text{Distance} &= \text{rate} \times \text{time} \\ 144 &= 64t \\ 2.25 &= t \end{aligned}$$

This means it took 2.25 hours for the first car to arrive. You need the number of minutes, so multiply 2.25 by 60 to get  $60 \times 2.25 = 135$  minutes. Now determine how long it took the second car. It started its drive at 2:18 PM and arrived at 4:00 PM, so it took 1 hour and 42 minutes, or 102 minutes. This means that the first car had been traveling for  $135 - 102 = 33$  minutes before the second car started its drive.

**38. 220****Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Break the question into short steps (first part of trip, stopped for accident, last part of trip).

**Getting to the Answer:** To get started, you'll need to find the distance for each part of the third car's trip—the question only tells you the total distance (25 miles). Then, use the formula  $\text{Distance} = \text{rate} \times \text{time}$  to find how long the car traveled at 15 mph and then how long it traveled at 30 mph.

*First part of trip:* (60% of the drive)

$$0.6 \times 25 \text{ mi} = 15 \text{ mi}$$

$$15 = 15t$$

$$t = 1$$

So the first part of the trip took 1 hour. Then the car did not move for 20 minutes due to the accident.

*Last part of trip:* (40% of the drive remained)

$$0.4 \times 25 \text{ mi} = 10 \text{ mi}$$

$$10 = 30t$$

$$t = \frac{1}{3}$$

So the last part of the trip took one-third of an hour, or 20 minutes. This means it took the third car a total of 1 hour and 40 minutes to arrive at the destination. Because the car arrived at 4:00 PM, it must have left at 2:20 PM. Enter the answer as 220.

# SAT PRACTICE TEST 7 ANSWER SHEET

Remove (or photocopy) this answer sheet and use it to complete the test. See the answer key following the test when finished.

Start with number 1 for each section. If a section has fewer questions than answer spaces, leave the extra spaces blank.

## SECTION

1

- |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| 1. (A) (B) (C) (D)  | 14. (A) (B) (C) (D) | 27. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 2. (A) (B) (C) (D)  | 15. (A) (B) (C) (D) | 28. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 3. (A) (B) (C) (D)  | 16. (A) (B) (C) (D) | 29. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D)  | 17. (A) (B) (C) (D) | 30. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D)  | 18. (A) (B) (C) (D) | 31. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D)  | 19. (A) (B) (C) (D) | 32. (A) (B) (C) (D) | 45. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D)  | 20. (A) (B) (C) (D) | 33. (A) (B) (C) (D) | 46. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D)  | 21. (A) (B) (C) (D) | 34. (A) (B) (C) (D) | 47. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D)  | 22. (A) (B) (C) (D) | 35. (A) (B) (C) (D) | 48. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 23. (A) (B) (C) (D) | 36. (A) (B) (C) (D) | 49. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 24. (A) (B) (C) (D) | 37. (A) (B) (C) (D) | 50. (A) (B) (C) (D) |
| 12. (A) (B) (C) (D) | 25. (A) (B) (C) (D) | 38. (A) (B) (C) (D) | 51. (A) (B) (C) (D) |
| 13. (A) (B) (C) (D) | 26. (A) (B) (C) (D) | 39. (A) (B) (C) (D) | 52. (A) (B) (C) (D) |

# right in  
Section 1
# wrong in  
Section 1

## SECTION

2

- |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| 1. (A) (B) (C) (D)  | 12. (A) (B) (C) (D) | 23. (A) (B) (C) (D) | 34. (A) (B) (C) (D) |
| 2. (A) (B) (C) (D)  | 13. (A) (B) (C) (D) | 24. (A) (B) (C) (D) | 35. (A) (B) (C) (D) |
| 3. (A) (B) (C) (D)  | 14. (A) (B) (C) (D) | 25. (A) (B) (C) (D) | 36. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D)  | 15. (A) (B) (C) (D) | 26. (A) (B) (C) (D) | 37. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D)  | 16. (A) (B) (C) (D) | 27. (A) (B) (C) (D) | 38. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D)  | 17. (A) (B) (C) (D) | 28. (A) (B) (C) (D) | 39. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D)  | 18. (A) (B) (C) (D) | 29. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D)  | 19. (A) (B) (C) (D) | 30. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D)  | 20. (A) (B) (C) (D) | 31. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 21. (A) (B) (C) (D) | 32. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 22. (A) (B) (C) (D) | 33. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |

# right in  
Section 2
# wrong in  
Section 2

SECTION 3

3

1. (A) (B) (C) (D)      5. (A) (B) (C) (D)      9. (A) (B) (C) (D)      13. (A) (B) (C) (D)  
 2. (A) (B) (C) (D)      6. (A) (B) (C) (D)      10. (A) (B) (C) (D)      14. (A) (B) (C) (D)  
 3. (A) (B) (C) (D)      7. (A) (B) (C) (D)      11. (A) (B) (C) (D)      15. (A) (B) (C) (D)  
 4. (A) (B) (C) (D)      8. (A) (B) (C) (D)      12. (A) (B) (C) (D)

# right in Section 3

# wrong in Section 3

16.

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8	8	8	8
9	9	9	9

17.

7	7		
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18.

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9	9	9	9

19.

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9	9	9	9

20.

7	7		
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6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

SECTION 4

4

1. (A) (B) (C) (D)      9. (A) (B) (C) (D)      17. (A) (B) (C) (D)      25. (A) (B) (C) (D)  
 2. (A) (B) (C) (D)      10. (A) (B) (C) (D)      18. (A) (B) (C) (D)      26. (A) (B) (C) (D)  
 3. (A) (B) (C) (D)      11. (A) (B) (C) (D)      19. (A) (B) (C) (D)      27. (A) (B) (C) (D)  
 4. (A) (B) (C) (D)      12. (A) (B) (C) (D)      20. (A) (B) (C) (D)      28. (A) (B) (C) (D)  
 5. (A) (B) (C) (D)      13. (A) (B) (C) (D)      21. (A) (B) (C) (D)      29. (A) (B) (C) (D)  
 6. (A) (B) (C) (D)      14. (A) (B) (C) (D)      22. (A) (B) (C) (D)      30. (A) (B) (C) (D)  
 7. (A) (B) (C) (D)      15. (A) (B) (C) (D)      23. (A) (B) (C) (D)  
 8. (A) (B) (C) (D)      16. (A) (B) (C) (D)      24. (A) (B) (C) (D)

# right in Section 4

# wrong in Section 4

31.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

32.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

33.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

34.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

35.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

36.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

37.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

38.

7	7		
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

# MATH TEST

25 Minutes—20 Questions

## NO-CALCULATOR SECTION

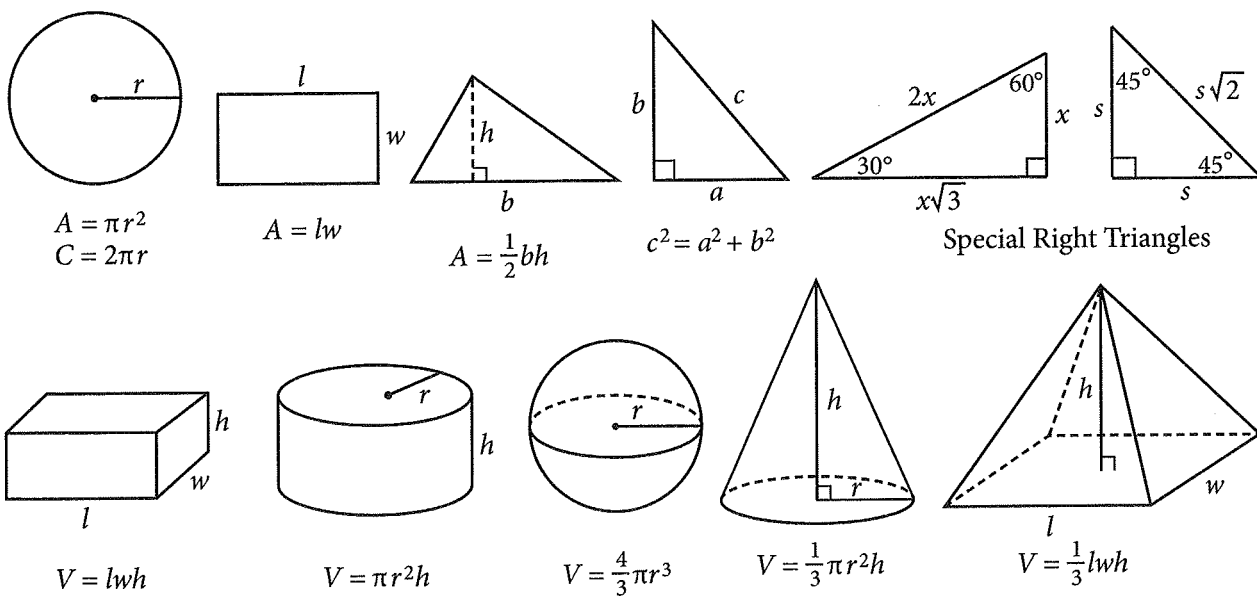
Turn to Section 3 of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding oval on the answer sheet. You may use any available space for scratch work.

Notes:

1. Calculator use is NOT permitted.
2. All numbers used are real numbers.
3. All figures used are necessary to solving the problems that they accompany. All figures are drawn to scale EXCEPT when it is stated that a specific figure is not drawn to scale.
4. Unless stated otherwise, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$ , for which  $f(x)$  is a real number.

Information:



The sum of the degree measures of the angles in a triangle is 180.

The number of degrees of arc in a circle is 360.

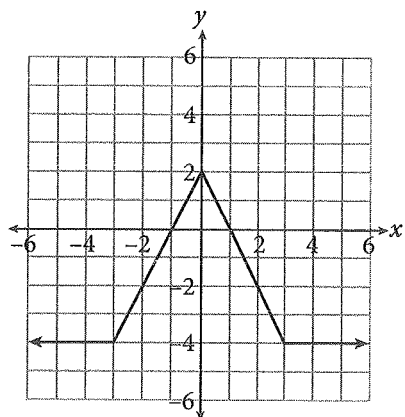
The number of radians of arc in a circle is  $2\pi$ .

$$\frac{4(n-2)+5}{2} = \frac{13-(9+4n)}{4}$$

1. In the equation above, what is the value of  $n$ ?
- A)  $\frac{5}{6}$   
 B)  $\frac{5}{2}$   
 C) There is no value of  $n$  that satisfies the equation.  
 D) There are infinitely many values of  $n$  that satisfy the equation.

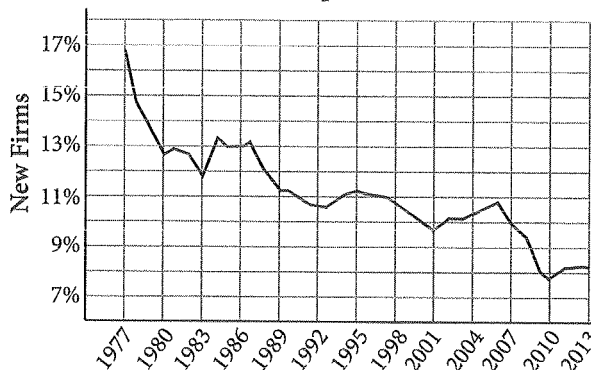
$$\frac{18x^3 + 9x^2 - 36x}{9x^2}$$

2. Which of the following is equivalent to the expression above?
- A)  $2x - \frac{4}{x}$   
 B)  $18x^3 - 36x$   
 C)  $2x + 1 - \frac{4}{x}$   
 D)  $18x^3 - 36x + 1$



3. The figure above shows the graph of  $f(x)$ . For which value(s) of  $x$  does  $f(x)$  equal 0?
- A) -3 and 3  
 B) -1 and 1  
 C) -1, 1, and 2  
 D) 2 only

Start-Up Businesses

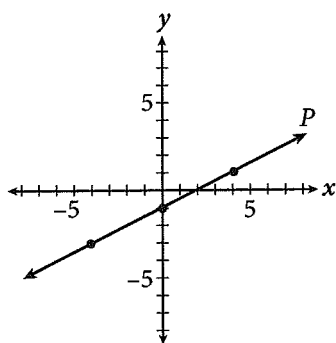


4. A start-up business is typically one that offers a “new” type of service or produces a “new” product. Start-ups are designed to search for a sustainable business model. The function shown in the graph represents new business start-up rates in the United States from 1977 to 2013 as reported by the U.S. Census Bureau. If  $t$  represents the year, then which of the following statements correctly describes the function?
- A) The function is increasing overall.  
 B) The function is decreasing overall.  
 C) The function is increasing for all  $t$  such that  $1977 < t < 2013$ .  
 D) The function is decreasing for all  $t$  such that  $1977 < t < 2013$ .
5. Which of the following systems of inequalities has no solution?
- A)  $\begin{cases} y \geq x \\ y \leq 2x \end{cases}$   
 B)  $\begin{cases} y \geq x \\ y \leq -x \end{cases}$   
 C)  $\begin{cases} y \geq x + 1 \\ y \leq x - 1 \end{cases}$   
 D)  $\begin{cases} y \geq -x + 1 \\ y \leq x - 1 \end{cases}$



6. At what value(s) of  $x$  do the graphs of  $y = -2x + 1$  and  $y = 2x^2 + 5x + 4$  intersect?

- A)  $-8$  and  $\frac{1}{2}$
- B)  $-3$  and  $-\frac{1}{2}$
- C)  $-3$  and  $3$
- D)  $-\frac{1}{2}$  and  $3$



7. If line  $P$  shown in the graph is reflected over the  $x$ -axis and shifted up 3 units, what is the new  $y$ -intercept?

- A)  $(0, -4)$
- B)  $(0, -2)$
- C)  $(0, 2)$
- D)  $(0, 4)$

8. Which of the following are roots of the equation  $3x^2 - 6x - 5 = 0$ ?

- A)  $1 \pm 2\sqrt{6}$
- B)  $\frac{1 \pm 2\sqrt{2}}{3}$
- C)  $\frac{3 \pm 2\sqrt{2}}{3}$
- D)  $\frac{3 \pm 2\sqrt{6}}{3}$

9. If  $m = \frac{1}{n^{-\frac{1}{4}}}$ , where both  $m > 0$  and  $n > 0$ , which of the following gives  $n$  in terms of  $m$ ?

- A)  $n = m^4$
- B)  $n = \frac{1}{m^4}$
- C)  $n = \frac{1}{\sqrt[4]{m}}$
- D)  $n = m^{\frac{1}{4}}$

$$\begin{cases} y = 3x - 1 \\ y = \frac{5x + 8}{2} \end{cases}$$

10. If  $(x, y)$  represents the solution to the system of equations shown above, what is the value of  $y$ ?

- A) 10
- B) 19
- C) 29
- D) 31

11. If  $0 < \frac{d}{2} + 1 \leq \frac{8}{5}$ , which of the following is not a possible value of  $d$ ?

- A)  $-2$
- B)  $-\frac{6}{5}$
- C)  $0$
- D)  $\frac{6}{5}$

12. The value of  $\cos 40^\circ$  is the same as which of the following?
- A)  $\sin 50^\circ$
  - B)  $\sin(-40^\circ)$
  - C)  $\cos(-50^\circ)$
  - D)  $\cos 140^\circ$
13. A business's "break-even point" is the point at which revenue (sales) equals expenses. When a company breaks even, no profit is being made, but the company is not losing any money either. Suppose a manufacturer buys materials for producing a particular item at a cost of \$4.85 per unit and has fixed monthly expenses of \$11,625 related to this item. The manufacturer sells this particular item to several retailers for \$9.50 per unit. How many units must the manufacturer sell per month to reach the break-even point for this item?
- A) 810
  - B) 1,225
  - C) 2,100
  - D) 2,500
14. If  $\frac{1}{2}y - \frac{3}{5}x = -16$ , what is the value of  $6x - 5y$ ?
- A) 32
  - B) 80
  - C) 96
  - D) 160
15. If  $f(g(2)) = -1$  and  $f(x) = x + 1$ , then which of the following could define  $g(x)$ ?
- A)  $g(x) = x - 6$
  - B)  $g(x) = x - 4$
  - C)  $g(x) = x - 2$
  - D)  $g(x) = x - 1$

**Directions:** For questions 16-20, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $\frac{7}{2}$ .

(If  $3\frac{1}{2}$  is entered into the grid as 

3	/	1	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)

- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Answer:  $\frac{7}{12}$

Write answer in boxes. →

7	/	1	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Grid in result. →

Answer: 2.5

2	.	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

← Decimal point

Answer: 201  
Either position is correct.

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

2	0	1	
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4

Acceptable ways to grid  $\frac{2}{3}$  are:

2	/	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6

.	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

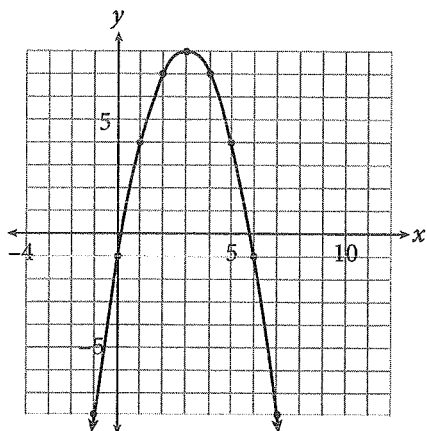
.	6	6	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

$$k(10x - 5) = 2(3 + x) - 7$$

16. If the equation above has infinitely many solutions and  $k$  is a constant, what is the value of  $k$ ?
17. A right triangle has leg lengths of 18 and 24 and a hypotenuse of  $15n$ . What is the value of  $n$ ?

$$\frac{\sqrt{x} \cdot x^{\frac{5}{4}} \cdot x^2}{\sqrt[4]{x^3}}$$

18. If the expression above is combined into a single power of  $x$  with a positive exponent, what is that exponent?
19. If the product of  $(3 + \sqrt{-16})(1 - \sqrt{-36})$  is written as a complex number in the form  $a + bi$ , what is the value of  $a$ ? (Note:  $\sqrt{-1} = i$ )



20. If the equation of the parabola shown in the graph is written in standard quadratic form,  $y = ax^2 + bx + c$ , and  $a = -1$ , then what is the value of  $b$ ?

# MATH TEST

55 Minutes—38 Questions

## CALCULATOR SECTION

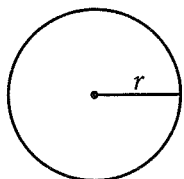
Turn to Section 4 of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding oval on the answer sheet. You may use any available space for scratch work.

Notes:

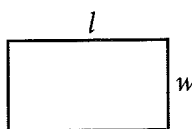
1. Calculator use is permitted.
2. All numbers used are real numbers.
3. All figures used are necessary to solving the problems that they accompany. All figures are drawn to scale EXCEPT when it is stated that a specific figure is not drawn to scale.
4. Unless stated otherwise, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$ , for which  $f(x)$  is a real number.

Information:

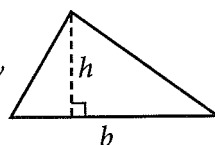


$$A = \pi r^2$$

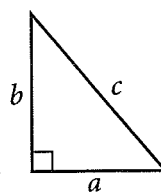
$$C = 2\pi r$$



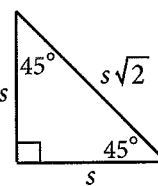
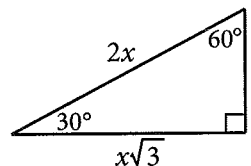
$$A = lw$$



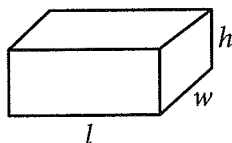
$$A = \frac{1}{2}bh$$



$$c^2 = a^2 + b^2$$



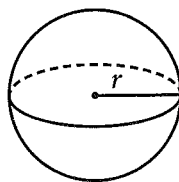
Special Right Triangles



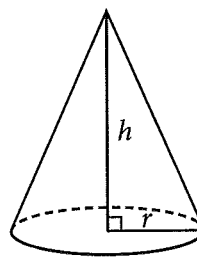
$$V = lwh$$



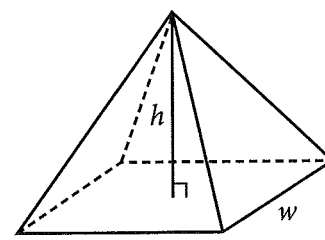
$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



$$V = \frac{1}{3}lwh$$

The sum of the degree measures of the angles in a triangle is 180.

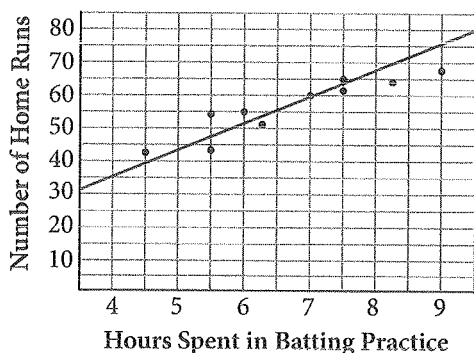
The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is  $2\pi$ .

$$\begin{cases} 4x + y = -5 \\ -4x - 2y = -2 \end{cases}$$

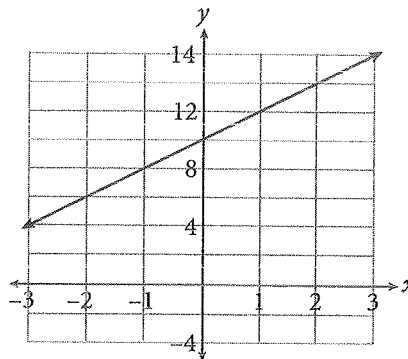
1. What is the  $y$ -coordinate of the solution to the system of equations shown above?

A) -7  
 B) -3  
 C) 0  
 D) 7

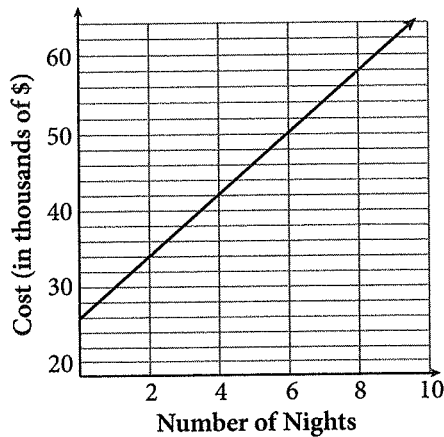


2. The scatterplot above shows data collected from 10 major league baseball players comparing the average weekly time each one spent in batting practice and the number of home runs he hit in a single season. The line of best fit for the data is also shown. What does the slope of the line represent in this context?

