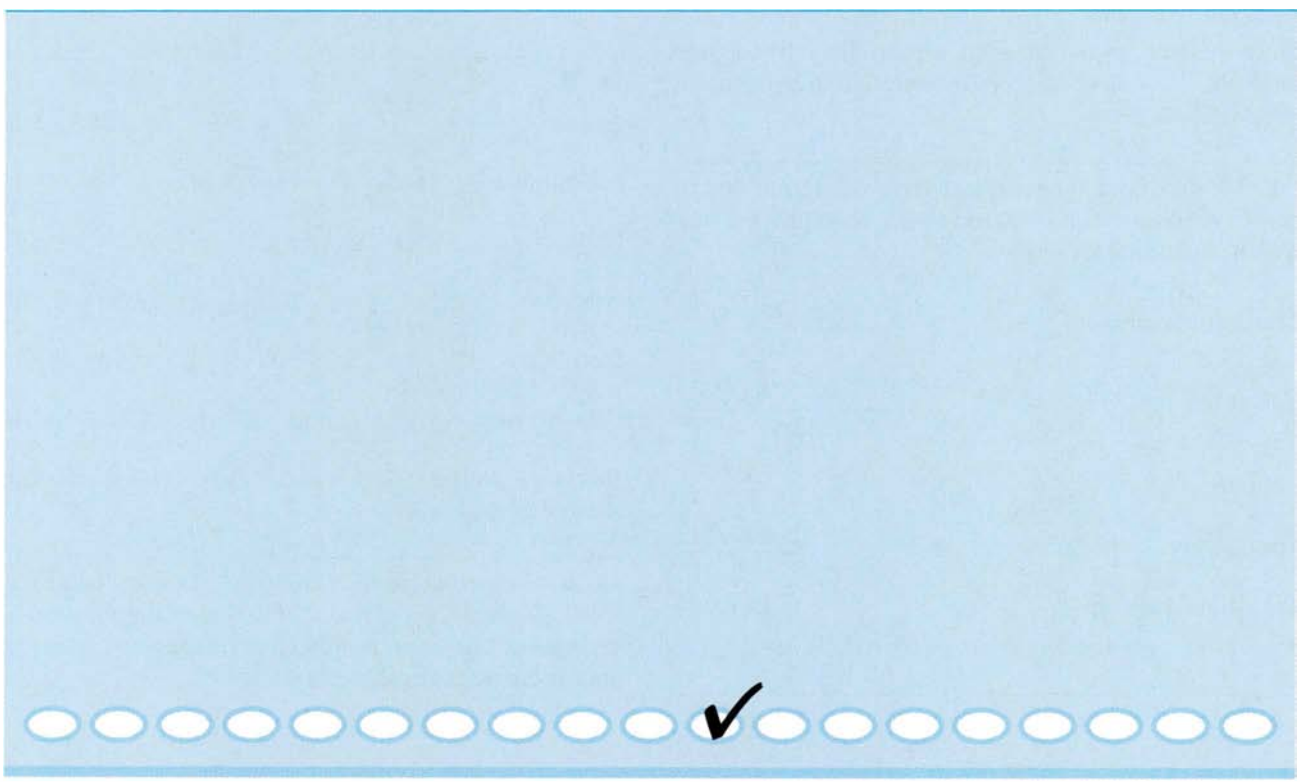
CHAPTER 11

PRACTICE TEST 1



3 3

Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

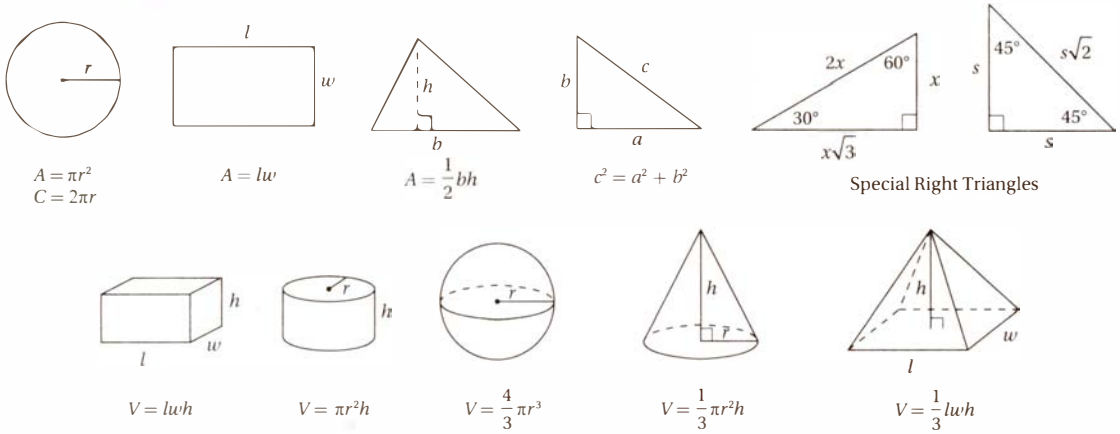
DIRECTIONS

For questions 1–15, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. **For questions 16–20,** solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 16 on how to enter your answers in the grid. You may use any available space in your test booklet for scratch work.

NOTES

1. The use of a calculator is NOT permitted.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the domain of a given function f is the set of all real numbers for which $f(x)$ is a real number.

REFERENCE



$A = \pi r^2$, $C = 2\pi r$ | $A = lw$ | $A = \frac{1}{2}bh$ | $c^2 = a^2 + b^2$ | 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 number of degrees of arc in a circle is 360.
The number of radians of arc in a circle is 2π.
The sum of the measures in degrees of the angles of a triangle is 180.

3

3

1

If $8x + 6 = 6m$, what is the value of $4x + 3$ in terms of m?

A) $2m - 3$

B) $2m$

C) $3m - 3$

D) $3m$

2

$$3x + 4y = 18$$

$$y = \frac{3}{2}x$$

Which of the following ordered pairs (x, y) is a solution of the system of equations above?

A) (2, 3)

B) (3, 2.25)

C) (4, 1.5)

D) (4, 6)

3

Which of the following is equivalent to $\frac{3x+4}{12}$?

A) $\frac{x+4}{4}$

B) $\frac{3x+1}{3}$

C) $\frac{x}{4}+\frac{1}{3}$

D) $\frac{x}{3}+\frac{1}{4}$

4

If $x - 3$ is a factor of the expression $x^2 + kx + 12$, what is the value of k?

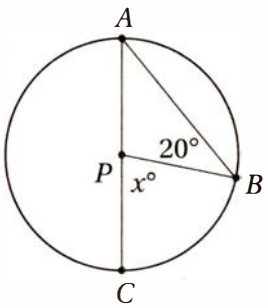
A) -7

B) -5

C) 5

D) 7

5



Note: Figure not drawn to scale.

In the figure above, P is the center of a circle and AC is its diameter. What is the value of x?

A) 60

B) 50

C) 40

D) 30

6

The nth term of a sequence is given by the expression $bn + 4$, where b is a positive constant. Which of the following is necessarily equal to b?

A) the value of the first term

B) the difference between the fourth term and the third term

C) the average (arithmetic mean) of the first three terms

D) the ratio of the second term to the first term

CONTINUE

3  3

7

If $m^3 = \sqrt{\sqrt{n}}$, where $n > 0$, what is the value of m in terms of n?

A) $n^{\frac{1}{12}}$

B) $n^{\frac{1}{7}}$

C) $n^{\frac{7}{12}}$

D) $n^{\frac{3}{4}}$

8

One bag of grass seed can cover 5,000 square feet of new lawn. If each bag costs p dollars, which of the following expressions gives the cost, in dollars, to cover a new rectangular lawn that measures a feet by b feet?

A) $\frac{5{,}000p}{ab}$

B) $\frac{abp}{5{,}000}$

C) $\frac{5{,}000ab}{p}$

D) $5{,}000abp$

9

If $\frac{5}{m} \leq \frac{2}{3}$, where $m > 0$, what is the least possible value of m?

A) 6.5

B) 7

C) 7.5

D) 8

10

If $f(x) = 3x + n$, where n is a constant, and $f(2) = 0$, then $f(n) =$

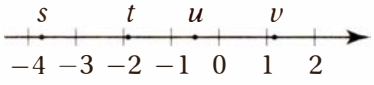
A) -24

B) -18

C) -12

D) 12

11



If s, t, u, and v are the coordinates of the indicated points on the number line above, which of the following is greatest?

A) $|s - v|$

B) $|s - t|$

C) $|s + v|$

D) $|u + v|$

12

How many solutions to the equation $4 \cos x = 1$ lie between $x = 0$ and $x = 3\pi$?

A) Two

B) Three

C) Four

D) Six

13

If $i = \sqrt{-1}$, which of the following is NOT equal to $i^3 + i$?

A) $(2i)^2 + 4$

B) $2 - 2i^4$

C) $2i^2 - 2$

D) $i^4 - 1$

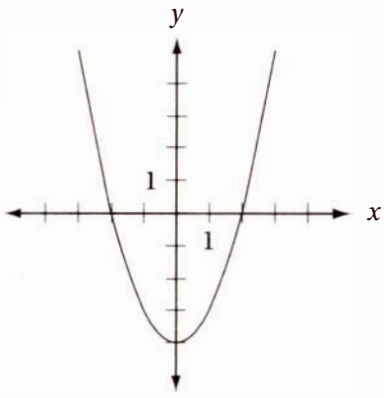
CONTINUE

3 3

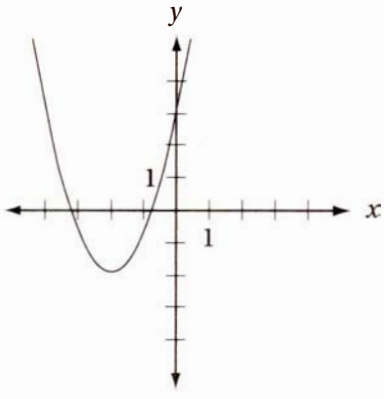
14

If $m > 1$, which of the following could be the graph of $y = -(x + m)^2 + m$ in the xy-plane?

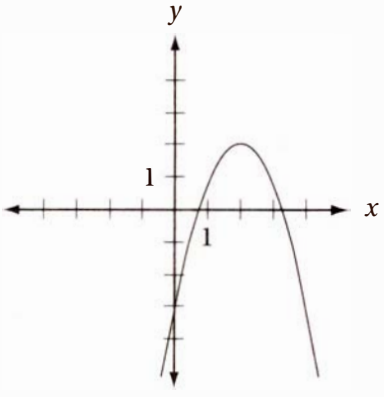
A)



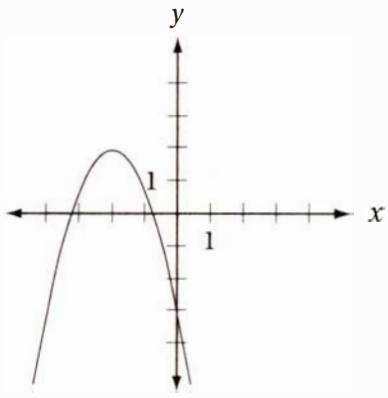
B)



C)



D)



15

$$x - 3y = -2$$
$$y = \frac{5}{x}$$

The values of x that satisfy the system of equations above also satisfy which of the following equations?

A) $(x - 5)(x + 3) = 0$

B) $(x - 3)(x + 5) = 0$

C) $(x - 2)(x - 5) = 0$

D) $(x + 2)(x + 5) = 0$

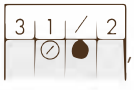
CONTINUE

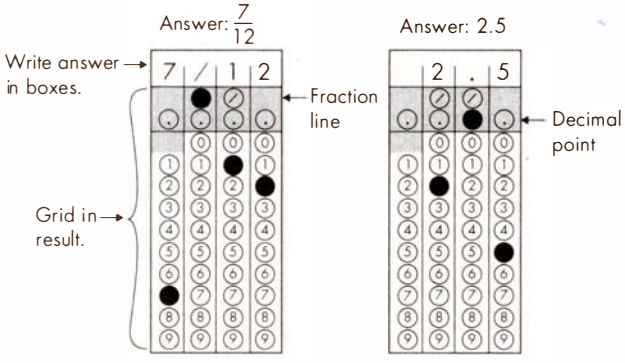
3 3

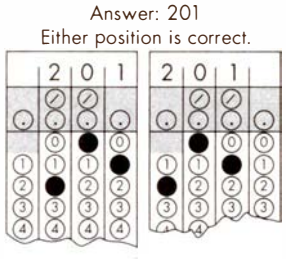
DIRECTIONS

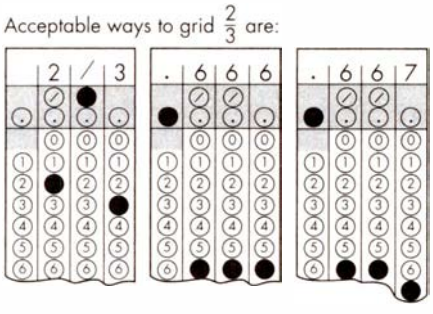
For questions 16–20, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

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  , 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.







CONTINUE

3  3

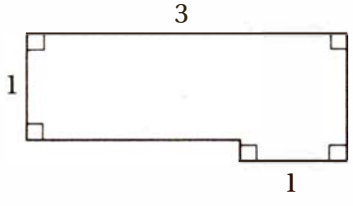
16

If $\frac{2}{3}a+\frac{1}{2}b=5$, and $b=4$, what is the value of a?

17

What is the smallest integer value of x such that $\frac{6}{x}+\frac{1}{2x}$ is less than 1?

18

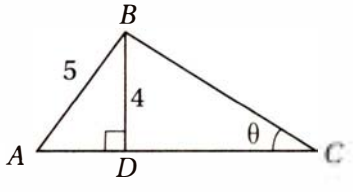


If the area of the figure above is $\frac{16}{5}$ square units, what is its perimeter?

19

What is one possible solution to the equation $\frac{6}{x+1}-\frac{3}{x-1}=\frac{1}{4}$?

20



In the figure above, triangle ABC has an area of 19. What is the value of $\tan\theta$?

STOP

If you finish before time is called, you may check your work on this section only. Do not turn to any other section of the test.

4 4

Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

DIRECTIONS

For questions 1–30, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. **For questions 31–38,** solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 31 on how to enter your answers in the grid. You may use any available space in your test booklet for scratch work.

NOTES

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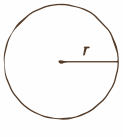
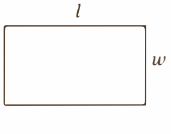
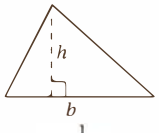
REFERENCE



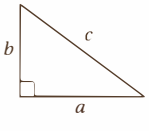
$A = \pi r^2$
$C = 2\pi r$



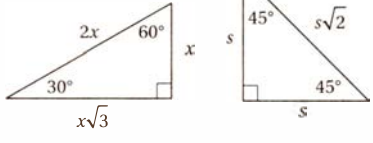
$A = lw$



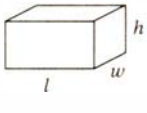
$A = \frac{1}{2}bh$



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



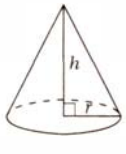
Special Right Triangles



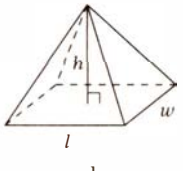
$V = lwh$

$V = \pi r^2 h$

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



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



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

The number of degrees of arc in a circle is 360.
The number of radians of arc in a circle is 2π.
The sum of the measures in degrees of the angles of a triangle is 180.

4  4

1

The fraction $\frac{n}{20}$ is equal to 0.8. What is the value of n?

A) 4
B) 8
C) 12
D) 16

2

The median of the numbers x, 10, and 12 is 12. Which of the following CANNOT be the value of x?

A) 8
B) 12
C) 16
D) 20

3

x	y
0	2
1	4
2	6
4	8

Based on the ordered pairs in the table above, which of the following could express a relationship between x and y?

A) $y = x + 4$
B) $y = 2x$
C) $y = 2x + 2$
D) $y = 2x + 4$

4

The average (arithmetic mean) of a set of 3 positive integers is m. If the number 24 is added to this set, what is the average (arithmetic mean) of the new set of numbers?

A) $\frac{3m + 24}{24}$
B) $\frac{3m + 24}{4}$
C) $m + 8$
D) $\frac{m + 24}{4}$

5

If $\frac{6}{x} + 3 = -1$, what is the value of x?

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

6

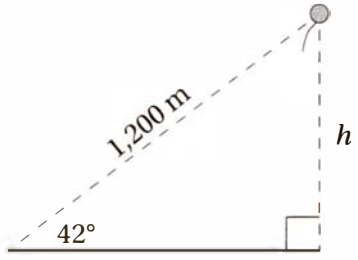
The Municipal Electric Company charges each household \$0.15 per kilowatt-hour of electricity plus a flat monthly service fee of \$16. If a household uses 30 kilowatt-hours of electricity and is charged \$$P$ in a given month, which of the following equations is true?

A) $0.15(30) + 16 = P$
B) $0.15P + 16 = 30$
C) $\frac{30}{0.15} + 16 = P$
D) $\frac{0.15}{P} + 16 = 30$

CONTINUE

4 4

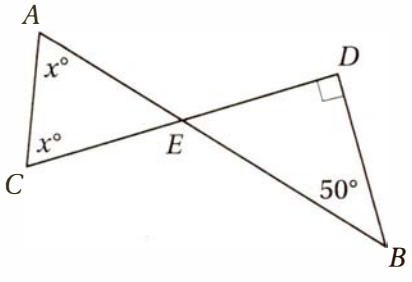
7



Alyssa determines that a floating balloon is 1,200 meters away from her at an angle of 42° from the ground, as in the figure above. What is the height, h, of the balloon from the ground? ($\sin 42° = 0.669$, $\cos 42° = 0.743$, $\tan 42° = 0.900$)

A) 802.8 meters
B) 891.6 meters
C) 1,080 meters
D) 1,793 meters

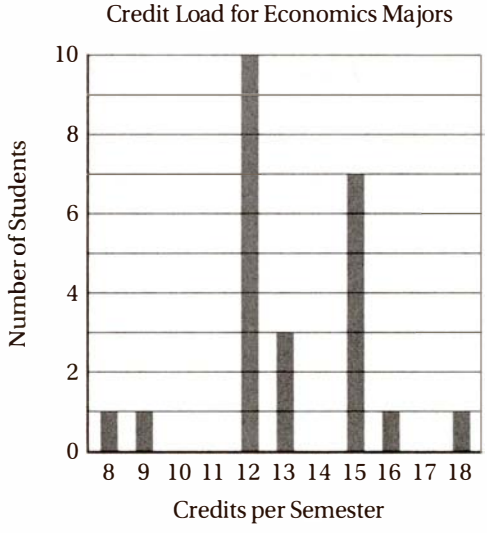
8



In the figure above, line segments $\overline{AB}$ and $\overline{CD}$ intersect at point E. What is the value of x?

A) 60°
B) 65°
C) 70°
D) 75°

Questions 9 and 10 are based on the graph below.



9

A university surveyed 24 economics majors and asked them how many credits they received the previous semester. The results are represented in the graph above. What percentage of these students received 15 or more credits that semester?

A) 29%
B) $33\frac{1}{3}\%$
C) $37\frac{1}{2}\%$
D) 54%

10

What is the median number of credits these students received the previous semester?

A) 10.5
B) 11.5
C) 12
D) 12.5

CONTINUE

4  4

11

If a and b are the coordinates of two points on the number line, then which of the following is equivalent to the statement that the absolute distance from a to b is greater than the absolute distance from -2 to 6?

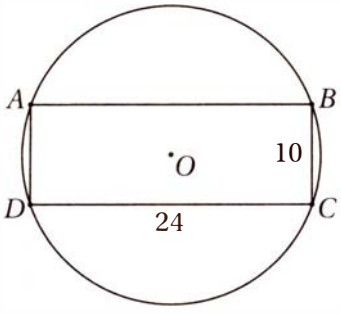
A) $|a| > -2$ and $|b| > 6$

B) $|a - b| > -8$

C) $|a + 2| > |b - 6|$

D) $|a - b| > 8$

12



Note: Figure not drawn to scale.

In the figure above, rectangle $ABCD$ is inscribed in the circle with center O. What is the area of the circle?

A) 26π

B) 121π

C) 144π

D) 169π

13

Everyone in Niko's class has a different birth date. If Niko is both the 8th oldest person and the 12th youngest person in his class, how many students are in Niko's class?

A) 18

B) 19

C) 20

D) 21

14

If $i = \sqrt{-1}$, which of the following is equivalent to $(2 - i)(3 - 2i)$?

A) $8 - 7i$

B) $6 + 2i$

C) $6 - 6i$

D) $4 - 7i$

15

If $f(x) = (x^2)^{-2b}$ and $f(3) = 3$, what is the value of b?

A) $-\frac{1}{2}$

B) $-\frac{1}{4}$

C) $\frac{1}{4}$

D) $\frac{1}{2}$

16

In a survey of 80 students, 55 students stated that they play a varsity sport, and 35 stated that they are taking at least one AP level course. Which of the following statements must be true?

A) At least 10 of these students are both playing a varsity sport and taking at least one AP level course.

B) Less than half of the students who play a varsity sport are also taking at least one AP level course.

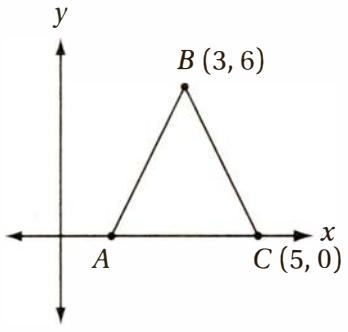
C) The number of students who do not play a varsity sport is greater than the number of students who do not take at least one AP level course.

D) At least one student who takes an AP level course does NOT play a varsity sport.

CONTINUE

4 4

17



Note: Figure not drawn to scale.

In the figure above, $AB = BC$. If $\overline{AB}$ has a slope of m and $\overline{BC}$ has a slope of n, what is the value of mn?

A) -9

B) $-\frac{1}{9}$

C) $\frac{1}{9}$

D) 9

18

The functions f, g, and h are defined by the equations $f(x) = x^2$, $g(x) = x$, and $h(x) = \sqrt{x}$. Which of the following must be true?

A) $h\left(\frac{1}{2}\right) < f\left(\frac{1}{2}\right) < g\left(\frac{1}{2}\right)$

B) $h\left(\frac{1}{2}\right) < g\left(\frac{1}{2}\right) < f\left(\frac{1}{2}\right)$

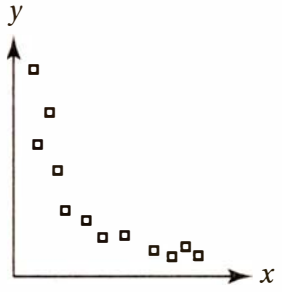
C) $g\left(\frac{1}{2}\right) < h\left(\frac{1}{2}\right) < f\left(\frac{1}{2}\right)$

D) $f\left(\frac{1}{2}\right) < g\left(\frac{1}{2}\right) < h\left(\frac{1}{2}\right)$

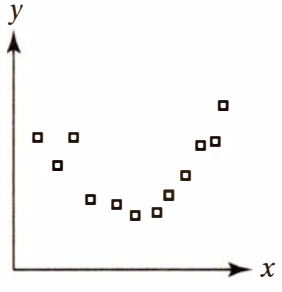
19

Which of the following scatterplots provides the strongest evidence in support of the hypothesis that y varies inversely as the square of x?

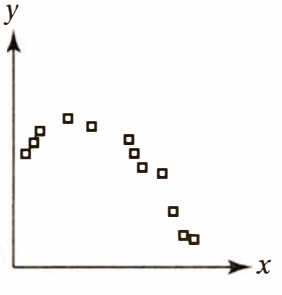
A)



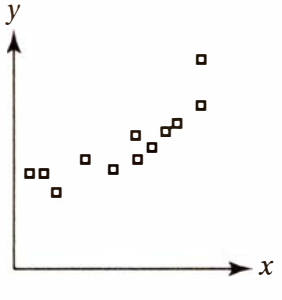
B)



C)



D)



4  4

20

The bird department of a pet store has 12 canaries, 30 finches, and 18 parrots. If the pet store purchased n more finches, then 80% of its birds would be finches. Which of the following equations must be true?

A) $\frac{1}{2}+n=\frac{4}{5}$

B) $\frac{30+n}{60}=\frac{4}{5}$

C) $\frac{30+n}{60+n}=\frac{4}{5}$

D) $\frac{n}{60+n}=\frac{4}{5}$

21

Let function $f(x)$ be defined by the equation $f(x)=x^2-1$. If b is a positive real number, then $f\left(\frac{1}{b}\right)=$

A) $\frac{(b-1)(b+1)}{b^2}$

B) $\frac{(1-b)(1+b)}{b^2}$

C) $\frac{b^2-1}{b}$

D) $\frac{b-1}{b^2}$

22

The value of y varies with x according to the equation $y = kx^2$, where $k > 0$. When the value of x increases from 3 to 12, which of the following best describes the behavior of y?

A) It increases by 81.

B) It increases by 135.

C) It is multiplied by 4.

D) It is multiplied by 16.

23

If the function f is defined by the equation $f(x) = k(x + 6)(x - 1)$, where $k > 5$, then which of the following is equivalent to $f(7)$?

A) $f(-78)$

B) $f(-12)$

C) $f(-2)$

D) $f(78)$

24

After its initial offering, the price of a stock increased by 20% in the first year, decreased by 25% in the second year, then increased by 10% in the third year. What was the net change in the stock price over the entire three-year period?

A) It increased by 5%.

B) It increased by 1%.

C) It decreased by 1%.

D) It decreased by 5%.

25

If $y = x^2$, where $x \neq 0$, and $w = y^6$, which of the following expresses the value of $\frac{w}{y^3}$ in terms of x?

A) x^2

B) x^4

C) x^5

D) x^6

CONTINUE

4 4

26

0	1	2	3	4	5
1	2	4	7		
2					
3					
4				x	
5					

With the exception of the shaded squares in the first row and first column, every square in the table above is to be filled in with a number equal to the sum of the number directly above it and the number directly to its left. For instance, the number 7 in the second row is the sum of 3 in the square above it and 4 in the square directly to its left. What is the value of x?

A) 16
B) 84
C) 96
D) 112

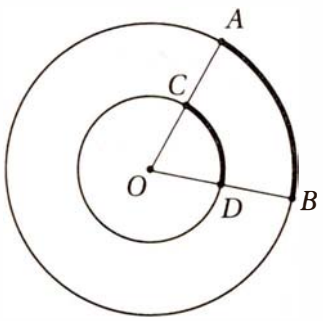
27

$$3x^2 = 4x + c$$

In the equation above, c is a constant. If $x = -1$ is a solution of this equation, what other value of x satisfies the equation?

A) $\frac{1}{7}$
B) $\frac{4}{3}$
C) $\frac{7}{3}$
D) 7

28



Note: Figure not drawn to scale.

