



SAT[®] Practice Test #1

IMPORTANT REMINDERS

1

**A No. 2 pencil is required for the test.
Do not use a mechanical pencil or pen.**

2

**Sharing any questions with anyone
is a violation of Test Security
and Fairness policies and may result
in your scores being canceled.**

This cover is representative of what you'll see on test day.

**THIS TEST BOOK MUST NOT BE TAKEN FROM THE ROOM. UNAUTHORIZED
REPRODUCTION OR USE OF ANY PART OF THIS TEST BOOK IS PROHIBITED.**



Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

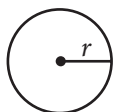
DIRECTIONS

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

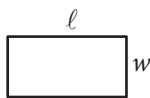
- The use of a calculator **is not permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated,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

REFERENCE

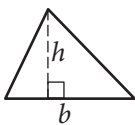


$$A = \pi r^2$$

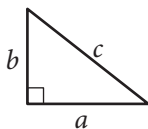
$$C = 2\pi r$$



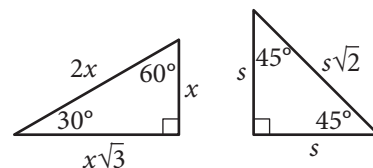
$$A = \ell w$$



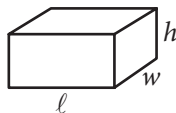
$$A = \frac{1}{2}bh$$



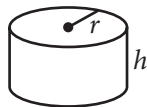
$$c^2 = a^2 + b^2$$



Special Right Triangles



$$V = \ell wh$$



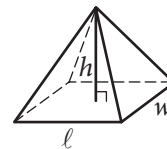
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}\ell wh$$

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.



1

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

- A) 2
- B) 4
- C) 9
- D) 10

2

For $i = \sqrt{-1}$, what is the sum $(7 + 3i) + (-8 + 9i)$?

- A) $-1 + 12i$
- B) $-1 - 6i$
- C) $15 + 12i$
- D) $15 - 6i$

3

On Saturday afternoon, Armand sent m text messages each hour for 5 hours, and Tyrone sent p text messages each hour for 4 hours. Which of the following represents the total number of messages sent by Armand and Tyrone on Saturday afternoon?

- A) $9mp$
- B) $20mp$
- C) $5m + 4p$
- D) $4m + 5p$

4

Kathy is a repair technician for a phone company. Each week, she receives a batch of phones that need repairs. The number of phones that she has left to fix at the end of each day can be estimated with the equation $P = 108 - 23d$, where P is the number of phones left and d is the number of days she has worked that week. What is the meaning of the value 108 in this equation?

- A) Kathy will complete the repairs within 108 days.
- B) Kathy starts each week with 108 phones to fix.
- C) Kathy repairs phones at a rate of 108 per hour.
- D) Kathy repairs phones at a rate of 108 per day.



5

$$(x^2y - 3y^2 + 5xy^2) - (-x^2y + 3xy^2 - 3y^2)$$

Which of the following is equivalent to the expression above?

- A) $4x^2y^2$
- B) $8xy^2 - 6y^2$
- C) $2x^2y + 2xy^2$
- D) $2x^2y + 8xy^2 - 6y^2$

6

$$h = 3a + 28.6$$

A pediatrician uses the model above to estimate the height h of a boy, in inches, in terms of the boy's age a , in years, between the ages of 2 and 5. Based on the model, what is the estimated increase, in inches, of a boy's height each year?

- A) 3
- B) 5.7
- C) 9.5
- D) 14.3

7

$$m = \frac{\left(\frac{r}{1,200}\right)\left(1 + \frac{r}{1,200}\right)^N}{\left(1 + \frac{r}{1,200}\right)^N - 1} P$$

The formula above gives the monthly payment m needed to pay off a loan of P dollars at r percent annual interest over N months. Which of the following gives P in terms of m , r , and N ?

- A) $P = \frac{\left(\frac{r}{1,200}\right)\left(1 + \frac{r}{1,200}\right)^N}{\left(1 + \frac{r}{1,200}\right)^N - 1} m$
- B) $P = \frac{\left(1 + \frac{r}{1,200}\right)^N - 1}{\left(\frac{r}{1,200}\right)\left(1 + \frac{r}{1,200}\right)^N} m$
- C) $P = \left(\frac{r}{1,200}\right) m$
- D) $P = \left(\frac{1,200}{r}\right) m$



8

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

- A) 0
- B) 1
- C) 2
- D) 4

9

$$\begin{aligned} 3x + 4y &= -23 \\ 2y - x &= -19 \end{aligned}$$

What is the solution (x, y) to the system of equations above?

- A) $(-5, -2)$
- B) $(3, -8)$
- C) $(4, -6)$
- D) $(9, -6)$

10

$$g(x) = ax^2 + 24$$

For the function g defined above, a is a constant and $g(4) = 8$. What is the value of $g(-4)$?

- A) 8
- B) 0
- C) -1
- D) -8

11

$$b = 2.35 + 0.25x$$

$$c = 1.75 + 0.40x$$

In the equations above, b and c represent the price per pound, in dollars, of beef and chicken, respectively, x weeks after July 1 during last summer. What was the price per pound of beef when it was equal to the price per pound of chicken?

- A) \$2.60
- B) \$2.85
- C) \$2.95
- D) \$3.35

12

A line in the xy -plane passes through the origin and has a slope of $\frac{1}{7}$. Which of the following points lies on the line?

- A) $(0, 7)$
- B) $(1, 7)$
- C) $(7, 7)$
- D) $(14, 2)$



13

If $x > 3$, which of the following is equivalent

to $\frac{1}{\frac{1}{x+2} + \frac{1}{x+3}}$?

A) $\frac{2x+5}{x^2+5x+6}$

B) $\frac{x^2+5x+6}{2x+5}$

C) $2x+5$

D) x^2+5x+6

14

If $3x - y = 12$, what is the value of $\frac{8^x}{2^y}$?

A) 2^{12}

B) 4^4

C) 8^2

D) The value cannot be determined from the information given.

15

If $(ax+2)(bx+7) = 15x^2 + cx + 14$ for all values of x , and $a+b=8$, what are the two possible values for c ?

A) 3 and 5

B) 6 and 35

C) 10 and 21

D) 31 and 41

**DIRECTIONS**

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

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or $7/2$. (If $\begin{array}{|c|c|c|c|} \hline 3 & 1 & / & 2 \\ \hline \bullet & \bullet & / & \bullet \\ \hline \end{array}$ is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Write answer → in boxes.

Grid result.

← Fraction line

← Decimal point

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

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

Answer: 2.5

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

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

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

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

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

Answer: 201 – either position is correct

	2	0	1
•	•	•	•
	0	•	0
①	①	①	•
②	•	②	②
③	③	③	③

	2	0	1
•	•	•	•
	•	0	0
①	①	•	①
②	•	②	②
③	③	③	③

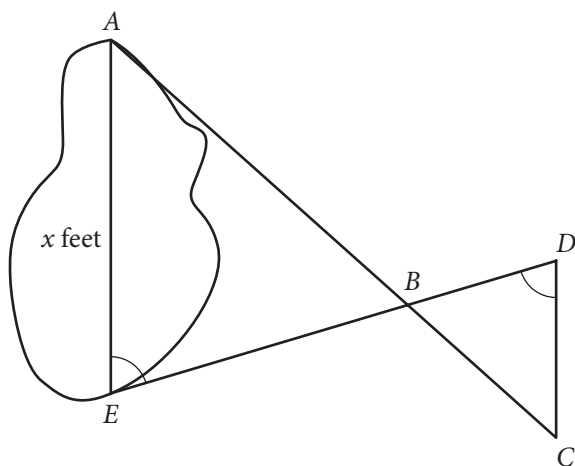
NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



16

If $t > 0$ and $t^2 - 4 = 0$, what is the value of t ?

17



A summer camp counselor wants to find a length, x , in feet, across a lake as represented in the sketch above. The lengths represented by AB , EB , BD , and CD on the sketch were determined to be 1800 feet, 1400 feet, 700 feet, and 800 feet, respectively. Segments AC and DE intersect at B , and $\angle AEB$ and $\angle CDB$ have the same measure. What is the value of x ?

18

$$\begin{aligned}x + y &= -9 \\x + 2y &= -25\end{aligned}$$

According to the system of equations above, what is the value of x ?

19

In a right triangle, one angle measures x° , where

$$\sin x^\circ = \frac{4}{5}. \text{ What is } \cos(90^\circ - x^\circ) ?$$

20

If $a = 5\sqrt{2}$ and $2a = \sqrt{2x}$, what is the value of x ?

STOP

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



Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

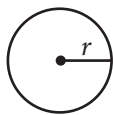
DIRECTIONS

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

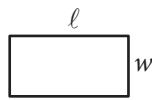
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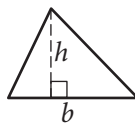


$$A = \pi r^2$$

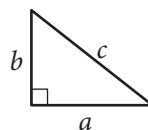
$$C = 2\pi r$$



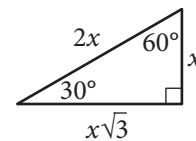
$$A = \ell w$$



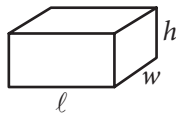
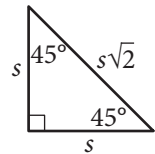
$$A = \frac{1}{2}bh$$



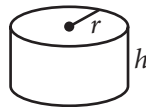
$$c^2 = a^2 + b^2$$



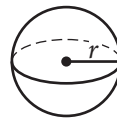
Special Right Triangles



$$V = \ell wh$$



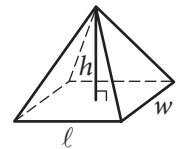
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}\ell wh$$

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

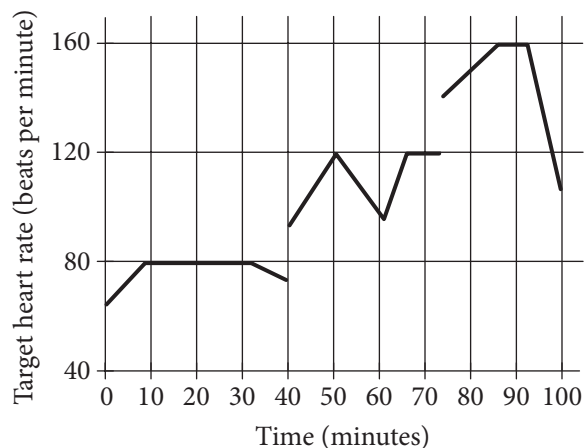
The number of radians of arc in a circle is 2π .

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



1

John runs at different speeds as part of his training program. The graph shows his target heart rate at different times during his workout. On which interval is the target heart rate strictly increasing then strictly decreasing?



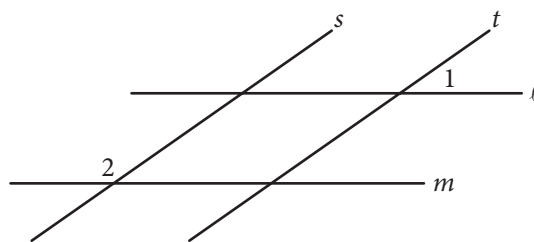
- A) Between 0 and 30 minutes
- B) Between 40 and 60 minutes
- C) Between 50 and 65 minutes
- D) Between 70 and 90 minutes

2

If $y = kx$, where k is a constant, and $y = 24$ when $x = 6$, what is the value of y when $x = 5$?

- A) 6
- B) 15
- C) 20
- D) 23

3



In the figure above, lines l and m are parallel and lines s and t are parallel. If the measure of $\angle 1$ is 35° , what is the measure of $\angle 2$?

- A) 35°
- B) 55°
- C) 70°
- D) 145°

4

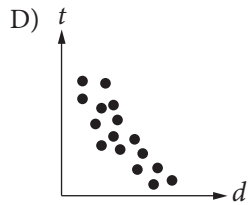
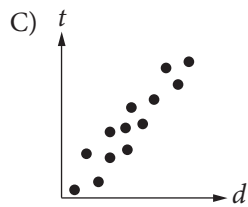
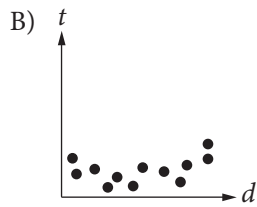
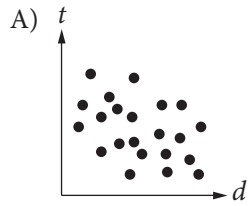
If $16 + 4x$ is 10 more than 14, what is the value of $8x$?

- A) 2
- B) 6
- C) 16
- D) 80



5

Which of the following graphs best shows a strong negative association between d and t ?



6

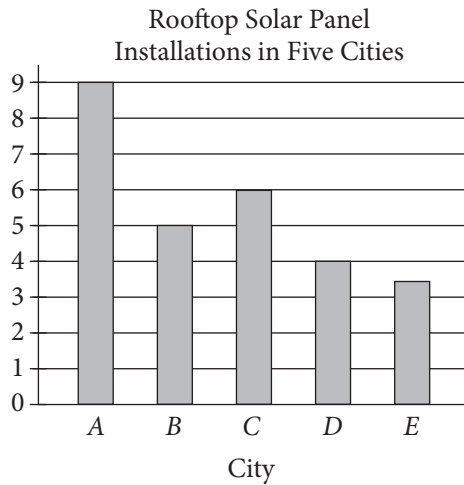
$1 \text{ decagram} = 10 \text{ grams}$ $1,000 \text{ milligrams} = 1 \text{ gram}$

A hospital stores one type of medicine in 2-decagram containers. Based on the information given in the box above, how many 1-milligram doses are there in one 2-decagram container?

- A) 0.002
- B) 200
- C) 2,000
- D) 20,000



7



The number of rooftops with solar panel installations in 5 cities is shown in the graph above. If the total number of installations is 27,500, what is an appropriate label for the vertical axis of the graph?

- A) Number of installations (in tens)
- B) Number of installations (in hundreds)
- C) Number of installations (in thousands)
- D) Number of installations (in tens of thousands)

8

For what value of n is $|n - 1| + 1$ equal to 0?

- A) 0
- B) 1
- C) 2
- D) There is no such value of n .



Questions 9 and 10 refer to the following information.

$$a = 1,052 + 1.08t$$

The speed of a sound wave in air depends on the air temperature. The formula above shows the relationship between a , the speed of a sound wave, in feet per second, and t , the air temperature, in degrees Fahrenheit ($^{\circ}\text{F}$).

9

Which of the following expresses the air temperature in terms of the speed of a sound wave?

- A) $t = \frac{a - 1,052}{1.08}$
- B) $t = \frac{a + 1,052}{1.08}$
- C) $t = \frac{1,052 - a}{1.08}$
- D) $t = \frac{1.08}{a + 1,052}$

10

At which of the following air temperatures will the speed of a sound wave be closest to 1,000 feet per second?

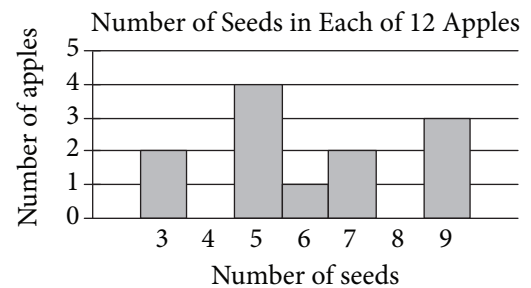
- A) -46°F
- B) -48°F
- C) -49°F
- D) -50°F

11

Which of the following numbers is NOT a solution of the inequality $3x - 5 \geq 4x - 3$?

- A) -1
- B) -2
- C) -3
- D) -5

12



Based on the histogram above, of the following, which is closest to the average (arithmetic mean) number of seeds per apple?

- A) 4
- B) 5
- C) 6
- D) 7



13

		Course			Total
		Algebra I	Geometry	Algebra II	
Gender	Female	35	53	62	150
	Male	44	59	57	160
	Total	79	112	119	310

A group of tenth-grade students responded to a survey that asked which math course they were currently enrolled in. The survey data were broken down as shown in the table above. Which of the following categories accounts for approximately 19 percent of all the survey respondents?

- A) Females taking Geometry
- B) Females taking Algebra II
- C) Males taking Geometry
- D) Males taking Algebra I

14

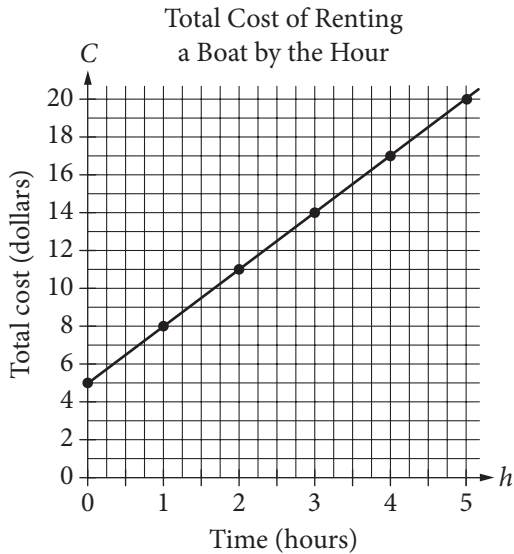
Lengths of Fish (in inches)						
8	9	9	9	10	10	11
11	12	12	12	12	13	13
13	14	14	15	15	16	24

The table above lists the lengths, to the nearest inch, of a random sample of 21 brown bullhead fish. The outlier measurement of 24 inches is an error. Of the mean, median, and range of the values listed, which will change the most if the 24-inch measurement is removed from the data?

- A) Mean
- B) Median
- C) Range
- D) They will all change by the same amount.



Questions 15 and 16 refer to the following information.



The graph above displays the total cost C , in dollars, of renting a boat for h hours.

15

What does the C -intercept represent in the graph?

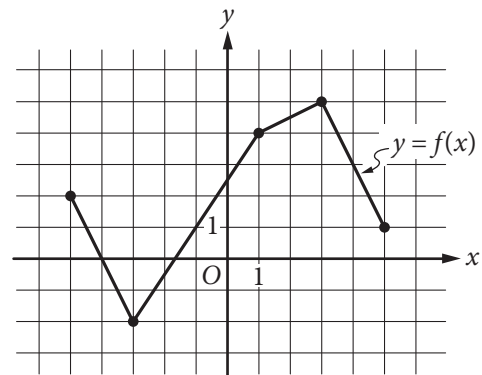
- A) The initial cost of renting the boat
- B) The total number of boats rented
- C) The total number of hours the boat is rented
- D) The increase in cost to rent the boat for each additional hour

16

Which of the following represents the relationship between h and C ?

- A) $C = 5h$
- B) $C = \frac{3}{4}h + 5$
- C) $C = 3h + 5$
- D) $h = 3C$

17



The complete graph of the function f is shown in the xy -plane above. For what value of x is the value of $f(x)$ at its minimum?

- A) -5
- B) -3
- C) -2
- D) 3



18

$$y < -x + a$$

$$y > x + b$$

In the xy -plane, if $(0, 0)$ is a solution to the system of inequalities above, which of the following relationships between a and b must be true?

- A) $a > b$
- B) $b > a$
- C) $|a| > |b|$
- D) $a = -b$

19

A food truck sells salads for \$6.50 each and drinks for \$2.00 each. The food truck's revenue from selling a total of 209 salads and drinks in one day was \$836.50. How many salads were sold that day?

- A) 77
- B) 93
- C) 99
- D) 105



20

Alma bought a laptop computer at a store that gave a 20 percent discount off its original price. The total amount she paid to the cashier was p dollars, including an 8 percent sales tax on the discounted price. Which of the following represents the original price of the computer in terms of p ?

- A) $0.88p$
- B) $\frac{p}{0.88}$
- C) $(0.8)(1.08)p$
- D) $\frac{p}{(0.8)(1.08)}$

21

Dreams Recalled during One Week

	None	1 to 4	5 or more	Total
Group X	15	28	57	100
Group Y	21	11	68	100
Total	36	39	125	200

The data in the table above were produced by a sleep researcher studying the number of dreams people recall when asked to record their dreams for one week. Group X consisted of 100 people who observed early bedtimes, and Group Y consisted of 100 people who observed later bedtimes. If a person is chosen at random from those who recalled at least 1 dream, what is the probability that the person belonged to Group Y ?

- A) $\frac{68}{100}$
- B) $\frac{79}{100}$
- C) $\frac{79}{164}$
- D) $\frac{164}{200}$



Questions 22 and 23 refer to the following information.

Annual Budgets for Different Programs in Kansas, 2007 to 2010

Program	Year			
	2007	2008	2009	2010
Agriculture/natural resources	373,904	358,708	485,807	488,106
Education	2,164,607	2,413,984	2,274,514	3,008,036
General government	14,347,325	12,554,845	10,392,107	14,716,155
Highways and transportation	1,468,482	1,665,636	1,539,480	1,773,893
Human resources	4,051,050	4,099,067	4,618,444	5,921,379
Public safety	263,463	398,326	355,935	464,233

The table above lists the annual budget, in thousands of dollars, for each of six different state programs in Kansas from 2007 to 2010.

22

Which of the following best approximates the average rate of change in the annual budget for agriculture/natural resources in Kansas from 2008 to 2010 ?

- A) \$50,000,000 per year
- B) \$65,000,000 per year
- C) \$75,000,000 per year
- D) \$130,000,000 per year

23

Of the following, which program's ratio of its 2007 budget to its 2010 budget is closest to the human resources program's ratio of its 2007 budget to its 2010 budget?

- A) Agriculture/natural resources
- B) Education
- C) Highways and transportation
- D) Public safety



24

Which of the following is an equation of a circle in the xy -plane with center $(0, 4)$ and a radius with endpoint $\left(\frac{4}{3}, 5\right)$?

- A) $x^2 + (y - 4)^2 = \frac{25}{9}$
- B) $x^2 + (y + 4)^2 = \frac{25}{9}$
- C) $x^2 + (y - 4)^2 = \frac{5}{3}$
- D) $x^2 + (y + 4)^2 = \frac{3}{5}$

25

$$h = -4.9t^2 + 25t$$

The equation above expresses the approximate height h , in meters, of a ball t seconds after it is launched vertically upward from the ground with an initial velocity of 25 meters per second. After approximately how many seconds will the ball hit the ground?

- A) 3.5
- B) 4.0
- C) 4.5
- D) 5.0

26

Katarina is a botanist studying the production of pears by two types of pear trees. She noticed that Type A trees produced 20 percent more pears than Type B trees did. Based on Katarina's observation, if the Type A trees produced 144 pears, how many pears did the Type B trees produce?

- A) 115
- B) 120
- C) 124
- D) 173

27

A square field measures 10 meters by 10 meters. Ten students each mark off a randomly selected region of the field; each region is square and has side lengths of 1 meter, and no two regions overlap. The students count the earthworms contained in the soil to a depth of 5 centimeters beneath the ground's surface in each region. The results are shown in the table below.

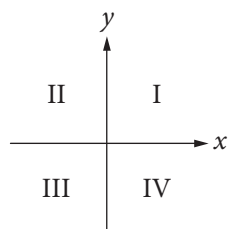
Region	Number of earthworms	Region	Number of earthworms
A	107	F	141
B	147	G	150
C	146	H	154
D	135	I	176
E	149	J	166

Which of the following is a reasonable approximation of the number of earthworms to a depth of 5 centimeters beneath the ground's surface in the entire field?

- A) 150
- B) 1,500
- C) 15,000
- D) 150,000



28



If the system of inequalities $y \geq 2x + 1$ and $y > \frac{1}{2}x - 1$ is graphed in the xy -plane above, which quadrant contains no solutions to the system?

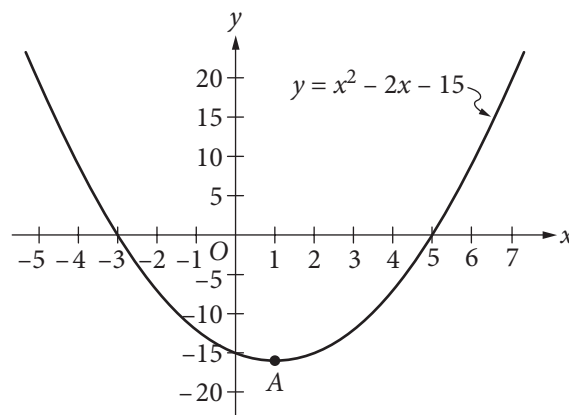
- A) Quadrant II
- B) Quadrant III
- C) Quadrant IV
- D) There are solutions in all four quadrants.

29

For a polynomial $p(x)$, the value of $p(3)$ is -2 . Which of the following must be true about $p(x)$?

- A) $x - 5$ is a factor of $p(x)$.
- B) $x - 2$ is a factor of $p(x)$.
- C) $x + 2$ is a factor of $p(x)$.
- D) The remainder when $p(x)$ is divided by $x - 3$ is -2 .

30



Which of the following is an equivalent form of the equation of the graph shown in the xy -plane above, from which the coordinates of vertex A can be identified as constants in the equation?

- A) $y = (x + 3)(x - 5)$
- B) $y = (x - 3)(x + 5)$
- C) $y = x(x - 2) - 15$
- D) $y = (x - 1)^2 - 16$



DIRECTIONS

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

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

3	1	/	2
•	•	•	•

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

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

	7	/	1	2
•	•	•	•	•
	0	0	0	0
①	①	●	①	①
②	②	②	●	②
③	③	③	③	③
④	④	④	④	④
⑤	⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥
●	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨

Write answer in boxes. →

← Fraction line

Grid in result.

Answer: 2.5

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

← Decimal point

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

	2	/	3
•	•	•	•
	0	0	0
①	①	①	①
②	●	②	②
③	③	③	●
④	④	④	④
⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨

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

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

Answer: 201 – either position is correct

	2	0	1
•	•	•	•
	0	●	0
①	①	①	●
②	●	②	②
③	③	③	③

	2	0	1
•	•	•	•
	●	0	0
①	①	●	①
②	②	②	②
③	③	③	③

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



31

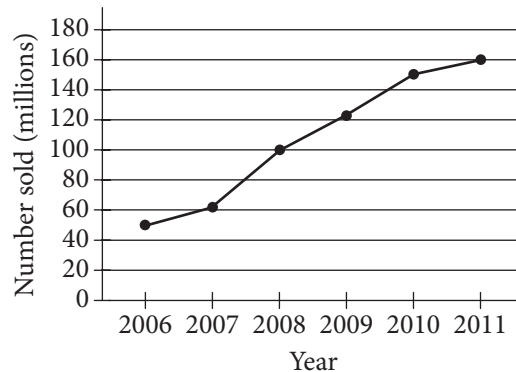
Wyatt can husk at least 12 dozen ears of corn per hour and at most 18 dozen ears of corn per hour. Based on this information, what is a possible amount of time, in hours, that it could take Wyatt to husk 72 dozen ears of corn?

32

The posted weight limit for a covered wooden bridge in Pennsylvania is 6000 pounds. A delivery truck that is carrying x identical boxes each weighing 14 pounds will pass over the bridge. If the combined weight of the empty delivery truck and its driver is 4500 pounds, what is the maximum possible value for x that will keep the combined weight of the truck, driver, and boxes below the bridge's posted weight limit?

33

Number of Portable Media Players
Sold Worldwide Each Year from 2006 to 2011



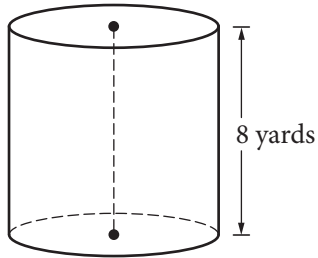
According to the line graph above, the number of portable media players sold in 2008 is what fraction of the number sold in 2011?

34

A local television station sells time slots for programs in 30-minute intervals. If the station operates 24 hours per day, every day of the week, what is the total number of 30-minute time slots the station can sell for Tuesday and Wednesday?



35



A dairy farmer uses a storage silo that is in the shape of the right circular cylinder above. If the volume of the silo is 72π cubic yards, what is the diameter of the base of the cylinder, in yards?

36

$$h(x) = \frac{1}{(x-5)^2 + 4(x-5) + 4}$$

For what value of x is the function h above undefined?

Questions 37 and 38 refer to the following information.

Jessica opened a bank account that earns 2 percent interest compounded annually. Her initial deposit was \$100, and she uses the expression $\$100(x)^t$ to find the value of the account after t years.

37

What is the value of x in the expression?

38

Jessica's friend Tyshaun found an account that earns 2.5 percent interest compounded annually. Tyshaun made an initial deposit of \$100 into this account at the same time Jessica made a deposit of \$100 into her account. After 10 years, how much more money will Tyshaun's initial deposit have earned than Jessica's initial deposit? (Round your answer to the nearest cent and ignore the dollar sign when gridding your response.)

STOP

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

QUESTION 43.

Choice D is the best answer because it creates a complete and coherent sentence.

Choices A, B, and C are incorrect because each inserts an unnecessary relative pronoun or conjunction, resulting in a sentence without a main verb.

QUESTION 44.

Choice D is the best answer because it provides a possessive pronoun that is consistent with the sentence's plural subject "students," thus creating a grammatically sound sentence.

Choices A, B, and C are incorrect because each proposes a possessive pronoun that is inconsistent with the plural noun "students," the established subject of the sentence.

Section 3: Math Test — No Calculator

QUESTION 1.

Choice D is correct. Since $k = 3$, one can substitute 3 for k in the equation $\frac{x-1}{3} = k$, which gives $\frac{x-1}{3} = 3$. Multiplying both sides of $\frac{x-1}{3} = 3$ by 3 gives $x-1 = 9$ and then adding 1 to both sides of $x-1 = 9$ gives $x = 10$.

Choices A, B, and C are incorrect because the result of subtracting 1 from the value and dividing by 3 is not the given value of k , which is 3.

QUESTION 2.

Choice A is correct. To calculate $(7 + 3i) + (-8 + 9i)$, add the real parts of each complex number, $7 + (-8) = -1$, and then add the imaginary parts, $3i + 9i = 12i$. The result is $-1 + 12i$.

Choices B, C, and D are incorrect and likely result from common errors that arise when adding complex numbers. For example, choice B is the result of adding $3i$ and $-9i$, and choice C is the result of adding 7 and 8.

QUESTION 3.

Choice C is correct. The total number of messages sent by Armand is the 5 hours he spent texting multiplied by his rate of texting: m texts/hour \times 5 hours = $5m$ texts. Similarly, the total number of messages sent by Tyrone is the 4 hours he spent texting multiplied by his rate of texting: p texts/hour \times 4 hours = $4p$ texts. The total number of messages sent by Armand and Tyrone is the sum of the total number of messages sent by Armand and the total number of messages sent by Tyrone: $5m + 4p$.

Choice A is incorrect and arises from adding the coefficients and multiplying the variables of $5m$ and $4p$. Choice B is incorrect and is the result of multiplying $5m$ and $4p$. The total number of messages sent by Armand and Tyrone should be the sum of $5m$ and $4p$, not the product of these terms. Choice D is incorrect because it multiplies Armand's number of hours spent texting by Tyrone's rate of texting, and vice versa. This mix-up results in an expression that does not equal the total number of messages sent by Armand and Tyrone.

QUESTION 4.

Choice B is correct. The value 108 in the equation is the value of P in $P = 108 - 23d$ when $d = 0$. When $d = 0$, Kathy has worked 0 days that week. In other words, 108 is the number of phones left before Kathy has started work for the week. Therefore, the meaning of the value 108 in the equation is that Kathy starts each week with 108 phones to fix because she has worked 0 days and has 108 phones left to fix.

Choice A is incorrect because Kathy will complete the repairs when $P = 0$. Since $P = 108 - 23d$, this will occur when $0 = 108 - 23d$ or when $d = \frac{108}{23}$, not when $d = 108$. Therefore, the value 108 in the equation does not represent the number of days it will take Kathy to complete the repairs. Choices C and D are incorrect because the number 23 in $P = 108 - 23d = 108$ indicates that the number of phones left will decrease by 23 for each increase in the value of d by 1; in other words, that Kathy is repairing phones at a rate of 23 per day, not 108 per hour (choice C) or 108 per day (choice D).

QUESTION 5.

Choice C is correct. Only like terms, with the same variables and exponents, can be combined to determine the answer as shown here:

$$\begin{aligned} & (x^2y - 3y^2 + 5xy^2) - (-x^2y + 3xy^2 - 3y^2) \\ &= (x^2y - (-x^2y)) + (-3y^2 - (-3y^2)) + (5xy^2 - 3xy^2) \\ &= 2x^2y + 0 + 2xy^2 \\ &= 2x^2y + 2xy^2 \end{aligned}$$

Choices A, B, and D are incorrect and are the result of common calculation errors or of incorrectly combining like and unlike terms.

QUESTION 6.

Choice A is correct. In the equation $h = 3a + 28.6$, if a , the age of the boy, increases by 1, then h becomes $h = 3(a + 1) + 28.6 = 3a + 3 + 28.6 = (3a + 28.6) + 3$. Therefore, the model estimates that the boy's height increases by 3 inches each year.

Alternatively: The height, h , is a linear function of the age, a , of the boy. The coefficient 3 can be interpreted as the rate of change of the function; in this

case, the rate of change can be described as a change of 3 inches in height for every additional year in age.

Choices B, C, and D are incorrect and are likely to result from common errors in calculating the value of h or in calculating the difference between the values of h for different values of a .

QUESTION 7.

Choice B is correct. Since the right-hand side of the equation is P times the

expression $\frac{\left(\frac{r}{1,200}\right)\left(1 + \frac{r}{1,200}\right)^N}{\left(1 + \frac{r}{1,200}\right)^N - 1}$, multiplying both sides of the equation by the reciprocal of this expression results in $\frac{\left(1 + \frac{r}{1,200}\right)^N - 1}{\left(\frac{r}{1,200}\right)\left(1 + \frac{r}{1,200}\right)^N} m = P$.

Choices A, C, and D are incorrect and are likely the result of conceptual or computation errors while trying to solve for P .

QUESTION 8.

Choice C is correct. Since $\frac{a}{b} = 2$, it follows that $\frac{b}{a} = \frac{1}{2}$. Multiplying both sides of the equation by 4 gives $4\left(\frac{b}{a}\right) = \frac{4b}{a} = 2$.

Choice A is incorrect because if $\frac{4b}{a} = 0$, then $\frac{a}{b}$ would be undefined. Choice B is incorrect because if $\frac{4b}{a} = 1$, then $\frac{a}{b} = 4$. Choice D is incorrect because if $\frac{4b}{a} = 4$, then $\frac{a}{b} = 1$.

QUESTION 9.

Choice B is correct. Adding x and 19 to both sides of $2y - x = -19$ gives $x = 2y + 19$. Then, substituting $2y + 19$ for x in $3x + 4y = -23$ gives $3(2y + 19) + 4y = -23$. This last equation is equivalent to $10y + 57 = -23$. Solving $10y + 57 = -23$ gives $y = -8$. Finally, substituting -8 for y in $2y - x = -19$ gives $2(-8) - x = -19$, or $x = 3$. Therefore, the solution (x, y) to the given system of equations is $(3, -8)$.

Choices A, C, and D are incorrect because when the given values of x and y are substituted in $2y - x = -19$, the value of the left side of the equation does not equal -19 .

QUESTION 10.

Choice A is correct. Since g is an even function, $g(-4) = g(4) = 8$.

Alternatively: First find the value of a , and then find $g(-4)$. Since $g(4) = 8$, substituting 4 for x and 8 for $g(x)$ gives $8 = a(4)^2 + 24 = 16a + 24$. Solving this

last equation gives $a = -1$. Thus $g(x) = -x^2 + 24$, from which it follows that $g(-4) = -(-4)^2 + 24$; $g(-4) = -16 + 24$; and $g(-4) = 8$.

Choices B, C, and D are incorrect because g is a function and there can only be one value of $g(-4)$.

QUESTION 11.

Choice D is correct. To determine the price per pound of beef when it was equal to the price per pound of chicken, determine the value of x (the number of weeks after July 1) when the two prices were equal. The prices were equal when $b = c$; that is, when $2.35 + 0.25x = 1.75 + 0.40x$. This last equation is equivalent to $0.60 = 0.15x$, and so $x = \frac{0.60}{0.15} = 4$. Then to determine b , the price per pound of beef, substitute 4 for x in $b = 2.35 + 0.25x$, which gives $b = 2.35 + 0.25(4) = 3.35$ dollars per pound.

Choice A is incorrect. It results from using the value 1, not 4, for x in $b = 2.35 + 0.25x$. Choice B is incorrect. It results from using the value 2, not 4, for x in $b = 2.35 + 0.25x$. Choice C is incorrect. It results from using the value 3, not 4, for x in $c = 1.75 + 0.40x$.

QUESTION 12.

Choice D is correct. Determine the equation of the line to find the relationship between the x - and y -coordinates of points on the line. All lines through the origin are of the form $y = mx$, so the equation is $y = \frac{1}{7}x$. A point lies on the line if and only if its y -coordinate is $\frac{1}{7}$ of its x -coordinate. Of the given choices, only choice D, $(14, 2)$, satisfies this condition: $2 = \frac{1}{7}(14)$.

Choice A is incorrect because the line determined by the origin $(0, 0)$ and $(0, 7)$ is the vertical line with equation $x = 0$; that is, the y -axis. The slope of the y -axis is undefined, not $\frac{1}{7}$. Therefore, the point $(0, 7)$ does not lie on the line that passes the origin and has slope $\frac{1}{7}$. Choices B and C are incorrect because neither of the ordered pairs has a y -coordinate that is $\frac{1}{7}$ the value of the x -coordinate.

QUESTION 13.

Choice B is correct. To rewrite $\frac{1}{\frac{1}{x+2} + \frac{1}{x+3}}$, multiply by $\frac{(x+2)(x+3)}{(x+2)(x+3)}$.

This results in the expression $\frac{(x+2)(x+3)}{(x+3) + (x+2)}$, which is equivalent to the expression in choice B.

Choices A, C, and D are incorrect and could be the result of common algebraic errors that arise while manipulating a complex fraction.

QUESTION 14.

Choice A is correct. One approach is to express $\frac{8^x}{2^y}$ so that the numerator and denominator are expressed with the same base. Since 2 and 8 are both

powers of 2, substituting 2^3 for 8 in the numerator of $\frac{8^x}{2^y}$ gives $\frac{(2^3)^x}{2^y}$, which can be rewritten as $\frac{2^{3x}}{2^y}$. Since the numerator and denominator of $\frac{2^{3x}}{2^y}$ have a common base, this expression can be rewritten as 2^{3x-y} . It is given that $3x - y = 12$, so one can substitute 12 for the exponent, $3x - y$, giving that the expression $\frac{8^x}{2^y}$ is equal to 2^{12} .

Choices B and C are incorrect because they are not equal to 2^{12} . Choice D is incorrect because the value of $\frac{8^x}{2^y}$ can be determined.

QUESTION 15.

Choice D is correct. One can find the possible values of a and b in $(ax + 2)(bx + 7)$ by using the given equation $a + b = 8$ and finding another equation that relates the variables a and b . Since $(ax + 2)(bx + 7) = 15x^2 + cx + 14$, one can expand the left side of the equation to obtain $abx^2 + 7ax + 2bx + 14 = 15x^2 + cx + 14$. Since ab is the coefficient of x^2 on the left side of the equation and 15 is the coefficient of x^2 on the right side of the equation, it must be true that $ab = 15$. Since $a + b = 8$, it follows that $b = 8 - a$. Thus, $ab = 15$ can be rewritten as $a(8 - a) = 15$, which in turn can be rewritten as $a^2 - 8a + 15 = 0$. Factoring gives $(a - 3)(a - 5) = 0$. Thus, either $a = 3$ and $b = 5$, or $a = 5$ and $b = 3$. If $a = 3$ and $b = 5$, then $(ax + 2)(bx + 7) = (3x + 2)(5x + 7) = 15x^2 + 31x + 14$. Thus, one of the possible values of c is 31. If $a = 5$ and $b = 3$, then $(ax + 2)(bx + 7) = (5x + 2)(3x + 7) = 15x^2 + 41x + 14$. Thus, another possible value for c is 41. Therefore, the two possible values for c are 31 and 41.

Choice A is incorrect; the numbers 3 and 5 are possible values for a and b , but not possible values for c . Choice B is incorrect; if $a = 5$ and $b = 3$, then 6 and 35 are the coefficients of x when the expression $(5x + 2)(3x + 7)$ is expanded as $15x^2 + 35x + 6x + 14$. However, when the coefficients of x are 6 and 35, the value of c is 41 and not 6 and 35. Choice C is incorrect; if $a = 3$ and $b = 5$, then 10 and 21 are the coefficients of x when the expression $(3x + 2)(5x + 7)$ is expanded as $15x^2 + 21x + 10x + 14$. However, when the coefficients of x are 10 and 21, the value of c is 31 and not 10 and 21.

QUESTION 16.

The correct answer is 2. To solve for t , factor the left side of $t^2 - 4 = 0$, giving $(t - 2)(t + 2) = 0$. Therefore, either $t - 2 = 0$ or $t + 2 = 0$. If $t - 2 = 0$, then $t = 2$, and if $t + 2 = 0$, then $t = -2$. Since it is given that $t > 0$, the value of t must be 2.