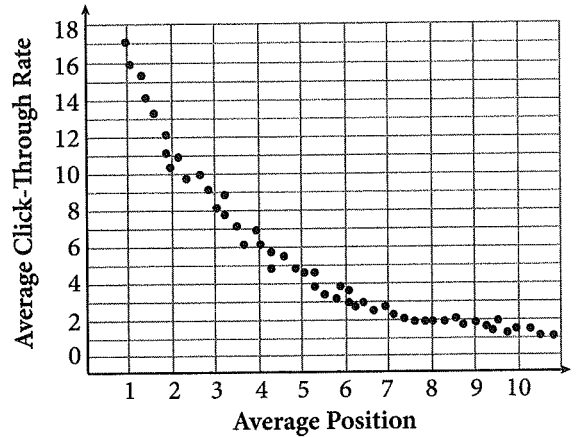
A) The estimated time spent in batting practice by a player who hits 0 home runs  
 B) The estimated number of single-season home runs hit by a player who spends 0 hours in batting practice  
 C) The estimated increase in time that a player spends in batting practice for each home run that he hits in a single season  
 D) The estimated increase in the number of single-season home runs hit by a player for each hour he spends in batting practice



3. Where will the line shown in the graph above intersect the  $x$ -axis?
- A) -5.5  
 B) -5  
 C) -4.5  
 D) -4
4. The function  $f(x)$  is defined as  $f(x) = -3g(x)$ , where  $g(x) = x + 2$ . What is the value of  $f(5)$ ?
- A) -21  
 B) -1  
 C) 4  
 D) 7
5. Sara is grocery shopping. She needs laundry detergent, which is on sale for 30% off its regular price of \$8.00. She also needs dog food, which she can buy at three cans for \$4.00. Which of the following represents the total cost, before tax, if Sara buys  $x$  bottles of laundry detergent and 12 cans of dog food?
- A)  $C = 2.4x + 48$   
 B)  $C = 5.6x + 16$   
 C)  $C = 5.6x + 48$   
 D)  $C = 8.4x + 16$



6. The graph shows the average cost of back surgery followed by a hospital stay in the United States. The hospital charges for the surgery itself plus all the costs associated with recovery care for each night the patient remains in the hospital. Based on the graph, what is the average cost per night spent in the hospital?
- A) \$2,600  
 B) \$4,000  
 C) \$6,600  
 D) \$8,000



7. The figure above represents a click-through rate curve, which shows the relationship between a search result position in a list of Internet search results and the number of people who clicked on advertisements on that result's page. Which of the following regression types would be the best model for this data?
- A) A linear function  
 B) A quadratic function  
 C) A polynomial function  
 D) An exponential function

8. Kudzu is a vine-like plant that grows indigenously in Asia. It was brought over to the United States in the early 20th century to help combat soil erosion. As can often happen when foreign species are introduced into a non-native habitat, kudzu growth exploded and it became invasive. In one area of Virginia, kudzu covered approximately 3,200 acres of a farmer's cropland, so he tried a new herbicide. After two weeks of use, 2,800 acres of the farmer's cropland were free of the kudzu. Based on these results, and assuming the same general conditions, how many of the 30,000 acres of kudzu-infested cropland in that region would still be covered if all the farmers in the entire region had used the herbicide?
- A) 3,750  
B) 4,000  
C) 26,000  
D) 26,250

$x$	-2	-1	0	1	2	3
$g(x)$	5	3	1	-1	-3	-5
$h(x)$	-3	-2	-1	0	1	2

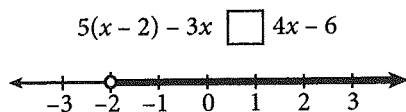
9. Several values for the functions  $g(x)$  and  $h(x)$  are shown in the table. What is the value of  $g(h(3))$ ?
- A) -5  
B) -3  
C) -1  
D) 2
10. Mae-Ling made 15 shots during a basketball game. Some were 3-pointers and others were worth 2 points each. If  $s$  shots were 3-pointers, which expression represents her total score?
- A)  $3s$   
B)  $s + 30$   
C)  $3s + 2$   
D)  $5s + 30$

11. Crude oil is sold by the barrel, which refers to both the physical container and a unit of measure, abbreviated as bbl. One barrel holds 42 gallons and, consequently, 1 bbl = 42 gal. An oil company is filling an order for 2,500 barrels. The machine the company uses to fill the barrels pumps at a rate of 37.5 gallons per minute. If the oil company has 8 machines working simultaneously, how long will it take to fill all the barrels in the order?
- A) 5 hours and 50 minutes  
B) 12 hours and 45 minutes  
C) 28 hours and 30 minutes  
D) 46 hours and 40 minutes

	Jan	Feb	Mar	April
Company A	54	146	238	330
Company B	15	30	60	120

12. Company A and Company B are selling two similar toys. The sales figures for each toy are recorded in the table above. The marketing department at Company A predicts that its monthly sales for this particular toy will continue to be higher than Company B's through the end of the year. Based on the data in the table, and assuming that each company sustains the pattern of growth the data suggests, which company will sell more of this toy in December of that year and how much more?
- A) Company A; 182  
B) Company A; 978  
C) Company B; 29,654  
D) Company B; 60,282





13. Which symbol correctly completes the inequality whose solution is shown above?
- A)  $<$
  - B)  $>$
  - C)  $\leq$
  - D)  $\geq$

**Questions 14 and 15 refer to the following information.**

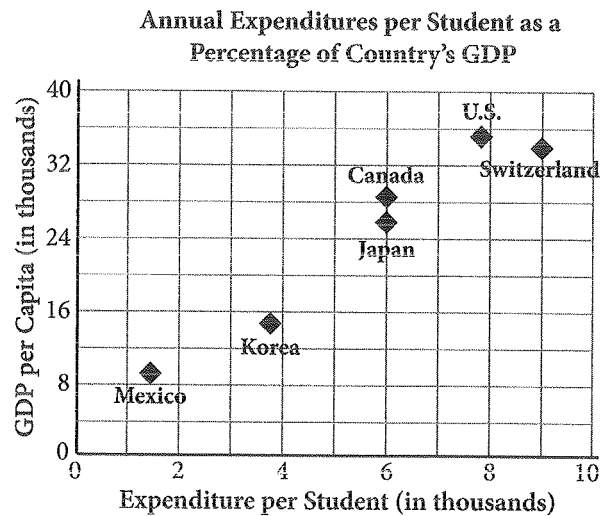
A student is drawing the human skeleton to scale for a school assignment. The assignment permits the student to omit all bones under a certain size because they would be too small to draw. The longest bone in the human body is the femur, or thighbone, with an average length of 19.9 inches. The tenth longest bone is the sternum, or breastbone, with an average length of 6.7 inches.

14. If the scale factor of the drawing is one-eighth, about how long in inches should the student draw the femur?
- A) 2
  - B) 2.5
  - C) 2.8
  - D) 3
15. The student draws the femur, but then realizes she drew it too long, at 3.5 inches. She doesn't want to erase and start over, so she decides she will adjust the scale factor to match her current drawing instead. Based on the new scale factor, about how long in inches should she draw the sternum?
- A) 0.8
  - B) 1
  - C) 1.2
  - D) 1.5

16. If a line that passes through the ordered pairs  $(4 - c, 2c)$  and  $(-c, -8)$  has a slope of  $\frac{1}{2}$ , what is the value of  $c$ ?
- A) -5  
B) -3  
C) -2  
D) 2

From	Distance to LHR
DCA	3,718
MIA	4,470

17. Two airplanes departed from different airports at 5:30 AM, both traveling nonstop to London Heathrow Airport (LHR). The distances the planes traveled are recorded in the table. The Washington, D.C. (DCA) flight flew through moderate cloud cover and as a result only averaged 338 mph. The flight from Miami (MIA) had good weather conditions for the first two-thirds of the trip and averaged 596 mph, but then encountered some turbulence and only averaged 447 mph for the last part of the trip. Which plane arrived first and how long was it at the London airport before the other plane arrived?
- A) MIA; 2 hours, 40 minutes  
B) MIA; 3 hours, 30 minutes  
C) DCA; 1 hour, 20 minutes  
D) DCA; 3 hours, 40 minutes
18. Which of the following quadratic equations has no solution?
- A)  $0 = -3(x + 1)(x - 8)$   
B)  $0 = 3(x + 1)(x - 8)$   
C)  $0 = -3(x + 1)^2 + 8$   
D)  $0 = 3(x + 1)^2 + 8$



Adapted from the Organization for Economic Cooperation and Development (OECD), 2003.

19. A student looked at the graph above and determined based on the data that spending more money per student causes the gross domestic product (GDP) to increase. Which of the following statements is true?
- A) The student is correct; the data shows that increased spending on students causes an increase in the GDP.  
B) The student is incorrect; the data shows that having a higher GDP causes an increase in the amount of money a country spends on students.  
C) The student is incorrect; there is no correlation and, therefore, no causation between GDP and expenditures on students.  
D) The student is incorrect; the two variables are correlated, but changes in one do not necessarily cause changes in the other.

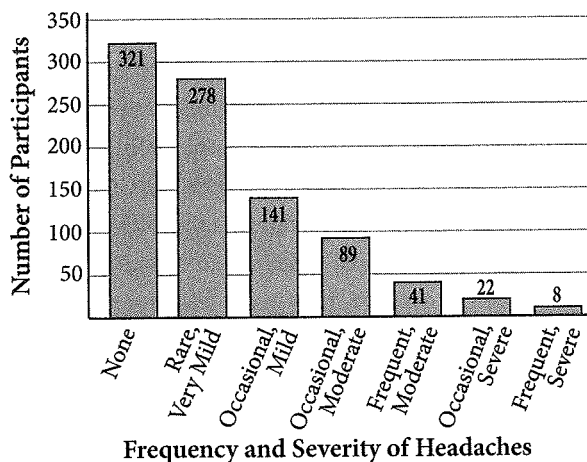
20. In chemistry, the combined gas law formula  $\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$  gives the relationship between the volumes, temperatures, and pressures for two fixed amounts of gas. Which of the following gives  $p_2$  in terms of the other variables?

- A)  $p_1 = p_2$   
 B)  $\frac{p_1 T}{V} = p_2$   
 C)  $\frac{p_1 V_1 T_2}{T_1 V_2} = p_2$   
 D)  $\frac{p_1 V_1 V_2}{T_1 T_2} = p_2$

21. An object's weight is dependent upon the gravitational force being exerted upon the object. This is why objects in space are weightless. If 1 pound on Earth is equal to 0.377 pounds on Mars and 2.364 pounds on Jupiter, how many more pounds does an object weighing 1.5 tons on Earth weigh on Jupiter than on Mars?

- A) 1,131  
 B) 4,092  
 C) 5,961  
 D) 7,092

**Clinical Trial: Headache Side Effect  
900-Participant Study**



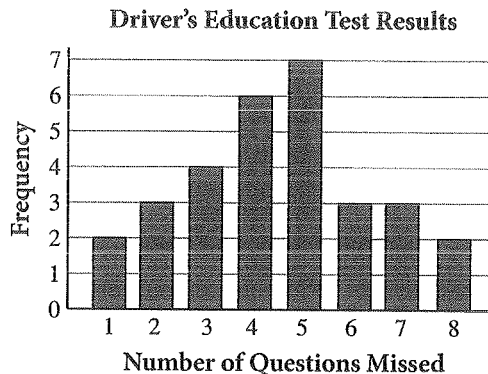
22. When a drug company wants to introduce a new drug, it must subject the drug to rigorous testing. The final stage of this testing is human clinical trials, in which progressively larger groups of volunteers are given the drug and carefully monitored. One aspect of this monitoring is keeping track of the frequency and severity of side effects. The figure above shows the results for the side effect of headaches for a certain drug. According to the trial guidelines, all moderate and severe headaches are considered to be adverse reactions. Which of the following best describes the data?
- A) The data is symmetric with over 50% of participants having adverse reactions.  
 B) The data is skewed to the right with over 50% of participants having adverse reactions.  
 C) The data is skewed to the right with over 75% of participants failing to have adverse reactions.  
 D) The data is skewed to the right with approximately 50% of participants having no reaction at all.

23. In the legal field, “reciprocity” means that an attorney can take and pass a bar exam in one state, and be allowed to practice law in a different state that permits such reciprocity. Each state bar association decides with which other states it will allow reciprocity. For example, Pennsylvania allows reciprocity with the District of Columbia. It costs \$25 less than 3 times as much to take the bar in Pennsylvania than in D.C. If both bar exams together cost \$775, how much less expensive is it to take the bar exam in D.C. than in Pennsylvania?

- A) \$200  
 B) \$275  
 C) \$375  
 D) \$575

24. A grain producer is filling a cylindrical silo 20 feet wide and 60 feet tall with wheat. Based on past experience, the producer has established a protocol for leaving the top 5% of the silo empty to allow for air circulation. Assuming the producer follows standard protocol, what is the maximum amount of wheat that should be put in the silo?

- A)  $5,144\pi$  ft<sup>3</sup>  
 B)  $5,700\pi$  ft<sup>3</sup>  
 C)  $20,577\pi$  ft<sup>3</sup>  
 D)  $22,800\pi$  ft<sup>3</sup>



25. Mr. Juno took his driver's education class to the Department of Motor Vehicles to take their driver's license test. The number of questions missed by each student in the class is recorded in the bar graph above. Which of the following statements is true?
- A) More than half of the students missed 5 or more questions.  
 B) The mean number of questions missed was between 4 and 5.  
 C) More students missed 3 questions than any other number of questions.  
 D) Thirty-six students from Mr. Juno's class took the driver's license test that day.
26. If the graph of the equation  $y = ax^2 + bx + c$  passes through the points  $(0, 2)$ ,  $(-6, -7)$ , and  $(8, -14)$ , what is the value of  $a + b + c$ ?
- A) -19  
 B) -2  
 C) 1.75  
 D) 2.25

27. A bakery sells three sizes of muffins—mini, regular, and jumbo. The baker plans daily muffin counts based on the size of his pans and how they fit in the oven, which results in the following ratios: mini to regular equals 5 to 2, and regular to jumbo equals 5 to 4. When the bakery caters events, it usually offers only the regular size, but it recently decided to offer a mix of mini and jumbo instead of regular. If the baker wants to keep the sizes in the same ratio as his daily counts, what ratio of mini to jumbo should he use?
- A) 1:1  
 B) 4:2  
 C) 5:2  
 D) 25:8
30. If a right cone is three times as wide at its base as it is tall, and the volume of the cone is  $384\pi$  cubic inches, what is the diameter in inches of the base of the cone?
- A) 8  
 B) 12  
 C) 16  
 D) 24

$$\begin{cases} \frac{1}{3}x + \frac{1}{2}y = 5 \\ kx - 4y = 16 \end{cases}$$

28. If the system of linear equations shown above has no solution, and  $k$  is a constant, what is the value of  $k$ ?
- A)  $-\frac{8}{3}$   
 B)  $-2$   
 C)  $\frac{1}{3}$   
 D) 3
29. What is the value of  $\frac{3^{90} \times 27^{90}}{9^{30}}$ ?
- A)  $9^5$   
 B)  $9^{15}$   
 C)  $9^{30}$   
 D)  $9^{150}$

**Directions:** For questions 31-38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $\frac{7}{2}$ .  
(If  $3\frac{1}{2}$  is entered into the grid as 

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>

, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Answer:  $\frac{7}{12}$

7	/	1	2
<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
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<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	4	4	4
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5	5	5	5
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6	6	6	6
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7	7	7	7
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8	8	8	8
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	9	9	9

Write answer in boxes. →

← Fraction line

Grid in result. →

Answer: 2.5

	2	.	5
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
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4	4	4	4
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5	5	5	5
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6	6	6	6
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7	7	7	7
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8	8	8	8
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	9	9	9

← Decimal point

Answer: 201  
Either position is correct.

	2	0	1
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<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
1	1	1	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
2	2	2	2
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3	3	3	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	4	4	4

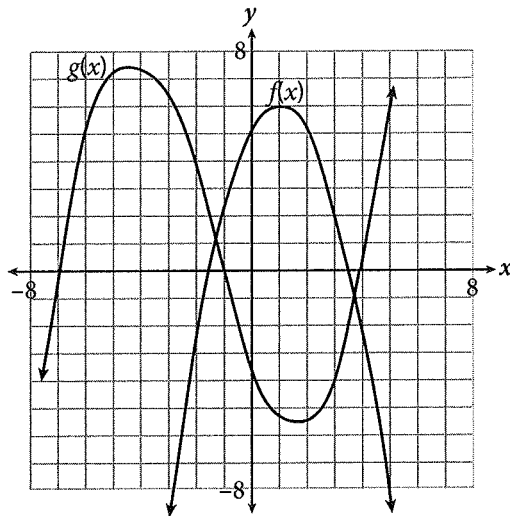
2	0	1	
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
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0	0	0	0
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
1	1	1	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
2	2	2	2
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3	3	3	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	4	4	4

Acceptable ways to grid  $\frac{2}{3}$  are:

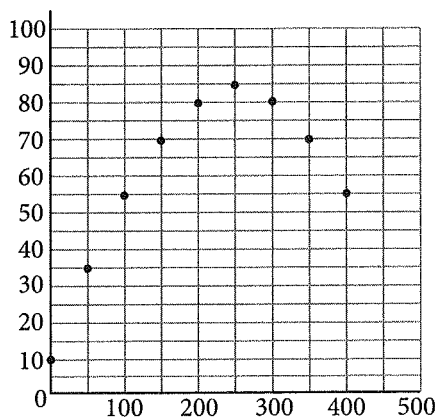
	2	/	3
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<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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3	3	3	3
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4	4	4	4
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	5	5	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	6	6	6

.	6	6	6
<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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3	3	3	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	4	4	4
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	5	5	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	6	6	6

31. If  $0.004 \leq m \leq 0.4$  and  $1.6 \leq n \leq 16$ , what is the maximum value of  $\frac{m}{n}$ ?



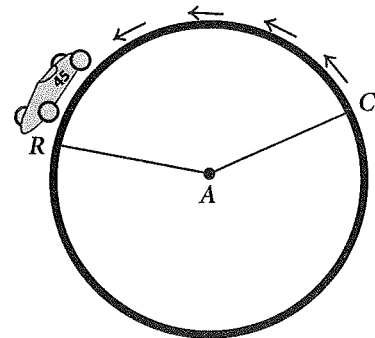
32. The graph above shows a quadratic function  $f(x)$  and a cubic function  $g(x)$ . Based on the graph, what is the value of  $(f - g)(3)$ , assuming all integer values?



33. Nine data points were used to generate the scatterplot shown above. Assuming all whole number values for the data points, what is the maximum value in the range of the data?

Years at Company	Female	Male
$y < 1$	38	30
$1 \leq y \leq 3$	15	19
$y > 3$	54	48

34. A company conducts a survey among its employees and categorizes the results based on gender and longevity (the number of years the employee has been working for the company). The Director of Human Resources wants to conduct a small follow-up focus group meeting with a few employees to discuss the overall survey results. If the HR Director randomly chooses four employees that participated in the initial survey, what is the probability that all of them will have been with the company for longer than 3 years? Enter your answer as a fraction.



35. Most racetracks are in the shape of an ellipse (an elongated circle similar to an oval), but Langhorne Speedway in Pennsylvania was originally a circular track. If a racecar is traveling around this track, starting at point C and traveling 1,500 feet to point R, and the radius of the track is 840 feet, what is the measure to the nearest degree of minor angle  $CAR$ ?

36. If  $Ax + By = C$  is the standard form of the line that passes through the points  $(-4, 1)$  and  $(3, -2)$ , where  $A$  is an integer greater than 1, what is the value of  $B$ ?

**Questions 37 and 38 refer to the following information.**

The Great Depression began in 1929 and lasted until 1939. It was a period of extreme poverty, marked by low prices and high unemployment. The main catalytic event to the Great Depression was the Wall Street Crash (stock market crash). The Dow, which measures the health of the stock market, started Black Thursday (October 24, 1929) at approximately 306 points.

37. The stock market had been in steady decline since its record high the month before. If the market had declined by 19.5% between its record high and opening on Black Thursday, what was the approximate value of the Dow at its record high? Round your answer to the nearest whole point.
38. By the end of business on Black Thursday, the Dow had dropped by 2%. Over the course of Friday and the half-day Saturday session, there was no significant change. Unfortunately, the market lost 13% on Black Monday, followed by another 12% on Black Tuesday. What was the total percent decrease from opening on Black Thursday to closing on Black Tuesday? Round your answer to the nearest whole percent and ignore the percent sign when entering your answer.



**ANSWER KEY****READING TEST**

1. B	14. C	27. A	40. B
2. C	15. A	28. A	41. C
3. D	16. B	29. B	42. D
4. B	17. B	30. C	43. C
5. A	18. C	31. D	44. D
6. D	19. D	32. C	45. A
7. C	20. D	33. D	46. C
8. D	21. B	34. B	47. A
9. C	22. C	35. D	48. B
10. A	23. D	36. D	49. C
11. A	24. B	37. A	50. D
12. A	25. D	38. C	51. B
13. B	26. B	39. B	52. D

**WRITING AND LANGUAGE TEST**

1. C	12. B	23. C	34. C
2. D	13. A	24. B	35. A
3. A	14. B	25. A	36. D
4. A	15. B	26. C	37. B
5. B	16. D	27. C	38. A
6. C	17. C	28. A	39. B
7. A	18. C	29. D	40. A
8. C	19. A	30. D	41. A
9. A	20. A	31. C	42. D
10. C	21. B	32. B	43. B
11. B	22. C	33. B	44. C

**MATH—NO CALCULATOR**

1. A	6. B	11. A	16. $\frac{1}{5}$ or .2
2. C	7. D	12. A	17. 2
3. B	8. D	13. D	18. 3
4. B	9. A	14. D	19. 27
5. C	10. C	15. B	20. 6

**MATH—CALCULATOR**

1. D	11. A	21. C	31. $\frac{1}{4}$ or .25
2. D	12. C	22. C	32. 6
3. B	13. A	23. C	33. 85
4. A	14. B	24. B	34. $\frac{1}{16}$
5. B	15. C	25. B	35. 102
6. B	16. B	26. C	36. 7
7. D	17. A	27. D	37. 380
8. A	18. D	28. A	38. 25
9. B	19. D	29. D	
10. B	20. C	30. D	

42. D

**Difficulty:** Easy**Category:** Writing & Language / Shifts in Construction**Strategic Advice:** Read the entire sentence to figure out who is the owner of the burned compositions. Then select the proper personal pronoun for this antecedent.**Getting to the Answer:** Choice (D) is the correct singular possessive pronoun because the burned compositions belonged to Varèse, one person, and not a group of artists.

43. B

**Difficulty:** Medium**Category:** Writing & Language / Quantitative**Strategic Advice:** Study the information in the graphic to determine which answer choice most accurately finishes the sentence.**Getting to the Answer:** Choice (B) is correct because it accurately reflects information included in the graphic.

44. C

**Difficulty:** Medium**Category:** Writing & Language / Development**Strategic Advice:** After reading the final paragraph, examine each answer choice to determine which best summarizes the paragraph's overall message.**Getting to the Answer:** Choice (C) is correct. It is the one sentence that sets up the idea that Varèse's challenging work has been an inspiration to many later artists, an idea supported by the rest of the paragraph.**MATH TEST: NO-CALCULATOR SECTION**

1. A

**Difficulty:** Easy**Category:** Heart of Algebra / Linear Equations**Strategic Advice:** You could start by cross-multiplying to get rid of the denominators, but simplifying the numerators first will make the calculations easier. Don't forget to distribute the negative to both terms in the parentheses on the right-hand side of the equation.**Getting to the Answer:**

$$\begin{aligned} \frac{4(n-2)+5}{2} &= \frac{13-(9+4n)}{4} \\ \frac{4n-8+5}{2} &= \frac{13-9-4n}{4} \\ \frac{4n-3}{2} &= \frac{4-4n}{4} \\ 4(4n-3) &= 2(4-4n) \\ 16n-12 &= 8-8n \\ 16n &= 20-8n \\ 24n &= 20 \\ n &= \frac{20}{24} = \frac{5}{6} \end{aligned}$$

2. C

**Difficulty:** Easy**Category:** Passport to Advanced Math / Exponents**Strategic Advice:** Don't be tempted—you can't simply cancel one term when a polynomial is divided by a monomial. You can, however, split the expression into three terms, each with a denominator of  $9x^2$ , and simplify. You could also use polynomial long division to answer the question. Use whichever method gets you to the answer more quickly on Test Day.**Getting to the Answer:**

$$\begin{aligned} \frac{18x^3 + 9x^2 - 36x}{9x^2} &= \frac{18x^3}{9x^2} + \frac{9x^2}{9x^2} - \frac{36x}{9x^2} \\ &= 2x + 1 - \frac{4}{x} \end{aligned}$$

3. B

**Difficulty:** Easy**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** When using function notation,  $f(x)$  is simply another way of saying  $y$ , so this question is asking you to find the value(s) of  $x$  for which  $y = 0$ , or in other words, where the graph crosses the  $x$ -axis. Don't be tempted by the flat parts of the graph—they have a slope of 0, but the function itself does not equal 0 here (it equals  $-4$ ).