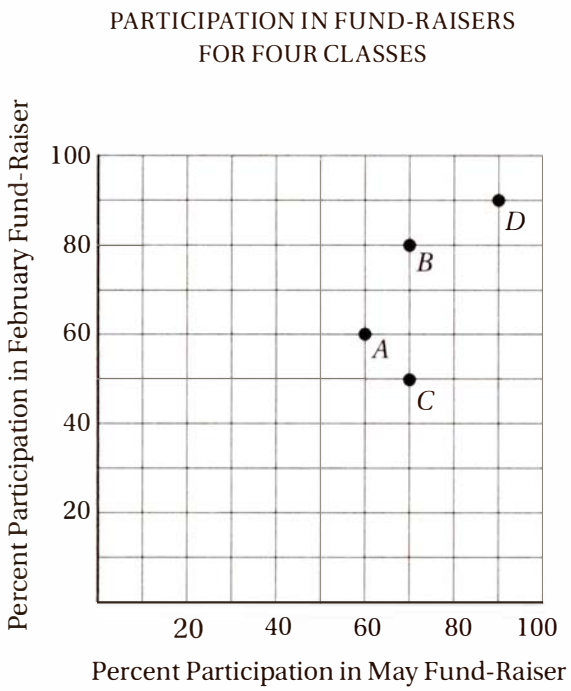
The figure above shows two concentric circles with center O. If $OD = 3$, $DB = 5$, and the length of arc AB is 5π, what is the length of arc CD?

A) $\frac{7}{4}\pi$
B) $\frac{15}{8}\pi$
C) 3π
D) $\frac{25}{8}\pi$

CONTINUE

4 4

Questions 29 and 30 refer to the following graph.



29

Four different classes at Corbett Elementary School participated in two fund-raisers last year, one in February and another in May. The rates of participation for each class are recorded in the graph above. Which class had the greatest change in percent participation from the February fund-raiser to the May fund-raiser?

A) Class A
B) Class B
C) Class C
D) Class D

30

If there were 20 students each in Class A and Class C, and 30 students each in Class B and Class D, how many students participated in the May fund-raiser?

A) 71
B) 72
C) 74
D) 76

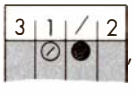
CONTINUE

4 4

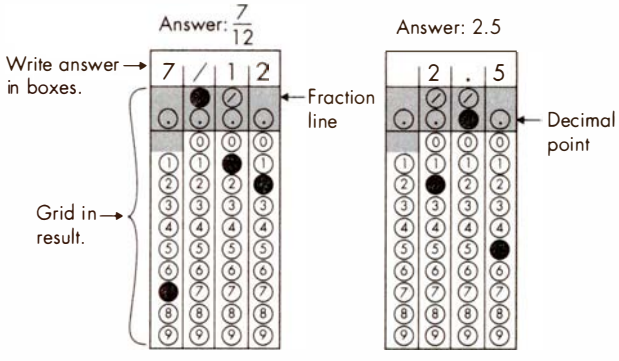
DIRECTIONS

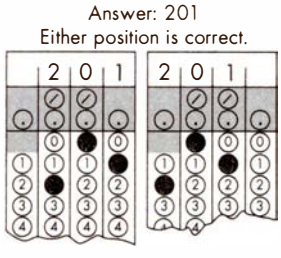
For questions 31–38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

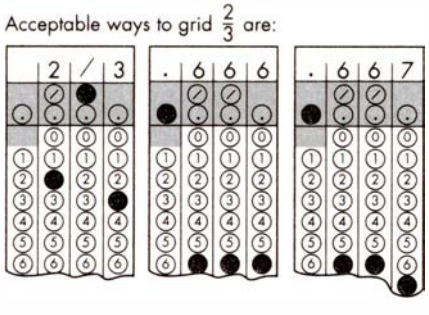
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
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 

, 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.







CONTINUE

4  4

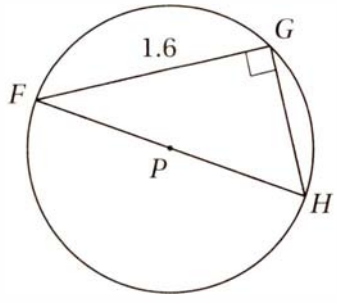
31

If $4+\sqrt{b}=7.2$, what is the value of $4-\sqrt{b}$?

32

In the xy-plane, the graph of the equation $y=3x^2-kx-35$ intersects the x-axis at (5, 0). What is the value of k?

33



In the figure above, triangle FGH is inscribed in the circle with center P. If the area of the circle is π, what is the area of triangle FGH?

34

If $-\frac{3}{5}<-2t+1<-\frac{3}{7}$, what is one possible value of $6t$?

35

If $\cos(x-\pi)=0.4$, what is the value of $\sin^2 x$?

36

If one pound of grain can feed either 5 chickens or 2 pigs, then ten pounds of grain can feed 20 chickens and how many pigs?

Questions 37 and 38 are based on the following information

Section	Price per Ticket	Number Sold
Front Orchestra	\$60	50
Rear Orchestra	\$50	60
First Mezzanine	\$40	x
Second Mezzanine	\$35	y
Third Mezzanine	\$30	100

The table above shows information about the tickets sold for a recent performance by a theater troupe. The total revenue in ticket sales for this performance was \$15,000.

37

If 15 more tickets were sold in the second mezzanine than in the first mezzanine, what is the total number of tickets that were sold for this performance?

38

Before the tickets for this performance went on sale, a consultant for the theater had predicted that n, the number of tickets sold per section, would vary with p, the price in dollars for a ticket in that section, according to the formula $n=\frac{2{,}800}{p}$. By how many tickets did this model underestimate the actual total number of tickets sold?

STOP

If you finish before time is called, you may check your work on this section only. Do not turn to any other section of the test.

SAT PRACTICE TEST 1 ANSWER KEY

Section 1: Reading

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

Total Reading Points (Section 1)

Section 2: Writing and Language

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

Total Writing and Language Points (Section 2)

Section 3: Math (No Calculator)

1. D
2. A
3. C
4. A
5. C
6. B
7. A
8. B
9. C
10. A
11. A
12. B
13. C
14. D
15. B
16. 4.5 or 9/2
17. 7
18. 8.4 or 42/5
19. 5 or 7
20. 8/13 or .615

Total Math Points (Section 3)

Section 4: Math (Calculator)

1. D
2. A
3. C
4. B
5. C
6. A
7. A
8. C
9. C
10. D
11. D
12. D
13. B
14. D
15. B
16. A
17. A
18. D
19. A
20. C
21. B
22. D
23. B
24. C
25. D
26. D
27. C
28. B
29. C
30. C
31. 0.8 or 4/5
32. 8
33. .96
34. $4.29 \leq x \leq 4.79$
35. .84
36. 12
37. 371
38. 25

Total Math Points (Section 4)

39. **A** **Parallelism**

The original phrasing is best because it creates the parallel phrasing *taking on . . . writing . . . and thus allowing*.

40. **C** **Sentence Fragments/Comparative Idiom**

The original phrasing is incorrect because it creates a sentence fragment. Choices (B) and (D) commit the same error. Only choice (D) forms a sentence with an independent clause. Note also that is correctly applies the comparative idiom *not only A but also B*.

41. **A** **Dangling Modifiers**

The original phrasing is best because it coordinates with the appositive phrase that begins the sentence. Choices (B) and (C) allow this appositive to dangle. Choice (D) is incorrect because the phrase *became targeted for* is not idiomatic.

42. **C** **Logical Coordination/Idiom**

This sentence describes the reason that Chaplin *drew the ire of J. Edgar Hoover*. Choice (C) provides the most logical phrase to coordinate this state of being and its cause: *because of*. The prepositional phrases in the original phrasing and in choices (B) and (D) do not convey this logical relationship.

43. **B** **Pronoun Agreement**

The original phrasing is incorrect because the definite pronoun *they* disagrees in number with the antecedent *government*. Choice (C) is incorrect because the subjunctive form *would have been* incorrectly implies that this clause in counterfactual. Choice (D) is incorrect because *propaganda*, although it sounds plural, is singular.

44. **B** **Diction**

In this context, *eradicated* does not work because it means *destroy completely, as a scourge*, which does not accurately modify a visa. Choice (B), *revoked* (officially invalidated) works nicely. Choice (C) is illogical because the visa is not disallowed entry into a group, as *excluded* would imply. Choice (D) is illogical because *abolish* more properly describes the formal termination of an institution, practice, or system.

Section 3: Math (No Calculator)

1. **D** **Algebra (solving equations) EASY**

$$8x + 6 = 6m$$

To solve in one step, just divide both sides by 2:

$$4x + 3 = 3m$$

2. **A** **Algebra (linear systems) EASY**

To determine which ordered pair is a solution to the system, just "plug in" the values for x and y and choose the one that satisfies both equations. Notice that $x = 2$ and $y = 3$ is a solution because $3(2) + 4(3) = 18$, and $3 = \left(\frac{3}{2}\right)(2)$.

3. **C** **Algebra (algebraic expressions) EASY**

$$\frac{3x+4}{12}$$

Distribute: $\frac{3x}{12} + \frac{4}{12}$

Simplify: $\frac{x}{4} + \frac{1}{3}$

4. **A** **Advanced Mathematics (polynomials) EASY**

There are several ways to approach this question. Perhaps the simplest is to use the Factor Theorem: If $x - c$ is a factor of a polynomial, then $x = c$ is a zero of that polynomial. Therefore, if $x - 3$ is a factor of our polynomial, $x = 3$ must be a zero:

$$x^2 + kx + 12 = (3)^2 + 3k + 12 = 0$$

Simplify: $9 + 3k + 12 = 0$

Subtract 21: $3k = -21$

Divide by 3: $k = -7$

Alternately, you might try to find the other factor of the quadratic. Since the constant term in the quadratic is 12, the constant term in the other binomial factor must be $12 \div -3 = -4$.

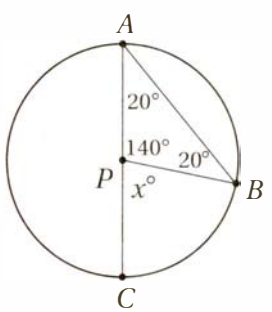
$$(x - 3)(x - 4) = x^2 + kx + 12$$

FOIL: $x^2 - 7x + 12 = x^2 + kx + 12$

Subtract x and 12: $-7x = kx$

Divide by x: $-7 = k$

5. **C** **Additional Topics (circles and triangles) MEDIUM**



Since PA and PB are both radii of the circle, they are congruent, and so triangle APB is isosceles. By the Isosceles Triangle Theorem, then, angle A must also be 20°. From here, you might simply notice that the angle we're looking for, CPB, is the external angle to this triangle, and so it has a measure equal to the sum of the two remote interior angles: $20° + 20° = 40°$. Alternately, you could notice that angle APB must have a measure of 140° (since all angles in a triangle

have a sum of 180°), and since AC is a straight line, angle $CPB = 180° - 140° = 40°$.

6. **B** **Advanced Mathematics (sequences) MEDIUM**

Let's choose a value, like $b = 2$, for our positive constant. This gives us an expression of $2n + 4$ for the nth term of the sequence. Substituting $n = 1$, $n = 2$, $n = 3$, etc. gives us a sequence of 6, 8, 10, 12, 14, and so on. Choice (A) is clearly incorrect, because the first term of this sequence is not 2. Choice (C) is also incorrect because the average of the first three terms is $(6 + 8 + 10)/3 = 8$, not 2. Choice (D) is also incorrect because the ratio of the second term to the first is $8/6 = 4/3$. Only choice (B), the difference between the fourth term and the third term, $12 - 10$, gives us a value of 2.

7. **A** **Advanced Mathematics (radical and exponential equations) MEDIUM**

For this question, we need to know two Laws of Exponentials from Chapter 9: Law #8 and Law #9. First, we use Law #9 to translate the radicals into exponents.

Given equation: $m^3 = \sqrt{\sqrt{n}}$

Apply Law of Exponentials #9: $m^3 = \sqrt{n^{\frac{1}{2}}}$

Apply Law of Exponentials #9 again: $m^3 = \left(n^{\frac{1}{2}}\right)^{\frac{1}{2}}$

Apply Law of Exponentials #8: $m^3 = n^{\frac{1}{4}}$

Raise to the $\frac{1}{3}$ power: $(m^3)^{\frac{1}{3}} = \left(n^{\frac{1}{4}}\right)^{\frac{1}{3}}$

Apply Law of Exponentials #8 again: $m = n^{\frac{1}{12}}$

8. **B** **Algebra (word problems) MEDIUM**

Perhaps the most straightforward way to approach this question is to regard it as a conversion from a given *area of lawn* (in square feet) to *cost* (in dollars).

Area of rectangular lawn: $A = bh = ab$ square feet

Convert using given conversion factors:

$$ab \text{ square feet} \times \frac{1 \text{ bag}}{5{,}000 \text{ square feet}} \times \frac{\$p}{1 \text{ bag}} = \$\frac{abp}{5{,}000}$$

Make sure to check this calculation by noticing that all units "cancel" as common factors, except for the unit we want, dollars, which remains in the numerator.

9. **C** **Advanced Mathematics (rational inequalities) MEDIUM**

Original inequality: $\frac{5}{m} \leq \frac{2}{3}$

Multiply by $3m$ (since $m > 0$, we don't "flip" the inequality): $15 \leq 2m$

Divide by 2: $7.5 \leq m$

Therefore, the least possible value of m is 7.5.

10. **A** **Algebra (linear functions) MEDIUM-HARD**

Given function: $f(x) = 3x + n$

Substitute $f(2) = 0$: $f(2) = 3(2) + n = 0$

Simplify: $6 + n = 0$

Subtract 6: $n = -6$

Therefore, the function is $f(x) = 3x - 6$.

Evaluate $f(n)$: $f(n) = f(-6) = 3(-6) - 6 = -18 - 6 = -24$

11. **A** **Algebra (absolute values) MEDIUM-HARD**

First, we should notice that each choice can be interpreted as a distance between two points on the number line.

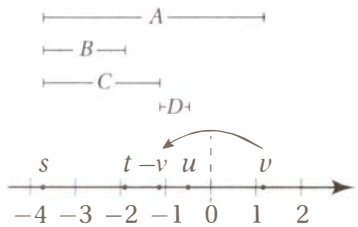
(A) $|s - v|$ = the distance between s and v

(B) $|s - t|$ = the distance between s and t

(C) $|s + v| = |s - (-v)|$ = the distance between s and $-v$

(D) $|u + v| = |u - (-v)|$ = the distance between u and $-v$

Thinking this way gives us a very straightforward way to solve the problem without doing any calculation. First we need to locate $-v$ on the number line by just reflecting v over the origin at 0. (Recall that multiplication by -1 is equivalent to reflecting a point on the number line over the origin at 0.) This makes it easy to see the distances the problem is asking us to compare:



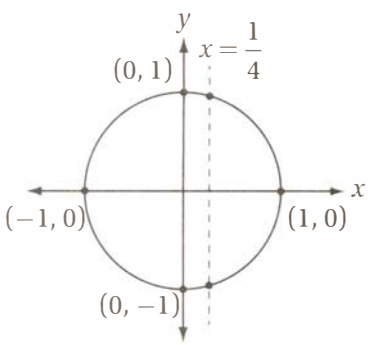
Clearly, the greatest of these distances is (A).

12. **B** **Special Topics (trigonometry) MEDIUM-HARD**

In order to solve this without a calculator, we need to know how to analyze this problem in terms of the unit circle. First, let's solve for $\cos x$: $4 \cos x = 1$

Divide by 4: $\cos x = \frac{1}{4}$

What does the mean in terms of the unit circle? Recall from Chapter 10, Lesson 9, that the cosine of any angle corresponds to the x-coordinate of the corresponding point for that angle on the unit circle:



Notice that there are exactly two points on the unit circle that have an x-coordinate of 1/4. Now let's think about

the angle. We are told that x goes from 0 to 3π. Remember that a full trip around the circle is 2π radians; therefore, a journey from $x = 0$ to $x = 3\pi$ is 1.5 trips around the circle counterclockwise starting from the positive x-axis. If you trace with your finger 1.5 times around the circle starting from the point (1, 0), you'll hit our "points of interest" exactly three times.

13. C Additional Topics (complex numbers) HARD

To solve this without a calculator, you must be able to evaluate a few low powers of i. Recall from Chapter 10, Lesson 10, that $i^0 = 1$, $i^1 = i$, $i^2 = -1$, $i^3 = -i$, and $i^4 = 1$. Therefore $i^3 + i = -i + i = 0$. Now, it's just a matter of finding the choice that does NOT equal 0.

(A) $(2i)^2 + 4 = -4 + 4 = 0$

(B) $2 - 2i^4 = 2 - 2 = 0$

(C) $2i^2 - 2 = -2 - 2 = -4$

(D) $i^4 - 1 = 1 - 1 = 0$

Therefore, the correct answer is (C).

14. D Algebra (graphs of quadratic equations) HARD

Recall from Chapter 9, Lesson 6, that any equation in the form $y = a(x - h)^2 + k$ has a vertex at (h, k) and is open up if $a > 0$ and down if $a < 0$. In the equation $y = -(x + m)^2 + m$, therefore, the vertex is $(-m, m)$, and $a = -1$. Since $m > 1$, this means that the vertex of the parabola has a negative x-coordinate and a positive y-coordinate, which means the vertex is in quadrant II. And since $a < 0$, the parabola is open down. The only graph among the choices that is an open down parabola with a vertex in the second quadrant is the graph in choice (D).

15. B Advanced Mathematics (linear and nonlinear systems) HARD

First, notice that the question is only asking us to find values of x, so it's a good idea to substitute in order to eliminate y from the system.

$$x - 3y = -2$$

Substitute $y = \frac{5}{x}$: $x - 3\left(\frac{5}{x}\right) = -2$

Multiply by x and simplify: $x^2 - 15 = -2x$

Add $2x$: $x^2 + 2x - 15 = 0$

Factor using Sum-Product Method: $(x - 3)(x + 5) = 0$

Therefore, the values of x that satisfy the original system also satisfy the equation $(x - 3)(x + 5) = 0$.

16. 4.5 or 9/2 Algebra (linear equations) EASY

Original equation: $\frac{2}{3}a + \frac{1}{2}b = 5$

Substitute $b = 4$: $\frac{2}{3}a + \frac{1}{2}(4) = 5$

Simplify: $\frac{2}{3}a + 2 = 5$

Subtract 2: $\frac{2}{3}a = 3$

Multiply by $\frac{3}{2}$: $a = \frac{9}{2}$

17. 7 Advanced Mathematics (rational equations) EASY

Given inequality: $\frac{6}{x} + \frac{1}{2x} < 1$

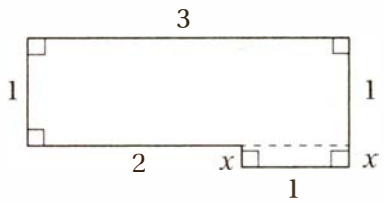
Multiply by $2x$: $12 + 1 < 2x$

Simplify: $13 < 2x$

Divide by 2: $6.5 < x$

The smallest integer that is greater than 6.5 is 7.

18. 8.4 or 42/5 Additional Topics (perimeters and area) MEDIUM-HARD



First, drawing a line as shown in the diagram shows that the figure is composed of two rectangles, but the height of the smaller one is unknown. Let's call it x. The area of the larger rectangle is $(3)(1) = 3$, and the area of the smaller rectangle is $(1)(x) = x$. Clearly, the area of the figure must be the sum of these two areas

$$\text{Area} = \frac{16}{5} = 3 + x$$

Subtract 3: $\frac{16}{5} - 3 = \frac{16}{5} - \frac{15}{5} = \frac{1}{5} = x$

Therefore, the perimeter of the figure is just the sum of the lengths of its sides. If we travel around the figure clockwise from the leftmost side, we get a perimeter of $1 + 3 + 1 + \frac{1}{5} + 1 + \frac{1}{5} + 2 = 8 + \frac{2}{5} = 8.4$.

19. 5 or 7 Algebra (rational equations) MEDIUM-HARD

Original equation: $\frac{6}{x+1} - \frac{3}{x-1} = \frac{1}{4}$

Multiply by $4(x + 1)(x - 1)$:

$$\frac{24(x+1)(x-1)}{x+1} - \frac{12(x+1)(x-1)}{x-1} = \frac{4(x+1)(x-1)}{4}$$

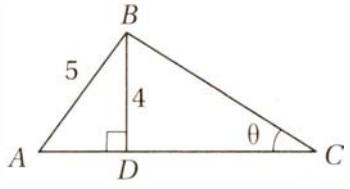
We do this because $4(x + 1)(x - 1)$ is the least common multiple of the denominators, so multiplying both sides by this will eliminate the denominators and simplify the equation.

Cancel common factors:

$$24(x - 1) - 12(x + 1) = (x + 1)(x - 1)$$

Distribute and FOIL: $(24x - 24) - (12x + 12) = x^2 - 1$
Collect like terms: $12x - 36 = x^2 - 1$
Subtract $12x$ and add 36: $0 = x^2 - 12x + 35$
Factor: $0 = (x - 5)(x - 7)$
Solve using Zero Product Property: $x = 5$ or 7

20. **8/13 or .615** **Special Topics (trigonometry) HARD**



Find AD with Pythagorean Theorem: $(AD)^2 + 4^2 = 5^2$
Simplify: $(AD)^2 + 16 = 25$
Subtract 16: $(AD)^2 = 9$
Take square root: $AD = 3$
Or, even better, just notice that triangle ADB is a 3-4-5 right triangle.
Use triangle area formula to find AC:

$$\text{Area} = \frac{1}{2}bh = \frac{1}{2}(AC)(4) = 19$$

Simplify: $2(AC) = 19$
Divide by 2: $AC = \frac{19}{2}$

Find DC: $DC = AC - AD = \frac{19}{2} - 3 = \frac{19}{2} - \frac{6}{2} = \frac{13}{2}$

Find $\tan\theta$: $\tan\theta = \frac{\text{opp}}{\text{hyp}} = \frac{BD}{DC} = \frac{4}{\frac{13}{2}} = 4 \times \frac{2}{13} = \frac{8}{13}$

Section 4: Math (Calculator)

1. **D** **Algebra (solving equations) EASY**

$$\frac{n}{20} = 0.8$$

Multiply by 20: $n = 0.8(20) = 16$

2. **A** **Data Analysis (central tendency) EASY**

The median of three numbers is the one in the middle when they are listed in order. If two of the numbers are 10 and 12, with 12 as the median, then the third number must be greater than or equal to 12, otherwise 12 would not be in the middle. Of the choices, only (A) 8 is not greater than or equal to 12.

3. **C** **Algebra/Data Analysis (expressing relationships) EASY**

The first ordered pair, $x = 0$ and $y = 2$, does not satisfy the equations in (A), (B), or (D), so those choices can be eliminated. You should also confirm that the equation in (C), $y = 2x + 2$, is satisfied by all four ordered pairs.

4. **B** **Data Analysis (central tendency) EASY**

Let's call the 3 positive integers a, b, and c. If the average of these numbers is m, then

$$\frac{a+b+c}{3} = m$$

Multiply by 3: $a + b + c = 3m$
New average when 24 is included in the set: $\frac{a+b+c+24}{4}$
Substitute $a + b + c = 3m$: $\frac{3m+24}{4}$

5. **C** **Algebra (rational equations) EASY**

$$\frac{6}{x} + 3 = -1$$

Multiply by x: $6 + 3x = -x$
Subtract $3x$: $6 = -4x$
Divide by -4: $x = \frac{6}{-4} = -\frac{3}{2}$

6. **A** **Algebra (representing quantities) EASY**

The cost for a month's worth of energy is the cost per kilowatt-hour times the total number of kilowatt-hours used: (\$0.15/kWh)(30 kWh). The total monthly charge, P, must also include the service fee: $P = 0.15(30) + 16$.

7. **A** **Advanced Mathematics (triangle trigonometry) EASY**

Remember the definitions of the basic trigonometric functions: SOH CAH TOA. Since the "side of interest" (h) is the opposite side to the given angle (42°), and since we know the length of the hypotenuse (1,200), we should use SOH.

$$\sin x = \frac{\text{opp}}{\text{hyp}}$$

Plug in the values: $\sin 42° = \frac{h}{1{,}200}$
Substitute $\sin 42° = 0.669$: $0.669 = \frac{h}{1{,}200}$
Multiply by 1,002: $(1{,}200)(0.669) = 802.8 = h$

8. **C** **Special Topics (polygons) EASY**

The sum of the measures if the interior angles of a triangle is 180°, therefore $m\angle BED + 90° + 50° = 180°$, and so $m\angle BED = 40°$. Since $\angle AEC$ is vertical to $\angle BED$, it must also have a measure of 40°, and so $40 + x + x = 180$
Simplify: $40 + 2x = 180$
Subtract 40: $2x = 140$
Divide by 2: $x = 70$

9. **C** **Data Analysis (histogram) MEDIUM**

According to the histogram, 7 students received 15 credits, 1 student received 16 credits, and 1 student received 18 credits, for a total of 9 students who received 15 or more credits. This is 9/24 of the total, or 37.5%

10. **D** **Data Analysis (histogram/central tendency) MEDIUM**

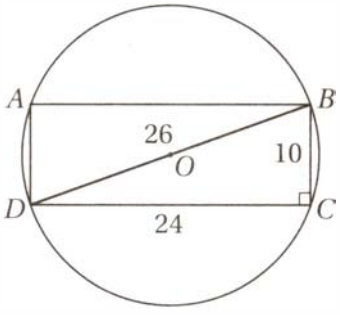
Data set: 8, 9, 12, 12, 12, 12, 12, 12, 12, 12, 12, 12, 13, 13, 13, 15, 15, 15, 15, 15, 15, 15, 16, 18

The median of a set of numbers is the "middle" number of the set when the numbers are listed in order. If the set contains an odd number of numbers, the median is the middle number, but if the set contains an even number of numbers, it is the average of the two middle numbers. Since this set contains 24 numbers, the median is the average or the 12th and the 13th numbers. The 12th number in the set is 12, and the 13th number in the set is 13, the median is 12.5.

11. **D** **Algebra (absolute values) EASY**

The absolute distance from a to b is $|a - b|$ and the absolute distance from -2 to 6 is $|-2 - 6| = 8$. Therefore, $|a - b| > 8$.

12. **D** **Special Topics (circles) MEDIUM**



Since $ABCD$ is a rectangle, we can find the length of its diagonal using the Pythagorean Theorem: $10^2 + 24^2 = d^2$. Even better, we can notice that the two legs are in a 5:12 ratio, and therefore triangle BCD is a 5-12-13 triangle. In either case, we find that $DB = 26$. Since DB is also a diameter of the circle, the radius of the circle is $26/2 = 13$, and therefore, the area of the circle is $\pi r^2 = \pi(13)^2 = 169\pi$.

13. **B** **Problem Solving/Data Analysis (enumeration of data) MEDIUM**

If Niko is the 8th oldest person in the class, then there are 7 students older than he is. If he is the 12th youngest person, then there are 11 students younger than he is. Therefore, there are 18 students in addition to him, for a total of 19 students.