Another way to solve for t is to add 4 to both sides of $t^2 - 4 = 0$, giving $t^2 = 4$. Then, taking the square root of the left and the right side of the equation gives $t = \pm\sqrt{4} = \pm 2$. Since it is given that $t > 0$, the value of t must be 2.

QUESTION 17.

The correct answer is 1600. It is given that $\angle AEB$ and $\angle CDB$ have the same measure. Since $\angle ABE$ and $\angle CBD$ are vertical angles, they have the same measure. Therefore, triangle EAB is similar to triangle DCB because the triangles have two pairs of congruent corresponding angles (angle-angle criterion for similarity of triangles). Since the triangles are similar, the corresponding sides are in the same proportion; thus $\frac{CD}{x} = \frac{BD}{EB}$. Substituting the given values of 800 for CD , 700 for BD , and 1400 for EB in $\frac{CD}{x} = \frac{BD}{EB}$ gives $\frac{800}{x} = \frac{700}{1400}$. Therefore, $x = \frac{(800)(1400)}{700} = 1600$.

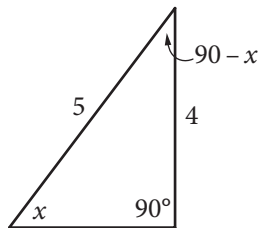
QUESTION 18.

The correct answer is 7. Subtracting the left and right sides of $x + y = -9$ from the corresponding sides of $x + 2y = -25$ gives $(x + 2y) - (x + y) = -25 - (-9)$, which is equivalent to $y = -16$. Substituting -16 for y in $x + y = -9$ gives $x + (-16) = -9$, which is equivalent to $x = -9 - (-16) = 7$.

QUESTION 19.

The correct answer is $\frac{4}{5}$ or 0.8. By the complementary angle relationship for sine and cosine, $\sin(x^\circ) = \cos(90^\circ - x^\circ)$. Therefore, $\cos(90^\circ - x^\circ) = \frac{4}{5}$. Either the fraction $\frac{4}{5}$ or its decimal equivalent, 0.8, may be gridded as the correct answer.

Alternatively, one can construct a right triangle that has an angle of measure x° such that $\sin(x^\circ) = \frac{4}{5}$, as shown in the figure below, where $\sin(x^\circ)$ is equal to the ratio of the opposite side to the hypotenuse, or $\frac{4}{5}$.



Since two of the angles of the triangle are of measure x° and 90° , the third angle must have the measure $180^\circ - 90^\circ - x^\circ = 90^\circ - x^\circ$. From the figure, $\cos(90^\circ - x^\circ)$, which is equal to the ratio of the adjacent side to the hypotenuse, is also $\frac{4}{5}$.

QUESTION 20.

The correct answer is 100. Since $a = 5\sqrt{2}$, one can substitute $5\sqrt{2}$ for a in $2a = \sqrt{2}x$, giving $10\sqrt{2} = \sqrt{2}x$. Squaring each side of $10\sqrt{2} = \sqrt{2}x$ gives $(10\sqrt{2})^2 = (\sqrt{2}x)^2$, which simplifies to $(10)^2(\sqrt{2})^2 = (\sqrt{2}x)^2$, or $200 = 2x$. This gives $x = 100$. Checking $x = 100$ in the original equation gives $2(5\sqrt{2}) = \sqrt{(2)(100)}$, which is true since $2(5\sqrt{2}) = 10\sqrt{2}$ and $\sqrt{(2)(100)} = (\sqrt{2})(\sqrt{100}) = 10\sqrt{2}$.

Section 4: Math Test — Calculator

QUESTION 1.

Choice B is correct. On the graph, a line segment with a positive slope represents an interval over which the target heart rate is strictly increasing as time passes. A horizontal line segment represents an interval over which there is no change in the target heart rate as time passes, and a line segment with a negative slope represents an interval over which the target heart rate is strictly decreasing as time passes. Over the interval between 40 and 60 minutes, the graph consists of a line segment with a positive slope followed by a line segment with a negative slope, with no horizontal line segment in between, indicating that the target heart rate is strictly increasing then strictly decreasing.

Choice A is incorrect because the graph over the interval between 0 and 30 minutes contains a horizontal line segment, indicating a period in which there was no change in the target heart rate. Choice C is incorrect because the graph over the interval between 50 and 65 minutes consists of a line segment with a negative slope followed by a line segment with a positive slope, indicating that the target heart rate is strictly decreasing then strictly increasing. Choice D is incorrect because the graph over the interval between 70 and 90 minutes contains horizontal line segments and no segment with a negative slope.

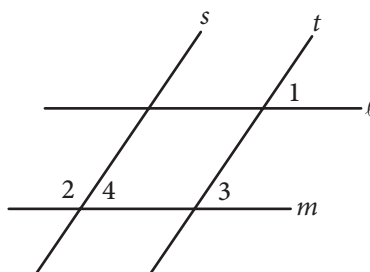
QUESTION 2.

Choice C is correct. Substituting 6 for x and 24 for y in $y = kx$ gives $24 = (k)(6)$, which gives $k = 4$. Hence, $y = 4x$. Therefore, when $x = 5$, the value of y is $(4)(5) = 20$. None of the other choices for y is correct because y is a function of x , and so there is only one y -value for a given x -value.

Choices A, B, and D are incorrect. Choice A is the result of using 6 for y and 5 for x when solving for k . Choice B results from using a value of 3 for k when solving for y . Choice D results from using $y = k + x$ instead of $y = kx$.

QUESTION 3.

Choice D is correct. Consider the measures of $\angle 3$ and $\angle 4$ in the figure below.



The measure of $\angle 3$ is equal to the measure of $\angle 1$ because they are corresponding angles for the parallel lines ℓ and m intersected by the transversal line t . Similarly, the measure of $\angle 3$ is equal to the measure of $\angle 4$ because they are corresponding angles for the parallel lines s and t intersected by the transversal line m . Since the measure of $\angle 1$ is 35° , the measures of $\angle 3$ and $\angle 4$ are also 35° . Since $\angle 4$ and $\angle 2$ are supplementary, the sum of the measures of these two angles is 180° . Therefore, the measure of $\angle 2$ is $180^\circ - 35^\circ = 145^\circ$.

Choice A is incorrect because 35° is the measure of $\angle 1$, and $\angle 1$ is not congruent to $\angle 2$. Choice B is incorrect because it is the measure of the complementary angle of $\angle 1$, and $\angle 1$ and $\angle 2$ are not complementary angles. Choice C is incorrect because it is double the measure of $\angle 1$.

QUESTION 4.

Choice C is correct. The description “ $16 + 4x$ is 10 more than 14” can be written as the equation $16 + 4x = 10 + 14$, which is equivalent to $16 + 4x = 24$. Subtracting 16 from each side of $16 + 4x = 24$ gives $4x = 8$. Since $8x$ is 2 times $4x$, multiplying both sides of $4x = 8$ by 2 gives $8x = 16$. Therefore, the value of $8x$ is 16.

Choice A is incorrect because it is the value of x , not $8x$. Choices B and D are incorrect; those choices may be a result of errors in rewriting $16 + 4x = 10 + 14$. For example, choice D could be the result of subtracting 16 from the left side of the equation and adding 16 to the right side of $16 + 4x = 10 + 14$, giving $4x = 40$ and $8x = 80$.

QUESTION 5.

Choice D is correct. A graph with a strong negative association between d and t would have the points on the graph closely aligned with a line that has a negative slope. The more closely the points on a graph are aligned with a line, the stronger the association between d and t , and a negative slope indicates a negative association. Of the four graphs, the points on graph D are most closely aligned with a line with a negative slope. Therefore, the graph in choice D has the strongest negative association between d and t .

Choice A is incorrect because the points are more scattered than the points in choice D, indicating a weak negative association between d and t . Choice B is incorrect because the points are aligned to either a curve or possibly a line with a small positive slope. Choice C is incorrect because the points are aligned to a line with a positive slope, indicating a positive association between d and t .

QUESTION 6.

Choice D is correct. Since there are 10 grams in 1 decagram, there are $2 \times 10 = 20$ grams in 2 decagrams. Since there are 1,000 milligrams in 1 gram, there are $20 \times 1,000 = 20,000$ milligrams in 20 grams. Therefore, 20,000 1-milligram doses of the medicine can be stored in a 2-decagram container.

Choice A is incorrect; 0.002 is the number of grams in 2 milligrams. Choice B is incorrect; it could result from multiplying by 1,000 and dividing by 10 instead of multiplying by both 1,000 and 10 when converting from decagrams to milligrams. Choice C is incorrect; 2,000 is the number of milligrams in 2 grams, not the number of milligrams in 2 decagrams.

QUESTION 7.

Choice C is correct. Let x represent the number of installations that each unit on the y -axis represents. Then $9x$, $5x$, $6x$, $4x$, and $3.5x$ are the number of rooftops with solar panel installations in cities A, B, C, D, and E, respectively. Since the total number of rooftops is 27,500, it follows that $9x + 5x + 6x + 4x + 3.5x = 27,500$, which simplifies to $27.5x = 27,500$. Thus, $x = 1,000$. Therefore, an appropriate label for the y -axis is “Number of installations (in thousands).”

Choices A, B, and D are incorrect and may result from errors when setting up and calculating the units for the y -axis.

QUESTION 8.

Choice D is correct. If the value of $|n - 1| + 1$ is equal to 0, then $|n - 1| + 1 = 0$. Subtracting 1 from both sides of this equation gives $|n - 1| = -1$. The expression $|n - 1|$ on the left side of the equation is the absolute value of $n - 1$, and the absolute value can never be a negative number. Thus $|n - 1| = -1$ has no solution. Therefore, there are no values for n for which the value of $|n - 1| + 1$ is equal to 0.

Choice A is incorrect because $|0 - 1| + 1 = 1 + 1 = 2$, not 0. Choice B is incorrect because $|1 - 1| + 1 = 0 + 1 = 1$, not 0. Choice C is incorrect because $|2 - 1| + 1 = 1 + 1 = 2$, not 0.

QUESTION 9.

Choice A is correct. Subtracting 1,052 from both sides of the equation $a = 1,052 + 1.08t$ gives $a - 1,052 = 1.08t$. Then dividing both sides of $a - 1,052 = 1.08t$ by 1.08 gives $t = \frac{a - 1,052}{1.08}$.

Choices B, C, and D are incorrect and could arise from errors in rewriting $a = 1,052 + 1.08t$. For example, choice B could result if 1,052 is added to the

left side of $a = 1,052 + 1.08t$ and subtracted from the right side, and then both sides are divided by 1.08.

QUESTION 10.

Choice B is correct. Substituting 1,000 for a in the equation $a = 1,052 + 1.08t$ gives $1,000 = 1,052 + 1.08t$, and thus $t = \frac{-52}{1.08} \approx -48.15$. Of the choices given, -48°F is closest to -48.15°F . Since the equation $a = 1,052 + 1.08t$ is linear, it follows that of the choices given, -48°F is the air temperature when the speed of a sound wave is closest to 1,000 feet per second.

Choices A, C, and D are incorrect, and might arise from errors in calculating $\frac{-52}{1.08}$ or in rounding the result to the nearest integer. For example, choice C could be the result of rounding -48.15 to -49 instead of -48 .

QUESTION 11.

Choice A is correct. Subtracting $3x$ and adding 3 to both sides of $3x - 5 \geq 4x - 3$ gives $-2 \geq x$. Therefore, x is a solution to $3x - 5 \geq 4x - 3$ if and only if x is less than or equal to -2 and x is NOT a solution to $3x - 5 \geq 4x - 3$ if and only if x is greater than -2 . Of the choices given, only -1 is greater than -2 and, therefore, cannot be a value of x .

Choices B, C, and D are incorrect because each is a value of x that is less than or equal to -2 and, therefore, could be a solution to the inequality.

QUESTION 12.

Choice C is correct. The average number of seeds per apple is the total number of seeds in the 12 apples divided by the number of apples, which is 12. On the graph, the horizontal axis is the number of seeds per apple and the height of each bar is the number of apples with the corresponding number of seeds. The first bar on the left indicates that 2 apples have 3 seeds each, the second bar indicates that 4 apples have 5 seeds each, the third bar indicates that 1 apple has 6 seeds, the fourth bar indicates that 2 apples have 7 seeds each, and the fifth bar indicates that 3 apples have 9 seeds each. Thus, the total number of seeds for the 12 apples is $(2 \times 3) + (4 \times 5) + (1 \times 6) + (2 \times 7) + (3 \times 9) = 73$, and the average number of seeds per apple is $\frac{73}{12} = 6.08$. Of the choices given, 6 is closest to 6.08.

Choice A is incorrect; it is the number of apples represented by the tallest bar but is not the average number of seeds for the 12 apples. Choice B is incorrect; it is the number of seeds per apple corresponding to the tallest bar, but is not the average number of seeds for the 12 apples. Choice D is incorrect; a student might choose this by correctly calculating the average number of seeds, 6.08, but incorrectly rounding up to 7.

QUESTION 13.

Choice C is correct. From the table, there was a total of 310 survey respondents, and 19% of all survey respondents is equivalent to $\frac{19}{100} \times 310 = 58.9$ respondents. Of the choices given, 59, the number of males taking geometry, is closest to 58.9 respondents.

Choices A, B, and D are incorrect because the number of males taking geometry is closer to 58.9 than the number of respondents in each of these categories.

QUESTION 14.

Choice C is correct. The range of the 21 fish is $24 - 8 = 16$ inches, and the range of the 20 fish after the 24-inch measurement is removed is $16 - 8 = 8$ inches. The change in range, 8 inches, is much greater than the change in the mean or median.

Choice A is incorrect. Let m be the mean of the lengths, in inches, of the 21 fish. Then the sum of the lengths, in inches, of the 21 fish is $21m$. After the 24-inch measurement is removed, the sum of the lengths, in inches, of the remaining 20 fish is $21m - 24$, and the mean length, in inches, of these 20 fish is $\frac{21m - 24}{20}$, which is a change of $\frac{24 - m}{20}$ inches. Since m must be between the smallest and largest measurements of the 21 fish, it follows that $8 < m < 24$, from which it can be seen that the change in the mean, in inches, is between $\frac{24 - 24}{20} = 0$ and $\frac{24 - 8}{20} = \frac{4}{5}$, and so must be less than the change in the range, 8 inches. Choice B is incorrect because the median length of the 21 fish is the length of the 11th fish, 12 inches. After removing the 24-inch measurement, the median of the remaining 20 lengths is the average of the 10th and 11th fish, which would be unchanged at 12 inches. Choice D is incorrect because the changes in the mean, median, and range of the measurements are different.

QUESTION 15.

Choice A is correct. The total cost C of renting a boat is the sum of the initial cost to rent the boat plus the product of the cost per hour and the number of hours, h , that the boat is rented. The C -intercept is the point on the C -axis where h , the number of hours the boat is rented, is 0. Therefore, the C -intercept is the initial cost of renting the boat.

Choice B is incorrect because the graph represents the cost of renting only one boat. Choice C is incorrect because the total number of hours of rental is represented by h -values, each of which corresponds to the first coordinate of a point on the graph. Choice D is incorrect because the increase in cost for each additional hour is given by the slope of the line, not by the C -intercept.

QUESTION 16.

Choice C is correct. The relationship between h and C is represented by any equation of the given line. The C -intercept of the line is 5. Since the points $(0, 5)$ and $(1, 8)$ lie on the line, the slope of the line is $\frac{8-5}{1-0} = \frac{3}{1} = 3$. Therefore, the relationship between h and C can be represented by $C = 3h + 5$, the slope-intercept equation of the line.

Choices A and D are incorrect because each uses the wrong values for both the slope and intercept. Choice B is incorrect; this choice would result from computing the slope by counting the number of grid lines instead of using the values represented by the axes.

QUESTION 17.

Choice B is correct. The minimum value of the function corresponds to the y -coordinate of the point on the graph that is the lowest along the vertical or y -axis. Since the grid lines are spaced 1 unit apart on each axis, the lowest point along the y -axis has coordinates $(-3, -2)$. Therefore, the value of x at the minimum of $f(x)$ is -3 .

Choice A is incorrect; -5 is the smallest value for an x -coordinate of a point on the graph of f , not the lowest point on the graph of f . Choice C is incorrect; it is the minimum value of f , not the value of x that corresponds to the minimum of f . Choice D is incorrect; it is the value of x at the maximum value of f , not at the minimum value of f .

QUESTION 18.

Choice A is correct. Since $(0, 0)$ is a solution to the system of inequalities, substituting 0 for x and 0 for y in the given system must result in two true inequalities. After this substitution, $y < -x + a$ becomes $0 < a$, and $y > x + b$ becomes $0 > b$. Hence, a is positive and b is negative. Therefore, $a > b$.

Choice B is incorrect because $b > a$ cannot be true if b is negative and a is positive. Choice C is incorrect because it is possible to find an example where $(0, 0)$ is a solution to the system, but $|a| < |b|$; for example, if $a = 6$ and $b = -7$. Choice D is incorrect because the equation $a = -b$ could be true, but doesn't have to be true; for example, if $a = 1$ and $b = -2$.

QUESTION 19.

Choice B is correct. To determine the number of salads sold, write and solve a system of two equations. Let x equal the number of salads sold and let y equal the number of drinks sold. Since the number of salads plus the number of drinks sold equals 209, the equation $x + y = 209$ must hold. Since each

salad cost \$6.50, each soda cost \$2.00, and the total revenue was \$836.50, the equation $6.50x + 2.00y = 836.50$ must also hold. The equation $x + y = 209$ is equivalent to $2x + 2y = 418$, and subtracting each side of $2x + 2y = 418$ from the respective side of $6.50x + 2.00y = 836.50$ gives $4.5x = 418.50$. Therefore, the number of salads sold, x , was $x = \frac{418.50}{4.50} = 93$.

Choices A, C, and D are incorrect and could result from errors in writing the equations and solving the system of equations. For example, choice C could have been obtained by dividing the total revenue, \$836.50, by the total price of a salad and a soda, \$8.50, and then rounding up.

QUESTION 20.

Choice D is correct. Let x be the original price of the computer, in dollars. The discounted price is 20 percent off the original price, so $x - 0.2x = 0.8x$ is the discounted price, in dollars. The tax is 8 percent of the discounted price, so $0.08(0.8x)$ is the tax on the purchase, in dollars. The price p , in dollars, that Alma paid the cashiers is the sum of the discounted price and the tax: $p = 0.8x + (0.08)(0.8x)$ which can be rewritten as $p = 1.08(0.8x)$. Therefore, the original price, x , of the computer, in dollars, can be written as $\frac{p}{(0.8)(1.08)}$ in terms of p .

Choices A, B, and C are incorrect; each choice either switches the roles of the original price and the amount Alma paid, or incorrectly combines the results of the discount and the tax as $0.8 + 0.08 = 0.88$ instead of as $(0.8)(1.08)$.

QUESTION 21.

Choice C is correct. The probability that a person from Group Y who recalled at least 1 dream was chosen from the group of all people who recalled at least 1 dream is equal to the number of people in Group Y who recalled at least 1 dream divided by the total number of people in the two groups who recalled at least 1 dream. The number of people in Group Y who recalled at least 1 dream is the sum of the 11 people in Group Y who recalled 1 to 4 dreams and the 68 people in Group Y who recalled 5 or more dreams: $11 + 68 = 79$. The total number of people who recalled at least 1 dream is the sum of the 79 people in Group Y who recalled at least 1 dream, the 28 people in Group X who recalled 1 to 4 dreams, and the 57 people in Group X who recalled 5 or more dreams: $79 + 28 + 57 = 164$. Therefore, the probability is $\frac{79}{164}$.

Choice A is incorrect; it is the number of people in Group Y who recalled 5 or more dreams divided by the total number of people in Group Y. Choice B is incorrect; it uses the total number of people in Group Y as the denominator of the probability. Choice D is incorrect; it is the total number of people in the two groups who recalled at least 1 dream divided by the total number of people in the two groups.

QUESTION 22.

Choice B is correct. The average rate of change in the annual budget for agriculture/natural resources from 2008 to 2010 is the total change from 2008 to 2010 divided by the number of years, which is 2. The total change in the annual budget for agriculture/natural resources from 2008 to 2010 is $488,106 - 358,708 = 129,398$, in thousands of dollars, so the average change in the annual budget for agriculture/natural resources from 2008 to 2010 is $\frac{\$129,398,000}{2} = \$64,699,000$ per year. Of the options given, this average rate of change is closest to \$65,000,000 per year.

Choices A and C are incorrect; they could result from errors in setting up or calculating the average rate of change. Choice D is incorrect; \$130,000,000 is the approximate total change from 2008 to 2010, not the average change from 2008 to 2010.

QUESTION 23.

Choice B is correct. The human resources budget in 2007 was 4,051,050 thousand dollars, and the human resources budget in 2010 was 5,921,379 thousand dollars. Therefore, the ratio of the 2007 budget to the 2010 budget is slightly greater than $\frac{4}{6} = \frac{2}{3}$. Similar estimates for agriculture/natural resources give a ratio of the 2007 budget to the 2010 budget of slightly greater than $\frac{3}{4}$; for education, a ratio of slightly greater than $\frac{2}{3}$; for highways and transportation, a ratio of slightly less than $\frac{5}{6}$; and for public safety, a ratio of slightly greater than $\frac{5}{9}$. Therefore, of the given choices, education's ratio of the 2007 budget to the 2010 budget is closest to that of human resources.

Choices A, C, and D are incorrect because the 2007 budget to 2010 budget ratio for each of these programs in these choices is further from the corresponding ratio for human resources than the ratio for education.

QUESTION 24.

Choice A is correct. The equation of a circle can be written as $(x - h)^2 + (y - k)^2 = r^2$ where (h, k) are the coordinates of the center of the circle and r is the radius of the circle. Since the coordinates of the center of the circle are $(0, 4)$, the equation is $x^2 + (y - 4)^2 = r^2$, where r is the radius. The radius of the circle is the distance from the center, $(0, 4)$, to the given endpoint of a radius, $(\frac{4}{3}, 5)$. By the distance formula, $r^2 = \left(\frac{4}{3} - 0\right)^2 + (5 - 4)^2 = \frac{25}{9}$. Therefore, an equation of the given circle is $x^2 + (y - 4)^2 = \frac{25}{9}$.

Choice B is incorrect; it results from the incorrect equation $(x + h)^2 + (y + k)^2 = r^2$. Choice C is incorrect; it results from using r instead of r^2 in the equation for the circle. Choice D is incorrect; it results from using the incorrect equation $(x + h)^2 + (y + k)^2 = \frac{1}{r}$.

QUESTION 25.

Choice D is correct. When the ball hits the ground, its height is 0 meters. Substituting 0 for h in $h = -4.9t^2 + 25t$ gives $0 = -4.9t^2 + 25t$, which can be rewritten as $0 = t(-4.9t + 25)$. Thus, the possible values of t are $t = 0$ and $t = \frac{25}{4.9} \approx 5.1$. The time $t = 0$ seconds corresponds to the time the ball is launched from the ground, and the time $t \approx 5.1$ seconds corresponds to the time after launch that the ball hits the ground. Of the given choices, 5.0 seconds is closest to 5.1 seconds, so the ball returns to the ground approximately 5.0 seconds after it is launched.

Choice A, B, and C are incorrect and could arise from conceptual or computation errors while solving $0 = -4.9t^2 + 25t$ for t .

QUESTION 26.

Choice B is correct. Let x represent the number of pears produced by the Type B trees. Then the Type A trees produce 20 percent more pears than x , which is $x + 0.20x = 1.20x$ pears. Since Type A trees produce 144 pears, the equation $1.20x = 144$ holds. Thus $x = \frac{144}{1.20} = 120$. Therefore, the Type B trees produced 120 pears.

Choice A is incorrect because while 144 is reduced by approximately 20 percent, increasing 115 by 20 percent gives 138, not 144. Choice C is incorrect; it results from subtracting 20 from the number of pears produced by the Type A trees. Choice D is incorrect; it results from adding 20 percent of the number of pears produced by Type A trees to the number of pears produced by Type A trees.

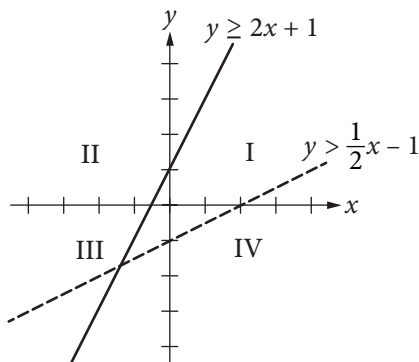
QUESTION 27.

Choice C is correct. The area of the field is 100 square meters. Each 1-meter-by-1-meter square has an area of 1 square meter. Thus, on average, the earthworm counts to a depth of 5 centimeters for each of the regions investigated by the students should be about $\frac{1}{100}$ of the total number of earthworms to a depth of 5 centimeters in the entire field. Since the counts for the smaller regions are from 107 to 176, the estimate for the entire field should be between 10,700 and 17,600. Therefore, of the given choices, 15,000 is a reasonable estimate for the number of earthworms to a depth of 5 centimeters in the entire field.

Choice A is incorrect; 150 is the approximate number of earthworms in 1 square meter. Choice B is incorrect; it results from using 10 square meters as the area of the field. Choice D is incorrect; it results from using 1,000 square meters as the area of the field.

QUESTION 28.

Choice C is correct. To determine which quadrant does not contain any solutions to the system of inequalities, graph the inequalities. Graph the inequality $y \geq 2x + 1$ by drawing a line through the y -intercept $(0, 1)$ and the point $(1, 3)$, and graph the inequality $y > \frac{1}{2}x - 1$ by drawing a dashed line through the y -intercept $(0, -1)$ and the point $(2, 0)$, as shown in the figure below.



The solution to the system of inequalities is the intersection of the shaded regions above the graphs of both lines. It can be seen that the solutions only include points in quadrants I, II, and III and do not include any points in quadrant IV.

Choices A and B are incorrect because quadrants II and III contain solutions to the system of inequalities, as shown in the figure above. Choice D is incorrect because there are no solutions in quadrant IV.

QUESTION 29.

Choice D is correct. If the polynomial $p(x)$ is divided by $x - 3$, the result can be written as $\frac{p(x)}{x - 3} = q(x) + \frac{r}{x - 3}$, where $q(x)$ is a polynomial and r is the remainder. Since $x - 3$ is a degree 1 polynomial, the remainder is a real number. Hence, $p(x)$ can be written as $p(x) = (x - 3)q(x) + r$, where r is a real number. It is given that $p(3) = -2$ so it must be true that $-2 = p(3) = (3 - 3)q(3) + r = (0)q(3) + r = r$. Therefore, the remainder when $p(x)$ is divided by $x - 3$ is -2 .

Choice A is incorrect because $p(3) = -2$ does not imply that $p(5) = 0$. Choices B and C are incorrect because the remainder -2 or its negative, 2 , need not be a root of $p(x)$.

QUESTION 30.

Choice D is correct. Any quadratic function q can be written in the form $q(x) = a(x - h)^2 + k$, where a , h , and k are constants and (h, k) is the vertex of the parabola when q is graphed in the coordinate plane. (Depending on the

sign of a , the constant k must be the minimum or maximum value of q , and h is the value of x for which $a(x - h)^2 = 0$ and $q(x)$ has value k .) This form can be reached by completing the square in the expression that defines q . The given equation is $y = x^2 - 2x - 15$, and since the coefficient of x is -2 , the equation can be written in terms of $(x - 1)^2 = x^2 - 2x + 1$ as follows: $y = x^2 - 2x - 15 = (x^2 - 2x + 1) - 16 = (x - 1)^2 - 16$. From this form of the equation, the coefficients of the vertex can be read as $(1, -16)$

Choices A and C are incorrect because the coordinates of the vertex A do not appear as constants in these equations. Choice B is incorrect because it is not equivalent to the given equation.

QUESTION 31.

The correct answer is any number between 4 and 6, inclusive. Since Wyatt can husk at least 12 dozen ears of corn per hour, it will take him no more than $\frac{72}{12} = 6$ hours to husk 72 dozen ears of corn. On the other hand, since Wyatt can husk at most 18 dozen ears of corn per hour, it will take him at least $\frac{72}{18} = 4$ hours to husk 72 dozen ears of corn. Therefore, the possible times it could take Wyatt to husk 72 dozen ears of corn are 4 hours to 6 hours, inclusive. Any number between 4 and 6, inclusive, can be gridded as the correct answer.

QUESTION 32.

The correct answer is 107. Since the weight of the empty truck and its driver is 4500 pounds and each box weighs 14 pounds, the weight, in pounds, of the delivery truck, its driver, and x boxes is $4500 + 14x$. This weight is below the bridge's posted weight limit of 6000 pounds if $4500 + 14x < 6000$. That inequality is equivalent to $14x \leq 1500$ or $x < \frac{1500}{14} = 107\frac{1}{7}$. Since the number of packages must be an integer, the maximum possible value for x that will keep the combined weight of the truck, its driver, and the x identical boxes below the bridge's posted weight limit is 107.

QUESTION 33.

The correct answer is $\frac{5}{8}$ or .625. Based on the line graph, the number of portable media players sold in 2008 was 100 million, and the number of portable media players sold in 2011 was 160 million. Therefore, the number of portable media players sold in 2008 is $\frac{100 \text{ million}}{160 \text{ million}}$ of the portable media players sold in 2011. This fraction reduces to $\frac{5}{8}$. Either $\frac{5}{8}$ or its decimal equivalent, .625, may be gridded as the correct answer.

QUESTION 34.

The correct answer is 96. Since each day has a total of 24 hours of time slots available for the station to sell, there is a total of 48 hours of time slots

available to sell on Tuesday and Wednesday. Each time slot is a 30-minute interval, which is equal to a $\frac{1}{2}$ -hour interval. Therefore, there are a total of $\frac{48 \text{ hours}}{\frac{1}{2} \text{ hours/time slot}} = 96$ time slots of 30 minutes for the station to sell on

Tuesday and Wednesday.

QUESTION 35.

The correct answer is 6. The volume of a cylinder is $\pi r^2 h$, where r is the radius of the base of the cylinder and h is the height of the cylinder. Since the storage silo is a cylinder with volume 72π cubic yards and height 8 yards, it is true that $72\pi = \pi r^2(8)$, where r is the radius of the base of the cylinder, in yards. Dividing both sides of $72\pi = \pi r^2(8)$ by 8π gives $r^2 = 9$, and so the radius of base of the cylinder is 3 yards. Therefore, the diameter of the base of the cylinder is 6 yards.

QUESTION 36.

The correct answer is 3. The function $h(x)$ is undefined when the denominator of $\frac{1}{(x-5)^2 + 4(x-5) + 4}$ is equal to zero. The expression $(x-5)^2 + 4(x-5) + 4$ is a perfect square: $(x-5)^2 + 4(x-5) + 4 = ((x-5) + 2)^2$, which can be rewritten as $(x-3)^2$. The expression $(x-3)^2$ is equal to zero if and only if $x = 3$. Therefore, the value of x for which $h(x)$ is undefined is 3.

QUESTION 37.

The correct answer is 1.02. The initial deposit earns 2 percent interest compounded annually. Thus at the end of 1 year, the new value of the account is the initial deposit of \$100 plus 2 percent of the initial deposit: $\$100 + \frac{2}{100}(\$100) = \$100(1.02)$. Since the interest is compounded annually, the value at the end of each succeeding year is the sum of the previous year's value plus 2 percent of the previous year's value. This is again equivalent to multiplying the previous year's value by 1.02. Thus, after 2 years, the value will be $\$100(1.02)(1.02) = \$100(1.02)^2$; after 3 years, the value will be $\$100(1.02)^3$; and after t years, the value will be $\$100(1.02)^t$. Therefore, in the formula for the value for Jessica's account after t years, $\$100(x)^t$, the value of x must be 1.02.

QUESTION 38.

The correct answer is 6.11. Jessica made an initial deposit of \$100 into her account. The interest on her account is 2 percent compounded annually, so after 10 years, the value of her initial deposit has been multiplied 10 times by the factor $1 + 0.02 = 1.02$. Hence, after 10 years, Jessica's deposit is worth $\$100(1.02)^{10} = \121.899 to the nearest tenth of a cent. Tyshaun made an initial deposit of \$100 into his account. The interest on his account is 2.5 percent compounded annually, so after 10 years, the value of his initial deposit

has been multiplied 10 times by the factor $1 + 0.025 = 1.025$. Hence, after 10 years, Tyshaun's deposit is worth $\$100(1.025)^{10} = \128.008 to the nearest tenth of a cent. Hence, Jessica's initial deposit earned \$21.899 and Tyshaun's initial deposit earned \$28.008. Therefore, to the nearest cent, Tyshaun's initial deposit earned \$6.11 more than Jessica's initial deposit.



SAT[®] Practice Test #2

IMPORTANT REMINDERS

1

**A No. 2 pencil is required for the test.
Do not use a mechanical pencil or pen.**

2

**Sharing any questions with anyone
is a violation of Test Security
and Fairness policies and may result
in your scores being canceled.**

This cover is representative of what you'll see on test day.

**THIS TEST BOOK MUST NOT BE TAKEN FROM THE ROOM. UNAUTHORIZED
REPRODUCTION OR USE OF ANY PART OF THIS TEST BOOK IS PROHIBITED.**



Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

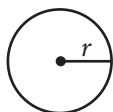
DIRECTIONS

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

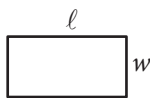
- The use of a calculator **is not permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated,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

REFERENCE

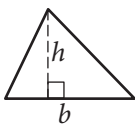


$$A = \pi r^2$$

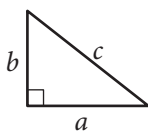
$$C = 2\pi r$$



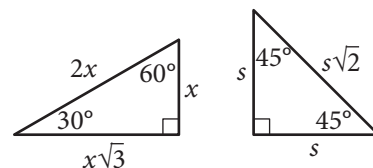
$$A = \ell w$$



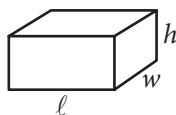
$$A = \frac{1}{2}bh$$



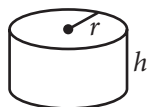
$$c^2 = a^2 + b^2$$



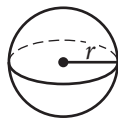
Special Right Triangles



$$V = \ell wh$$



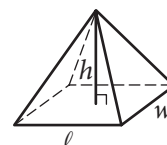
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}\ell wh$$

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.



1

If $5x + 6 = 10$, what is the value of $10x + 3$?

- A) 4
- B) 9
- C) 11
- D) 20

2

$$\begin{aligned}x + y &= 0 \\ 3x - 2y &= 10\end{aligned}$$

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

- A) $(3, -2)$
- B) $(2, -2)$
- C) $(-2, 2)$
- D) $(-2, -2)$

3

A landscaping company estimates the price of a job, in dollars, using the expression $60 + 12nh$, where n is the number of landscapers who will be working and h is the total number of hours the job will take using n landscapers. Which of the following is the best interpretation of the number 12 in the expression?

- A) The company charges \$12 per hour for each landscaper.
- B) A minimum of 12 landscapers will work on each job.
- C) The price of every job increases by \$12 every hour.
- D) Each landscaper works 12 hours a day.

4

$$9a^4 + 12a^2b^2 + 4b^4$$

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

- A) $(3a^2 + 2b^2)^2$
- B) $(3a + 2b)^4$
- C) $(9a^2 + 4b^2)^2$
- D) $(9a + 4b)^4$



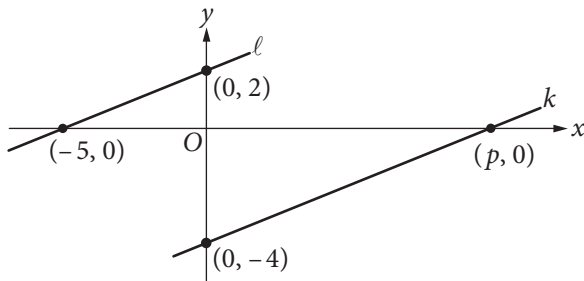
5

$$\sqrt{2k^2 + 17} - x = 0$$

If $k > 0$ and $x = 7$ in the equation above, what is the value of k ?

- A) 2
- B) 3
- C) 4
- D) 5

6



In the xy -plane above, line ℓ is parallel to line k . What is the value of p ?

- A) 4
- B) 5
- C) 8
- D) 10

7

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

of $a - b$?

- A) 8
- B) 14
- C) 16
- D) 18

8

$$nA = 360$$

The measure A , in degrees, of an exterior angle of a regular polygon is related to the number of sides, n , of the polygon by the formula above. If the measure of an exterior angle of a regular polygon is greater than 50° , what is the greatest number of sides it can have?

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



9

The graph of a line in the xy -plane has slope 2 and contains the point $(1, 8)$. The graph of a second line passes through the points $(1, 2)$ and $(2, 1)$. If the two lines intersect at the point (a, b) , what is the value of $a + b$?

- A) 4
- B) 3
- C) -1
- D) -4

10

Which of the following equations has a graph in the xy -plane for which y is always greater than or equal to -1 ?

- A) $y = |x| - 2$
- B) $y = x^2 - 2$
- C) $y = (x - 2)^2$
- D) $y = x^3 - 2$

11

Which of the following complex numbers is equivalent to $\frac{3 - 5i}{8 + 2i}$? (Note: $i = \sqrt{-1}$)

- A) $\frac{3}{8} - \frac{5i}{2}$
- B) $\frac{3}{8} + \frac{5i}{2}$
- C) $\frac{7}{34} - \frac{23i}{34}$
- D) $\frac{7}{34} + \frac{23i}{34}$

12

$$R = \frac{F}{N + F}$$

A website uses the formula above to calculate a seller's rating, R , based on the number of favorable reviews, F , and unfavorable reviews, N . Which of the following expresses the number of favorable reviews in terms of the other variables?

- A) $F = \frac{RN}{R - 1}$
- B) $F = \frac{RN}{1 - R}$
- C) $F = \frac{N}{1 - R}$
- D) $F = \frac{N}{R - 1}$



13

What is the sum of all values of m that satisfy $2m^2 - 16m + 8 = 0$?

- A) -8
- B) $-4\sqrt{3}$
- C) $4\sqrt{3}$
- D) 8

14

A radioactive substance decays at an annual rate of 13 percent. If the initial amount of the substance is 325 grams, which of the following functions f models the remaining amount of the substance, in grams, t years later?

- A) $f(t) = 325(0.87)^t$
- B) $f(t) = 325(0.13)^t$
- C) $f(t) = 0.87(325)^t$
- D) $f(t) = 0.13(325)^t$

15

The expression $\frac{5x-2}{x+3}$ is equivalent to which of the following?

- A) $\frac{5-2}{3}$
- B) $5 - \frac{2}{3}$
- C) $5 - \frac{2}{x+3}$
- D) $5 - \frac{17}{x+3}$

**DIRECTIONS**

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

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or 7/2. (If $\begin{array}{|c|c|c|c|} \hline 3 & 1 & / & 2 \\ \hline \bullet & \bullet & / & \bullet \\ \hline \end{array}$ is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Write answer → in boxes.

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

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

← Fraction line

Grid in result.

Answer: 2.5

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

← Decimal point

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

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

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

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

Answer: 201 – either position is correct

	2	0	1	
	•	•	•	•
	0	•	0	
1	1	1	•	
2	•	2	2	
3	3	3	3	

	2	0	1	
	•	•	•	•
	•	0	0	
1	1	•	1	
2	•	2	2	
3	3	3	3	

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



16

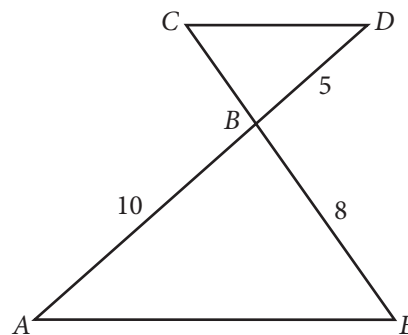
The sales manager of a company awarded a total of \$3000 in bonuses to the most productive salespeople. The bonuses were awarded in amounts of \$250 or \$750. If at least one \$250 bonus and at least one \$750 bonus were awarded, what is one possible number of \$250 bonuses awarded?

17

$$2x(3x + 5) + 3(3x + 5) = ax^2 + bx + c$$

In the equation above, a , b , and c are constants. If the equation is true for all values of x , what is the value of b ?

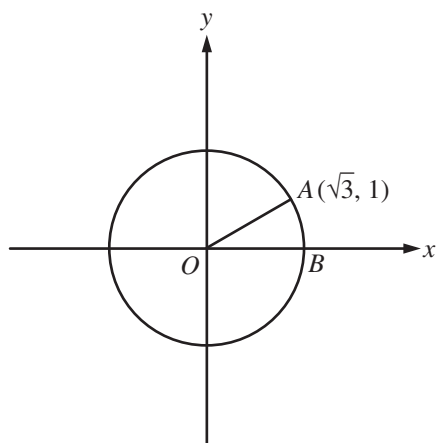
18



In the figure above, $\overline{AE} \parallel \overline{CD}$ and segment AD intersects segment CE at B . What is the length of segment CE ?



19



In the xy -plane above, O is the center of the circle, and the measure of $\angle AOB$ is $\frac{\pi}{a}$ radians. What is the value of a ?

20

$$ax + by = 12$$

$$2x + 8y = 60$$

In the system of equations above, a and b are constants. If the system has infinitely many solutions, what is the value of $\frac{a}{b}$?