**Getting to the Answer:** The graph crosses the  $x$ -axis at the points  $(-1, 0)$  and  $(1, 0)$ , so the values of  $x$  for which  $f(x) = 0$  are  $-1$  and  $1$ .

4. B

**Difficulty:** Easy**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Your only choice for this question is to compare each statement to the graph. Cross out false statements as you go. Pay attention to keywords that tell you whether the statement is a general statement or a precise statement.

**Getting to the Answer:** A function is decreasing when the slope is negative; it is increasing when the slope is positive. You can see from the graph that the trend is decreasing (going down from left to right), so eliminate A and C. Now, take a closer look to see that there are some time intervals over which the function increases (goes up), so you can't say that the function is decreasing for *all*  $t$  such that  $1977 < t < 2013$ . You can only make a general statement about the nature of the function, like the one in (B). The right-hand side of the graph is lower than the left side, so the function is decreasing overall.

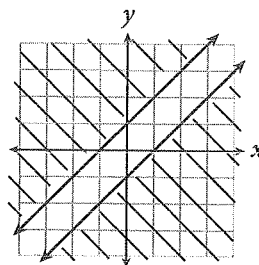
5. C

**Difficulty:** Medium**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** You don't need to use algebra to answer this question, and you also don't need

to graph each system. Instead, think about how the graphs would look. The only time a system of inequalities has no solution is when it consists of two parallel lines shaded in opposite directions.

**Getting to the Answer:** All the inequalities are written in slope-intercept form, so look for parallel lines (two lines that have the same slope but different  $y$ -intercepts). The slopes in A are different ( $m = 1$  and  $m = 2$ ), so eliminate this choice. The same is true for B ( $m = 1$  and  $m = -1$ ) and D ( $m = -1$  and  $m = 1$ ). This means (C) must be correct ( $m = 1$  and  $m = 1$ ,  $b = 1$  and  $b = -1$ ). The graph of the system is shown here:



Because the shading never overlaps, the system has no solution.

6. B

**Difficulty:** Medium**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** Although this question asks where the graphs intersect, it is not necessary to actually graph them. Understanding the connection between graphing the equations and the algebra behind the graphs will save valuable time on Test Day.

**Getting to the Answer:** The point(s) at which the two graphs intersect are the points where the two equations are equal to each other. So, set the equations equal and use algebra to solve for  $x$ . Because the question only asks for the  $x$ -values, you don't need to substitute the results back into the equations to solve for  $y$ .

$$-2x + 1 = 2x^2 + 5x + 4$$

$$-2x = 2x^2 + 5x + 3$$

$$0 = 2x^2 + 7x + 3$$

$$0 = (2x + 1)(x + 3)$$

Now that the equation is factored, use the Zero-Product Property to solve for  $x$ :

$$\begin{aligned} 2x+1=0 & \quad \text{and} \quad x+3=0 \\ 2x=-1 & \quad \quad \quad x=-3 \\ x=-\frac{1}{2} & \end{aligned}$$

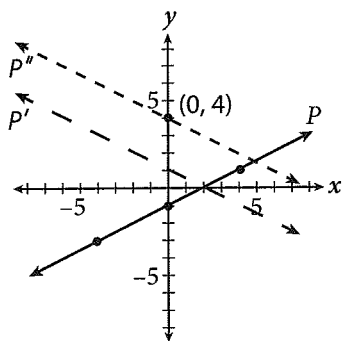
**7. D**

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** You can approach this question conceptually or concretely. When dealing with simple transformations, drawing a quick sketch is most likely the safest approach.

**Getting to the Answer:** You are only concerned about the  $y$ -intercept, so keep your focus there. When the graph is reflected over the  $x$ -axis, the  $y$ -intercept will go from  $(0, -1)$  to  $(0, 1)$ . Next, the line is shifted up 3 units, which adds 3 to the  $y$ -coordinates of all the points on the line, making the new  $y$ -intercept  $(0, 4)$ . A sketch is provided here:



**8. D**

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** The roots of an equation are the same as its solutions. Take a peek at the answer choices—they contain radicals, which tells you that the equation can't be factored. Instead, either complete the square or solve the equation using the quadratic formula, whichever you are most comfortable with.

**Getting to the Answer:** The equation is already written in the form  $y = ax^2 + bx + c$  and the coefficients are fairly small, so using the quadratic formula is probably the quickest method. Jot down the values that you'll need:  $a = 3$ ,  $b = -6$ , and  $c = -5$ . Then, substitute these values into the quadratic formula and simplify:

$$\begin{aligned} x &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\ &= \frac{-(-6) \pm \sqrt{(-6)^2 - 4(3)(-5)}}{2(3)} \\ &= \frac{6 \pm \sqrt{36 + 60}}{6} \\ &= \frac{6 \pm \sqrt{96}}{6} \end{aligned}$$

This is not one of the answer choices, so simplify the radical. To do this, look for a perfect square that divides into 96 and take its square root. Then, if possible, cancel any factors that are common to the numerator and the denominator.

$$\begin{aligned} x &= \frac{6 \pm \sqrt{16 \times 6}}{6} \\ &= \frac{6 \pm 4\sqrt{6}}{6} \\ &= \frac{\cancel{2}(3 \pm 2\sqrt{6})}{\cancel{2}(3)} \\ &= \frac{3 \pm 2\sqrt{6}}{3} \end{aligned}$$

Be careful—you can't simplify the answer any further because you cannot divide the square root of 6 by 3.

**9. A**

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** When you write an equation in terms of a specific variable, you are simply solving the equation for that variable. In this question, you'll need to relate fractional exponents to radicals and understand how to use negative exponents. Be careful—you're not just rewriting the equation, you're also solving it for  $n$ .

**Getting to the Answer:** Raising a quantity to the one-fourth power is the same as taking its fourth root. Applying a negative exponent to a quantity is the same as writing its reciprocal. Rewrite the equation using these properties, and then solve for  $n$  using inverse operations. Note that the inverse of taking a fourth root of a quantity is raising the quantity to the fourth power.

$$m = \frac{1}{n^{-\frac{1}{4}}}$$

$$m = \frac{\sqrt[4]{n}}{1}$$

$$(m)^4 = (\sqrt[4]{n})^4$$

$$m^4 = n$$

10. C

**Difficulty:** Medium

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** When a system consists of two equations already written in terms of  $y$ , the quickest way to solve the system is to set the equations equal to each other and then use inverse operations.

**Getting to the Answer:** Don't let the fraction intimidate you—you can write the first equation as a fraction over 1 and use cross-multiplication.

$$\frac{3x-1}{1} = \frac{5x+8}{2}$$

$$2(3x-1) = 5x+8$$

$$6x-2 = 5x+8$$

$$6x = 5x+10$$

$$x = 10$$

Don't let A fool you—the question is asking for the value of  $y$ , not the value of  $x$ . To find  $y$ , substitute 10 for  $x$  in either equation and simplify:

$$y = 3(10) - 1$$

$$= 30 - 1$$

$$= 29$$

11. A

**Difficulty:** Medium

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** The fractions in this question make it look more complicated than it really is, so start by clearing them. To do this, multiply everything by the least common denominator, 10.

**Getting to the Answer:** You don't need to separate this compound inequality into pieces. Just remember, whatever you do to one piece, you must do to all three pieces.

$$0 < \frac{d}{2} + 1 \leq \frac{8}{5}$$

$$10(0) < 10\left(\frac{d}{2} + 1\right) \leq \left(\frac{8}{5}\right)10$$

$$0 < 5d + 10 \leq 16$$

$$-10 < 5d \leq 6$$

$$-2 < d \leq \frac{6}{5}$$

Now, read the inequality symbols carefully. The value of  $d$  is between  $-2$  and  $\frac{6}{5}$ , not including  $-2$  because of the  $<$  symbol, so (A) is the correct answer. Don't let C fool you—you can't have a 0 denominator in a rational expression, but in this expression, the variable is in the numerator, so it *can* equal 0.

12. A

**Difficulty:** Medium

**Category:** Additional Topics in Math / Trigonometry

**Strategic Advice:** The measure of  $40^\circ$  does not appear on the unit circle, which should give you a clue that there must be a property or relationship on which you can rely to help you answer the question.

**Getting to the Answer:** Complementary angles have a special relationship relative to trig values: The cosine of an acute angle is equal to the sine of the angle's complement and vice versa. Because only one of the answers can be correct, look for the

simplest relationship (complementary angles):  $50^\circ$  is complementary to  $40^\circ$ , so  $\cos 40^\circ = \sin 50^\circ$ , which means (A) is correct.

**13. D****Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Try not to get too bogged down in the context. Assign a variable to the unknown, and then create an equation that represents the scenario.

**Getting to the Answer:** Let  $n$  be the number of units the manufacturer sells in a month. Sales must equal expenses for the manufacturer to break even (sales = expenses). The sales are equal to the selling price (\$9.50) times the number of units sold ( $n$ ), so write  $9.5n$  on one side of the equal sign. The monthly expenses are the fixed expenses (\$11,625) plus the amount paid for the materials needed to produce one unit (\$4.85) times the number of units ( $x$ ), so write  $11,625 + 4.85x$  on the other side of the equal sign. Then, solve for  $x$ .

$$9.5x = 11,625 + 4.85x$$

$$4.65x = 11,625$$

$$x = 2,500$$

**14. D****Difficulty:** Hard**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** There is only one equation given, and it has two variables. This means that you don't have enough information to solve for either variable. Instead, look for the relationship between the left side of the equation and the other expression that you are trying to find.

**Getting to the Answer:** The expression you are trying to find ( $6x - 5y$ ) has the  $x$ -term first and then the  $y$ -term, so start by reversing the order of the terms on the left side of the given equation. Also,

notice that the  $x$  term in  $6x - 5y$  is not negative, so multiply the equation by  $-1$ .

$$\begin{aligned} \frac{1}{2}y - \frac{3}{5}x &= -16 \rightarrow -\frac{3}{5}x + \frac{1}{2}y = -16 \\ -1\left(-\frac{3}{5}x + \frac{1}{2}y = -16\right) &\rightarrow \frac{3}{5}x - \frac{1}{2}y = 16 \end{aligned}$$

Finally, there are no fractions in the desired expression, so clear the fractions by multiplying both sides of the equation by 10. This yields the expression that you are looking for, so no further work is required—just read the value on the right-hand side of the equation, which is 160.

$$\begin{aligned} 10\left(\frac{3}{5}x - \frac{1}{2}y\right) &= 16(10) \\ 6x - 5y &= 160 \end{aligned}$$

**15. B****Difficulty:** Hard**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Understanding the language of functions will make questions that seem complicated much more doable on Test Day. When you know the output of a function (or in this question, a composition of two functions), you can work backward to find the input.

**Getting to the Answer:** Because  $g(x)$  is the inside function for this composition, its output becomes the input for  $f(x)$ . Unfortunately, you don't have any information about  $g$  yet. You do know however that  $f$  of some number, ( $g(2)$ ), is  $-1$ , so set  $f(x)$  equal to  $-1$  and solve for  $x$ :

$$-1 = x + 1$$

$$-2 = x$$

You now know that  $f(-2) = -1$ . In the equation for the composition,  $g(2)$  represents  $x$ , so you also know that  $g(2)$  must be  $-2$ . Your only option now is to use brute force to determine which equation for  $g$ , when evaluated at 2, results in  $-2$ .

Choice A:  $g(2) = 2 - 6 = -4$  (not  $-2$ ), so eliminate.

Choice B:  $g(2) = 2 - 4 = -2$

You don't need to go any further; (B) is correct.

You could check your answer by working forward, starting with  $g(2)$ :

$$g(2) = 2 - 4 = -2$$

$$f(g(2)) = f(-2) = -2 + 1 = -1$$

### 16. $\frac{1}{5}$ or .2

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** There are two variables but only one equation, so you can't actually solve the equation for  $k$ . Instead, recall that an equation has infinitely many solutions when the left side is identical to the right side. When this happens, everything cancels out and you get  $0 = 0$ , which is always true.

**Getting to the Answer:** Start by simplifying the right-hand side of the equation. Don't simplify the left side because  $k$  is already in a good position.

$$k(10x - 5) = 2(3 + x) - 7$$

$$k(10x - 5) = 6 + 2x - 7$$

$$k(10x - 5) = 2x - 1$$

Next, compare the left side of the equation to the right side. Rather than distributing the  $k$ , notice that  $2x$  is a fifth of  $10x$  and  $-1$  is a fifth of  $-5$ , so if  $k$  were  $\frac{1}{5}$  (or 0.2), then both sides of the equation would equal  $2x - 1$ , and it would therefore have infinitely many solutions. Thus,  $k$  is  $\frac{1}{5}$  or .2.

### 17. 2

**Difficulty:** Medium

**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** Take a second to think about this question before you go right to the Pythagorean

theorem. Remember that the PSAT often tests your knowledge of "shortcut" information.

**Getting to the Answer:** You could use the Pythagorean theorem to solve this, but it will save valuable time on Test Day if you recognize that this question is testing your knowledge of Pythagorean triples. The triangle is a right triangle with leg lengths of 18 and 24, which, when divided by 6, are in the proportion 3:4. This means that the triangle is a scaled up 3:4:5 right triangle with a scale factor of 6. To keep the same proportion, the hypotenuse must be  $5 \times 6 = 30$ . For  $15n$  to equal 30,  $n$  must be 2.

### 18. 3

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** You need to use rules of exponents to simplify the expression. Before you can do that, you must rewrite the radicals as fraction exponents. Use the phrase "power over root" to help you convert the radicals:  $\sqrt{x} = \text{root} \rightarrow 2 \sqrt{x^{1-\text{power}}} = x^{\frac{1}{2}}$  and  $\text{root} \rightarrow 4 \sqrt{x^{3-\text{power}}} = x^{\frac{3}{4}}$ .

**Getting to the Answer:** Write each factor in the expression in exponential form. Then use rules of exponents to simplify the expression. Add the exponents of the factors that are being multiplied and subtract the exponent of the factor that is being divided:

$$\frac{\sqrt{x} \cdot x^{\frac{5}{4}} \cdot x^2}{\sqrt[4]{x^3}} = \frac{x^{\frac{1}{2}} \cdot x^{\frac{5}{4}} \cdot x^{\frac{2}{1}}}{x^{\frac{3}{4}}}$$

$$= x^{\frac{1}{2} + \frac{5}{4} + \frac{2}{1} - \frac{3}{4}} = x^{\frac{2}{4} + \frac{5}{4} + \frac{8}{4} - \frac{3}{4}} = x^{\frac{12}{4}} = x^3$$

The exponent of the simplified expression is 3.

### 19. 27

**Difficulty:** Hard

**Category:** Additional Topics in Math / Imaginary Numbers



**Strategic Advice:** Each of the factors in this product has two terms, so they behave like binomials. This means you can use FOIL to find the product. To avoid messy numbers, simplify the two radicals first using the definition of  $i$ .

**Getting to the Answer:** Write each of the numbers under the radicals as a product of  $-1$  and the number, take the square roots, and then FOIL the resulting expressions:

$$\begin{aligned}(3 + \sqrt{-16})(1 - \sqrt{-36}) &= (3 + \sqrt{16 \times (-1)})(1 - \sqrt{36 \times (-1)}) \\ &= (3 + 4i)(1 - 6i) \\ &= 3 - 18i + 4i - 24i^2 \\ &= 3 - 14i - 24(-1) \\ &= 3 - 14i + 24 \\ &= 27 - 14i\end{aligned}$$

The question asks for the value of  $a$  (the real part of the expression), so the correct answer is 27.

## 20. 6

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** When you are given the graph of a parabola, try to use what you know about intercepts, the vertex, and the axis of symmetry to answer the question. Here, you could try to use points from the graph to find its equation, but this is not necessary because the question only asks for the value of  $b$ . As a shortcut, recall that you can find the vertex of a parabola using the formula  $x = -\frac{b}{2a}$  (the quadratic formula without the radical part).

**Getting to the Answer:** You are given that  $a = -1$ . Now look at the graph—the vertex of the parabola is  $(3, 8)$ , so substitute 3 for  $x$ ,  $-1$  for  $a$ , and solve for  $b$ .

$$\begin{aligned}3 &= -\frac{b}{2(-1)} \\ 3 &= -\left(\frac{b}{-2}\right) \\ 3 &= \frac{b}{2} \\ 3(2) &= b \\ 6 &= b\end{aligned}$$

As an alternate method, you could plug the value of  $a$  and the vertex (from the graph) into vertex form of a quadratic equation and simplify:

$$\begin{aligned}y &= a(x - h)^2 + k \\ &= -1(x - 3)^2 + 8 \\ &= -1(x^2 - 6x + 9) + 8 \\ &= -x^2 + 6x - 9 + 8 \\ &= -x^2 + 6x - 1\end{aligned}$$

The coefficient of  $x$  is  $b$ , so  $b = 6$ .

## MATH TEST: CALCULATOR SECTION

### 1. D

**Difficulty:** Easy

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** A quick examination of the equations in the system will tell you which strategy to use to solve it. Because  $4x$  and  $-4x$  are opposites of one another, the system is already perfectly set up to solve by elimination (combining the two equations by adding them).

**Getting to the Answer:**

$$\begin{array}{r}4x + y = -5 \\ -4x - 2y = -2 \\ \hline -y = -7 \\ y = 7\end{array}$$

**2. D****Difficulty:** Easy**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** You don't need to know the slope of the line of best fit to answer the question, so don't waste valuable time trying to find it. Instead, use the labels on the axes to determine the meaning of the slope.

**Getting to the Answer:** Graphically, slope is the ratio of the change in the  $y$ -values (rise) to the change in the  $x$ -values (run). In a real-world scenario, this is the same as the unit rate. In this context, the rise describes the change in the number of home runs hit in a single season, and the run describes the change in the number of hours a player spends in batting practice. Thus, the unit rate, or slope, represents the estimated increase (since the data trends upward) in the number of single-season home runs hit by a player for each hour he spends in batting practice.

**3. B****Difficulty:** Easy**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Finding an  $x$ -intercept is easy when you know the equation of the line—it's the value of  $x$  when  $y$  is 0. Notice that the answer choices are very close together. This means you shouldn't just estimate visually. Take the time to do the math.

**Getting to the Answer:** Everything you need to write the equation is shown on the graph—just pay careful attention to how the grid-lines are labeled. The  $y$ -intercept is 10 and the line rises 2 units and runs 1 unit from one point to the next, so the slope is  $\frac{2}{1} = 2$ . This means the equation of the line, in

slope-intercept form, is  $y = 2x + 10$ . Now, set the equation equal to zero and solve for  $x$ :

$$\begin{aligned} 0 &= 2x + 10 \\ -10 &= 2x \\ -5 &= x \end{aligned}$$

The line will intersect the  $x$ -axis at  $-5$ .

**4. A****Difficulty:** Easy**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Understanding function notation will earn you valuable points on Test Day. When you see an expression like  $f(x)$ , it means to substitute the given value for  $x$  in the function's equation. When there is more than one function involved, pay careful attention to which function should be evaluated first.

**Getting to the Answer:** You are looking for the value of  $f(x)$  at  $x = 5$ . Because  $f(x)$  is defined in terms of  $g(x)$ , evaluate  $g(5)$  first by substituting 5 for  $x$  in the expression  $x + 2$ .

$$g(5) = 5 + 2 = 7$$

$$f(5) = -3g(5) = -3(7) = -21$$

**5. B****Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Don't peek at the answers. They may confuse you because the numbers look different than the ones given in the question. Instead, write your own equation in words first, and then translate from English into math.

**Getting to the Answer:** Keep in mind that the laundry detergent is on sale, but the dog food is not. The detergent is 30% off, which means Sara only pays  $100 - 30 = 70\%$  of the price, or  $0.7(\$8) = \$5.60$ . The dog food is three cans for \$4 and she buys 12 cans, which means she buys 4 sets of 3, so she

pays  $4 \times \$4 = \$16$  for the dog food. The total cost equals the detergent price (\$5.60) times how many she buys ( $x$ ) plus the total dog food price (\$16). In math, this translates as  $C = 5.6x + 16$ . Note that there are variables in the answer choices, so you could also use the Picking Numbers strategy to answer this question.

### 6. B

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** In a real-world scenario, the slope of a line represents a unit rate and the  $y$ -intercept represents a flat fee or a starting amount.

**Getting to the Answer:** The cost per night in the hospital is the same as the unit rate, which is represented by the slope of the line. Use the grid-lines and the axis labels to count the rise and the run from the  $y$ -intercept of the line (0, 26,000) to the next point that hits an intersection of two grid-lines (2, 34,000). Pay careful attention to how the grid-lines are marked (by 2s on the  $x$ -axis and by 2,000s on the  $y$ -axis). The line rises 8,000 units and runs 2 units, so the slope is  $\frac{8,000}{2}$ , which means it costs an average of \$4,000 per night to stay in the hospital. Note that you could also use the slope formula and the two points to find the slope:

$$\frac{34,000 - 26,000}{2 - 0} = \frac{8,000}{2} = 4,000$$

### 7. D

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** You aren't given much information to go on except the shape of the graph, so you'll need to think about what the shape means. Remember, linear functions increase at a constant rate, exponential functions increase at either an increasing or decreasing rate, gradually at first and

then more quickly or vice versa, and quadratics and polynomials reverse direction one or more times.

**Getting to the Answer:** The graph begins by decreasing extremely quickly, but then it almost (but not quite) levels off. Therefore, it can't be linear and because it doesn't change direction, it can't be quadratic or polynomial. This means an exponential function would be the best model for the data.

### 8. A

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** This is a science crossover question. Read the first three sentences quickly—they are simply describing the context of the question. The second half of the paragraph poses the question, so read that more carefully.

**Getting to the Answer:** In the sample, 2,800 out of 3,200 acres were free of kudzu after applying the herbicide. This is  $\frac{2,800}{3,200} = 0.875 = 87.5\%$  of the area.

For the whole region, assuming the same general conditions,  $0.875(30,000) = 26,250$  acres should be free of the kudzu. Be careful—this is not the answer. The question asks how much of the cropland would *still be covered* by kudzu, so subtract to get  $30,000 - 26,250 = 3,750$  acres.

### 9. B

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** The notation  $g(h(x))$  indicates a composition of two functions, which can be read "g of h of x." It means that the output when  $x$  is substituted in  $h(x)$  becomes the input for  $g(x)$ .

**Getting to the Answer:** First, use the top and bottom rows of the table to find that  $h(3)$  is 2. This is your new input. Now, use the top and middle rows of the table to find  $g(2)$ , which is  $-3$ .

10. B

**Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** The key to answering this type of question is determining how many results fit in each category. Here, you need to know how many shots were 3-pointers and how many were 2-pointers. Mae-Ling successfully made 15 shots total and  $s$  were 3-pointers, so the rest, or  $15 - s$ , must have been 2-pointers.