14. **D** **Additional Topics (complex numbers) MEDIUM**

$$(2 - i)(3 - 2i)$$

FOIL: $6 - 4i - 3i + 2i^2$

Substitute $i^2 = -1$: $6 - 4i - 3i + 2(-1)$

Combine like terms: $4 - 7i$

15. **B** **Advanced Mathematics (exponentials) MEDIUM**

$$f(3) = (3^2)^{-2b} = 3$$

Exponential Law #8 (from Chapter 9, Lesson 9): $3^{-4b} = 3^1$

Exponential Law #10 (from Chapter 9, Lesson 9) $-4b = 1$

Divide by -4: $b = -\frac{1}{4}$

16. **A** **Data Analysis (probability) MEDIUM**

Since the sum of 55 and 35 is 90, which is 10 greater than 80, there must be at least 10 in the overlap between the two sets. Statement (B) is not necessarily true, because it is possible that all 35 students taking AP courses are also varsity athletes, which is more than half of 55. Statement (C) is not true because $80 - 55 = 25$ students do not play varsity sports, and $80 - 35 = 45$ students do not take at least one AP course. Statement (D) is not necessarily true, because 35 students take at least one AP course and 25 students do not play a varsity sport, and this sum, $35 + 25 = 60$, is less than the total number of students, so it is possible that there is no overlap between these two sets.

17. **A** **Algebra (slopes) MEDIUM**

If $AB = BC$, then triangle ABC is isosceles and therefore the two base angles are congruent and the triangle has a vertical axis of symmetry at the line $x = 3$. This implies that the slopes of lines $\overline{AB}$ and $\overline{BC}$ are opposites. We can calculate the slope of $\overline{BC}$ from its endpoints:

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - 6}{5 - 3} = -\frac{6}{2} = -3$$

Therefore, the slope of $\overline{AB}$ is 3, and so $mn = (3)(-3) = -9$.

18. **D** **Advanced Mathematics (functions) MEDIUM-HARD**

To answer this question, we must evaluate each of the three functions for an input of ½:

$$f\left(\frac{1}{2}\right) = \left(\frac{1}{2}\right)^2 = \frac{1}{4} = 0.25$$

$$g\left(\frac{1}{2}\right) = \frac{1}{2} = 0.50$$

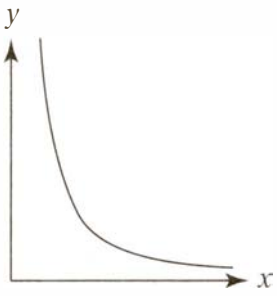
$$h\left(\frac{1}{2}\right) = \sqrt{\frac{1}{2}} = \frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2} \approx 0.71$$

Therefore, $f\left(\frac{1}{2}\right) < g\left(\frac{1}{2}\right) < h\left(\frac{1}{2}\right)$.

19. **A** **Data Analysis (graphing data) MEDIUM-HARD**

If y varies inversely as the square of x, then the variables are related by the equation $f = \frac{k}{x^2}$, where k is a positive

constant. The graph of such an equation in the xy-plane looks like this:



This most closely resembles the scatterplot in choice (A).

20. **C** **Algebra (expressing relationships) MEDIUM-HARD**

The portion of the birds that are finches is just the number of finches divided by the total number of birds. Since there are already 30 finches, adding n finches makes $30 + n$ finches. Since there are already $12 + 30 + 18 = 60$ total birds, adding n finches makes $60 + n$ total birds. Since $80\% = 4/5$, $\frac{30+n}{60+n} = \frac{4}{5}$.

21. **B** **Advanced Mathematics (functions) MEDIUM-HARD**

$f(x) = x^2 - 1$

Substitute $x = \frac{1}{b}$: $f\left(\frac{1}{b}\right) = \left(\frac{1}{b}\right)^2 - 1$

Simplify: $f\left(\frac{1}{b}\right) = \frac{1}{b^2} - 1$

Get common denominator: $f\left(\frac{1}{b}\right) = \frac{1}{b^2} - \frac{b^2}{b^2}$

Subtract fractions: $f\left(\frac{1}{b}\right) = \frac{1-b^2}{b^2}$

Factor numerator: $f\left(\frac{1}{b}\right) = \frac{(1-b)(1+b)}{b^2}$

22. **D** **Advanced Mathematics (quadratics) MEDIUM-HARD**

Since k can be any number greater than 0, let's pick $k = 1$ for convenience. If $x = 3$, then $y = (1)(3)^2 = 9$, and if $x = 12$, then $y = (1)(12)^2 = 144$. In this case, both statement (B) and statement (D) are true, since $9 + 135 = 144$ and $9(16) = 144$; therefore, we can eliminate choices (A) and (C). Now let's choose $k = 2$. If $x = 3$, then $y = (2)(3)^2 = 18$, and if $x = 12$, then $y = 2(12)^2 = 288$. Since $18 + 135 \neq 288$, but $18(16) = 288$, the correct answer is (D).

Notice, also, that since y varies directly as the square of x, then when x is multiplied by n, y is multiplied by n^2. Since x is being multiplied by 4 (to go from 3 to 12), then y must be multiplied by $4^2 = 16$.

23. **B** **Advanced Mathematics (analyzing quadratics) HARD**

One way to tackle this question is simply to simplify the expression for $f(7)$, and then see which choice gives the same expression.

$f(7) = k(7 + 6)(7 - 1) = k(13)(6) = 78k$

Evaluate (A):

$f(-78) = k(-78 + 6)(-78 - 1) = k(-72)(-79) = 5{,}688k$

Evaluate (B):

$f(-12) = k(-12 + 6)(-12 - 1) = k(-6)(-13) = 78k$

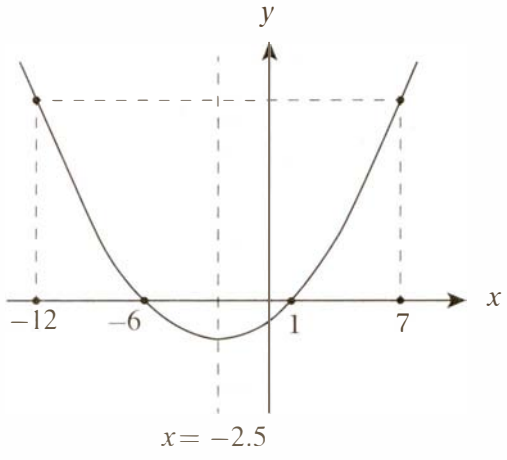
Evaluate (C):

$f(-2) = k(-2 + 6)(-2 - 1) = k(4)(-3) = -12k$

Evaluate (D):

$f(78) = k(78 + 6)(78 - 1) = k(84)(77) = 6{,}468k$

This shows that $f(-12)$ is equal to $f(7)$. Alternately, you might just make a quick sketch of the parabola and take advantage of the symmetry:



24. **C** **Problem Solving (percentages) MEDIUM-HARD**

Let p = the initial price per share of the stock. After the first year, its price increased by 20%, so its price was $(1.20)p$. After the second year, this price declined 25%, so its price was $(0.75)(1.20)p$. After the second year, this price increased by 10% so its price was $(1.10)(0.75)(1.20)p = 0.99p$, which means that overall the price decreased by 1%.

25. **D** **Algebra (exponentials) MEDIUM-HARD**

Expression to be evaluated: $\frac{w}{y^3}$

Substitute $w = y^6$: $\frac{y^6}{y^3}$

Simplify with Exponential Law #6 (from Chapter 9, Lesson 9): y^3

Substitute $y = x^2$: $(x^2)^3$

Simplify with Exponential Law #8 (from Chapter 9, Lesson 9): x^6

26. **D** **Data Analysis (tables) MEDIUM-HARD**

Although we don't need to fill in the entire table, it's interesting to note that it has a "diagonal symmetry" when it is completed. Just following the rule and moving systematically toward x reveals that it is $56 + 56 = 112$.

0	1	2	3	4	5
1	2	4	7	11	16
2	4	8	15	26	42
3	7	15	30	56	98
4	11	26	56	**112**	210
5	16	42	98	210	420

27. **C** **Advanced Mathematics (quadratics) HARD**

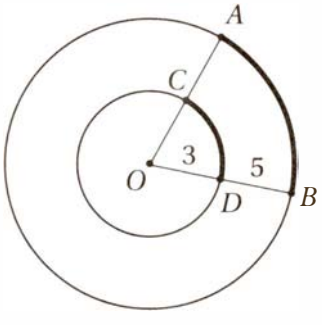
We can find the value of c by just substituting $x = -1$ into the equation.

Given equation: $3x^2 = 4x + c$
Substitute $x = -1$: $3(-1)^2 = 4(-1) + c$
Simplify: $3 = -4 + c$
Add 4: $7 = c$
Therefore, the equation is: $3x^2 = 4x + 7$
Subtract $4x$ and 7: $3x^2 - 4x - 7 = 0$
Factor using Sum-Product Method: $(x + 1)(3x - 7) = 0$

(Notice that the factor $(x + 1)$ corresponds to the fact that $x = -1$ is a solution to the quadratic.)

Use Zero Product Property to find other solution: $3x - 7 = 0$
Add 7: $3x = 7$
Divide by 3: $x = 7/3$

28. **B** **Special Topics (arcs) HARD**



First, we should make sure we mark up the diagram with the measurements we know: $OD = 3$ and $DB = 5$. This means that the radius of the small circle is 3 and the radius of the large circle is 8. Notice that sectors AOB and COD share a central angle, and therefore are similar. So the measures of arc CD and arc AB are in a ratio of 3:8.

$$\frac{m\overset{\frown}{CD}}{m\overset{\frown}{AB}} = \frac{m\overset{\frown}{CD}}{5\pi} = \frac{3}{8}$$

Cross multiply: $8\left(m\overset{\frown}{CD}\right) = 15\pi$

Divide by 8: $m\overset{\frown}{CD} = \frac{15\pi}{8}$

29. **C** **Data Analysis (graphs) MEDIUM**

Since there are only four data points, it's not hard to list the February-May ordered pairs. Notice that the February axis is vertical, and the May axis is horizontal, so the typical x-y relationship is reversed:

Class A: February: 60, May: 60
Class B: February: 80, May: 70
Class C: February: 50, May: 70
Class D: February: 90, May: 90

Notice that the only class that saw an increase in percent participation is Class C.

30. **C** **Data Analysis (graphs) HARD**

We just need to tally the number of students who participated from each class.

Class A: 60% of 20 students = 12 students
Class B: 70% of 30 students = 21 students
Class C: 70% of 20 students = 14 students
Class D: 90% of 30 students = 27 students
$12 + 21 + 14 + 27 = 74$ students

31. **0.8 or 4/5** **Algebra (radical equations) EASY**

Given equation: $4 + \sqrt{b} = 7.2$
Subtract 4: $\sqrt{b} = 3.2$

Therefore, $4 - \sqrt{b} = 4 - 3.2 = 0.8$.

32. **8** **Advance Mathematics (quadratics) EASY**

Given equation: $y = 3x^2 - kx - 35$
Substitute $x = 5$ and $y = 0$: $0 = 3(5)^2 - k(5) - 35$
Simplify: $0 = 75 - 5k - 35$
Simplify: $0 = 40 - 5k$
Add $5k$: $5k = 40$
Divide by 5: $k = 8$

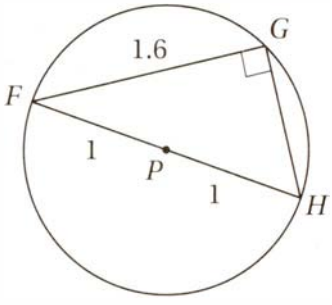
33. **.96** **Additional Topics (circles/triangles) MEDIUM-HARD**

When looking for the area of the triangle, remember that there are two basic methods: the direct method and the indirect method. With the direct method, we simply plug the base and height measurements into the formula $A = \frac{bh}{2}$, and with the indirect method, we find the area as the sum or difference of other areas. In this

case, since we know the lengths of one of the sides, the direct method is probably best. But we will need to find the height as well.

Area of the circle is π: $\pi r^2 = \pi$
Divide by π: $r^2 = 1$
Take square root: $r = 1$

Now let's mark up the diagram with this information. Since the radius of the circle is 1, the diameter FH has a length of 2. Now we can use the Pythagorean Theorem to find the length of GH, which is the height of the triangle if FG is taken as the base. $(1.6)^2 + (GH)^2 = 2^2$



Simplify: $2.56 + (GH)^2 = 4$
Subtract 2.56: $(GH)^2 = 1.44$
Take square root: $GH = 1.2$

(Notice that this is in fact a 3-4-5 triangle: if we multiply 3-4-5 by 0.4, we get 1.2-1.6-2.)

Plug into area formula: $A = \frac{bh}{2} = \frac{(1.2)(1.6)}{2} = 0.96$

---

34. **$4.29 \leq x \leq 4.79$** **Algebra (solving inequalities) HARD**

$$-\frac{3}{5} < -2t + 1 < -\frac{3}{7}$$

Multiply by -3 and "flip" inequalities: $\frac{9}{5} > 6t - 3 > \frac{9}{7}$

Add 3: $\frac{24}{5} > 6t > \frac{30}{7}$

Divide to get decimal form: $4.80 > 6t > 4.2857$

Therefore any decimal value between 4.29 and 4.79, inclusive, is acceptable.

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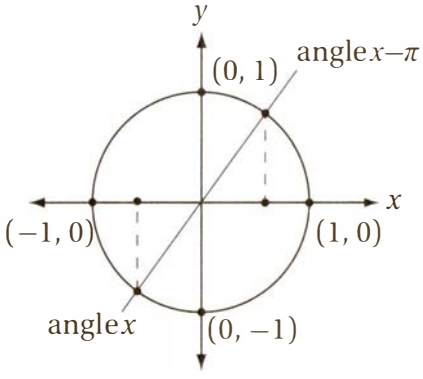
35. **.84** **Advanced Mathematics (trigonometry) MEDIUM-HARD**

You may find it helpful to make a quick sketch of the unit circle on the xy-plane, as we discussed in Chapter 10. Subtracting π radians (or 180°) from an angle just means rotating the terminal ray of that angle 180° clockwise. It should be clear, then, that in the xy-plane, the angle with measure $x - \pi$ points in the opposite direction of the angle with measure x. Recall that the cosine of an angle is just the x-coordinate of the point where its terminal ray intersects the unit circle. Since $\cos(x - \pi) = 0.4$ (that is, its cosine is positive), its terminal ray must be in a quadrant where the x-coordinates are positive: either quadrant I or quadrant IV. Let's just put it in quadrant I. This means that the angle with measure x is in quadrant III, and so it has the opposite cosine:



$\cos x = -0.4$

Recall Pythagorean Identity from Chapter 10: $\sin^2 x + \cos^2 x = 1$
Substitute $\cos x = 0.4$: $\sin^2 x + (-0.4)^2 = 1$
Simplify: $\sin^2 x + 0.16 = 1$
Subtract 0.16: $\sin^2 x = 0.84$

---

36. **12** **Problem Solving/Data Analysis (word problem) MEDIUM-HARD**

This one is a bit trickier than it looks. We have 10 pounds of grain and have used it to feed 20 chickens. Since one pound of grain feeds 5 chickens, proportionally we need 4 pounds of grain to feed 20 chickens. This leaves us $10 - 4 = 6$ pounds of grain to feed the pigs. Since 1 pound of grain can feed 2 pigs, proportionally 6 pounds of grain can feed 12 pigs.

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37. **371** **Problem Solving (extended thinking) HARD**

The total revenue from the tickets sold is \$60(50) + \$50(60) + \$40x + \$35y + \$30(100). If the total revenue was \$15,000, then $3{,}000 + 3{,}000 + 40x + 35x + 3{,}000 = 15{,}000$

Subtract 9,000: $40x + 35y = 6{,}000$
Divide by 5: $8x + 7y = 1{,}200$
If 15 more tickets were sold in the second mezzanine than the first mezzanine: $y = x + 15$
Substitute $y = x + 15$ in previous equation: $8x + 7(x + 15) = 1{,}200$
Distribute: $8x + 7x + 105 = 1{,}200$
Subtract 105: $15x = 1{,}095$
Divide by 15: $x = 73$
Substitute to find y: $y = x + 15 = 73 + 15 = 88$

Therefore, the total number of tickets sold is $50 + 60 + 73 + 88 + 100 = 371$.

38. **25** **Problem Solving (extended thinking) HARD**
The mathematical model $n = \frac{2{,}800}{p}$ has embedded in it the predicted revenue per section: np = revenue per section = \$2,800. Notice that this prediction is \$200 less than the actual average revenue per section of \$3,000, so clearly the model underestimated the number of tickets sold per section.

If we want to analyze this situation in detail, we can compare the predicted tickets sold to the actual tickets sold by adding a new column to the table entitled "predicted sold," which we can fill in using the calculations from our model. Also, it might be helpful to also add columns for "total revenue" for each situation.

Section	Price Per Ticket	Number Sold	Section Revenue	Predicted Sold	Predicted Revenue
Front Orchestra	\$60	50	\$3,000	46.667	\$2,800
Rear Orchestra	\$50	60	\$3,000	56	\$2,800
First Mezzanine	\$40	73	\$2,920	70	\$2,800
Second Mezzanine	\$35	88	\$3,080	80	\$2,800
Third Mezzanine	\$30	100	\$3,000	93.333	\$2,800
Total		371	\$15,000	346	\$14,000

You might notice that the predicted number of tickets sold in the Front Orchestra and the Third Mezzanine are fractions, which seems strange. (Of course we can't sell a fraction of a ticket!) But even if we round these predictions to the nearest whole numbers, 47 and 93, the total number of tickets is the same: 346, which underestimates the number of tickets sold by 25.

Section 5: Essay

Sample Response

Reading Score: 8 out of 8
Analysis Score: 8 out of 8
Writing Score: 8 out of 8

As Ellis Parker Butler sees it, American English spelling at the turn of the 20th century is a disaster. It defies logic and common sense, and it even destroys reason itself. Or so it seems. In fact, Butler's essay is not so much about American English spelling rules as it is about American intellectual culture at the turn of the 20th century: it is inclined toward the petty and the self-important. In his essay, Butler builds his argument with humor and charm, and proposes tongue-in-cheek alternatives to traditional standards of, and more recent revisions to, American English spelling. In so doing he pokes ample fun at how Americans think and behave, delving into commentary on politics, technology, and cultural expectations. He uses metaphor, personification, anecdote, and sharp irony to skewer not only the American elite but also himself.

Butler begins his essay with mock-anger at "the spelling profession." He claims it is "the reason America so long lagged behind Europe in the production of genius," noting that, while Shakespeare (a Brit) was clearly a genius, Noah Webster (the American lexicographer) was less so. He mounts his high horse with indignant braggadocio: ". . . self-made authors like me, who never can spell but who simply blaze with genius, will be hooted out of the magazines to make room for a stupid sort of literature that is spelled correctly." Butler's juxtaposition of overconfidence and incompetence (at least in the arena of spelling) establish his wry and ironic tone, which he maintains consistently throughout the essay.

Butler then lashes the "spelling reformers" who want "this new phonetic spelling brought into use" for doing what "we Americans do not like," namely, advocating for sudden change. He illustrates this cultural foible with the example of automobiles, "sixty horsepower snorters" that smell "like an eighteenth-century literary debate" that became acceptable because they were introduced gradually. In fact, Butler says, "we take to being killed by the automobile quite naturally now." At this point, the reader is probably wondering if this essay is really about spelling after all.

Then he turns his gaze to the problem at hand: silent letters. But to Butler, unlike the "spelling reformers," the problem is not practical but moral: we despise silent letters in our words because "we want no idle class in America, whether tramp, aristocrat, or silent letter." His solution? To "set the idle letters to work." Butler then announces that he, perhaps as a lone insurgent, will commence pronouncing them: "although" will now be a three-syllable word with an audible "ugh" at the end.

At this point, the reader probably recognizes Butler's shift in topic to be a feint: in fact, the object of his satire is not spelling at all, but those who are obsessed with the idea of reform. The preposterousness of his theory is intended to reflect the preposterousness of those who spend so much time and mental energy on silly rules. His satire even extends to the peculiarly American obsession with committee meetings and reform projects: "I propose to have some millionaire endow my plan, and Serena (Butler's wife) and I will then form a society for the reforming of English pronunciation."

The greatest disadvantage of Butler's plan, he admits, is that it is too commonsensical: it's advantage is "so manifest that I am afraid it will never be adopted." Here, we readers can't help but wonder if Butler is making a

wry commentary on bureaucratic incompetence in government and business.

Butler concludes by considering a "Plan B" offered by his wife, Serena: boycott words with silent letters. To Butler, this plan is less intellectual, but "more American": "Why should people write 'although' when they can write 'notwithstanding that,' and not have a silent letter in it?" By calling Serena's plan "more American," he seems to be criticizing the fickleness of the American consumer, who will change habits sometimes for nonsensical reasons.

Butler uses ironic humor to skewer the American habit of arguing over silly things. By using himself as a foil, together with skillful use of metaphor, anecdote, and personification ("'Although' does all the work, and 'ugh' sits on the fence and whittles"), Butler encourages us to laugh at ourselves, and perhaps then move on to more serious matters.

Scoring

Reading—8 (both readers gave it a score of 4)

This response demonstrates thorough comprehension of Butler's essay through skillful use of summary, paraphrases, and direct quotations. The author summarizes Butler's central purpose and main idea (*Butler's essay is not so much about American English spelling rules as it is about American intellectual culture at the turn of the 20th century: it is inclined toward the petty and the self-important*) and presents many details from the text, including abundant direct quotations. Each quotation is accompanied by insightful commentary that demonstrates that this author has thoroughly comprehended Butler's central idea, as well as his skillful use of devices like irony, metaphor, and personification to support that claim.

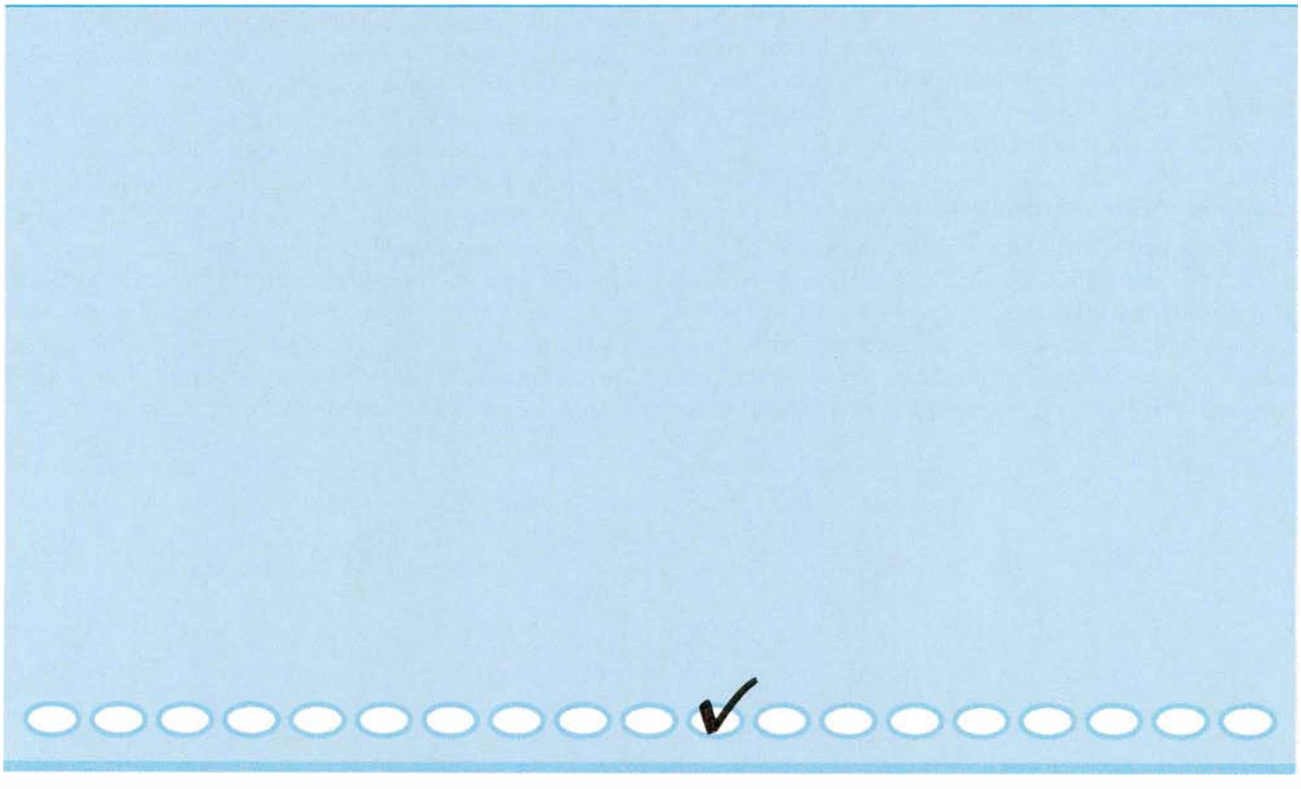
Analysis—8 (both readers gave it a score of 4)

This response presents an insightful analysis of Butler's essay and demonstrates a sophisticated understanding of the analytical task. This author has identified Butler's primary modes of expression (*metaphor, personification, anecdote, and sharp irony*) and has uncovered the core message of the essay by exploring Butler's use of these devices (*he pokes ample fun at how Americans think and behave, delving into commentary on politics, technology, and cultural expectations*). For example, the author identifies the devices that establish the essay's overall tone (*Butler's juxtaposition of overconfidence and incompetence (at least in the arena of spelling) establish his wry and ironic tone, which he maintains consistently throughout the essay*) as well as elements that establish layers of meaning (*we readers can't help but wonder if Butler is making a wry commentary on bureaucratic incompetence in government and business*) and shift focus to more subtle ideas (*the reader probably recognizes Butler's shift in topic to be a feint: in fact, the object of his satire is not spelling at all, but those who are obsessed with the idea of reform*). This response explores Butler's essay systematically, from introduction to conclusion, with thoughtful commentary throughout.

Writing—8 (both readers gave it a score of 4)

This response shows a masterful use of language and sentence structure to establish a clear and insightful central claim (*Butler's essay is not so much about American English spelling rules as it is about American intellectual culture at the turn of the 20th century: it is inclined toward the petty and the self-important. . . . He uses metaphor, personification, anecdote, and sharp irony to skewer not only the American elite but also himself*). The response maintains a consistent focus on this central claim, and supports it with a clear and deliberate analysis of Butler's essay. The author shows particular skill in verb choice (*defies logic . . . builds his argument . . . delving into commentary . . . establish his wry and ironic tone . . . lashes the "spelling reformers"*), strength in using parallel structures (*not only the American elite but also himself . . . while Shakespeare (a Brit) was clearly a genius, Noah Webster (the American lexicographer) was less so . . . the problem is not practical but moral*), and thoughtfulness in diction and phrasing (*[h]e mounts his high horse with indignant braggadocio . . . perhaps as a lone insurgent . . . perhaps as a lone insurgent . . . [h]is satire even extends to the peculiarly American obsession with committee meetings and reform projects*). Largely free of grammatical error, this response demonstrates strong command of language and advanced proficiency in writing.