STOP

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



Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

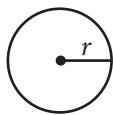
DIRECTIONS

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

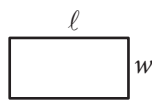
- The use of a calculator **is permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated, the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

REFERENCE

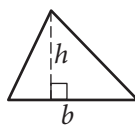


$$A = \pi r^2$$

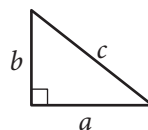
$$C = 2\pi r$$



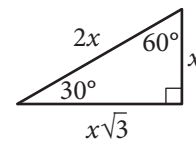
$$A = \ell w$$



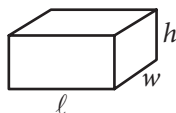
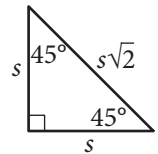
$$A = \frac{1}{2}bh$$



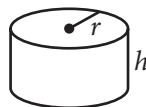
$$c^2 = a^2 + b^2$$



Special Right Triangles



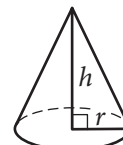
$$V = \ell wh$$



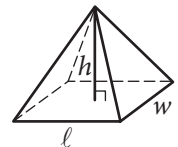
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}\ell wh$$

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.



1

A musician has a new song available for downloading or streaming. The musician earns \$0.09 each time the song is downloaded and \$0.002 each time the song is streamed. Which of the following expressions represents the amount, in dollars, that the musician earns if the song is downloaded d times and streamed s times?

- A) $0.002d + 0.09s$
- B) $0.002d - 0.09s$
- C) $0.09d + 0.002s$
- D) $0.09d - 0.002s$

2

A quality control manager at a factory selects 7 lightbulbs at random for inspection out of every 400 lightbulbs produced. At this rate, how many lightbulbs will be inspected if the factory produces 20,000 lightbulbs?

- A) 300
- B) 350
- C) 400
- D) 450

3

$$\ell = 24 + 3.5m$$

One end of a spring is attached to a ceiling. When an object of mass m kilograms is attached to the other end of the spring, the spring stretches to a length of ℓ centimeters as shown in the equation above. What is m when ℓ is 73?

- A) 14
- B) 27.7
- C) 73
- D) 279.5

**Questions 4 and 5 refer to the following information.**

The amount of money a performer earns is directly proportional to the number of people attending the performance. The performer earns \$120 at a performance where 8 people attend.

4

How much money will the performer earn when 20 people attend a performance?

- A) \$960
- B) \$480
- C) \$300
- D) \$240

5

The performer uses 43% of the money earned to pay the costs involved in putting on each performance. The rest of the money earned is the performer's profit. What is the profit the performer makes at a performance where 8 people attend?

- A) \$51.60
- B) \$57.00
- C) \$68.40
- D) \$77.00

6

When 4 times the number x is added to 12, the result is 8. What number results when 2 times x is added to 7?

- A) -1
- B) 5
- C) 8
- D) 9

7

$$y = x^2 - 6x + 8$$

The equation above represents a parabola in the xy -plane. Which of the following equivalent forms of the equation displays the x -intercepts of the parabola as constants or coefficients?

- A) $y - 8 = x^2 - 6x$
- B) $y + 1 = (x - 3)^2$
- C) $y = x(x - 6) + 8$
- D) $y = (x - 2)(x - 4)$



8

In a video game, each player starts the game with k points and loses 2 points each time a task is not completed. If a player who gains no additional points and fails to complete 100 tasks has a score of 200 points, what is the value of k ?

- A) 0
- B) 150
- C) 250
- D) 400

9

A worker uses a forklift to move boxes that weigh either 40 pounds or 65 pounds each. Let x be the number of 40-pound boxes and y be the number of 65-pound boxes. The forklift can carry up to either 45 boxes or a weight of 2,400 pounds. Which of the following systems of inequalities represents this relationship?

- A) $\begin{cases} 40x + 65y \leq 2,400 \\ x + y \leq 45 \end{cases}$
- B) $\begin{cases} \frac{x}{40} + \frac{y}{65} \leq 2,400 \\ x + y \leq 45 \end{cases}$
- C) $\begin{cases} 40x + 65y \leq 45 \\ x + y \leq 2,400 \end{cases}$
- D) $\begin{cases} x + y \leq 2,400 \\ 40x + 65y \leq 2,400 \end{cases}$

10

A function f satisfies $f(2) = 3$ and $f(3) = 5$. A function g satisfies $g(3) = 2$ and $g(5) = 6$. What is the value of $f(g(3))$?

- A) 2
- B) 3
- C) 5
- D) 6

11

Number of hours Tony plans to read the novel per day	3
Number of parts in the novel	8
Number of chapters in the novel	239
Number of words Tony reads per minute	250
Number of pages in the novel	1,078
Number of words in the novel	349,168

Tony is planning to read a novel. The table above shows information about the novel, Tony's reading speed, and the amount of time he plans to spend reading the novel each day. If Tony reads at the rates given in the table, which of the following is closest to the number of days it would take Tony to read the entire novel?

- A) 6
- B) 8
- C) 23
- D) 324



12

On January 1, 2000, there were 175,000 tons of trash in a landfill that had a capacity of 325,000 tons. Each year since then, the amount of trash in the landfill increased by 7,500 tons. If y represents the time, in years, after January 1, 2000, which of the following inequalities describes the set of years where the landfill is at or above capacity?

- A) $325,000 - 7,500 \leq y$
- B) $325,000 \leq 7,500y$
- C) $150,000 \geq 7,500y$
- D) $175,000 + 7,500y \geq 325,000$

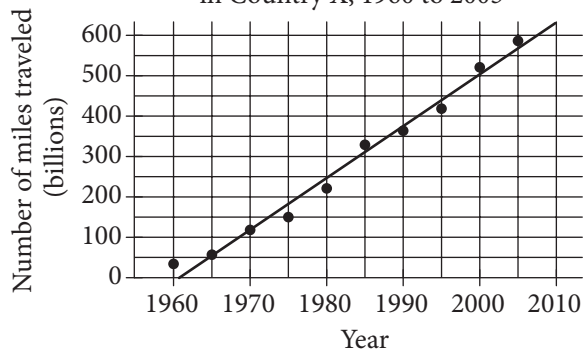
13

A researcher conducted a survey to determine whether people in a certain large town prefer watching sports on television to attending the sporting event. The researcher asked 117 people who visited a local restaurant on a Saturday, and 7 people refused to respond. Which of the following factors makes it least likely that a reliable conclusion can be drawn about the sports-watching preferences of all people in the town?

- A) Sample size
- B) Population size
- C) The number of people who refused to respond
- D) Where the survey was given

14

Miles Traveled by Air Passengers
in Country X, 1960 to 2005



According to the line of best fit in the scatterplot above, which of the following best approximates the year in which the number of miles traveled by air passengers in Country X was estimated to be 550 billion?

- A) 1997
- B) 2000
- C) 2003
- D) 2008



15

The distance traveled by Earth in one orbit around the Sun is about 580,000,000 miles. Earth makes one complete orbit around the Sun in one year. Of the following, which is closest to the average speed of Earth, in miles per hour, as it orbits the Sun?

- A) 66,000
- B) 93,000
- C) 210,000
- D) 420,000

16

Results on the Bar Exam of Law School Graduates

	Passed bar exam	Did not pass bar exam
Took review course	18	82
Did not take review course	7	93

The table above summarizes the results of 200 law school graduates who took the bar exam. If one of the surveyed graduates who passed the bar exam is chosen at random for an interview, what is the probability that the person chosen did not take the review course?

- A) $\frac{18}{25}$
- B) $\frac{7}{25}$
- C) $\frac{25}{200}$
- D) $\frac{7}{200}$

17

The atomic weight of an unknown element, in atomic mass units (amu), is approximately 20% less than that of calcium. The atomic weight of calcium is 40 amu. Which of the following best approximates the atomic weight, in amu, of the unknown element?

- A) 8
- B) 20
- C) 32
- D) 48

18

A survey was taken of the value of homes in a county, and it was found that the mean home value was \$165,000 and the median home value was \$125,000. Which of the following situations could explain the difference between the mean and median home values in the county?

- A) The homes have values that are close to each other.
- B) There are a few homes that are valued much less than the rest.
- C) There are a few homes that are valued much more than the rest.
- D) Many of the homes have values between \$125,000 and \$165,000.



Questions 19 and 20 refer to the following information.

A sociologist chose 300 students at random from each of two schools and asked each student how many siblings he or she has. The results are shown in the table below.

Students' Sibling Survey

Number of siblings	Lincoln School	Washington School
0	120	140
1	80	110
2	60	30
3	30	10
4	10	10

There are a total of 2,400 students at Lincoln School and 3,300 students at Washington School.

19

What is the median number of siblings for all the students surveyed?

- A) 0
- B) 1
- C) 2
- D) 3

20

Based on the survey data, which of the following most accurately compares the expected total number of students with 4 siblings at the two schools?

- A) The total number of students with 4 siblings is expected to be equal at the two schools.
- B) The total number of students with 4 siblings at Lincoln School is expected to be 30 more than at Washington School.
- C) The total number of students with 4 siblings at Washington School is expected to be 30 more than at Lincoln School.
- D) The total number of students with 4 siblings at Washington School is expected to be 900 more than at Lincoln School.

21

A project manager estimates that a project will take x hours to complete, where $x > 100$. The goal is for the estimate to be within 10 hours of the time it will actually take to complete the project. If the manager meets the goal and it takes y hours to complete the project, which of the following inequalities represents the relationship between the estimated time and the actual completion time?

- A) $x + y < 10$
- B) $y > x + 10$
- C) $y < x - 10$
- D) $-10 < y - x < 10$



Questions 22 and 23 refer to the following information.

$$I = \frac{P}{4\pi r^2}$$

At a large distance r from a radio antenna, the intensity of the radio signal I is related to the power of the signal P by the formula above.

22

Which of the following expresses the square of the distance from the radio antenna in terms of the intensity of the radio signal and the power of the signal?

- A) $r^2 = \frac{IP}{4\pi}$
- B) $r^2 = \frac{P}{4\pi I}$
- C) $r^2 = \frac{4\pi I}{P}$
- D) $r^2 = \frac{I}{4\pi P}$

23

For the same signal emitted by a radio antenna, Observer A measures its intensity to be 16 times the intensity measured by Observer B. The distance of Observer A from the radio antenna is what fraction of the distance of Observer B from the radio antenna?

- A) $\frac{1}{4}$
- B) $\frac{1}{16}$
- C) $\frac{1}{64}$
- D) $\frac{1}{256}$

24

$$x^2 + y^2 + 4x - 2y = -1$$

The equation of a circle in the xy -plane is shown above. What is the radius of the circle?

- A) 2
- B) 3
- C) 4
- D) 9

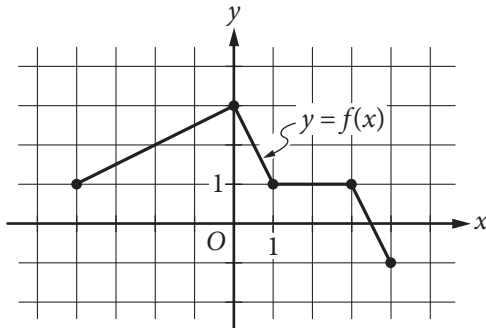


25

The graph of the linear function f has intercepts at $(a, 0)$ and $(0, b)$ in the xy -plane. If $a + b = 0$ and $a \neq b$, which of the following is true about the slope of the graph of f ?

- A) It is positive.
- B) It is negative.
- C) It equals zero.
- D) It is undefined.

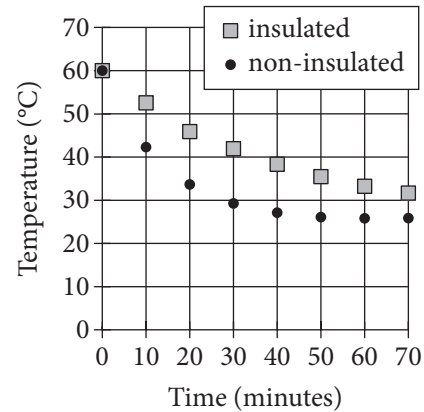
26



The complete graph of the function f is shown in the xy -plane above. Which of the following are equal to 1?

- I. $f(-4)$
 - II. $f\left(\frac{3}{2}\right)$
 - III. $f(3)$
- A) III only
 - B) I and III only
 - C) II and III only
 - D) I, II, and III

27

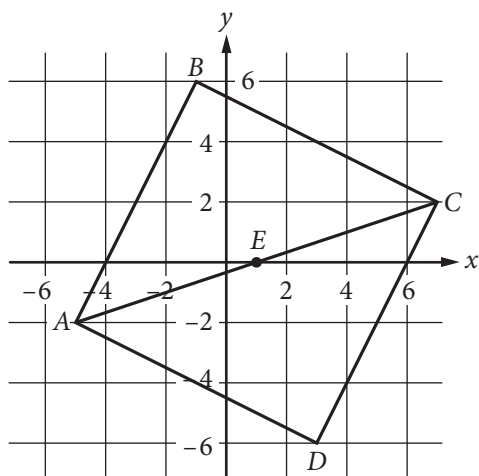


Two samples of water of equal mass are heated to 60 degrees Celsius ($^{\circ}\text{C}$). One sample is poured into an insulated container, and the other sample is poured into a non-insulated container. The samples are then left for 70 minutes to cool in a room having a temperature of 25°C . The graph above shows the temperature of each sample at 10-minute intervals. Which of the following statements correctly compares the average rates at which the temperatures of the two samples change?

- A) In every 10-minute interval, the magnitude of the rate of change of temperature of the insulated sample is greater than that of the non-insulated sample.
- B) In every 10-minute interval, the magnitude of the rate of change of temperature of the non-insulated sample is greater than that of the insulated sample.
- C) In the intervals from 0 to 10 minutes and from 10 to 20 minutes, the rates of change of temperature of the insulated sample are of greater magnitude, whereas in the intervals from 40 to 50 minutes and from 50 to 60 minutes, the rates of change of temperature of the non-insulated sample are of greater magnitude.
- D) In the intervals from 0 to 10 minutes and from 10 to 20 minutes, the rates of change of temperature of the non-insulated sample are of greater magnitude, whereas in the intervals from 40 to 50 minutes and from 50 to 60 minutes, the rates of change of temperature of the insulated sample are of greater magnitude.



28



In the xy -plane above, $ABCD$ is a square and point E is the center of the square. The coordinates of points C and E are $(7, 2)$ and $(1, 0)$, respectively. Which of the following is an equation of the line that passes through points B and D ?

- A) $y = -3x - 1$
- B) $y = -3(x - 1)$
- C) $y = -\frac{1}{3}x + 4$
- D) $y = -\frac{1}{3}x - 1$

29

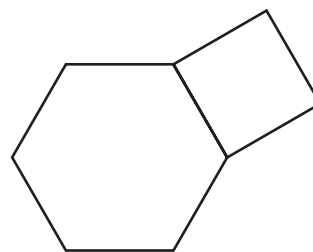
$$y = 3$$

$$y = ax^2 + b$$

In the system of equations above, a and b are constants. For which of the following values of a and b does the system of equations have exactly two real solutions?

- A) $a = -2, b = 2$
- B) $a = -2, b = 4$
- C) $a = 2, b = 4$
- D) $a = 4, b = 3$

30



The figure above shows a regular hexagon with sides of length a and a square with sides of length a . If the area of the hexagon is $384\sqrt{3}$ square inches, what is the area, in square inches, of the square?

- A) 256
- B) 192
- C) $64\sqrt{3}$
- D) $16\sqrt{3}$


DIRECTIONS

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

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or 7/2. (If $\begin{array}{|c|c|c|c|} \hline 3 & 1 & / & 2 \\ \hline \bullet & \bullet & \bullet & \bullet \\ \hline \end{array}$ is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Write answer → in boxes.

Grid result.

← Fraction line

← Decimal point

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

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

Answer: 2.5

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

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

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

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

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

Answer: 201 – either position is correct

	2	0	1
•	•	•	•
	0	•	0
①	①	①	•
②	•	②	②
③	③	③	③

	2	0	1
•	•	•	•
	•	0	0
①	①	•	①
②	•	②	②
③	③	③	③

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



31

A coastal geologist estimates that a certain country's beaches are eroding at a rate of 1.5 feet per year. According to the geologist's estimate, how long will it take, in years, for the country's beaches to erode by 21 feet?

32

If h hours and 30 minutes is equal to 450 minutes, what is the value of h ?

33

In the xy -plane, the point $(3, 6)$ lies on the graph of the function $f(x) = 3x^2 - bx + 12$. What is the value of b ?

34

In one semester, Doug and Laura spent a combined 250 hours in the tutoring lab. If Doug spent 40 more hours in the lab than Laura did, how many hours did Laura spend in the lab?

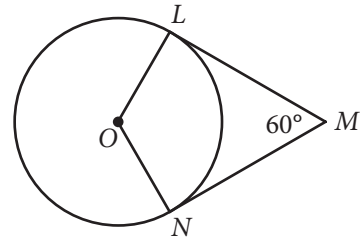


35

$$a = 18t + 15$$

Jane made an initial deposit to a savings account. Each week thereafter she deposited a fixed amount to the account. The equation above models the amount a , in dollars, that Jane has deposited after t weekly deposits. According to the model, how many dollars was Jane's initial deposit? (Disregard the \$ sign when gridding your answer.)

36



In the figure above, point O is the center of the circle, line segments LM and MN are tangent to the circle at points L and N , respectively, and the segments intersect at point M as shown. If the circumference of the circle is 96, what is the length of minor arc \widehat{LN} ?



Questions 37 and 38 refer to the following information.

A botanist is cultivating a rare species of plant in a controlled environment and currently has 3000 of these plants. The population of this species that the botanist expects to grow next year, $N_{\text{next year}}$, can be estimated from the number of plants this year, $N_{\text{this year}}$, by the equation below.

$$N_{\text{next year}} = N_{\text{this year}} + 0.2 \left(N_{\text{this year}} \right) \left(1 - \frac{N_{\text{this year}}}{K} \right)$$

The constant K in this formula is the number of plants the environment is able to support.

37

According to the formula, what will be the number of plants two years from now if $K = 4000$? (Round your answer to the nearest whole number.)

38

The botanist would like to increase the number of plants that the environment can support so that the population of the species will increase more rapidly. If the botanist's goal is that the number of plants will increase from 3000 this year to 3360 next year, how many plants must the modified environment support?

STOP

If you finish before time is called, you may check your work on this section only.

Do not turn to any other section.

Section 3: Math Test — No Calculator

QUESTION 1.

Choice C is correct. Subtracting 6 from each side of $5x + 6 = 10$ yields $5x = 4$.

Dividing both sides of $5x = 4$ by 5 yields $x = \frac{4}{5}$. The value of x can now be substituted into the expression $10x + 3$, giving $10\left(\frac{4}{5}\right) + 3 = 11$.

Alternatively, the expression $10x + 3$ can be rewritten as $2(5x + 6) - 9$, and 10 can be substituted for $5x + 6$, giving $2(10) - 9 = 11$.

Choices A, B, and D are incorrect. Each of these choices leads to $5x + 6 \neq 10$, contradicting the given equation, $5x + 6 = 10$. For example, choice A is incorrect because if the value of $10x + 3$ were 4, then it would follow that $x = 0.1$, and the value of $5x + 6$ would be 6.5, not 10.

QUESTION 2.

Choice B is correct. Multiplying each side of $x + y = 0$ by 2 gives $2x + 2y = 0$. Then, adding the corresponding sides of $2x + 2y = 0$ and $3x - 2y = 10$ gives $5x = 10$. Dividing each side of $5x = 10$ by 5 gives $x = 2$. Finally, substituting 2 for x in $x + y = 0$ gives $2 + y = 0$, or $y = -2$. Therefore, the solution to the given system of equations is $(2, -2)$.

Alternatively, the equation $x + y = 0$ can be rewritten as $x = -y$, and substituting x for $-y$ in $3x - 2y = 10$ gives $5x = 10$, or $x = 2$. The value of y can then be found in the same way as before.

Choices A, C, and D are incorrect because when the given values of x and y are substituted into $x + y = 0$ and $3x - 2y = 10$, either one or both of the equations are not true. These answers may result from sign errors or other computational errors.

QUESTION 3.

Choice A is correct. The price of the job, in dollars, is calculated using the expression $60 + 12nh$, where 60 is a fixed price and $12nh$ depends on the number of landscapers, n , working the job and the number of hours, h , the job takes those n landscapers. Since nh is the total number of hours of work done when n landscapers work h hours, the cost of the job increases by \$12 for each hour a landscaper works. Therefore, of the choices given, the best interpretation of the number 12 is that the company charges \$12 per hour for each landscaper.

Choice B is incorrect because the number of landscapers that will work each job is represented by n in the equation, not by the number 12. Choice C is incorrect because the price of the job increases by $12n$ dollars each hour, which will not be equal to 12 dollars unless $n = 1$. Choice D is incorrect because the total number of hours each landscaper works is equal to h . The number of hours each landscaper works in a day is not provided.

QUESTION 4.

Choice A is correct. If a polynomial expression is in the form $(x)^2 + 2(x)(y) + (y)^2$, then it is equivalent to $(x + y)^2$. Because $9a^4 + 12a^2b^2 + 4b^4 = (3a^2)^2 + 2(3a^2)(2b^2) + (2b^2)^2$, it can be rewritten as $(3a^2 + 2b^2)^2$.

Choice B is incorrect. The expression $(3a + 2b)^4$ is equivalent to the product $(3a + 2b)(3a + 2b)(3a + 2b)(3a + 2b)$. This product will contain the term $4(3a)^3(2b) = 216a^3b$. However, the given polynomial, $9a^4 + 12a^2b^2 + 4b^4$, does not contain the term $216a^3b$. Therefore, $9a^4 + 12a^2b^2 + 4b^4 \neq (3a + 2b)^4$. Choice C is incorrect. The expression $(9a^2 + 4b^2)^2$ is equivalent to the product $(9a^2 + 4b^2)(9a^2 + 4b^2)$. This product will contain the term $(9a^2)(9a^2) = 81a^4$. However, the given polynomial, $9a^4 + 12a^2b^2 + 4b^4$, does not contain the term $81a^4$. Therefore, $9a^4 + 12a^2b^2 + 4b^4 \neq (9a^2 + 4b^2)^2$. Choice D is incorrect. The expression $(9a + 4b)^4$ is equivalent to the product $(9a + 4b)(9a + 4b)(9a + 4b)(9a + 4b)$. This product will contain the term $(9a)(9a)(9a)(9a) = 6,561a^4$. However, the given polynomial, $9a^4 + 12a^2b^2 + 4b^4$, does not contain the term $6,561a^4$. Therefore, $9a^4 + 12a^2b^2 + 4b^4 \neq (9a + 4b)^4$.

QUESTION 5.

Choice C is correct. Since $\sqrt{2k^2 + 17} - x = 0$, and $x = 7$, one can substitute 7 for x , which gives $\sqrt{2k^2 + 17} - 7 = 0$. Adding 7 to each side of $\sqrt{2k^2 + 17} - 7 = 0$ gives $\sqrt{2k^2 + 17} = 7$. Squaring each side of $\sqrt{2k^2 + 17} = 7$ will remove the square root symbol: $(\sqrt{2k^2 + 17})^2 = (7)^2$, or $2k^2 + 17 = 49$. Then subtracting 17 from each side of $2k^2 + 17 = 49$ gives $2k^2 = 49 - 17 = 32$, and dividing each side of $2k^2 = 32$ by 2 gives $k^2 = 16$. Finally, taking the square root of each side of $k^2 = 16$ gives $k = \pm 4$, and since the problem states that $k > 0$, it follows that $k = 4$.

Since the sides of an equation were squared while solving $\sqrt{2k^2 + 17} - 7 = 0$, it is possible that an extraneous root was produced. However, substituting 4 for k in $\sqrt{2k^2 + 17} - 7 = 0$ confirms that 4 is a solution for k : $\sqrt{2(4)^2 + 17} - 7 = \sqrt{32 + 17} - 7 = \sqrt{49} - 7 = 7 - 7 = 0$.

Choices A, B, and D are incorrect because substituting any of these values for k in $\sqrt{2k^2 + 17} - 7 = 0$ does not yield a true statement.

QUESTION 6.

Choice D is correct. Since lines ℓ and k are parallel, the lines have the same slope. Line ℓ passes through the points $(-5, 0)$ and $(0, 2)$, so its slope is $\frac{0 - 2}{-5 - 0}$, which is $\frac{2}{5}$. The slope of line k must also be $\frac{2}{5}$. Since line k has slope $\frac{2}{5}$ and passes through the points $(0, -4)$ and $(p, 0)$, it follows that $\frac{-4 - 0}{0 - p} = \frac{2}{5}$, or $\frac{4}{p} = \frac{2}{5}$. Multiplying each side of $\frac{4}{p} = \frac{2}{5}$ by $5p$ gives $20 = 2p$, and therefore, $p = 10$.

Choices A, B, and C are incorrect and may result from conceptual or calculation errors.

QUESTION 7.

Choice A is correct. Since the numerator and denominator of $\frac{x^{a^2}}{x^{b^2}}$ have a common base, it follows by the laws of exponents that this expression can be rewritten as $x^{a^2 - b^2}$. Thus, the equation $\frac{x^{a^2}}{x^{b^2}} = 16$ can be rewritten as $x^{a^2 - b^2} = x^{16}$. Because the equivalent expressions have the common base x , and $x > 1$, it follows that the exponents of the two expressions must also be equivalent. Hence, the equation $a^2 - b^2 = 16$ must be true. The left-hand side of this new equation is a difference of squares, and so it can be factored: $(a + b)(a - b) = 16$. It is given that $(a + b) = 2$; substituting 2 for the factor $(a + b)$ gives $2(a - b) = 16$. Finally, dividing both sides of $2(a - b) = 16$ by 2 gives $a - b = 8$.

Choices B, C, and D are incorrect and may result from errors in applying the laws of exponents or errors in solving the equation $a^2 - b^2 = 16$.

QUESTION 8.

Choice C is correct. The relationship between n and A is given by the equation $nA = 360$. Since n is the number of sides of a polygon, n must be a positive integer, and so $nA = 360$ can be rewritten as $A = \frac{360}{n}$. If the value of A is greater than 50, it follows that $\frac{360}{n} > 50$ is a true statement. Thus, $50n < 360$, or $n < \frac{360}{50} = 7.2$. Since n must be an integer, the greatest possible value of n is 7.

Choices A and B are incorrect. These are possible values for n , the number of sides of a regular polygon, if $A > 50$, but neither is the greatest possible value of n . Choice D is incorrect. If $A < 50$, then $n = 8$ is the least possible value of n , the number of sides of a regular polygon. However, the question asks for the greatest possible value of n if $A > 50$, which is $n = 7$.

QUESTION 9.

Choice B is correct. Since the slope of the first line is 2, an equation of this line can be written in the form $y = 2x + c$, where c is the y -intercept of the line. Since the line contains the point $(1, 8)$, one can substitute 1 for x and 8 for y in $y = 2x + c$, which gives $8 = 2(1) + c$, or $c = 6$. Thus, an equation of the first line is $y = 2x + 6$. The slope of the second line is equal to $\frac{1 - 2}{2 - 1}$ or -1 . Thus, an equation of the second line can be written in the form $y = -x + d$, where d is the y -intercept of the line. Substituting 2 for x and 1 for y gives $1 = -2 + d$, or $d = 3$. Thus, an equation of the second line is $y = -x + 3$.

Since a is the x -coordinate and b is the y -coordinate of the intersection point of the two lines, one can substitute a for x and b for y in the two equations, giving the system $b = 2a + 6$ and $b = -a + 3$. Thus, a can be found by solving the equation $2a + 6 = -a + 3$, which gives $a = -1$. Finally, substituting -1 for a into the equation $b = -a + 3$ gives $b = -(-1) + 3$, or $b = 4$. Therefore, the value of $a + b$ is 3.

Alternatively, since the second line passes through the points $(1, 2)$ and $(2, 1)$, an equation for the second line is $x + y = 3$. Thus, the intersection point of the first line and the second line, (a, b) lies on the line with equation $x + y = 3$. It follows that $a + b = 3$.

Choices A and C are incorrect and may result from finding the value of only a or b , but not calculating the value of $a + b$. Choice D is incorrect and may result from a computation error in finding equations of the two lines or in solving the resulting system of equations.

QUESTION 10.

Choice C is correct. Since the square of any real number is nonnegative, every point on the graph of the quadratic equation $y = (x - 2)^2$ in the xy -plane has a nonnegative y -coordinate. Thus, $y \geq 0$ for every point on the graph. Therefore, the equation $y = (x - 2)^2$ has a graph for which y is always greater than or equal to -1 .

Choices A, B, and D are incorrect because the graph of each of these equations in the xy -plane has a y -intercept at $(0, -2)$. Therefore, each of these equations contains at least one point where y is less than -1 .

QUESTION 11.

Choice C is correct. To perform the division $\frac{3 - 5i}{8 + 2i}$, multiply the numerator and denominator of $\frac{3 - 5i}{8 + 2i}$ by the conjugate of the denominator, $8 - 2i$. This gives $\frac{(3 - 5i)(8 - 2i)}{(8 + 2i)(8 - 2i)} = \frac{24 - 6i - 40i + (-5i)(-2i)}{8^2 - (2i)^2}$. Since $i^2 = -1$, this can be simplified to $\frac{24 - 6i - 40i - 10}{64 + 4} = \frac{14 - 46i}{68}$, which then simplifies to $\frac{7}{34} - \frac{23i}{34}$.

Choices A and B are incorrect and may result from misconceptions about fractions. For example, $\frac{a + b}{c + d}$ is equal to $\frac{a}{c + d} + \frac{b}{c + d}$, not $\frac{a}{c} + \frac{b}{d}$. Choice D is incorrect and may result from a calculation error.

QUESTION 12.

Choice B is correct. Multiplying each side of $R = \frac{F}{N + F}$ by $N + F$ gives $R(N + F) = F$, which can be rewritten as $RN + RF = F$. Subtracting RF from each side of $RN + RF = F$ gives $RN = F - RF$, which can be factored

as $RN = F(1 - R)$. Finally, dividing each side of $RN = F(1 - R)$ by $1 - R$, expresses F in terms of the other variables: $F = \frac{RN}{1 - R}$.

Choices A, C, and D are incorrect and may result from calculation errors when rewriting the given equation.

QUESTION 13.

Choice D is correct. The problem asks for the sum of the roots of the quadratic equation $2m^2 - 16m + 8 = 0$. Dividing each side of the equation by 2 gives $m^2 - 8m + 4 = 0$. If the roots of $m^2 - 8m + 4 = 0$ are s_1 and s_2 , then the equation can be factored as $m^2 - 8m + 4 = (m - s_1)(m - s_2) = 0$. Looking at the coefficient of x on each side of $m^2 - 8m + 4 = (m - s_1)(m - s_2)$ gives $-8 = -s_1 - s_2$, or $s_1 + s_2 = 8$.

Alternatively, one can apply the quadratic formula to either $2m^2 - 16m + 8 = 0$ or $m^2 - 8m + 4 = 0$. The quadratic formula gives two solutions, $4 - 2\sqrt{3}$ and $4 + 2\sqrt{3}$ whose sum is 8.

Choices A, B, and C are incorrect and may result from calculation errors when applying the quadratic formula or a sign error when determining the sum of the roots of a quadratic equation from its coefficients.

QUESTION 14.

Choice A is correct. Each year, the amount of the radioactive substance is reduced by 13 percent from the prior year's amount; that is, each year, 87 percent of the previous year's amount remains. Since the initial amount of the radioactive substance was 325 grams, after 1 year, $325(0.87)$ grams remains; after 2 years $325(0.87)(0.87) = 325(0.87)^2$ grams remains; and after t years, $325(0.87)^t$ grams remains. Therefore, the function $f(t) = 325(0.87)^t$ models the remaining amount of the substance, in grams, after t years.

Choice B is incorrect and may result from confusing the amount of the substance remaining with the decay rate. Choices C and D are incorrect and may result from confusing the original amount of the substance and the decay rate.

QUESTION 15.

Choice D is correct. Dividing $5x - 2$ by $x + 3$ gives:

$$\begin{array}{r} 5 \\ x + 3 \overline{)5x - 2} \\ \underline{5x + 15} \\ -17 \end{array}$$

Therefore, the expression $\frac{5x - 2}{x + 3}$ can be rewritten as $5 - \frac{17}{x + 3}$.

Alternatively, $\frac{5x - 2}{x + 3}$ can be rewritten as

$$\frac{5x - 2}{x + 3} = \frac{(5x + 15) - 15 - 2}{x + 3} = \frac{5(x + 3) - 17}{x + 3} = 5 - \frac{17}{x + 3}.$$

Choices A and B are incorrect and may result from incorrectly canceling out the x in the expression $\frac{5x - 2}{x + 3}$. Choice C is incorrect and may result from finding an incorrect remainder when performing long division.

QUESTION 16.

The correct answer is 3, 6, or 9. Let x be the number of \$250 bonuses awarded, and let y be the number of \$750 bonuses awarded. Since \$3000 in bonuses were awarded, and this included at least one \$250 bonus and one \$750 bonus, it follows that $250x + 750y = 3000$, where x and y are positive integers. Dividing each side of $250x + 750y = 3000$ by 250 gives $x + 3y = 12$, where x and y are positive integers. Since $3y$ and 12 are each divisible by 3, it follows that $x = 12 - 3y$ must also be divisible by 3. If $x = 3$, then $y = 3$; if $x = 6$, then $y = 2$; and if $x = 9$, then $y = 1$. If $x = 12$, then $y = 0$, but this is not possible since there was at least one \$750 bonus awarded. Therefore, the possible numbers of \$250 bonuses awarded are 3, 6, and 9. Any of the numbers 3, 6, or 9 may be gridded as the correct answer.

QUESTION 17.

The correct answer is 19. Since $2x(3x + 5) + 3(3x + 5) = ax^2 + bx + c$ for all values of x , the two sides of the equation are equal, and the value of b can be determined by simplifying the left-hand side of the equation and writing it in the same form as the right-hand side. Using the distributive property, the equation becomes $(6x^2 + 10x) + (9x + 15) = ax^2 + bx + c$. Combining like terms gives $6x^2 + 19x + 15 = ax^2 + bx + c$. The value of b is the coefficient of x , which is 19.

QUESTION 18.

The correct answer is 12. Angles ABE and DBC are vertical angles and thus have the same measure. Since segment AE is parallel to segment CD , angles A and D are of the same measure by the alternate interior angle theorem. Thus, by the angle-angle theorem, triangle ABE is similar to triangle DBC , with vertices A , B , and E corresponding to vertices D , B , and C , respectively. Thus, $\frac{AB}{DB} = \frac{EB}{CB}$ or $\frac{10}{5} = \frac{8}{CB}$. It follows that $CB = 4$, and so $CE = CB + BE = 4 + 8 = 12$.

QUESTION 19.

The correct answer is 6. By the distance formula, the length of radius OA is $\sqrt{(\sqrt{3})^2 + 1^2} = \sqrt{3 + 1} = 2$. Thus, $\sin(\angle AOB) = \frac{1}{2}$. Therefore, the measure of $\angle AOB$ is 30° , which is equal to $30\left(\frac{\pi}{180}\right) = \frac{\pi}{6}$ radians. Hence, the value of a is 6.

QUESTION 20.

The correct answer is $\frac{1}{4}$ or .25. In order for a system of two linear equations to have infinitely many solutions, the two equations must be equivalent.

Thus, the equation $ax + by = 12$ must be equivalent to the equation $2x + 8y = 60$. Multiplying each side of $ax + by = 12$ by 5 gives $5ax + 5by = 60$, which must be equivalent to $2x + 8y = 60$. Since the right-hand sides of $5ax + 5by = 60$ and $2x + 8y = 60$ are the same, equating coefficients gives $5a = 2$, or $a = \frac{2}{5}$, and $5b = 8$, or $b = \frac{8}{5}$. Therefore, the value of $\frac{a}{b} = \left(\frac{2}{5}\right) \div \left(\frac{8}{5}\right)$, which is equal to $\frac{1}{4}$. Either the fraction $\frac{1}{4}$ or its equivalent decimal, .25, may be gridded as the correct answer.

Alternatively, since $ax + by = 12$ is equivalent to $2x + 8y = 60$, the equation $ax + by = 12$ is equal to $2x + 8y = 60$ multiplied on each side by the same constant. Since multiplying $2x + 8y = 60$ by a constant does not change the ratio of the coefficient of x to the coefficient of y , it follows that $\frac{a}{b} = \frac{2}{8} = \frac{1}{4}$.

Section 4: Math Test — Calculator

QUESTION 1.

Choice C is correct. Since the musician earns \$0.09 for each download, the musician earns $0.09d$ dollars when the song is downloaded d times. Similarly, since the musician earns \$0.002 each time the song is streamed, the musician earns $0.002s$ dollars when the song is streamed s times. Therefore, the musician earns a total of $0.09d + 0.002s$ dollars when the song is downloaded d times and streamed s times.

Choice A is incorrect because the earnings for each download and the earnings for time streamed are interchanged in the expression. Choices B and D are incorrect because in both answer choices, the musician will lose money when a song is either downloaded or streamed. However, the musician only earns money, not loses money, when the song is downloaded or streamed.

QUESTION 2.

Choice B is correct. The quality control manager selects 7 lightbulbs at random for inspection out of every 400 lightbulbs produced. A quantity of 20,000 lightbulbs is equal to $\frac{20,000}{400} = 50$ batches of 400 lightbulbs. Therefore, at the rate of 7 lightbulbs per 400 lightbulbs produced, the quality control manager will inspect a total of $50 \times 7 = 350$ lightbulbs.

Choices A, C, and D are incorrect and may result from calculation errors or misunderstanding of the proportional relationship.

QUESTION 3.

Choice A is correct. The value of m when ℓ is 73 can be found by substituting the 73 for ℓ in $\ell = 24 + 3.5m$ and then solving for m . The resulting equation is $73 = 24 + 3.5m$; subtracting 24 from each side gives $49 = 3.5m$. Then, dividing each side of $49 = 3.5m$ by 3.5 gives $14 = m$. Therefore, when ℓ is 73, m is 14.

Choice B is incorrect and may result from adding 24 to 73, instead of subtracting 24 from 73, when solving $73 = 24 + 3.5m$. Choice C is incorrect because 73 is the given value for ℓ , not for m . Choice D is incorrect and may result from substituting 73 for m , instead of for ℓ , in the equation $\ell = 24 + 3.5m$.

QUESTION 4.

Choice C is correct. The amount of money the performer earns is directly proportional to the number of people who attend the performance. Thus, by the definition of direct proportionality, $M = kP$, where M is the amount of money the performer earns, in dollars, P is the number of people who attend the performance, and k is a constant. Since the performer earns \$120 when 8 people attend the performance, one can substitute 120 for M and 8 for P , giving $120 = 8k$. Hence, $k = 15$, and the relationship between the number of people who attend the performance and the amount of money, in dollars, the performer earns is $M = 15P$. Therefore, when 20 people attend the performance, the performer earns $15(20) = 300$ dollars.

Choices A, B, and D are incorrect and may result from either misconceptions about proportional relationships or computational errors.

QUESTION 5.

Choice C is correct. If 43% of the money earned is used to pay for costs, then the rest, 57%, is profit. A performance where 8 people attend earns the performer \$120, and 57% of \$120 is $\$120 \times 0.57 = \68.40 .

Choice A is incorrect. The amount \$51.60 is 43% of the money earned from a performance where 8 people attend, which is the cost of putting on the performance, not the profit from the performance. Choice B is incorrect. It is given that 57% of the money earned is profit, but 57% of \$120 is not equal to \$57.00. Choice D is incorrect. The profit can be found by subtracting 43% of \$120 from \$120, but 43% of \$120 is \$51.60, not \$43.00. Thus, the profit is $\$120 - \$51.60 = \$68.40$, not $\$120 - \$43.00 = \$77.00$.

QUESTION 6.

Choice B is correct. When 4 times the number x is added to 12, the result is $12 + 4x$. Since this result is equal to 8, the equation $12 + 4x = 8$ must be true. Subtracting 12 from each side of $12 + 4x = 8$ gives $4x = -4$, and then dividing both sides of $4x = -4$ by 4 gives $x = -1$. Therefore, 2 times x added to 7, or $7 + 2x$, is equal to $7 + 2(-1) = 5$.

Choice A is incorrect because -1 is the value of x , not the value of $7 + 2x$. Choices C and D are incorrect and may result from calculation errors.

QUESTION 7.

Choice D is correct. The x -intercepts of the parabola represented by $y = x^2 - 6x + 8$ in the xy -plane are the values of x for which y is equal to 0. The factored form of the equation, $y = (x - 2)(x - 4)$, shows that y equals 0 if and only if $x = 2$ or $x = 4$. Thus, the factored form, $y = (x - 2)(x - 4)$, displays the x -intercepts of the parabola as the constants 2 and 4.

Choices A, B, and C are incorrect because none of these forms shows the x -intercepts 2 and 4 as constants or coefficients.

QUESTION 8.