**Getting to the Answer:** Write the expression in words first: points per 3-pointers (3) times number of shots that were 3-pointers ( $s$ ), plus points per regular goal (2) times number of regular goals ( $15 - s$ ). Now, translate from English into math:  $3s + 2(15 - s)$ . This is not one of the answer choices, so simplify the expression by distributing the 2 and then combining like terms:  $3s + 2(15 - s) = 3s + 30 - 2s = s + 30$ .

11. A

**Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Let the units in this question guide you to the answer. You can do one conversion at a time, or all of them at once. Just be sure to line up the units so they'll cancel correctly.

**Getting to the Answer:** The company uses 8 machines, each of which pumps at a rate of 37.5 gallons per minute, so the rate is actually  $8 \times 37.5 = 300$  gallons per minute. Find the total number of gallons needed, and then use the rate to find the time.

$$2,500 \text{ gal} \times \frac{1 \text{ min}}{300 \text{ gal}} = 8\frac{1}{3} \text{ min}$$

The answers are given in hours and minutes, so change 350 minutes to  $350 \div 60 = 5.833$  hours = 5 hours and 50 minutes.

12. C

**Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Functions

**Strategic Advice:** Look for a pattern for the sales of each company. Then apply that pattern to see which one will sell more in the last month of the year. Writing a function that represents each pattern will also help, but you have to be careful that you evaluate the function at the correct input value.

**Getting to the Answer:** Company A's sales can be represented by a linear function because each month the company sells 92 more of the toy than the month before, which is a constant difference. The sales can be represented by the function  $f(t) = 92t + 54$ , where  $t$  is the number of months *after January*. December is 11 months (not 12) after January, so during the last month of the year Company A should sell  $f(11) = 92(11) + 54 = 1,066$  of the toy. Company B's sales can be represented by an exponential function because the sales are doubling each month, which is a constant ratio (2 for doubling). The function is  $g(t) = 15(2)^t$ , where  $t$  is again the number of months *after January*. In December, Company B should sell  $g(11) = 15(2)^{11} = 30,720$ . This means that in December, Company B should sell  $30,720 - 1,066 = 29,654$  more of the toy than Company A.

13. A

**Difficulty:** Medium**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Apply logic to this question first, and then algebra. The dot at the beginning of the shaded portion is an open dot, so  $-2$  is not included in the solution set of the inequality. This means you can eliminate C and D because those symbols *would* include the endpoint. Don't immediately choose B just because the arrow is pointing to the right, which typically indicates *greater than*. When dealing with an inequality, if you multiply or divide by a negative

number, you must flip the symbol, so the answer is not necessarily what you might think.

**Getting to the Answer:** Because you were able to eliminate two of the choices, the quickest approach is to pick one of the remaining symbols, plug it in, and see if it works. If it does, choose that answer. If it doesn't, then it must be the other symbol. Try (A):

$$\begin{aligned}5(x-2)-3x &< 4x-6 \\5x-10-3x &< 4x-6 \\2x-10 &< 4x-6 \\-2x &< 4 \\x &> -2\end{aligned}$$

The resulting inequality,  $x > -2$ , means all the values on the number line greater than (or to the right of)  $-2$ , so the initial inequality symbol must have been  $<$ . Choice (A) is correct.

**14. B**

**Difficulty:** Easy

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percents

**Strategic Advice:** Whenever a question involves scale factors, you can set up a proportion and solve for the missing value.

**Getting to the Answer:**

$$\begin{aligned}\frac{1}{8} &= \frac{x}{19.9} \\8x &= 19.9 \\x &= 2.4875 \approx 2.5\end{aligned}$$

**15. C**

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percents

**Strategic Advice:** Don't make this question harder than it actually is. You don't need to find the new scale factor. Instead, use the length that the student drew the femur and the actual length to set up and solve a new proportion.

**Getting to the Answer:**

$$\begin{aligned}\frac{\text{drawing of sternum}}{\text{actual sternum}} &= \frac{\text{drawing of femur}}{\text{actual femur}} \\ \frac{x}{6.7} &= \frac{3.5}{19.9} \\ 23.45 &= 19.9x \\ 1.1783 &= x \\ x &\approx 1.2\end{aligned}$$

**16. B**

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Given two points (even when the coordinates are variables), the slope of the line between the points can be found using the formula

$$m = \frac{y_2 - y_1}{x_2 - x_1}.$$

**Getting to the Answer:** You are given a numerical value for the slope and a pair of ordered pairs that have variables in them. To find the value of  $c$ , plug the points into the slope formula, and then solve for  $c$ . Be careful of all the negative signs.

$$\begin{aligned}m &= \frac{y_2 - y_1}{x_2 - x_1} \\ \frac{1}{2} &= \frac{-8 - 2c}{-c - (4 - c)} \\ \frac{1}{2} &= \frac{-8 - 2c}{-c - 4 + c} \\ \frac{1}{2} &= \frac{-8 - 2c}{-4} \\ 1(-4) &= 2(-8 - 2c) \\ -4 &= -16 - 4c \\ 12 &= -4c \\ -3 &= c\end{aligned}$$

**17. A**

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percents

**Strategic Advice:** Questions that involve distance, rate, and time can almost always be solved using the formula Distance = rate  $\times$  time. Break the question into short steps (first part of trip, second part of trip).

**Getting to the Answer:** Start with the plane from DCA. Use the speed, or rate, of the plane, 338 mph, and its distance from London, 3,718 miles, to determine when it arrived. You don't know the time, so call it  $t$ .

$$\text{Distance} = \text{rate} \times \text{time}$$

$$3,718 = 338t$$

$$11 = t$$

It took the DCA flight 11 hours. Now determine how long it took the plane from MIA. You'll need to find the distance for each part of the trip—the question only tells you the total distance. Then, use the formula to find how long the plane flew at 596 mph and how long it flew at 447 mph.

*First part of trip:*

$$\frac{2}{3} \times 4,470 = 2,980 \text{ mi}$$

$$2,980 = 596t$$

$$5 = t$$

*Second part of trip:*

$$\frac{1}{3} \times 4,470 = 1,490 \text{ mi}$$

$$1,490 = 447t$$

$$3.\bar{3} = t$$

This means it took the MIA flight 5 hours + 3 hours, 20 minutes = 8 hours, 20 minutes. So, the plane from MIA arrived first. It arrived 11 hours – 8 hours, 20 minutes = 2 hours, 40 minutes before the plane from DCA.

## 18. D

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** Making connections between equations and their graphs will save valuable time on this question. The graph of every quadratic equation is a parabola, which may or may not cross the  $x$ -axis, depending on where its vertex is and which way it opens. Don't forget—if the equation is written in vertex form,  $y = a(x - h)^2 + k$ , then the vertex is  $(h, k)$  and the value of  $a$  tells you which way the parabola opens.

**Getting to the Answer:** When an equation has no solution, its graph does not cross the  $x$ -axis, so try to envision the graph of each of the answer choices (or you could graph each one in your graphing calculator, but this will probably take longer). When a quadratic equation is written in factored form, the factors tell you the  $x$ -intercepts, which means  $A$  and  $B$  (which are factored) must cross the  $x$ -axis, so eliminate them. Now, imagine the graph of the equation in  $C$ : The vertex is  $(-1, 8)$  and  $a$  is negative, so the parabola opens downward and consequently must cross the  $x$ -axis. This means  $(D)$  must be correct. The vertex is also  $(-1, 8)$ , but  $a$  is positive, so the graph opens up and does not cross the  $x$ -axis.

## 19. D

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** One of the most important rules in data analysis is that correlation does not prove causation.

**Getting to the Answer:** The two variables are certainly correlated—as one goes up, the other goes up. A linear regression model would fit the data fairly well, so you can eliminate  $C$ . The spending is graphed on the  $x$ -axis, so it is the independent variable and therefore does not depend on the GDP, graphed on the  $y$ -axis, so you can eliminate  $B$  as well. The data does show that as spending on students increases, so does the GDP, but this is simply correlation, not causation. Without additional data, no statements can be made about whether spending more on students is the reason for the increased GDP, so  $(D)$  is correct.

## 20. C

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Don't spend too much time worrying about the scientific explanation of the

equation. Focus on the question at the very end—it's just asking you to solve the equation for  $p_2$ .

**Getting to the Answer:** Multiply both sides by  $T_2$  to get rid of the denominator on the right-hand side of the equation. Then divide by  $V_2$  to isolate  $p_2$ .

$$\begin{aligned}\frac{p_1 V_1}{T_1} &= \frac{p_2 V_2}{T_2} \\ \frac{p_1 V_1 T_2}{T_1} &= p_2 V_2 \\ \frac{p_1 V_1 T_2}{T_1 V_2} &= p_2\end{aligned}$$

Stop here! You cannot cancel the  $V$ 's and  $T$ 's because the subscripts indicate that they are not the same variable. In math, subscripts do not behave the same way superscripts (exponents) do.

## 21. C

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percents

**Strategic Advice:** The factor-label method (canceling units) is a great strategy for this question. You're starting with tons, so work from that unit, arranging conversions so that units cancel.

**Getting to the Answer:** To keep units straight, use an E for Earth, an M for Mars, and a J for Jupiter.

$$\begin{aligned}1.5 \cancel{\text{t}} \times \frac{2,000 \text{ lb (E)}}{1 \cancel{\text{t}}} \times \frac{0.377 \text{ lb (M)}}{1 \text{ lb (E)}} &= 1,131 \text{ lb (M)} \\ 1.5 \cancel{\text{t}} \times \frac{2,000 \text{ lb (E)}}{1 \cancel{\text{t}}} \times \frac{2.364 \text{ lb (J)}}{1 \text{ lb (E)}} &= 7,092 \text{ lb (J)}\end{aligned}$$

The object weighs 1,131 pounds on Mars and 7,092 pounds on Jupiter, so it weighs  $7,092 - 1,131 = 5,961$  more pounds on Jupiter.

## 22. C

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** Examine the shape of the data and familiarize yourself with the title and the axis labels on the graph. Data is *symmetric* if it is fairly evenly spread out, and it is *skewed* if it has a long tail on either side.

**Getting to the Answer:** Notice that the data is skewed to the right (which means it's not symmetric), so you can immediately eliminate A. Choices B, (C), and D all describe the data as skewed to the right, so you'll need to examine those statements more closely. For B, "adverse reactions" include the last four bars, which represent  $89 + 41 + 22 + 8 = 160$  participants total, which is not even close to 50% of 900, so eliminate B. Note that you don't need to add all the bar heights to find that there were 900 participants—the title of the graph tells you that. Now look at C—"failed to have adverse reactions" means "None" or "Mild" (the first three bars), which represent  $900 - 160 = 740$  of the 900 participants.  $75\%$  of  $900 = 675$ , and 740 is more than 675, so (C) is correct. For D, the "None" column contains 320 participants, which does not equal approximately 50% of 900, so it too is incorrect.

## 23. C

**Difficulty:** Medium

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Use the Kaplan Method for Translating English into Math. Write a system of equations with  $p$  = the cost in dollars of the Pennsylvania bar exam and  $d$  = the cost of the D.C. bar exam.

**Getting to the Answer:** The Pennsylvania bar exam ( $p$ ) costs \$25 less ( $-25$ ) than 3 times as much ( $3d$ ) as the D.C. bar exam, or  $p = 3d - 25$ . Together, both bar exams cost \$775, so  $d + p = 775$ . The system is:

$$\begin{cases} p = 3d - 25 \\ d + p = 775 \end{cases}$$

The top equation is already solved for  $p$ , so substitute  $3d - 25$  into the second equation for  $p$ , and solve for  $d$ :

$$d + (3d - 25) = 775$$

$$4d = 800$$

$$d = 200$$

Be careful—that's not the answer. The D.C. bar exam costs \$200, which means the Pennsylvania bar exam costs  $\$775 - \$200 = \$575$ . This means the D.C. bar exam is  $\$575 - \$200 = \$375$  less expensive than the Pennsylvania bar exam.

#### 24. B

**Difficulty:** Medium

**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** Check the formula page at the beginning of the Math section—the formula for finding the volume of a cylinder is  $V = \pi r^2 h$ .

**Getting to the Answer:** Leaving the top 5% of the silo empty is another way of saying that the silo should only be filled to 95% of its total height, so multiply the height (60 ft) by 0.95 to get 57 ft and then find the volume. Don't forget to divide the width of the silo (20 ft) by 2 to find the radius:

$$V = \pi r^2 h$$

$$V = \pi(10)^2(57)$$

$$V = \pi(100)(57)$$

$$V = 5,700\pi$$

#### 25. B

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** Always read the axis labels carefully when a question involves a chart or graph. *Frequency*, which is plotted along the vertical axis, tells you how many students missed the number of questions indicated under each bar.

**Getting to the Answer:** Evaluate each statement as quickly as you can.

**Choice A:** Add the bar heights (frequencies) that represent students that missed 5 or more questions:  $7 + 3 + 3 + 2 = 15$ . Then, find the total number of students represented, which is the number that missed less than 5 questions plus the 15 you just found:  $2 + 3 + 4 + 6 = 15$ , plus the 15 you already found, for a total of 30 students. The statement is not true because 15 is exactly half (not more than half) of 30.

**Choice (B):** This calculation will take a bit of time so skip it for now.

**Choice C:** The tallest bar tells you which number of questions was missed most often, which was 5 questions, not 3 questions, so this statement is not true.

**Choice D:** The number of students from Mr. Juno's class who took the test that day is the sum of the heights of the bars, which you already know is 30, not 36.

This means (B) must be correct. Mark it and move on to the next question. (Find the mean by multiplying each number of questions missed by the corresponding frequency, adding all the products, and dividing by the total number of students, which you already know is 30:

$$\begin{aligned} \text{mean} &= \frac{2 + 6 + 12 + 24 + 35 + 18 + 21 + 16}{30} \\ &= \frac{134}{30} = 4.\overline{46} \end{aligned}$$

The mean is indeed between 4 and 5.)

#### 26. C

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** Writing quadratic equations can be tricky and time-consuming. If you know the roots, you can use factors to write the equation. If you



don't know the roots, you need to create a system of equations to find the coefficients of the variable terms.

**Getting to the Answer:** You don't know the roots of this equation, so start with the point that has the nicest values (0, 2) and substitute them into the equation,  $y = ax^2 + bx + c$ , to get  $2 = a(0)^2 + b(0) + c$ , or  $2 = c$ . Now your equation looks like  $y = ax^2 + bx + 2$ . Next, use the other two points to create a system of two equations in two variables.

$$\begin{aligned}(-6, -7) &\rightarrow -7 = a(-6)^2 + b(-6) + 2 \rightarrow -9 = 36a - 6b \\(8, -14) &\rightarrow -14 = a(8)^2 + b(8) + 2 \rightarrow -16 = 64a + 8b\end{aligned}$$

You now have a system of equations to solve. If you multiply the top equation by 4 and the bottom equation by 3, and then add the equations, the  $b$  terms will eliminate each other.

$$\begin{array}{rcl}4[-9 = 36a - 6b] & \rightarrow & -36 = 144a - 24b \\3[-16 = 64a + 8b] & \rightarrow & -48 = 192a + 24b \\ \hline & & -84 = 336a \\ & & -0.25 = a\end{array}$$

Now, find  $b$  by substituting  $a = -0.25$  into either of the original equations. Using the top equation, you get:

$$\begin{aligned}-9 &= 36(-0.25) - 6b \\-9 &= -9 - 6b \\0 &= 6b \\0 &= b\end{aligned}$$

The value of  $a + b + c$  is  $(-0.25) + 0 + 2 = 1.75$ .

## 27. D

**Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Read the question, organizing important information as you go. You need to find the ratio of mini muffins to jumbo muffins. You're given two ratios: mini to regular and regular to jumbo.

**Getting to the Answer:** Both of the given ratios contain regular muffin size units, but the regular amounts (2 and 5) are not identical. To directly compare them, find a common multiple (10). Multiply each ratio by the factor that will make the number of regular muffins equal to 10.

$$\text{Mini to regular: } (5:2) \times (5:5) = 25:10$$

$$\text{Regular to jumbo: } (5:4) \times (2:2) = 10:8$$

Now that the number of regular muffins is the same in both ratios (10), you can merge the two ratios to compare mini to jumbo directly: 25:10:8. So, the proper ratio of mini muffins to jumbo muffins is 25:8.

## 28. A

**Difficulty:** Hard

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Graphically, a system of linear equations that has no solution indicates two parallel lines, or in other words, two lines that have the same slope. So, write each of the equations in slope-intercept form ( $y = mx + b$ ) and set their slopes ( $m$ ) equal to each other to solve for  $k$ . Before finding the slopes, multiply the top equation by 6 to make it easier to manipulate.

**Getting to the Answer:**

$$\begin{aligned}6\left(\frac{1}{3}x + \frac{1}{2}y = 5\right) &\rightarrow 2x + 3y = 30 \rightarrow y = -\frac{2}{3}x + 10 \\kx - 4y = 16 &\rightarrow -4y = -kx + 16 \rightarrow y = \frac{k}{4}x - 4\end{aligned}$$

The slope of the first line is  $-\frac{2}{3}$ , and the slope of the second line is  $\frac{k}{4}$ . Set them equal and solve for  $k$ .

$$\begin{aligned}-\frac{2}{3} &= \frac{k}{4} \\-8 &= 3k \\-\frac{8}{3} &= k\end{aligned}$$

29. D

**Difficulty:** Hard**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** The numbers in some questions are simply too large to use a calculator (you get an “overflow” error message). Instead, you’ll have to rely on rules of exponents.

**Getting to the Answer:** Notice that all of the base numbers have 3 as a factor, so rewrite everything in terms of 3. This will allow you to use the rules of exponents. Because 27 is the cube of 3, you can rewrite  $27^{90}$  as a power of 3. Then you can use rules of exponents to simplify:

$$\begin{aligned} 27^{90} &= (3^3)^{90} \\ &= 3^{3 \times 90} \\ &= 3^{270} \end{aligned}$$

Now the numerator should read:  $3^{90} \times 3^{270}$ , which is equal to  $3^{90+270} = 3^{360}$ . Repeat this process for the denominator:

$$9^{30} = (3^2)^{30} = 3^{2 \times 30} = 3^{60}$$

Finally, use rules of exponents one more time to simplify the new expression:

$$\frac{3^{360}}{3^{60}} = 3^{360-60} = 3^{300}$$

All the answer choices are given as powers of 9, so rewrite your answer as a power of 9:

$$3^{300} = 3^{2 \times 150} = (3^2)^{150} = 9^{150}$$

30. D

**Difficulty:** Hard**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** Don’t forget to check the formulas provided for you at the beginning of each math section. The volume of a right cone is given by  $V = \frac{1}{3}\pi r^2 h$ . Here, you only know the value of one of

the variables,  $V$ , so you’ll need to use the information in the question to somehow write  $r$  and  $h$  in terms of just one variable.

**Getting to the Answer:** If the cone is three times as wide at the base as it is tall, then call the diameter  $3x$  and the height of the cone one-third of that, or  $x$ . The volume formula calls for the radius, which is half the diameter, or  $\frac{3x}{2}$ . Substitute these values into the formula and solve for  $x$ :

$$\begin{aligned} V &= \frac{1}{3}\pi r^2 h \\ 384\pi &= \frac{1}{3}\pi \left(\frac{3}{2}x\right)^2 x \\ 384 &= \left(\frac{1}{3}\right)\left(\frac{9}{4}x^2\right)x \\ 384 &= \frac{3}{4}x^3 \\ 512 &= x^3 \\ \sqrt[3]{512} &= x \\ 8 &= x \end{aligned}$$

The question asks for the diameter of the base, which is  $3x = 3(8) = 24$ .

31. 1/4 or .25

**Difficulty:** Medium**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** The question is asking about  $\frac{m}{n}$ , so think about how fractions work. Large numerators result in larger values ( $\frac{3}{2}$ , for example, is larger than  $\frac{1}{2}$ ), and smaller denominators result in larger values ( $\frac{1}{2}$ , for example, is greater than  $\frac{1}{4}$ ).

**Getting to the Answer:** The largest possible value of  $\frac{m}{n}$  is found by choosing the largest possible value of  $m$  and the smallest possible value for  $n$ :  $\frac{0.4}{1.6} = 0.25$ .

**32. 6****Difficulty:** Medium**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Understanding the language of functions will come in very handy on Test Day. Here,  $(f - g)(3)$  means  $f(3) - g(3)$ . You don't know the equations of the functions, so you'll need to read the values from the graph.

**Getting to the Answer:** Graphically,  $f(3)$  means the  $y$ -value at  $x = 3$  on the graph of  $f$ , which is 2. Likewise,  $g(3)$  means the  $y$ -value at  $x = 3$  on the graph of  $g$ , which is  $-4$ . The difference,  $f - g$ , is  $2 - (-4) = 6$ .

**33. 85****Difficulty:** Easy**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** The *range* of a set of data points is the set of outputs, which correspond to the  $y$ -values of the data points on the graph.

**Getting to the Answer:** To find the maximum value in the range of the data, look for the highest point on the graph, which is  $(250, 85)$ . The  $y$ -value is 85, so 85 is the maximum value in the range.

**34. 1/16****Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** The probability that the same event (the employee has been there longer than 3 years) will occur 4 times can be found by finding the probability that the event will occur once and then multiplying it by itself 4 times.

**Getting to the Answer:** First, find the probability that if an employee is chosen at random, it will be one who has been with the company for longer than 3 years. The total number of employees who

participated in the study is  $38 + 30 + 15 + 19 + 54 + 48 = 204$ . The total number of both females and males who have been with the company longer (greater) than 3 years is  $54 + 48 = 102$ . Therefore, the probability of choosing one employee who has been with the company longer than 3 years is:  $\frac{102}{204} = \frac{1}{2}$ . This means the probability that all 4 employees would have been with the company longer than 3 years is  $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{16}$ .

**35. 102****Difficulty:** Medium**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** The distance around part of a circle is the same as arc length, so use the relationship  $\frac{\text{arc length}}{\text{circumference}} = \frac{\text{central angle}}{360^\circ}$  to answer the question.

**Getting to the Answer:** The unknown in the relationship is the central angle, so call it  $A$ . Before you can fill in the rest of the equation, you need to find the circumference of the circle:  $C = 2\pi r = 2\pi(840) = 1,680\pi$ . Now you're ready to solve for  $A$ :

$$\begin{aligned} \frac{\text{arc length}}{\text{circumference}} &= \frac{\text{central angle}}{360^\circ} \\ \frac{1,500}{1,680\pi} &= \frac{A}{360} \\ \frac{1,500 \times 360}{1,680\pi} &= A \\ 102.314 &\approx A \end{aligned}$$

Be careful when you enter this expression into your calculator—you need to put  $1,680\pi$  in parentheses so that the calculator doesn't divide by 1,680 and then multiply by  $\pi$ . If entered correctly, the result is about 102 degrees.

36. 7

**Difficulty:** Hard**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** To write the equation of a line, you need two things: the slope and the  $y$ -intercept. Start by finding these, substituting them into slope-intercept form of a line ( $y = mx + b$ ), and then manipulate the equation so that it is written in standard form.

**Getting to the Answer:** Use the given points,  $(-4, 1)$  and  $(3, -2)$ , and the slope formula to find  $m$ :

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2 - 1}{3 - (-4)} = -\frac{3}{7}$$

Next, find the  $y$ -intercept,  $b$ , using the slope and one of the points:

$$\begin{aligned} y &= -\frac{3}{7}x + b \\ 1 &= -\frac{3}{7}(-4) + b \\ 1 &= \frac{12}{7} + b \\ -\frac{5}{7} &= b \end{aligned}$$

Write the equation in slope-intercept form:

$$y = -\frac{3}{7}x - \frac{5}{7}$$

Now, rewrite the equation in the form  $Ax + By = C$ , making sure that  $A$  is a positive integer (a whole number greater than 0):

$$\begin{aligned} y &= -\frac{3}{7}x - \frac{5}{7} \\ \frac{3}{7}x + y &= -\frac{5}{7} \\ 7\left(\frac{3}{7}x + y = -\frac{5}{7}\right) & \\ 3x + 7y &= -5 \end{aligned}$$

The question asks for the value of  $B$  (the coefficient of  $y$ ), so the correct answer is 7.