PRACTICE TEST 2



3 3

Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

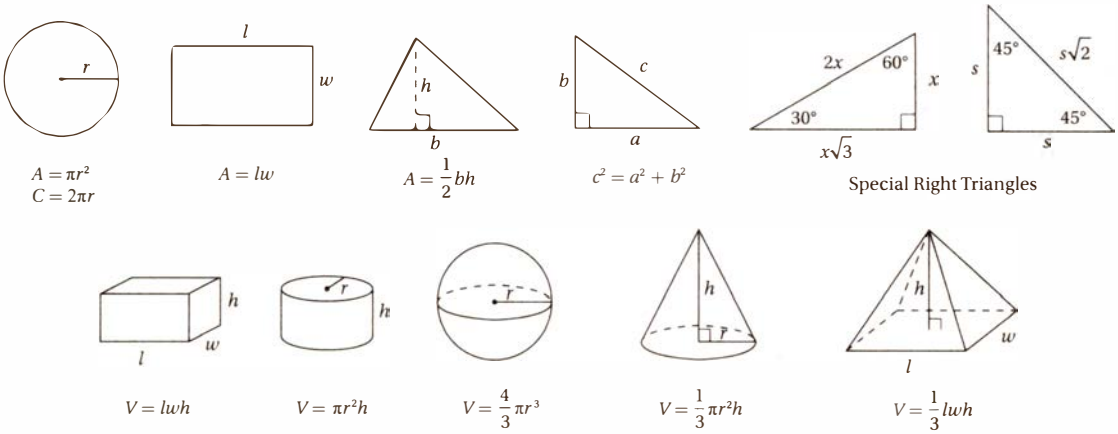
DIRECTIONS

For questions 1–15, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. **For questions 16–20,** solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 16 on how to enter you answers in the grid. You may use any available space in your test booklet for scratch work.

NOTES

1. The use of a calculator is NOT permitted.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the domain of a given function f is the set of all real numbers for which $f(x)$ is a real number.

REFERENCE



$A = \pi r^2$
$C = 2\pi r$

$A = lw$

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

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

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 number of degrees of arc in a circle is 360.
The number of radians of arc in a circle is 2π.
The sum of the measures in degrees of the angles of a triangle is 180.

CONTINUE

3  3

1

If $2b - 1 = 5$, what is the value of $2b^2 - 1$?

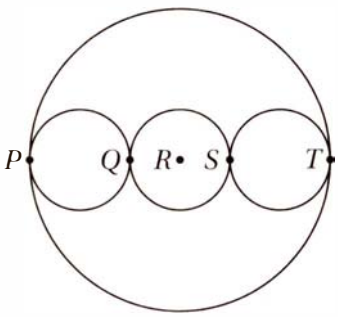
A) 15

B) 17

C) 24

D) 25

2



In the figure above, points P, Q, R, S, and T lie on the same line, and R is the center of the large circle. If the three smaller circles are congruent and the radius of the large circle is 6, what is the radius of one of the smaller circles?

A) 1

B) 2

C) 3

D) 4

3

Jeri has edited $\frac{1}{5}$ of her term paper. If she has edited 15 pages, how many pages does she have left to edit?

A) 45

B) 50

C) 60

D) 75

4

7, 12, 22, 42, 82

Which of the following gives a rule for finding each term in the sequence after the first?

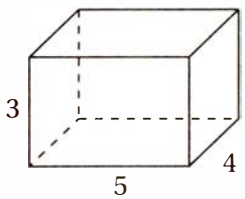
A) Add 5 to the preceding number.

B) Add 5 to the sum of all of the preceding terms.

C) Double the preceding term and then subtract 2 from the result.

D) Add 14 to the preceding term and divide that result by 2.

5



The figure above shows a rectangular box. What is the longest length of a diagonal of one of the faces of this box?

A) $\sqrt{24}$

B) $\sqrt{41}$

C) $\sqrt{50}$

D) $\sqrt{60}$

6

Which of the following points is NOT on the graph of the line $-2x - 3y = 36$ in the xy-plane?

A) $(-9, 6)$

B) $(-24, 4)$

C) $(6, -16)$

D) $(12, -20)$

CONTINUE

3  3

7

During a coyote repopulation study, researchers determine that the equation $P = 250(1.32)^t$ describes the population P of coyotes t years after their introduction into a new region. Which of the following gives the values of I, the initial population of coyotes, and r, the annual percent increase in this population?

A) $I = 250, r = 32\%$

B) $I = 250, r = 132\%$

C) $I = 330, r = 32\%$

D) $I = 330, r = 132\%$

8

Which of the following is equal to $\frac{1}{\sqrt{3}+1}$?

A) $\frac{\sqrt{3}}{2} - \frac{1}{2}$

B) $\frac{\sqrt{3}}{2} + \frac{1}{2}$

C) $\frac{\sqrt{3}}{4} - \frac{1}{4}$

D) $\frac{\sqrt{3}}{4} + \frac{1}{4}$

9

Which of the following could be the x-intercept and y-intercept of a line that is perpendicular to the line $3x + 6y = 0$?

A) $(-6, 0)$ and $(0, 3)$

B) $(3, 0)$ and $(0, -6)$

C) $(3, 0)$ and $(0, 6)$

D) $(6, 0)$ and $(0, 3)$

10

The function f is defined by the equation $f(x) = x - x^2$. Which of the following represents a quadratic with no real zeros?

A) $f(x) + \frac{1}{2}$

B) $f(x) - \frac{1}{2}$

C) $f\left(\frac{x}{2}\right)$

D) $f\left(x - \frac{1}{2}\right)$

11

In the xy-plane, the graph of the line $y = \frac{15}{4}$ intersects the graph of the equation $y = x^2 + x$ at two points. What is the distance between these two points?

A) $\frac{3}{2}$

B) $\frac{5}{2}$

C) $\frac{15}{4}$

D) 4

12

If $i^{2k} = 1$, and $i = \sqrt{-1}$, which of the following must be true about k?

A) k is a multiple of 4.

B) k is a positive integer.

C) When $2k$ is divided by 4, the remainder is 1.

D) $\frac{k}{2}$ is an integer.

CONTINUE

3  3

13

For all numbers x and y, let z be defined by the equation $z = |2^2 - x^2 - y^2| + 2^2$. What is the smallest possible value of z?

A) 0
B) 4
C) 8
D) 16

14

If the polynomial $P(x)$ has factors of 12, $(x - 5)$, and $(x + 4)$, which of the following must also be a factor of $P(x)$?

A) $2x^2 + 8$
B) $4x^2 - 20$
C) $6x^2 - 6x - 120$
D) $x^2 - 10x + 25$

15

If $f(x) = -x + 7$ and $g(f(x)) = 2x + 1$, what is the value of $g(2)$?

A) -11
B) -5
C) 5
D) 11

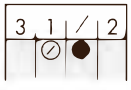
CONTINUE

3 3

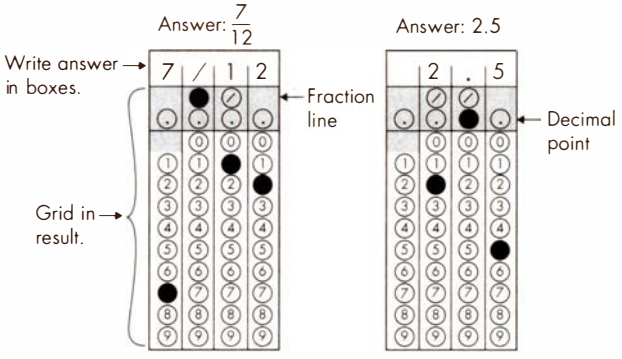
DIRECTIONS

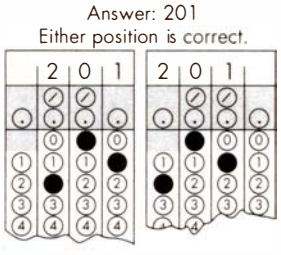
For questions 16–20, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

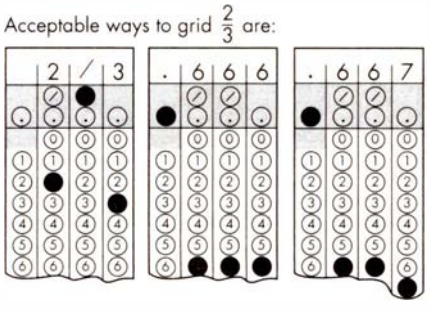
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
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 

, 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.







3  3

16

In a writer's workshop, there are half as many men as women. If there are 24 total men and women in the writer's workshop, how many men are there?

17

If $3-\frac{1}{b}=\frac{3}{2}$ what is the value of b?

18

The square of a positive number is 0.24 greater than the number itself. What is the number?

19

The function f is a quadratic function with zeros at $x = 1$ and $x = 5$. The graph of $y = f(x)$ in the xy-plane is a parabola with a vertex at $(3, -2)$. What is the y-intercept of this graph?

20

When graphed in the xy-plane, the line $y = mx - 4$ intersects the x-axis at an angle of θ. If $m > 0$, $0° < \theta < 90°$, and $\cos\theta = \frac{3}{\sqrt{58}}$, what is the value of m?

STOP

If you finish before time is called, you may check your work on this section only. Do not turn to any other section of the test.

4  4

Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

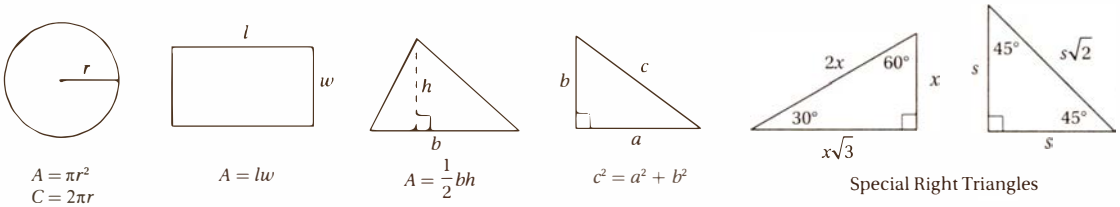
DIRECTIONS

For questions 1–30, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. **For questions 31–38,** solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 31 on how to enter you answers in the grid. You may use any available space in your test booklet for scratch work.

NOTES

1. The use of a calculator is permitted.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the domain of a given function f is the set of all real numbers for which $f(x)$ is a real number.

REFERENCE



$A = \pi r^2$
$C = 2\pi r$

$A = lw$

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

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

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 number of degrees of arc in a circle is 360.
The number of radians of arc in a circle is 2π.
The sum of the measures in degrees of the angles of a triangle is 180.

CONTINUE

4  4

1

If $a = \frac{1}{2}b$ and $2a + 4b = 20$, what is the value of b?

A) 2.5

B) 4

C) 5

D) 15

2

Spin	Frequency
1	3
2	4
3	3
4	0
5	1
6	1
7	1
8	3
9	1
10	3

The spinner for a board game has 10 sectors, numbered 1 through 10. It is spun 20 times and the results summarized in the table above. What is the median value of these 20 spins?

A) 2

B) 4

C) 5

D) 6

3

A 48-gram serving of breakfast cereal contains 8 grams of sugar. How many grams of sugar are there in a 57-gram serving of the same cereal?

A) 9.5

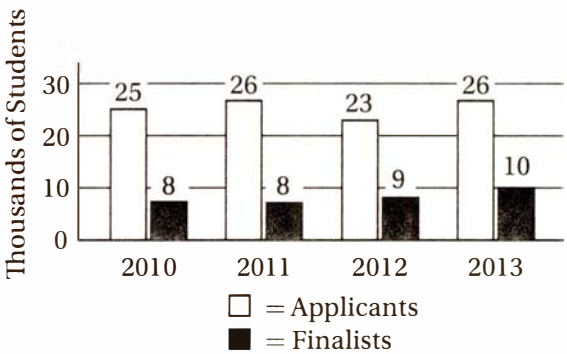
B) 10.5

C) 11.5

D) 12.5

4

STATEWIDE COLLEGE SCHOLARSHIP APPLICANTS AND FINALISTS



The graph above shows the number of applicants and finalists for a statewide college scholarship program over four consecutive years. For which year was the ratio of finalists to applicants the greatest?

A) 2010

B) 2011

C) 2012

D) 2013

5

If $y^3 = 20$ and $z^2 = 10$, what is the value of $(yz)^6$?

A) 2×10^5

B) 4×10^4

C) 2×10^5

D) 4×10^5

CONTINUE

4 4

6

If the sum of a, b, and c is three times the sum of a and b, which of the following expresses the value of a in terms of b and c?

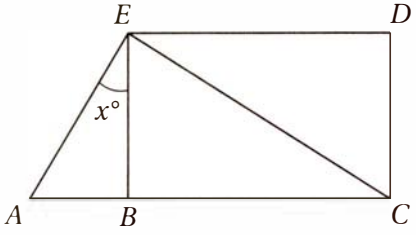
A) $\frac{c-2b}{2}$

B) $\frac{2b-c}{2}$

C) $\frac{c-3b}{3}$

D) $\frac{3b-c}{3}$

7



Note: Figure not drawn to scale.

In the figure above, $BCDE$ is a rectangle, $AC = 14$, $BC = 12$, and $EC = 13$. What is the value of $\tan x$?

A) 0.4

B) 0.6

C) 1.3

D) 2.5

8

Which of the following binomials is a factor of $x^2 - 6x + 8$?

A) $x - 4$

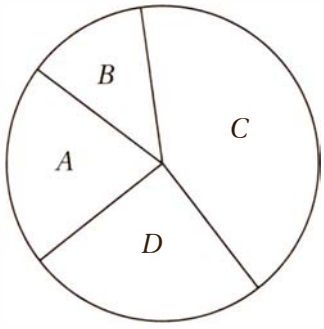
B) $x + 4$

C) $x + 2$

D) $x - 8$

Questions 9–11 are based on the graph below.

MONTHLY SALES



The pie graph above represents the monthly ad sales for four salespeople—Maria, Eli, Georgia, and Zoe—at a social media website. For the month, Maria's sales accounted for 25% of the total, Eli had $3,000 in sales, Georgia had $5,000 in sales, and Zoe had $10,000 in sales.

9

Which sector represents Georgia's sales for the month?

A) Sector A

B) Sector B

C) Sector C

D) Sector D

10

What is the sum of the monthly sales for all four salespeople?

A) $22,500

B) $24,000

C) $25,000

D) $27,000

CONTINUE

4  4

11

If Eli and Georgia both earn 10% commission on their sales, and Maria and Zoe both earn 15% commission on their sales, how much more did Maria earn in monthly commissions than Georgia?

A) $300
B) $360
C) $375
D) $400

12

Let the function f be defined by $f(x) = 2 - |x - 4|$ for all real values of x. What is the greatest value of f?

A) -2
B) 2
C) 4
D) 6

13

If $\frac{3}{b} - \frac{2}{5} = 1$, what is the value of b?

A) $\frac{5}{7}$
B) $\frac{6}{5}$
C) $\frac{15}{7}$
D) 5

14

For the function f, $f(1) = 4$ and $f(2) = 13$. Which of the following equations could describe f?

A) $f(x) = x^2 + 3$
B) $f(x) = x^2 + 9$
C) $f(x) = 2x^2 + 2$
D) $f(x) = 3x^2 + 1$

15

Which of the following is NOT equivalent to $12b^2$?

A) $(6b)(6b)$
B) $12b(b)$
C) $\left(b\sqrt{12}\right)^2$
D) $6b^2 + 6b^2$

16

If m is a number chosen randomly from the set {2, 3, 4, 6} and n is a number chosen randomly from the set {1, 2, 3, 4}, what is the probability that mn is a multiple of 12?

A) $\frac{1}{16}$
B) $\frac{1}{8}$
C) $\frac{1}{4}$
D) $\frac{1}{2}$

17

If $y = 3x + 4$ and $x < 3$, which of the following represents all the possible values of y?

A) $y > 7$
B) $y < 13$
C) $7 < y < 13$
D) $y > 13$

18

If $g(x + 1) = x^2 + 2x + 4$ for all values of x, which of the following is equal to $g(x)$?

A) $x^2 + 4$
B) $x^2 + 3$
C) $(x - 1)^2 + 4$
D) $(x - 1)^2 + 3$

CONTINUE

4 4

19

A: 2, 7, 12, 17, 22, . . .

B: 5, 15, 25, 35, 45, . . .

Two sequences, A and B, follow the patterns shown above. If the nth term of sequence A is 72, what is the nth term of sequence B?

A) 125

B) 135

C) 145

D) 155

20

A website received 2,100 visitors in July from both subscribers and nonsubscribers. If the ratio of subscribers to nonsubscribers among this group was 2:5, how many more nonsubscribers visited the site in July than subscribers?

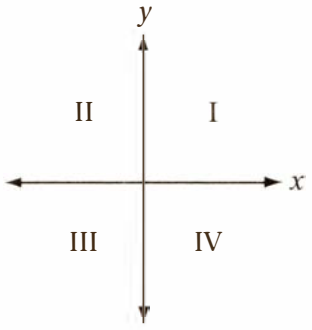
A) 126

B) 630

C) 900

D) 1,260

21



The figure above shows the locations of quadrants I–IV in the xy-plane. Which of the following represents a pair of linear equations that do NOT intersect in quadrant I?

A) $3x + 5y = 15$
$y = 4$

B) $5x + 3y = 15$
$y = 4$

C) $5x - 3y = 15$
$y = 4$

D) $3x - 5y = 15$
$y = 4$

22

During a 40-minute session at a 220 volt charging station, the charge on an electric car battery increases from an initial charge of 50 power units to a final charge of 106 power units. If this charge increases linearly with time, which of the following best describes the charge, q, in power units, on this same battery after charging for t hours from an initial charge of 20 power units? (1 hour = 60 minutes)

A) $q = 55t + 50$

B) $q = 84t + 50$

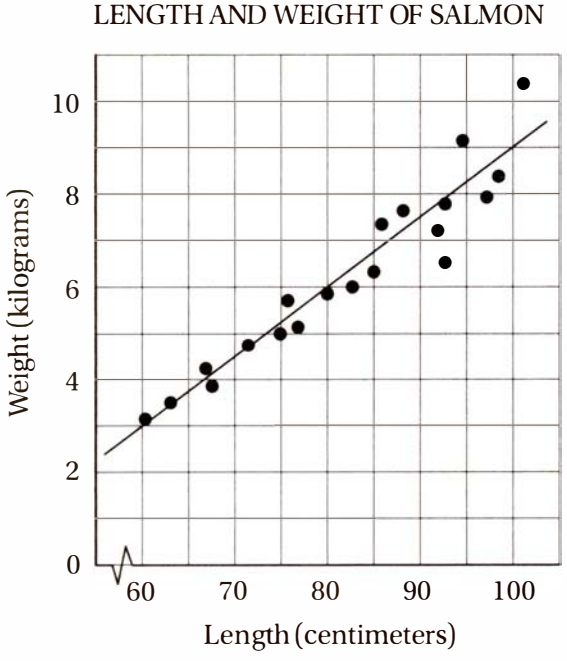
C) $q = 55t + 20$

D) $q = 84t + 20$

CONTINUE

4 4

Questions 23 and 24 are based on the graph below.



23

The scatterplot above shows the length and weight of a group of 20 salmon and the line of best fit for the data. According to this line of best fit, which of the following best approximates the weight, in kilograms, of a salmon that is 95 centimeters long?

A) 7.6
B) 7.8
C) 8.3
D) 8.8

24

Which of the following equations best describes the relationship between w, the weight in kilograms of each salmon, and l, its length in centimeters?

A) $w = \frac{3}{20}l + 2$
B) $w = \frac{20}{3}l + 2$
C) $w = \frac{3}{40}l - 6$
D) $w = \frac{3}{20}l - 6$

25

The average size of a compressed image file is 750 kB. If Ronika's data plan allows her to send 2 GB of data each month before she pays any overage charges, but she plans to use 85% of that data for texting, approximately how many compressed images can she send each month before she incurs any overage charges? (1 GB = 1,000 MB; 1 MB = 1,000 kB)

A) 227
B) 400
C) 2,267
D) 4,000

CONTINUE

4 4

26

Perfectioner's Chocolate Company makes two varieties of truffles: dark chocolate and milk chocolate. Each dark chocolate truffle requires 0.65 ounces of cocoa powder, and each milk chocolate truffle requires 0.45 ounces of cocoa powder. If cocoa powder costs c dollars per pound, and Perfectioner's Chocolate Company has budgeted $200 per week for cocoa powder, which of the following inequalities indicates the restrictions on the number of dark chocolate truffles, d, and the number of milk chocolate truffles, m, the company can make in one week? (1 pound = 16 ounces)

A) $\frac{200}{c} \geq 0.65d + 0.45m$

B) $\frac{200}{16c} \geq 0.65d + 0.45m$

C) $\frac{3{,}200}{c} \geq 0.65d + 0.45m$

D) $3{,}200c \geq \frac{0.65}{d} + \frac{0.45}{m}$

27

If n is a positive integer and $m = 2^{n+2} + 2^n$, what is 2^{n+3} in terms of m?

A) m

B) $\frac{2m}{5}$

C) $\frac{8m}{5}$

D) $3m^2$

28

For how many values of x between 0 and 2π does $\sin 3x = \frac{1}{2}$?

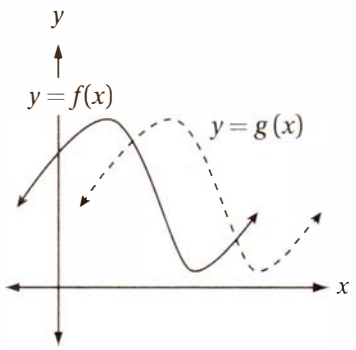
A) Two

B) Three

C) Four

D) Six

29



The figure above shows the graphs of functions f and g in the xy-plane. Which of the following equations could express the relationship between f and g?

A) $f(x) = g(x - 2)$

B) $f(x) = g(x + 2)$

C) $f(x) = g(x) + 2$

D) $f(x) = g(x) - 2$

30

A researcher is trying to estimate the daily amount of time undergraduate computer science majors spend on nonrecreational computer activities. She surveys 120 students from among the computer science majors at a large state university and asks them, "How much time do you spend in nonrecreational computer activities each day?" The mean of these responses is 210 minutes per day, with a standard deviation of 16.5 minutes. If another researcher wishes to present the same question to a new set of subjects at the same university, which of the following subject groups would most likely yield a data set with a smaller margin of error for the estimated daily amount of time undergraduate computer science majors spend on nonrecreational computer activities?

A) 240 randomly selected computer science majors

B) 240 randomly selected liberal arts majors

C) 80 randomly selected computer science majors

D) 80 randomly selected liberal art majors

CONTINUE

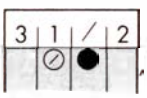
4 4

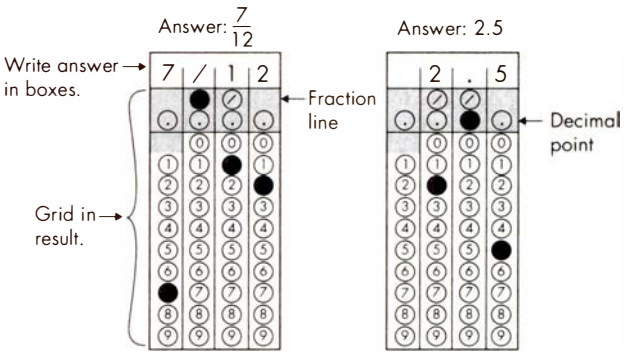
Student-Produced Response Questions

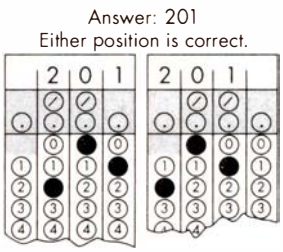
DIRECTIONS

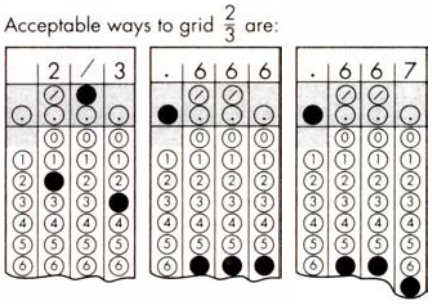
For questions 31–38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

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  , 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.







CONTINUE

4  4

31

What number is 40% greater than the sum of 40 and 80?

32

x	$h(x)$
3	6
5	14

The table above shows a set of ordered pairs that correspond to the function $h(x) = \frac{x^2}{2} + k$. What is the value of k?

33

$$hx + 4y = -3$$

The equation above is the equation of a line in the xy-plane, and h is a constant. If the slope of this line is -13, what is the value of h?

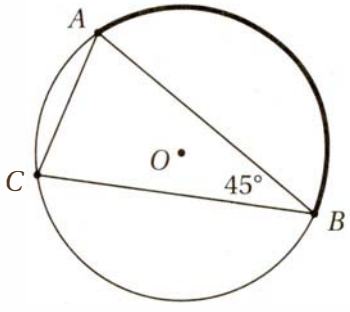
34

The sum of two numbers is four times their difference. The smaller of these numbers is 15. What is the greater number?

35

If $0 < x < 2\pi$ and $5 \cos x = \sqrt{5}$, what is the value of $\left(\frac{\sin x}{3}\right)^2$?

36



Note: Figure not drawn to scale.

In the figure above, the circle with center O has a circumference of 50, and $AB = BC$. What is the length of arc AB?

CONTINUE

4  4

Questions 37 and 38 are based on the scenario described below.

An Internet service provider offers three different plans for residential users. Plan A charges users $500 for the first year of service, and $80 per month thereafter. Plan B charges users $68 per month. Plan C is a "high speed" plan that offers 200% higher speeds for $92 per month.

37

Isabelle has been using Plan A for over a year. She recently reviewed her plan and realized that if she had been using Plan B for same amount of time, she would have saved $104 for Internet service over the entire period. At the time of her review, how many months had Isabelle been on Plan A?

38

Isabelle is now considering switching to either Plan B or Plan C for her home business, but she calculates that having the "high speed" plan will save her only approximately 45 minutes of work each month. At what minimum hourly rate, in dollars per hour, would she have to value her work (that is, how much more would she have to value one hour of free time over one hour of work time) for Plan C to be worth the extra cost over Plan B?

STOP

If you finish before time is called, you may check your work on this section only. Do not turn to any other section of the test.

SAT PRACTICE TEST 2 ANSWER KEY

Section 1: Reading

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

Total Reading Points (Section 1)

Section 2: Writing and Language

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

Total Writing and Language Points (Section 2)

Section 3: Math (No Calculator)

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

---

16. 8
17. 2/3 or .666 or .667
18. 1.2 or 6/5
19. 2.5 or 5/2
20. 7/3 or 2.33

Total Math Points (Section 3)

Section 4: Math (Calculator)

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

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31. 168
32. 3/2 or 1.5
33. 52
34. 25
35. 4/45 or .088 or .089
36. 75/4 or 18.7 or 18.8
37. 47
38. 32

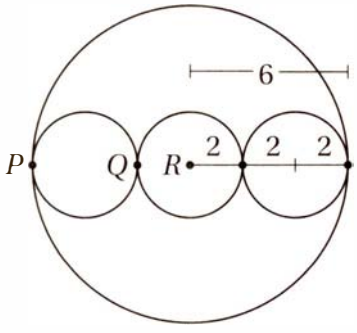
Total Math Points (Section 4)

Section 3: Math (No Calculator)

1. **B** **Algebra (solving equations) EASY**

Original equation: $2b - 1 = 5$
Add 1: $2b = 6$
Divide by 2: $b = 3$
Substitute $b = 3$ into $2b^2 - 1$: $2b^2 - 1 = 2(3)^2 - 1$
$= 18 - 1 = 17$

2. **B** **Special Topics (circles) EASY**



Marking up the diagram with the given information, as shown, shows that three of the smaller radii make up one larger radius. Therefore, the radius of each small circle is $6/3 = 2$.