Choice D is correct. Since a player starts with k points and loses 2 points each time a task is not completed, the player's score will be $k - 2n$ after n tasks are not completed (and no additional points are gained). Since a player who fails to complete 100 tasks has a score of 200 points, the equation $200 = k - 100(2)$ must be true. This equation can be solved by adding 200 to each side, giving $k = 400$.

Choices A, B, and C are incorrect and may result from errors in setting up or solving the equation relating the player's score to the number of tasks the player fails to complete. For example, choice A may result from subtracting 200 from the left-hand side of $200 = k - 100(2)$ and adding 200 to the right-hand side.

QUESTION 9.

Choice A is correct. Since x is the number of 40-pound boxes, $40x$ is the total weight, in pounds, of the 40-pound boxes; and since y is the number of 65-pound boxes, $65y$ is the total weight, in pounds, of the 65-pound boxes. The combined weight of the boxes is therefore $40x + 65y$, and the total number of boxes is $x + y$. Since the forklift can carry up to 45 boxes or up to 2,400 pounds, the inequalities that represent these relationships are $40x + 65y \leq 2,400$ and $x + y \leq 45$.

Choice B is incorrect. The second inequality correctly represents the maximum number of boxes on the forklift, but the first inequality divides, rather than multiplies, the number of boxes by their respective weights. Choice C is incorrect. The combined weight of the boxes, $40x + 65y$, must be less than or equal to 2,400 pounds, not 45; the total number of boxes, $x + y$, must be less than or equal to 45, not 2,400. Choice D is incorrect. The second inequality correctly represents the maximum weight, in pounds, of the boxes on the forklift, but the total number of boxes, $x + y$, must be less than or equal to 45, not 2,400.

QUESTION 10.

Choice B is correct. It is given that $g(3) = 2$. Therefore, to find the value of $f(g(3))$, substitute 2 for $g(3)$: $f(g(3)) = f(2) = 3$.

Choices A, C, and D are incorrect and may result from misunderstandings about function notation.

QUESTION 11.

Choice B is correct. Tony reads 250 words per minute, and he plans to read for 3 hours, which is 180 minutes, each day. Thus, Tony is planning to read $250 \times 180 = 45,000$ words of the novel per day. Since the novel has 349,168 words, it will take Tony $\frac{349,168}{45,000} \approx 7.76$ days of reading to finish the novel. That is, it will take Tony 7 full days of reading and most of an 8th day of reading to finish the novel. Therefore, it will take Tony 8 days to finish the novel.

Choice A is incorrect and may result from an incorrect calculation or incorrectly using the numbers provided in the table. Choice C is incorrect and may result from taking the total number of words in the novel divided by the rate Tony reads per hour. Choice D is incorrect and may result from taking the total number of words in the novel divided by the number of pages in the novel.

QUESTION 12.

Choice D is correct. Since there were 175,000 tons of trash in the landfill on January 1, 2000, and the amount of trash in the landfill increased by 7,500 tons each year after that date, the amount of trash, in tons, in the landfill y years after January 1, 2000 can be expressed as $175,000 + 7,500y$. The landfill has a capacity of 325,000 tons. Therefore, the set of years where the amount of trash in the landfill is at (equal to) or above (greater than) capacity is described by the inequality $175,000 + 7,500y \geq 325,000$.

Choice A is incorrect. This inequality does not account for the 175,000 tons of trash in the landfill on January 1, 2000, nor does it accurately account for the 7,500 tons of trash that are added to the landfill each year after January 1, 2000. Choice B is incorrect. This inequality does not account for the 175,000 tons of trash in the landfill on January 1, 2000. Choice C is incorrect. This inequality represents the set of years where the amount of trash in the landfill is at or below capacity.

QUESTION 13.

Choice D is correct. Survey research is an efficient way to estimate the preferences of a large population. In order to reliably generalize the results of survey research to a larger population, the participants should be randomly selected from all people in that population. Since this survey was conducted

with a population that was not randomly selected, the results are not reliably representative of all people in the town. Therefore, of the given factors, where the survey was given makes it least likely that a reliable conclusion can be drawn about the sports-watching preferences of all people in the town.

Choice A is incorrect. In general, larger sample sizes are preferred over smaller sample sizes. However, a sample size of 117 people would have allowed a reliable conclusion about the population if the participants had been selected at random. Choice B is incorrect. Whether the population is large or small, a large enough sample taken from the population is reliably generalizable if the participants are selected at random from that population. Thus, a reliable conclusion could have been drawn about the population if the 117 survey participants had been selected at random. Choice C is incorrect. When giving a survey, participants are not forced to respond. Even though some people refused to respond, a reliable conclusion could have been drawn about the population if the participants had been selected at random.

QUESTION 14.

Choice C is correct. According to the graph, the horizontal line that represents 550 billion miles traveled intersects the line of best fit at a point whose horizontal coordinate is between 2000 and 2005, and slightly closer to 2005 than to 2000. Therefore, of the choices given, 2003 best approximates the year in which the number of miles traveled by air passengers in Country X was estimated to be 550 billion.

Choice A is incorrect. According to the line of best fit, in 1997 the estimated number of miles traveled by air passengers in Country X was about 450 billion, not 550 billion. Choice B is incorrect. According to the line of best fit, in 2000 the estimated number of miles traveled by air passengers in Country X was about 500 billion, not 550 billion. Choice D is incorrect. According to the line of best fit, in 2008 the estimated number of miles traveled by air passengers in Country X was about 600 billion, not 550 billion.

QUESTION 15.

Choice A is correct. The number of miles Earth travels in its one-year orbit of the Sun is 580,000,000. Because there are about 365 days per year, the number of miles Earth travels per day is $\frac{580,000,000}{365} \approx 1,589,041$. There are 24 hours in one day, so Earth travels at $\frac{1,589,041}{24} \approx 66,210$ miles per hour. Therefore, of the choices given, 66,000 miles per hour is closest to the average speed of Earth as it orbits the Sun.

Choices B, C, and D are incorrect and may result from calculation errors.

QUESTION 16.

Choice B is correct. According to the table, there are $18 + 7 = 25$ graduates who passed the bar exam, and 7 of them did not take the review course. Therefore, if one of the surveyed graduates who passed the bar exam is chosen at random, the probability that the person chosen did not take the review course is $\frac{7}{25}$.

Choices A, C, and D are incorrect. Each of these choices represents a different probability from the conditional probability that the question asks for. Choice A represents the following probability. If one of the surveyed graduates who passed the bar exam is chosen at random, the probability that the person chosen did take the review course is $\frac{18}{25}$. Choice C represents the following probability. If one of the surveyed graduates is chosen at random, the probability that the person chosen passed the bar exam is $\frac{25}{200}$. Choice D represents the following probability. If one of the surveyed graduates is chosen at random, the probability that the person chosen passed the exam and took the review course is $\frac{7}{200}$.

QUESTION 17.

Choice C is correct. To find the atomic weight of an unknown element that is 20% less than the atomic weight of calcium, multiply the atomic weight, in amu, of calcium by $(1 - 0.20)$: $(40)(1 - 0.20) = (40)(0.8) = 32$.

Choice A is incorrect. This value is 20% of the atomic weight of calcium, not an atomic weight 20% less than that atomic weight of calcium. Choice B is incorrect. This value is 20 amu less, not 20% less, than the atomic weight of calcium. Choice D is incorrect. This value is 20% more, not 20% less, than the atomic weight of calcium.

QUESTION 18.

Choice C is correct. The mean and median values of a data set are equal when there is a symmetrical distribution. For example, a normal distribution is symmetrical. If the mean and the median values are not equal, then the distribution is not symmetrical. Outliers are a small group of values that are significantly smaller or larger than the other values in the data. When there are outliers in the data, the mean will be pulled in their direction (either smaller or larger) while the median remains the same. The example in the question has a mean that is larger than the median, and so an appropriate conjecture is that large outliers are present in the data; that is, that there are a few homes that are valued much more than the rest.

Choice A is incorrect because a set of home values that are close to each other will have median and mean values that are also close to each other.

Choice B is incorrect because outliers with small values will tend to make the mean lower than the median. Choice D is incorrect because a set of data where many homes are valued between \$125,000 and \$165,000 will likely have both a mean and a median between \$125,000 and \$165,000.

QUESTION 19.

Choice B is correct. The median of a data set is the middle value when the data points are sorted in either ascending or descending order. There are a total of 600 data points provided, so the median will be the average of the 300th and 301st data points. When the data points are sorted in order:

- ▶ Values 1 through 260 will be 0.
- ▶ Values 261 through 450 will be 1.
- ▶ Values 451 through 540 will be 2.
- ▶ Values 541 through 580 will be 3.
- ▶ Values 581 through 600 will be 4.

Therefore, both the 300th and 301st values are 1, and hence the median is 1.

Choices A, C, and D are incorrect and may result from either a calculation error or a conceptual error.

QUESTION 20.

Choice C is correct. When survey participants are selected at random from a larger population, the sample statistics calculated from the survey can be generalized to the larger population. Since 10 of 300 students surveyed at Lincoln School have 4 siblings, one can estimate that this same ratio holds for all 2,400 students at Lincoln School. Also, since 10 of 300 students surveyed at Washington School have 4 siblings, one can estimate that this same ratio holds for all 3,300 students at Washington School. Therefore, approximately $\frac{10}{300} \times 2,400 = 80$ students at Lincoln School and $\frac{10}{300} \times 3,300 = 110$ students at Washington School are expected to have 4 siblings. Thus, the total number of students with 4 siblings at Washington School is expected to be $110 - 80 = 30$ more than the total number of students with 4 siblings at Lincoln School.

Choices A, B, and D are incorrect and may result from either conceptual or calculation errors. For example, choice A is incorrect; even though there is the same ratio of survey participants from Lincoln School and Washington School with 4 siblings, the two schools have a different total number of students, and thus, a different expected total number of students with 4 siblings.

QUESTION 21.

Choice D is correct. The difference between the number of hours the project takes, y , and the number of hours the project was estimated to take, x , is $|y - x|$. If the goal is met, the difference is less than 10, which can be represented as $|y - x| < 10$ or $-10 < y - x < 10$.

Choice A is incorrect. This inequality states that the estimated number of hours plus the actual number of hours is less than 10, which cannot be true because the estimate is greater than 100. Choice B is incorrect. This inequality states that the actual number of hours is greater than the estimated number of hours plus 10, which could be true only if the goal of being within 10 hours of the estimate were not met. Choice C is incorrect. This inequality states that the actual number of hours is less than the estimated number of hours minus 10, which could be true only if the goal of being within 10 hours of the estimate were not met.

QUESTION 22.

Choice B is correct. To rearrange the formula $I = \frac{P}{4\pi r^2}$ in terms of r^2 , first multiply each side of the equation by r^2 . This yields $r^2 I = \frac{P}{4\pi}$. Then dividing each side of $r^2 I = \frac{P}{4\pi}$ by I gives $r^2 = \frac{P}{4\pi I}$.

Choices A, C, and D are incorrect and may result from algebraic errors during the rearrangement of the formula.

QUESTION 23.

Choice A is correct. If I_A is the intensity measured by Observer A from a distance of r_A and I_B is the intensity measured by Observer B from a distance of r_B , then $I_A = 16I_B$. Using the formula $I = \frac{P}{4\pi r^2}$, the intensity measured by Observer A is $I_A = \frac{P}{4\pi r_A^2}$, which can also be written in terms of I_B as $I_A = 16I_B = 16 \left(\frac{P}{4\pi r_B^2} \right)$. Setting the right-hand sides of these two equations equal to each other gives $\frac{P}{4\pi r_A^2} = 16 \left(\frac{P}{4\pi r_B^2} \right)$, which relates the distance of Observer A from the radio antenna to the distance of Observer B from the radio antenna. Canceling the common factor $\frac{P}{4\pi}$ and rearranging the equation gives $r_B^2 = 16r_A^2$. Taking the square root of each side of $r_B^2 = 16r_A^2$ gives $r_B = 4r_A$, and then dividing each side by 4 yields $r_A = \frac{1}{4}r_B$. Therefore, the distance of Observer A from the radio antenna is $\frac{1}{4}$ the distance of Observer B from the radio antenna.

Choices B, C, and D are incorrect and may result from errors in deriving or using the formula $\frac{P}{4\pi r_A^2} = (16) \left(\frac{P}{4\pi r_B^2} \right)$.

QUESTION 24.

Choice A is correct. The equation of a circle with center (h, k) and radius r is $(x - h)^2 + (y - k)^2 = r^2$. To put the equation $x^2 + y^2 + 4x - 2y = -1$ in this form, complete the square as follows:

$$\begin{aligned}x^2 + y^2 + 4x - 2y &= -1 \\(x^2 + 4x) + (y^2 - 2y) &= -1 \\(x^2 + 4x + 4) - 4 + (y^2 - 2y + 1) - 1 &= -1 \\(x + 2)^2 + (y - 1)^2 - 4 - 1 &= -1 \\(x + 2)^2 + (y - 1)^2 &= 4 = 2^2\end{aligned}$$

Therefore, the radius of the circle is 2.

Choice C is incorrect because it is the square of the radius, not the radius. Choices B and D are incorrect and may result from errors in rewriting the given equation in standard form.

QUESTION 25.

Choice A is correct. In the xy -plane, the slope m of the line that passes through the points (x_1, y_1) and (x_2, y_2) is given by the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$. Thus, if the graph of the linear function f has intercepts at $(a, 0)$ and $(0, b)$, then the slope of the line that is the graph of $y = f(x)$ is $m = \frac{0 - b}{a - 0} = -\frac{b}{a}$. It is given that $a + b = 0$, and so $a = -b$. Finally, substituting $-b$ for a in $m = -\frac{b}{a}$ gives $m = -\frac{b}{-b} = 1$, which is positive.

Choices B, C, and D are incorrect and may result from a conceptual misunderstanding or a calculation error.

QUESTION 26.

Choice D is correct. The definition of the graph of a function f in the xy -plane is the set of all points $(x, f(x))$. Thus, for $-4 \leq a \leq 4$, the value of $f(a)$ is 1 if and only if the unique point on the graph of f with x -coordinate a has y -coordinate equal to 1. The points on the graph of f with x -coordinates $-4, \frac{3}{2}$, and 3 are, respectively, $(-4, 1), (\frac{3}{2}, 1)$, and $(3, 1)$. Therefore, all of the values of f given in I, II, and III are equal to 1.

Choices A, B, and C are incorrect because they each omit at least one value of x for which $f(x) = 1$.

QUESTION 27.

Choice D is correct. According to the graph, in the interval from 0 to 10 minutes, the non-insulated sample decreased in temperature by about 18°C , while the insulated sample decreased by about 8°C ; in the interval from 10 to 20 minutes, the non-insulated sample decreased in temperature by about 9°C , while the insulated sample decreased by about 5°C ; in the interval

from 40 to 50 minutes, the non-insulated sample decreased in temperature by about 1°C , while the insulated sample decreased by about 3°C ; and in the interval from 50 to 60 minutes, the non-insulated sample decreased in temperature by about 1°C , while the insulated sample decreased by about 2°C . The description in choice D accurately summarizes these rates of temperature change over the given intervals. (Note that since the two samples of water have equal mass and so must lose the same amount of heat to cool from 60°C to 25°C , the faster cooling of the non-insulated sample at the start of the cooling process must be balanced out by faster cooling of the insulated sample at the end of the cooling process.)

Choices A, B, and C are incorrect. None of these descriptions accurately compares the rates of temperature change shown in the graph for the 10-minute intervals.

QUESTION 28.

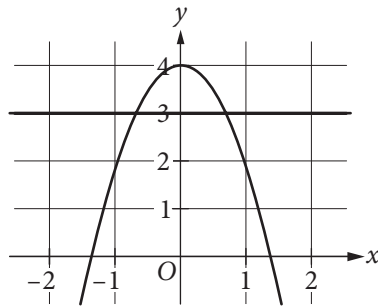
Choice B is correct. In the xy -plane, the slope m of the line that passes through the points (x_1, y_1) and (x_2, y_2) is $m = \frac{y_2 - y_1}{x_2 - x_1}$. Thus, the slope of the line through the points $C(7, 2)$ and $E(1, 0)$ is $\frac{2 - 0}{7 - 1}$, which simplifies to $\frac{2}{6} = \frac{1}{3}$. Therefore, diagonal AC has a slope of $\frac{1}{3}$. The other diagonal of the square is a segment of the line that passes through points B and D . The diagonals of a square are perpendicular, and so the product of the slopes of the diagonals is equal to -1 . Thus, the slope of the line that passes through B and D is -3 because $\frac{1}{3}(-3) = -1$. Hence, an equation of the line that passes through B and D can be written as $y = -3x + b$, where b is the y -intercept of the line. Since diagonal BD will pass through the center of the square, $E(1, 0)$, the equation $0 = -3(1) + b$ holds. Solving this equation for b gives $b = 3$. Therefore, an equation of the line that passes through points B and D is $y = -3x + 3$, which can be rewritten as $y = -3(x - 1)$.

Choices A, C, and D are incorrect and may result from a conceptual error or a calculation error.

QUESTION 29.

Choice B is correct. Substituting 3 for y in $y = ax^2 + b$ gives $3 = ax^2 + b$, which can be rewritten as $3 - b = ax^2$. Since $y = 3$ is one of the equations in the given system, any solution x of $3 - b = ax^2$ corresponds to the solution $(x, 3)$ of the given system. Since the square of a real number is always nonnegative, and a positive number has two square roots, the equation $3 - b = ax^2$ will have two solutions for x if and only if (1) $a > 0$ and $b < 3$ or (2) $a < 0$ and $b > 3$. Of the values for a and b given in the choices, only $a = -2$, $b = 4$ satisfy one of these pairs of conditions.

Alternatively, if $a = -2$ and $b = 4$, then the second equation would be $y = -2x^2 + 4$. The graph of this quadratic equation in the xy -plane is a parabola with y -intercept $(0, 4)$ that opens downward. The graph of the first equation, $y = 3$, is the horizontal line that contains the point $(0, 3)$. As shown below, these two graphs have two points of intersection, and therefore, this system of equations has exactly two real solutions. (Graphing shows that none of the other three choices produces a system with exactly two real solutions.)



Choices A, C, and D are incorrect and may result from calculation or conceptual errors.

QUESTION 30.

Choice A is correct. The regular hexagon can be divided into 6 equilateral triangles of side length a by drawing the six segments from the center of the regular hexagon to each of its 6 vertices. Since the area of the hexagon is $384\sqrt{3}$ square inches, the area of each equilateral triangle will be $\frac{384\sqrt{3}}{6} = 64\sqrt{3}$ square inches.

Drawing any altitude of an equilateral triangle divides it into two 30° - 60° - 90° triangles. If the side length of the equilateral triangle is a , then the hypotenuse of each 30° - 60° - 90° triangle is a , and the altitude of the equilateral triangle will be the side opposite the 60° angle in each of the 30° - 60° - 90° triangles. Thus, the altitude of the equilateral triangle is $\frac{\sqrt{3}}{2}a$, and the area of the equilateral triangle is $\frac{1}{2}(a)\left(\frac{\sqrt{3}}{2}a\right) = \frac{\sqrt{3}}{4}a^2$. Since the area of each equilateral triangle is $64\sqrt{3}$ square inches, it follows that $a^2 = \frac{4}{\sqrt{3}}(64\sqrt{3}) = 256$ square inches. And since the area of the square with side length a is a^2 , it follows that the square has area 256 square inches.

Choices B, C, and D are incorrect and may result from calculation or conceptual errors.

QUESTION 31.

The correct answer is 14. Since the coastal geologist estimates that the country's beaches are eroding at a rate of 1.5 feet every year, they will erode by $1.5x$ feet in x years. Thus, if the beaches erode by 21 feet in x years, the equation $1.5x = 21$ must hold. The value of x is then $\frac{21}{1.5} = 14$. Therefore, according to the geologist's estimate, it will take 14 years for the country's beaches to erode by 21 feet.

QUESTION 32.

The correct answer is 7. There are 60 minutes in each hour, and so there are $60h$ minutes in h hours. Since h hours and 30 minutes is equal to 450 minutes, it follows that $60h + 30 = 450$. This equation can be simplified to $60h = 420$, and so the value of h is $\frac{420}{60} = 7$.

QUESTION 33.

The correct answer is 11. It is given that the function $f(x)$ passes through the point $(3, 6)$. Thus, if $x = 3$, the value of $f(x)$ is 6 (since the graph of f in the xy -plane is the set of all points $(x, f(x))$). Substituting 3 for x and 6 for $f(x)$ in $f(x) = 3x^2 - bx + 12$ gives $6 = 3(3)^2 - b(3) + 12$. Performing the operations on the right-hand side of this equation gives $6 = 3(9) - 3b + 12 = 27 - 3b + 12 = 39 - 3b$. Subtracting 39 from each side of $6 = 39 - 3b$ gives $-33 = -3b$, and then dividing each side of $-33 = -3b$ by -3 gives the value of b as 11.

QUESTION 34.

The correct answer is 105. Let D be the number of hours Doug spent in the tutoring lab, and let L be the number of hours Laura spent in the tutoring lab. Since Doug and Laura spent a combined total of 250 hours in the tutoring lab, the equation $D + L = 250$ holds. The number of hours Doug spent in the lab is 40 more than the number of hours Laura spent in the lab, and so the equation $D = L + 40$ holds. Substituting $L + 40$ for D in $D + L = 250$ gives $(L + 40) + L = 250$, or $40 + 2L = 250$. Solving this equation gives $L = 105$. Therefore, Laura spent 105 hours in the tutoring lab.

QUESTION 35.

The correct answer is 15. The amount, a , that Jane has deposited after t fixed weekly deposits is equal to the initial deposit plus the total amount of money Jane has deposited in the t fixed weekly deposits. This amount a is given to be $a = 18t + 15$. The amount she deposited in the t fixed weekly deposits is the amount of the weekly deposit times t ; hence, this amount must be given by the term $18t$ in $a = 18t + 15$ (and so Jane must have deposited 18 dollars each week after the initial deposit). Therefore, the amount of Jane's original deposit, in dollars, is $a - 18t = 15$.

QUESTION 36.

The correct answer is 32. Since segments LM and MN are tangent to the circle at points L and N , respectively, angles OLM and ONM are right angles. Thus, in quadrilateral $OLMN$, the measure of angle O is $360^\circ - (90^\circ + 60^\circ + 90^\circ) = 120^\circ$. Thus, in the circle, central angle O cuts off $\frac{120}{360} = \frac{1}{3}$ of the circumference; that is, minor arc \widehat{LN} is $\frac{1}{3}$ of the circumference. Since the circumference is 96, the length of minor arc \widehat{LN} is $\frac{1}{3} \times 96 = 32$.

QUESTION 37.

The correct answer is 3284. According to the formula, the number of plants one year from now will be $3000 + 0.2(3000)\left(1 - \frac{3000}{4000}\right)$, which is equal to 3150. Then, using the formula again, the number of plants two years from now will be $3150 + 0.2(3150)\left(1 - \frac{3150}{4000}\right)$, which is 3283.875. Rounding this value to the nearest whole number gives 3284.

QUESTION 38.

The correct answer is 7500. If the number of plants is to be increased from 3000 this year to 3360 next year, then the number of plants that the environment can support, K , must satisfy the equation $3360 = 3000 + 0.2(3000)\left(1 - \frac{3000}{K}\right)$. Dividing both sides of this equation by 3000 gives $1.12 = 1 + 0.2\left(1 - \frac{3000}{K}\right)$, and therefore, it must be true that $0.2\left(1 - \frac{3000}{K}\right) = 0.12$, or equivalently, $1 - \frac{3000}{K} = 0.6$. It follows that $\frac{3000}{K} = 0.4$, and so $K = \frac{3000}{0.4} = 7500$.



SAT[®] Practice Test #3

IMPORTANT REMINDERS

1

**A No. 2 pencil is required for the test.
Do not use a mechanical pencil or pen.**

2

**Sharing any questions with anyone
is a violation of Test Security
and Fairness policies and may result
in your scores being canceled.**

This cover is representative of what you'll see on test day.

**THIS TEST BOOK MUST NOT BE TAKEN FROM THE ROOM. UNAUTHORIZED
REPRODUCTION OR USE OF ANY PART OF THIS TEST BOOK IS PROHIBITED.**



Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

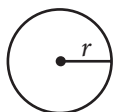
DIRECTIONS

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

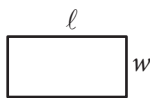
- The use of a calculator **is not permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated,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

REFERENCE

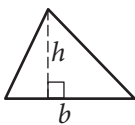


$$A = \pi r^2$$

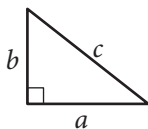
$$C = 2\pi r$$



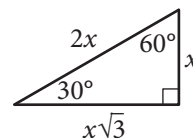
$$A = \ell w$$



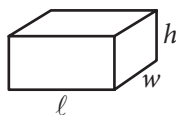
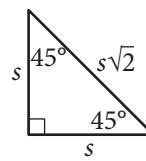
$$A = \frac{1}{2}bh$$



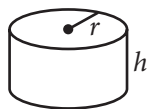
$$c^2 = a^2 + b^2$$



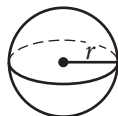
Special Right Triangles



$$V = \ell wh$$



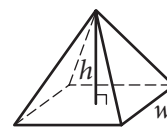
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}\ell wh$$

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.



1

A painter will paint n walls with the same size and shape in a building using a specific brand of paint. The painter's fee can be calculated by the expression $nK\ell h$, where n is the number of walls, K is a constant with units of dollars per square foot, ℓ is the length of each wall in feet, and h is the height of each wall in feet. If the customer asks the painter to use a more expensive brand of paint, which of the factors in the expression would change?

- A) h
- B) ℓ
- C) K
- D) n

2

If $3r = 18$, what is the value of $6r + 3$?

- A) 6
- B) 27
- C) 36
- D) 39

3

Which of the following is equal to $a^{\frac{2}{3}}$, for all values of a ?

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

4

The number of states that joined the United States between 1776 and 1849 is twice the number of states that joined between 1850 and 1900. If 30 states joined the United States between 1776 and 1849 and x states joined between 1850 and 1900, which of the following equations is true?

- A) $30x = 2$
- B) $2x = 30$
- C) $\frac{x}{2} = 30$
- D) $x + 30 = 2$



5

If $\frac{5}{x} = \frac{15}{x+20}$, what is the value of $\frac{x}{5}$?

- A) 10
- B) 5
- C) 2
- D) $\frac{1}{2}$

6

$$2x - 3y = -14$$

$$3x - 2y = -6$$

If (x, y) is a solution to the system of equations above, what is the value of $x - y$?

- A) -20
- B) -8
- C) -4
- D) 8

7

x	$f(x)$
0	3
2	1
4	0
5	-2

The function f is defined by a polynomial. Some values of x and $f(x)$ are shown in the table above. Which of the following must be a factor of $f(x)$?

- A) $x - 2$
- B) $x - 3$
- C) $x - 4$
- D) $x - 5$

8

The line $y = kx + 4$, where k is a constant, is graphed in the xy -plane. If the line contains the point (c, d) , where $c \neq 0$ and $d \neq 0$, what is the slope of the line in terms of c and d ?

- A) $\frac{d-4}{c}$
- B) $\frac{c-4}{d}$
- C) $\frac{4-d}{c}$
- D) $\frac{4-c}{d}$



9

$$kx - 3y = 4$$

$$4x - 5y = 7$$

In the system of equations above, k is a constant and x and y are variables. For what value of k will the system of equations have no solution?

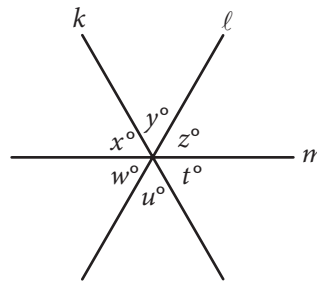
- A) $\frac{12}{5}$
 B) $\frac{16}{7}$
 C) $-\frac{16}{7}$
 D) $-\frac{12}{5}$

10

In the xy -plane, the parabola with equation $y = (x - 11)^2$ intersects the line with equation $y = 25$ at two points, A and B . What is the length of \overline{AB} ?

- A) 10
 B) 12
 C) 14
 D) 16

11



Note: Figure not drawn to scale.

In the figure above, lines k , l , and m intersect at a point. If $x + y = u + w$, which of the following must be true?

- I. $x = z$
 II. $y = w$
 III. $z = t$
- A) I and II only
 B) I and III only
 C) II and III only
 D) I, II, and III

12

$$y = a(x - 2)(x + 4)$$

In the quadratic equation above, a is a nonzero constant. The graph of the equation in the xy -plane is a parabola with vertex (c, d) . Which of the following is equal to d ?

- A) $-9a$
 B) $-8a$
 C) $-5a$
 D) $-2a$



13

The equation $\frac{24x^2 + 25x - 47}{ax - 2} = -8x - 3 - \frac{53}{ax - 2}$ is true for all values of $x \neq \frac{2}{a}$, where a is a constant.

What is the value of a ?

- A) -16
- B) -3
- C) 3
- D) 16

14

What are the solutions to $3x^2 + 12x + 6 = 0$?

- A) $x = -2 \pm \sqrt{2}$
- B) $x = -2 \pm \frac{\sqrt{30}}{3}$
- C) $x = -6 \pm \sqrt{2}$
- D) $x = -6 \pm 6\sqrt{2}$

15

$$C = \frac{5}{9}(F - 32)$$

The equation above shows how a temperature F , measured in degrees Fahrenheit, relates to a temperature C , measured in degrees Celsius. Based on the equation, which of the following must be true?

- I. A temperature increase of 1 degree Fahrenheit is equivalent to a temperature increase of $\frac{5}{9}$ degree Celsius.
- II. A temperature increase of 1 degree Celsius is equivalent to a temperature increase of 1.8 degrees Fahrenheit.
- III. A temperature increase of $\frac{5}{9}$ degree Fahrenheit is equivalent to a temperature increase of 1 degree Celsius.

- A) I only
- B) II only
- C) III only
- D) I and II only

**DIRECTIONS**

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

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or 7/2. (If $\begin{array}{|c|c|c|c|} \hline 3 & 1 & / & 2 \\ \hline \bullet & \bullet & / & \bullet \\ \hline \end{array}$ is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Write answer → in boxes.

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

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

← Fraction line

Grid in result.

Answer: 2.5

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

← Decimal point

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

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

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

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

Answer: 201 – either position is correct

	2	0	1
	/	/	
●	●	●	●
	0	●	0
①	①	①	●
②	●	②	②
③	③	③	③

	2	0	1
	/	/	
●	●	●	●
	●	0	0
①	①	●	①
②	●	②	②
③	③	③	③

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



16

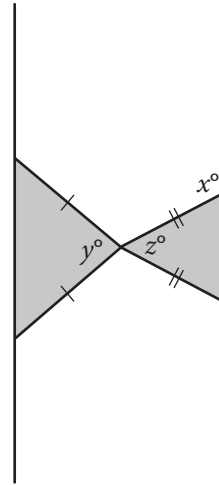
$$x^3(x^2 - 5) = -4x$$

If $x > 0$, what is one possible solution to the equation above?

17

If $\frac{7}{9}x - \frac{4}{9}x = \frac{1}{4} + \frac{5}{12}$, what is the value of x ?

18



Note: Figure not drawn to scale.

Two isosceles triangles are shown above. If $180 - z = 2y$ and $y = 75$, what is the value of x ?



19

At a lunch stand, each hamburger has 50 more calories than each order of fries. If 2 hamburgers and 3 orders of fries have a total of 1700 calories, how many calories does a hamburger have?

20

In triangle ABC , the measure of $\angle B$ is 90° , $BC = 16$, and $AC = 20$. Triangle DEF is similar to triangle ABC , where vertices D , E , and F correspond to vertices A , B , and C , respectively, and each side of triangle DEF is $\frac{1}{3}$ the length of the corresponding side of triangle ABC . What is the value of $\sin F$?

STOP

If you finish before time is called, you may check your work on this section only.

Do not turn to any other section.



Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

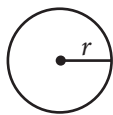
DIRECTIONS

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

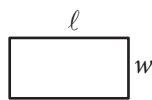
- The use of a calculator **is permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated, the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

REFERENCE

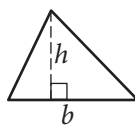


$$A = \pi r^2$$

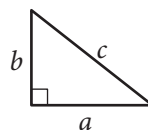
$$C = 2\pi r$$



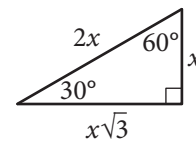
$$A = \ell w$$



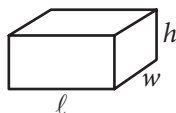
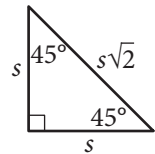
$$A = \frac{1}{2}bh$$



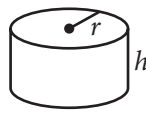
$$c^2 = a^2 + b^2$$



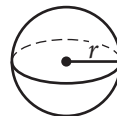
Special Right Triangles



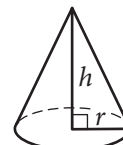
$$V = \ell wh$$



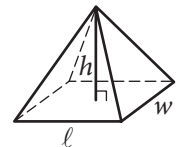
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}\ell wh$$

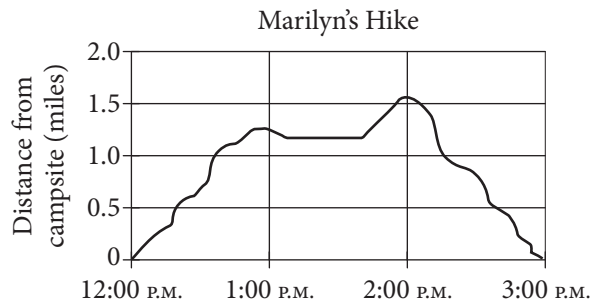
The number of degrees of arc in a circle is 360.

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.



1



The graph above shows Marilyn's distance from her campsite during a 3-hour hike. She stopped for 30 minutes during her hike to have lunch. Based on the graph, which of the following is closest to the time she finished lunch and continued her hike?

- A) 12:40 P.M.
- B) 1:10 P.M.
- C) 1:40 P.M.
- D) 2:00 P.M.

2

Gender	Age		Total
	Under 40	40 or older	
Male	12	2	14
Female	8	3	11
Total	20	5	25

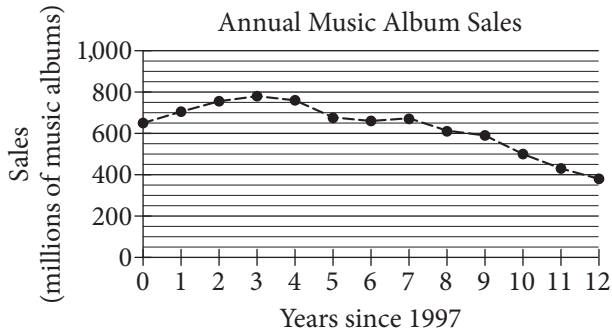
The table above shows the distribution of age and gender for 25 people who entered a contest. If the contest winner will be selected at random, what is the probability that the winner will be either a female under age 40 or a male age 40 or older?

- A) $\frac{4}{25}$
- B) $\frac{10}{25}$
- C) $\frac{11}{25}$
- D) $\frac{16}{25}$



3

The graph below shows the total number of music album sales, in millions, each year from 1997 through 2009.



Based on the graph, which of the following best describes the general trend in music album sales from 1997 through 2009?

- A) Sales generally increased each year since 1997.
- B) Sales generally decreased each year since 1997.
- C) Sales increased until 2000 and then generally decreased.
- D) Sales generally remained steady from 1997 through 2009.

4

n	1	2	3	4
$f(n)$	-2	1	4	7

The table above shows some values of the linear function f . Which of the following defines f ?

- A) $f(n) = n - 3$
- B) $f(n) = 2n - 4$
- C) $f(n) = 3n - 5$
- D) $f(n) = 4n - 6$

5

At Lincoln High School, approximately 7 percent of enrolled juniors and 5 percent of enrolled seniors were inducted into the National Honor Society last year. If there were 562 juniors and 602 seniors enrolled at Lincoln High School last year, which of the following is closest to the total number of juniors and seniors at Lincoln High School last year who were inducted into the National Honor Society?

- A) 140
- B) 69
- C) 39
- D) 30

6

$$3x^2 - 5x + 2$$

$$5x^2 - 2x - 6$$

Which of the following is the sum of the two polynomials shown above?

- A) $8x^2 - 7x - 4$
- B) $8x^2 + 7x - 4$
- C) $8x^4 - 7x^2 - 4$
- D) $8x^4 + 7x^2 - 4$



7

If $\frac{3}{5}w = \frac{4}{3}$, what is the value of w ?

- A) $\frac{9}{20}$
- B) $\frac{4}{5}$
- C) $\frac{5}{4}$
- D) $\frac{20}{9}$

8

The average number of students per classroom at Central High School from 2000 to 2010 can be modeled by the equation $y = 0.56x + 27.2$, where x represents the number of years since 2000, and y represents the average number of students per classroom. Which of the following best describes the meaning of the number 0.56 in the equation?

- A) The total number of students at the school in 2000
- B) The average number of students per classroom in 2000
- C) The estimated increase in the average number of students per classroom each year
- D) The estimated difference between the average number of students per classroom in 2010 and in 2000

9

Nate walks 25 meters in 13.7 seconds. If he walks at this same rate, which of the following is closest to the distance he will walk in 4 minutes?

- A) 150 meters
- B) 450 meters
- C) 700 meters
- D) 1,400 meters



Questions 10 and 11 refer to the following information.

Planet	Acceleration due to gravity $\left(\frac{\text{m}}{\text{sec}^2}\right)$
Mercury	3.6
Venus	8.9
Earth	9.8
Mars	3.8
Jupiter	26.0
Saturn	11.1
Uranus	10.7
Neptune	14.1

The chart above shows approximations of the acceleration due to gravity in meters per second squared $\left(\frac{\text{m}}{\text{sec}^2}\right)$ for the eight planets in our solar system. The weight of an object on a given planet can be found by using the formula $W = mg$, where W is the weight of the object measured in newtons, m is the mass of the object measured in kilograms, and g is the acceleration due to gravity on the planet measured in $\frac{\text{m}}{\text{sec}^2}$.

10

What is the weight, in newtons, of an object on Mercury with a mass of 90 kilograms?

- A) 25
- B) 86
- C) 101
- D) 324

11

An object on Earth has a weight of 150 newtons. On which planet would the same object have an approximate weight of 170 newtons?

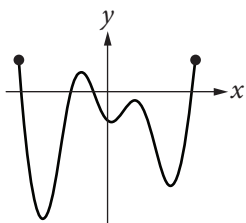
- A) Venus
- B) Saturn
- C) Uranus
- D) Neptune



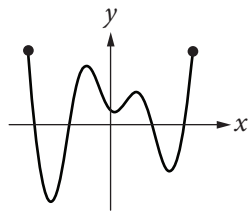
12

If the function f has five distinct zeros, which of the following could represent the complete graph of f in the xy -plane?

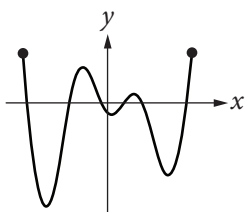
A)



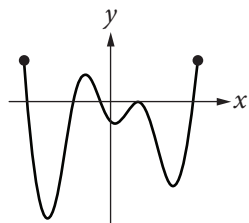
B)



C)



D)



13

$$h = -16t^2 + vt + k$$

The equation above gives the height h , in feet, of a ball t seconds after it is thrown straight up with an initial speed of v feet per second from a height of k feet. Which of the following gives v in terms of h , t , and k ?

A) $v = h + k - 16t$

B) $v = \frac{h - k + 16}{t}$

C) $v = \frac{h + k}{t} - 16t$

D) $v = \frac{h - k}{t} + 16t$

14

The cost of using a telephone in a hotel meeting room is \$0.20 per minute. Which of the following equations represents the total cost c , in dollars, for h hours of phone use?

A) $c = 0.20(60h)$

B) $c = 0.20h + 60$

C) $c = \frac{60h}{0.20}$

D) $c = \frac{0.20h}{60}$

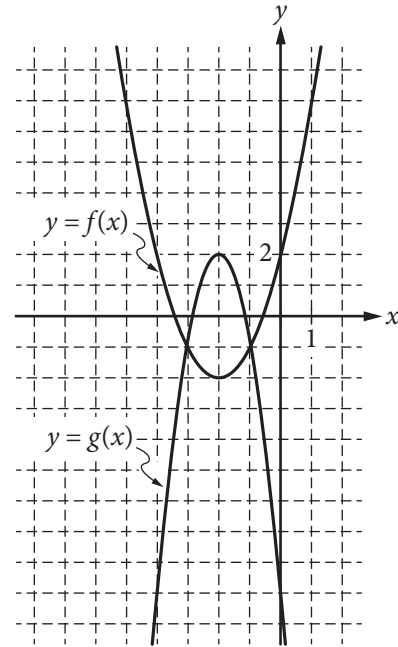


15

In order to determine if treatment X is successful in improving eyesight, a research study was conducted. From a large population of people with poor eyesight, 300 participants were selected at random. Half of the participants were randomly assigned to receive treatment X, and the other half did not receive treatment X. The resulting data showed that participants who received treatment X had significantly improved eyesight as compared to those who did not receive treatment X. Based on the design and results of the study, which of the following is an appropriate conclusion?