37. 380

**Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percents

**Strategic Advice:** You can use the formula  $\text{Percent} \times \text{whole} = \text{part}$  to solve this problem, but you will first need to think conceptually about what the question is asking.

**Getting to the Answer:** The question is asking for the Dow value *before* the 19.5% decrease to 306. This means that 306 represents  $100 - 19.5 = 80.5\%$  of what the stock market was at its record high. Fill these amounts into the equation and solve for the original whole, the record high Dow value.

$$\begin{aligned} 0.805 \times w &= 306 \\ w &= \frac{306}{0.805} \\ w &= 380.124 \end{aligned}$$

Rounded to the nearest whole point, the record high was approximately 380 points.

38. 25

**Difficulty:** Hard**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percents

**Strategic Advice:** Percent change is given by the ratio  $\frac{\text{amount of change}}{\text{original amount}}$ . To find the total percent change, you'll need to work your way through each of the days, and then use the ratio. Jot down the Dow value at the end of each day as you go. Do not round until you reach your final answer.

**Getting to the Answer:** First, calculate the value of the Dow at closing on Black Thursday: It opened at 306 and decreased by 2%, which means the value at the end of the day was  $100 - 2 = 98\%$  of the starting amount, or  $306 \times 0.98 = 299.88$ . Then, it decreased again on Monday by 13% to close at  $100 - 13 = 87\%$  of the opening amount, or  $299.88 \times 0.87 = 260.8956$ . Finally, it decreased on Tuesday by another 12% to end at  $100 - 12 = 88\%$  of the starting amount, or  $260.8956 \times 0.88 = 229.588$ . Now use the percent change formula to calculate the percent decrease from opening on Black Thursday (306) to closing on Black Tuesday (229.588):

$$\text{Percent decrease} = \frac{306 - 229.588}{306} = \frac{76.412}{306} = 0.2497$$

The Dow had a total percent decrease of approximately 25% between opening on Black Thursday and closing on Black Tuesday.

# SAT PRACTICE TEST 8 ANSWER SHEET

Remove (or photocopy) this answer sheet and use it to complete the test. See the answer key following the test when finished.

Start with number 1 for each section. If a section has fewer questions than answer spaces, leave the extra spaces blank.

## SECTION

1

- |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| 1. (A) (B) (C) (D)  | 14. (A) (B) (C) (D) | 27. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 2. (A) (B) (C) (D)  | 15. (A) (B) (C) (D) | 28. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 3. (A) (B) (C) (D)  | 16. (A) (B) (C) (D) | 29. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D)  | 17. (A) (B) (C) (D) | 30. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D)  | 18. (A) (B) (C) (D) | 31. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D)  | 19. (A) (B) (C) (D) | 32. (A) (B) (C) (D) | 45. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D)  | 20. (A) (B) (C) (D) | 33. (A) (B) (C) (D) | 46. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D)  | 21. (A) (B) (C) (D) | 34. (A) (B) (C) (D) | 47. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D)  | 22. (A) (B) (C) (D) | 35. (A) (B) (C) (D) | 48. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 23. (A) (B) (C) (D) | 36. (A) (B) (C) (D) | 49. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 24. (A) (B) (C) (D) | 37. (A) (B) (C) (D) | 50. (A) (B) (C) (D) |
| 12. (A) (B) (C) (D) | 25. (A) (B) (C) (D) | 38. (A) (B) (C) (D) | 51. (A) (B) (C) (D) |
| 13. (A) (B) (C) (D) | 26. (A) (B) (C) (D) | 39. (A) (B) (C) (D) | 52. (A) (B) (C) (D) |

# right in  
Section 1
# wrong in  
Section 1

## SECTION

2

- |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| 1. (A) (B) (C) (D)  | 12. (A) (B) (C) (D) | 23. (A) (B) (C) (D) | 34. (A) (B) (C) (D) |
| 2. (A) (B) (C) (D)  | 13. (A) (B) (C) (D) | 24. (A) (B) (C) (D) | 35. (A) (B) (C) (D) |
| 3. (A) (B) (C) (D)  | 14. (A) (B) (C) (D) | 25. (A) (B) (C) (D) | 36. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D)  | 15. (A) (B) (C) (D) | 26. (A) (B) (C) (D) | 37. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D)  | 16. (A) (B) (C) (D) | 27. (A) (B) (C) (D) | 38. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D)  | 17. (A) (B) (C) (D) | 28. (A) (B) (C) (D) | 39. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D)  | 18. (A) (B) (C) (D) | 29. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D)  | 19. (A) (B) (C) (D) | 30. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D)  | 20. (A) (B) (C) (D) | 31. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 21. (A) (B) (C) (D) | 32. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 22. (A) (B) (C) (D) | 33. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |

# right in  
Section 2
# wrong in  
Section 2

SECTION 3

1. (A) (B) (C) (D)      5. (A) (B) (C) (D)      9. (A) (B) (C) (D)      13. (A) (B) (C) (D)  
 2. (A) (B) (C) (D)      6. (A) (B) (C) (D)      10. (A) (B) (C) (D)      14. (A) (B) (C) (D)  
 3. (A) (B) (C) (D)      7. (A) (B) (C) (D)      11. (A) (B) (C) (D)      15. (A) (B) (C) (D)  
 4. (A) (B) (C) (D)      8. (A) (B) (C) (D)      12. (A) (B) (C) (D)

# right in Section 3

# wrong in Section 3

16.

	7	7	
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3	3	3	3
4	4	4	4
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7	7	7	7
8	8	8	8
9	9	9	9

17.

	7	7	
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2	2	2	2
3	3	3	3
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7	7	7	7
8	8	8	8
9	9	9	9

18.

	7	7	
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7	7	7	7
8	8	8	8
9	9	9	9

19.

	7	7	
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
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7	7	7	7
8	8	8	8
9	9	9	9

20.

	7	7	
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

SECTION 4

1. (A) (B) (C) (D)      9. (A) (B) (C) (D)      17. (A) (B) (C) (D)      25. (A) (B) (C) (D)  
 2. (A) (B) (C) (D)      10. (A) (B) (C) (D)      18. (A) (B) (C) (D)      26. (A) (B) (C) (D)  
 3. (A) (B) (C) (D)      11. (A) (B) (C) (D)      19. (A) (B) (C) (D)      27. (A) (B) (C) (D)  
 4. (A) (B) (C) (D)      12. (A) (B) (C) (D)      20. (A) (B) (C) (D)      28. (A) (B) (C) (D)  
 5. (A) (B) (C) (D)      13. (A) (B) (C) (D)      21. (A) (B) (C) (D)      29. (A) (B) (C) (D)  
 6. (A) (B) (C) (D)      14. (A) (B) (C) (D)      22. (A) (B) (C) (D)      30. (A) (B) (C) (D)  
 7. (A) (B) (C) (D)      15. (A) (B) (C) (D)      23. (A) (B) (C) (D)  
 8. (A) (B) (C) (D)      16. (A) (B) (C) (D)      24. (A) (B) (C) (D)

# right in Section 4

# wrong in Section 4

31.

	7	7	
	0	0	0
1	1	1	1
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3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

32.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

33.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

34.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

35.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

36.

	7	7	
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

37.

	7	7	
	0	0	0
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2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

38.

	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

# MATH TEST

25 Minutes—20 Questions

## NO-CALCULATOR SECTION

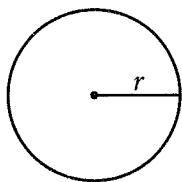
Turn to Section 3 of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding oval on the answer sheet. You may use any available space for scratch work.

Notes:

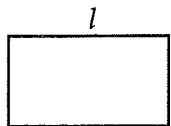
1. Calculator use is NOT permitted.
2. All numbers used are real numbers.
3. All figures used are necessary to solving the problems that they accompany. All figures are drawn to scale EXCEPT when it is stated that a specific figure is not drawn to scale.
4. Unless stated otherwise, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$ , for which  $f(x)$  is a real number.

Information:

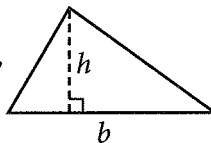


$$A = \pi r^2$$

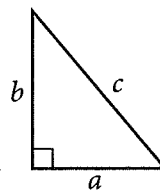
$$C = 2\pi r$$



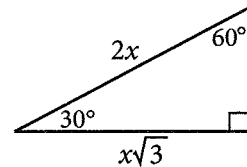
$$A = lw$$



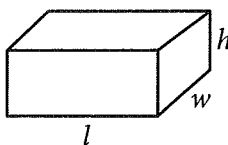
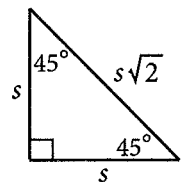
$$A = \frac{1}{2}bh$$



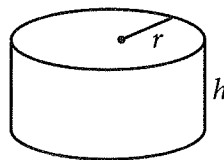
$$c^2 = a^2 + b^2$$



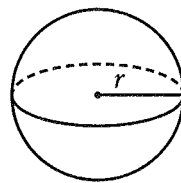
Special Right Triangles



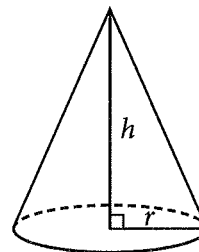
$$V = lwh$$



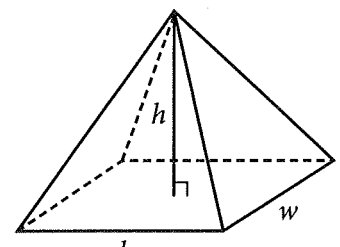
$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



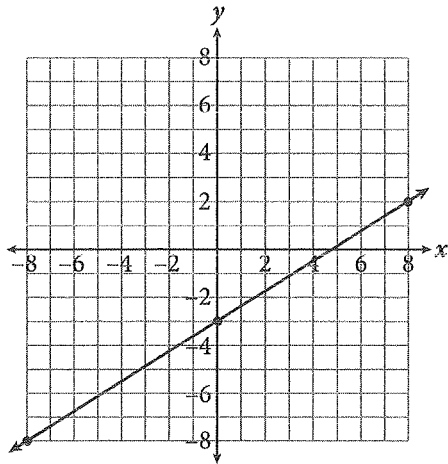
$$V = \frac{1}{3}lwh$$

The sum of the degree measures of the angles in a triangle is 180.

The number of degrees of arc in a circle is 360.

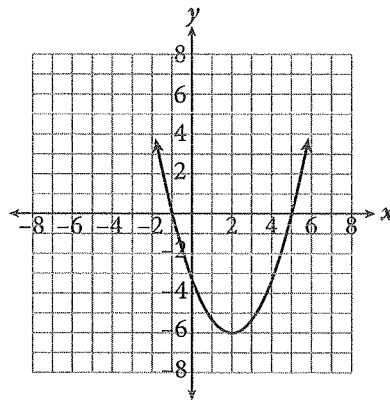
The number of radians of arc in a circle is  $2\pi$ .





1. What is the average rate of change for the line graphed in the figure above?

- A)  $\frac{3}{5}$   
 B)  $\frac{5}{8}$   
 C)  $\frac{8}{5}$   
 D)  $\frac{5}{3}$



2. Which of the following could be the factored form of the equation graphed in the figure above?

- A)  $y = \frac{1}{5}(x - 2)(x + 6)$   
 B)  $y = \frac{1}{5}(x + 2)(x - 6)$   
 C)  $y = \frac{2}{3}(x - 1)(x + 5)$   
 D)  $y = \frac{2}{3}(x + 1)(x - 5)$

3. Kinetic energy is the energy of motion. The equation  $E_K = \frac{1}{2}mv^2$  represents the kinetic energy in joules of an object with a mass of  $m$  kg traveling at a speed of  $v$  meters per second. What is the kinetic energy in joules of an unmanned aircraft with a mass of  $2 \times 10^3$  kg traveling at a speed of approximately  $3 \times 10^3$  meters per second?

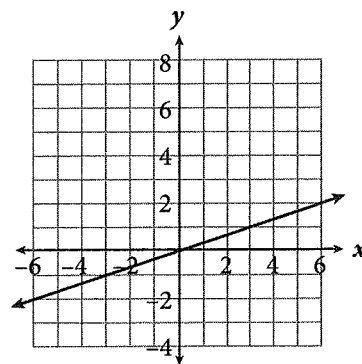
- A)  $9 \times 5^9$   
 B)  $9 \times 10^8$   
 C)  $9 \times 10^9$   
 D)  $1.8 \times 10^{10}$

$$\frac{3(k-1)+5}{2} = \frac{17-(8+k)}{4}$$

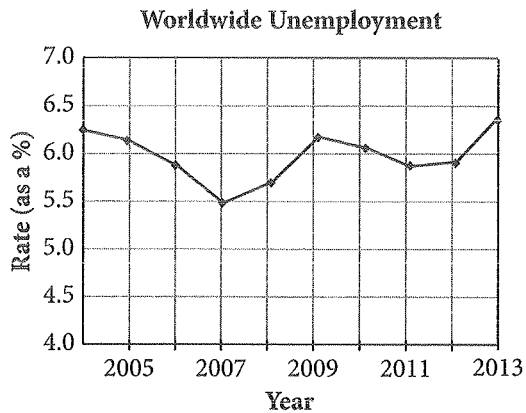
4. In the equation above, what is the value of  $k$ ?
- A)  $\frac{9}{13}$   
 B)  $\frac{5}{7}$   
 C)  $\frac{8}{7}$   
 D)  $\frac{8}{5}$
5. An environmental protection group had its members sign a pledge to try to reduce the amount of garbage they throw out by 3% each year. On the year that the pledge was signed, each person threw out an average of 1,800 pounds of garbage. Which exponential function could be used to model the average amount of garbage each person who signed the pledge should throw out each year after signing the pledge?
- A)  $y = 0.97 \times 1,800^t$   
 B)  $y = 1,800 \times t^{0.97}$   
 C)  $y = 1,800 \times 1.97^t$   
 D)  $y = 1,800 \times 0.97^t$

$$\frac{6x+2}{x+5} - \frac{3x-8}{x+5}$$

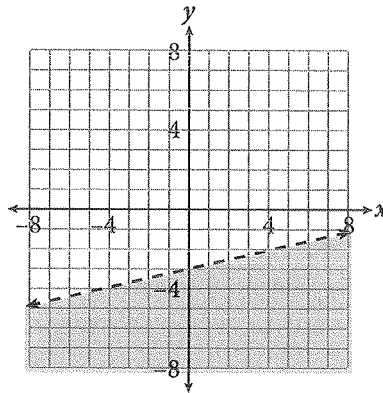
6. Which of the following is equivalent to the expression above?
- A)  $\frac{3x-6}{x+5}$   
 B)  $\frac{3x+10}{x+5}$   
 C)  $\frac{3x-6}{2x+10}$   
 D)  $\frac{3x+10}{2x+10}$



7. If the equation of the line shown in the figure above is written in the form  $\frac{y}{x} = m$ , which of the following could be the value of  $m$ ?
- A)  $-3$   
 B)  $-\frac{1}{3}$   
 C)  $\frac{1}{3}$   
 D)  $3$
8. If  $4x^2 + 7x + 1$  is multiplied by  $3x + 5$ , what is the coefficient of  $x$  in the resulting polynomial?
- A)  $3$   
 B)  $12$   
 C)  $35$   
 D)  $38$



9. The figure above shows worldwide unemployment rates from 2004 to 2013. Which of the following statements is true?
- A) The graph is decreasing everywhere.
- B) The graph is increasing from 2007 to 2010.
- C) The graph is decreasing from 2004 to 2007 and from 2009 to 2011.
- D) The graph is increasing from 2007 to 2010 and decreasing from 2011 to 2013.



10. The solution to which inequality is represented in the graph above?
- A)  $\frac{1}{4}x - y > 3$
- B)  $\frac{1}{4}x - y < 3$
- C)  $\frac{1}{4}x + y > -3$
- D)  $\frac{1}{4}x + y < -3$

$$\frac{1}{2}(4a + 10b) = b$$

11. If  $(a, b)$  is a solution to the equation above, what is the ratio  $\frac{b}{a}$ , given that  $a \neq 0$ ?
- A)  $-3$
- B)  $-2$
- C)  $-\frac{1}{2}$
- D)  $-\frac{1}{3}$

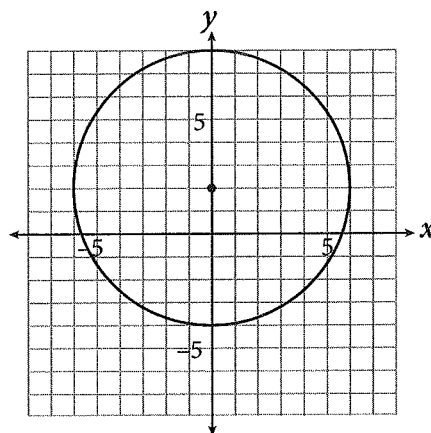
$$\begin{cases} \frac{1}{3}x + \frac{2}{3}y = -8 \\ ax + 6y = 15 \end{cases}$$

12. If the system of linear equations above has no solution, and  $a$  is a constant, what is the value of  $a$ ?

- A)  $-\frac{1}{3}$   
 B)  $\frac{1}{3}$   
 C)  $\frac{3}{2}$   
 D) 3

13. A taxi in the city charges \$3.00 for the first  $\frac{1}{4}$  mile, plus \$0.25 for each additional  $\frac{1}{8}$  mile. Eric plans to spend no more than \$20 on a taxi ride around the city. Which inequality represents the number of miles,  $m$ , that Eric could travel without exceeding his limit?

- A)  $2.5 + 2m \leq 20$   
 B)  $3 + 0.25m \leq 20$   
 C)  $3 + 2m \leq 20$   
 D)  $12 + 2m \leq 20$



14. If the equation of the circle shown above is written in the form  $x^2 + y^2 + ax + by = c$ , what is the value of  $ab + c$ ?
- A) 6  
 B) 16  
 C) 28  
 D) 32
15. A projectile is any moving object that is thrown near the Earth's surface. The path of the projectile is called the trajectory and can be modeled by a quadratic equation, assuming the only force acting on the motion is gravity (no friction). If a projectile is launched from a platform 8 feet above the ground with an initial velocity of 64 feet per second, then its trajectory can be modeled by the equation  $h = -16t^2 + 64t + 8$ , where  $h$  represents the height of the projectile  $t$  seconds after it was launched. Based on this model, what is the maximum height in feet that the projectile will reach?
- A) 72  
 B) 80  
 C) 92  
 D) 108

**Directions:** For questions 16-20, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
4. Some problems may have more than one correct answer. In such cases, grid only one answer.
5. **Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $\frac{7}{2}$ .

(If  $3\frac{1}{2}$  is entered into the grid as 

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)

6. **Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Answer:  $\frac{7}{12}$

Write answer in boxes. →

7	/	1	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Grid in result. →

Answer: 2.5

2	.	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

← Decimal point

Answer: 201  
Either position is correct.

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3

Acceptable ways to grid  $\frac{2}{3}$  are:

2	/	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6

.	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

.	6	6	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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1	1	1	1
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3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

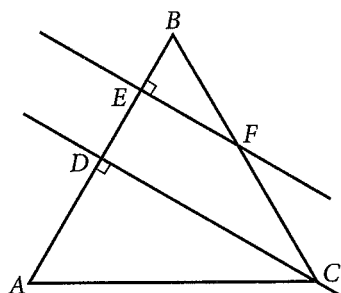
16. If  $\frac{3}{4}x + \frac{5}{6}y = 12$ , what is the value of  $9x + 10y$ ?

$$\frac{3x^{\frac{3}{2}}(16x^2)^3}{8x^{-\frac{1}{2}}}$$

17. How many degrees does the minute hand of an analogue clock rotate from 3:20 PM to 3:45 PM?

19. What is the exponent on  $x$  when the expression above is written in simplest form?

20. An exponential function is given in the form  $f(x) = a \cdot b^x$ . If  $f(0) = 3$  and  $f(1) = 15$ , what is the value of  $f(-2)$ ?



18. Triangle  $ABC$  shown above is an equilateral triangle cut by two parallel lines. If the ratio of  $BF$  to  $FC$  is 3:4 and  $EB = 3$ , what is the length of  $DE$ ?

# MATH TEST

55 Minutes—38 Questions

## CALCULATOR SECTION

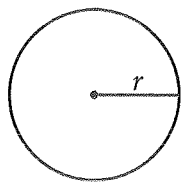
Turn to Section 4 of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding oval on the answer sheet. You may use any available space for scratch work.

Notes:

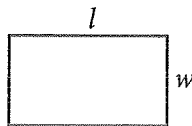
1. Calculator use is permitted.
2. All numbers used are real numbers.
3. All figures used are necessary to solving the problems that they accompany. All figures are drawn to scale EXCEPT when it is stated that a specific figure is not drawn to scale.
4. Unless stated otherwise, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$ , for which  $f(x)$  is a real number.

Information:

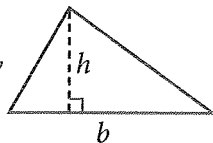


$$A = \pi r^2$$

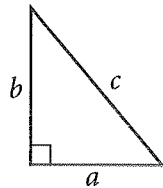
$$C = 2\pi r$$



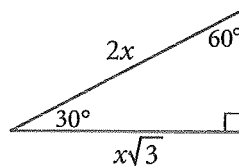
$$A = lw$$



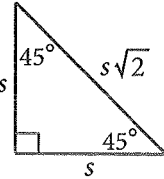
$$A = \frac{1}{2}bh$$



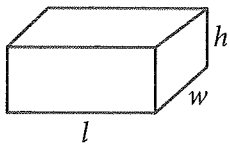
$$c^2 = a^2 + b^2$$



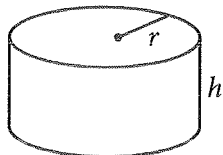
$$x\sqrt{3}$$



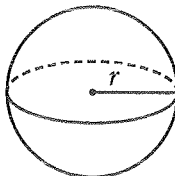
Special Right Triangles



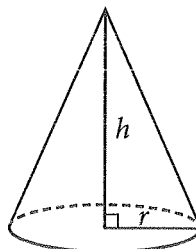
$$V = lwh$$



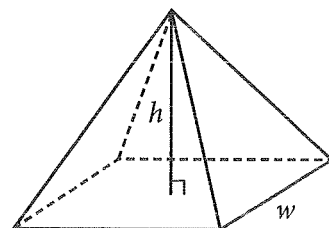
$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



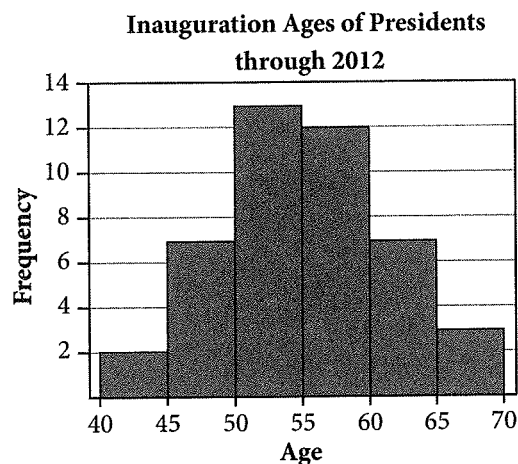
$$V = \frac{1}{3}lwh$$

The sum of the degree measures of the angles in a triangle is 180.