3. **C** **Algebra (word problems/fractions) EASY**

If 1/5 of her term paper is 15 pages, then the entire paper must be $15 \times 5 = 75$ pages long. This means she has $75 - 15 = 60$ more pages to edit.

4. **C** **Advanced Mathematics (functions and sequences) EASY**

Notice that the rule in choice (C) generates the entire sequence: 7 (times 2 minus 2 equals) 12 (times 2 minus 2 equals) 22 (times 2 minus 2 equals) 42 (times 2 minus 2 equals) 82.

5. **B** **Special Topics (three dimensional geometry) MEDIUM**

Notice that the question asks us for the longest length of a diagonal on one of the *faces* of the box, and that there are three different rectangles as faces: a 3×4 rectangle, a 3×5 rectangle, and a 4×5 rectangle. Clearly the one with the two greatest dimensions will have the longest diagonal, which we can find using the Pythagorean Theorem.

$4^2 + 5^2 = d^2$
Simplify: $16 + 25 = d^2$
Simplify: $41 = d^2$
Take the square root: $\sqrt{41} = d$

6. **A** **Algebra (linear equations) MEDIUM**

We can test each point to find the one that does NOT satisfy the equation.
(A) $-2(-9) - 3(6) = 18 - 18 = 0 \neq 36$
(B) $-2(-24) - 3(4) = 48 - 12 = 36$
(C) $-2(6) - 3(-16) = -12 + 48 = 36$
(D) $-2(12) - 3(-20) = -24 + 60 = 36$
Therefore, the correct answer is (A).

7. **A** **Advanced Mathematics (parabolas) MEDIUM**

The initial population, I, is the population when the time is 0. Therefore, $I = 250(1.32)^0 = 250(1) = 250$. The annual percent increase in the population, r, can be calculated by finding the population at $t = 1$ and then calculating the percent change from the initial population. If $t = 1$, $P = 250(1.32)^1$. As we discussed in Chapter 8, Lesson 7, multiplying a quantity by 1.32 is equivalent to increasing a number by 32% (that is, 1.32 = 100% + 32%), so $r = 32\%$.

8. **A** **Advanced Mathematics (rational expressions) MEDIUM**

$$\frac{1}{\sqrt{3}+1}$$

$$3 + 1$$

Multiply the numerator and denominator by the conjugate $(\sqrt{3}-1)$:

$$\frac{1}{\sqrt{3}+1} \times \frac{\sqrt{3}-1}{\sqrt{3}-1}$$

Simplify:

$$\frac{\sqrt{3}-1}{3-1}$$

Simplify:

$$\frac{\sqrt{3}-1}{2}$$

Distribute:

$$\frac{\sqrt{3}}{2} - \frac{1}{2}$$

9. **B** **Algebra (linear relationships) MEDIUM**

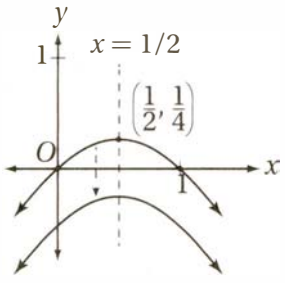
As we discussed in Chapter 7, Lesson 5, a line in the form $ax + by = c$ has a slope of $-a/b$. Therefore, the line $3x + 6y = 0$ has a slope of $-3/6 = -1/2$. Recall, also, from Chapter 7, Lesson 7, that perpendicular lines have slopes that are opposite reciprocals. Therefore, the line we are looking for must have a slope of 2. You might draw a quick sketch of the xy-plane and plot the points given in each choice to find the line that has a slope of 2, or you could use the slope formula from Chapter 7, Lesson 5: slope $= (y_2 - y_1)/(x_2 - x_1)$.

(A) slope $= (3 - 0)/(0 - (-6)) = 3/6 = 1/2$
(B) slope $= (-6 - 0)/(0 - 3) = -6/-3 = 2$
(C) slope $= (6 - 0)/(0 - 3) = 6/-3 = -2$
(D) slope $= (3 - 0)/(0 - 6) = 3/-6 = -1/2$

The only choice that gives a slope of 2 is (B).

10. **B** **Advanced Mathematics (quadratics) HARD**

Perhaps the simplest way to begin this problem is to draw a quick sketch of the function in the *xy*-plane, and then compare this graph to the transformations of the original function given in the choices. Notice that the original function $f(x) = x - x^2$ is easily factored *as* $f(x) = x(1 - x)$. The Zero Product Property (Chapter 9, Lesson 5) tells us that this function must have zeros at $x = 0$ and $x = 1$. Notice, also, that since the coefficient of the x^2 term in the original function is negative (-1), the graph of this quadratic is an "open-down" parabola. Also, the axis of symmetry is halfway between the zeros, at $x = ½$. Plugging $x = ½$ back into the function gives us $f\left(\frac{1}{2}\right) = \frac{1}{2} - \left(\frac{1}{2}\right)^2 = \frac{1}{2} - \frac{1}{4} = \frac{1}{4}$, and therefore, the vertex of the parabola is $\left(\frac{1}{2}, \frac{1}{4}\right)$.



The question asks us to find the function that has no real zeros. This means that the graph of this function must not intersect the *x*-axis at all. Each answer choice indicates a different transformation of the function *f*. Recall from Chapter 9, Lesson 3, that choice (A) $f(x) + ½$ is the graph of *f* shifted *up* ½ unit, choice (B) $f(x) - ½$ is the graph of *f* shifted *down* ½ unit, choice (C) $f(x/2)$ is the graph of *f* *stretched* by a factor of 2 in the horizontal direction, and choice (D) $f(x - ½)$ is the graph of *f* shifted *right* ½ unit. As the sketch above shows, only (B) yields a graph that does not intersect the *x*-axis.

11. **D** **Advanced Mathematics (polynomials) MEDIUM-HARD**

Given equation:	$y = x^2 + x$
Substitute $y = \frac{15}{4}$:	$\frac{15}{4} = x^2 + x$
Multiply by 4:	$15 = 4x^2 + 4x$
Subtract 15:	$0 = 4x^2 + 4x - 15$
Factor using the Product-Sum Method (Chapter 9, Lesson 4):	$0 = (2x + 5)(2x - 3)$
Use Zero Product Property (Chapter 9, Lesson 5):	$2x + 5 = 0; 2x - 3 = 0$
Solve each equation for *x*:	$x = -5/2; x = 3/2$

Therefore, the two points of intersection are $\left(-\frac{5}{2}, \frac{15}{4}\right)$ and $\left(\frac{3}{2}, \frac{15}{4}\right)$, and the distance between these points is

$$\frac{3}{2} - \left(-\frac{5}{2}\right) = \frac{3}{2} + \frac{5}{2} = \frac{8}{2} = 4$$

12. **D** **Special Topics (complex numbers) MEDIUM-HARD**

Recall from Chapter 10, Lesson 10, that $i^n = 1$ if and only if *n* is a multiple of 4. (If you need refreshing, just confirm that $i^4 = 1$, $i^8 = 1$, $i^{12} = 1$, etc.) Therefore, if $i^{2k} = 1$, then $2k$ must be a multiple of 4, and therefore, *k* must be a multiple of2. If *k* is a multiple of2, then $k/2$ must be an integer. Choice (A) is incorrect, because $k = 2$ is a solution, but 2 is not a multiple of 4. Choice (B) is incorrect because $k = -2$ is a solution, and -2 is not a positive integer. Choice (C) is incorrect because $k = 2$ is a solution, but when $2(2) = 4$ is divided by 4, the remainder is 0, not 1.

13. **B** **Algebra (absolute values) MEDIUM-HARD**

In order to minimize the value of $|2^2 - x^2 - y^2| + 2^2$, we must minimize the absolute value. But the least possible value *of any* absolute value expression is 0, so we must ask: is it possible for the expression inside the absolute value operator to equal 0? A little trial and error should reveal that it can if, for instance, $x = 2$ and $y = 0$. Notice that this gives us $|2 - 2^2 - 0^2| + 2 = |0| + 2^2 = 4$. Since the absolute value cannot be less than 0, this must be the minimum possible value.

14. **C** **Advanced Mathematics (analyzing polynomial functions) HARD**

The simplest polynomial with factors of 12, $(x - 5)$, and $(x + 4)$ is $P(x) = 12(x - 5)(x + 4)$. The completely factored form (including the prime factorization of the coefficient) of this polynomial is $P(x) = (2)^2(3)(x - 5)(x + 4)$.

Now, using the methods we discussed in Chapter 9, Lesson 4, we can look at the factored form of each choice:

(A) $2x^2 + 8 = 2(x^2 + 8)$ $(x^2 + 8$ is not factorable over the reals, but it does equal $(x - \sqrt{8i})(x + \sqrt{8i})$

(B) $4x^2 - 20 = 4(x^2 - 5) = (2)^2(x - \sqrt{5})(x - \sqrt{5})$

(C) $6x^2 - 6x - 120 = 6(x^2 - x - 20) = (2)(3)(x - 5)(x + 4)$

(D) $x^2 - 10x + 25 = (x - 5)(x - 5)$

Notice that every polynomial in (A), (B), and (D) contains at least one factor that is NOT in the factored form of $P(x)$. (In (D), the factor $(x - 5)$ appears twice, but it appears only once in $P(x)$.) Only choice (C) contains ONLY factors that appear in $P(x)$, so it is the only choice that must be a factor of $P(x)$.

15. **D** **Advanced Mathematics (functions) HARD**

Given function: $g(f(x)) = 2x + 1$
Substitute $f(x) = -x + 7$: $g(-x + 7) = 2x + 1$
To evaluate $g(2)$, we must let $-x + 7 = 2$: $-x + 7 = 2$
Subtract 7: $-x = -5$
Multiply by -1: $x = 5$
Substitute $x = 5$: $g(-5 + 7) = 2(5) + 1$
Simplify: $g(2) = 11$

16. **8** **Algebra (ratios/word problems) EASY**

Let x equal the number of men in the workshop. If there are half as many men as women, there must be $2x$ women in the workshop, or a total of $x + 2x = 3x$ men and women in the workshop. Since this total equals 24: $3x = 24$
Divide by 3: $x = 8$

As with all algebra problems, make sure you confirm that the value you've solved for is the value the question is asking for. Since x is in fact the number of men, it is the final answer.

17. **2/3 or .666 or .667** **Advanced Mathematics (rational equations) EASY**

$3 - \frac{1}{b} = \frac{3}{2}$
Multiply by the common denominator, $2b$: $6b - 2 = 3b$
Add 2: $6b = 3b + 2$
Subtract $3b$: $3b = 2$
Divide by 3: $b = \frac{2}{3}$

18. **1.2 or 6/5** **Algebra (word problems) HARD**

First, translate the given fact into an equation.
The square of a positive number is 0.24 greater than the number itself: $x^2 = x + 0.24$
Subtract x and 0.24: $x^2 - x - 0.24 = 0$
Multiply by 100 to eliminate the decimal: $100x^2 - 100x - 24 = 0$

Now we factor using Product-Sum Method. Remember that the product number is $ac = (100)(-24) = -2{,}400$, and the sum number is $b = -100$. The two numbers with a sum of -100 and a product of $-2{,}400$ are 20 and -120.
Expand middle term using $-100 = 20 - 120$: $100x^2 + 20x - 120x - 24 = 0$
Factor by grouping in pairs: $20x(5x + 1) - 24(5x + 1) = 0$
Take out common factor: $(5x + 1)(20x - 24) = 0$

Using the Zero Product Property, we see that $x = -1/5$ or $x = 24/20 = 6/5$. Since we are told that x is a positive number, $x = 6/5$ or 1.2.

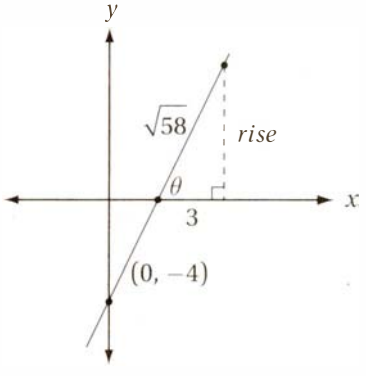
19. **5/2 or 2.5** **Advanced Mathematics (quadratics) MEDIUM-HARD**

Using the Factor Theorem from Chapter 9, Lesson 7, we know that if a quadratic has zeroes at $x = 1$ and $x = 5$, it must have factors of $(x - 1)$ and $(x - 5)$. Since a quadratic can only have two linear factors, f must be of the form $f(x) = k(x - 1)(x - 5)$.
Substitute $x = 3$ and $y = -2$ for the coordinates of vertex: $-2 = k(3 - 1)(3 - 5)$
Simplify: $-2 = k(2)(-2)$
Simplify: $-2 = -4k$
Divide by -4: $\frac{1}{2} = k$

Therefore the equation of the function is $f(x) = \frac{1}{2}(x - 1)(x - 5)$, and we can find its y-intercept by substituting $x = 0$: $f(0) = \frac{1}{2}(0 - 1)(0 - 5)$
Simplify: $f(0) = \frac{5}{2}$

20. **7/3 or 2.33** **Special Topics (trigonometry) HARD**

The graph of the line $y = mx - 4$ has a slope of m and a y-intercept of -4. Since $m > 0$, this slope is positive. We are told that this line intersects the x-axis at an angle of θ, where $\cos\theta = \frac{3}{\sqrt{58}}$. This gives us enough information to sketch a fairly detailed graph:



Notice that this information lets us construct a right triangle that includes θ, in which the adjacent side has length 3 and the hypotenuse has length $\sqrt{58}$ (remember $\cos\theta$ = adjacent/hypotenuse). This triangle is particularly handy because it depicts the *rise* and the *run* for a portion of the line, which will enable us to find the slope. We simply have to find the rise with the Pythagorean Theorem: $3^2 + rise^2 = \left(\sqrt{58}\right)^2$
Simplify: $9 + rise^2 = 58$
Subtract 9: $rise^2 = 49$
Take square root: $rise = 7$
Therefore, the slope of the line is $m = rise/run = 7/3$.

Section 4: Math (Calculator)

1. **B** **Algebra (systems) EASY**

Since the question asks for the value of b, it makes sense to substitute for a so that we get a single equation in terms of b.

Second equation: $2a + 4b = 20$

Substitute $a = \frac{1}{2}b$: $2\left(\frac{1}{2}b\right) + 4b = 20$

Simplify and combine: $b + 4b = 5b = 20$

Divide by 5: $b = 4$

2. **B** **Data Analysis (central tendency) EASY**

The table summarizes the following list of 20 numbers: 1, 1, 1, 2, 2, 2, 2, 3, 3, 3, 5, 6, 7, 8, 8, 8, 9, 10, 10, 10. If a set of numbers is listed in increasing order, the median is the middle number (if the set contains an odd number of elements) or the average of the *two* middle terms (if the set contains an even number of elements). The median of a set of 20 numbers, therefore, is the average of the 10th and 11th terms. Since the 10th number is 3 and the 11th number is 5, the median is $(3 + 5)/2 = 4$.

3. **A** **Problem Solving/Data Analysis (proportions) EASY**

Set up a proportion: $\frac{48}{8} = \frac{57}{x}$

Cross multiply: $456 = 48x$

Divide by 48: $9.5 = x$

4. **C** **Data Analysis (tables) EASY**

The ratio of applicants to finalists is simply the quotient of those two values, which we can calculate for each year.

(A) $8/25 = 0.32$,

(B) $8/26 \approx 0.31$,

(C) $9/23 \approx 0.39$,

(D) $10/26 \approx 0.38$.

5. **D** **Algebra (exponentials) EASY**

Although solving for y and z isn't hard, it is even simpler to just express $(yz)^6$ in terms of y^3 and z^2, using the Laws of Exponentials from Chapter 9, Lesson 9.

Original expression: $(yz)^6$

Law of Exponentials #5: $y^6 z^6$

Law of Exponentials #8: $(y^3)^2(z^2)^3$

Substitute $y^3 = 20$ and $z^2 = 10$: $(20)^2(10)^3$

Substitute $20 = (2)(10)$: $(2)^2(10)^2(10)^3$

Combine terms with like bases with Law of Exponents #4: $2^2(10)^5$

Simplify: 4×10^5

6. **A** **Algebra (word problems) EASY**

The sum of a, b, and c is three times the sum of a and b: $a + b + c = 3(a + b)$

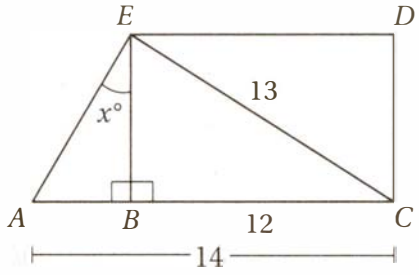
Distribute: $a + b + c = 3a + 3b$

Subtract a: $b + c = 2a + 3b$

Subtract $3b$: $-2b + c = 2a$

Divide by 2: $\frac{c - 2b}{2} = a$

7. **A** **Advanced Mathematics (triangle trigonometry) EASY**



First, let's mark up the diagram with the given lengths, as above. Remember from SOH CAH TOA that the tangent of an angle is equal to the opposite side over the adjacent side, so $\tan x = AB/EB$. $AB = AC - BC = 14 - 12 = 2$, and we can find EB with the Pythagorean Theorem: $EB^2 + 12^2 = 13^2$

Simplify: $EB^2 + 144 = 169$

Subtract 144: $EB^2 = 25$

Take the square root: $EB = 5$

Or, even better, just notice that triangle EBC is a 5-12-13 triangle.

So, $\tan x = AB/EB = 2/5 = 0.4$

8. **A** **Advanced Math (quadratics) EASY**

We can factor this quadratic easily with the Product-Sum Method from Chapter 9, Lesson 4.

$x^2 - 6x + 8 = (x - 4)(x - 2)$

9. **A** **Data Analysis (pie graph) MEDIUM**

Since Maria's sales accounted for 25% of the total, her sector must be $0.25(360°) = 90°$, which is sector D. This means that Eli ($3,000), Georgia ($5,000), and Zoe ($10,000) account for sectors A, B, and C. Since Georgia's total is between Eli's and Zoe's, her sector is the neither the largest nor the smallest of the remaining sectors. Therefore, it must be sector A, which is in the middle.

10. **B** **Data Analysis (pie graph) MEDIUM**

Perhaps the simplest way to approach this is to notice that, since Maria's sales account for 25% of the total, the other salespeople must account for $100\% - 25\% = 75\%$ of

the total. Since this total is \$3,000 + \$5,000 + \$10,000 = \$18,000, we can find the total with a proportion.

$$\frac{\$18{,}000}{75} = \frac{x}{100}$$

Cross multiply: $\$1{,}800{,}000 = 75x$
Divide by 75: $\$24{,}000 = x$

11. **D** **Data Analysis (pie graph) MEDIUM**

Since Maria accounted for 25% of the total sales, she accounted for (0.25)(\$24,000) = \$6,000 in sales. If she earned 15% commission for all sales, she earned (0.15)(\$6,000) = \$900 in commissions. If Georgia earns 10% in commissions, she earned (0.10)(\$5,000) = \$500. Therefore, Maria earned \$900 − \$500 = \$400 more in commissions that Georgia did.

12. **B** **Algebra (absolute value) MEDIUM**

The function $f(x) = 2 - |x - 4|$ reaches its greatest value when the absolute value is minimized. Since absolute values cannot be negative, the least value $|x - 4|$ can have is 0, which it has when $x = 4$:
$f(4) = 2 - |4 - 4| = 2 - 0 = 2$

13. **C** **Advanced Math (rational equations) MEDIUM**

Original equation: $\frac{3}{b} - \frac{2}{5} = 1$
Multiply both sides by common denominator $5b$: $15 - 2b = 5b$
Add $2b$: $15 = 7b$
Divide by 7: $\frac{15}{7} = b$

14. **D** **Advanced Mathematics (functions) MEDIUM**

(A) $f(1) = 1^2 + 3 = 4; f(2) = 2^2 + 3 = 7$
(B) $f(1) = 1^2 + 9 = 10; f(2) = 2^2 + 9 = 13$
(C) $f(1) = 2(1)^2 + 2 = 4; f(2) = 2(2)^2 + 2 = 10$
(D) $f(1) = 3(1)^2 + 1 = 4; f(2) = 3(2)^2 + 1 = 13$
The only function that satisfies the two given equations is (D).

15. **A** **Advanced Mathematics (exponentials) MEDIUM**

(A) $(6b)(6b) = 36b^2$
(B) $12b(b) = 12b^2$
(C) $\left(b\sqrt{12}\right)^2 = \left(b\sqrt{12}\right)\left(b\sqrt{12}\right) = 12b^2$
(D) $6b^2 + 6b^2 = b^2(6 + 6) = 12b^2$

16. **C** **Data Analysis (probability) MEDIUM**

One way to represent this problem clearly is to construct a table that shows all of the possible products mn. A representation of all the equally likely possible outcomes of an event is called the **sample space** for that event. We can label the columns with the possible values of m and the rows with the possible values of n. As we write in the products, let's shade in those that are multiples of 12.

×	2	3	4	6
1	2	3	4	6
2	4	6	8	12
3	6	9	12	18
4	8	12	16	24

This shows that 4 out of the possible 16 products are multiples of 12, and therefore, the probability is 4/16 or $\frac{1}{4}$.

17. **B** **Algebra (inequalities) MEDIUM**

Original inequality: $x < 3$
Multiply by 3: $3x < 9$
Add 4: $3x + 4 < 13$
Substitute $y = 3x + 4$: $y < 13$

18. **B** **Advanced Mathematics (functions) MEDIUM-HARD**

Since the function takes "all values of x," one way to solve this problem is to choose a value of x to work with, like $x = 1$.
Original function: $g(x + 1) = x^2 + 2x + 4$
Substitute $x = 1$: $g(2) = (1)^2 + 2(1) + 4 = 1 + 2 + 4 = 7$
Therefore, the function $g(x)$ will give an output of 7 for an input of 2. We can now test our choices for an input of $x = 2$. (Notice $g(x)$ and $g(x + 1)$ have different inputs.)
(A) $(2)^2 + 4 = 8$
(B) $(2)^2 + 3 = 7$
(C) $(2 - 1)^2 + 4 = 5$
(D) $(2 - 1)^2 + 3 = 4$
Notice that only the expression in (B) gives the correct output.

19. **C** **Advanced Mathematics (sequences) MEDIUM-HARD**

The "brute force" method is to write out sequence A until you reach 72, and see which element in sequence B "matches up" to it. But first we must determine the rule for each sequence. A little guessing and checking should confirm that sequence A follows the "add 5" rule, and sequence B follows the "add 10" rule.

A	2	7	12	17	22	27	32	37
B	5	15	25	35	45	55	65	75
A	42	47	52	57	62	67	72	
B	85	95	105	115	125	135	145	

A more elegant method, however, is to find the formulas for the nth term of A and the nth term of B. This would be a much more efficient method, also, if it takes a while for 72

to appear in set A. If you recall the general formula for the nth term of an arithmetic sequence ($a_n = a_1 + (n - 1)d$), then it's straightforward to see that the formula for A is $a_n = 2 + (n - 1)5 = 5n - 3$ and the formula for B is $b_n = 5 + (n - 1)10 = 10n - 5$. Since we're looking for where the number 72 appears in set A, we can solve $5n - 3 = 72$ to find $n = 15$, then insert this value for n into the formula for B: $b_{15} = 10(15) - 5 = 145$.

20. **C** **Problem Solving and Data Analysis (ratios) MEDIUM**

If the ratio of subscribers to nonsubscribers is 2:5, then we can say there are $2n$ subscribers and $5n$ nonsubscribers, where n is some integer. This means there were a total of $2n + 5n = 7n$ July visitors to the website. Since we know that there were 2,100 visitors in July, we can solve for n: $2{,}100 = 7n$

Divide by 7: $300 = n$

Therefore, there were $2(300) = 600$ subscriber visits and $5(300) = 1{,}500$ nonsubscriber visits, and so there were $1{,}500 - 600 = 900$ more nonsubscribing visitors than subscribing visitors.

21. **A** **Algebra (graphing lines) MEDIUM-HARD**

In quadrant I, both the x- and y-coordinates are positive. Since $y = 4$ in all four systems, we simply need to find the system for which the x-coordinate of the solution is *not* positive. We can find the corresponding x-coordinate for each system by just substituting $y = 4$ and solving for x.

Substitute $y = 4$ into first equation in (A): $3x + 5(4) = 15$

Simplify: $3x + 20 = 15$

Subtract 20: $3x = -5$

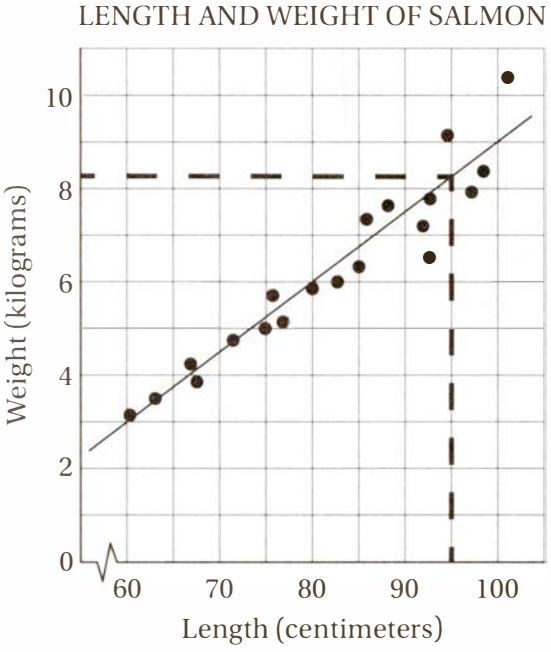
Divide by 3: $x = -5/3$

In this case, we don't need to go any further, because the solution to the system in (A) is $(-5/3, 4)$, which is in quadrant II, not quadrant I.

22. **D** **Advanced Mathematics (quadratics) MEDIUM-HARD**

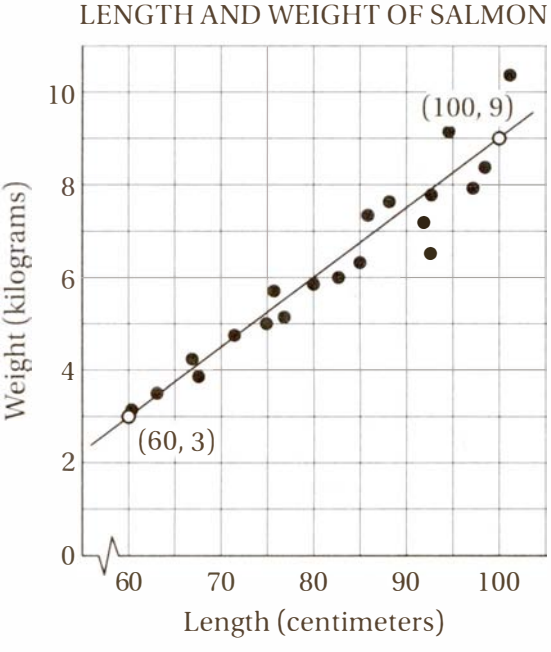
Read the question carefully, and note particularly what it is asking for and what information can help you find it. We are asked to find an equation to relate two variables, q, the number of power units, and t, the number of hours the battery has been charging. We are told that the *initial* charge is 20 power units, so $q = 20$ when $t = 0$. We are also told that the charge increases from 50 power units to 106 power units in 40 minutes. But since our time unit t is in *hours*, we should convert 40 minutes to $40/60 = 2/3$ hours. Therefore, the charging station charges at a rate of $(106 - 50)/(2/3) = (56)/(2/3) = 84$ charging units per hour. This unit rate is the slope of the line, as we discussed in Chapter 8, Lesson 5. Therefore, the equation should represent a line with slope of 84 that contains the point $t = 0$ and $q = 20$, which is the equation in (D) $q = 84t + 20$.