- A) Treatment X is likely to improve the eyesight of people who have poor eyesight.
- B) Treatment X improves eyesight better than all other available treatments.
- C) Treatment X will improve the eyesight of anyone who takes it.
- D) Treatment X will cause a substantial improvement in eyesight.

16



Graphs of the functions f and g are shown in the xy -plane above. For which of the following values of x does $f(x) + g(x) = 0$?

- A) -3
- B) -2
- C) -1
- D) 0



Questions 17 and 18 refer to the following information.

$$S(P) = \frac{1}{2}P + 40$$
$$D(P) = 220 - P$$

The quantity of a product supplied and the quantity of the product demanded in an economic market are functions of the price of the product. The functions above are the estimated supply and demand functions for a certain product. The function $S(P)$ gives the quantity of the product supplied to the market when the price is P dollars, and the function $D(P)$ gives the quantity of the product demanded by the market when the price is P dollars.

17

How will the quantity of the product supplied to the market change if the price of the product is increased by \$10?

- A) The quantity supplied will decrease by 5 units.
- B) The quantity supplied will increase by 5 units.
- C) The quantity supplied will increase by 10 units.
- D) The quantity supplied will increase by 50 units.

18

At what price will the quantity of the product supplied to the market equal the quantity of the product demanded by the market?

- A) \$90
- B) \$120
- C) \$133
- D) \$155

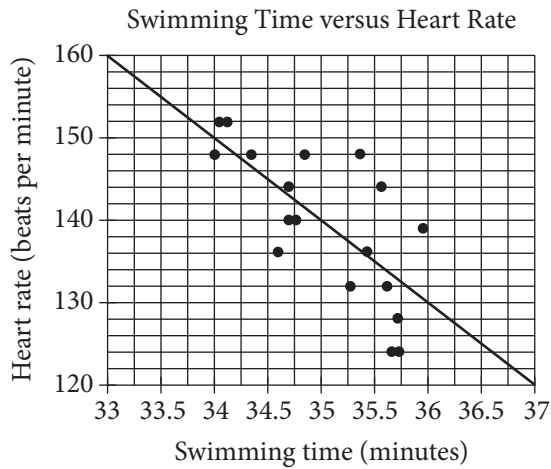
19

Graphene, which is used in the manufacture of integrated circuits, is so thin that a sheet weighing one ounce can cover up to 7 football fields. If a football field has an area of approximately $1\frac{1}{3}$ acres, about how many acres could 48 ounces of graphene cover?

- A) 250
- B) 350
- C) 450
- D) 1,350



20



Michael swam 2,000 yards on each of eighteen days. The scatterplot above shows his swim time for and corresponding heart rate after each swim. The line of best fit for the data is also shown. For the swim that took 34 minutes, Michael's actual heart rate was about how many beats per minutes less than the rate predicted by the line of best fit?

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

21

Of the following four types of savings account plans, which option would yield exponential growth of the money in the account?

- A) Each successive year, 2% of the initial savings is added to the value of the account.
- B) Each successive year, 1.5% of the initial savings and \$100 is added to the value of the account.
- C) Each successive year, 1% of the current value is added to the value of the account.
- D) Each successive year, \$100 is added to the value of the account.

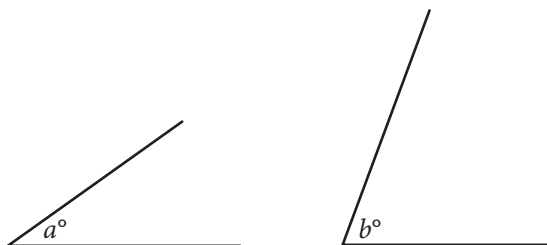
22

The sum of three numbers is 855. One of the numbers, x , is 50% more than the sum of the other two numbers. What is the value of x ?

- A) 570
- B) 513
- C) 214
- D) 155



23



Note: Figures not drawn to scale.

The angles shown above are acute and $\sin(a^\circ) = \cos(b^\circ)$. If $a = 4k - 22$ and $b = 6k - 13$, what is the value of k ?

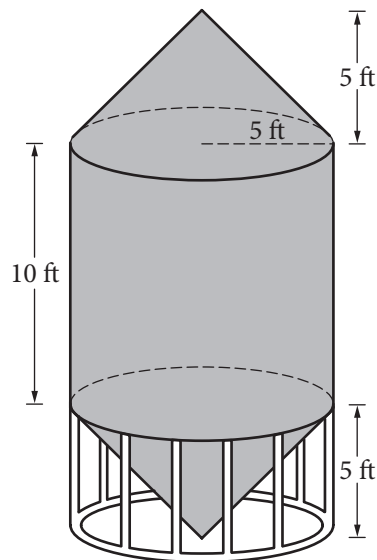
- A) 4.5
- B) 5.5
- C) 12.5
- D) 21.5

24

Mr. Kohl has a beaker containing n milliliters of solution to distribute to the students in his chemistry class. If he gives each student 3 milliliters of solution, he will have 5 milliliters left over. In order to give each student 4 milliliters of solution, he will need an additional 21 milliliters. How many students are in the class?

- A) 16
- B) 21
- C) 23
- D) 26

25



A grain silo is built from two right circular cones and a right circular cylinder with internal measurements represented by the figure above. Of the following, which is closest to the volume of the grain silo, in cubic feet?

- A) 261.8
- B) 785.4
- C) 916.3
- D) 1,047.2



26

In the xy -plane, the line determined by the points $(2, k)$ and $(k, 32)$ passes through the origin. Which of the following could be the value of k ?

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

27

A rectangle was altered by increasing its length by 10 percent and decreasing its width by p percent. If these alterations decreased the area of the rectangle by 12 percent, what is the value of p ?

- A) 12
- B) 15
- C) 20
- D) 22

28

In planning maintenance for a city's infrastructure, a civil engineer estimates that, starting from the present, the population of the city will decrease by 10 percent every 20 years. If the present population of the city is 50,000, which of the following expressions represents the engineer's estimate of the population of the city t years from now?

- A) $50,000(0.1)^{20t}$
- B) $50,000(0.1)^{\frac{t}{20}}$
- C) $50,000(0.9)^{20t}$
- D) $50,000(0.9)^{\frac{t}{20}}$



29

Gender	Handedness	
	Left	Right
Female		
Male		
Total	18	122

The incomplete table above summarizes the number of left-handed students and right-handed students by gender for the eighth-grade students at Keisel Middle School. There are 5 times as many right-handed female students as there are left-handed female students, and there are 9 times as many right-handed male students as there are left-handed male students. If there is a total of 18 left-handed students and 122 right-handed students in the school, which of the following is closest to the probability that a right-handed student selected at random is female? (Note: Assume that none of the eighth-grade students are both right-handed and left-handed.)

- A) 0.410
- B) 0.357
- C) 0.333
- D) 0.250

30

$$3x + b = 5x - 7$$

$$3y + c = 5y - 7$$

In the equations above, b and c are constants.

If b is c minus $\frac{1}{2}$, which of the following is true?

- A) x is y minus $\frac{1}{4}$.
- B) x is y minus $\frac{1}{2}$.
- C) x is y minus 1.
- D) x is y plus $\frac{1}{2}$.


DIRECTIONS

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

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

3	1	/	2
•	•	•	•

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

Write answer in boxes. →

← Fraction line

← Decimal point

Grid in result.

Answer: $\frac{7}{12}$			
7	/	1	2
•	•	•	•
0	0	0	0
①	①	①	①
②	②	②	②
③	③	③	③
④	④	④	④
⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨

Answer: 2.5			
2	.	5	
•	•	•	•
0	0	0	0
①	①	①	①
②	②	②	②
③	③	③	③
④	④	④	④
⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨

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

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

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

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

Answer: 201 – either position is correct

2	0	1	
•	•	•	•
0	0	0	0
①	①	①	①
②	②	②	②
③	③	③	③

2	0	1	
•	•	•	•
0	0	0	0
①	①	①	①
②	②	②	②
③	③	③	③

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



31

Tickets for a school talent show cost \$2 for students and \$3 for adults. If Chris spends at least \$11 but no more than \$14 on x student tickets and 1 adult ticket, what is one possible value of x ?

32

Ages of the First 12 United States Presidents at the Beginning of Their Terms in Office

President	Age (years)	President	Age (years)
Washington	57	Jackson	62
Adams	62	Van Buren	55
Jefferson	58	Harrison	68
Madison	58	Tyler	51
Monroe	59	Polk	50
Adams	58	Taylor	65

The table above lists the ages of the first 12 United States presidents when they began their terms in office. According to the table, what was the mean age, in years, of these presidents at the beginning of their terms? (Round your answer to the nearest tenth.)

33

$$(-3x^2 + 5x - 2) - 2(x^2 - 2x - 1)$$

If the expression above is rewritten in the form $ax^2 + bx + c$, where a , b , and c are constants, what is the value of b ?

34

In a circle with center O , central angle AOB has a measure of $\frac{5\pi}{4}$ radians. The area of the sector formed by central angle AOB is what fraction of the area of the circle?



35

An online store receives customer satisfaction ratings between 0 and 100, inclusive. In the first 10 ratings the store received, the average (arithmetic mean) of the ratings was 75. What is the least value the store can receive for the 11th rating and still be able to have an average of at least 85 for the first 20 ratings?

36

$$y \leq -15x + 3000$$

$$y \leq 5x$$

In the xy -plane, if a point with coordinates (a, b) lies in the solution set of the system of inequalities above, what is the maximum possible value of b ?



Questions 37 and 38 refer to the following information.

If shoppers enter a store at an average rate of r shoppers per minute and each stays in the store for an average time of T minutes, the average number of shoppers in the store, N , at any one time is given by the formula $N = rT$. This relationship is known as Little's law.

The owner of the Good Deals Store estimates that during business hours, an average of 3 shoppers per minute enter the store and that each of them stays an average of 15 minutes. The store owner uses Little's law to estimate that there are 45 shoppers in the store at any time.

37

Little's law can be applied to any part of the store, such as a particular department or the checkout lines. The store owner determines that, during business hours, approximately 84 shoppers per hour make a purchase and each of these shoppers spend an average of 5 minutes in the checkout line. At any time during business hours, about how many shoppers, on average, are waiting in the checkout line to make a purchase at the Good Deals Store?

38

The owner of the Good Deals Store opens a new store across town. For the new store, the owner estimates that, during business hours, an average of 90 shoppers per hour enter the store and each of them stays an average of 12 minutes. The average number of shoppers in the new store at any time is what percent less than the average number of shoppers in the original store at any time? (Note: Ignore the percent symbol when entering your answer. For example, if the answer is 42.1%, enter 42.1)

STOP

If you finish before time is called, you may check your work on this section only.

Do not turn to any other section.

Choices B, C, and D are incorrect because each provides a statement that does not logically connect to the examples that follow.

QUESTION 43.

Choice D is the best answer. It accurately states that the information in the proposed additional sentence is not related to formal portraits of cats, the main topic of the paragraph.

Choices A, B, and C are incorrect because each fails to recognize that the proposed sentence interrupts the logical development of the paragraph.

QUESTION 44.

Choice D is the best answer. The tone corresponds with that established in the passage, and the phrasing appropriately focuses on the cats' contribution to protecting artwork rather than on simply killing rodents.

Choices A, B, and C are incorrect because none makes explicit the link between the cats' hunting activities and the service to the museum.

Section 3: Math Test — No Calculator

QUESTION 1.

Choice C is correct. The painter's fee is given by $nK\ell h$, where n is the number of walls, K is a constant with units of dollars per square foot, ℓ is the length of each wall in feet, and h is the height of each wall in feet. Examining this equation shows that ℓ and h will be used to determine the area of each wall. The variable n is the number of walls, so n times the area of the walls will give the amount of area that will need to be painted. The only remaining variable is K , which represents the cost per square foot and is determined by the painter's time and the price of paint. Therefore, K is the only factor that will change if the customer asks for a more expensive brand of paint.

Choice A is incorrect because a more expensive brand of paint would not cause the height of each wall to change. Choice B is incorrect because a more expensive brand of paint would not cause the length of each wall to change. Choice D is incorrect because a more expensive brand of paint would not cause the number of walls to change.

QUESTION 2.

Choice D is correct. Dividing each side of the equation $3r = 18$ by 3 gives $r = 6$. Substituting 6 for r in the expression $6r + 3$ gives $6(6) + 3 = 39$.

Alternatively, the expression $6r + 3$ can be rewritten as $2(3r) + 3$. Substituting 18 for $3r$ in the expression $2(3r) + 3$ yields $2(18) + 3 = 36 + 3 = 39$.

Choice A is incorrect because 6 is the value of r ; however, the question asks for the value of the expression $6r + 3$. Choices B and C are incorrect because if $6r + 3$ were equal to either of these values, then it would not be possible for $3r$ to be equal to 18, as stated in the question.

QUESTION 3.

Choice D is correct. By definition, $a^{\frac{m}{n}} = \sqrt[n]{a^m}$ for any positive integers m and n . It follows, therefore, that $a^{\frac{2}{3}} = \sqrt[3]{a^2}$.

Choice A is incorrect. By definition, $a^{\frac{1}{n}} = \sqrt[n]{a}$ for any positive integer n . Applying this definition as well as the power property of exponents to the expression $\sqrt{a^{\frac{1}{3}}}$ yields $\sqrt{a^{\frac{1}{3}}} = (a^{\frac{1}{3}})^{\frac{1}{2}} = a^{\frac{1}{6}}$. Because $a^{\frac{1}{6}} \neq a^{\frac{2}{3}}$, $\sqrt{a^{\frac{1}{3}}}$ is not the correct answer. Choice B is incorrect. By definition, $a^{\frac{1}{n}} = \sqrt[n]{a}$ for any positive integer n . Applying this definition as well as the power property of exponents to the expression $\sqrt{a^3}$ yields $\sqrt{a^3} = (a^3)^{\frac{1}{2}} = a^{\frac{3}{2}}$. Because $a^{\frac{3}{2}} \neq a^{\frac{2}{3}}$, $\sqrt{a^3}$ is not the correct answer. Choice C is incorrect. By definition, $a^{\frac{1}{n}} = \sqrt[n]{a}$ for any positive integer n . Applying this definition as well as the power property of exponents to the expression $\sqrt[3]{a^{\frac{1}{2}}}$ yields $\sqrt[3]{a^{\frac{1}{2}}} = (a^{\frac{1}{2}})^{\frac{1}{3}} = a^{\frac{1}{6}}$. Because $a^{\frac{1}{6}} \neq a^{\frac{2}{3}}$, $\sqrt[3]{a^{\frac{1}{2}}}$ is not the correct answer.

QUESTION 4.

Choice B is correct. To fit the scenario described, 30 must be twice as large as x . This can be written as $2x = 30$.

Choices A, C, and D are incorrect. These equations do not correctly relate the numbers and variables described in the stem. For example, the expression in choice C states that 30 is half as large as x , not twice as large as x .

QUESTION 5.

Choice C is correct. Multiplying each side of $\frac{5}{x} = \frac{15}{x+20}$ by $x(x+20)$ gives $15x = 5(x+20)$. Distributing the 5 over the values within the parentheses yields $15x = 5x + 100$, and then subtracting $5x$ from each side gives $10x = 100$. Finally, dividing both sides by 10 gives $x = 10$. Therefore, the value of $\frac{x}{5}$ is $\frac{10}{5} = 2$.

Choice A is incorrect because it is the value of x , not $\frac{x}{5}$. Choices B and D are incorrect and may be the result of errors in arithmetic operations on the given equation.

QUESTION 6.

Choice C is correct. Multiplying each side of the equation $2x - 3y = -14$ by 3 gives $6x - 9y = -42$. Multiplying each side of the equation $3x - 2y = -6$ by 2 gives $6x - 4y = -12$. Then, subtracting the sides of $6x - 4y = -12$ from the corresponding sides of $6x - 9y = -42$ gives $-5y = -30$. Dividing each side of the equation $-5y = -30$ by -5 gives $y = 6$. Finally, substituting 6 for y in $2x - 3y = -14$ gives $2x - 3(6) = -14$, or $x = 2$. Therefore, the value of $x - y$ is $2 - 6 = -4$.

Alternatively, adding the corresponding sides of $2x - 3y = -14$ and $3x - 2y = -6$ gives $5x - 5y = -20$, from which it follows that $x - y = -4$.

Choices A, B, and D are incorrect and may be the result of an arithmetic error when solving the system of equations.

QUESTION 7.

Choice C is correct. If $x - b$ is a factor of $f(x)$, then $f(b)$ must equal 0. Based on the table, $f(4) = 0$. Therefore, $x - 4$ must be a factor of $f(x)$.

Choice A is incorrect because $f(2) \neq 0$; choice B is incorrect because no information is given about the value of $f(3)$, so $x - 3$ may or may not be a factor of $f(x)$; and choice D is incorrect because $f(5) \neq 0$.

QUESTION 8.

Choice A is correct. The linear equation $y = kx + 4$ is in slope-intercept form, and so the slope of the line is k . Since the line contains the point (c, d) , the coordinates of this point satisfy the equation $y = kx + 4$: $d = kc + 4$. Solving this equation for the slope, k , gives $k = \frac{d - 4}{c}$.

Choices B, C, and D are incorrect and may be the result of errors in substituting the coordinates of (c, d) in $y = kx + 4$ or of errors in solving for k in the resulting equation.

QUESTION 9.

Choice A is correct. If a system of two linear equations has no solution, then the lines represented by the equations in the coordinate plane are parallel. The equation $kx - 3y = 4$ can be rewritten as $y = \frac{k}{3}x - \frac{4}{3}$, where $\frac{k}{3}$ is the slope of the line, and the equation $4x - 5y = 7$ can be rewritten as $y = \frac{4}{5}x - \frac{7}{5}$, where $\frac{4}{5}$ is the slope of the line. If two lines are parallel, then the slopes of the line are equal. Therefore, $\frac{4}{5} = \frac{k}{3}$, or $k = \frac{12}{5}$. (Since the y -intercepts of the lines represented by the equations are $-\frac{4}{3}$ and $-\frac{7}{5}$, the lines are parallel, not identical.)

Choices B, C, and D are incorrect and may be the result of a computational error when rewriting the equations or solving the equation representing the equality of the slopes for k .

QUESTION 10.

Choice A is correct. Substituting 25 for y in the equation $y = (x - 11)^2$ gives $25 = (x - 11)^2$. It follows that $x - 11 = 5$ or $x - 11 = -5$, so the x -coordinates of the two points of intersection are $x = 16$ and $x = 6$, respectively. Since both points of intersection have a y -coordinate of 25, it follows that the two points are $(16, 25)$ and $(6, 25)$. Since these points lie on the horizontal line $y = 25$, the distance between these points is the positive difference of the x -coordinates: $16 - 6 = 10$.

Choices B, C, and D are incorrect and may be the result of an error in solving the quadratic equation that results when substituting 25 for y in the given quadratic equation.

QUESTION 11.

Choice B is correct. Since the angles marked y° and u° are vertical angles, $y = u$. Subtracting the sides of $y = u$ from the corresponding sides of $x + y = u + w$ gives $x = w$. Since the angles marked w° and z° are vertical angles, $w = z$. Therefore, $x = z$, and so I must be true.

The equation in II need not be true. For example, if $x = w = z = t = 70$ and $y = u = 40$, then all three pairs of vertical angles in the figure have equal measure and the given condition $x + y = u + w$ holds. But it is not true in this case that y is equal to w . Therefore, II need not be true.

Since the top three angles in the figure form a straight angle, it follows that $x + y + z = 180$. Similarly, $w + u + t = 180$, and so $x + y + z = w + u + t$. Subtracting the sides of the given equation $x + y = u + w$ from the corresponding sides of $x + y + z = w + u + t$ gives $z = t$. Therefore, III must be true. Since only I and III must be true, the correct answer is choice B.

Choices A, C, and D are incorrect because each of these choices includes II, which need not be true.

QUESTION 12.

Choice A is correct. The parabola with equation $y = a(x - 2)(x + 4)$ crosses the x -axis at the points $(-4, 0)$ and $(2, 0)$. The x -coordinate of the vertex of the parabola is halfway between the x -coordinates of $(-4, 0)$ and $(2, 0)$. Thus, the x -coordinate of the vertex is $\frac{-4 + 2}{2} = -1$. This is the value of c . To find the y -coordinate of the vertex, substitute -1 for x in $y = a(x - 2)(x + 4)$:
 $y = a(x - 2)(x + 4) = a(-1 - 2)(-1 + 4) = a(-3)(3) = -9a$.

Therefore, the value of d is $-9a$.

Choice B is incorrect because the value of the constant term in the equation is not the y -coordinate of the vertex, unless there were no linear terms in the quadratic. Choice C is incorrect and may be the result of a sign error in finding the x -coordinate of the vertex. Choice D is incorrect because the negative of the coefficient of the linear term in the quadratic is not the y -coordinate of the vertex.

QUESTION 13.

Choice B is correct. Since $24x^2 + 25x - 47$ divided by $ax - 2$ is equal to $-8x - 3$ with remainder -53 , it is true that $(-8x - 3)(ax - 2) - 53 = 24x^2 + 25x - 47$. (This can be seen by multiplying each side of the given equation by $ax - 2$). This can be rewritten as $-8ax^2 + 16x - 3ax = 24x^2 + 25x - 47$. Since the coefficients of the x^2 -term have to be equal on both sides of the equation, $-8a = 24$, or $a = -3$.

Choices A, C, and D are incorrect and may be the result of either a conceptual misunderstanding or a computational error when trying to solve for the value of a .

QUESTION 14.

Choice A is correct. Dividing each side of the given equation by 3 gives the equivalent equation $x^2 + 4x + 2 = 0$. Then using the quadratic formula, $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$, with $a = 1$, $b = 4$, and $c = 2$, gives the solutions $x = -2 \pm \sqrt{2}$.

Choices B, C, and D are incorrect and may be the result of errors when applying the quadratic formula.

QUESTION 15.

Choice D is correct. If C is graphed against F , the slope of the graph is equal to $\frac{5}{9}$ degrees Celsius/degrees Fahrenheit, which means that for an increase of 1 degree Fahrenheit, the increase is $\frac{5}{9}$ of 1 degree Celsius. Thus, statement I is true. This is the equivalent to saying that an increase of 1 degree Celsius is equal to an increase of $\frac{9}{5}$ degrees Fahrenheit. Since $\frac{9}{5} = 1.8$, statement II is true. On the other hand, statement III is not true, since a temperature increase of $\frac{9}{5}$ degrees Fahrenheit, not $\frac{5}{9}$ degree Fahrenheit, is equal to a temperature increase of 1 degree Celsius.

Choices A, B, and C are incorrect because each of these choices omits a true statement or includes a false statement.

QUESTION 16.

The correct answer is either 1 or 2. The given equation can be rewritten as $x^5 - 5x^3 + 4x = 0$. Since the polynomial expression on the left has no constant term, it has x as a factor: $x(x^4 - 5x^2 + 4) = 0$. The expression in parentheses is a quadratic equation in x^2 that can be factored, giving $x(x^2 - 1)(x^2 - 4) = 0$. This further factors as $x(x - 1)(x + 1)(x - 2)(x + 2) = 0$. The solutions for x are $x = 0$, $x = 1$, $x = -1$, $x = 2$, and $x = -2$. Since it is given that $x > 0$, the possible values of x are $x = 1$ and $x = 2$. Either 1 or 2 may be gridded as the correct answer.

QUESTION 17.

The correct answer is 2. First, clear the fractions from the given equation by multiplying each side of the equation by 36 (the least common multiple of 4, 9, and 12). The equation becomes $28x - 16x = 9 + 15$. Combining like terms on each side of the equation yields $12x = 24$. Finally, dividing both sides of the equation by 12 yields $x = 2$.

Alternatively, since $\frac{7}{9}x - \frac{4}{9}x = \frac{3}{9}x = \frac{1}{3}x$ and $\frac{1}{4} + \frac{5}{12} = \frac{3}{12} + \frac{5}{12} = \frac{8}{12} = \frac{2}{3}$, the given equation simplifies to $\frac{1}{3}x = \frac{2}{3}$. Multiplying each side of $\frac{1}{3}x = \frac{2}{3}$ by 3 yields $x = 2$.

QUESTION 18.

The correct answer is 105. Since $180 - z = 2y$ and $y = 75$, it follows that $180 - z = 150$, and so $z = 30$. Thus, each of the base angles of the isosceles triangle on the right has measure $\frac{180^\circ - 30^\circ}{2} = 75^\circ$. Therefore, the measure of the angle marked x° is $180^\circ - 75^\circ = 105^\circ$, and so the value of x is 105.

QUESTION 19.

The correct answer is 370. A system of equations can be used where h represents the number of calories in a hamburger and f represents the number of calories in an order of fries. The equation $2h + 3f = 1700$ represents the fact that 2 hamburgers and 3 orders of fries contain a total of 1700 calories, and the equation $h = f + 50$ represents the fact that one hamburger contains 50 more calories than an order of fries. Substituting $f + 50$ for h in $2h + 3f = 1700$ gives $2(f + 50) + 3f = 1700$. This equation can be solved as follows:

$$2f + 100 + 3f = 1700$$

$$5f + 100 = 1700$$

$$5f = 1600$$

$$f = 320$$

The number of calories in an order of fries is 320, so the number of calories in a hamburger is 50 more than 320, or 370.

QUESTION 20.

The correct answer is $\frac{3}{5}$ or .6. Triangle ABC is a right triangle with its right angle at B . Thus, \overline{AC} is the hypotenuse of right triangle ABC , and \overline{AB} and \overline{BC} are the legs of right triangle ABC . By the Pythagorean theorem, $AB = \sqrt{20^2 - 16^2} = \sqrt{400 - 256} = \sqrt{144} = 12$. Since triangle DEF is similar to triangle ABC , with vertex F corresponding to vertex C , the measure of angle F equals the measure of angle C . Thus, $\sin F = \sin C$. From the side lengths of triangle ABC , $\sin C = \frac{\text{opposite side}}{\text{hypotenuse}} = \frac{AB}{AC} = \frac{12}{20} = \frac{3}{5}$. Therefore, $\sin F = \frac{3}{5}$. Either $\frac{3}{5}$ or its decimal equivalent, .6, may be gridded as the correct answer.

Section 4: Math Test – Calculator

QUESTION 1.

Choice C is correct. Marilyn's distance from her campsite remained the same during the time she ate lunch. This is represented by a horizontal segment in the graph. The only horizontal segment in the graph starts at a time of about 1:10 P.M. and ends at about 1:40 P.M. Therefore, Marilyn finished her lunch and continued her hike at about 1:40 P.M.

Choices A, B, and D are incorrect and may be the result of a misinterpretation of the graph. For example, choice B is the time Marilyn started her lunch, and choice D is the time Marilyn was at the maximum distance from her campsite.

QUESTION 2.

Choice B is correct. Of the 25 people who entered the contest, there are 8 females under age 40 and 2 males age 40 or older. Therefore, the probability that the contest winner will be either a female under age 40 or a male age 40 or older is $\frac{8}{25} + \frac{2}{25} = \frac{10}{25}$.

Choice A is incorrect and may be the result of dividing 8 by 2, instead of adding 8 to 2, to find the probability. Choice C is incorrect; it is the probability that the contest winner will be either a female under age 40 or a female age 40 or older. Choice D is incorrect and may be the result of multiplying 8 and 2, instead of adding 8 and 2, to find the probability.

QUESTION 3.

Choice C is correct. Based on the graph, sales increased in the first 3 years since 1997, which is until year 2000, and then generally decreased thereafter.

Choices A, B, and D are incorrect; each of these choices contains inaccuracies in describing the general trend of music album sales from 1997 to 2000.

QUESTION 4.

Choice C is correct. The graph of $y = f(n)$ in the coordinate plane is a line that passes through each of the points given in the table. From the table, one can see that an increase of 1 unit in n results in an increase of 3 units in $f(n)$; for example, $f(2) - f(1) = 1 - (-2) = 3$. Therefore, the graph of $y = f(n)$ in the coordinate plane is a line with slope 3. Only choice C is a line with slope 3. The y -intercept of the line is the value of $f(0)$. Since an increase of 1 unit in n results in an increase of 3 units in $f(n)$, it follows that $f(1) - f(0) = 3$. Since $f(1) = -2$, it follows that $f(0) = f(1) - 3 = -5$. Therefore, the y -intercept of the graph of $f(n)$ is -5 , and the slope-intercept equation for $f(n)$ is $f(n) = 3n - 5$.

Choices A, B, and D are incorrect because each equation has the incorrect slope of the line (the y -intercept in each equation is also incorrect).

QUESTION 5.

Choice B is correct. Since 7 percent of the 562 juniors is $0.07(562)$ and 5 percent of the 602 seniors is $0.05(602)$, the expression $0.07(562) + 0.05(602)$ can be evaluated to determine the total number of juniors and seniors inducted into the honor society. Of the given choices, 69 is closest to the value of the expression.

Choice A is incorrect and may be the result of adding the number of juniors and seniors and the percentages given and then using the expression $(0.07 + 0.05)(562 + 602)$. Choices C and D are incorrect and may be the result of finding either only the number of juniors inducted or only the number of seniors inducted.

QUESTION 6.

Choice A is correct. The sum of the two polynomials is $(3x^2 - 5x + 2) + (5x^2 - 2x - 6)$. This can be rewritten by combining like terms:

$$(3x^2 - 5x + 2) + (5x^2 - 2x - 6) = (3x^2 + 5x^2) + (-5x - 2x) + (2 - 6) = 8x^2 - 7x - 4.$$

Choice B is incorrect and may be the result of a sign error when combining the coefficients of the x -term. Choice C is incorrect and may be the result of adding the exponents, as well as the coefficients, of like terms. Choice D is incorrect and may be the result of a combination of the errors described in B and C.

QUESTION 7.

Choice D is correct. To solve the equation for w , multiply both sides of the equation by the reciprocal of $\frac{3}{5}$, which is $\frac{5}{3}$. This gives $\left(\frac{5}{3}\right) \cdot \frac{3}{5}w = \frac{4}{5} \cdot \left(\frac{5}{3}\right)$, which simplifies to $w = \frac{20}{9}$.

Choices A, B, and C are incorrect and may be the result of errors in arithmetic when simplifying the given equation.

QUESTION 8.

Choice C is correct. In the equation $y = 0.56x + 27.2$, the value of x increases by 1 for each year that passes. Each time x increases by 1, y increases by 0.56 since 0.56 is the slope of the graph of this equation. Since y represents the average number of students per classroom in the year represented by x , it follows that, according to the model, the estimated increase each year in the average number of students per classroom at Central High School is 0.56.

Choice A is incorrect because the total number of students in the school in 2000 is the product of the average number of students per classroom and the total number of classrooms, which would appropriately be approximated by the y -intercept (27.2) times the total number of classrooms, which is not given. Choice B is incorrect because the average number of students per classroom in 2000 is given by the y -intercept of the graph of the equation, but the question is asking for the meaning of the number 0.56, which is the slope. Choice D is incorrect because 0.56 represents the estimated yearly change in the average number of students per classroom. The estimated difference between the average number of students per classroom in 2010 and 2000 is 0.56 times the number of years that have passed between 2000 and 2010, that is, $0.56 \times 10 = 5.6$.

QUESTION 9.

Choice B is correct. Because Nate walks 25 meters in 13.7 seconds, and 4 minutes is equal to 240 seconds, the proportion $\frac{25 \text{ meters}}{13.7 \text{ sec}} = \frac{x \text{ meters}}{240 \text{ sec}}$ can be used to find out how many meters, x , Nate walks in 4 minutes. The proportion can be simplified to $\frac{25}{13.7} = \frac{x}{240}$, because the units of meters per second cancel, and then each side of the equation can be multiplied by 240, giving $\frac{(240)(25)}{13.7} = x \approx 438$. Therefore, of the given options, 450 meters is closest to the distance Nate will walk in 4 minutes.

Choice A is incorrect and may be the result of setting up the proportion as $\frac{13.7 \text{ sec}}{25 \text{ meters}} = \frac{x \text{ meters}}{240 \text{ sec}}$ and finding that $x \approx 132$, which is close to 150. Choices C and D are incorrect and may be the result of errors in calculation.

QUESTION 10.

Choice D is correct. On Mercury, the acceleration due to gravity is 3.6 m/sec^2 . Substituting 3.6 for g and 90 for m in the formula $W = mg$ gives $W = 90(3.6) = 324$ newtons.

Choice A is incorrect and may be the result of dividing 90 by 3.6. Choice B is incorrect and may be the result of subtracting 3.6 from 90 and rounding to the nearest whole number. Choice C is incorrect because an object with a weight of 101 newtons on Mercury would have a mass of about 28 kilograms, not 90 kilograms.

QUESTION 11.

Choice B is correct. On Earth, the acceleration due to gravity is 9.8 m/sec^2 . Thus, for an object with a weight of 150 newtons, the formula $W = mg$ becomes $150 = m(9.8)$, which shows that the mass of an object with a weight of 150 newtons on Earth is about 15.3 kilograms. Substituting this mass into the formula $W = mg$ and now using the weight of 170 newtons gives $170 = 15.3g$, which shows that the second planet's acceleration due to gravity is about 11.1 m/sec^2 . According to the table, this value for the acceleration due to gravity holds on Saturn.

Choices A, C, and D are incorrect. Using the formula $W = mg$ and the values for g in the table shows that an object with a weight of 170 newtons on these planets would not have the same mass as an object with a weight of 150 newtons on Earth.

QUESTION 12.

Choice D is correct. A zero of a function corresponds to an x -intercept of the graph of the function in the xy -plane. Therefore, the complete graph of the function f , which has five distinct zeros, must have five x -intercepts. Only the graph in choice D has five x -intercepts, and therefore, this is the only one of the given graphs that could be the complete graph of f in the xy -plane.

Choices A, B, and C are incorrect. The number of x -intercepts of each of these graphs is not equal to five; therefore, none of these graphs could be the complete graph of f , which has five distinct zeros.

QUESTION 13.

Choice D is correct. Starting with the original equation, $h = -16t^2 + vt + k$, in order to get v in terms of the other variables, $-16t^2$ and k need to be subtracted from each side. This yields $vt = h + 16t^2 - k$, which when divided by t will give v in terms of the other variables. However, the equation $v = \frac{h + 16t^2 - k}{t}$ is not one of the options, so the right side needs to be further simplified. Another way to write the previous equation is $v = \frac{h - k}{t} + \frac{16t^2}{t}$, which can be simplified to $v = \frac{h - k}{t} + 16t$.

Choices A, B, and C are incorrect and may be the result of arithmetic errors when rewriting the original equation to express v in terms of h , t , and k .

QUESTION 14.

Choice A is correct. The hotel charges \$0.20 per minute to use the meeting-room phone. This per-minute rate can be converted to the hourly rate using the conversion 1 hour = 60 minutes, as shown below.

$$\frac{\$0.20}{\text{minute}} \times \frac{60 \text{ minutes}}{1 \text{ hour}} = \frac{\$(0.20 \times 60)}{\text{hour}}$$

Thus, the hotel charges $\$(0.20 \times 60)$ per hour to use the meeting-room phone. Therefore, the cost c , in dollars, for h hours of use is $c = (0.20 \times 60)h$, which is equivalent to $c = 0.20(60h)$.

Choice B is incorrect because in this expression the per-minute rate is multiplied by h , the number of hours of phone use. Furthermore, the equation indicates that there is a flat fee of \$60 in addition to the per-minute or per-hour rate. This is not the case. Choice C is incorrect because the expression indicates that the hotel charges $\left(\frac{60}{0.20}\right)$ per hour for use of the meeting-room phone, not $\$0.20(60)$ per hour. Choice D is incorrect because the expression indicates that the hourly rate is $\frac{1}{60}$ times the per-minute rate, not 60 times the per-minute rate.

QUESTION 15.

Choice A is the correct answer. Experimental research is a method used to study a small group of people and generalize the results to a larger population. However, in order to make a generalization involving cause and effect:

- ▶ The population must be well defined.
- ▶ The participants must be selected at random.
- ▶ The participants must be randomly assigned to treatment groups.

When these conditions are met, the results of the study can be generalized to the population with a conclusion about cause and effect. In this study, all conditions are met and the population from which the participants were selected are people with poor eyesight. Therefore, a general conclusion can be drawn about the effect of Treatment X on the population of people with poor eyesight.

Choice B is incorrect. The study did not include all available treatments, so no conclusion can be made about the relative effectiveness of all available treatments. Choice C is incorrect. The participants were selected at random from a large population of people with poor eyesight. Therefore, the results can be generalized only to that population and not to anyone in general. Also, the conclusion is too strong: an experimental study might show that people are likely to be helped by a treatment, but it cannot show that anyone who takes the treatment will be helped. Choice D is incorrect.

This conclusion is too strong. The study shows that Treatment X is likely to improve the eyesight of people with poor eyesight, but it cannot show that the treatment definitely will cause improvement in eyesight for every person. Furthermore, since the people undergoing the treatment in the study were selected from people with poor eyesight, the results can be generalized only to this population, not to all people.

QUESTION 16.

Choice B is correct. For any value of x , say $x = x_0$, the point $(x_0, f(x_0))$ lies on the graph of f and the point $(x_0, g(x_0))$ lies on the graph of g . Thus, for any value of x , say $x = x_0$, the value of $f(x_0) + g(x_0)$ is equal to the sum of the y -coordinates of the points on the graphs of f and g with x -coordinate equal to x_0 . Therefore, the value of x for which $f(x) + g(x)$ is equal to 0 will occur when the y -coordinates of the points representing $f(x)$ and $g(x)$ at the same value of x are equidistant from the x -axis and are on opposite sides of the x -axis. Looking at the graphs, one can see that this occurs at $x = -2$: the point $(-2, -2)$ lies on the graph of f , and the point $(-2, 2)$ lies on the graph of g . Thus, at $x = -2$, the value of $f(x) + g(x)$ is $-2 + 2 = 0$.

Choices A, C, and D are incorrect because none of these x -values satisfy the given equation, $f(x) + g(x) = 0$.

QUESTION 17.

Choice B is correct. The quantity of the product supplied to the market is given by the function $S(P) = \frac{1}{2}P + 40$. If the price P of the product increases by \$10, the effect on the quantity of the product supplied can be determined by substituting $P + 10$ for P as the argument in the function. This gives $S(P + 10) = \frac{1}{2}(P + 10) + 40 = \frac{1}{2}P + 45$, which shows that $S(P + 10) = S(P) + 5$. Therefore, the quantity supplied to the market will increase by 5 units when the price of the product is increased by \$10.

Alternatively, look at the coefficient of P in the linear function S . This is the slope of the graph of the function, where P is on the horizontal axis and $S(P)$ is on the vertical axis. Since the slope is $\frac{1}{2}$, for every increase of 1 in P , there will be an increase of $\frac{1}{2}$ in $S(P)$, and therefore, an increase of 10 in P will yield an increase of 5 in $S(P)$.

Choice A is incorrect. If the quantity supplied decreases as the price of the product increases, the function $S(P)$ would be decreasing, but $S(P) = \frac{1}{2}P + 40$ is an increasing function. Choice C is incorrect and may be the result of assuming the slope of the graph of $S(P)$ is equal to 1. Choice D is incorrect and may be the result of confusing the y -intercept of the graph of $S(P)$ with the slope, and then adding 10 to the y -intercept.

QUESTION 18.

Choice B is correct. The quantity of the product supplied to the market will equal the quantity of the product demanded by the market if $S(P)$ is equal to $D(P)$, that is, if $\frac{1}{2}P + 40 = 220 - P$. Solving this equation gives $P = 120$, and so \$120 is the price at which the quantity of the product supplied will equal the quantity of the product demanded.

Choices A, C, and D are incorrect. At these dollar amounts, the quantities given by $S(P)$ and $D(P)$ are not equal.

QUESTION 19.

Choice C is correct. It is given that 1 ounce of graphene covers 7 football fields. Therefore, 48 ounces can cover $7 \times 48 = 336$ football fields. If each football field has an area of $1\frac{1}{3}$ acres, then 336 football fields have a total area of $336 \times 1\frac{1}{3} = 448$ acres. Therefore, of the choices given, 450 acres is closest to the number of acres 48 ounces of graphene could cover.

Choice A is incorrect and may be the result of dividing, instead of multiplying, the number of football fields by $1\frac{1}{3}$. Choice B is incorrect and may be the result of finding the number of football fields, not the number of acres, that can be covered by 48 ounces of graphene. Choice D is incorrect and may be the result of setting up the expression $\frac{7 \times 48 \times 4}{3}$ and then finding only the numerator of the fraction.

QUESTION 20.

Choice B is correct. To answer this question, find the point in the graph that represents Michael's 34-minute swim and then compare the actual heart rate for that swim with the expected heart rate as defined by the line of best fit. To find the point that represents Michael's swim that took 34 minutes, look along the vertical line of the graph that is marked "34" on the horizontal axis. That vertical line intersects only one point in the scatterplot, at 148 beats per minute. On the other hand, the line of best fit intersects the vertical line representing 34 minutes at 150 beats per minute. Therefore, for the swim that took 34 minutes, Michael's actual heart rate was $150 - 148 = 2$ beats per minute less than predicted by the line of best fit.

Choices A, C, and D are incorrect and may be the result of misreading the scale of the graph.