The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is  $2\pi$ .

1. A home improvement store that sells carpeting charges a flat installation fee and a certain amount per square foot of carpet ordered. If the total cost for  $f$  square feet of carpet is given by the function  $C(f) = 3.29f + 199$ , then the value 3.29 best represents which of the following?
- A) The installation fee  
 B) The cost of one square foot of carpet  
 C) The number of square feet of carpet ordered  
 D) The total cost not including the installation fee



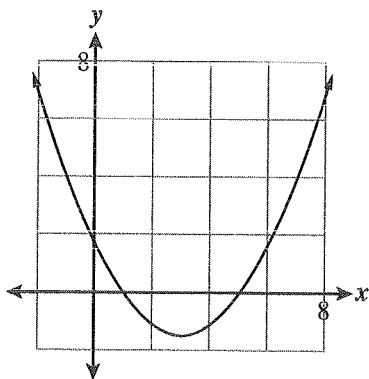
2. The United States Constitution requires that any candidate for the presidency be at least 35 years of age, although no president to date has been that young. The figure above shows the distribution of the ages of the presidents through 2012 at the time they were inaugurated. Based on the information shown, which of the following statements is true?
- A) The shape of the data is skewed to the left, so the mean age of the presidents is greater than the median.  
 B) The shape of the data is fairly symmetric, so the mean age of the presidents is approximately equal to the median.  
 C) The data has no clear shape, so it is impossible to make a reliable statement comparing the mean and the median.  
 D) The same number of 55-or-older presidents have been inaugurated as ones who were younger than 55, so the mean age is exactly 55.



$$\frac{1}{3}(5x - 8) = 3x + 4$$

3. Which value of  $x$  satisfies the equation above?

- A) -5
- B) -3
- C) -1
- D) 1

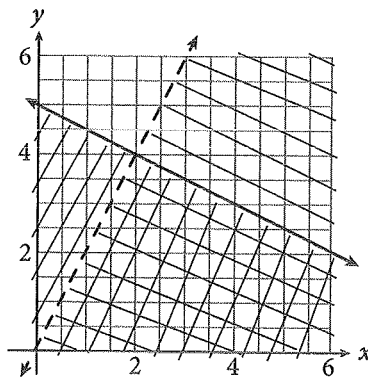


4. The following quadratic equations are all representations of the graph shown above. Which equation could you use to find the minimum value of the function, without doing any additional work?

- A)  $y = \frac{3}{8}(x-3)^2 - \frac{3}{2}$
- B)  $y = \frac{3}{8}(x-1)(x-5)$
- C)  $y - \frac{15}{8} = \frac{3}{8}x^2 - \frac{9}{4}x$
- D)  $y = \frac{3}{8}x^2 - \frac{9}{4}x + \frac{15}{8}$

5. The Farmers' Market sells apples by the basket. The market charges \$3.00 for the basket itself, plus \$1.97 per pound of apples. A 6% sales tax is also applied to the entire purchase. Which equation represents the total cost of  $p$  pounds of apples at the Farmers' Market?

- A)  $c = (1.97 + 0.06p) + 3$
- B)  $c = 1.06(1.97p) + 3$
- C)  $c = 1.06(1.97 + 3)p$
- D)  $c = 1.06(1.97p + 3)$



6. Which of the following is a solution to the system of inequalities shown in the figure above?

- A) (1, 5)
- B) (2, 6)
- C) (4, 1)
- D) (5, 4)

7. Marion is a city planner. The city she works for recently purchased new property on which it plans to build administrative offices. Marion has been given the task of sizing the lots for new buildings, using the following guidelines:

- The square footage of each lot should be greater than or equal to 3,000 square feet, but less than or equal to 15,000 square feet.
- Each lot size should be at least 30% greater in area than the size before it.
- To simplify tax assessment calculations, the square footage of each lot must be a multiple of 1,000 square feet.

Which list of lot sizes meets the city guidelines and includes as many lots as possible?

- A) 3,000; 5,000; 10,000; 15,000  
 B) 3,000; 4,500; 6,000; 7,500; 10,000; 15,000  
 C) 3,000; 4,000; 6,000; 8,000; 11,000; 15,000  
 D) 3,000; 3,900; 5,100; 6,600; 8,600; 11,200; 14,600
8. One function of the Environmental Protection Agency (EPA) is to reduce air pollution. After implementing several pollution reduction programs in a certain city, EPA calculated that the air pollution should decrease by approximately 8% each year. What kind of function could be used to model the amount of air pollution in this city over the next several years, assuming no other significant changes?
- A) A linear function  
 B) A quadratic function  
 C) A polynomial function  
 D) An exponential function

9. Escape velocity is the speed that a traveling object needs to break free of a planet or moon's gravitational field without additional propulsion (for example, without using fuel). The formula used to calculate escape velocity is  $v = \sqrt{\frac{2Gm}{r}}$ , where  $G$  represents the universal gravitational constant,  $m$  is the mass of the body from which the object is escaping, and  $r$  is the distance between the object and the body's center of gravity. Which equation represents the value of  $r$  in terms of  $v$ ,  $G$ , and  $m$ ?

- A)  $r = \frac{2Gm}{v^2}$   
 B)  $r = \frac{4G^2m^2}{v^2}$   
 C)  $r = \sqrt{\frac{2Gm}{v}}$   
 D)  $r = \sqrt{\frac{v}{2Gm}}$

10. A movie rental kiosk dispenses DVDs and Blu-rays. DVDs cost \$2.00 per night and Blu-rays cost \$3.50 per night. Between 5 PM and 9 PM on Saturday, the kiosk dispensed 209 movies and collected \$562.00. Solving which system of equations would yield the number of DVDs,  $d$ , and the number of Blu-rays,  $b$ , that the kiosk dispensed during the 4-hour period?

- A)  $\begin{cases} d + b = 209 \\ 2d + 3.5b = \frac{562}{4} \end{cases}$   
 B)  $\begin{cases} d + b = 562 \\ 2d + 3.5b = 209 \end{cases}$   
 C)  $\begin{cases} d + b = 562 \\ 2d + 3.5b = 209 \times 4 \end{cases}$   
 D)  $\begin{cases} d + b = 209 \\ 2d + 3.5b = 562 \end{cases}$

11. The United States Senate has two voting members for each of the 50 states. The 113th Congress had a 4:1 male-to-female ratio in the Senate. Forty-five of the male senators were Republican. Only 20 percent of the female senators were Republican. How many senators in the 113th Congress were Republican?
- A) 20  
B) 49  
C) 55  
D) 65
12. According to the *Project on Student Debt* prepared by The Institute for College Access and Success, 7 out of 10 students graduating in 2012 from a four-year college in the United States had student loan debt. The average amount borrowed per student was \$29,400, which is up from \$18,750 in 2004. If student debt experiences the same total percent increase over the next eight years, approximately how much will a college student graduating in 2020 owe, assuming she takes out student loans to pay for her education?
- A) \$40,100  
B) \$44,300  
C) \$46,100  
D) \$48,200
13. Annalisa has 10 beanbags to throw in a game. She gets 7 points if a beanbag lands in the smaller basket and 3 points if it lands in the larger basket. If she gets  $b$  beanbags into the larger basket and the rest into the smaller basket, which expression represents her total score?
- A)  $3b$   
B)  $3b + 7$   
C)  $30 + 4b$   
D)  $70 - 4b$

Questions 14 and 15 refer to the following information.

In a 2010 poll, surveyors asked registered voters in four different New York voting districts whether they would consider voting to ban fracking in the state. Hydraulic fracturing, or “fracking,” is a mining process that involves splitting rocks underground to remove natural gas. According to ecologists, environmental damage can occur as a result of fracking, including contamination of water. The results of the 2010 survey are shown in the following table.

	In Favor of Ban	Against Ban	No Opinion	Total
District A	23,247	17,106	3,509	43,862
District B	13,024	12,760	2,117	27,901
District C	43,228	49,125	5,891	98,244
District D	30,563	29,771	3,205	63,539
Total	110,062	108,762	14,722	233,546

14. According to the data, which district had the smallest percentage of voters with no opinion on fracking?
- A) District A  
 B) District B  
 C) District C  
 D) District D
15. A random follow-up survey was administered to 500 of the respondents in District C. They were asked if they planned to vote in the next election. The follow-up survey results were: 218 said they planned to vote, 174 said they did not plan to vote, and 108 said they were unsure. Based on the data from both the initial survey and the follow-up survey, which of the following is most likely an accurate statement?
- A) Approximately 19,000 people in District C who support a ban on fracking can be expected to vote in the next election.  
 B) Approximately 21,000 people in District C who support a ban on fracking can be expected to vote in the next election.  
 C) Approximately 43,000 people in District C who support a ban on fracking can be expected to vote in the next election.  
 D) Approximately 48,000 people in District C who support a ban on fracking can be expected to vote in the next election.

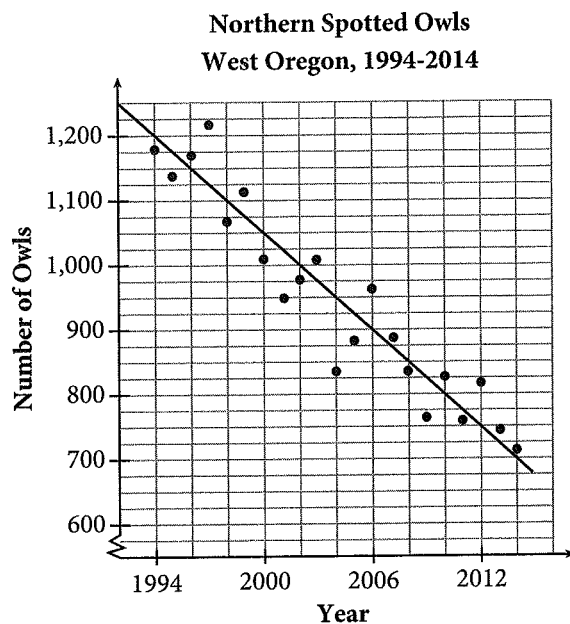
$$\begin{cases} 2x + 4y = 13 \\ x - 3y = -11 \end{cases}$$

16. Based on the system of equations above, what is the value of the sum of  $x$  and  $y$ ?
- A)  $-\frac{1}{2}$   
 B) 3  
 C)  $3\frac{1}{2}$   
 D) 4

	Bowling Scores		
	Ian	Mae	Jin
Game 1	160	110	120
Game 2	135	160	180
Game 3	185	140	105
Game 4	135	130	160
Game 5	185	110	135
Mean Score	160	130	140
Standard Deviation	22	19	27

17. Ian, Mae, and Jin bowled five games during a bowling tournament. The table above shows their scores. According to the data, which of the following conclusions is correct?
- A) Ian bowled the most consistently because the mean of his scores is the highest.  
 B) Mae bowled the least consistently because the standard deviation of her scores is the lowest.  
 C) Mae bowled the most consistently because the standard deviation of her scores is the lowest.  
 D) Jin bowled the most consistently because the standard deviation of his scores is the highest.

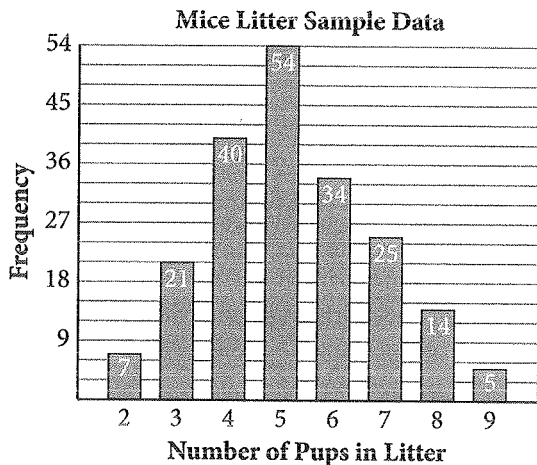
18. Which of the following are solutions to the quadratic equation  $(x + 3)^2 = 16$ ?
- A)  $x = -19$  and  $x = 13$   
 B)  $x = -7$  and  $x = 1$   
 C)  $x = -1$  and  $x = 1$   
 D)  $x = -1$  and  $x = 7$
19. An architect is building a scale model of the Statue of Liberty. The real statue measures 305 feet, 6 inches from the bottom of the base to the tip of the torch. The architect plans to make her model 26 inches tall. If Lady Liberty's nose on the actual statue is 4 feet, 6 inches long, how long in inches should the nose on the model be?
- A)  $\frac{1}{26}$   
 B)  $\frac{26}{141}$   
 C)  $\frac{18}{47}$   
 D)  $\frac{13}{27}$
20. If  $f(x) = 3x + 5$ , what is  $f(6) - f(2)$ ?
- A) 11  
 B) 12  
 C) 17  
 D) 23



21. The United States Fish and Wildlife Service classifies animals whose populations are at low levels as either threatened or endangered. Endangered species are animals that are currently on the brink of extinction, whereas threatened species have a high probability of being on the brink in the near future. Since 1990, the Northern Spotted Owl has been listed as threatened. The figure above shows the populations of the Northern Spotted Owl in a certain region in Oregon from 1994 to 2014. Based on the line of best fit shown in the figure, which of the following values most accurately reflects the average change per year in the number of Northern Spotted Owls?
- A) -25  
 B) -0.04  
 C) 0.04  
 D) 25

22. The  $x$ -coordinates of the solutions to a system of equations are  $-4$  and  $2$ . Which of the following could be the system?

- A)  $\begin{cases} y = 2x - 4 \\ y = (x + 4)^2 \end{cases}$
- B)  $\begin{cases} y = x - 2 \\ y = (x + 4)^2 + 2 \end{cases}$
- C)  $\begin{cases} y = x - 2 \\ y = (x - 4)^2 - 16 \end{cases}$
- D)  $\begin{cases} y = 2x - 4 \\ y = (x + 2)^2 - 16 \end{cases}$

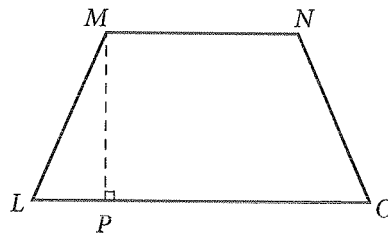


23. The White-footed Mouse, named for its darker body fur and white feet, is primarily found on the East Coast of the United States, living in warm, dry forests and brushland. A scientist in Virginia studied a sample of 200 white-footed mice to see how many offspring they had per birth. The results of the study are recorded in the figure above. Based on the data, given a population of 35,000 female white-footed mice living in Virginia, how many would you expect to have a litter of seven or more pups?

- A) 3,325  
B) 4,375  
C) 7,700  
D) 15,400

24. Human beings have a resting heart rate and an active heart rate. The resting heart rate is the rate at which the heart beats when a person is at rest, engaging in no activity. The active heart rate rises as activity rises. For a fairly active woman in her 20s, eight minutes of moderate exercise results in a heart rate of about 90 beats per minute. After 20 minutes, the same woman's heart rate will be about 117 beats per minute. If the human heart rate increases at a constant rate as the time spent exercising increases, which of the following linear models represents this same woman's heart rate,  $r$ , after  $t$  minutes of moderate exercise?

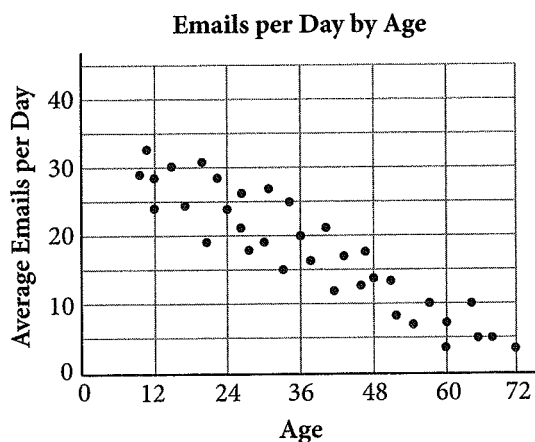
- A)  $r = 0.15t - 5.3$   
B)  $r = 0.44t - 32$   
C)  $r = 2.25t + 72$   
D)  $r = 6.75t + 36$



25. What would the percent increase in the area of the isosceles trapezoid shown above be if  $MN$  and  $LO$  were each multiplied by 4 and  $MP$  was reduced by 75%?

- A) 0  
B) 25  
C) 100  
D) 400

26. Chantal buys new furniture using store credit, which offers five-year, no-interest financing. She sets up a payment plan to pay the debt off as soon as possible. The function  $40x + y = 1,400$  can be used to model her payment plan, where  $x$  is the number of payments Chantal has made, and  $y$  is the amount of debt remaining. If a solution to the equation is  $(21, 560)$ , which of the following statements is true?
- A) Chantal pays \$21 per month.  
 B) Chantal pays \$560 per month.  
 C) After 21 payments, \$560 remains to be paid.  
 D) After 21 payments, Chantal will have paid off \$560 of the debt.



27. Which of the following equations best represents the trend of the data shown in the figure above?
- A)  $y = -2.4x + 30$   
 B)  $y = -1.2x + 40$   
 C)  $y = -0.8x + 40$   
 D)  $y = -0.4x + 36$
28. The graph of  $f(x)$  passes through the point  $(5, 1)$ . Through which point does the graph of  $-f(x + 3) - 2$  pass?
- A)  $(-2, -1)$   
 B)  $(2, -3)$   
 C)  $(2, 1)$   
 D)  $(8, -3)$
29. When a certain kitchen appliance store decides to sell a floor model, it marks the retail price of the model down 25% and puts a "Floor Model Sale" sign on it. Every 30 days after that, the price is marked down an additional 10% until it is sold. The store decides to sell a floor model refrigerator on January 15th. If the retail price of the refrigerator was \$1,500 and it is sold on April 2nd of the same year, what is the final selling price, not including tax?
- A) \$820.13  
 B) \$825.00  
 C) \$911.25  
 D) \$1,012.50
30. When New York City built its 34th Street subway station, which has multiple underground levels, it built an elevator that runs along a diagonal track approximately 170 feet long to connect the upper and lower levels. The angle formed between the elevator track and the bottom level is just under 30 degrees. What is the approximate vertical distance in feet between the upper and lower levels of the subway station?
- A) 85  
 B) 98  
 C) 120  
 D) 147



**Directions:** For questions 31-38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $\frac{7}{2}$ .

(If  $3\frac{1}{2}$  is entered into the grid as 

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)

- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Answer:  $\frac{7}{12}$

7	/	1	2
<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
<input checked="" type="radio"/>	7	7	7
8	8	8	8
9	9	9	9

Write answer in boxes. →

← Fraction line

Grid in result. →

Answer: 2.5

2	.	5
<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	<input checked="" type="radio"/>	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

← Decimal point

Answer: 201  
Either position is correct.

2	0	1
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	<input checked="" type="radio"/>	0
1	1	<input checked="" type="radio"/>
2	<input checked="" type="radio"/>	2
3	3	3
4	4	4

2	0	1
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	<input checked="" type="radio"/>	0
1	1	<input checked="" type="radio"/>
2	<input checked="" type="radio"/>	2
3	3	3

Acceptable ways to grid  $\frac{2}{3}$  are:

2	/	3
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	<input checked="" type="radio"/>	2
3	3	<input checked="" type="radio"/>
4	4	4
5	5	5
6	6	6

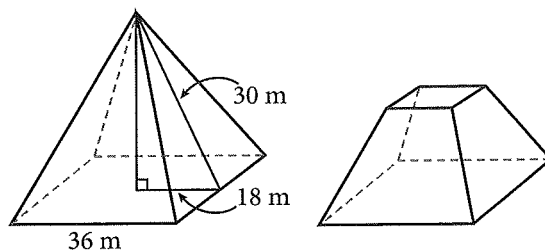
.	6	6	6
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<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

.	6	6	7
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

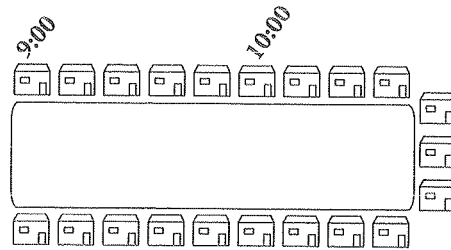
31. If  $-\frac{3}{2} < 3 - \frac{a}{5} < -\frac{1}{4}$ , what is the maximum possible whole number value of  $a$ ?

Boeing Jets	Coach	Business	First Class
747-400	310	52	12
767-300	151	26	6
777-200	194	37	16
777-300	227	52	8

32. The table above shows the seating configuration for several commercial airplanes. The day before a particular flight departs, a travel agent books the last seat available for a client. If the seat is on one of the two Boeing 777s, what is the probability that the seat is a Business Class seat, assuming that all seats have an equal chance of being the last one available?
33. Heating water accounts for a good portion of the average home's energy consumption. Tankless water heaters, which run on natural gas, are about 22% more energy efficient on average than electric hot water heaters. However, a tankless hot water heater typically costs significantly more. Suppose one tankless water heater costs \$160 more than twice as much as a conventional hot water heater. If both water heaters cost \$1,000 together, how many more dollars does the tankless water heater cost than the conventional one?
34. Medically speaking, remission is a period in which the symptoms of a disease or condition subside or, for some diseases, a period during which the condition stops spreading or worsening. In a certain drug trial in which a drug designed to treat cancer was tested, exactly 48% of patients experienced remission while take the drug. What is the fewest number of patients who could have participated in this trial?
35. When the top of a pyramid (or a cone) is cut off, the remaining bottom part is called a frustum. Suppose the top third (based on the height) of the square pyramid shown above is cut off and discarded. What will be the volume, in cubic meters, of the remaining frustum?
36. After a surface has been cleaned, bacteria begin to regrow. Because bacteria reproduce in all directions, the area covered is usually in the shape of a circle. The diameter of the circle in millimeters can give scientists an idea of how long the bacteria have been growing. For a certain kind of bacteria, the equation  $d = 0.015 \times \sqrt{h - 24}$  can be used to find the number of hours,  $h \geq 24$ , that the bacteria have been growing. If the diameter of a circle of these bacteria is 0.12 millimeters, how many hours have the bacteria been growing?



Questions 37 and 38 refer to the following information.



Daniel works for a pest control company and is spraying all the lawns in a neighborhood. The figure above shows the layout of the neighborhood and the times that Daniel started spraying the lawns at two of the houses. Each lawn in the neighborhood is approximately 0.2 acres in size and takes the same amount of time to spray.