23. **C** **Data Analysis (scatterplots) EASY**



This question simply asks us to find the point on the line of best fit that corresponds to a length of 95 centimeters. As the dotted lines show below, this corresponds to a weight less than halfway between 8 and 9 kilograms, so (C) 8.3 is the best approximation among the choices.

24. **D** **Data Analysis (scatterplots) HARD**



To find the equation of the line of best fit, we can take two points on the line and then use the point-slope formula (Chapter 7, Lesson 5) to find the equation of the

line. To get the most accurate representation of the line, we should choose two points that are fairly far apart, but whose coordinates are easy to determine. The graph shows that this line appears to pass through the points (60, 3) and (100, 9), and so, by the slope formula (Chapter 7, Lesson 5) we can calculate that the slope is (9 − 3)/(100 − 60) = 6/40 = 3/20. Using the first point in the point-slope formula gives $w - 3 = \frac{3}{20}(l - 60)$

Distribute: $w - 3 = \frac{3}{20}l - 9$

Add 3: $w = \frac{3}{20}l - 6$

25. **B** **Problem Solving (rates) MEDIUM**

If Ronika plans to use 85% of her 2 GB data plan for texting, she will have only (15%)(2 GB) = (0.15)(2,000 MB) = 300 MB = 300,000 kB available for image files. Since the average image file is 750 kB, she will be able to send 300,000 kB/750 kB = 400 images per month.

26. **C** **Problem Solving (rates) HARD**

This question asks us to write a mathematical statement that "indicates the restrictions" in this situation. So, what keeps us from making as many truffles as we want? Simple: we are only allowed to spend $200 per week on cocoa powder. Therefore, we can state the restriction on truffles as "the total cost of cocoa powder for our weekly production of truffles must be less than or equal to $200."

Now we must figure out a way to express "the total cost of cocoa powder for our weekly production of truffles." Clearly, this is the total cost for the dark chocolate truffles *plus* the total cost for the milk chocolate truffles:

Cost of cocoa powder for d dark chocolate truffles: $d \text{ truffles} \times \frac{0.65 \text{ oz cocoa}}{1 \text{ truffle}} \times \frac{\$c}{16 \text{ oz cocoa}}$

Simplify: $\$\frac{0.65cd}{16}$

Cost of cocoa powder for m milk chocolate truffles: $m \text{ truffles} \times \frac{0.45 \text{ oz cocoa}}{1 \text{ truffle}} \times \frac{\$c}{16 \text{ oz cocoa}}$

Simplify: $\$\frac{0.45cm}{16}$

The total cost for cocoa powder must not be greater than $200: $200 \geq \frac{0.65cd}{16} + \frac{0.45cm}{16}$

Multiply by 16: $3{,}200 \geq 0.65cd + 0.45cm$

Divide by c: $\frac{3{,}200}{c} \geq 0.65d + 0.45m$

27. **C** **Advanced Mathematics (exponentials) HARD**

Notice that this question asks us to find the value of 2^{n+3}, so we should try to solve the given equation for 2^{n+3}.

Original equation: $m = 2^{n+2} + 2^n$

Factor $2n$ from the terms on the right side: $m = 2^n(2^2 + 1)$

Simplify: $m = 2^n(5)$

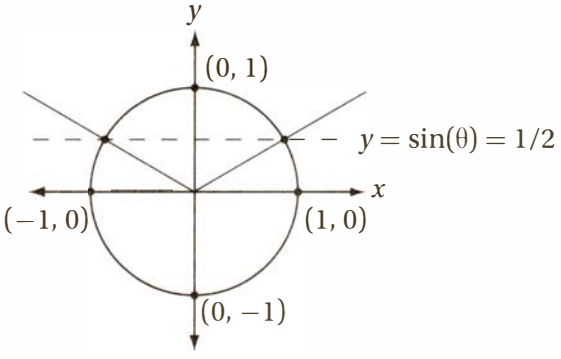
Divide by 5: $\frac{m}{5} = 2^n$

Multiply by 2^3: $2^3\left(\frac{m}{5}\right) = 2^n \times 2^3$

Simplify: $\frac{8m}{5} = 2^{n+3}$

28. **D** **Special Topics (trigonometry) HARD**

Although this question can be solved by graphing, it is simpler and more efficient to imagine the unit circle, as we discussed in Chapter 10, Lesson 9.



We are asked to consider those angles that have a sine of ½. As you recall from Chapter 10, Lesson 9, the angles whose sine is ½ correspond to those angles that intersect the unit circle at any point where $y = ½$, as shown in the diagram above. Notice that the line $y = ½$ intersects the unit circle in two points. We are asked to consider sin $3x$, where x takes values from 0 to 2π. This means that $3x$ takes values from 0 to 6π. In other words, we are taking three complete trips around the unit circle (since each trip around is 2π radians). How many times will we visit those two points if we take three trips around the circle? Clearly (3)(2) = 6 times.

29. **B** **Advanced Mathematics (function transformations) HARD**

The figure clearly shows that the function $y = f(x)$ is similar in shape to the function $y = g(x)$, but is shifted to the left by some positive distance. Recall from Chapter 9, Lesson 3, that when the graph of $y = g(x)$ is shifted to the left by k units, the equation of the new function is $y = g(x + k)$. The only equation that has this form is (*B*) $f(x) = g(x + 2)$.

30. **A** **Data Analysis (data spread) HARD**

One important rule in data gathering is, **the more data we can gather on a population, the more reliable our statistics about that population will be**. More specifically, the greater fraction of the population we can sample, the smaller our margin of error from the true value of the population statistic. Another important rule in data gathering is **the more similar our sample is to the population of interest, the smaller our statistical error will be**. Since the sample size is highest and the group is most like the population (of undergraduate computer science majors) in choice (A), that group should produce the smallest margin of error in the data.

31. **168** **Algebra (percents) EASY**

The sum of 40 and 80 is 120, and 40% of 120 is (0.40)(120) = 48, so the number that is 40% greater than 120 is 120 + 48 = 168. Also remember that increasing a number by 40% is equivalent to multiplying it by 1.4.

32. **3/2 or 1.5** **Advance Mathematics (quadratics) MEDIUM**

Original function: $h(x)=\frac{x^2}{2}+k$

Substitute $h(3) = 6$ (from table): $6=\frac{3^2}{2}+k$

Simplify: $6 = 4.5 + k$

Subtract 4.5: $1.5 = k$

To check your answer, you can plug in the second row of the table to verify that $\frac{5^2}{2}+1.5=14$

33. **52** **Algebra (linear equations) MEDIUM**

In Chapter 7, Lesson 5 we discussed the fact that the slope of a linear equation in "standard form," $ax + by = c$ is equal to $-a/b$. Therefore, the linear equation $hx + 4y = -3$ has a slope of $-h/4$. If this slope equals -3, then

$$\frac{-h}{4}=-13$$

Multiply by -4: $h = 52$

34. **25** **Algebra (word problems) EASY**

Let's let x be the larger number. 15 is the smaller number. The sum of the numbers is four times their difference:

$x + 15 = 4(x - 15)$

Distribute: $x + 15 = 4x - 60$

Add 60: $x + 75 = 4x$

Subtract x: $75 = 3x$

Divide by 3: $25 = x$

35. **4/45 or .088 or .089** **Special Topics (trigonometry) MEDIUM-HARD**

Given equation: $5\cos x=\sqrt{5}$

Divide by 5: $\cos x=\frac{\sqrt{5}}{5}$

This gives us the value of cos x, but we are asked to evaluate $\left(\frac{\sin x}{3}\right)^2$, which of course is in terms of sin x. This should remind you of the Pythagorean Identity we discussed in Chapter 10, Lesson 9: for all real numbers x, $\sin^2 x + \cos^2 x = 1$.

Pythagorean Identity: $\sin^2 x+\cos^2 x=1$

Subtract $\cos^2 x$: $\sin^2 x=1-\cos^2 x$

Expression to be evaluated: $\left(\frac{\sin x}{3}\right)^2$

Simplify: $\frac{\sin^2 x}{9}$

Substitute $\sin^2 x = 1 - \cos^2 x$: $\frac{1-\cos^2 x}{9}$

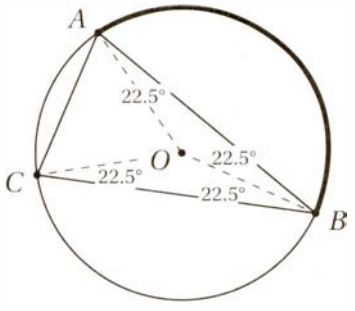
Substitute $\cos x=\frac{\sqrt{5}}{5}$: $\frac{1-\left(\frac{\sqrt{5}}{5}\right)^2}{9}$

Simplify: $\frac{1-\frac{5}{25}}{9}$

Simplify: $\frac{\frac{4}{5}}{9}$

Simplify by multiplying $\frac{5}{5}$: $\frac{4}{45}$

36. **75/4 or 18.7 or 18.8** **Special Topics (arcs and triangles) MEDIUM-HARD**



Let's start by drawing the three radii OA, OB, and OC. Since these radii are all congruent, and because $AB = BC$, the triangles AOB and COB are congruent (by the SSS Theorem). This implies that OB bisects angle ABC, so the base angles of both isosceles triangles must have measure $45°/2 = 22.5°$. Therefore, angle AOB, which is the central angle for arc AB, must have measure $180° - 22.5° - 22.5° = 135°$. Now we can use the fact that the circumference of the circle is 50 to find the length or arc AB.

$$\frac{m\overset{\frown}{AB}}{135^\circ}=\frac{50}{360^\circ}$$

Let $x = m\overset{\frown}{AB}$ and cross multiply:	$360x = 6{,}750$
Divide by 360:	$x = 75/4 = 18.75$

37. **47** **Problem Solving (extended thinking) HARD**

Let n equal the number of months that Isabelle has been on Plan A. If she has been on Plan A for over a year, then $n > 12$. This means that she has been on Plan A for $n - 12$ months beyond the first year. Since Plan A costs \$500 for the first year and \$80 per month thereafter, the total cost for her n months of service is $\$500 + \$80(n - 12)$. If she had been on Plan B, the cost would have been \$68 per month, or a total of $\$68n$. If Plan B would have saved her \$104 over this period, $500 + 80(n - 12) - 104 = 68n$

Distribute and simplify:	$396 + 80n - 960 = 68n$
Simplify:	$80n - 564 = 68n$
Add 564:	$80n = 68n + 564$
Subtract $68n$:	$12n = 564$
Divide by 12:	$n = 47$

38. **32** **Problem Solving (extended thinking) HARD**

Since Plan C costs \$92 per month and Plan B costs \$68 per month, Plan C costs $\$92 - \$68 = \$24$ more dollars per month than plan B. Since shifting plans would save her only 45 minutes of work, or 3/4 hour, each month, she would have to value one hour of free time over one hour of work time at \$24/(¾ hour) = \$32.

Section 5: Essay

Sample Response

Reading Score: 8 out of 8
Analysis Score: 8 out of 8
Writing Score: 8 out of 8

James Schlesinger's essay, "Cold Facts on Global Warming," is a counterargument to the "political alarmism" (to use Schlesinger's words) over global warming. His tone is critical but sober, and he makes frequent use of carefully selected scientific and historical data, juxtaposed with hints at the dangers of political posturing, to make the case for caution in addressing the issue of climate change. He appeals frequently to the ethics of economic prudence and global stewardship, as well as the value of scientific judiciousness. Unfortunately, because Schlesinger's essay was written over a decade ago, it lacks the evidence from the current golden age of climate science. More substantially, however, Schlesinger undermines his own purpose by making political criticisms while calling for nonpartisan objectivity, by mongering fearsome scenarios while arguing against "scare tactics," and by ignoring the scientific evidence against his claims while advocating an "emphasis on science."

Schlesinger begins his discussion with a call for "facts and logic" over "rhetoric." This is classic polemical posturing: we all believe that our positions are "factual and logical" and that our opponents' are merely "rhetoric." In Schlesinger's view, the "rhetoric" includes the claims that "emissions of carbon dioxide are the primary cause of any change in global temperature and inevitably will lead to serious environmental harm in the decades ahead." By inserting the modifiers "any" and "inevitably," he creates a straw man. Most who argue about the seriousness of climate change generally avoid such absolute assertions and instead present evidence from satellites, ice cores, atmospheric analysis, and comprehensive long-term climatic studies to build a case for action. Schlesinger does not address this evidence.

In his argument, Schlesinger appears to value small government and the protection of American industry over the stewardship of the planet. His concern about the Kyoto Protocol of 1997 is not that it eschews the "facts and logic" of climate science, but rather that it "could cost \$300 billion annually." He presents no scientific critique of the Kyoto Protocol of 1997 beyond the assertion that Democrat Al Gore was "willing to embrace" a "treaty that would harm the economy," and the vague claim that "the treaty's flaws have become more evident." His method of argumentation here appears to contradict his call for "facts and logic" over "rhetoric."

In contrast to the irresponsibility of Al Gore and the Clinton administration, Schlesinger offers the soberly scientific Bush administration, which "focused on filling in gaps in our state of knowledge, promoting the development of new technology, encouraging volunteer programs, and working with other nations on controlling the growth of greenhouse gas emissions." Schlesinger does not offer a specific benefit our planet has gained from these efforts, which even Schlesinger himself admits involved "spending more than \$4 billion annually." Someone pleading for fiscal responsibility might try to account for such a huge expenditure.

Schlesinger believes that our inaction on climate change is a virtue: that scientific prudence requires "filling the gaps in our state of knowledge" above everything else, including industrial restraint. He states that "what we know for sure is quite limited," yet is confident enough in his limited knowledge to assert that "the theory that increasing concentrations of greenhouse gases like carbon dioxide will lead to further warming is at least an oversimplification," directly contradicting the simple middle school experiment showing that a soda bottle filled with carbon dioxide warms far more quickly than one filled only with air.

Schlesinger then selects data trends that seem to support his call for caution, rather than action: he asserts that "satellite measurements over 35 years show no significant warming in the lower atmosphere" and that there was "atmospheric cooling from 1940 to around

1975." Schlesinger does not explain why climate scientists, who are certainly aware of these data, nevertheless believe in anthropogenic global warming.

Not to be accused of cherry-picking data, Schlesinger next offers "a longer view of climate history." He asserts that temperatures "were 1 to 2 degrees warmer than they are today" during the Climatic Optimum of the early Middle Ages, and this warming did not have "anything to do with man-made greenhouse gases." Evidently, we should think that because it was warmer a very long time ago, burning coal today must not be changing the climate.

In the last two paragraphs, Schlesinger essentially retracts his concern about "filling the gaps in our state of knowledge" after all, because he believes it is impossible to fill the most important gaps: "It is not possible to know now how much of the warming over the last 100 years or so was caused by human activities and how much was because of natural forces." So if it is impossible to know, we might ask, why should we expend "more than $4 billion annually" to study it? He does not say. We get Schlesinger's most sonorous call to action in the last paragraph, where he suggests "engagement of the business community on voluntary programs." That is, get big government off the backs of corporations and let them do as they please.

Scoring

Reading—8 (both readers gave it a score of 4)

This response demonstrates a very strong and thorough comprehension of Schlesinger's essay through skillful use of summary, paraphrase, and direct quotations. The author summarizes Schlesinger's central tone, thesis, and modes of persuasion (*His tone is critical but sober, and he makes frequent use of carefully selected scientific and historical data, juxtaposed with hints at the dangers of political posturing, to make the case for caution in addressing the issue of climate change.*) and shows a clear understanding of how Schlesinger's supporting ideas string together and serve his overall thesis (*Schlesinger begins his discussion with a call . . . He appears to value small government . . . Schlesinger offers the soberly scientific Bush administration . . . Schlesinger believes that our inaction on global warming is a virtue . . . Schlesinger next offers . . . In the last two paragraph, Schlesinger essentially retracts his concern*). Importantly, this response also offers abundant supporting quotations to illustrate each paraphrase. Taken together, these elements demonstrate outstanding comprehension of Schlesinger's essay.

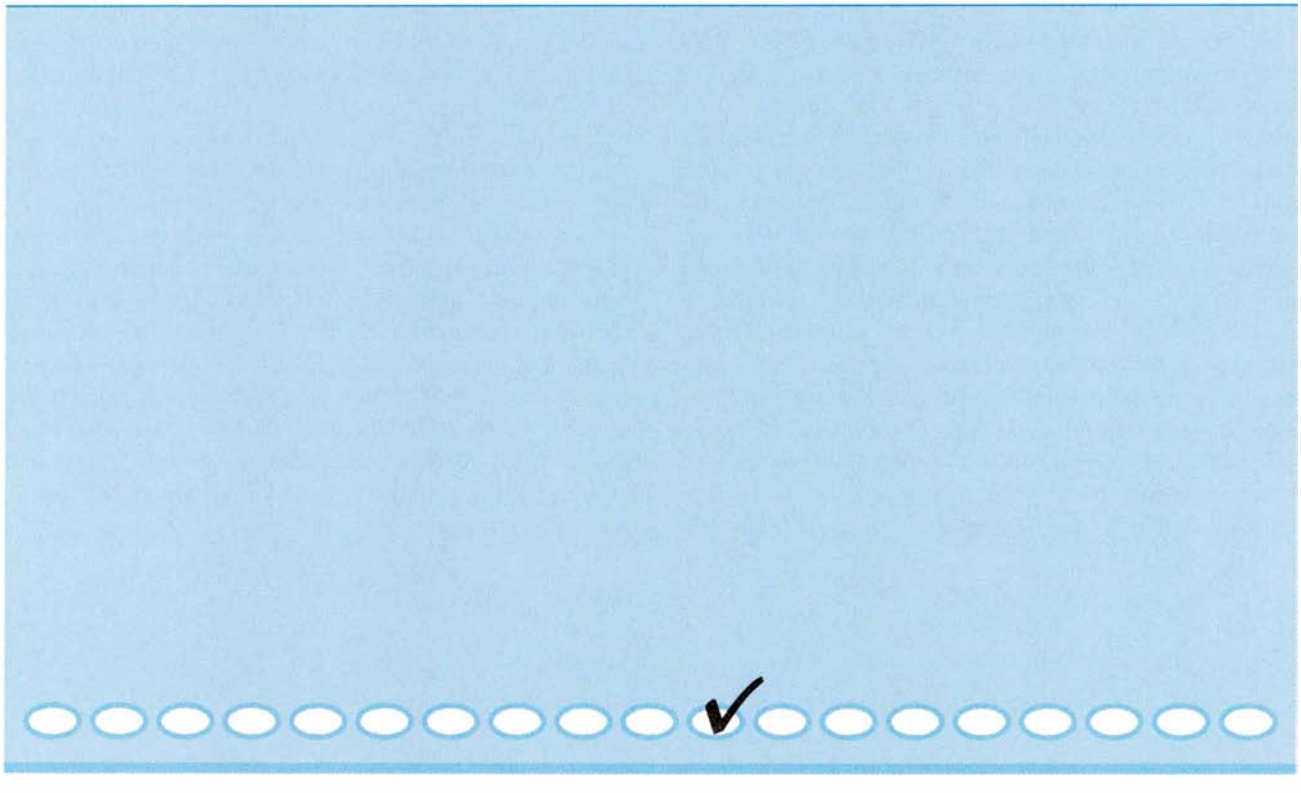
Analysis—8 (both readers gave it a score of 4)

Although this response occasionally veers toward advocacy, it never turns away from careful analysis. Indeed, its thoughtful and thorough critique of Schlesinger's essay demonstrates a sophisticated understanding of the analytical task. The author has identified Schlesinger's primary modes of argument (*He appeals frequently to the ethics of economic prudence and global stewardship, as well as the value of scientific judiciousness*) and even uses those standards to analyze Schlesinger's essay itself, and indicates points at which Schlesinger's argument seems self-defeating (*Schlesinger undermines his own purpose by making political criticisms while calling for nonpartisan objectivity, by mongering fearsome scenarios while arguing against "scare tactics," and by ignoring the scientific evidence against his claims while advocating an "emphasis on science"*). Overall, this analysis of Schlesinger's essays demonstrates a thorough understanding not only of the rhetorical task that Schlesinger has set for himself, but also of the degree to which it upholds its own standards.

Writing—8 (both readers gave it a score of 4)

This response demonstrates an articulate and effective use of language and sentence structure to establish and develop a clear and insightful central claim that *Schlesinger's essay is a counterargument to the "political alarmism" . . . over global warming* . . . but that *it undermines [its] own purpose.* The response maintains a consistent focus on this central claim, and supports it with a well-developed and cohesive analysis of Schlesinger's essay. The author demonstrates effective choice of words and phrasing (*undermines his own purpose . . . mongering fearsome scenarios . . . Schlesinger believes that our inaction on climate change is a virtue*), strong grasp of relevant analytical and rhetorical terms, like *economic prudence, nonpartisan objectivity, and polemical posturing.* The response is well-developed, progressing from general claim to specific analysis to considered evaluation. Largely free from grammatical error, this response demonstrates strong command of language and proficiency in writing.

PRACTICE TEST 3



3 3

Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

DIRECTIONS

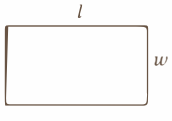
For questions 1–15, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. **For questions 16–20,** solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 16 on how to enter you answers in the grid. You may use any available space in your test booklet for scratch work.

NOTES

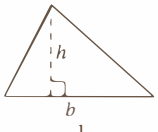
1. The use of a calculator is NOT permitted.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the domain of a given function f is the set of all real numbers for which $f(x)$ is a real number.

REFERENCE

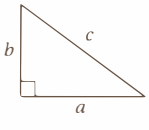
$A = \pi r^2$
$C = 2\pi r$



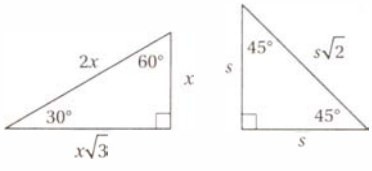
$A = lw$



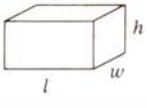
$A = \frac{1}{2}bh$



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



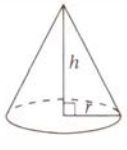
Special Right Triangles



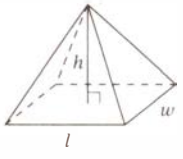
$V = lwh$

$V = \pi r^2 h$

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



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



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

The number of degrees of arc in a circle is 360.
The number of radians of arc in a circle is 2π.
The sum of the measures in degrees of the angles of a triangle is 180.

3  3

1

If $2x - 3y = 9$ and $y = 3$, then what is the value of x?

A) 0

B) 3

C) 6

D) 9

2

$$x - y = -4$$

$$x - 2y = -6$$

Which of the following ordered pairs (x, y) satisfies the system of equations above?

A) $(-2, 2)$

B) $(-2, 4)$

C) $(4, 8)$

D) $(4, -8)$

3

An information technology company estimates the cost of a project, in dollars, using the expression $240 + 3nt$, where n is the number of computer servers working on the project and t is the total time, in hours, the project will take using n servers. Which of the following is the best interpretation of the number 3 in the expression?

A) Each server costs the company $3 per hour to run.

B) A minimum of 3 servers will work on the project.

C) The price of the project increases by $3 every hour.

D) Each server can work 3 hours per day.

4

If $\frac{5}{8}x = -\frac{1}{16}$, what is the value of x?

A) $-\frac{11}{16}$

B) $-\frac{1}{10}$

C) $-\frac{5}{128}$

D) $\frac{9}{16}$

5

$$a^4 - 6a^2 + 10$$

Which of the following is equivalent to the expression shown above?

A) $(a^2 - 2)(a^2 - 5)$

B) $(a^2 - 1)(a^2 - 10)$

C) $(a^2 + 3)^2 + 1$

D) $(a^2 - 3)^2 + 1$

6

In triangle ABC, angle C has a measure of 90°. If $\sin A = 0.6$, what is the value of $\cos B$?

A) 0.3

B) 0.4

C) 0.6

D) 0.8

CONTINUE

3  3

7

$$\sqrt{m^2 - 13} - x = 0$$

If $m < 0$ and $x = 6$ in the equation above, what is the value of m?

A) -13

B) -10

C) -7

D) -3

8

If $\frac{x^b}{x^a} = 16$ and $x^{-2} = \frac{1}{16}$, what is the value of $b - a$?

A) -2

B) 2

C) 4

D) 8

9

b	2	4	6	8
$f(b)$	1	25	65	121

The table above shows ordered pairs that satisfy the function f. Which of the following could define f?

A) $f(b) = 3b^2 - 2$

B) $f(b) = 3b^2 - 4$

C) $f(b) = 2b^2 - 7$

D) $f(b) = 2b^2$

10

The equation $y = kx - 1$, where k is a constant, describes a line in the xy-plane. If the graph of this line contains the point (a, b), where a and b are nonzero, what is the value of k in terms of a and b?

A) $\frac{b + 1}{a}$

B) $\frac{b - 1}{a}$

C) $\frac{a}{b + 1}$

D) $\frac{a}{b - 1}$

11

The equation $\frac{12x^2 + 6x - 23}{bx - 3} = -2x - \frac{23}{bx - 3}$ is true for all values of $x \neq \frac{3}{b}$, where b is a constant. What is the value of b?

A) -12

B) -6

C) 4

D) 6

12

If h and k are functions such that $h(x) = x + 3$ and $h(g(2)) = 9$, which of the following could describe $g(x)$?

A) $x^2 + 2$

B) $x^2 + 3$

C) $x^2 + 4$

D) $x^2 + 5$

CONTINUE

3 3

13

$$y = a(x + 3)(x - 1)$$

In the quadratic function above, a is a nonzero constant. The graph of the equation in the xy-plane is a parabola with vertex (m, n). Which of the following is equal to n?

A) 0

B) $-a$

C) $-2a$

D) $-4a$

14

$$x^2 - 2ax + b = 0$$

In the equation above, a and b are constants. If this equation is solved for x, there are two solutions. What is the sum of these two solutions?