QUESTION 21.

Choice C is correct. Let I be the initial savings. If each successive year, 1% of the current value is added to the value of the account, then after 1 year, the amount in the account will be $I + 0.01I = I(1 + 0.01)$; after 2 years, the amount in the account will be $I(1 + 0.01) + 0.01I(1 + 0.01) = (1 + 0.01)I(1 + 0.01) = I(1 + 0.01)^2$; and after t years, the amount in the account will be $I(1 + 0.01)^t$. This is exponential growth of the money in the account.

Choice A is incorrect. If each successive year, 2% of the initial savings, I , is added to the value of the account, then after t years, the amount in the account will be $I + 0.02It$, which is linear growth. Choice B is incorrect. If each successive year, 1.5% of the initial savings, I , and \$100 is added to the value of the the account, then after t years the amount in the account will be $I + (0.015I + 100)t$, which is linear growth. Choice D is incorrect. If each successive year, \$100 is added to the value of the account, then after t years the amount in the account will be $I + 100t$, which is linear growth.

QUESTION 22.

Choice B is correct. One of the three numbers is x ; let the other two numbers be y and z . Since the sum of three numbers is 855, the equation $x + y + z = 855$ is true. The statement that x is 50% more than the sum of the other two numbers can be represented as $x = 1.5(y + z)$, or $\frac{x}{1.5} = y + z$. Substituting $\frac{x}{1.5}$ for $y + z$ in $x + y + z = 855$ gives $x + \frac{x}{1.5} = 855$. This last equation can be rewritten as $x + \frac{2x}{3} = 855$, or $\frac{5x}{3} = 855$. Therefore, x equals $\frac{3}{5} \times 855 = 513$.

Choices A, C, and D are incorrect and may be the result of calculation errors.

QUESTION 23.

Choice C is correct. Since the angles are acute and $\sin(a^\circ) = \cos(b^\circ)$, it follows from the complementary angle property of sines and cosines that $a + b = 90$. Substituting $4k - 22$ for a and $6k - 13$ for b gives $(4k - 22) + (6k - 13) = 90$, which simplifies to $10k - 35 = 90$. Therefore, $10k = 125$, and $k = 12.5$.

Choice A is incorrect and may be the result of mistakenly assuming that $a + b$ and making a sign error. Choices B and D are incorrect because they result in values for a and b such that $\sin(a^\circ) \neq \cos(b^\circ)$.

QUESTION 24.

Choice D is correct. Let c be the number of students in Mr. Kohl's class. The conditions described in the question can be represented by the equations $n = 3c + 5$ and $n + 21 = 4c$. Substituting $3c + 5$ for n in the second equation gives $3c + 5 + 21 = 4c$, which can be solved to find $c = 26$.

Choices A, B, and C are incorrect because the values given for the number of students in the class cannot fulfill both conditions given in the question. For example, if there were 16 students in the class, then the first condition would imply that there are $3(16) + 5 = 53$ milliliters of solution in the beaker, but the second condition would imply that there are $4(16) - 21 = 43$ milliliters of solution in the beaker. This contradiction shows that there cannot be 16 students in the class.

QUESTION 25.

Choice D is correct. The volume of the grain silo can be found by adding the volumes of all the solids of which it is composed. The silo is made up of a cylinder with height 10 feet (ft) and base radius 5 feet and two cones, each having height 5 ft and base radius 5 ft. The formulas $V_{\text{cylinder}} = \pi r^2 h$ and $V_{\text{cone}} = \frac{1}{3} \pi r^2 h$ can be used to determine the total volume of the silo. Since the two cones have identical dimensions, the total volume, in cubic feet, of the silo is given by $V_{\text{silo}} = \pi(5)^2(10) + (2)\left(\frac{1}{3}\right)\pi(5)^2(5) = \left(\frac{4}{3}\right)(250)\pi$, which is approximately equal to 1,047.2 cubic feet.

Choice A is incorrect because this is the volume of only the two cones. Choice B is incorrect because this is the volume of only the cylinder. Choice C is incorrect because this is the volume of only one of the cones plus the cylinder.

QUESTION 26.

Choice C is correct. The line passes through the origin, $(2, k)$, and $(k, 32)$. Any two of these points can be used to find the slope of the line. Since the line passes through $(0, 0)$ and $(2, k)$, the slope of the line is equal to $\frac{k-0}{2-0} = \frac{k}{2}$. Similarly, since the line passes through $(0, 0)$ and $(k, 32)$, the slope of the line is equal to $\frac{32-0}{k-0} = \frac{32}{k}$. Since each expression gives the slope of the same line, it must be true that $\frac{k}{2} = \frac{32}{k}$. Multiplying each side of $\frac{k}{2} = \frac{32}{k}$ by $2k$ gives $k^2 = 64$, from which it follows that $k = 8$ or $k = -8$. Therefore, of the given choices, only 8 could be the value of k .

Choices A, B, and D are incorrect and may be the result of calculation errors.

QUESTION 27.

Choice C is correct. Let ℓ and w be the length and width, respectively, of the original rectangle. The area of the original rectangle is $A = \ell w$. The rectangle is altered by increasing its length by 10 percent and decreasing its width by p percent; thus, the length of the altered rectangle is 1.1ℓ , and the width of the altered rectangle is $\left(1 - \frac{p}{100}\right)w$. The alterations decrease the area by 12 percent, so the area of the altered rectangle is $(1 - 0.12)A = 0.88A$.

The altered rectangle is the product of its length and width, so $0.88A = (1.1\ell)\left(1 - \frac{P}{100}\right)w$. Since $A = \ell w$, this last equation can be rewritten as $0.88A = (1.1)\left(1 - \frac{P}{100}\right)\ell w = (1.1)\left(1 - \frac{P}{100}\right)A$, from which it follows that $0.88 = (1.1)\left(1 - \frac{P}{100}\right)$, or $0.8 = \left(1 - \frac{P}{100}\right)$. Therefore, $\frac{P}{100} = 0.2$, and so the value of p is 20.

Choice A is incorrect and may be the result of confusing the 12 percent decrease in area with the percent decrease in width. Choice B is incorrect because decreasing the width by 15 percent results in a 6.5 percent decrease in area, not a 12 percent decrease. Choice D is incorrect and may be the result of adding the percents given in the question ($10 + 12$).

QUESTION 28.

Choice D is correct. For the present population to decrease by 10 percent, it must be multiplied by the factor 0.9. Since the engineer estimates that the population will decrease by 10 percent every 20 years, the present population, 50,000, must be multiplied by $(0.9)^n$, where n is the number of 20-year periods that will have elapsed t years from now. After t years, the number of 20-year periods that have elapsed is $\frac{t}{20}$. Therefore, $50,000(0.9)^{\frac{t}{20}}$ represents the engineer's estimate of the population of the city t years from now.

Choices A, B, and C are incorrect because each of these choices either confuses the percent decrease with the multiplicative factor that represents the percent decrease or mistakenly multiplies t by 20 to find the number of 20-year periods that will have elapsed in t years.

QUESTION 29.

Choice A is correct. Let x be the number of left-handed female students and let y be the number of left-handed male students. Then the number of right-handed female students will be $5x$ and the number of right-handed male students will be $9y$. Since the total number of left-handed students is 18 and the total number of right-handed students is 122, the system of equations below must be satisfied.

$$\begin{cases} x + y = 18 \\ 5x + 9y = 122 \end{cases}$$

Solving this system gives $x = 10$ and $y = 8$. Thus, 50 of the 122 right-handed students are female. Therefore, the probability that a right-handed student selected at random is female is $\frac{50}{122}$, which to the nearest thousandth is 0.410.

Choices B, C, and D are incorrect and may be the result of incorrect calculation of the missing values in the table.

QUESTION 30.

Choice A is correct. Subtracting the sides of $3y + c = 5y - 7$ from the corresponding sides of $3x + b = 5x - 7$ gives $(3x - 3y) + (b - c) = (5x - 5y)$. Since $b = c - \frac{1}{2}$, or $b - c = -\frac{1}{2}$, it follows that $(3x - 3y) + \left(-\frac{1}{2}\right) = (5x - 5y)$. Solving this equation for x in terms of y gives $x = y - \frac{1}{4}$. Therefore, x is y minus $\frac{1}{4}$.

Choices B, C, and D are incorrect and may be the result of making a computational error when solving the equations for x in terms of y .

QUESTION 31.

The correct answer is either 4 or 5. Because each student ticket costs \$2 and each adult ticket costs \$3, the total amount, in dollars, that Chris spends on x student tickets and 1 adult ticket is $2(x) + 3(1)$. Because Chris spends at least \$11 but no more than \$14 on the tickets, one can write the compound inequality $2x + 3 \geq 11$ and $2x + 3 \leq 14$. Subtracting 3 from each side of both inequalities and then dividing each side of both inequalities by 2 yields $x \geq 4$ and $x \leq 5.5$. Thus, the value of x must be an integer that is both greater than or equal to 4 and less than or equal to 5.5. Therefore, $x = 4$ or $x = 5$. Either 4 or 5 may be gridded as the correct answer.

QUESTION 32.

The correct answer is 58.6. The mean of a data set is determined by calculating the sum of the values and dividing by the number of values in the data set. The sum of the ages, in years, in the data set is 703, and the number of values in the data set is 12. Thus, the mean of the ages, in years, of the first 12 United States presidents at the beginning of their terms is $\frac{703}{12}$. The fraction $\frac{703}{12}$ cannot be entered into the grid, so the decimal equivalent, rounded to the nearest tenth, is the correct answer. This rounded decimal equivalent is 58.6.

QUESTION 33.

The correct answer is 9. To rewrite the difference $(-3x^2 + 5x - 2) - 2(x^2 - 2x - 1)$ in the form $ax^2 + bx + c$, the expression can be simplified by using the distributive property and combining like terms as follows:

$$\begin{aligned} &(-3x^2 + 5x - 2) - (2x^2 - 4x - 2) \\ &(-3x^2 - 2x^2) + (5x - (-4x)) + (-2 - (-2)) \\ &-5x^2 + 9x + 0 \end{aligned}$$

The coefficient of x is the value of b , which is 9.

Alternatively, since b is the coefficient of x in the difference $(-3x^2 + 5x - 2) - 2(x^2 - 2x - 1)$, one need only compute the x -term in the difference. The x -term is $5x - 2(-2x) = 5x + 4x = 9x$, so the value of b is 9.

QUESTION 34.

The correct answer is $\frac{5}{8}$ or .625. A complete rotation around a point is 360° or 2π radians. Since the central angle AOB has measure $\frac{5\pi}{4}$ radians, it represents $\frac{\frac{5\pi}{4}}{2\pi} = \frac{5}{8}$ of a complete rotation around point O . Therefore, the sector formed by central angle AOB has area equal to $\frac{5}{8}$ the area of the entire circle. Either the fraction $\frac{5}{8}$ or its decimal equivalent, .625, may be gridded as the correct answer.

QUESTION 35.

The correct answer is 50. The mean of a data set is the sum of the values in the data set divided by the number of values in the data set. The mean of 75 is obtained by finding the sum of the first 10 ratings and dividing by 10. Thus, the sum of the first 10 ratings was 750. In order for the mean of the first 20 ratings to be at least 85, the sum of the first 20 ratings must be at least $(85)(20) = 1700$. Therefore, the sum of the next 10 ratings must be at least $1700 - 750 = 950$. The maximum rating is 100, so the maximum possible value of the sum of the 12th through 20th ratings is $9 \times 100 = 900$. Therefore, for the store to be able to have an average of at least 85 for the first 20 ratings, the least possible value for the 11th rating is $950 - 900 = 50$.

QUESTION 36.

The correct answer is 750. The inequalities $y \leq -15x + 3000$ and $y \leq 5x$ can be graphed in the xy -plane. They are represented by the half-planes below and include the boundary lines $y = -15x + 3000$ and $y = 5x$, respectively. The solution set of the system of inequalities will be the intersection of these half-planes, including the boundary lines, and the solution (a, b) with the greatest possible value of b will be the point of intersection of the boundary lines. The intersection of boundary lines of these inequalities can be found by setting them equal to each other: $5x = -15x + 3000$, which has solution $x = 150$. Thus, the x -coordinate of the point of intersection is 150. Therefore, the y -coordinate of the point of intersection of the boundary lines is $5(150) = -15(150) + 3000 = 750$. This is the maximum possible value of b for a point (a, b) that is in the solution set of the system of inequalities.

QUESTION 37.

The correct answer is 7. The average number of shoppers, N , in the checkout line at any time is $N = rt$, where r is the number of shoppers entering the checkout line per minute and T is the average number of minutes each shopper spends in the checkout line. Since 84 shoppers per hour make a purchase, 84 shoppers per hour enter the checkout line. This needs to be converted to the number of shoppers per minute. Since there are 60 minutes in one hour, the rate is $\frac{84 \text{ shoppers}}{60 \text{ minutes}} = 1.4$ shoppers per minute. Using the given formula with $r = 1.4$ and $t = 5$ yields $N = rt = (1.4)(5) = 7$. Therefore, the average number of shoppers, N , in the checkout line at any time during business hours is 7.

QUESTION 38.

The correct answer is 60. The estimated average number of shoppers in the original store at any time is 45. In the new store, the manager estimates that an average of 90 shoppers per hour enter the store, which is equivalent to 1.5 shoppers per minute. The manager also estimates that each shopper stays in the store for an average of 12 minutes. Thus, by Little's law, there are, on average, $N = rt = (1.5)(12) = 18$ shoppers in the new store at any time. This is $\frac{45 - 18}{45} \times 100 = 60$ percent less than the average number of shoppers in the original store at any time.



SAT[®] Practice Test #4

IMPORTANT REMINDERS

1

**A No. 2 pencil is required for the test.
Do not use a mechanical pencil or pen.**

2

**Sharing any questions with anyone
is a violation of Test Security
and Fairness policies and may result
in your scores being canceled.**

This cover is representative of what you'll see on test day.

**THIS TEST BOOK MUST NOT BE TAKEN FROM THE ROOM. UNAUTHORIZED
REPRODUCTION OR USE OF ANY PART OF THIS TEST BOOK IS PROHIBITED.**



Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

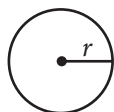
DIRECTIONS

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

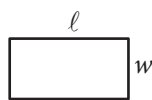
- The use of a calculator **is not permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated,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

REFERENCE

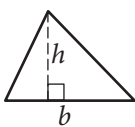


$$A = \pi r^2$$

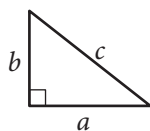
$$C = 2\pi r$$



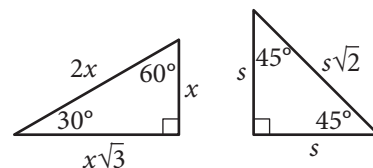
$$A = \ell w$$



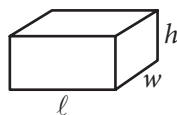
$$A = \frac{1}{2}bh$$



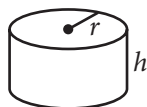
$$c^2 = a^2 + b^2$$



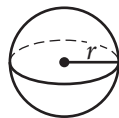
Special Right Triangles



$$V = \ell wh$$



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



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



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



$$V = \frac{1}{3}\ell wh$$

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.



1

Which of the following expressions is equal to 0 for some value of x ?

- A) $|x - 1| - 1$
- B) $|x + 1| + 1$
- C) $|1 - x| + 1$
- D) $|x - 1| + 1$

2

$$f(x) = \frac{3}{2}x + b$$

In the function above, b is a constant. If $f(6) = 7$, what is the value of $f(-2)$?

- A) -5
- B) -2
- C) 1
- D) 7

3

$$\frac{x}{y} = 6$$
$$4(y + 1) = x$$

If (x, y) is the solution to the system of equations above, what is the value of y ?

- A) 2
- B) 4
- C) 12
- D) 24

4

If $f(x) = -2x + 5$, what is $f(-3x)$ equal to?

- A) $-6x - 5$
- B) $6x + 5$
- C) $6x - 5$
- D) $6x^2 - 15x$



5

$$3(2x + 1)(4x + 1)$$

Which of the following is equivalent to the expression above?

- A) $45x$
- B) $24x^2 + 3$
- C) $24x^2 + 18x + 3$
- D) $18x^2 + 6$

6

If $\frac{a-b}{b} = \frac{3}{7}$, which of the following must also be true?

- A) $\frac{a}{b} = -\frac{4}{7}$
- B) $\frac{a}{b} = \frac{10}{7}$
- C) $\frac{a+b}{b} = \frac{10}{7}$
- D) $\frac{a-2b}{b} = -\frac{11}{7}$

7

While preparing to run a marathon, Amelia created a training schedule in which the distance of her longest run every week increased by a constant amount. If Amelia's training schedule requires that her longest run in week 4 is a distance of 8 miles and her longest run in week 16 is a distance of 26 miles, which of the following best describes how the distance Amelia runs changes between week 4 and week 16 of her training schedule?

- A) Amelia increases the distance of her longest run by 0.5 miles each week.
- B) Amelia increases the distance of her longest run by 2 miles each week.
- C) Amelia increases the distance of her longest run by 2 miles every 3 weeks.
- D) Amelia increases the distance of her longest run by 1.5 miles each week.



8

Which of the following equations represents a line that is parallel to the line with equation $y = -3x + 4$?

- A) $6x + 2y = 15$
- B) $3x - y = 7$
- C) $2x - 3y = 6$
- D) $x + 3y = 1$

9

$$\sqrt{x-a} = x - 4$$

If $a = 2$, what is the solution set of the equation above?

- A) $\{3, 6\}$
- B) $\{2\}$
- C) $\{3\}$
- D) $\{6\}$

10

If $\frac{t+5}{t-5} = 10$, what is the value of t ?

- A) $\frac{45}{11}$
- B) 5
- C) $\frac{11}{2}$
- D) $\frac{55}{9}$

11

$$x = 2y + 5$$

$$y = (2x - 3)(x + 9)$$

How many ordered pairs (x, y) satisfy the system of equations shown above?

- A) 0
- B) 1
- C) 2
- D) Infinitely many

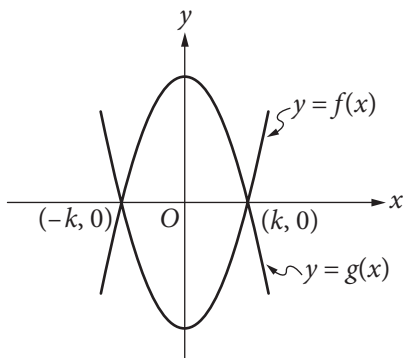


12

Ken and Paul each ordered a sandwich at a restaurant. The price of Ken's sandwich was x dollars, and the price of Paul's sandwich was \$1 more than the price of Ken's sandwich. If Ken and Paul split the cost of the sandwiches evenly and each paid a 20% tip, which of the following expressions represents the amount, in dollars, each of them paid? (Assume there is no sales tax.)

- A) $0.2x + 0.2$
- B) $0.5x + 0.1$
- C) $1.2x + 0.6$
- D) $2.4x + 1.2$

13



The functions f and g , defined by $f(x) = 8x^2 - 2$ and $g(x) = -8x^2 + 2$, are graphed in the xy -plane above. The graphs of f and g intersect at the points $(k, 0)$ and $(-k, 0)$. What is the value of k ?

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

14

$$\frac{8 - i}{3 - 2i}$$

If the expression above is rewritten in the form $a + bi$, where a and b are real numbers, what is the value of a ? (Note: $i = \sqrt{-1}$)

- A) 2
- B) $\frac{8}{3}$
- C) 3
- D) $\frac{11}{3}$

15

$$x^2 - \frac{k}{2}x = 2p$$

In the quadratic equation above, k and p are constants. What are the solutions for x ?

- A) $x = \frac{k}{4} \pm \frac{\sqrt{k^2 + 2p}}{4}$
- B) $x = \frac{k}{4} \pm \frac{\sqrt{k^2 + 32p}}{4}$
- C) $x = \frac{k}{2} \pm \frac{\sqrt{k^2 + 2p}}{2}$
- D) $x = \frac{k}{2} \pm \frac{\sqrt{k^2 + 32p}}{4}$

**DIRECTIONS**

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

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

3	1	/	2
•	•	•	•

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

Write answer in boxes. →

Grid in result. →

← Fraction line

← Decimal point

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

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

Answer: 2.5

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

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

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

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

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

Answer: 201 – either position is correct

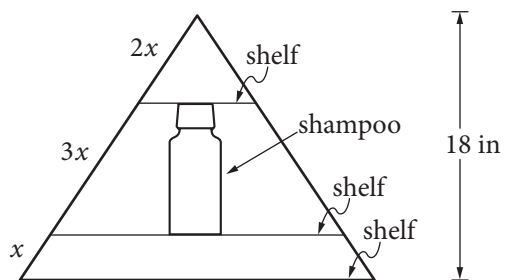
	2	0	1
•	•	•	•
0	0	•	0
1	1	1	•
2	•	2	2
3	3	3	3

	2	0	1
•	•	•	•
0	•	0	0
1	1	•	1
2	•	2	2
3	3	3	3

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.

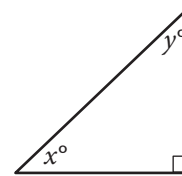


16



Jim has a triangular shelf system that attaches to his showerhead. The total height of the system is 18 inches, and there are three parallel shelves as shown above. What is the maximum height, in inches, of a shampoo bottle that can stand upright on the middle shelf?

17



In the triangle above, the sine of x° is 0.6. What is the cosine of y° ?

18

$$x^3 - 5x^2 + 2x - 10 = 0$$

For what real value of x is the equation above true?



19

$$-3x + 4y = 20$$

$$6x + 3y = 15$$

If (x, y) is the solution to the system of equations above, what is the value of x ?

20

The mesosphere is the layer of Earth's atmosphere between 50 kilometers and 85 kilometers above Earth's surface. At a distance of 50 kilometers from Earth's surface, the temperature in the mesosphere is -5° Celsius, and at a distance of 80 kilometers from Earth's surface, the temperature in the mesosphere is -80° Celsius. For every additional 10 kilometers from Earth's surface, the temperature in the mesosphere decreases by k° Celsius, where k is a constant. What is the value of k ?

STOP

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



Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

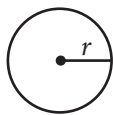
DIRECTIONS

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

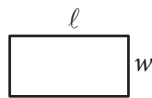
- The use of a calculator **is permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated, the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

REFERENCE

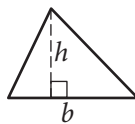


$$A = \pi r^2$$

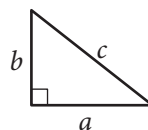
$$C = 2\pi r$$



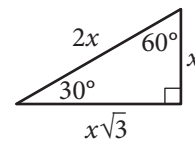
$$A = \ell w$$



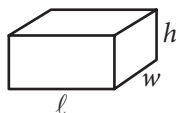
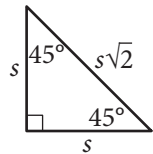
$$A = \frac{1}{2}bh$$



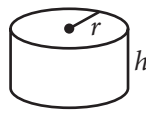
$$c^2 = a^2 + b^2$$



Special Right Triangles



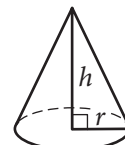
$$V = \ell wh$$



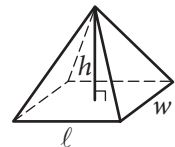
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}\ell wh$$

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.



1

The monthly membership fee for an online television and movie service is \$9.80. The cost of viewing television shows online is included in the membership fee, but there is an additional fee of \$1.50 to rent each movie online. For one month, Jill's membership and movie rental fees were \$12.80. How many movies did Jill rent online that month?

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

2

One of the requirements for becoming a court reporter is the ability to type 225 words per minute. Donald can currently type 180 words per minute, and believes that with practice he can increase his typing speed by 5 words per minute each month. Which of the following represents the number of words per minute that Donald believes he will be able to type m months from now?

- A) $5 + 180m$
- B) $225 + 5m$
- C) $180 + 5m$
- D) $180 - 5m$

3

If a 3-pound pizza is sliced in half and each half is sliced into thirds, what is the weight, in ounces, of each of the slices? (1 pound = 16 ounces)

- A) 4
- B) 6
- C) 8
- D) 16

4

Nick surveyed a random sample of the freshman class of his high school to determine whether the Fall Festival should be held in October or November. Of the 90 students surveyed, 25.6% preferred October. Based on this information, about how many students in the entire 225-person class would be expected to prefer having the Fall Festival in October?

- A) 50
- B) 60
- C) 75
- D) 80



5

The density of an object is equal to the mass of the object divided by the volume of the object. What is the volume, in milliliters, of an object with a mass of 24 grams and a density of 3 grams per milliliter?

- A) 0.125
- B) 8
- C) 21
- D) 72

6

Last week Raul worked 11 more hours than Angelica. If they worked a combined total of 59 hours, how many hours did Angelica work last week?

- A) 24
- B) 35
- C) 40
- D) 48

7

Movies with Greatest Ticket Sales in 2012

MPAA rating	Type of movie				Total
	Action	Animated	Comedy	Drama	
PG	2	7	0	2	11
PG-13	10	0	4	8	22
R	6	0	5	6	17
Total	18	7	9	16	50

The table above represents the 50 movies that had the greatest ticket sales in 2012, categorized by movie type and Motion Picture Association of America (MPAA) rating. What proportion of the movies are comedies with a PG-13 rating?

- A) $\frac{2}{25}$
- B) $\frac{9}{50}$
- C) $\frac{2}{11}$
- D) $\frac{11}{25}$

8

Line ℓ in the xy -plane contains points from each of Quadrants II, III, and IV, but no points from Quadrant I. Which of the following must be true?

- A) The slope of line ℓ is undefined.
- B) The slope of line ℓ is zero.
- C) The slope of line ℓ is positive.
- D) The slope of line ℓ is negative.



Number of Registered Voters
in the United States in 2012, in Thousands

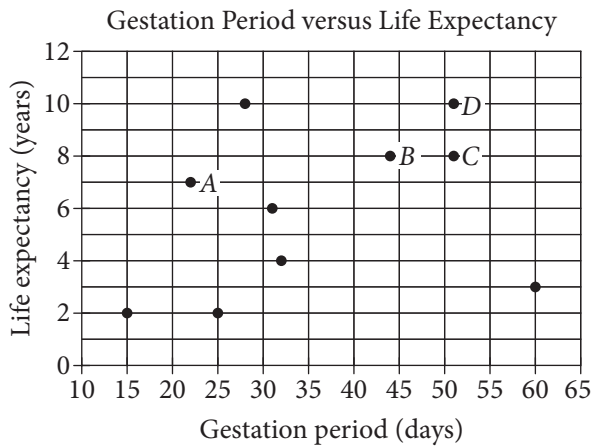
Region	Age, in years					Total
	18 to 24	25 to 44	45 to 64	65 to 74	75 and older	
Northeast	2,713	8,159	10,986	3,342	2,775	27,975
Midwest	3,453	11,237	13,865	4,221	3,350	36,126
South	5,210	18,072	21,346	7,272	4,969	56,869
West	3,390	10,428	11,598	3,785	2,986	32,187
Total	14,766	47,896	57,795	18,620	14,080	153,157

The table above shows the number of registered voters in 2012, in thousands, in four geographic regions and five age groups. Based on the table, if a registered voter who was 18 to 44 years old in 2012 is chosen at random, which of the following is closest to the probability that the registered voter was from the Midwest region?

- A) 0.10
- B) 0.25
- C) 0.40
- D) 0.75



Questions 10 and 11 refer to the following information.



A curator at a wildlife society created the scatterplot above to examine the relationship between the gestation period and life expectancy of 10 species of animals.

10

What is the life expectancy, in years, of the animal that has the longest gestation period?

- A) 3
- B) 4
- C) 8
- D) 10

11

Of the labeled points, which represents the animal for which the ratio of life expectancy to gestation period is greatest?

- A) A
- B) B
- C) C
- D) D

12

In the xy -plane, the graph of function f has x -intercepts at -3 , -1 , and 1 . Which of the following could define f ?

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



13

The population of mosquitoes in a swamp is estimated over the course of twenty weeks, as shown in the table.

Time (weeks)	Population
0	100
5	1,000
10	10,000
15	100,000
20	1,000,000

Which of the following best describes the relationship between time and the estimated population of mosquitoes during the twenty weeks?

- A) Increasing linear
- B) Decreasing linear
- C) Exponential growth
- D) Exponential decay

14

$$1,000\left(1 + \frac{r}{1,200}\right)^{12}$$

The expression above gives the amount of money, in dollars, generated in a year by a \$1,000 deposit in a bank account that pays an annual interest rate of $r\%$, compounded monthly. Which of the following expressions shows how much additional money is generated at an interest rate of 5% than at an interest rate of 3%?

A) $1,000\left(1 + \frac{5-3}{1,200}\right)^{12}$

B) $1,000\left(1 + \frac{\frac{5}{3}}{1,200}\right)^{12}$

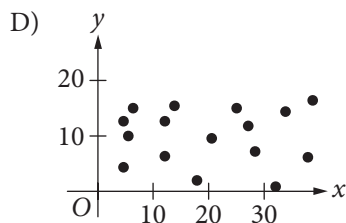
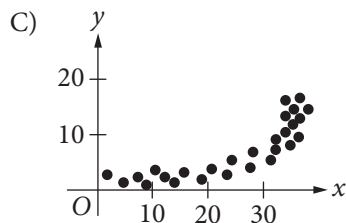
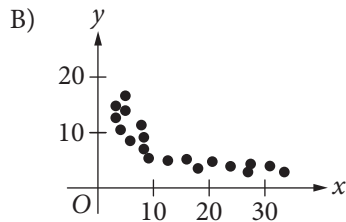
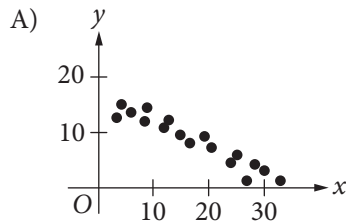
C) $\frac{1,000\left(1 + \frac{5}{1,200}\right)^{12}}{1,000\left(1 + \frac{3}{1,200}\right)^{12}}$

D) $1,000\left(1 + \frac{5}{1,200}\right)^{12} - 1,000\left(1 + \frac{3}{1,200}\right)^{12}$



15

Which of the following scatterplots shows a relationship that is appropriately modeled with the equation $y = ax^b$, where a is positive and b is negative?



Questions 16 and 17 refer to the following information.

Mr. Martinson is building a concrete patio in his backyard and deciding where to buy the materials and rent the tools needed for the project. The table below shows the materials' cost and daily rental costs for three different stores.

Store	Materials' Cost, M (dollars)	Rental cost of wheelbarrow, W (dollars per day)	Rental cost of concrete mixer, K (dollars per day)
A	750	15	65
B	600	25	80
C	700	20	70

The total cost, y , for buying the materials and renting the tools in terms of the number of days, x , is given by $y = M + (W + K)x$.

16

For what number of days, x , will the total cost of buying the materials and renting the tools from Store B be less than or equal to the total cost of buying the materials and renting the tools from Store A?

- A) $x \leq 6$
- B) $x \geq 6$
- C) $x \leq 7.3$
- D) $x \geq 7.3$



17

If the relationship between the total cost, y , of buying the materials and renting the tools at Store C and the number of days, x , for which the tools are rented is graphed in the xy -plane, what does the slope of the line represent?

- A) The total cost of the project
 - B) The total cost of the materials
 - C) The total daily cost of the project
 - D) The total daily rental costs of the tools
-

18

Jim has identical drinking glasses each in the shape of a right circular cylinder with internal diameter of 3 inches. He pours milk from a gallon jug into each glass until it is full. If the height of milk in each glass is about 6 inches, what is the largest number of full milk glasses that he can pour from one gallon of milk? (Note: There are 231 cubic inches in 1 gallon.)

- A) 2
- B) 4
- C) 5
- D) 6

19

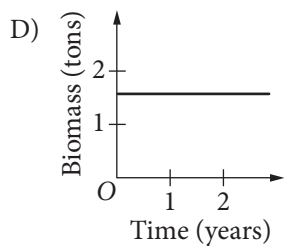
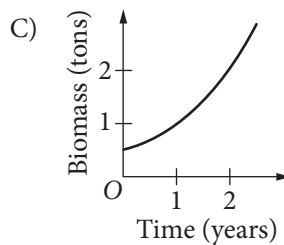
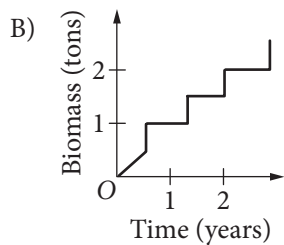
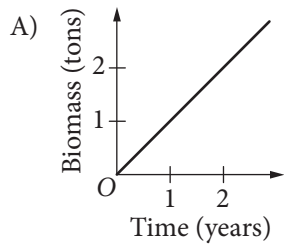
If $3p - 2 \geq 1$, what is the least possible value of $3p + 2$?

- A) 5
- B) 3
- C) 2
- D) 1

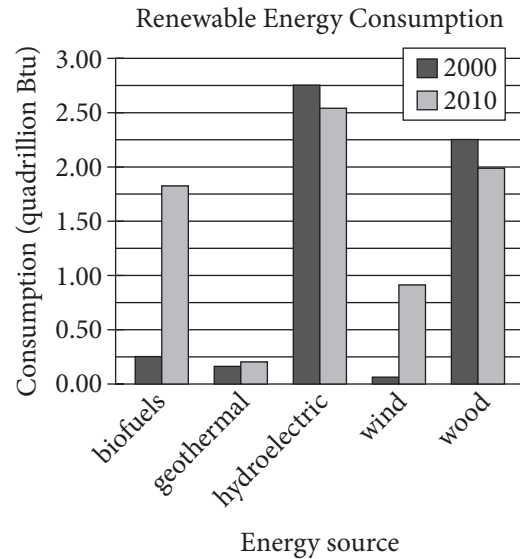


20

The mass of living organisms in a lake is defined to be the biomass of the lake. If the biomass in a lake doubles each year, which of the following graphs could model the biomass in the lake as a function of time? (Note: In each graph below, O represents $(0, 0)$.)



Questions 21 and 22 refer to the following information.



The bar graph above shows renewable energy consumption in quadrillions of British thermal units (Btu) in the United States, by energy source, for several energy sources in the years 2000 and 2010.

21

In a scatterplot of this data, where renewable energy consumption in the year 2000 is plotted along the x -axis and renewable energy consumption in the year 2010 is plotted along the y -axis for each of the given energy sources, how many data points would be above the line $y = x$?

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



22

Of the following, which best approximates the percent decrease in consumption of wood power in the United States from 2000 to 2010 ?

- A) 6%
- B) 11%
- C) 21%
- D) 26%



23

The tables below give the distribution of high temperatures in degrees Fahrenheit ($^{\circ}\text{F}$) for City A and City B over the same 21 days in March.

City A

Temperature ($^{\circ}\text{F}$)	Frequency
80	3
79	14
78	2
77	1
76	1

City B

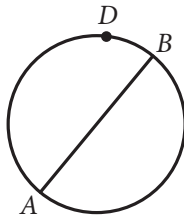
Temperature ($^{\circ}\text{F}$)	Frequency
80	6
79	3
78	2
77	4
76	6

Which of the following is true about the data shown for these 21 days?

- A) The standard deviation of temperatures in City A is larger.
- B) The standard deviation of temperatures in City B is larger.
- C) The standard deviation of temperatures in City A is the same as that of City B.
- D) The standard deviation of temperatures in these cities cannot be calculated with the data provided.



24



In the circle above, segment AB is a diameter. If the length of arc \widehat{ADB} is 8π , what is the length of the radius of the circle?

- A) 2
- B) 4
- C) 8
- D) 16

25

$$f(x) = 2x^3 + 6x^2 + 4x$$

$$g(x) = x^2 + 3x + 2$$

The polynomials $f(x)$ and $g(x)$ are defined above. Which of the following polynomials is divisible by $2x + 3$?

- A) $h(x) = f(x) + g(x)$
- B) $p(x) = f(x) + 3g(x)$
- C) $r(x) = 2f(x) + 3g(x)$
- D) $s(x) = 3f(x) + 2g(x)$

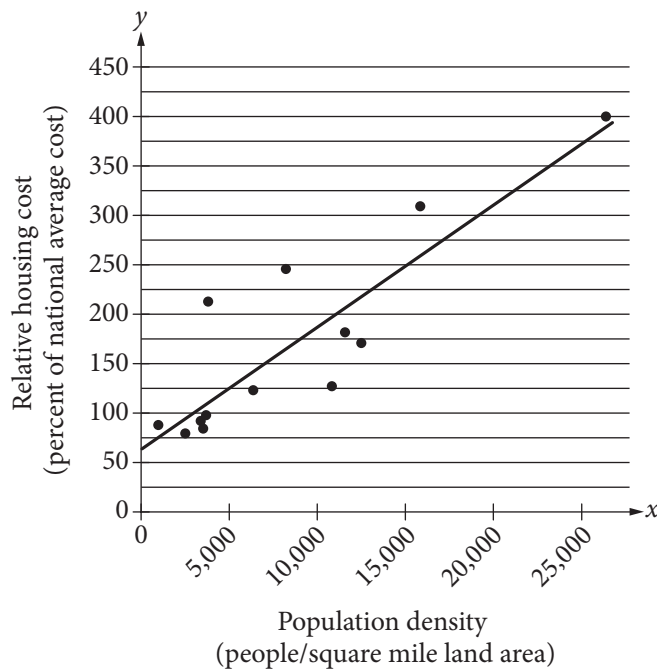
26

Let x and y be numbers such that $-y < x < y$. Which of the following must be true?

- I. $|x| < y$
 - II. $x > 0$
 - III. $y > 0$
- A) I only
 - B) I and II only
 - C) I and III only
 - D) I, II, and III



The relative housing cost for a US city is defined to be the ratio $\frac{\text{average housing cost for the city}}{\text{national average housing cost}}$, expressed as a percent.



The scatterplot above shows the relative housing cost and the population density for several large US cities in the year 2005. The line of best fit is also shown and has equation $y = 0.0125x + 61$. Which of the following best explains how the number 61 in the equation relates to the scatterplot?

- A) In 2005, the lowest housing cost in the United States was about \$61 per month.
- B) In 2005, the lowest housing cost in the United States was about 61% of the highest housing cost.
- C) In 2005, even in cities with low population densities, housing costs were never below 61% of the national average.
- D) In 2005, even in cities with low population densities, housing costs were likely at least 61% of the national average.



28

$$f(x) = (x + 6)(x - 4)$$

Which of the following is an equivalent form of the function f above in which the minimum value of f appears as a constant or coefficient?

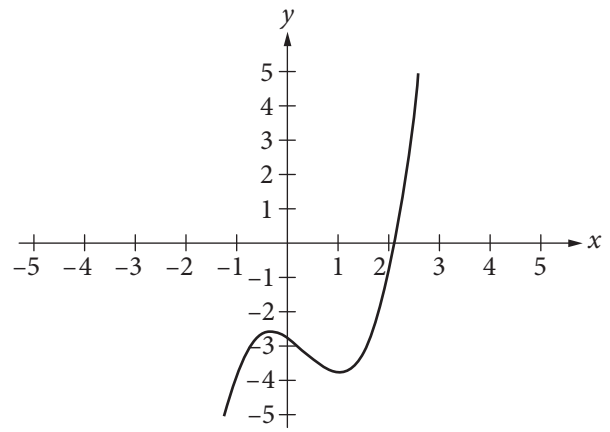
- A) $f(x) = x^2 - 24$
- B) $f(x) = x^2 + 2x - 24$
- C) $f(x) = (x - 1)^2 - 21$
- D) $f(x) = (x + 1)^2 - 25$

29

If x is the average (arithmetic mean) of m and 9, y is the average of $2m$ and 15, and z is the average of $3m$ and 18, what is the average of x , y , and z in terms of m ?

- A) $m + 6$
- B) $m + 7$
- C) $2m + 14$
- D) $3m + 21$

30



The function $f(x) = x^3 - x^2 - x - \frac{11}{4}$ is graphed in the xy -plane above. If k is a constant such that the equation $f(x) = k$ has three real solutions, which of the following could be the value of k ?

- A) 2
- B) 0
- C) -2
- D) -3


DIRECTIONS

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

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or 7/2. (If $\begin{array}{|c|c|c|c|} \hline 3 & 1 & / & 2 \\ \hline \bullet & \bullet & / & \bullet \\ \hline \end{array}$ is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Write answer → in boxes.

Grid in result.

← Fraction line

← Decimal point

Answer: $\frac{7}{12}$				Answer: 2.5			
	7	/	12		2	.	5
	•	•	•		•	•	•
	0	0	0		0	0	0
①	①	•	①	①	①	①	①
②	②	②	•	②	•	②	②
③	③	③	③	③	③	③	③
④	④	④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	⑤	⑤	•
⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥
•	⑦	⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨

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

2 / 3				.666				.667					
	2	/	3		.	6	6	6		.	6	6	7
	•	•	•		•	•	•	•		•	•	•	•
	0	0	0		0	0	0	0		0	0	0	0
①	①	①	①	①	①	①	①	①	①	①	①	①	①
②	•	②	②	②	②	②	②	②	②	②	②	②	②
③	③	③	•	③	③	③	③	③	③	③	③	③	③
④	④	④	④	④	④	④	④	④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥	•	⑥	⑥	⑥	⑥	•	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	•
⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨

Answer: 201 – either position is correct

2 0 1				2 0 1			
	2	0	1		2	0	1
	•	•	•		•	•	•
	0	•	0		0	•	0
①	①	①	•	①	①	•	①
②	•	②	②	②	•	②	②
③	③	③	③	③	③	③	③

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



31

A partially filled pool contains 600 gallons of water. A hose is turned on, and water flows into the pool at the rate of 8 gallons per minute. How many gallons of water will be in the pool after 70 minutes?