37. How many minutes will it take Daniel to spray all of the lawns in the neighborhood?
38. Daniel uses a mobile spray rig that holds 20 gallons of liquid. It takes 1 gallon to spray 2,500 square feet of lawn. How many times, including the first time, will Daniel need to fill the spray rig, assuming he fills it to the very top each time? [1 acre = 43,560 square feet]

**ANSWER KEY****READING TEST**

1. C	14. C	27. C	40. C
2. D	15. D	28. D	41. C
3. A	16. B	29. B	42. A
4. C	17. B	30. A	43. B
5. D	18. D	31. D	44. B
6. A	19. B	32. A	45. A
7. D	20. C	33. D	46. D
8. A	21. A	34. D	47. B
9. B	22. C	35. B	48. C
10. D	23. C	36. D	49. B
11. D	24. B	37. C	50. D
12. D	25. C	38. B	51. D
13. A	26. A	39. D	52. B

**WRITING AND LANGUAGE TEST**

1. B	12. D	23. D	34. C
2. B	13. B	24. C	35. D
3. C	14. D	25. B	36. D
4. A	15. B	26. D	37. B
5. B	16. C	27. D	38. A
6. A	17. B	28. A	39. B
7. A	18. C	29. B	40. C
8. C	19. A	30. C	41. B
9. A	20. C	31. C	42. B
10. D	21. D	32. D	43. A
11. C	22. B	33. D	44. D

**MATH—NO CALCULATOR**

1. B	6. B	11. C	16. 144
2. D	7. C	12. D	17. 150
3. C	8. D	13. A	18. 4
4. B	9. C	14. D	19. 8
5. D	10. A	15. A	20. $\frac{3}{25}$ or .12

**MATH—CALCULATOR**

1. B	11. B	21. A	31. 22
2. B	12. C	22. D	32. $\frac{1}{6}$ or .166 or .167
3. A	13. D	23. C	33. 440
4. A	14. D	24. C	34. 25
5. D	15. A	25. A	35. 9984
6. C	16. B	26. C	36. 88
7. C	17. C	27. D	37. 252
8. D	18. B	28. B	38. 4
9. A	19. C	29. C	
10. D	20. B	30. A	

**Getting to the Answer:** Since “readily available” cannot be quantified and implies the author’s opinion, using the word “specific” in (C) creates a more exact statement that precedes the information on the precise tools used.

41. B

**Difficulty:** Medium

**Category:** Writing & Language / Usage

**Strategic Advice:** Read closely to find the subject of the verb. Sometimes, the closest noun is not the subject.

**Getting to the Answer:** The subject of the sentence is “strength and direction,” not “energy.” Choice (B) is the correct answer because it matches the subject in number and maintains a consistent tense with the rest of the passage.

42. B

**Difficulty:** Hard

**Category:** Writing & Language / Effective Language Use

**Strategic Advice:** Eliminate extraneous and redundant information (“the public”) and needless prepositions. Then reorder the verb and nouns to achieve the most efficient language possible.

**Getting to the Answer:** Making adjustments to the passage language as shown in (B) results in the most concise phrasing.

43. A

**Difficulty:** Hard

**Category:** Writing & Language / Sentence Formation

**Strategic Advice:** Consider the meanings of each introductory word carefully. Use the context clues in the rest of the sentence to choose the correct word.

**Getting to the Answer:** The context clues in the rest of the sentence reveal that the Northern Lights

can create communication and weather problems and yet are still beautiful. Keeping the word “While” makes the most sense in this context, so (A) is the correct answer.

44. D

**Difficulty:** Hard

**Category:** Writing & Language / Quantitative

**Strategic Advice:** Reread paragraph 4 for information that will help you understand how to read the graphic. Use that information to calculate the precise start and end time for the solar flare as indicated in the graphic.

**Getting to the Answer:** The passage states that a solar flare is represented by any Kp-Index of 5 or higher. While there is one three-hour period where the Kp-Index reached 6, there is a consistent period where the chart shows readings of level 5 or higher. Choice (D) is the correct answer. This choice gives the complete time period showing a reading of level 5 or higher, according to the chart.

## MATH TEST: NO-CALCULATOR SECTION

1. B

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** The average rate of change for a linear function is the same as the slope of the line.

**Getting to the Answer:** Find the slope of the line by either using the slope formula or by counting the rise and the run from one point to the next. If you start at (0, -3), the line rises 5 units and runs 8 units to get to (8, 2), so the slope, or average rate of change, is  $\frac{5}{8}$ .

**2. D****Difficulty:** Easy**Category:** Passport to Advanced Math / Quadratics**Strategic Advice:** Factored form reveals the roots, or  $x$ -intercepts, of the equation, so start by identifying the  $x$ -intercepts on the graph.**Getting to the Answer:** A root of an equation is an  $x$ -value that corresponds to a  $y$ -value of 0. The  $x$ -intercepts of the graph, and therefore the roots of the equation, are  $x = -1$  and  $x = 5$ . When  $x = -1$ ,  $x + 1 = 0$ , so one of the factors is  $x + 1$ . When  $x = 5$ ,  $x - 5 = 0$ , so the other factor is  $x - 5$ . The equation in (D) is the only one that contains these factors and is therefore correct.**3. C****Difficulty:** Easy**Category:** Passport to Advanced Math / Exponents**Strategic Advice:** You do not need a calculator to answer this question—just use the rules of exponents. Remember, when raising a power to a power, you multiply the exponents.**Getting to the Answer:** Substitute the values given in the question into the formula. Then simplify using the rules of exponents.

$$\begin{aligned}
 KE &= \frac{1}{2}(2 \times 10^3)(3 \times 10^3)^2 \\
 &= \frac{1}{2}(2 \times 10^3)(3^2 \times 10^{3 \times 2}) \\
 &= \frac{1}{2} \times 2 \times 10^3 \times 9 \times 10^6 \\
 &= 9 \times 10^{3+6} \\
 &= 9 \times 10^9
 \end{aligned}$$

**4. B****Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations**Strategic Advice:** Choose the best strategy to answer the question. You could start by cross-multiplying

to get rid of the denominators, but simplifying the numerators first will make the calculations easier.

**Getting to the Answer:**

$$\begin{aligned}
 \frac{3(k-1)+5}{2} &= \frac{17-(8+k)}{4} \\
 \frac{3k-3+5}{2} &= \frac{17-8-k}{4} \\
 \frac{3k+2}{2} &= \frac{9-k}{4} \\
 4(3k+2) &= 2(9-k) \\
 12k+8 &= 18-2k \\
 14k &= 10 \\
 k &= \frac{10}{14} = \frac{5}{7}
 \end{aligned}$$

**5. D****Difficulty:** Medium**Category:** Passport to Advanced Math / Functions**Strategic Advice:** Whenever a quantity repeatedly increases or decreases by the same percentage (or fraction) over time, an exponential model can be used to represent the situation. Choice B is not an exponential equation, so you can eliminate it right away.**Getting to the Answer:** The amount of garbage is decreasing, so the scenario represents exponential decay and you can use the form  $y = a \times (1 - r)^t$ , where  $a$  is the initial amount,  $r$  is the rate of decay, and  $t$  is time in years. The initial amount is 1,800, the rate is 3%, or 0.03, and  $t$  is unknown, so the correct equation is  $y = 1,800 \times (1 - 0.03)^t$ , which simplifies to  $y = 1,800 \times 0.97^t$ .**6. B****Difficulty:** Medium**Category:** Passport to Advanced Math / Exponents**Strategic Advice:** When the denominators of rational expressions are the same, you can combine the numerators and keep the same denominator.

**Getting to the Answer:** The terms in the expression have the same denominator,  $x + 5$ , so their numerators can be subtracted. Simply combine like terms and keep the denominator the same. Don't forget to distribute the negative to both  $3x$  and  $-8$ .

$$\begin{aligned} \frac{6x+2}{x+5} - \frac{3x-8}{x+5} &= \frac{6x+2-(3x-8)}{x+5} \\ &= \frac{6x+2-3x-(-8)}{x+5} \\ &= \frac{6x-3x+2+8}{x+5} \\ &= \frac{3x+10}{x+5} \end{aligned}$$

7. C

**Difficulty:** Medium**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** The slope-intercept form of a line is  $y = mx + b$ . In this question, the graph passes through the origin, so  $b$  is 0.

**Getting to the Answer:** Because  $b$  is 0, the equation of this line in slope-intercept form is  $y = mx$ , which can be rewritten as  $\frac{y}{x} = m$ . Count the rise and the run from the origin,  $(0, 0)$ , to the next point,  $(3, 1)$ , to get a slope of  $m = \frac{1}{3}$ .

8. D

**Difficulty:** Medium**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** When multiplying polynomials, carefully multiply each term in the first factor by each term in the second factor. This question doesn't ask for the entire product, so check to make sure you answered the right question (the coefficient of  $x$ ).

**Getting to the Answer:** After performing the initial multiplication, look for the  $x$ -terms and add their coefficients. To save time, you do not need to simplify the other terms in the expression.

$$\begin{aligned} &(4x^2 + 7x + 1)(3x + 5) \\ &= 4x^2(3x + 5) + 7x(3x + 5) + 1(3x + 5) \\ &= 12x^3 + 20x^2 + 21x^2 + \underline{35x} + \underline{3x} + 5 \end{aligned}$$

The coefficient of  $x$  is  $35 + 3 = 38$ .

9. C

**Difficulty:** Medium**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Your only choice for this question is to compare each statement to the graph. Cross out false statements as you go. Stop when you find a true statement.

**Getting to the Answer:** A graph is *decreasing* when the slope is negative; it is *increasing* when the slope is positive. Eliminate A because there are some segments on the graph that have a positive slope. Eliminate B because the slope is negative, not positive, between 2009 and 2010. Choice (C) is correct because the slope is negative for each segment between 2004 and 2007 and also between 2009 and 2011.

10. A

**Difficulty:** Medium**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Don't answer this question too quickly. The shading is below the line, but that does not necessarily mean that the symbol in the equation will be the less than symbol ( $<$ ).

**Getting to the Answer:** Start by writing the equation of the dashed line shown in the graph in slope-intercept form. Then use the shading to determine the correct inequality symbol. The slope of the line shown in the graph is  $\frac{1}{4}$  and the  $y$ -intercept is  $-3$ , so the equation of the dashed line is  $y = \frac{1}{4}x - 3$ . The graph is shaded below the boundary line, so use the  $<$  symbol. When written in slope-intercept form, the inequality is  $y < \frac{1}{4}x - 3$ . The inequalities



in the answer choices are given in standard form ( $Ax + By = C$ ), so rewrite your answer in this form. Don't forget to reverse the inequality symbol if you multiply or divide by a negative number.

$$y < \frac{1}{4}x - 3$$

$$-\frac{1}{4}x + y < -3$$

$$\frac{1}{4}x - y > 3$$

11. C

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** When you're given only one equation but two variables, chances are that you can't actually solve the equation (unless one variable happens to cancel out), but rather that you are going to need to manipulate it to look like the desired expression (which in this question is  $\frac{b}{a}$ ).

**Getting to the Answer:** This type of question can't be planned out step-by-step—instead, start with basic algebraic manipulations and see where they take you. First, distribute the  $\frac{1}{2}$  on the left side of the equation to get  $2a + 5b = b$ . There are two terms that have a  $b$ , so subtract  $5b$  from both sides to get  $2a = -4b$ . You're hoping for plain  $b$  in the numerator, so divide both sides by  $-4$  to get  $\frac{2a}{-4} = b$ . Finally, divide both sides by  $a$  to move the  $a$  into a denominator position under  $b$ . The result is  $\frac{2}{-4} = \frac{b}{a}$ , which means the ratio  $\frac{b}{a}$  is  $-\frac{2}{4}$ , or  $-\frac{1}{2}$ .

12. D

**Difficulty:** Hard

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Graphically, a system of linear equations that has no solution indicates two parallel lines, or in other words, two lines that have the same slope. So, write each of the equations in slope-intercept form ( $y = mx + b$ ) and set their slopes ( $m$ ) equal to each other to solve for  $a$ . Before finding the slopes, multiply the top equation by 3 to make it easier to manipulate.

**Getting to the Answer:**

$$3\left(\frac{1}{3}x + \frac{2}{3}y = -8\right) \rightarrow x + 2y = -24 \rightarrow y = -\frac{1}{2}x - 12$$

$$ax + 6y = 15 \rightarrow 6y = -ax + 15 \rightarrow y = -\frac{a}{6}x + \frac{15}{6}$$

The slope of the first line is  $-\frac{1}{2}$  and the slope of the second line is  $-\frac{a}{6}$ .

$$-\frac{1}{2} = -\frac{a}{6}$$

$$-6(1) = -a(2)$$

$$-6 = -2a$$

$$3 = a$$

13. A

**Difficulty:** Hard

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Pay careful attention to units, particularly when a question involves rates. The \$3.00 for the first  $\frac{1}{4}$  mile is a flat fee. Before you write the inequality, you need to find the *per mile* rate for the remaining miles.

**Getting to the Answer:** The taxi charges \$3.00 for the first  $\frac{1}{4}$  mile, which is a flat fee, so write 3. The additional charge is \$0.25 per  $\frac{1}{8}$  mile, or 0.25 times  $8 = \$2.00$  per mile. The number of miles after the first  $\frac{1}{4}$  mile is  $m - \frac{1}{4}$ , so the cost of the trip, not including the first  $\frac{1}{4}$  mile is  $2\left(m - \frac{1}{4}\right)$ . This means the cost of the whole trip is  $3 + 2\left(m - \frac{1}{4}\right)$ . The clue

"no more than \$20" means that much or less, so use the symbol  $\leq$ . The inequality is  $3 + 2\left(m - \frac{1}{4}\right) \leq 20$ , which simplifies to  $2.5 + 2m \leq 20$ .

14. D

**Difficulty:** Hard

**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** Knowing how to write the equation of a circle will earn you points on Test Day. You'll also need to be able to algebraically expand that equation. Don't forget—when you square a binomial, you should write it as repeated multiplication and use FOIL.

**Getting to the Answer:** First, find the center and the radius of the circle: Each grid-line represents one unit on the graph, so the center is  $(0, 2)$ , and the radius is 6. Substitute these values into the equation for a circle,  $(x - h)^2 + (y - k)^2 = r^2$ , and then simplify until the equation looks like the one given in the question:

$$(x - 0)^2 + (y - 2)^2 = 6^2$$

$$x^2 + (y - 2)^2 = 36$$

$$x^2 + (y - 2)(y - 2) = 36$$

$$x^2 + y^2 - 4y + 4 = 36$$

$$x^2 + y^2 - 4y = 32$$

There is no  $x$  term, so  $a = 0$ . The coefficient of  $y$  is  $-4$  and  $c = 32$ , so  $ab + c = (0)(-4) + 32 = 32$ .

15. A

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** Quadratic equations can be written in several different forms, each of which reveals something special about the graph. The maximum value of a quadratic function is equal to the  $y$ -value of the vertex of its graph, so vertex form,  $y = a(x - h)^2 + k$ , reveals the maximum.

**Getting to the Answer:** The quadratic equation is given in standard form, so use the method of completing the square to rewrite the equation in vertex form. Then, read the value of  $k$  to find the maximum height of the projectile.

$$h = -16t^2 + 64t + 8$$

$$h = -16(t^2 - 4t + \_\_) + 8 - \_\_$$

$$h = -16(t^2 - 4t + 4) + 8 - (-16 \times 4)$$

$$h = -16(t - 2)^2 + 8 - (-64)$$

$$h = -16(t - 2)^2 + 72$$

The vertex is  $(2, 72)$ , so the maximum height is 72 feet.

16. 144

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** There is only one equation given and it has two variables. This means that you don't have enough information to solve for either variable. Instead, look for the relationship between the left side of the equation and the other expression that you are trying to find.

**Getting to the Answer:** Start by clearing the fractions by multiplying both sides of the original equation by 12. This yields the expression that you are looking for,  $9x + 10y$ , so no further work is required—just read the value on the right-hand side of the equation.

$$\frac{3}{4}x + \frac{5}{6}y = 12$$

$$12\left(\frac{3}{4}x + \frac{5}{6}y\right) = 12(12)$$

$$9x + 10y = 144$$

17. 150

**Difficulty:** Medium

**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** There are  $360^\circ$  in a circle. You need to figure out how many degrees each minute on the face of a clock represents.

**Getting to the Answer:** There are 60 minutes on the face of an analogue clock. This means that each minute represents  $360 \div 60 = 6$  degrees. Between 3:20 and 3:45, 25 minutes go by, so the minute hand rotates  $25 \times 6 = 150$  degrees.

**18. 4**

**Difficulty:** Medium

**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** Start by marking up the figure with the information you're given. You know the length of  $EB$ , which is 3. You also know the triangle is equilateral, which means all three sides are congruent and all three angles are  $60^\circ$ . This means angles  $A$  and  $B$  are both  $60^\circ$ , which further means that triangles  $BEF$  and  $ADC$  are 30-60-90 triangles, and therefore similar by the AAA theorem.

**Getting to the Answer:** Remember, 30-60-90 triangles have side lengths in the ratio  $x : x\sqrt{3} : 2x$ , which means if  $EB$  is 3, then  $BF$  (the hypotenuse) is  $2(3) = 6$ . Now, because you know the ratio of  $BF$  to  $FC$ , you can find the length of  $FC$ :

$$\begin{aligned}\frac{3}{4} &= \frac{6}{FC} \\ 3(FC) &= 24 \\ FC &= 8\end{aligned}$$

Now you can find the length of each side of the original equilateral triangle:  $6 + 8 = 14$ , which is the length of  $AC$ , the hypotenuse of triangle  $ADC$ . This means side  $AD$ , being the shorter leg of triangle  $ADC$ , is  $14 \div 2 = 7$ . You now have enough information to find the length of  $DE$ , which is  $AB - (AD + EB) = 14 - (7 + 3) = 4$ .

**19. 8**

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Read the question carefully to determine what part of the expression you need to simplify and what part you don't. Sometimes, you can work a simpler question and still arrive at the correct answer.

**Getting to the Answer:** The question only asks for the exponent on  $x$ , so you do not have to simplify the coefficients. Rewrite the expression without the coefficients and simplify using the rules of exponents.

$$\begin{aligned}\frac{3x^{\frac{3}{2}}(16x^2)^3}{8x^{-\frac{1}{2}}} &\rightarrow \frac{x^{\frac{3}{2}}(x^2)^3}{x^{-\frac{1}{2}}} \\ &= x^{\frac{3}{2} - \left(-\frac{1}{2}\right)} \cdot x^{2 \times 3} \\ &= x^{\frac{3}{2} + \frac{1}{2}} \cdot x^6 \\ &= x^2 \cdot x^6 \\ &= x^8\end{aligned}$$

The exponent on  $x$  is 8.

**20. 3/25 or .12**

**Difficulty:** Hard

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** When a question involving a function provides one or more ordered pairs, substitute them into the function to see what information you can glean.

**Getting to the Answer:** Start with  $x = 0$  because doing so often results in the elimination of a variable.

$$\begin{aligned}f(x) &= a \cdot b^x \\ f(0) &= a \cdot b^0 \\ 3 &= a \cdot b^0 \\ 3 &= a \cdot 1 \\ 3 &= a\end{aligned}$$

Now you know the value of  $a$ , so the equation looks like  $f(x) = 3 \cdot b^x$ . Substitute the second pair of values into the new equation:

$$\begin{aligned} f(x) &= 3 \cdot b^x \\ f(1) &= 3 \cdot b^1 \\ 15 &= 3 \cdot b^1 \\ 15 &= 3b \\ 5 &= b \end{aligned}$$

The exponential function is  $f(x) = 3 \cdot 5^x$ . The final step is to find the value being asked for,  $f(-2)$ . Substitute  $-2$  for  $x$  and simplify:

$$f(-2) = 3 \cdot 5^{-2} = \frac{3}{5^2} = \frac{3}{25}$$

Grid this in as  $3/25$  or  $.12$ .

## MATH TEST: CALCULATOR SECTION

1. B

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** A *flat* fee does not depend on the variable and is, therefore, a constant. A unit rate, however, is always multiplied by the independent variable.

**Getting to the Answer:** The total cost consists of a flat installation fee and a price per square foot. The installation fee is a one-time fee that does not depend on the number of feet ordered and therefore should not be multiplied by  $f$ . This means that 199 is the installation fee. The other expression in the equation,  $3.29f$ , represents the cost per square foot (the unit price) times the number of feet,  $f$ . Hence, 3.29 must represent the cost of one square foot of carpet.

2. B

**Difficulty:** Easy

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** Quickly read each answer choice. Cross out false statements as you go. Stop when you arrive at a true statement.

**Getting to the Answer:** There is no long “tail” of data on either side, so the shape is not skewed and you can eliminate A. The shape of the data *is* symmetric because the data is fairly evenly spread out, with about half of the ages above and half below the median. When the shape of a data set is symmetric, the mean is approximately equal to the median, so (B) is correct. Don’t let D fool you—the *median* is 55, not the *mean*.

3. A

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Choose the best strategy to answer the question. If you distribute the  $\frac{1}{3}$ , it creates messy numbers. Instead, clear the fraction by multiplying both sides of the equation by 3. Then use inverse operations to solve for  $x$ .

**Getting to the Answer:**

$$\begin{aligned} \frac{1}{3}(5x - 8) &= 3x + 4 \\ 5x - 8 &= 3(3x + 4) \\ 5x - 8 &= 9x + 12 \\ -4x &= 20 \\ x &= -5 \end{aligned}$$

4. A

**Difficulty:** Easy

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** Quadratic equations can be written in several different forms, each of which reveals something special about the graph. For example, factored form reveals the solutions, or  $x$ -intercepts, of the graph, while standard form reveals the  $y$ -intercept.

**Getting to the Answer:** The minimum value of a quadratic function is equal to the  $y$ -value of the vertex of its graph, so vertex form,  $y = a(x - h)^2 + k$ , reveals the minimum without doing any additional work. Choice (A) is the only equation written in this form and therefore must be correct. The minimum value of this function is  $-\frac{3}{2}$ .

**5. D**

**Difficulty:** Easy

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Organize information as you read the question; the total cost includes the per-pound rate, the cost of the basket, and the 6% tax on the entire purchase.

**Getting to the Answer:** If a customer buys  $p$  pounds of apples, the total cost is the per-pound rate, \$1.97, multiplied by the number of pounds,  $p$ , plus the \$3.00 fee for the basket, or  $1.97p + 3$ . This expression represents the untaxed amount of the purchase. To calculate the amount that includes the 6% tax, multiply the untaxed amount by 1.06. So the equation is  $c = 1.06(1.97p + 3)$ .

**6. C**

**Difficulty:** Easy

**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** The intersection (overlap) of the two shaded regions is the solution to the system of inequalities.

**Getting to the Answer:** The point (4, 1) lies within the intersection of the two shaded regions, so it is a solution to the system shown in the figure. None of the other points lie within the intersection.

**7. C**

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Check that you answered the right question. Make sure your answer satisfies all of the guidelines given in the bulleted list as well as the criteria set forth in the question itself (includes as many lots as possible).

**Getting to the Answer:** Start with the smallest possible lot size, 3,000 square feet. The next lot must be at least 30% larger, so multiply by 1.3 to get 3,900 square feet. Then, round up to the next thousand (which is not necessarily the nearest thousand) to meet the tax assessment requirement. You must always round up because rounding down would make the subsequent lot size less than 30% larger than the one before it. Continue this process until you reach the maximum square footage allowed, 15,000 square feet.

$$3,000 \times 1.3 = 3,900 \rightarrow 4,000$$

$$4,000 \times 1.3 = 5,200 \rightarrow 6,000$$

$$6,000 \times 1.3 = 7,800 \rightarrow 8,000$$

$$8,000 \times 1.3 = 10,400 \rightarrow 11,000$$

$$11,000 \times 1.3 = 14,300 \rightarrow 15,000$$

**8. D**

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Functions

**Strategic Advice:** Determine whether the change in the amount of pollution is a common difference (linear function) or a common ratio (exponential function), or if it changes direction (quadratic or polynomial function).

**Getting to the Answer:** Each year, the amount of pollution should be  $100 - 8 = 92\%$  of the year before. You can write 92% as  $\frac{92}{100}$ , which represents

a common ratio from one year to the next. This means that the best model is an exponential function of the form  $y = a \cdot (0.92)^x$ .

9. A

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** Don't spend too much time reading the scientific explanation of the equation. Focus on the question at the very end—it's just asking you to solve the equation for  $r$ , or in other words to get  $r$  on one side of the equation by itself.