A) $2a$

B) $-2a$

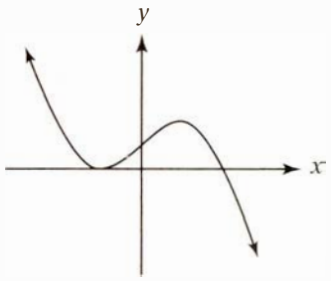
C) b

D) $-b$

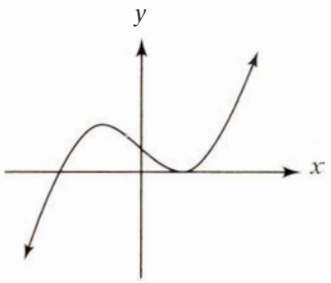
15

Which of the following can represent the graph in the xy-plane of $y = a(x - b)(x + c)^2$, where a, b, and c are all positive constants?

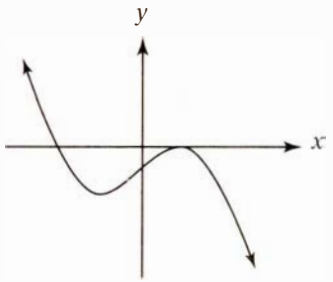
A)



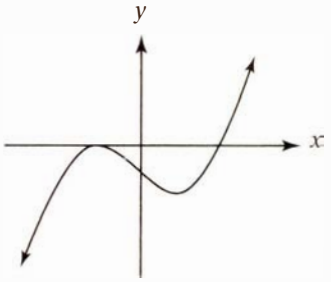
B)



C)



D)



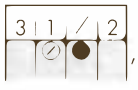
CONTINUE

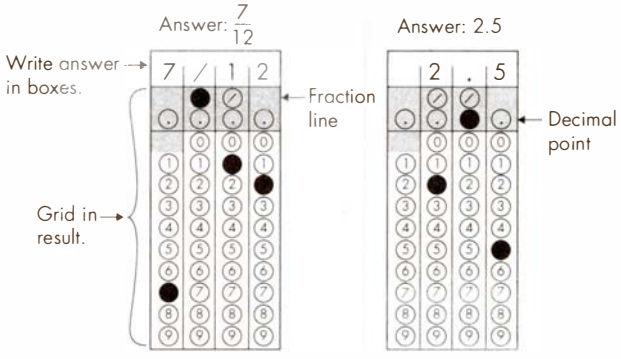
3 3

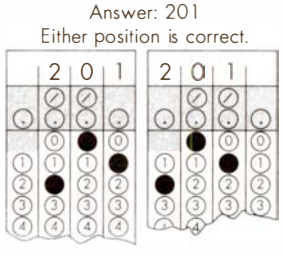
DIRECTIONS

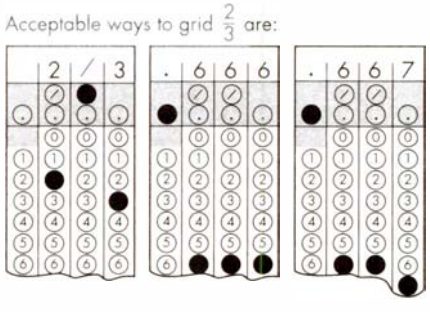
For questions 16–20, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

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  , 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.







CONTINUE

3  3

16

At a restaurant, each large order of fries has 350 more calories than one large soda. If 2 large orders of fries and 3 large sodas have a total of 1,500 calories, how many calories does one large order of fries have?

17

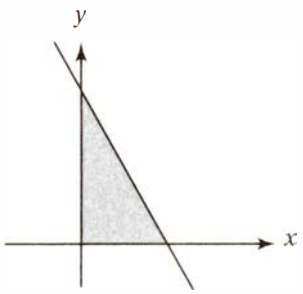
If $a = 4\sqrt{2}$ and $2a = \sqrt{2b}$, what is the value of b?

18

$$x + \frac{36}{x} = 12$$

If $x > 0$, what is the solution to the equation above?

19



Note: Figure not drawn to scale.

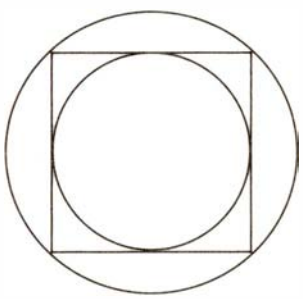
$$x \geq 0$$

$$y \geq 0$$

$$3x + y \leq k$$

In the figure above, the shaded region represents the solution set for the system of inequalities shown. If the area of this shaded region is 24 square units, what is the value of k?

20



In the figure above, a circle is inscribed in a square that is inscribed in a larger circle. If the area of the larger circle is 16.5 square units, what is the area of the smaller circle?

STOP

If you finish before time is called, you may check your work on this section only. Do not turn to any other section of the test.

4 4

Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

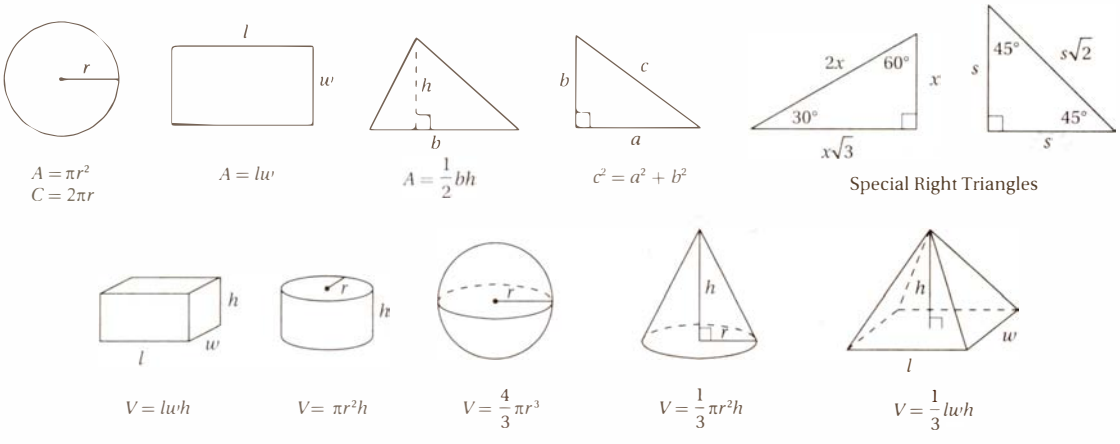
DIRECTIONS

For questions 1–30, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. **For questions 31–38,** solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 31 on how to enter you answers in the grid. You may use any available space in your test booklet for scratch work.

NOTES

1. The use of a calculator is permitted.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the domain of a given function f is the set of all real numbers for which $f(x)$ is a real number.

REFERENCE



$A = \pi r^2$, $C = 2\pi r$ | $A = lw$ | $A = \frac{1}{2}bh$ | $c^2 = a^2 + b^2$ | 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 number of degrees of arc in a circle is 360.
The number of radians of arc in a circle is 2π.
The sum of the measures in degrees of the angles of a triangle is 180.

CONTINUE

4 4

1

A multiple-choice math test consists of 50 questions. Every student earns 2 points for each correct answer, −0.25 points for each incorrect answer, and 0 points for each question left unanswered. If a student answers 40 questions and gets 32 of them correct, how many points does the student earn?

A) 61.5

B) 62.0

C) 62.5

D) 64.0

2

If the average of 3, 5, and m is 10, what is the value of m?

A) 2

B) 6

C) 12

D) 22

3

If $3b + 4 = -1$, what is the value of $9b + 12$?

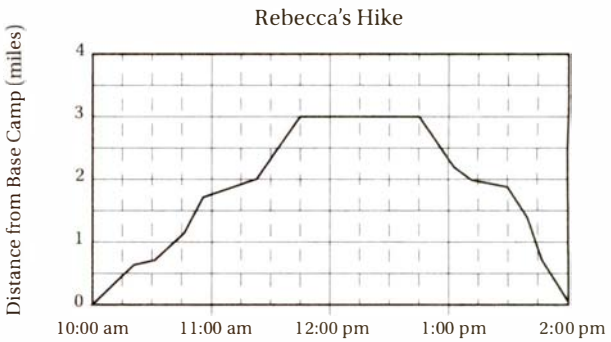
A) −8

B) −4

C) −3

D) −2

4



The graph above shows Rebecca's distance from her base camp as she hiked to a mountaintop, took a 1-hour break for lunch, and returned back to base camp. According to the graph, approximately how much longer was her hike to the mountaintop than her hike from the mountaintop back to base camp?

A) 20 minutes

B) 30 minutes

C) 45 minutes

D) 60 minutes

5

In the 2014 season, the Bombers baseball team had a win-to-loss ratio of 5:3, with no game ending in a tie. If the Bombers played 120 total games in 2014, how many games did they lose?

A) 24

B) 36

C) 45

D) 72

CONTINUE

4 4

6

$$3x^3 - 2x^2 + 5$$

$$5x^2 + x - 10$$

Which of the following is the sum of the two polynomials shown above?

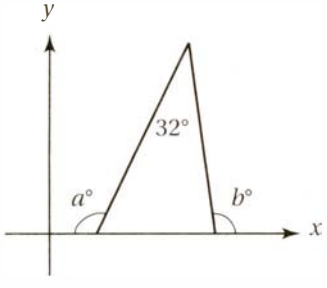
A) $8x^3 - 2x - 5$

B) $3x^3 - x^2 - 5$

C) $3x^3 + 3x^2 + x - 5$

D) $8x^5 - x^3 - 5$

7



In the figure above, what is the value of $a + b$?

A) 212

B) 238

C) 296

D) 328

8

If $\frac{K + i}{i} = 1 - 2i$, where $i = \sqrt{-1}$, what is the value of K?

A) 2

B) -2

C) $2 + i$

D) $-2 + i$

9

x	y
2	10
4	5
10	2

Based on the ordered pairs in the table above, which of the following could express the relationship between the variables x and y?

A) y varies linearly with, but not directly as, x.

B) y varies directly as x.

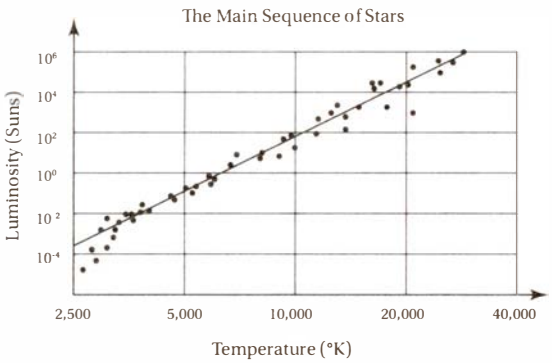
C) y varies inversely as x.

D) y varies exponentially as x.

CONTINUE

4 4

Questions 10–12 refer to the following information.



The scatterplot above charts the temperature (in degrees Kelvin) and luminosity (in Suns) for 50 stars, including our own sun, that fall under the category of "Main Sequence" stars.

10

The vertical axis indicates the luminosity of the stars in units called "Suns." (A Sun unit equals the luminosity of our own sun.) According to the scatterplot, which of the following is the best estimate for the temperature of our sun?

A) 2,600°K
B) 5,800°K
C) 10,100°K
D) 12,400°K

11

According to the line of best fit shown on the scatterplot, a Main Sequence star with a temperature of 10,000°K is approximately how many times as luminous as a Main Sequence star with a temperature of 5,000°K?

A) 9 times as luminous
B) 90 times as luminous
C) 900 times as luminous
D) 900,000 times as luminous

12

What percent of the stars represented in the scatterplot have a luminosity less than 0.0001 Sun?

A) 0.2%
B) 0.4%
C) 2%
D) 4%

CONTINUE

4 4

13

$$\frac{a+k}{b+k} = -2$$

Given the formula above, which of the following expresses k in terms of a and b?

A) $\frac{-a-2b}{3}$

B) $\frac{a-2b}{3}$

C) $\frac{-a+2b}{2}$

D) $\frac{a-2b}{2}$

14

Which of the following functions, when graphed in the xy-plane, will intersect the x-axis exactly 3 times?

A) $f(x) = (x^2 + 1)(x^2 + 1)$

B) $f(x) = (x^2 - 1)(x^2 + 1)$

C) $f(x) = x^2(x^2 - 1)$

D) $f(x) = x^2(x^2 + 1)$

15

For how many distinct integer values of n is $(n + 2)(n + 8)$ negative?

A) Four

B) Five

C) Six

D) Seven

16

Lauren's car can travel d miles per gallon of gasoline. If she travels at a constant speed of s miles per hour, which of the following represents the number of hours she can travel on 6 gallons of gasoline?

A) $\frac{6d}{s}$

B) $\frac{6s}{d}$

C) $\frac{d}{6s}$

D) $\frac{s}{6d}$

17

$$\frac{2x+1}{2y} = \frac{a}{b}$$

If a and b are non-zero constants in the linear equation above, what is the slope of this line when it is graphed in the xy-plane?

A) $\frac{b}{a}$

B) $\frac{b}{2a}$

C) $\frac{b+a}{2a}$

D) $\frac{b-a}{2a}$

CONTINUE

4  4

Questions 18 and 19 refer to the following information.

$$P(t) = 250(2.4)^t$$

The formula above shows the relationship between the population, P, of a certain mushroom species on a one-acre plot of land as a function of t, the number of weeks that have passed since the mushrooms were first introduced on the plot.

18

What is the meaning of the number 250 in the formula above?

A) The plot initially contained 250 mushrooms.

B) The population of mushrooms increases by 250 mushrooms per week.

C) The population of mushrooms increases by 250% each week.

D) It will take 250 weeks for the population of mushrooms to double.

19

By what percent should we expect the mushroom population to increase between the start of week 6 and the start of week 7?

A) 40%

B) 140%

C) 240%

D) 480%

20

If $\frac{x^2+1}{2} + \frac{x}{p} = 1$, which of the following expressions gives both possible values of x, in terms of p?

A) $\frac{-p \pm \sqrt{p^2 - 8p}}{2p}$

B) $\frac{-p \pm \sqrt{p^2 - 4p}}{2p}$

C) $\frac{-2 \pm \sqrt{4 + 4p^2}}{2p}$

D) $\frac{-2 \pm \sqrt{4 - 4p^2}}{2p}$

21

If the variable a varies inversely as b, which of the following statements must be true?

A) $a + b$ is a constant.

B) $a - b$ is a constant.

C) $\frac{a}{b}$ is a constant.

D) ab is a constant.

CONTINUE

4  4

22

	Test positive for antibody	Test negative for antibody	Total
Antibody present	480	20	500
No antibody	5	495	500
Total	485	515	1,000

A researcher is studying the effectiveness of a method for testing the presence of an antibody in a patient's bloodstream. The table above shows the results of 1,000 patient trials. According to these data, what is the probability that a patient who has the antibody will nevertheless have a negative test result?

A) 0.01

B) 0.04

C) 0.05

D) 0.20

23

Class A: 68, 79, 88, 91, 97, 98, 99

Class B: 85, 85, 85, 88, 88, 90, 90

The lists above indicate the tests scores, in increasing order, for two of Mr. Pearlman's classes, each of which has 6 students. Which of the following correctly compares the standard deviation of the scores for each class?

A) The standard deviation of the scores in Class A is smaller.

B) The standard deviation of the scores in Class B is smaller.

C) The standard deviations of the scores in Class A and Class B are equal.

D) The relationship cannot be determined from the information given.

24

Mrs. Black has a bag of candy bars to hand out to the students in her class before they take their AP calculus BC exam. If she gives each student 3 candy bars, she will have 6 left over. In order to give each student 5 candy bars, she will need 50 more candy bars. How many students are in Mrs. Black's class?

A) 18

B) 27

C) 28

D) 44

25

The sum of three numbers is 240. If the greatest of these numbers is 50% more than the sum of the other two, what is the value of the greatest of these numbers?

A) 96

B) 120

C) 140

D) 144

26

In the xy-plane, points $A(2, 5)$ and $B(-12, k)$ lie on a line that has a slope of $-\frac{4}{7}$. What is the value of k?

A) 13

B) 16.5

C) 18

D) 29.5

CONTINUE

4 4

27

The original price of an outboard motor was marked down by 30% for a week-long sale. Since the motor was not sold in the first week, it was marked down an additional p percent. If the total markdown from the original price was then 58%, what is the value of p?

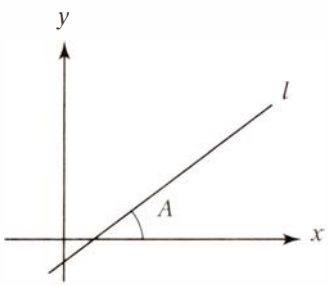
A) 12

B) 28

C) 40

D) 42

28



In the figure above, if $\cos A = 0.8$, what is the slope of line l?

A) 0.60

B) 0.75

C) 0.90

D) 1.10

Questions 29 and 30 refer to the following information.

	Yes	No	Total
Males	150	90	240
Females	107	173	280
Total	255	265	520

The table above shows the results of a survey of 520 adults who were asked whether they approved of a recent state budget proposal.

29

If n of the females had voted yes instead of no, the ratio of yes votes to no votes would have been exactly the same for the females as for the males. What is the value of n?

A) 62

B) 66

C) 68

D) 70

30

If this survey is representative of the entire voting population of a state in which 32,760 people are expected to vote on this budget referendum, how many males are expected to vote yes?

A) 9,450

B) 15,120

C) 19,270

D) 20,475

CONTINUE

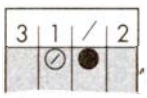
4 4

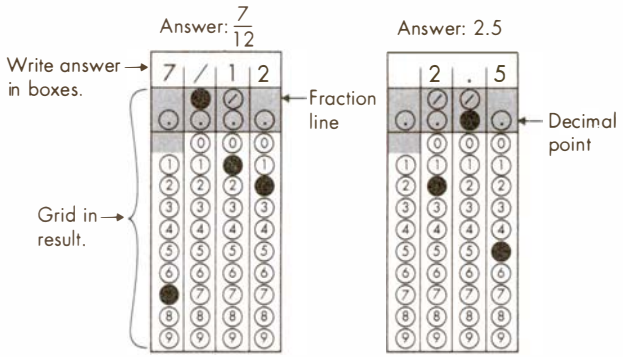
Student-Produced Response Questions

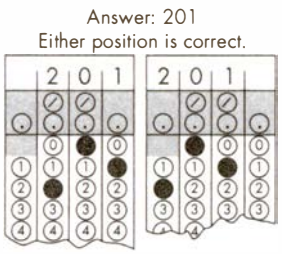
DIRECTIONS

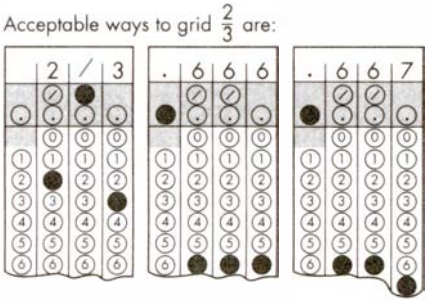
For questions 31–38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

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  , 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.







CONTINUE

4 4

31

If a shipment of fruit contains 6 tons of bananas, 4 tons of grapes, 2 tons of apples, and 3 tons of oranges, what fraction of the shipment, by weight, is oranges?

32

A state environmental study determines that the coastal regions of the state lose 24.5 acres of wetlands per month. At this rate, how many months will it take these coastal regions to lose a total of 343 acres?

33

$$d_n = 13n + 200$$

The formula above represents the number of donuts, d_n, that a bakery sold on the nth day of a festival. If the festival lasted 3 days, what was the total number of donuts that the bakery sold during the festival?

34

Connor and Joachim collaborated to write a computer program that consisted of 3,500 lines of code. If Joachim wrote 600 more lines of code than Connor did, how many lines of code did Connor write?

35

$$V(t) = 1000(1 + k)^m$$

An analyst wants to use the formula above to estimate the value, in dollars, of a $1,000 initial investment in a mutual fund after m quarters have passed. If a $1,000 initial investment in this fund is worth $1,102.50 after 2 quarters, what number should the analyst choose for k?

36

The figure above shows a hemispherical bowl made of glass. The bowl is 9 centimeters high and the glass is 3 centimeter thick. A second bowl is to be constructed to scale with the original bowl, but with one-half the height and diameter. The smaller bowl can hold a maximum of $k\pi$ cubic centimeters of water. What is the value of k? (The volume of a sphere with radius r is given by the formula $V = \frac{4}{3}\pi r^3$.)

CONTINUE

4  4

Questions 37 and 38 refer to the following information.

$$I = \frac{FV}{(1 + r)^n}$$

The formula above indicates the initial investment, I, that must be made in an account with an annual interest rate of r to ensure a future value of FV after a period of n years.

37

To the nearest dollar, what initial investment should be made in an account that earns 20% annually ($r = 0.20$) in order to ensure a future value of \$432 in two years? (Ignore the \$ sign when gridding your answer. That is, enter \$125 as 125.)

38

What value of r, to the nearest thousandth, would ensure that the value of an investment would increase by 69% in 2 years?

STOP

If you finish before time is called, you may check your work on this section only. Do not turn to any other section of the test.

SAT PRACTICE TEST 2 ANSWER KEY

Section 1: Reading

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

Total Reading Points (Section 1)

Section 2: Writing and Language

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

Total Writing and Language Points (Section 2)

Section 3: Math (No Calculator)

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

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16. 510
17. 64
18. 6
19. 12
20. 8.25

Total Math Points (Section 3)

Section 4: Math (Calculator)

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

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31. .2 or 1/5
32. 14
33. 678
34. 1450
35. .05 or 1/20
36. 18
37. 300
38. .300

Total Math Points (Section 4)

33. **C** **Parallelism**

Parallelism requires the phrasing *usually for little pay, but often with as much skill*. Notice that both phrases are prepositional phrases.

34. **D** **Diction/Clear Expression**

This word *sufficed* is illogical here because this sentence does not indicate that stars served any specific need for these cultures. Stars cannot *perform* as omens, because they are not people or mechanisms. Rather, they *served* as omens to ancient cultures.

35. **B** **Idiom/Misplaced Modifiers**

In the original phrasing the idiom *beckon for* is used illogically, and the modifier *long* is misplaced. Choice (B) is the only choice that avoids both of these problems.

36. **A** **Coordination**

The original phrasing best establishes the contrast between the two clauses in this sentence. Choice (B) indicates a contrast, but the wrong one: it implies a contrast between the *previous* sentence and this one, rather than between the two ideas within this sentence.

37. **D** **Logic/Verb Mood**

The point in this sentence is that these objects of astronomical study are very far away. They are so far away that *we could never hope* to send probes there. The other phrasings create illogical statements.

38. **C** **Development/Logical Cohesiveness**

This sentence should not be deleted, because this question *provides a logical transition to the discussion of inferential methods that follows*. The paragraph that follows answers this question very nicely.

39. **C** **Dangling Modifiers/Voice/Logical Comparisons**

The sentence clearly intends to compare *stars* to *other objects of fascination*. This requires that the subject of the underlined clause be *stars*. This eliminates choices (A) and (B). Choice (D) is incorrect because the phrase in *observation* is not idiomatic.

40. **D** **Coordination**

Choice (D) most effectively joins the ideas in a logical temporal sequence.

41. **A** **Cohesiveness/Development**

The original phrasing matches the expository and measured tone of the passage, and adds a specific detail supporting the idea that much astronomical information is gathered indirectly.

42. **D** **Pronoun-Antecedent Agreement/Commas**

The original phrasing is incorrect because the pronoun *their* disagrees in number with its antecedent *light*. Choice (B) is incorrect for the same reason. Choice (C) is incorrect because the context requires the possessive form *its* rather than the contraction *it's [it is]*.

43. **C** **Diction/Clear Expression**

The point of this sentence is that the amount of the redshift in the light indicates how far the light has traveled. In other words, the *extent of this redshifting tells astronomers how far away the star is (or was)*.

44. **C** **Idiom**

This sentence discusses how the *characteristics of the spectrum* indicate the size and composition of the star. Choice (C) is the only one that uses the proper idiom for this prepositional phrase.

Section 3: Math (No Calculator)

1. **D** **Algebra (solving equations) EASY**

Original equation: $2x - 3y = 9$
Substitute $y = 3$: $2x - 3(3) = 9$
Simplify: $2x - 9 = 9$
Add 9: $2x = 18$
Divide by 2: $x = 9$

2. **A** **Algebra (linear systems) EASY**

Original system: $x - y = -4$
$x - 2y = -6$
Subtract corresponding sides of equation:
$(x - y) - (x - 2y) = -4 - (-6)$
Simplify: $y = 2$
Substitute $y = 2$ into first equation to find x: $x - 2 = -4$
Add 2: $x = -2$
Therefore the ordered pair is $(-2, 2)$.

3. **A** **Algebra (interpreting formulas) EASY-MEDIUM**

One way to analyze a formula is by "dimensional analysis." This is simply a way to check that the units in the formula represent what they are supposed to represent. For instance, we are told that the expression $240 + 3nt$ represents the cost, *in dollars*, of the project. This means that both terms in this expression must be in *dollars*. Notice, also, that n is the number of *servers* and t is the number of *hours*. Let's use a ? to represent the units of the number 3 in the expression $3nt$. Translating the term into units, this gives us

(?)(servers)(hours) = $

Divide by (servers)(hours): $\frac{\text{?}}{\text{(servers)(hours)}} = \frac{\$}{\text{server} \times \text{hour}}$ = dollars per server per hour

In other words, it costs the company 3 dollars per hour per server.

4. **B** **Algebra (linear equations) EASY**

$$\frac{5}{8}x = -\frac{1}{16}$$

Multiply by 16 (the common denominator): $10x = -1$
Divide by 10: $x = -1/10$

5. **D** **Advanced Mathematics (multiplying polynomials) EASY-MEDIUM**

The simplest way to approach this problem is to "expand" the choices to see which one yields an expression that is equivalent to the original expression. You must remember how to FOIL (Chapter 9, Lesson 4) when multiplying two binomials:

(A) $(a^2 - 2)(a^2 - 5) = a^4 - 5a^2 - 2a^2 + 10 = a^4 - 7a^2 + 10$
(Close, but no.)

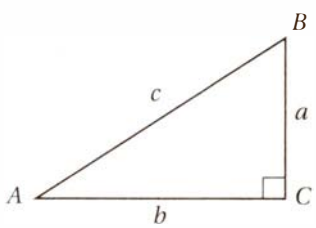
(B) $(a^2 - 1)(a^2 - 10) = a^4 - 10a^2 - 1a^2 + 10 = a^4 - 11a^2 + 10$
(Close, but no.)

(C) $(a^2 + 3)^2 + 1 = a^4 + 3a^2 + 3a^2 + 9 + 1 = a^4 + 6a^2 + 10$
(Close, but no.)

(D) $(a^2 - 3)^2 + 1 = a^4 - 3a^2 - 3a^2 + 9 + 1 = a^4 - 6a^2 + 10$
(Yes.)

6. **C** **Additional Topics (trigonometry) EASY**

It always helps to draw a diagram for geometry and trigonometry problems. For this problem, we also have to remember the basic definitions of the trigonometric functions discussed in Chapter 10, Lesson 9: SOH CAH TOA.



Since $\sin A = 0.6$, this means $a/c = 0.6$. Notice that $\cos B$ is also a/c, so it must also equal 0.6. This is an example of the **cofunction identity** we discussed in Chapter 10, Lesson 10.

7. **C** **Advanced Mathematics (rational equations) EASY-MEDIUM**

Original equation: $\sqrt{m^2 - 13} - x = 0$
Substitute $x = 6$: $\sqrt{m^2 - 13} - 6 = 0$
Add 6: $\sqrt{m^2 - 13} = 6$
Square both sides: $m^2 - 13 = 36$
Add 13: $m^2 = 49$
Take the square root: $m = \pm 7$
But since $m < 0$, $m = -7$.