32

The normal systolic blood pressure P , in millimeters of mercury, for an adult male x years old can be modeled by the equation $P = \frac{x + 220}{2}$. According to the model, for every increase of 1 year in age, by how many millimeters of mercury will the normal systolic blood pressure for an adult male increase?

33

The *pes*, a Roman measure of length, is approximately equal to 11.65 inches. It is also equivalent to 16 smaller Roman units called digits. Based on these relationships, 75 Roman digits is equivalent to how many feet, to the nearest hundredth? (12 inches = 1 foot)

34

In a study of bat migration habits, 240 male bats and 160 female bats have been tagged. If 100 more female bats are tagged, how many more male bats must be tagged so that $\frac{3}{5}$ of the total number of bats in the study are male?

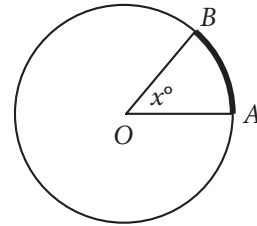


35

$$q = \frac{1}{2}nv^2$$

The dynamic pressure q generated by a fluid moving with velocity v can be found using the formula above, where n is the constant density of the fluid. An aeronautical engineer uses the formula to find the dynamic pressure of a fluid moving with velocity v and the same fluid moving with velocity $1.5v$. What is the ratio of the dynamic pressure of the faster fluid to the dynamic pressure of the slower fluid?

36



Note: Figure not drawn to scale.

In the figure above, the circle has center O and has radius 10. If the length of arc \widehat{AB} (shown in bold) is between 5 and 6, what is one possible integer value of x ?



Questions 37 and 38 refer to the following information.

The stock price of one share in a certain company is worth \$360 today. A stock analyst believes that the stock will lose 28 percent of its value each week for the next three weeks. The analyst uses the equation $V = 360(r)^t$ to model the value, V , of the stock after t weeks.

37

What value should the analyst use for r ?

38

To the nearest dollar, what does the analyst believe the value of the stock will be at the end of three weeks? (Note: Disregard the \$ sign when gridding your answer.)

STOP

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

QUESTION 40.

Choice B is the best answer because it provides the singular nouns “writer” and “speaker” to agree with the singular pronoun “anyone.”

Choices A, C, and D are incorrect because none creates pronoun-referent agreement.

QUESTION 41.

Choice D is the best answer because it expresses in the clearest, simplest way the idea that many game designers start out as programmers.

Choices A, B, and C are incorrect because each is unnecessarily wordy and obscures meaning.

QUESTION 42.

Choice D is the best answer because it logically and appropriately modifies the phrase “collaboration skills.”

Choices A, B, and C are incorrect because none appropriately describes the value of collaboration skills.

QUESTION 43.

Choice A is the best answer because it provides a logical subject for the modifying phrase “demanding and deadline driven.”

Choices B, C, and D are incorrect because each creates a dangling modifier.

QUESTION 44.

Choice B is the best answer because sentence 5 expresses the main point upon which the paragraph elaborates.

Choices A, C, and D are incorrect because none places sentence 5 in the appropriate position to set up the details contained in the paragraph.

Section 3: Math Test — No Calculator

QUESTION 1.

Choice A is correct. The expression $|x - 1| - 1$ will equal 0 if $|x - 1| = 1$. This is true for $x = 2$ and for $x = 0$. For example, substituting $x = 2$ into the expression $|x - 1| - 1$ and simplifying the result yields $|2 - 1| - 1 = |1| - 1 = 1 - 1 = 0$. Therefore, there is a value of x for which $|x - 1| - 1$ is equal to 0.

Choice B is incorrect. By definition, the absolute value of any expression is a nonnegative number. Substituting any value for x into the expression

$|x + 1|$ will yield a nonnegative number as the result. Because the sum of a nonnegative number and a positive number is positive, $|x + 1| + 1$ will be a positive number for any value of x . Therefore, $|x + 1| + 1 \neq 0$ for any value of x . Choice C is incorrect. By definition, the absolute value of any expression is a nonnegative number. Substituting any value for x into the expression $|1 - x|$ will yield a nonnegative number as the result. Because the sum of a nonnegative number and a positive number is positive, $|1 - x| + 1$ will be a positive number for any value of x . Therefore, $|1 - x| + 1 \neq 0$ for any value of x . Choice D is incorrect. By definition, the absolute value of any expression is a nonnegative number. Substituting any value for x into the expression $|x - 1|$ will yield a nonnegative number as the result. Because the sum of a nonnegative number and a positive number is positive, $|x - 1| + 1$ will be a positive number for any value of x . Therefore, $|x - 1| + 1 \neq 0$ for any value of x .

QUESTION 2.

Choice A is correct. Since $f(x) = \frac{3}{2}x + b$ and $f(6) = 7$, substituting 6 for x in $f(x) = \frac{3}{2}x + b$ gives $f(6) = \frac{3}{2}(6) + b = 7$. Then, solving the equation $\frac{3}{2}(6) + b = 7$ for b gives $\frac{18}{2} + b = 7$, or $9 + b = 7$. Thus, $b = 7 - 9 = -2$. Substituting this value back into the original function gives $f(x) = \frac{3}{2}x - 2$; therefore, one can evaluate $f(-2)$ by substituting -2 for x : $\frac{3}{2}(-2) - 2 = -\frac{6}{2} - 2 = -3 - 2 = -5$.

Choice B is incorrect as it is the value of b , not of $f(-2)$. Choice C is incorrect as it is the value of $f(2)$, not of $f(-2)$. Choice D is incorrect as it is the value of $f(6)$, not of $f(-2)$.

QUESTION 3.

Choice A is correct. The first equation can be rewritten as $x = 6y$. Substituting $6y$ for x in the second equation gives $4(y + 1) = 6y$. The left-hand side can be rewritten as $4y + 4$, giving $4y + 4 = 6y$. Subtracting $4y$ from both sides of the equation gives $4 = 2y$, or $y = 2$.

Choices B, C, and D are incorrect and may be the result of a computational or conceptual error when solving the system of equations.

QUESTION 4.

Choice B is correct. If $f(x) = -2x + 5$, then one can evaluate $f(-3x)$ by substituting $-3x$ for every instance of x . This yields $f(-3x) = -2(-3x) + 5$, which simplifies to $6x + 5$.

Choices A, C, and D are incorrect and may be the result of miscalculations in the substitution or of misunderstandings of how to evaluate $f(-3x)$.

QUESTION 5.

Choice C is correct. The expression $3(2x + 1)(4x + 1)$ can be simplified by first distributing the 3 to yield $(6x + 3)(4x + 1)$, and then expanding to obtain $24x^2 + 12x + 6x + 3$. Combining like terms gives $24x^2 + 18x + 3$.

Choice A is incorrect and may be the result of performing the term-by-term multiplication of $3(2x + 1)(4x + 1)$ and treating every term as an x -term. Choice B is incorrect and may be the result of correctly finding $(6x + 3)(4x + 1)$, but then multiplying only the first terms, $(6x)(4x)$, and the last terms, $(3)(1)$, but not the outer or inner terms. Choice D is incorrect and may be the result of incorrectly distributing the 3 to both terms to obtain $(6x + 3)(12x + 3)$, and then adding $3 + 3$ and $6x + 12x$ and incorrectly adding the exponents of x .

QUESTION 6.

Choice B is correct. The equation $\frac{a - b}{b} = \frac{3}{7}$ can be rewritten as $\frac{a}{b} - \frac{b}{b} = \frac{3}{7}$, from which it follows that $\frac{a}{b} - 1 = \frac{3}{7}$, or $\frac{a}{b} = \frac{3}{7} + 1 = \frac{10}{7}$.

Choices A, C, and D are incorrect and may be the result of calculation errors in rewriting $\frac{a - b}{b} = \frac{3}{7}$. For example, choice A may be the result of a sign error in rewriting $\frac{a - b}{b}$ as $\frac{a}{b} + \frac{b}{b} = \frac{a}{b} + 1$.

QUESTION 7.

Choice D is correct. In Amelia's training schedule, her longest run in week 16 will be 26 miles and her longest run in week 4 will be 8 miles. Thus, Amelia increases the distance of her longest run by 18 miles over the course of 12 weeks. Since Amelia increases the distance of her longest run each week by a constant amount, the amount she increases the distance of her longest run each week is $\frac{26 - 8}{16 - 4} = \frac{18}{12} = \frac{3}{2} = 1.5$ miles.

Choices A, B, and C are incorrect because none of these training schedules would result in increasing Amelia's longest run from 8 miles in week 4 to 26 miles in week 16. For example, choice A is incorrect because if Amelia increases the distance of her longest run by 0.5 miles each week and has her longest run of 8 miles in week 4, her longest run in week 16 would be $8 + 0.5 \cdot 12 = 14$ miles, not 26 miles.

QUESTION 8.

Choice A is correct. For an equation of a line in the form $y = mx + b$, the constant m is the slope of the line. Thus, the line represented by $y = -3x + 4$ has slope -3 . Lines that are parallel have the same slope. To find out which of the given equations represents a line with the same slope as the line represented by $y = -3x + 4$, one can rewrite each equation in the form $y = mx + b$, that is, solve each equation for y . Choice A, $6x + 2y = 15$, can

be rewritten as $2y = -6x + 15$ by subtracting $6x$ from each side of the equation. Then, dividing each side of $2y = -6x + 15$ by 2 gives $y = -\frac{6}{2}x + \frac{15}{2} = -3x + \frac{15}{2}$. Therefore, this line has slope -3 and is parallel to the line represented by $y = -3x + 4$. (The lines are parallel, not coincident, because they have different y -intercepts.)

Choices B, C, and D are incorrect and may be the result of common misunderstandings about which value in the equation of a line represents the slope of the line.

QUESTION 9.

Choice D is correct. The question states that $\sqrt{x-a} = x-4$ and that $a = 2$, so substituting 2 for a in the equation yields $\sqrt{x-2} = x-4$. To solve for x , square each side of the equation, which gives $(\sqrt{x-2})^2 = (x-4)^2$, or $x-2 = (x-4)^2$. Then, expanding $(x-4)^2$ yields $x-2 = x^2-8x+16$, or $0 = x^2-9x+18$. Factoring the right-hand side gives $0 = (x-3)(x-6)$, and so $x = 3$ or $x = 6$. However, for $x = 3$, the original equation becomes $\sqrt{3-2} = 3-4$, which yields $1 = -1$, which is not true. Hence, $x = 3$ is an extraneous solution that arose from squaring each side of the equation. For $x = 6$, the original equation becomes $\sqrt{6-2} = 6-4$, which yields $\sqrt{4} = 2$, or $2 = 2$. Since this is true, the solution set of $\sqrt{x-2} = x-4$ is $\{6\}$.

Choice A is incorrect because it includes the extraneous solution in the solution set. Choice B is incorrect and may be the result of a calculation or factoring error. Choice C is incorrect because it includes only the extraneous solution, and not the correct solution, in the solution set.

QUESTION 10.

Choice D is correct. Multiplying each side of $\frac{t+5}{t-5} = 10$ by $t-5$ gives $t+5 = 10(t-5)$. Distributing the 10 over the values in the parentheses yields $t+5 = 10t-50$. Subtracting t from each side of the equation gives $5 = 9t-50$, and then adding 50 to each side gives $55 = 9t$. Finally, dividing each side by 9 yields $t = \frac{55}{9}$.

Choices A, B, and C are incorrect and may be the result of calculation errors or using the distribution property improperly.

QUESTION 11.

Choice C is correct. Since $y = (2x-3)(x+9)$ and $x = 2y+5$, it follows that $x = 2((2x-3)(x+9)) + 5 = 4x^2 + 30x - 54$. This can be rewritten as $4x^2 + 29x - 54 = 0$. Because the discriminant of this quadratic equation, $29^2 - (4)(-54) = 29^2 + 4(54)$, is positive, this equation has 2 distinct roots. Using each of the roots as the value of x and finding y from the equation $x = 2y + 5$ gives 2 ordered pairs (x, y) that satisfy the given system of

equations. Since no other value of x satisfies $4x^2 + 29x - 54 = 0$, there are no other ordered pairs that satisfy the given system. Therefore, there are 2 ordered pairs (x, y) that satisfy the given system of equations.

Choices A and B are incorrect and may be the result of either a miscalculation or a conceptual error. Choice D is incorrect because a system of one quadratic equation and one linear equation cannot have infinitely many solutions.

QUESTION 12.

Choice C is correct. Since the price of Ken's sandwich was x dollars, and Paul's sandwich was \$1 more, the price of Paul's sandwich was $x + 1$ dollars. Thus, the total cost of the sandwiches was $2x + 1$ dollars. Since this cost was split evenly, Ken and Paul each paid $\frac{2x + 1}{2} = x + 0.5$ dollars plus a 20% tip. After adding the 20% tip, each of them paid $(x + 0.5) + 0.2(x + 0.5) = 1.2(x + 0.5) = 1.2x + 0.6$ dollars.

Choices A, B, and D are incorrect. These expressions do not model the given context. They may be the result of errors in setting up the expression or of calculation errors.

QUESTION 13.

Choice B is correct. One can find the intersection points of the two graphs by setting the functions $f(x)$ and $g(x)$ equal to one another and then solving for x . This yields $8x^2 - 2 = -8x^2 + 2$. Adding $8x^2$ and 2 to each side of the equation gives $16x^2 = 4$. Then dividing each side by 16 gives $x^2 = \frac{1}{4}$, and then taking the square root of each side gives $x = \pm \frac{1}{2}$. From the graph, the value of k is the x -coordinate of the point of intersection on the positive x -axis. Therefore, $k = \frac{1}{2}$.

Alternatively, since $(k, 0)$ lies on the graph of both f and g , it follows that $f(k) = g(k) = 0$. Thus, evaluating $f(x) = 8x^2 - 2$ at $x = k$ gives $0 = 8k^2 - 2$. Adding 2 to each side yields $2 = 8k^2$ and then dividing each side by 8 gives $\frac{1}{4} = k^2$. Taking the square root of each side then gives $k = \pm \frac{1}{2}$. From the graph, k is positive, so $k = \frac{1}{2}$.

Choices A, C, and D are incorrect and may be the result of calculation errors in solving for x or k .

QUESTION 14.

Choice A is correct. To rewrite $\frac{8 - i}{3 - 2i}$ in the standard form $a + bi$, multiply the numerator and denominator of $\frac{8 - i}{3 - 2i}$ by the conjugate, $3 + 2i$. This gives $\left(\frac{8 - i}{3 - 2i}\right)\left(\frac{3 + 2i}{3 + 2i}\right) = \frac{24 + 16i - 3i + (-i)(2i)}{3^2 - (2i)^2}$. Since $i^2 = -1$, this last fraction

can be rewritten as $\frac{24 + 16i - 3i + 2}{9 - (-4)} = \frac{26 + 13i}{13}$, which simplifies to $2 + i$.

Therefore, when $\frac{8 - i}{3 - 2i}$ is rewritten in the standard form $a + bi$, the value of a is 2.

Choices B, C, and D are incorrect and may be the result of errors in symbolic manipulation. For example, choice B could be the result of mistakenly rewriting $\frac{8 - i}{3 - 2i}$ as $\frac{8}{3} + \frac{1}{2}i$.

QUESTION 15.

Choice B is correct. The given quadratic equation can be rewritten as $2x^2 - kx - 4p = 0$. Applying the quadratic formula, $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$, to this equation with $a = 2$, $b = -k$, and $c = -4p$ gives the solutions $\frac{k}{4} \pm \frac{\sqrt{k^2 + 32p}}{4}$.

Choices A, C, and D are incorrect and may be the result of errors in applying the quadratic formula.

QUESTION 16.

The correct answer is 9. Since the three shelves of the triangular shelf system are parallel, the three triangles in the figure are similar. Since the shelves divide the left side of the largest triangle in the ratio 2 to 3 to 1, the similarity ratios of the triangles are as follows.

- ▶ Smallest to middle: 2 to 5
- ▶ Smallest to largest: 2 to 6, or 1 to 3
- ▶ Middle to largest: 5 to 6

The height of the largest shampoo bottle that can stand upright on the middle shelf is equal to the height of the middle shelf. The height of the entire triangular shelf system is 18 inches. This is the height of the largest triangle. The height of the middle shelf is the height of the middle triangle minus the height of the smallest triangle. Since the similarity ratio of the middle triangle to the largest triangle is 5 to 6, the height of the middle shelf is $\frac{5}{6}(18) = 15$ inches. Since the similarity ratio of the smallest triangle to the largest triangle is 1 to 3, the height of the middle shelf is $\frac{1}{3}(18) = 6$ inches. Therefore, the height of the middle shelf is 9 inches.

QUESTION 17.

The correct answer is .6 or $\frac{3}{5}$. The angles marked x° and y° are acute angles in a right triangle. Thus, they are complementary angles. By the complementary angle relationship between sine and cosine, it follows that $\sin(x^\circ) = \cos(y^\circ)$. Therefore, the cosine of y° is .6. Either .6 or the equivalent fraction $\frac{3}{5}$ may be gridded as the correct answer.

Alternatively, since the sine of x° is .6, the ratio of the side opposite the x° angle to the hypotenuse is .6. The side opposite the x° angle is the side adjacent to the y° angle. Thus, the ratio of the side adjacent to the y° angle to the hypotenuse, which is equal to the cosine of y° , is equal to .6.

QUESTION 18.

The correct answer is 5. The four-term polynomial expression can be factored completely, by grouping, as follows:

$$(x^3 - 5x^2) + (2x - 10) = 0$$

$$x^2(x - 5) + 2(x - 5) = 0$$

$$(x - 5)(x^2 + 2) = 0$$

By the zero product property, set each factor of the polynomial equal to 0 and solve each resulting equation for x . This gives $x = 5$ or $x = \pm i\sqrt{2}$, respectively. Because the question asks for the real value of x that satisfies the equation, the correct answer is 5.

QUESTION 19.

The correct answer is 0. Multiplying each side of $-3x + 4y = 20$ by 2 gives $-6x + 8y = 40$. Adding each side of $-6x + 8y = 40$ to the corresponding side of $6x + 3y = 15$ gives $11y = 55$, or $y = 5$. Finally, substituting 5 for y in $6x + 3y = 15$ gives $6x + 3(5) = 15$, or $x = 0$.

QUESTION 20.

The correct answer is 25. In the mesosphere, an increase of 10 kilometers in the distance above Earth results in a decrease in the temperature by k° Celsius where k is a constant. Thus, the temperature in the mesosphere is linearly dependent on the distance above Earth. Using the values provided and the slope formula, one can calculate the unit rate of change for the temperature in the mesosphere to be $\frac{-80 - (-5)}{80 - 50} = \frac{-75}{30} = \frac{-2.5}{1}$. The slope indicates that, within the mesosphere, if the distance above Earth increases by 1 kilometer, the temperature decreases by 2.5° Celsius. Therefore, if the distance above Earth increases by $(1 \times 10) = 10$ kilometers, the temperature will decrease by $(2.5 \times 10) = 25^\circ$ Celsius. Thus, the value of k is 25.

Section 4: Math Test — Calculator

QUESTION 1.

Choice B is correct. Let m be the number of movies Jill rented online during the month. Since the monthly membership fee is \$9.80 and there is an additional fee of \$1.50 to rent each movie online, the total of the membership fee and the movie rental fees, in dollars, can be written as $9.80 + 1.50m$. Since

the total of these fees for the month was \$12.80, the equation $9.80 + 1.50m = 12.80$ must be true. Subtracting 9.80 from each side and then dividing each side by 1.50 yields $m = 2$.

Choices A, C, and D are incorrect and may be the result of errors in setting up or solving the equation that represents the context.

QUESTION 2.

Choice C is correct. Donald believes he can increase his typing speed by 5 words per minute each month. Therefore, in m months, he believes he can increase his typing speed by $5m$ words per minute. Because he is currently able to type at a speed of 180 words per minute, he believes that in m months, he will be able to increase his typing speed to $180 + 5m$ words per minute.

Choice A is incorrect because the expression indicates that Donald currently types 5 words per minute and will increase his typing speed by 180 words per minute each month. Choice B is incorrect because the expression indicates that Donald currently types 225 words per minute, not 180 words per minute. Choice D is incorrect because the expression indicates that Donald will decrease, not increase, his typing speed by 5 words per minute each month.

QUESTION 3.

Choice C is correct. Because there are 16 ounces in 1 pound, a 3-pound pizza weighs $3 \times 16 = 48$ ounces. One half of the pizza weighs $\frac{1}{2} \times 48 = 24$ ounces, and one-third of the half weighs $\frac{1}{3} \times 24 = 8$ ounces.

Alternatively, since $\frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$, cutting the pizza into halves and then into thirds results in a pizza that is cut into sixths. Therefore, each slice of the 48-ounce pizza weighs $\frac{1}{6} \times 48 = 8$ ounces.

Choice A is incorrect and is the result of cutting each half into sixths rather than thirds. Choice B is incorrect and is the result of cutting each half into fourths rather than thirds. Choice D is incorrect and is the result of cutting the whole pizza into thirds.

QUESTION 4.

Choice B is correct. Because Nick surveyed a random sample of the freshman class, his sample was representative of the entire freshman class. Thus, the percent of students in the entire freshman class expected to prefer the Fall Festival in October is appropriately estimated by the percent of students who preferred it in the sample, 25.6%. Thus, of the 225 students in the freshman class, approximately $225 \times 0.256 = 57.6$ students would be expected to prefer having the Fall Festival in October. Of the choices given, this is closest to 60.

Choices A, C, and D are incorrect. These choices may be the result of misapplying the concept of percent or of calculation errors.

QUESTION 5.

Choice B is correct. The density of an object is equal to the mass of the object divided by the volume of the object, which can be expressed as $\text{density} = \frac{\text{mass}}{\text{volume}}$. Thus, if an object has a density of 3 grams per milliliter and a mass of 24 grams, the equation becomes $3 \text{ grams/milliliter} = \frac{24 \text{ grams}}{\text{volume}}$. This can be rewritten as $\text{volume} = \frac{24 \text{ grams}}{3 \text{ grams/milliliter}} = 8 \text{ milliliters}$.

Choice A is incorrect and may be the result of confusing the density and the volume and setting up the density equation as $24 = \frac{3}{\text{volume}}$. Choice C is incorrect and may be the result of a conceptual error that leads to subtracting 3 from 24. Choice D is incorrect and may be the result of confusing the mass and the volume and setting up the density equation as $24 = \frac{\text{volume}}{3}$.

QUESTION 6.

Choice A is correct. Let a be the number of hours Angelica worked last week. Since Raul worked 11 more hours than Angelica, Raul worked $a + 11$ hours last week. Since they worked a combined total of 59 hours, the equation $a + (a + 11) = 59$ must hold. This equation can be simplified to $2a + 11 = 59$, or $2a = 48$. Therefore, $a = 24$, and Angelica worked 24 hours last week.

Choice B is incorrect because it is the number of hours Raul worked last week. Choice C is incorrect. If Angelica worked 40 hours and Raul worked 11 hours more, Raul would have worked 51 hours, and the combined total number of hours they worked would be 91, not 59. Choice D is incorrect and may be the result of solving the equation $a + 11 = 59$ rather than $a + (a + 11) = 59$.

QUESTION 7.

Choice A is correct. According to the table, of the 50 movies with the greatest ticket sales in 2012, 4 are comedy movies with a PG-13 rating. Therefore, the proportion of the 50 movies with the greatest ticket sales in 2012 that are comedy movies with a PG-13 rating is $\frac{4}{50}$, or equivalently, $\frac{2}{25}$.

Choice B is incorrect; $\frac{9}{50}$ is the proportion of the 50 movies with the greatest ticket sales in 2012 that are comedy movies, regardless of rating. Choice C is incorrect; $\frac{2}{11} = \frac{4}{22}$ is the proportion of movies with a PG-13 rating that are comedy movies. Choice D is incorrect; $\frac{11}{25} = \frac{22}{50}$ is the proportion of the 50 movies with the greatest ticket sales in 2012 that have a rating of PG-13.

QUESTION 8.

Choice D is correct. The quadrants of the xy -plane are defined as follows: Quadrant I is above the x -axis and to the right of the y -axis; Quadrant II is above the x -axis and to the left of the y -axis; Quadrant III is below the x -axis and to the left of the y -axis; and Quadrant IV is below the x -axis and to the right of the y -axis. It is possible for line ℓ to pass through Quadrants II, III, and IV, but not Quadrant I, only if line ℓ has negative x - and y -intercepts. This implies that line ℓ has a negative slope, since between the negative x -intercept and the negative y -intercept the value of x increases (from negative to zero) and the value of y decreases (from zero to negative); so the quotient of the change in y over the change in x , that is, the slope of line ℓ , must be negative.

Choice A is incorrect because a line with an undefined slope is a vertical line, and if a vertical line passes through Quadrant IV, it must pass through Quadrant I as well. Choice B is incorrect because a line with a slope of zero is a horizontal line and, if a horizontal line passes through Quadrant II, it must pass through Quadrant I as well. Choice C is incorrect because if a line with a positive slope passes through Quadrant IV, it must pass through Quadrant I as well.

QUESTION 9.

Choice B is correct. According to the table, in 2012 there was a total of $14,766 + 47,896 = 62,662$ registered voters between 18 and 44 years old, and $3,453 + 11,237 = 14,690$ of them were from the Midwest region. Therefore, the probability that a randomly chosen registered voter who was between 18 and 44 years old in 2012 was from Midwest region is $\frac{14,690}{62,662} \approx 0.234$. Of the given choices, 0.25 is closest to this value.

Choices A, C, and D are incorrect and may be the result of errors in selecting the correct proportion or in calculating the correct value.

QUESTION 10.

Choice A is correct. According to the graph, the animal with the longest gestation period (60 days) has a life expectancy of 3 years.

Choices B, C, and D are incorrect. All the animals that have a life expectancy of 4, 8, or 10 years have a gestation period that is shorter than 60 days, which is the longest gestation period.

QUESTION 11.

Choice A is correct. The ratio of life expectancy to gestation period for the animal represented by point A is approximately $\frac{7 \text{ years}}{23 \text{ days}}$, or about

0.3 years/day, which is greater than the ratio for the animals represented by the other labeled points (the ratios for points B , C , and D , in units of years of life expectancy per day of gestation, are approximately $\frac{8}{44}$, $\frac{8}{51}$, and $\frac{10}{51}$ respectively, each of which is less than 0.2 years/day).

Choices B , C , and D are incorrect and may be the result of errors in calculating the ratio or in reading the graph.

QUESTION 12.

Choice C is correct. All of the given choices are polynomials. If the graph of a polynomial function f in the xy -plane has an x -intercept at b , then $(x - b)$ must be a factor of $f(x)$. Since -3 , -1 , and 1 are each x -intercepts of the graph of f , it follows that $(x + 3)$, $(x + 1)$, and $(x - 1)$ must each be a factor of $f(x)$. The factored polynomial function in choice C is the only polynomial given with these 3 factors.

Choices A , B , and D are incorrect because they do not contain all three factors that must exist if the graph of the polynomial function f has x -intercepts at -3 , -1 , and 1 .

QUESTION 13.

Choice C is correct. The mosquito population starts at 100 in week 0 and then is multiplied by a factor of 10 every 5 weeks. Thus, if $P(t)$ is the mosquito population after t weeks, then based on the table, $P(t) = 100(10)^{\frac{t}{5}}$, which indicates an exponential growth relationship.

Choices A , B , and D are incorrect and may be the result of an incorrect interpretation of the relationship or errors in modeling the relationship.

QUESTION 14.

Choice D is correct. According to the given formula, the amount of money generated for a year at 5% interest, compounded monthly, is $1,000\left(1 + \frac{5}{1,200}\right)^{12}$, whereas the amount of money generated at 3% interest, compounded monthly, is $1,000\left(1 + \frac{3}{1,200}\right)^{12}$. Therefore, the difference between these two amounts, $1,000\left(1 + \frac{5}{1,200}\right)^{12} - 1,000\left(1 + \frac{3}{1,200}\right)^{12}$, shows how much additional money is generated at an interest rate of 5% than at an interest rate of 3%.

Choices A , B , and C are incorrect and may be the result of misinterpreting the given formula. For example, the expression in choice C gives how many times as much money, not how much additional money, is generated at an interest rate of 5% than at an interest rate of 3%.

QUESTION 15.

Choice B is correct. The graph of $y = ax^b$, where a is positive and b is negative, has a positive y -intercept and rapidly decreases (in particular, decreases at a faster rate than a linear function) toward the x -axis as x increases. Of the scatterplots shown, only the one in choice B would be appropriately modeled by such a function.

Choice A is incorrect, as this scatterplot is appropriately modeled by a linear function. Choice C is incorrect, as this scatterplot is appropriately modeled by an increasing function. Choice D is incorrect, as this scatterplot shows no clear relationship between x and y .

QUESTION 16.

Choice A is correct. The total cost y , in dollars, of buying the materials and renting the tools for x days from Store A and Store B is found by substituting the respective values for these stores from the table into the given equation, $y = M + (W + K)x$, as shown below.

$$\text{Store A: } y = 750 + (15 + 65)x = 750 + 80x$$

$$\text{Store B: } y = 600 + (25 + 80)x = 600 + 105x$$

Thus, the number of days, x , for which the total cost of buying the materials and renting the tools from Store B is less than or equal to the total cost of buying the materials and renting the tools from Store A can be found by solving the inequality $600 + 105x \leq 750 + 70x$. Subtracting $80x$ and 600 from each side of $600 + 105x \leq 750 + 70x$ and combining like terms yields $25x \leq 150$. Dividing each side of $25x \leq 150$ by 25 yields $x \leq 6$.

Choice B is incorrect. The inequality $x \geq 6$ is the number of days for which the total cost of buying the materials and renting the tools from Store B is greater than or equal to the total cost of buying the materials and renting the tools from Store A. Choices C and D are incorrect and may be the result of an error in setting up or simplifying the inequality.

QUESTION 17.

Choice D is correct. The total cost, y , of buying the materials and renting the tools in terms of the number of days, x , is given as $y = M + (W + K)x$. If this relationship is graphed in the xy -plane, the slope of the graph is equal to $W + K$, which is the daily rental cost of the wheelbarrow plus the daily rental cost of the concrete mixer, that is, the total daily rental costs of the tools.

Choice A is incorrect because the total cost of the project is y . Choice B is incorrect because the total cost of the materials is M , which is the y -intercept of the graph of $y = M + (W + K)x$. Choice C is incorrect because the total daily cost of the project is the total cost of the project divided by the total number of days the project took and, since materials cost more than 0 dollars, this is not the same as the total daily rental costs.

QUESTION 18.

Choice C is correct. The volume V of a right circular cylinder is given by the formula $V = \pi r^2 h$, where r is the base radius of the cylinder and h is the height of the cylinder. Since each glass has an internal diameter of 3 inches, each glass has a base radius of $\frac{3}{2}$ inches. Since the height of the milk in each glass is 6 inches, the volume of milk in each glass is $V = \pi \left(\frac{3}{2}\right)^2 (6) \approx 42.41$ cubic inches. The total number of glasses Jim can pour from 1 gallon is equal to $\frac{\text{number of cubic inches in 1 gallon}}{\text{number of cubic inches in 1 glass}} = \frac{231}{42.41}$, which is approximately 5.45 glasses. Since the question asks for the largest number of full glasses Jim can pour, the number of glasses needs to be rounded down to 5.

Choices A, B, and D are incorrect and may be the result of conceptual errors or calculation errors. For example, choice D is incorrect because even though Jim can pour more than 5 full glasses, he will not have enough milk to pour a full 6th glass.

QUESTION 19.

Choice A is correct. Adding 4 to each side of the inequality $3p - 2 \geq 1$ yields the inequality $3p + 2 \geq 5$. Therefore, the least possible value of $3p + 2$ is 5.

Choice B is incorrect because it gives the least possible value of $3p$, not of $3p + 2$. Choice C is incorrect. If the least possible value of $3p + 2$ were 2, then it would follow that $3p + 2 \geq 2$. Subtracting 4 from each side of this inequality would yield $3p - 2 \geq -2$. This contradicts the given inequality, $3p - 2 \geq 1$. Therefore, the least possible value of $3p + 2$ cannot be 2. Choice D is incorrect because it gives the least possible value of p , not of $3p + 2$.

QUESTION 20.

Choice C is correct. Since the biomass of the lake doubles each year, the biomass starts at a positive value and then increases exponentially over time. Of the graphs shown, only the graph in choice C is of an increasing exponential function.

Choice A is incorrect because the biomass of the lake must start at a positive value, not zero. Furthermore, this graph shows linear growth, not exponential growth. Choice B is incorrect because the biomass of the lake must start at a positive value, not zero. Furthermore, this graph has vertical segments and is not a function. Choice D is incorrect because the biomass of the lake does not remain the same over time.

QUESTION 21.

Choice C is correct. The exact coordinates of the scatterplot in the xy -plane cannot be read from the bar graph provided. However, for a data point to be

above the line $y = x$, the value of y must be greater than the value of x . That is, the consumption in 2010 must be greater than the consumption in 2000. This occurs for 3 types of energy sources shown in the bar graph: biofuels, geothermal, and wind.

Choices A, B, and D are incorrect and may be the result of a conceptual error in presenting the data shown in a scatterplot. For example, choice B is incorrect because there are 2 data points in the scatterplot that lie below the line $y = x$.

QUESTION 22.

Choice B is correct. Reading the graph, the amount of wood power used in 2000 was 2.25 quadrillion BTUs and the amount used in 2010 was 2.00 quadrillion BTUs. To find the percent decrease, find the difference between the two numbers, divide by the original value, and then multiply by 100: $\frac{2.25 - 2.00}{2.25} \times 100 = \frac{0.25}{2.25} \times 100 \approx 11.1$ percent. Of the choices given, 11% is closest to the percent decrease in the consumption of wood power from 2000 to 2010.

Choices A, C, and D are incorrect and may be the result of errors in reading the bar graph or in calculating the percent decrease.

QUESTION 23.

Choice B is correct. The standard deviation is a measure of how far the data set values are from the mean. In the data set for City A, the large majority of the data are in three of the five possible values, which are the three values closest to the mean. In the data set for City B, the data are more spread out, with many values at the minimum and maximum values. Therefore, by observation, the data for City B have a larger standard deviation.

Alternatively, one can calculate the mean and visually inspect the difference between the data values and the mean. For City A the mean is $\frac{1,655}{21} \approx 78.8$, and for City B the mean is $\frac{1,637}{21} \approx 78.0$. The data for City A are closely clustered near 79, which indicates a small standard deviation. The data for City B are spread out away from 78, which indicates a larger standard deviation.

Choices A, C, and D are incorrect and may be the result of misconceptions about the standard deviation.

QUESTION 24.

Choice C is correct. Since segment AB is a diameter of the circle, it follows that arc \widehat{ADB} is a semicircle. Thus, the circumference of the circle is twice the length of arc \widehat{ADB} which is $2(8\pi) = 16\pi$. Since the circumference of a circle is 2π times the radius of the circle, the radius of this circle is 16π divided by 2π , which is equal to 8.

Choices A, B, and D are incorrect and may be the result of losing track of factors of 2 or of solving for the diameter of the circle instead of the radius. For example, choice D is the diameter of the circle.

QUESTION 25.

Choice B is correct. In $f(x)$, factoring out the greatest common factor, $2x$, yields $f(x) = 2x(x^2 + 3x + 2)$. It is given that $g(x) = x^2 + 3x + 2$, so using substitution, $f(x)$ can be rewritten as $f(x) = 2x \cdot g(x)$. In the equation $p(x) = f(x) + 3g(x)$, substituting $2x \cdot g(x)$ for $f(x)$ yields $p(x) = 2x \cdot g(x) + 3 \cdot g(x)$. In $p(x)$, factoring out the greatest common factor, $g(x)$, yields $p(x) = (g(x))(2x + 3)$. Because $2x + 3$ is a factor of $p(x)$, it follows that $p(x)$ is divisible by $2x + 3$.

Choices A, C, and D are incorrect because $2x + 3$ is not a factor of the polynomials $h(x)$, $r(x)$, or $s(x)$. Using the substitution $f(x) = 2x \cdot g(x)$, and factoring further, $h(x)$, $r(x)$, and $s(x)$ can be rewritten as follows:

$$h(x) = (x + 1)(x + 2)(2x + 1)$$

$$r(x) = (x + 1)(x + 2)(4x + 3)$$

$$s(x) = 2(x + 1)(x + 2)(3x + 1)$$

Because $2x + 3$ is not a factor of $h(x)$, $r(x)$, or $s(x)$, it follows that $h(x)$, $r(x)$, and $s(x)$ are not divisible by $2x + 3$.

QUESTION 26.

Choice C is correct. If $-y < x < y$, the value of x is either between $-y$ and 0 or between 0 and y , so statement I, $|x| < y$ is true. It is possible that the value of x is greater than zero, but x could be negative. For example, a counterexample to statement II, $x > 0$, is $x = -2$ and $y = 3$, yielding $-3 < -2 < 3$, so the given condition is satisfied. Statement III must be true since $-y < x < y$ implies that $-y < y$, so y must be greater than 0. Therefore, statements I and III are the only statements that must be true.

Choices A, B, and D are incorrect because each of these choices either omits a statement that must be true or includes a statement that could be false.

QUESTION 27.

Choice D is correct. To interpret what the number 61 in the equation of the line of best fit represents, one must first understand what the data in the scatterplot represent. Each of the points in the scatterplot represents a large US city, graphed according to its population density (along the horizontal axis) and its relative housing cost (along the vertical axis). The line of best fit for this data represents the expected relative housing cost for a certain population density, based on the data points in the graph. Thus, one might say, on average, a city of population density x is expected to have a relative

housing cost of $y\%$, where $y = 0.0125x + 61$. The number 61 in the equation represents the y -intercept of the line of best fit, in that when the population density, x , is 0, there is an expected relative housing cost of 61%. This might not make the best sense within the context of the problem, in that when the population density is 0, the population is 0, so there probably wouldn't be any housing costs. However, it could be interpreted that for cities with low population densities, housing costs were likely around or above 61% (since below 61% would be for cities with negative population densities, which is impossible).

Choice A is incorrect because it interprets the values of the vertical axis as dollars and not percentages. Choice B is incorrect because the lowest housing cost is about 61% of the national average, not 61% of the highest housing cost. Choice C is incorrect because one cannot absolutely assert that no city with a low population density had housing costs below 61% of the national average, as the model shows that it is unlikely, but not impossible.

QUESTION 28.

Choice D is correct. The minimum value of a quadratic function appears as a constant in the vertex form of its equation, which can be found from the standard form by completing the square. Rewriting $f(x) = (x + 6)(x - 4)$ in standard form gives $f(x) = x^2 + 2x - 24$. Since the coefficient of the linear term is 2, the equation for $f(x)$ can be rewritten in terms of $(x + 1)^2$ as follows:

$$f(x) = x^2 + 2x - 24 = (x^2 + 2x + 1) - 1 - 24 = (x + 1)^2 - 25$$

Since the square of a real number is always nonnegative, the vertex form $f(x) = (x + 1)^2 - 25$ shows that the minimum value of f is -25 (and occurs at $x = -1$). Therefore, this equivalent form of f shows the minimum value of f as a constant.

Choices A and C are incorrect because they are not equivalent to the given equation for f . Choice B is incorrect because the minimum value of f , which is -25 , does not appear as a constant or a coefficient.

QUESTION 29.

Choice B is correct. Since the average of 2 numbers is the sum of the 2 numbers divided by 2, the equations $x = \frac{m+9}{2}$, $y = \frac{2m+15}{2}$ and $z = \frac{3m+18}{2}$ are true. The average of x , y , and z is given by $\frac{x+y+z}{3}$. Substituting the preceding expressions in m for each variable gives $\frac{\frac{m+9}{2} + \frac{2m+15}{2} + \frac{3m+18}{2}}{3}$. This fraction can be simplified to $\frac{6m+42}{6}$, or $m+7$.

Choices A, C, and D are incorrect and may be the result of conceptual errors or calculation errors. For example, choice D is the sum of x , y , and z , not the average.

QUESTION 30.

Choice D is correct. The equation $f(x) = k$ gives the solutions to the system of equations $y = f(x) = x^3 - x^2 - x - \frac{11}{4}$ and $y = k$. A real solution of a system of two equations corresponds to a point of intersection of the graphs of the two equations in the xy -plane. The graph of $y = k$ is a horizontal line that contains the point $(0, k)$. Thus, the line with equation $y = -3$ is a horizontal line that intersects the graph of the cubic equation three times, and it follows that the equation $f(x) = -3$ has three real solutions.

Choices A, B, and C are incorrect because the graphs of the corresponding equations are horizontal lines that do not intersect the graph of the cubic equation three times.

QUESTION 31.