**Getting to the Answer:** Solve for  $r$  using inverse operations. First, square both sides of the equation to remove the radical. Then, multiply both sides by  $r$  to get the  $r$  out of the denominator. Finally, divide both sides by  $v^2$ .

$$\begin{aligned}v &= \sqrt{\frac{2Gm}{r}} \\v^2 &= \frac{2Gm}{r} \\v^2 r &= 2Gm \\r &= \frac{2Gm}{v^2}\end{aligned}$$

10. D

**Difficulty:** Medium

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** One equation should represent the total *number* of rentals, while the other equation represents the *cost* of the rentals.

**Getting to the Answer:** The number of DVDs plus the number of Blu-rays equals the total number of rentals, 209. Therefore, one equation is  $d + b = 209$ . This means you can eliminate choices B and C. Now write the cost equation: cost per DVD times number of DVDs ( $2d$ ) plus cost per Blu-ray times number of Blu-rays ( $3.5b$ ) equals the total amount collected

(562). The cost equation is  $2d + 3.5b = 562$ . Don't let A fool you. The question says nothing about the cost *per hour*, so there is no reason to divide the cost by 4. Choice (D) is correct.

11. B

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Break the question into short steps. Step 1: Find the number of female senators. Step 2: Use that number to find the number of female Republican senators. Step 3: Find the total number of Republican senators.

**Getting to the Answer:** Each of the 50 states gets 2 voting members in the Senate, so there are  $50 \times 2 = 100$  senators. The ratio of males to females in the 113th Congress was 4:1, so 4 parts male plus 1 part female equals a total of 100 senators. Write this as  $4x + x = 100$ , where  $x$  represents one part and therefore the number of females. Next, simplify and solve the equation to find that  $x = 20$  female senators. To find the number of female senators that were Republican, multiply 20% (or 0.20) times 20 to get 4. Finally, add to get 45 male plus 4 female = 49 Republican senators in the 113th Congress.

12. C

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Find the percent increase using this formula: amount of change divided by original amount. Then apply the same percent increase to the amount for 2012.

**Getting to the Answer:** The amount of increase is  $29,400 - 18,750 = 10,650$ , so the percent increase is  $10,650 \div 18,750 = 0.568 = 56.8\%$  over 8 years. If the total percent increase over the next 8 years is the same, the average student who borrowed money

will have loans totaling  $29,400 \times 1.568 = 46,099.20$ , or about \$46,100.

**13. D**

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** The key to answering this question is determining how many beanbags go into each size basket. If there are 10 beanbags total and  $b$  go into the larger basket, the rest, or  $10 - b$ , must go into the smaller basket.

**Getting to the Answer:** Write the expression in words first: points per large basket (3) times number of beanbags in large basket ( $b$ ), plus points per small basket (7) times number of beanbags in small basket ( $10 - b$ ). Now, translate the words to numbers, variables, and operations:  $3b + 7(10 - b)$ . This is not one of the answer choices, so simplify the expression by distributing the 7 and then combining like terms:  $3b + 7(10 - b) = 3b + 70 - 7b = 70 - 4b$ .

**14. D**

**Difficulty:** Easy

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** You do not need to use all of the information presented in the table to find the answer. Read the question carefully to make sure you use only what you do need.

**Getting to the Answer:** To calculate the percentage of the voters in each district who had no opinion on fracking, divide the number of voters in *that* district who had no opinion by the total number of voters in *that* district. Choice (D) is correct because  $3,205 \div 63,539 \approx 0.05 = 5\%$ , which is a lower percentage than in the other three districts that were polled (District A = 8%; District B = 7.6%; District C = 6%).

**15. A**

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** Scan the answer choices quickly to narrow down the amount of information in the table that you need to analyze. Each choice makes a statement about people from District C who support a ban on fracking that can be expected to vote in the next election.

**Getting to the Answer:** To extrapolate from the follow-up survey sample, multiply the fraction of people from the follow-up survey who plan to vote in the upcoming election  $\left(\frac{218}{500}\right)$  by the number of people in District C who support a ban on fracking (43,228) to get 18,847.408, or approximately 19,000 people.

**16. B**

**Difficulty:** Medium

**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Solve the system of equations using substitution. Then, check that you answered the right question (find the sum of  $x$  and  $y$ ).

**Getting to the Answer:** First, solve the second equation for  $x$  to get  $x = 3y - 11$ , and then substitute this equation into the first equation to find  $y$ :

$$\begin{aligned} 2x + 4y &= 13 \\ 2(3y - 11) + 4y &= 13 \\ 6y - 22 + 4y &= 13 \\ 10y - 22 &= 13 \\ 10y &= 35 \\ y &= \frac{7}{2} \end{aligned}$$

Now, substitute the result into  $x = 3y - 11$  and simplify to find  $x$ :

$$\begin{aligned} x &= 3\left(\frac{7}{2}\right) - 11 \\ &= \frac{21}{2} - 11 \\ &= -\frac{1}{2} \end{aligned}$$

The question asks for the sum, so add  $x$  and  $y$  to get  $-\frac{1}{2} + \frac{7}{2} = \frac{6}{2} = 3$ .

**17. C**

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** The keyword in the answer choices is “consistently,” which relates to how spread out a player’s scores are. Standard deviation, not mean, is a measure of spread, so you can eliminate choice A right away.

**Getting to the Answer:** A lower standard deviation indicates scores that are less spread out and therefore more consistent. Likewise, a higher standard deviation indicates scores that are more spread out and therefore less consistent. Notice the opposite nature of this relationship: lower standard deviation = more consistent; higher standard deviation = less consistent. Choice (C) is correct because the standard deviation of Mae’s scores is the lowest, which means she bowled the most consistently.

**18. B**

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** Notice the structure of the equation. The expression on the left side of the equation is the square of a quantity, so start by taking the square root of both sides.

**Getting to the Answer:** After taking the square roots, solve the resulting equations. Remember,  $4^2 = 16$  and  $(-4)^2 = 16$ , so there will be two equations to solve.

$$\begin{aligned} (x+3)^2 &= 16 \\ \sqrt{(x+3)^2} &= \sqrt{16} \\ x+3 &= \pm 4 \\ x+3 &= 4 \rightarrow x=1 \\ x+3 &= -4 \rightarrow x=-7 \end{aligned}$$

**19. C**

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Pay careful attention to the units. You need to convert all of the dimensions to inches, and then set up and solve a proportion.

**Getting to the Answer:** The real statue’s height is  $305 \times 12 = 3,660 + 6 = 3,666$  inches; the length of the nose on the real statue is  $4 \times 12 = 48 + 6 = 54$  inches; the height of the model statue is 26 inches; the length of the nose on the model is unknown.

$$\begin{aligned} \frac{3,666}{54} &= \frac{26}{x} \\ 3,666x &= 26(54) \\ 3,666x &= 1,404 \\ x &= \frac{1,404}{3,666} = \frac{18}{47} \end{aligned}$$

**20. B**

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** When evaluating a function, substitute the value inside the parentheses for  $x$  in the equation.



**Getting to the Answer:** Evaluate the function at  $x = 6$  and at  $x = 2$ , and then subtract the second output from the first. Note that this is not the same as first subtracting  $6 - 2$  and then evaluating the function at  $x = 4$ .

$$f(6) = 3(6) + 5 = 18 + 5 = 23$$

$$f(2) = 3(2) + 5 = 6 + 5 = 11$$

$$f(6) - f(2) = 23 - 11 = 12$$

21. A

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** Examine the graph, paying careful attention to units and labels. Here, the years increase by 2 for each grid-line and the number of owls by 25.

**Getting to the Answer:** The average change per year is the same as the slope of the line of best fit. Find the slope of the line of best fit using the slope formula,  $m = \frac{y_2 - y_1}{x_2 - x_1}$ , and any two points that lie on

(or very close to) the line. Using the two endpoints of the data, (1994, 1,200) and (2014, 700), the average change per year is  $\frac{700 - 1,200}{2014 - 1994} = \frac{-500}{20} = -25$ .

Pay careful attention to the sign of the answer—the number of owls is decreasing, so the rate of change is negative.

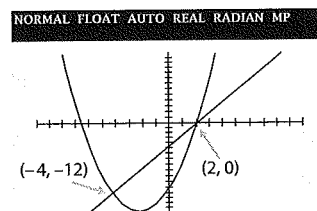
22. D

**Difficulty:** Medium

**Category:** Passport to Advanced Math / Quadratics

**Strategic Advice:** The solution to a system of equations is the point(s) where their graphs intersect. You could solve this question algebraically, one system at a time, but this is not time efficient. Instead, graph each pair of equations in your graphing calculator and look for the graphs that intersect at  $x = -4$  and  $x = 2$ .

**Getting to the Answer:** The graphs of the equations in A and B don't intersect at all, so you can eliminate them right away. The graphs in C intersect, but both points of intersection have a positive  $x$ -coordinate. This means (D) must be correct. The graph looks like:



23. C

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** Read the question, identifying parts of the graphic you need—the question asks about litters of 7 or more pups, so you'll only use the heights of the bars for 7, 8, and 9 pups.

**Getting to the Answer:** Start by finding the percent of the mice in the study that had a litter of 7 or more pups. Of the 200 mice in the sample,  $25 + 14 + 5 = 44$  had a litter of 7 or more pups. This is  $\frac{44}{200} = \frac{22}{100} = 22\%$  of the mice in the study. Given the same general conditions (such as living in the same geographic region), you would expect approximately the same results, so multiply the number of female mice in the whole population by the percent you found:  $35,000 \times 0.22 = 7,700$ .

24. C

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** You'll need to interpret the information given in the question to write two ordered pairs. Then you can use the ordered pairs to find the slope and the  $y$ -intercept of the linear model.

**Getting to the Answer:** In an ordered pair, the independent variable is always written first. Here, the heart rate depends on the amount of exercise, so the ordered pairs should be written in the form (time, heart rate). They are (8, 90) and (20, 117). Use these points in the slope formula,  $m = \frac{y_2 - y_1}{x_2 - x_1}$ , to

find that  $m = \frac{117 - 90}{20 - 8} = \frac{27}{12} = 2.25$ . Then, substitute the slope (2.25) and either of the points into slope-intercept form and simply to find the y-intercept:

$$90 = 2.25(8) + b$$

$$90 = 18 + b$$

$$72 = b$$

Finally, write the equation using the slope and the y-intercept that you found to get  $r = 2.25t + 72$ . Note that the only choice with a slope of 2.25 is (C), so you could have eliminated the other three choices before finding the y-intercept and saved yourself a bit of time.

**25. A**

**Difficulty:** Medium

**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** The formula for finding the area of a trapezoid is  $A = \frac{1}{2}h(b_1 + b_2)$ . This particular formula is not given on the formula page; memorizing it prior to Test Day will save you a bit of time (rather than having to find the sum of the areas of the triangles and the rectangle that make up the trapezoid).

**Getting to the Answer:** You could pick numbers to represent the lengths of the bases and height, and then find the area of the trapezoid before and after the indicated changes. Or, you might happen to notice that reducing the height by 75% means the new height is  $\frac{1}{4}$  of the original height, which is likely to cancel nicely with the 4 that the bases are being multiplied by. Using the second strategy, the

formula for the area of the new trapezoid becomes

$A = \left(\frac{1}{2}\right)\left(\frac{1}{4}h\right)(4b_1 + 4b_2)$ . If you factor 4 out of the bases, you can cancel it with the 4 in the denominator of the new height:  $A = \left(\frac{1}{2}\right)\left(\frac{1}{4}h\right)4(b_1 + b_2)$ . The

resulting equation is  $A = \frac{1}{2}h(b_1 + b_2)$ , the same as the original equation, which means the area has not changed, and therefore the percent increase is 0%.

**26. C**

**Difficulty:** Medium

**Category:** Heart of Algebra / Linear Equations

**Strategic Advice:** Pay careful attention to what the question tells you about the variables. The x-value is the number of payments already made, and the y-value is the amount of debt remaining (not how much has been paid).

**Getting to the Answer:** If a solution is (21, 560), the x-value is 21, which means Chantal has made 21 payments already. The y-value is 560, which means \$560 is the amount of debt *left to be paid*, making (C) correct.

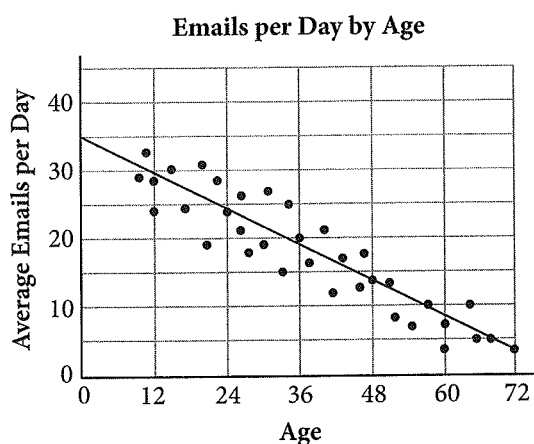
**27. D**

**Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Scatterplots

**Strategic Advice:** A line that “represents the trend of the data” is another way of saying line of best fit.

**Getting to the Answer:** The trend of the data is clearly linear because the path of the dots does not turn around or curve, so draw a line of best fit on the graph. Remember, about half of the points should be above the line and half below.



If you draw your line of best fit all the way to the  $y$ -axis, you'll save yourself a step by simply looking at the scatterplot to find the  $y$ -intercept. For this graph, it's about 35. This means you can eliminate choices B and C. Next, find the approximate slope using two points that lie on (or very close to) the line. You can use the  $y$ -intercept,  $(0, 35)$ , as one of them to save time and estimate the second, such as  $(72, 4)$ . Use the slope formula to find the slope:

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 35}{72 - 0} = \frac{-31}{72} \approx -0.43$$

The equation that has the closest slope and  $y$ -intercept is (D). (Note that if you choose different points, your line may have a slightly different slope or  $y$ -intercept, but the answer choices will be far enough apart that you should be able to determine which is the *best fit* to the data.)

**28. B****Difficulty:** Hard**Category:** Passport to Advanced Math / Functions

**Strategic Advice:** Transformations that are grouped with the  $x$  in a function shift the graph horizontally and, therefore, affect the  $x$ -coordinates of points on the graph. Transformations that are not grouped with the  $x$  shift the graph vertically and, therefore, affect the  $y$ -coordinates of points on the graph.

Remember, horizontal shifts are always backward of what they look like.

**Getting to the Answer:** Start with  $(x + 3)$ . This shifts the graph left 3, so subtract 3 from the  $x$ -coordinate of the given point:  $(5, 1) \rightarrow (5 - 3, 1) = (2, 1)$ . Next, apply the negative in front of  $f$ , which is not grouped with the  $x$ , so it makes the  $y$ -coordinate negative:  $(2, 1) \rightarrow (2, -1)$ . Finally,  $-2$  is not grouped with  $x$ , so subtract 2 from the  $y$ -coordinate:  $(2, -1 - 2) \rightarrow (2, -3)$ .

**29. C****Difficulty:** Hard

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Draw a chart or diagram detailing the various price reductions for each 30 days.

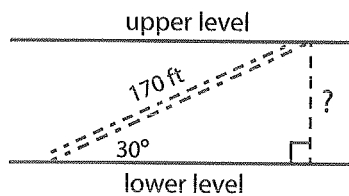
**Getting to the Answer:**

Date	% of Most Recent Price	Resulting Price
Jan. 15	$100 - 25\% = 75\%$	$\$1,500 \times 0.75 = \$1,125$
Feb. 15	$100 - 10\% = 90\%$	$\$1,125 \times 0.9 = \$1,012.50$
Mar. 15	$100 - 10\% = 90\%$	$\$1,012.50 \times 0.9 = \$911.25$

You can stop here because the refrigerator was sold on April 2, which is not 30 days after March 15. The final selling price was \$911.25.

**30. A****Difficulty:** Hard**Category:** Additional Topics in Math / Geometry

**Strategic Advice:** Organize information as you read the question. Here, you'll definitely want to draw and label a sketch.

**Getting to the Answer:**

The lower level, the vertical distance between levels, and the diagonal elevator track form a 30-60-90 triangle, where the elevator track is the hypotenuse. The vertical distance is opposite the  $30^\circ$  angle so it is the shortest leg. The rules for 30-60-90 triangles state that the shortest leg is half the length of the hypotenuse, so the vertical distance between levels is approximately  $170 \div 2 = 85$  feet.

**31. 22****Difficulty:** Medium**Category:** Heart of Algebra / Inequalities

**Strategic Advice:** Choose the best strategy to answer the question. Here, the fractions make it look more complicated than it really is, so start by clearing the fractions by multiplying everything by 20.

**Getting to the Answer:** You don't need to separate this compound inequality into pieces. Just remember, whatever you do to one piece, you must do to all three pieces. Don't forget to flip the inequality symbols if you multiply or divide by a negative number.

$$\begin{aligned} 20\left(-\frac{3}{2}\right) &< 20\left(3 - \frac{a}{5}\right) < 20\left(-\frac{1}{4}\right) \\ -30 &< 60 - 4a < -5 \\ -30 - 60 &< 60 - 60 - 4a < -5 - 60 \\ -90 &< -4a < -65 \\ \frac{-90}{-4} &> \frac{-4a}{-4} > \frac{-65}{-4} \\ 22.5 &> a > 16.25 \\ 16.25 &< a < 22.5 \end{aligned}$$

The question asks for the maximum possible whole number value of  $a$ , so the correct answer is 22.

**32. 1/6 or .166 or .167****Difficulty:** Easy**Category:** Problem Solving and Data Analysis / Statistics and Probability

**Strategic Advice:** This question requires concentration, but no complicated calculations. First, you need to identify the rows that contain information about the seating on the 777s, which are the bottom two rows.

**Getting to the Answer:** To find the probability that the seat is a Business Class seat, find the total number of seats in that category (in only the bottom two rows), and divide by the total number of seats on the planes (in only the bottom two rows):

$$\begin{aligned} P(\text{Business Class}) &= \frac{37 + 52}{194 + 37 + 16 + 227 + 52 + 8} \\ &= \frac{89}{534} = \frac{1}{6} = 0.\overline{16} \end{aligned}$$

Grid in your answer as 1/6 or .166 or .167.

**33. 440****Difficulty:** Medium**Category:** Heart of Algebra / Systems of Linear Equations

**Strategic Advice:** Translate from English into math to write a system of equations with  $t$  = the cost of the tankless heater in dollars, and  $c$  = the cost of the conventional heater in dollars.

**Getting to the Answer:** First, a tankless heater ( $t$ ) costs \$160 more (+160) than twice as much ( $2c$ ) as the conventional one, or  $t = 2c + 160$ . Together, a tankless heater ( $t$ ) and a conventional heater ( $c$ ) cost \$1,000, or  $t + c = 1,000$ . The system is:

$$\begin{cases} t = 2c + 160 \\ t + c = 1,000 \end{cases}$$

The top equation is already solved for  $t$ , so substitute  $2c + 160$  into the second equation for  $t$  and solve for  $c$ :

$$\begin{aligned}2c + 160 + c &= 1,000 \\3c + 160 &= 1,000 \\3c &= 840 \\c &= 280\end{aligned}$$

Be careful—that's not the answer! The conventional hot water heater costs \$280, so the tankless heater costs  $2(280) + 160 = \$720$ . This means the tankless heater costs  $\$720 - \$280 = \$440$  more than the conventional heater.

### 34. 25

**Difficulty:** Medium

**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** The key to answering this question is reading carefully—the word “exactly” is very important because it tells you that there cannot be a portion of a patient, so you are looking for the smallest whole number of which 48% is also a whole number.

**Getting to the Answer:** Every percent can be written as a number over 100 (because *per cent* means *per hundred*), so start by writing 48% as a fraction and reducing it:  $\frac{48}{100} = \frac{12}{25}$ . The denominator of this

fraction (25) gives the least possible number of patients who could have participated in the trial because it is the first number that will cancel when multiplied by the fraction.

### 35. 9984

**Difficulty:** Hard

**Category:** Additional Topics in Math / Geometry

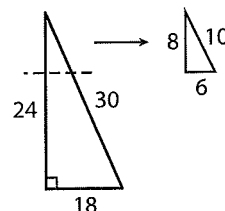
**Strategic Advice:** Don't be too quick to answer a question like this. You can't simply find two-thirds of the volume of the pyramid because the top is considerably smaller than the bottom. Instead, you'll

need to find the volume of the whole pyramid and subtract the volume of the top piece that is being discarded.

**Getting to the Answer:** The figure shows a right triangle inside the pyramid. The bottom leg is given as 18 and the slant height, or hypotenuse of the triangle, is given as 30. You might recognize this as a multiple of the Pythagorean triplet, 3-4-5, which is in this case 18-24-30. This means the height of the original pyramid is 24. You now have enough information to find the volume of the original pyramid.

$$\begin{aligned}V &= \frac{1}{3}lwh \\V &= \frac{1}{3}(36)(36)(24) \\V &= \frac{1}{3}(31,104) \\V &= 10,368\end{aligned}$$

To determine the dimensions of the top piece that is cut off, use similar triangles.



One-third of the original height is  $24 \div 3 = 8$ , resulting in a 6-8-10 triangle, making the length of the smaller leg 6, which means the length of the whole cutoff pyramid is  $6 \times 2 = 12$ . Substitute this into the formula for volume again.

$$\begin{aligned}V &= \frac{1}{3}lwh \\V &= \frac{1}{3}(12)(12)(8) \\V &= \frac{1}{3}(1,152) \\V &= 384\end{aligned}$$

Thus, the volume of the frustum is  $10,368 - 384 = 9,984$  cubic meters.

36. 88

**Difficulty:** Hard**Category:** Passport to Advanced Math / Exponents

**Strategic Advice:** When you're asked to solve an equation that has two variables, the question usually gives you the value of one of the variables. Read carefully to see which variable is given and which one you're solving for.

**Getting to the Answer:** You are given the diameter (0.12), so substitute this value for  $d$  in the equation and then solve for the other variable,  $h$ . Before dealing with the radical, divide both sides of the equation by 0.015.

$$0.12 = 0.015 \times \sqrt{h - 24}$$

$$8 = \sqrt{h - 24}$$

$$8^2 = (\sqrt{h - 24})^2$$

$$64 = h - 24$$

$$88 = h$$

37. 252

**Difficulty:** Medium**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** Break the question into steps. First, find how long it took Daniel to spray one lawn, and then use that amount to find how long it took him to spray all the lawns.

**Getting to the Answer:** According to the figure, he started the first house at 9:00 and the sixth house at 10:00, so it took him 1 hour, or 60 minutes, to spray 5 houses. This gives a unit rate of  $60 \div 5 = 12$  minutes per house. Count the houses in the figure—there are 21. Multiply the unit rate by the number of houses to get  $12 \times 21 = 252$  minutes to spray all the lawns.

38. 4

**Difficulty:** Hard**Category:** Problem Solving and Data Analysis / Rates, Ratios, Proportions, and Percentages

**Strategic Advice:** This part of the question contains several steps. Think about the units given in the question and what you need to convert so that you can get to the answer.

**Getting to the Answer:** The total acreage of all the lawns in the neighborhood is  $21 \times 0.2 = 4.2$  acres. This is equivalent to  $4.2 \times 43,560 = 182,952$  square feet. Each gallon of spray covers 2,500 square feet, so divide to find that Daniel needs  $182,952 \div 2,500 = 73.1808$  gallons to spray all the lawns. The spray rig holds 20 gallons, so Daniel will need to fill it 4 times. After he fills it the fourth time and finishes all the lawns, there will be some spray left over.

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