8. **B** **Advanced Mathematics (exponents) MEDIUM**

$$x^{-2} = \frac{1}{16}$$

Substitute $x^{-2} = \frac{1}{x^2}$
(Law #3 from Chapter 9, Lesson 9): $\frac{1}{x^2} = \frac{1}{16}$

Cross-multiply: $x^2 = 16$
Take the square root: $x = \pm 4$

Recall the other equation: $\frac{x^b}{x^a} = 16$

Law #6 from Chapter 9, Lesson 9: $x^{b-a} = 16$
Substitute $x = \pm 4$: $(\pm 4)^{b-a} = 16$
Notice that both $4^2 = 16$ and $(-4)^2 = 16$, therefore: $b - a = 2$

9. **C** **Advanced Mathematics (functions) MEDIUM**

This question asks us to find the function that is satisfied by all four ordered pairs. Here, it is probably easiest to work by process of elimination, and cross off those choices that *aren't* satisfied by at least one of the ordered pairs. Let's consider the first ordered pair, (2, 1), and see which functions give an output of 1 for an input of 2:

(A) $f(2) = 3(2)^2 - 2 = 3(4) - 2 = 12 - 2 = 10$
(No—eliminate.)

(B) $f(2) = 3(2)^2 - 4 = 3(4) - 4 = 12 - 4 = 8$
(No—eliminate.)

(C) $f(2) = 2(2)^2 - 7 = 2(4) - 7 = 8 - 7 = 1$
(Yes—don't eliminate.)

(D) $f(2) = 2(2)^2 = 2(4) = 8$
(No—eliminate.)

So, it turns out we only have to test one ordered pair to get the right answer.

10. **A** **Algebra (linear equations) MEDIUM**

Original equation: $y = kx - 1$
Substitute $x = a$ and $y = b$: $b = ka - 1$
Add 1: $b + 1 = ka$
Divide by a: $\frac{b+1}{a} = k$

11. **B** **Advanced Mathematics (rational equations) MEDIUM-HARD**

The fact that the denominators are equal in both fractions suggests that multiplying both sides will simplify the equation:

$$\frac{12x^2 + 6x - 23}{bx - 3} = -2x - \frac{23}{bx - 3}$$

Multiply by $bx - 3$: $12x^2 + 6x - 23 = -2x(bx - 3) - 23$
Distribute: $12x^2 + 6x - 23 = -2bx^2 + 6x - 23$
Subtract $6x - 23$: $12x^2 = -2bx^2$
Divide by x^2: $12 = -2b$
Divide by -2: $-6 = b$

12. **A** **Advanced Mathematics (functions) MEDIUM-HARD**

Given: $h(g(2)) = 9$
Apply definition $h(x) = x + 3$: $g(2) + 3 = 9$
Subtract 3: $g(2) = 6$

Therefore, g must be a function that takes an input of 2 and gives an output of 6. The only choice that satisfies this condition is (A) $g(x) = x^2 + 2$, because $g(2) = (2)^2 + 2 = 4 + 2 = 6$.

13. **D** **Advanced Mathematics (analyzing quadratics) HARD**

Original equation: $y = a(x + 3)(x - 1)$
This equation represents a quadratic in x. Since it is in factored form, it shows us that the function has x-intercepts (also known as zeroes or roots) when $x + 3 = 0$ or $x - 1 = 0$, so its x-intercepts are at $x = -3$ and $x = 1$. Recall (from Chapter 9, Lesson 6) that a parabola representing a quadratic function has an axis of symmetry at $x = k$, where k is midway between the x-intercepts. Therefore, $k = (-3 + 1)/2 = -1$. This axis of symmetry, $x = -1$, must pass through the vertex. We can get the y-coordinate of this vertex by just plugging $x = -1$ back into the function: $y = a(-1 + 3)(-1 - 1)$
Simplify: $y = a(2)(-2) = -4a$

14. **A** **Advanced Mathematics (solving quadratics) MEDIUM-HARD**

Recall from Chapter 9, Lesson 5, that the solutions to quadratic of the form $x^2 + bx + c = 0$, the sum of those solutions is $-b$ (the opposite of whatever the x coefficient is), and the product of those solutions is c (whatever the constant term is). In the quadratic $x^2 - 2ax + b = 0$, the x coefficient is $-2a$. Since this must be the opposite of the sum of the solutions, the sum of the solutions is $2a$.

Although using this theorem gives us a quick and easy solution, the theorem may seem a little abstract and mysterious to you. (You might want to review Lesson 5 in Chapter 9 to refresh yourself on the proof.) So, there is another way to attack this question: just choose values of a and b so that the quadratic is easy to factor. For instance, if we choose $a = 1$ and $b = -3$, we get:

$x^2 - 2(1)x - 3 = 0$
Simplify: $x^2 - 2x - 3 = 0$
Factor: $(x - 3)(x + 1) = 0$
Solve with the Zero Product Property: $x = 3$ or -1
The sum of these two solutions is $3 + -1 = 2$.
Now we plug $a = 1$ and $b = -3$ into the answer choices and we get (A) 2, (B) -2, (C) -3, (D) 3. Clearly, the only choice that gives the correct sum is (A).

15. **D** **Advanced Mathematics (analyzing polynomial graphs) HARD**

By the Zero Product Property (Chapter 9, Lesson 5), the graph of $y = a(x - b)(x + c)^2$ has zeroes at $x = b$ and a "double root" at $x = -c$ (because this expression has two factors of $(x + c)$). Since b and c are both positive, this means that the graph must have one single positive root and a "double" negative root. That is, the graph passes through the x-axis at a positive value of x and "bounces" off of the x-axis at a negative value of x. Notice that this eliminates choices (B) and (C). We also know that a, the "leading coefficient" of the polynomial, is positive. If the leading coefficient of the polynomial is positive, the polynomial must eventually "shoot up" toward positive infinity; that is, it must go up as we move to the right. This rules out choice (A) and leaves only choice (D) as correct.

16. **510** **Algebra (rates) EASY**

Let x represent the number of calories in a large order of fries, because that is what the question is asking us to find. Since we are told that this is 350 calories more than the calories in a large soda, the number of calories in a large soda is $x - 350$. If 2 large fries and 3 large sodas have a total of 1,500 calories,

$x + 3(x - 350) = 1{,}500$
Distribute: $2x + 3x - 1{,}050 = 1{,}500$
Simplify: $5x - 1{,}050 = 1{,}500$
Add 1,050: $5x = 2{,}550$
Divide by 5: $x = 510$

17. **64** **Advanced Mathematics (radical equations) MEDIUM-HARD**

Given: $a = 4\sqrt{2}$
Multiply by 2: $2a = 8\sqrt{2}$
Substitute $2a = \sqrt{2b}$: $\sqrt{2b} = 8\sqrt{2}$
Square both sides: $2b = 64(2)$
Divide by 2: $b = 64$

18. **6** **Advanced Mathematics (quadratic equations) HARD**

Although this does not look like a quadratic equation, in fact it is.

Original equation: $x + \frac{36}{x} = 12$

Multiply by x: $x^2 + 36 = 12x$

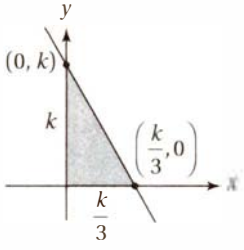
Subtract $12x$: $x^2 - 12x + 36 = 0$

Factor: $(x - 6)(x - 6) = 0$

Solve using the Zero Product Property: $x - 6 = 0$, so $x = 6$

19. **12** **Additional topics (coordinate geometry) MEDIUM-HARD**

The system of inequalities indicates that the line containing the hypotenuse of the triangle is given by the equation $3x + y = k$, which has an x-intercept of $\left(\frac{k}{3}, 0\right)$ and a y-intercept of $(0, k)$. This means that the



triangle has a base of $\frac{k}{3}$ and a height of k.

The area of the triangle is 24: $\frac{1}{2} \times \frac{k}{3} \times k = 24$

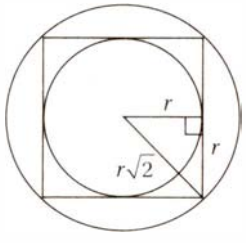
Simplify: $\frac{k^2}{6} = 24$

Multiply by 6: $k^2 = 144$

Take the square root: $k = 12$

20. **8.25** **Additional Topics (triangles, circles, and squares) HARD**

Most students will begin this problem by trying to find the length of the radius of the larger circle. This is a bit of a pain and, as it turns out, completely unnecessary. Instead, start by drawing in the 45°-45°-90° triangle as shown, and notice that one leg of this triangle is the radius of the smaller circle, and the hypotenuse is the radius of the larger circle. This is the key to the relationship between the circles.



If we label the smaller leg r and use either the Pythagorean Theorem or the Reference Information about 45°-45°-90° triangles given at the beginning of the test, we find that the hypotenuse is $r\sqrt{2}$. Therefore, the area of the smaller circle is πr^2 and the area of the larger circle is $\pi(r\sqrt{2})^2 = 2\pi r^2$. In other words, the larger circle has an area that is twice the area of the smaller circle. Therefore, if the larger circle has area 16.5, the smaller circle has an area of $16.5 \div 2 = 8.25$.

Section 4: Math (Calculator)

1. **B** **Algebra (word problems) EASY**

For getting 32 questions correct and $40 - 32 = 8$ questions wrong, the student earned $32(2) - 0.25(8) = 64 - 2 = 62$ points.

2. **D** **Problem Solving and Data Analysis (central tendency) EASY**

The average of the three numbers is 10: $\frac{3 + 5 + m}{3} = 10$

Multiply by 3: $3 + 5 + m = 30$

Simplify: $8 + m = 30$

Subtract 8: $m = 22$

3. **C** **Algebra (linear equations) EASY**

Original equation: $3b + 4 = -1$

Multiply by 3: $9b + 12 = -3$

4. **B** **Data Analysis and Problem Solving (graphical analysis) EASY**

The graph indicates that Rebecca started her hike at 10:00 a.m. and stopped for lunch at 11:45 a.m. (The horizontal segment indicates when she is not moving, so that represents her 1-hour lunch break.) This first part of her hike, therefore. took 1 hour 45 minutes, or 105 minutes. The return hike began at 12:45 and lasted until 2:00 p.m., for a time of 1 hour 15 minutes, or 75 minutes. The difference is $105 - 75 = 30$ minutes.

5. **C** **Algebra (ratios) EASY**

The win-to-loss ratio of 5:3 is a "part-to-part" ratio, so we can represent each part as a fraction of the whole. We can do this by simply adding $3 + 5 = 8$ (the "whole") and dividing by that total. This gives us a ratio of $\frac{5}{8} : \frac{3}{8}$, which means that the Bombers won $\frac{5}{8}$ of their games and lost $\frac{3}{8}$ of them. Since they played a total of 120 games, they won $\frac{5}{8} \times 120 = 75$ games and lost $\frac{3}{8} \times 120 = 45$ games.

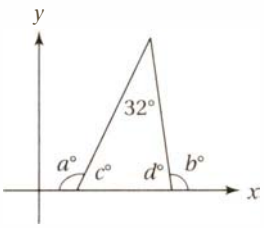
6. **C** **Advanced Mathematics (adding polynomials) MEDIUM**

$$(3x^3 - 2x^2 + 5) + (5x^2 + x - 10)$$

Distribute coefficients to eliminate parentheses: $3x^3 - 2x^2 + 5 + 5x^2 + x - 10$
Group like terms together: $3x^3 - 2x^2 + 5x^2 + x + 5 - 10$
Combine like terms: $3x^3 + 3x^2 + x - 5$

7. **A** **Additional Topics (triangles) MEDIUM**

It helps to mark the measures of the other two interior angles to the triangle as $c°$ and $d°$, because we know something about these angles.



Since angles in a triangle must have a sum of 180°: $c + d + 32 = 180$
Subtract 32: $c + d = 148$
Since angles in a linear pair have a sum of 180°: $a + c = 180$
$b + d = 180$
Add previous two equations: $a + b + c + d = 360$
Subtract $c + d = 148$: $-(c + d = 148)$
$a + b = 212$

8. **A** **Additional Topics (complex numbers) MEDIUM**

$$\frac{K + i}{i} = 1 - 2i$$

Multiply by i: $K + i = i(1 - i)$
Distribute: $K + i = i - 2i^2$
Substitute $i^2 = -1$: $K + i = i + 2$
Subtract i: $K = 2$

9. **C** **Advanced Mathematics (variation) MEDIUM**

To answer this question, it helps to be familiar with the concepts we discussed in Chapter 8, Lesson 4. The first thing to notice about the ordered pairs is that as the value of x increases, the value of y decreases. More specifically, notice that the *product* of the two values in each ordered pair is *always the same*: (2)(10) = 20, (4)(5) = 20, and (10)(2) = 20. A discussed in Chapter 8, Lesson 4, this is the hallmark of an *inverse variation*. The equation for this particular relationship is $y = 20/x$.

10. **B** **Problem Solving and Data Analysis (scatterplots) MEDIUM-HARD**

Since, by definition, the luminosity of our sun is "1 sun," we must look for the number 1 on the vertical ("luminosity") axis. These numbers are given as powers of 10, so we have to remember that $100 = 1$. If we trace the horizontal line representing 100 lumens, we can see that it intersects the line of best fit at roughly 6,000°K. The choice that is closest to this value is (B) 5,800°K.

11. **C** **Advanced Mathematics (rational equations) MEDIUM-HARD**

The line of best fit appears to cross the points (10,000°K, 10^2 suns) and (5,000°K, 10^{-1} suns), give or take a small error. This means that a Main Sequence star with a temperature of 10,000°K is about $10^2 \div 10^{-1} = 10^3 = 1{,}000$ times as bright as a Main Sequence star with a temperature of 5,000°K. Choice (C) 900 is the only choice within an acceptable margin of error.

12. **D** **Problem Solving and Data Analysis (scatterplots) MEDIUM-HARD**

First, we need to recognize that $0.0001 = 10^{-4}$. The scatterplot shows precisely two points below the 10^{-4} line. Since there are 50 stars represented in the scatterplot (no need to count them—the description of the graph tells us!), these two stars represent 2/50 = 4/100 = 4% of the total.

13. **A** **Algebra (linear equations) MEDIUM**

Original equation: $\frac{a + k}{b + k} = -2$
Multiply by $b + k$: $a + k = -2(b + k)$
Distribute: $a + k = -2b - 2k$
Subtract k: $a = -2b - 3k$
Add $2b$: $a + 2b = -3k$
Divide by -3: $\frac{-a - 2b}{3} = k$

14. **C** **Advanced Mathematics (graphing polynomials) MEDIUM**

First, notice that the answer choices include the factors $x^2 - 1$ and $x^2 + 1$. The first of these is a difference of squares, so it can be factored further: $x^2 - 1 = (x + 1)(x - 1)$. However, $x^2 + 1$ is a *sum* of squares, which cannot be factored over the real numbers. This enables us to express each function in completely factored form:

(A) $f(x) = (x^2 + 1)(x^2 + 1)$ $= (x^2 + 1)(x^2 + 1)$
(B) $f(x) = (x^2 - 1)(x^2 + 1)$ $= (x + 1)(x - 1)(x^2 + 1)$
(C) $f(x) = x^2(x^2 - 1)$ $= x^2(x + 1)(x - 1)$
(D) $f(x) = x^2(x^2 + 1)$ $= x^2(x^2 + 1)$

Now we can find all of the x-intercepts by setting each factor to 0 and (if possible) solving for x. Notice that if we do this for the factored form of each function, we see that (A) has no x-intercepts, (B) has intercepts at $x = -1$ and $x = 1$, (C) has intercepts at $x = 0$, $x = -1$, and $x = 1$, and (D) has an intercept at $x = 0$. Therefore, the function in choice (C) is the only one that has three x-intercepts.

15. **B** **Algebra (quantitative reasoning) MEDIUM-HARD**

First, we should notice the fact that $n + 8$ must be greater than $n + 2$, no matter the value of n. Next, we should notice that, in order for the product of two numbers to be negative, one of those numbers must be positive and *the other* one negative. Obviously, the greater number is the positive one, and the lesser one is the negative one.

Therefore: $n + 2 < 0$ and $n + 8 > 0$

Solve each inequality for n: $n < -2$ and $n > -8$

Since n must have an integer value and must satisfy the inequalities above, it can take only the values -7, -6, -5, -4, and -3.

16. **A** **Algebra (rates) MEDIUM**

Although this problem can be solved by "plugging in" convenient numbers for the unknowns, it is actually much more straightforward to treat this as a conversion problem, as discussed in Chapter 7, Lesson 4. The question gives us the "initial fact" that Lauren has 6 gallons of gas in her car, and we'd like to "convert" that fact into the number of hours she can travel. Using the rates given in the problem, the conversion should look like this:

$$6 \text{ gallons} \times \frac{d \text{ miles}}{1 \text{ gallon}} \times \frac{1 \text{ hour}}{s \text{ miles}} = \frac{6d}{s} \text{ hours}$$

Notice that all the units on the left-hand side cancel except for hours, which is the desired unit.

17. **A** **Algebra (linear equations) MEDIUM-HARD**

Perhaps the best way to find the slope of the line is to get the equation into "slope-intercept form" (Chapter 7, Lesson 5).

Original equation: $\frac{2x + 1}{2y} = \frac{a}{b}$

Cross-multiply: $a(2y) = b(2x + 1)$

Simplify: $2ay = 2bx + b$

Divide by $2a$: $y = \frac{2b}{2a}x + \frac{b}{2a}$

Simplify: $y = \frac{b}{a}x + \frac{b}{2a}$

Therefore, the slope of the line is b/a.

18. **A** **Advanced Mathematics (exponential functions) MEDIUM**

Notice that substituting $t = 0$ into the function gives us $P(0) = 250(2.4)0 = 250(1) = 250$. Therefore, the number 250 in the equation means the population of mushrooms on the plot when $t = 0$.

19. **B** **Advanced Mathematics (exponential functions) MEDIUM-HARD**

The fastest way to answer this question is to notice that in exponential growth and decay functions in which the exponent is the time variable, t, the base of the exponential (in this case 2.4) must represent $1 + r$, where r is the rate of change per time unit. This means that the rate of weekly increase (recall that t is measured in weeks) must be $2.4 - 1 = 1.4 = 140\%$.

Another way to solve the problem is to calculate the populations at the specified times and then calculate the percent change. At the beginning of the sixth week, 5 weeks have passed, and so the population is $250(2.4)^5 = 19{,}906$. At the beginning of the seventh week, the population is $250(2.4)^6 = 47{,}776$. To calculate the percent change, we find the difference and divide by the initial amount: $(47{,}776 - 19{,}906)/19{,}906 = 1.40 = 140\%$.

20. **C** **Algebra (rewriting expressions) MEDIUM-HARD**

Original equation: $\frac{x^2 + 1}{2} + \frac{x}{p} = 1$

Multiply by $2p$ (the common denominator): $p(x^2 + 1) + 2x = 2p$

Distribute: $px^2 + p + 2x = 2p$

Subtract $2p$ and write in descending powers of x: $px^2 + 2x - p = 0$

Put into quadratic formula with $a = p$, $b = 2$, and $c = -p$: $\frac{-2 \pm \sqrt{4 + 4p^2}}{2p}$

21. **D** **Problem Solving and Data Analysis (variation) MEDIUM-HARD**

Recall from Chapter 8, Lesson 4, that if a is inversely proportional to b, then $a = \frac{k}{b}$, where k is some positive constant. If we multiply both sides of this equation by b, we get $ab = k$, which means that the product ab is a constant.

22. **B** **Problem Solving and Data Analysis (quadratics) MEDIUM**

The table indicates that a total 500 patients had the antibody and that 20 of these patients nevertheless had a negative test result. Therefore the probability of this result is $20/500 = 0.04$.

23. **B** **Problem Solving and Data Analysis (data spread) MEDIUM**

As we discussed in Chapter 8, Lesson 3, the standard deviation of a set of numbers tells us how "spread out" the data are from the average—the greater the standard deviation, the greater the spread from the average. It should be clear by inspection that the scores for Class B are more "clustered" than the scores for Class A. For instance, there is only a 5-point difference between the lowest and highest scores in Class B, but a 31-point difference between the lowest and highest scores in Class A. This means that the standard deviation of the scores in Class B is smaller.

24. **C** **Algebra (word problems) MEDIUM-HARD**

Begin by assuming that there are n students in Mrs. Black's class. If she gives out 3 candy bars to each student and has 6 left over, she must have $3n + 6$ candy bars. If she needs 50 more candy bars in order to give each student 5 candy bars, she must have $5n - 50$ candy bars. Since these two expressions both express the total number of candy bars, $3n + 6 = 5n - 50$

Add 50 and subtract $3n$: $56 = 2n$

Divide by 2: $28 = n$

25. **D** **Problem Solving (rates) MEDIUM**

Let's call the three numbers a, b, and c.

If their sum is 240, $a + b + c = 240$

Let's say the largest number is c. If this is 50% larger than the sum of the others, $c = 1.5(a + b)$

Divide by 1.5: $\frac{c}{1.5} = a + b$

Substitute $a + b = \frac{c}{1.5}$ into the first equation: $\frac{c}{1.5} + c = 240$

Multiply by 1.5: $c + 1.5c = 360$

Simplify: $2.5c = 360$

Divide by 2.5: $c = 144$

26. **A** **Algebra (graphs of linear equations) MEDIUM**

Recall the slope formula from Chapter 7, Lesson 5:

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{k - 5}{-12 - 2} = \frac{k - 5}{-14}$$

Since the slope equals $-\frac{4}{7}$:

Cross-multiply: $7k - 35 = 56$

Add 35: $7k = 91$

Divide by 7: $k = 13$

27. **C** **Algebra (word problems/percent change) HARD**

The question makes it clear that we will get the same answer regardless of the original price of the motor. Since we are working with percentages, it is convenient to assume the original price of the motor is \$100.

After a markdown of 30%, the price becomes \$100 − 0.30(\$100) = \$70. If it is marked down an additional p percent, its price becomes $\$70\left(1 - \frac{p}{100}\right)$. Since this is equivalent to a one-time markdown of 58%, then

$$70\left(1 - \frac{p}{100}\right) = 100(1 - 0.58) = 42$$

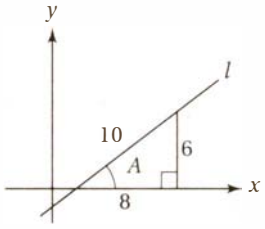
Divide by 70: $1 - \frac{p}{100} = \frac{42}{70} = 0.6$

Subtract 1: $-\frac{p}{100} = -0.4$

Multiply by −100: $p = 40$

28. **B** **Additional Topics (trigonometry/coordinate geometry) HARD**

If this question gave you trouble, review Chapter 10, particularly Lessons 3, 4, and 9. Since the question asks about the slope, we should draw in a right triangle to show the "rise" and "run" of the line. If $\cos A = 0.8$, then the adjacent side of this triangle could be 8 and the hypotenuse could be 10 (because o/h = 8/10 = 0.8) as shown below.



We can find the third side of the triangle with the Pythagorean Theorem ($8^2 + x^2 = 10^2$), although it's easier to simply notice that this is a triangle in the 3-4-5 family: 6-8-10. Since the slope of a line is the rise over the run, the slope is 6/8 = 0.75.

29. **C** **Problem Solving/Data Analysis (tables/ratios) MEDIUM-HARD**

For the males, the ratio of yes votes to no votes is 150:90 = 5:3. If n of the females had shifted their votes from no to yes, then $173 - n$ would have voted no and $107 + n$ would have voted yes. If this ratio is then equal to the ratio for males, $\frac{107 + n}{173 - n} = \frac{5}{3}$

Cross-multiply: $321 + 3n = 865 - 5n$

Subtract 321 and add $5n$: $8n = 544$

Divide by 8: $n = 68$

30. **A** **Problem Solving/Data Analysis (tables/proportions) HARD**

The table shows that 150 males voted yes out of a sample population of 520. If this is a representative ratio, and if x represents the total number of males who vote yes out of the entire population, then

$$\frac{150}{520} = \frac{15}{52} = \frac{x}{32{,}760}$$

Cross-multiply: $(32{,}760)(15) = 52x$

Divide by 52: $x = \frac{(32{,}760)(15)}{52} = 9{,}450$

31. **.2** **Problem Solving and Data Analysis (ratios) EASY**

The total weight of the shipment is 6 + 4 + 2 + 3 = 15, and the total weight of oranges is 3, so the fraction of the shipment that is oranges is 3/15 = .2.

32. **14** **Problem Solving and Data Analysis (proportions) EASY**

If x is the number of months it takes until the regions lose 343 acres, then $24.5 = \frac{343}{x}$

Cross-multiply: $24.5x = 343$

Divide by 24.5: $x = 14$

33. **678** **Problem Solving and Data Analysis (data from formula) MEDIUM**

The formula indicates how many donuts were sold on each day of the festival. One day 1, the bakery sold $13(1) + 200 = 213$ donuts. On day 2, the bakery sold $13(2) + 200 = 226$ donuts. On day 3, the bakery sold $13(3) + 200 = 239$ donuts, for a total of $213 + 226 + 239 = 678$ donuts.

34. **1450** **Problem Solving and Data Analysis (rates) MEDIUM**

If Connor wrote x lines of code, then Joachim wrote $x + 600$ lines of code. Together they wrote $(x) + (x + 600) = 3{,}500$ lines of code: $x + x + 600 = 3{,}500$

Simplify and subtract 600: $2x = 2{,}900$

Divide by 2: $x = 1{,}450$

Therefore Connor wrote 1,450 lines of code.

35. **.05** **Problem Solving (analyzing formulas) HARD**

If the investment is worth \$1,102.50 after 2 quarters, $1{,}000(1 + k)^2 = 1{,}102.5$

Divide by 1000: $(1 + k)^2 = 1.1025$

Take the square root: $1 + k = 1.05$

Subtract 1: $k = .05$

36. **18** **Additional Topics (volumes and similarity) HARD**

The radius of the inside of the larger bowl is $9 - 3 = 6$ centimeters, so the radius of the smaller bowl is 3 centimeters. The volume of the smaller bowl is therefore $\frac{1}{2}\left(\frac{4}{3}\pi(3)^3\right) = \frac{4\pi(27)}{6} = 18\pi$. Therefore, $k = 18$.

37. **300** **Problem Solving and Data Analysis (formula analysis) MEDIUM**

This requires simply substituting into the formula:

$$I = \frac{432}{(1 + 0.2)^2} = \frac{432}{1.44} = 300$$

38. **.300** **Problem Solving and Data Analysis (formula analysis) HARD**

If the value of the investment increases by 69% in 2 years, this means that $FV = 1.691$ when $n = 2$. Substituting into the formula gives $I = \frac{1.69I}{(1 + r)^2}$

Divide by I: $1 = \frac{1.69}{(1 + r)^2}$

Cross-multiply: $(1 + r)^2 = 1.69$

Take the square root: $1 + r = 1.3$

Subtract 1: $r = 1.3 - 1 = 0.3$