The correct answer is 1160. The pool contains 600 gallons of water before the hose is turned on, and water flows from the hose into the pool at a rate of 8 gallons per minute. Thus, the number of gallons of water in the pool m minutes after the hose is turned on is given by the expression $600 + 8m$. Therefore, after 70 minutes, there will be $600 + 8(70) = 1160$ gallons of water in the pool.

QUESTION 32.

The correct answer is $\frac{1}{2}$ or .5. The equation that models the normal systolic blood pressure, in millimeters of mercury, for a male x years old, $P = \frac{x + 220}{2}$, can be rewritten as $P = \frac{1}{2}x + 110$. For each increase of 1 year in age, the value of x increases by 1; hence, P becomes $\frac{1}{2}(x + 1) + 110 = \left(\frac{1}{2}x + 110\right) + \frac{1}{2}$. That is, P increases by $\frac{1}{2}$ millimeter of mercury. Either the fraction $\frac{1}{2}$ or its decimal equivalent, .5, may be gridded as the correct answer.

QUESTION 33.

The correct answer is 4.55. Since there are 16 Roman digits in a Roman pes, 75 digits is equal to $\frac{75}{16}$ pes. Since 1 pes is equal to 11.65 inches, $\frac{75}{16}$ pes is equal to $\frac{75}{16}(11.65)$ inches. Since 12 inches is equal to 1 foot, $\frac{75}{16}(11.65)$ inches is equal to $\frac{75}{16}(11.65)\left(\frac{1}{12}\right) 4.55078125$ feet. Therefore, 75 digits is equal to $\frac{75}{16}(11.65)\left(\frac{1}{12}\right) = 4.55078125$ feet. Rounded to the nearest hundredth of a foot, 75 Roman digits is equal to 4.55 feet.

QUESTION 34.

The correct answer is 150. In the study, 240 male and 160 plus another 100 female bats have been tagged, so that 500 bats have been tagged altogether. If x more male bats must be tagged for $\frac{3}{5}$ of the total number of bats to be male, the proportion $\frac{\text{male bats}}{\text{total bats}} = \frac{240 + x}{500 + x} = \frac{3}{5}$ must be true. Multiplying each side of $\frac{240 + x}{500 + x} = \frac{3}{5}$ by $5(500 + x)$ gives $5(240 + x) = 3(500 + x)$, which simplifies to $1200 + 5x = 1500 + 3x$. Therefore, $x = 150$, and 150 more male bats must be tagged; this will bring the total to 390 male bats out of 650 bats, which is equal to $\frac{3}{5}$.

QUESTION 35.

The correct answer is 2.25 or $\frac{9}{4}$. Let q_s be the dynamic pressure of the slower fluid moving with velocity v_s , and let q_f be the dynamic pressure of the faster fluid moving with velocity v_f . Then $v_f = 1.5v_s$.

Given the equation $q = \frac{1}{2}nv^2$, substituting the dynamic pressure and velocity of the faster fluid gives $q_f = \frac{1}{2}nv_f^2$. Since $v_f = 1.5v_s$, the expression $1.5v_s$ can be substituted for v_f in this equation, giving $q_f = \frac{1}{2}n(1.5v_s)^2$. This can be rewritten as $q_f = (2.25)\frac{1}{2}nv_s^2 = (2.25)q_s$. Therefore, the ratio of the dynamic pressure of the faster fluid is $\frac{q_f}{q_s} = \frac{2.25q_s}{q_s} = 2.25$. Either 2.25 or the equivalent improper fraction $\frac{9}{4}$ may be gridded as the correct answer.

QUESTION 36.

The correct answer is 29, 30, 31, 32, 33, or 34. Since the radius of the circle is 10, its circumference is 20π . The full circumference of a circle is 360° . Thus, an arc of length s on the circle corresponds to a central angle of x° , where $\frac{x}{360} = \frac{s}{20\pi}$, or $x = \frac{360}{20\pi}s$. Since $5 < s < 6$, it follows that $\frac{360}{20\pi}(5) < x < \frac{360}{20\pi}(6)$, which becomes, to the nearest tenth, $28.6 < x < 34.4$. Therefore, the possible integer values of x are 29, 30, 31, 32, 33, and 34. Any one of these numbers may be gridded as the correct answer.

QUESTION 37.

The correct answer is .72. According to the analyst's estimate, the value V , in dollars, of the stock will decrease by 28% each week for t weeks, where $t = 1, 2,$ or 3 , with its value being given by the formula $V = 360(r)^t$. This equation is an example of exponential decay. A stock losing 28% of its value each week is the same as the stock's value decreasing to 72% of its value from the previous week, since $V - (.28)V = (.72)V$. Using this information, after 1 week the value, in dollars, of the stock will be $V = 360(.72)$; after 2 weeks the value of the stock will be $V = 360(.72)(.72) = 360(.72)^2$; and after 3 weeks the value of the stock will be $V = 360(.72)(.72)(.72) = 360(.72)^3$. For all of the values of t in question, namely $t = 1, 2,$ and 3 , the equation $V = 360(.72)^t$ is true. Therefore, the analyst should use .72 as the value of r .

QUESTION 38.

The correct answer is 134. The analyst's prediction is that the stock will lose 28 percent of its value for each of the next three weeks. Thus, the predicted value of the stock after 1 week is $\$360 - (0.28)\$360 = \$259.20$; after 2 weeks, $\$259.20 - (0.28)\$259.20 \approx \$186.62$; and after 3 weeks, $\$186.62 - (0.28)\$186.62 \approx \$134.37$. Therefore, to the nearest dollar, the stock analyst believes the stock will be worth 134 dollars after three weeks.

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Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

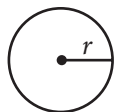
DIRECTIONS

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

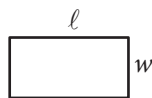
- The use of a calculator **is not permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated,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

REFERENCE

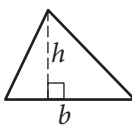


$$A = \pi r^2$$

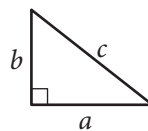
$$C = 2\pi r$$



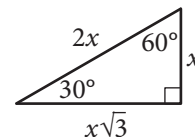
$$A = \ell w$$



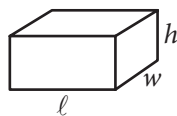
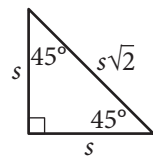
$$A = \frac{1}{2}bh$$



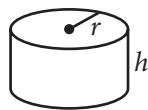
$$c^2 = a^2 + b^2$$



Special Right Triangles



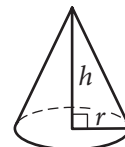
$$V = \ell wh$$



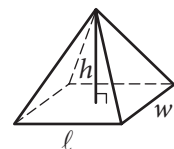
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}\ell wh$$

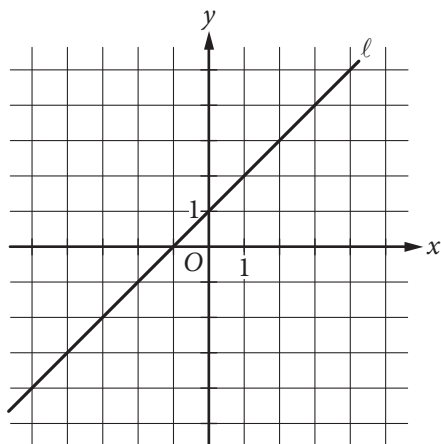
The number of degrees of arc in a circle is 360.

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.



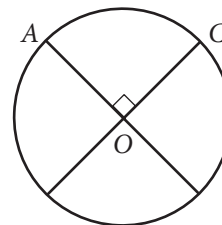
1



Which of the following is an equation of line l in the xy -plane above?

- A) $x = 1$
- B) $y = 1$
- C) $y = x$
- D) $y = x + 1$

2



The circle above with center O has a circumference of 36. What is the length of minor arc \widehat{AC} ?

- A) 9
- B) 12
- C) 18
- D) 36

3

What are the solutions of the quadratic equation $4x^2 - 8x - 12 = 0$?

- A) $x = -1$ and $x = -3$
- B) $x = -1$ and $x = 3$
- C) $x = 1$ and $x = -3$
- D) $x = 1$ and $x = 3$



4

Which of the following is an example of a function whose graph in the xy -plane has no x -intercepts?

- A) A linear function whose rate of change is not zero
- B) A quadratic function with real zeros
- C) A quadratic function with no real zeros
- D) A cubic polynomial with at least one real zero

5

$$\sqrt{k+2} - x = 0$$

In the equation above, k is a constant. If $x = 9$, what is the value of k ?

- A) 1
- B) 7
- C) 16
- D) 79

6

Which of the following is equivalent to the sum of the expressions $a^2 - 1$ and $a + 1$?

- A) $a^2 + a$
- B) $a^3 - 1$
- C) $2a^2$
- D) a^3

7

Jackie has two summer jobs. She works as a tutor, which pays \$12 per hour, and she works as a lifeguard, which pays \$9.50 per hour. She can work no more than 20 hours per week, but she wants to earn at least \$220 per week. Which of the following systems of inequalities represents this situation in terms of x and y , where x is the number of hours she tutors and y is the number of hours she works as a lifeguard?

- A) $12x + 9.5y \leq 220$
 $x + y \geq 20$
- B) $12x + 9.5y \leq 220$
 $x + y \leq 20$
- C) $12x + 9.5y \geq 220$
 $x + y \leq 20$
- D) $12x + 9.5y \geq 220$
 $x + y \geq 20$



8

In air, the speed of sound S , in meters per second, is a linear function of the air temperature T , in degrees Celsius, and is given by $S(T) = 0.6T + 331.4$. Which of the following statements is the best interpretation of the number 331.4 in this context?

- A) The speed of sound, in meters per second, at 0°C
- B) The speed of sound, in meters per second, at 0.6°C
- C) The increase in the speed of sound, in meters per second, that corresponds to an increase of 1°C
- D) The increase in the speed of sound, in meters per second, that corresponds to an increase of 0.6°C

9

$$y = x^2$$
$$2y + 6 = 2(x + 3)$$

If (x, y) is a solution of the system of equations above and $x > 0$, what is the value of xy ?

- A) 1
- B) 2
- C) 3
- D) 9

10

If $a^2 + b^2 = z$ and $ab = y$, which of the following is equivalent to $4z + 8y$?

- A) $(a + 2b)^2$
- B) $(2a + 2b)^2$
- C) $(4a + 4b)^2$
- D) $(4a + 8b)^2$



11

The volume of right circular cylinder A is 22 cubic centimeters. What is the volume, in cubic centimeters, of a right circular cylinder with twice the radius and half the height of cylinder A?

- A) 11
- B) 22
- C) 44
- D) 66

12

Which of the following is equivalent to $9^{\frac{3}{4}}$?

- A) $\sqrt[3]{9}$
- B) $\sqrt[4]{9}$
- C) $\sqrt{3}$
- D) $3\sqrt{3}$

13

At a restaurant, n cups of tea are made by adding t tea bags to hot water. If $t = n + 2$, how many additional tea bags are needed to make each additional cup of tea?

- A) None
- B) One
- C) Two
- D) Three

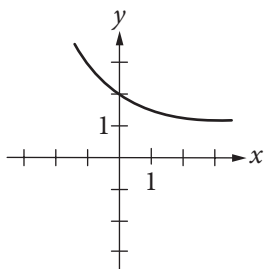


14

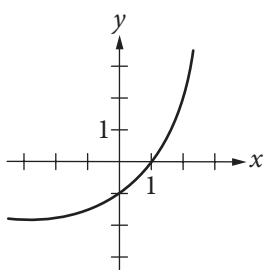
$$f(x) = 2^x + 1$$

The function f is defined by the equation above. Which of the following is the graph of $y = -f(x)$ in the xy -plane?

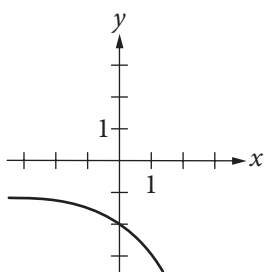
A)



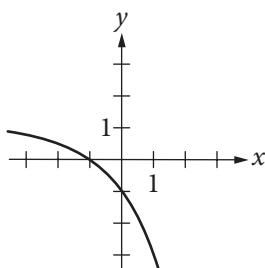
B)



C)



D)



15

Alan drives an average of 100 miles each week. His car can travel an average of 25 miles per gallon of gasoline. Alan would like to reduce his weekly expenditure on gasoline by \$5. Assuming gasoline costs \$4 per gallon, which equation can Alan use to determine how many fewer average miles, m , he should drive each week?

A) $\frac{25}{4}m = 95$

B) $\frac{25}{4}m = 5$

C) $\frac{4}{25}m = 95$

D) $\frac{4}{25}m = 5$



DIRECTIONS

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

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

3	1	/	2
○	○	○	○

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

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

	7	/	1	2
○	○	○	○	○
○	○	○	○	○
○	○	○	○	○
○	○	○	○	○
○	○	○	○	○
○	○	○	○	○
○	○	○	○	○
○	○	○	○	○
○	○	○	○	○
○	○	○	○	○
○	○	○	○	○

← Fraction line

Answer: 2.5

	2	.	5
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○

← Decimal point

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

	2	/	3
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
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○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○

.	6	6	6
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○

.	6	6	7
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○

Answer: 201 – either position is correct

	2	0	1
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○

2	0	1	
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○
○	○	○	○

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



16

Maria plans to rent a boat. The boat rental costs \$60 per hour, and she will also have to pay for a water safety course that costs \$10. Maria wants to spend no more than \$280 for the rental and the course. If the boat rental is available only for a whole number of hours, what is the maximum number of hours for which Maria can rent the boat?

17

$$2(p + 1) + 8(p - 1) = 5p$$

What value of p is the solution of the equation above?

18

$$\begin{aligned}\frac{1}{2}(2x + y) &= \frac{21}{2} \\ y &= 2x\end{aligned}$$

The system of equations above has solution (x, y) .
What is the value of x ?



19

$$\frac{2x+6}{(x+2)^2} - \frac{2}{x+2}$$

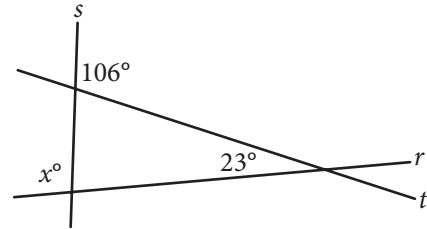
The expression above is equivalent to $\frac{a}{(x+2)^2}$,

where a is a positive constant and $x \neq -2$.

What is the value of a ?

20

Intersecting lines r , s , and t are shown below.



What is the value of x ?

STOP

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

No Test Material On This Page



Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

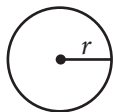
DIRECTIONS

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

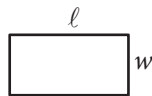
- The use of a calculator **is permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated, the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

REFERENCE

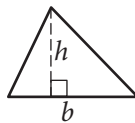


$$A = \pi r^2$$

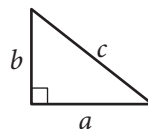
$$C = 2\pi r$$



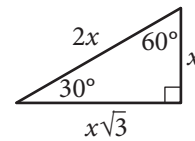
$$A = \ell w$$



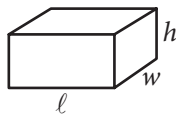
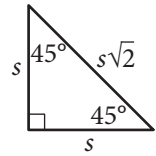
$$A = \frac{1}{2}bh$$



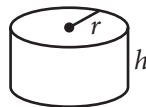
$$c^2 = a^2 + b^2$$



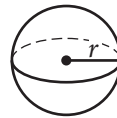
Special Right Triangles



$$V = \ell wh$$



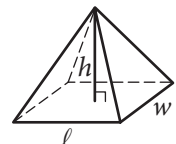
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}\ell wh$$

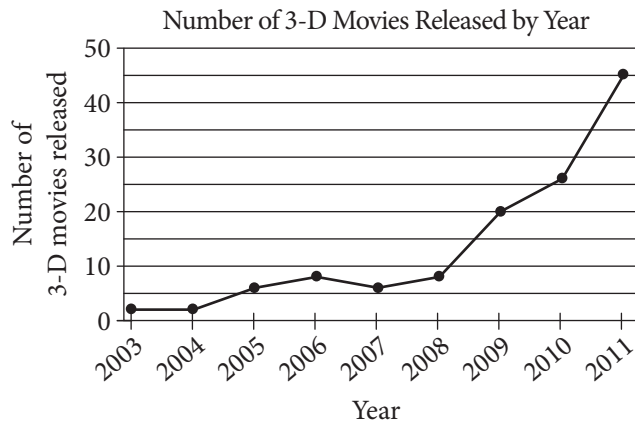
The number of degrees of arc in a circle is 360.

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.



1



According to the line graph above, between which two consecutive years was there the greatest change in the number of 3-D movies released?

- A) 2003–2004
- B) 2008–2009
- C) 2009–2010
- D) 2010–2011

2

x	$f(x)$
1	5
3	13
5	21

Some values of the linear function f are shown in the table above. Which of the following defines f ?

- A) $f(x) = 2x + 3$
- B) $f(x) = 3x + 2$
- C) $f(x) = 4x + 1$
- D) $f(x) = 5x$

3

To make a bakery's signature chocolate muffins, a baker needs 2.5 ounces of chocolate for each muffin. How many pounds of chocolate are needed to make 48 signature chocolate muffins?
(1 pound = 16 ounces)

- A) 7.5
- B) 10
- C) 50.5
- D) 120



4

If $3(c + d) = 5$, what is the value of $c + d$?

- A) $\frac{3}{5}$
- B) $\frac{5}{3}$
- C) 3
- D) 5

5

The weight of an object on Venus is approximately $\frac{9}{10}$ of its weight on Earth. The weight of an object on Jupiter is approximately $\frac{23}{10}$ of its weight on Earth. If an object weighs 100 pounds on Earth, approximately how many more pounds does it weigh on Jupiter than it weighs on Venus?

- A) 90
- B) 111
- C) 140
- D) 230

6

An online bookstore sells novels and magazines. Each novel sells for \$4, and each magazine sells for \$1. If Sadie purchased a total of 11 novels and magazines that have a combined selling price of \$20, how many novels did she purchase?

- A) 2
- B) 3
- C) 4
- D) 5



7

The Downtown Business Association (DBA) in a certain city plans to increase its membership by a total of n businesses per year. There were b businesses in the DBA at the beginning of this year. Which function best models the total number of businesses, y , the DBA plans to have as members x years from now?

- A) $y = nx + b$
- B) $y = nx - b$
- C) $y = b(n)^x$
- D) $y = n(b)^x$

8

Which of the following is an equivalent form of $(1.5x - 2.4)^2 - (5.2x^2 - 6.4)$?

- A) $-2.2x^2 + 1.6$
- B) $-2.2x^2 + 11.2$
- C) $-2.95x^2 - 7.2x + 12.16$
- D) $-2.95x^2 - 7.2x + 0.64$

9

In the 1908 Olympic Games, the Olympic marathon was lengthened from 40 kilometers to approximately 42 kilometers. Of the following, which is closest to the increase in the distance of the Olympic marathon, in miles? (1 mile is approximately 1.6 kilometers.)

- A) 1.00
- B) 1.25
- C) 1.50
- D) 1.75



10

The density d of an object is found by dividing the mass m of the object by its volume V . Which of the following equations gives the mass m in terms of d and V ?

- A) $m = dV$
- B) $m = \frac{d}{V}$
- C) $m = \frac{V}{d}$
- D) $m = V + d$

11

$$-2x + 3y = 6$$

In the xy -plane, the graph of which of the following equations is perpendicular to the graph of the equation above?

- A) $3x + 2y = 6$
- B) $3x + 4y = 6$
- C) $2x + 4y = 6$
- D) $2x + 6y = 3$

12

$$\begin{aligned}\frac{1}{2}y &= 4 \\ x - \frac{1}{2}y &= 2\end{aligned}$$

The system of equations above has solution (x, y) . What is the value of x ?

- A) 3
- B) $\frac{7}{2}$
- C) 4
- D) 6

13

$$\begin{aligned}y &\leq 3x + 1 \\ x - y &> 1\end{aligned}$$

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

- A) $(-2, -1)$
- B) $(-1, 3)$
- C) $(1, 5)$
- D) $(2, -1)$



14

Type of surgeon	Major professional activity		Total
	Teaching	Research	
General	258	156	414
Orthopedic	119	74	193
Total	377	230	607

In a survey, 607 general surgeons and orthopedic surgeons indicated their major professional activity. The results are summarized in the table above. If one of the surgeons is selected at random, which of the following is closest to the probability that the selected surgeon is an orthopedic surgeon whose indicated professional activity is research?

- A) 0.122
- B) 0.196
- C) 0.318
- D) 0.379



15

A polling agency recently surveyed 1,000 adults who were selected at random from a large city and asked each of the adults, “Are you satisfied with the quality of air in the city?” Of those surveyed, 78 percent responded that they were satisfied with the quality of air in the city. Based on the results of the survey, which of the following statements must be true?

- I. Of all adults in the city, 78 percent are satisfied with the quality of air in the city.
 - II. If another 1,000 adults selected at random from the city were surveyed, 78 percent of them would report they are satisfied with the quality of air in the city.
 - III. If 1,000 adults selected at random from a different city were surveyed, 78 percent of them would report they are satisfied with the quality of air in the city.
- A) None
 - B) II only
 - C) I and II only
 - D) I and III only

Questions 16-18 refer to the following information.

Species of tree	Growth factor
Red maple	4.5
River birch	3.5
Cottonwood	2.0
Black walnut	4.5
White birch	5.0
American elm	4.0
Pin oak	3.0
Shagbark hickory	7.5

One method of calculating the approximate age, in years, of a tree of a particular species is to multiply the diameter of the tree, in inches, by a constant called the growth factor for that species. The table above gives the growth factors for eight species of trees.

16

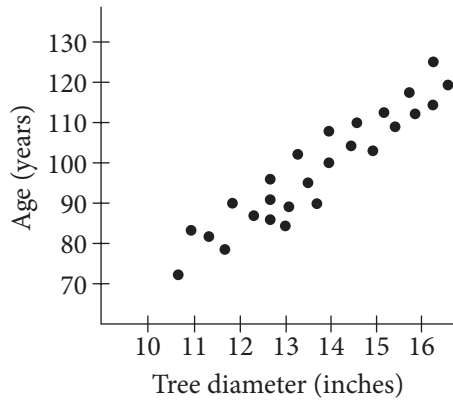
According to the information in the table, what is the approximate age of an American elm tree with a diameter of 12 inches?

- A) 24 years
- B) 36 years
- C) 40 years
- D) 48 years



17

Tree Diameter versus Age



The scatterplot above gives the tree diameter plotted against age for 26 trees of a single species. The growth factor of this species is closest to that of which of the following species of tree?

- A) Red maple
- B) Cottonwood
- C) White birch
- D) Shagbark hickory

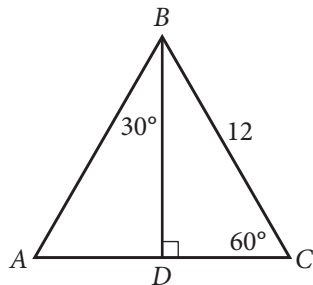
18

If a white birch tree and a pin oak tree each now have a diameter of 1 foot, which of the following will be closest to the difference, in inches, of their diameters 10 years from now? (1 foot = 12 inches)

- A) 1.0
- B) 1.2
- C) 1.3
- D) 1.4



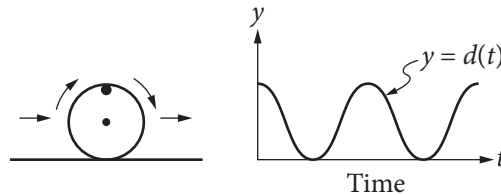
19



In $\triangle ABC$ above, what is the length of \overline{AD} ?

- A) 4
- B) 6
- C) $6\sqrt{2}$
- D) $6\sqrt{3}$

20



The figure on the left above shows a wheel with a mark on its rim. The wheel is rolling on the ground at a constant rate along a level straight path from a starting point to an ending point. The graph of $y = d(t)$ on the right could represent which of the following as a function of time from when the wheel began to roll?

- A) The speed at which the wheel is rolling
- B) The distance of the wheel from its starting point
- C) The distance of the mark on the rim from the center of the wheel
- D) The distance of the mark on the rim from the ground



21

$$\frac{a-b}{a} = c$$

In the equation above, if a is negative and b is positive, which of the following must be true?

- A) $c > 1$
- B) $c = 1$
- C) $c = -1$
- D) $c < -1$

22

In State X, Mr. Camp's eighth-grade class consisting of 26 students was surveyed and 34.6 percent of the students reported that they had at least two siblings. The average eighth-grade class size in the state is 26. If the students in Mr. Camp's class are representative of students in the state's eighth-grade classes and there are 1,800 eighth-grade classes in the state, which of the following best estimates the number of eighth-grade students in the state who have fewer than two siblings?

- A) 16,200
- B) 23,400
- C) 30,600
- D) 46,800



Questions 23 and 24 refer to the following information.

Townsend Realty Group Investments		
Property address	Purchase price (dollars)	Monthly rental price (dollars)
Clearwater Lane	128,000	950
Driftwood Drive	176,000	1,310
Edgemont Street	70,000	515
Glenview Street	140,000	1,040
Hamilton Circle	450,000	3,365

The Townsend Realty Group invested in the five different properties listed in the table above. The table shows the amount, in dollars, the company paid for each property and the corresponding monthly rental price, in dollars, the company charges for the property at each of the five locations.

23

The relationship between the monthly rental price r , in dollars, and the property's purchase price p , in thousands of dollars, can be represented by a linear function. Which of the following functions represents the relationship?

- A) $r(p) = 2.5p - 870$
- B) $r(p) = 5p + 165$
- C) $r(p) = 6.5p + 440$
- D) $r(p) = 7.5p - 10$

24

Townsend Realty purchased the Glenview Street property and received a 40% discount off the original price along with an additional 20% off the discounted price for purchasing the property in cash. Which of the following best approximates the original price, in dollars, of the Glenview Street property?

- A) \$350,000
- B) \$291,700
- C) \$233,300
- D) \$175,000



25

A psychologist set up an experiment to study the tendency of a person to select the first item when presented with a series of items. In the experiment, 300 people were presented with a set of five pictures arranged in random order. Each person was asked to choose the most appealing picture. Of the first 150 participants, 36 chose the first picture in the set. Among the remaining 150 participants, p people chose the first picture in the set. If more than 20% of all participants chose the first picture in the set, which of the following inequalities best describes the possible values of p ?

- A) $p > 0.20(300 - 36)$, where $p \leq 150$
- B) $p > 0.20(300 + 36)$, where $p \leq 150$
- C) $p - 36 > 0.20(300)$, where $p \leq 150$
- D) $p + 36 > 0.20(300)$, where $p \leq 150$

26

The surface area of a cube is $6\left(\frac{a}{4}\right)^2$, where a is a positive constant. Which of the following gives the perimeter of one face of the cube?

- A) $\frac{a}{4}$
- B) a
- C) $4a$
- D) $6a$

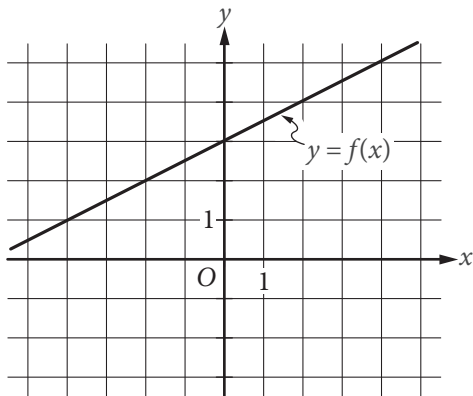
27

The mean score of 8 players in a basketball game was 14.5 points. If the highest individual score is removed, the mean score of the remaining 7 players becomes 12 points. What was the highest score?

- A) 20
- B) 24
- C) 32
- D) 36



28



The graph of the linear function f is shown in the xy -plane above. The slope of the graph of the linear function g is 4 times the slope of the graph of f . If the graph of g passes through the point $(0, -4)$, what is the value of $g(9)$?

- A) 5
- B) 9
- C) 14
- D) 18

29

$$x^2 + 20x + y^2 + 16y = -20$$

The equation above defines a circle in the xy -plane. What are the coordinates of the center of the circle?

- A) $(-20, -16)$
- B) $(-10, -8)$
- C) $(10, 8)$
- D) $(20, 16)$

30

$$y = x^2 - a$$

In the equation above, a is a positive constant and the graph of the equation in the xy -plane is a parabola. Which of the following is an equivalent form of the equation?

- A) $y = (x + a)(x - a)$
- B) $y = (x + \sqrt{a})(x - \sqrt{a})$
- C) $y = \left(x + \frac{a}{2}\right)\left(x - \frac{a}{2}\right)$
- D) $y = (x + a)^2$

**DIRECTIONS**

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

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or $7/2$. (If $\begin{array}{|c|c|c|c|} \hline 3 & 1 & / & 2 \\ \hline \bullet & \bullet & \bullet & \bullet \\ \hline \end{array}$ is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Write answer in boxes. →

Grid in result. →

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

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

← Fraction line

Answer: 2.5

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

← Decimal point

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

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

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

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

Answer: 201 – either position is correct

	2	0	1
•	•	•	•
	0	•	0
①	①	①	•
②	•	②	②
③	③	③	③

2	0	1	
•	•	•	•
	•	0	0
①	①	•	①
•	②	②	②
③	③	③	③

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



31

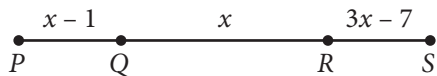
Horsepower and watts are units of measure of power. They are directly proportional such that 5 horsepower is equal to 3730 watts. How much power, in watts, is equal to 2 horsepower?

32

The painting *The Starry Night* by Vincent van Gogh is rectangular in shape with height 29 inches and width 36.25 inches. If a reproduction was made where each dimension is $\frac{1}{3}$ the corresponding original dimension, what is the height of the reproduction, in inches?



33



Note: Figure not drawn to scale.

On \overline{PS} above, $PQ = RS$. What is the length of \overline{PS} ?

34

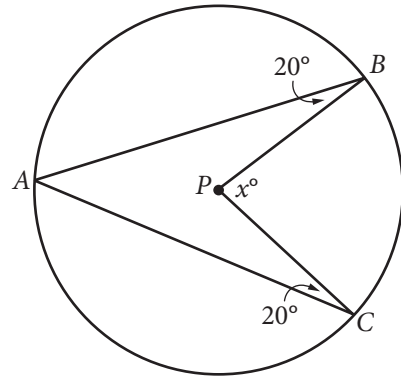
In the xy -plane, the point $(2, 5)$ lies on the graph of the function f . If $f(x) = k - x^2$, where k is a constant, what is the value of k ?



35

A landscaper is designing a rectangular garden. The length of the garden is to be 5 feet longer than the width. If the area of the garden will be 104 square feet, what will be the length, in feet, of the garden?

36



Point P is the center of the circle in the figure above. What is the value of x ?



Questions 37 and 38 refer to the following information.

Ms. Simon's Workday Morning Drive

Segment of drive	Distance (miles)	Average driving speed with no traffic delay (mph)
From home to freeway entrance	0.6	25
From freeway entrance to freeway exit	15.4	50
From freeway exit to workplace	1.4	35

Ms. Simon drives her car from her home to her workplace every workday morning. The table above shows the distance, in miles, and her average driving speed, in miles per hour (mph), when there is no traffic delay, for each segment of her drive.

37

One morning, Ms. Simon drove directly from her home to her workplace in 24 minutes. What was her average speed, in miles per hour, during her drive that morning?

38

If Ms. Simon starts her drive at 6:30 a.m., she can drive at her average driving speed with no traffic delay for each segment of the drive. If she starts her drive at 7:00 a.m., the travel time from the freeway entrance to the freeway exit increases by 33% due to slower traffic, but the travel time for each of the other two segments of her drive does not change. Based on the table, how many more minutes does Ms. Simon take to arrive at her workplace if she starts her drive at 7:00 a.m. than if she starts her drive at 6:30 a.m.? (Round your answer to the nearest minute.)

STOP

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

Choices B and C are incorrect because placing a colon before or after “such as” would create an error in sentence structure: a colon must be preceded by an independent clause. Choice D is incorrect because no comma is necessary here.

QUESTION 43

Choice A is the best answer because the transitional phrase “for example” appropriately indicates that the Help Me Investigate project discussed in the sentence is an example of the use of social media mentioned in the previous sentence.

Choices B, C, and D are incorrect because neither “therefore,” “however,” nor “in any case” indicates the true relationship between this and the previous sentence. The Help Me Investigate project discussed in the current sentence is an example of the use of social media mentioned in the previous sentence.

QUESTION 44

Choice C is the best answer because the full subject of the independent clause, “the advent of the digital age,” directly follows the dependent clause that introduces it.

Choices A, B, and D are incorrect because the subjects of their independent clauses do not directly follow the introductory dependent clause. “Far from marking the end of investigative journalism” refers to the “advent of the digital age,” not to “cooperation among journalists” (choice A) or “the number of potential investigators” (choice B). In choice D, an interrupting phrase (“by facilitating cooperation among journalists and ordinary citizens”) separates the subject from the dependent clause that modifies it.

Section 3: Math Test - No Calculator

QUESTION 1

Choice D is correct. From the graph, the y -intercept of line ℓ is $(0, 1)$. The line also passes through the point $(1, 2)$. Therefore the slope of the line is $\frac{2-1}{1-0} = \frac{1}{1} = 1$, and in slope-intercept form, the equation for line ℓ is $y = x + 1$.

Choice A is incorrect. It is the equation of the vertical line that passes through the point $(1, 0)$. Choice B is incorrect. It is the equation of the horizontal line that passes through the point $(0, 1)$. Choice C is incorrect. The line defined by this equation has y -intercept $(0, 0)$, whereas line ℓ has y -intercept $(0, 1)$.

QUESTION 2

Choice A is correct. A circle has 360 degrees of arc. In the circle shown, O is the center of the circle and angle AOC is a central angle of the circle. From the figure, the two diameters that meet to form angle AOC are perpendicular, so the measure of angle AOC is 90° . This central angle intercepts minor arc AC , meaning minor arc AC has 90° of arc. Since the circumference (length) of the entire circle is 36, the length of minor arc AC is $\frac{90}{360} \times 36 = 9$.

Choices B, C, and D are incorrect. The perpendicular diameters divide the circumference of the circle into four equal arcs; therefore, minor arc AC is $\frac{1}{4}$ of the circumference. However, the lengths in choices B and C are, respectively, $\frac{1}{3}$ and $\frac{1}{2}$ the circumference of the circle, and the length in choice D is the length of the entire circumference. None of these lengths is $\frac{1}{4}$ the circumference.

QUESTION 3

Choice B is correct. Dividing both sides of the quadratic equation $4x^2 - 8x - 12 = 0$ by 4 yields $x^2 - 2x - 3 = 0$. The equation $x^2 - 2x - 3 = 0$ can be factored as $(x + 1)(x - 3) = 0$. This equation is true when $x + 1 = 0$ or $x - 3 = 0$. Solving for x gives the solutions to the original quadratic equation: $x = -1$ and $x = 3$.

Choices A and C are incorrect because -3 is not a solution of $4x^2 - 8x - 12 = 0$: $4(-3)^2 - 8(-3) - 12 = 36 + 24 - 12 \neq 0$. Choice D is incorrect because 1 is not a solution of $4x^2 - 8x - 12 = 0$: $4(1)^2 - 8(1) - 12 = 4 - 8 - 12 \neq 0$.

QUESTION 4

Choice C is correct. If f is a function of x , then the graph of f in the xy -plane consists of all points $(x, f(x))$. An x -intercept is where the graph intersects the x -axis; since all points on the x -axis have y -coordinate 0, the graph of f will cross the x -axis at values of x such that $f(x) = 0$. Therefore, the graph of a function f will have no x -intercepts if and only if f has no real zeros. Likewise, the graph of a quadratic function with no real zeros will have no x -intercepts.

Choice A is incorrect. The graph of a linear function in the xy -plane whose rate of change is not zero is a line with a nonzero slope. The x -axis is a horizontal line and thus has slope 0, so the graph of the linear function whose rate of change is not zero is a line that is not parallel to the x -axis. Thus, the graph must intersect the x -axis at some point, and this point is an x -intercept.

of the graph. Choices B and D are incorrect because the graph of any function with a real zero must have an x -intercept.

QUESTION 5

Choice D is correct. If $x = 9$ in the equation $\sqrt{k+2} - x = 0$, this equation becomes $\sqrt{k+2} - 9 = 0$, which can be rewritten as $\sqrt{k+2} = 9$. Squaring each side of $\sqrt{k+2} = 9$ gives $k + 2 = 81$, or $k = 79$. Substituting $k = 79$ into the equation $\sqrt{k+2} - 9 = 0$ confirms this is the correct value for k .

Choices A, B, and C are incorrect because substituting any of these values for k in the equation $\sqrt{k+2} - 9 = 0$ gives a false statement. For example, if $k = 7$, the equation becomes $\sqrt{7+2} - 9 = \sqrt{9} - 9 = 3 - 9 = 0$, which is false.

QUESTION 6

Choice A is correct. The sum of $(a^2 - 1)$ and $(a + 1)$ can be rewritten as $(a^2 - 1) + (a + 1)$, or $a^2 - 1 + a + 1$, which is equal to $a^2 + a + 0$. Therefore, the sum of the two expressions is equal to $a^2 + a$.

Choices B and D are incorrect. Since neither of the two expressions has a term with a^3 , the sum of the two expressions cannot have the term a^3 when simplified. Choice C is incorrect. This choice may result from mistakenly adding the terms a^2 and a to get $2a^2$.

QUESTION 7

Choice C is correct. If Jackie works x hours as a tutor, which pays \$12 per hour, she earns $12x$ dollars. If Jackie works y hours as a lifeguard, which pays \$9.50 per hour, she earns $9.5y$ dollars. Thus the total, in dollars, Jackie earns in a week that she works x hours as a tutor and y hours as a lifeguard is $12x + 9.5y$. Therefore, the condition that Jackie wants to earn at least \$220 is represented by the inequality $12x + 9.5y \geq 220$. The condition that Jackie can work no more than 20 hours per week is represented by the inequality $x + y \leq 20$. These two inequalities form the system shown in choice C.

Choice A is incorrect. This system represents the conditions that Jackie earns no more than \$220 and works at least 20 hours. Choice B is incorrect. The first inequality in this system represents the condition that Jackie earns no more than \$220. Choice D is incorrect. The second inequality in this system represents the condition that Jackie works at least 20 hours.

QUESTION 8

Choice A is correct. The constant term 331.4 in $S(T) = 0.6T + 331.4$ is the value of S when $T = 0$. The value $T = 0$ corresponds to a temperature of 0°C . Since $S(T)$ represents the speed of sound, 331.4 is the speed of sound, in meters per second, when the temperature is 0°C .

Choice B is incorrect. When $T = 0.6^\circ\text{C}$, $S(T) = 0.6(0.6) + 331.4 = 331.76$, not 331.4, meters per second. Choice C is incorrect. Based on the given formula, the speed of sound increases by 0.6 meters per second for every increase of temperature by 1°C , as shown by the equation $0.6(T + 1) + 331.4 = (0.6T + 331.4) + 0.6$. Choice D is incorrect. An increase in the speed of sound, in meters per second, that corresponds to an increase of 0.6°C is $0.6(0.6) = 0.36$.

QUESTION 9

Choice A is correct. Substituting x^2 for y in the second equation gives $2(x^2) + 6 = 2(x + 3)$. This equation can be solved as follows:

$$2x^2 + 6 = 2x + 6 \text{ (Apply the distributive property.)}$$

$$2x^2 + 6 - 2x - 6 = 0 \text{ (Subtract } 2x \text{ and } 6 \text{ from both sides of the equation.)}$$

$$2x^2 - 2x = 0 \text{ (Combine like terms.)}$$

$$2x(x - 1) = 0 \text{ (Factor both terms on the left side of the equation by } 2x\text{.)}$$

Thus, $x = 0$ and $x = 1$ are the solutions to the system. Since $x > 0$, only $x = 1$ needs to be considered. The value of y when $x = 1$ is $y = x^2 = 1^2 = 1$. Therefore, the value of xy is $(1)(1) = 1$.

Choices B, C, and D are incorrect and likely result from a computational or conceptual error when solving this system of equations.

QUESTION 10

Choice B is correct. Substituting $a^2 + b^2$ for z and ab for y into the expression $4z + 8y$ gives $4(a^2 + b^2) + 8ab$. Multiplying $a^2 + b^2$ by 4 gives $4a^2 + 4b^2 + 8ab$, or equivalently $4(a^2 + 2ab + b^2)$. Since $(a^2 + 2ab + b^2) = (a + b)^2$, it follows that $4z + 8y$ is equivalent to $(2a + 2b)^2$.

Choices A, C, and D are incorrect and likely result from errors made when substituting or factoring.

QUESTION 11

Choice C is correct. The volume of right circular cylinder A is given by the expression $\pi r^2 h$, where r is the radius of its circular base and h is its height. The volume of a cylinder with twice

the radius and half the height of cylinder A is given by $\pi(2r)^2(\frac{1}{2})h$, which is equivalent to $4\pi r^2(\frac{1}{2})h = 2\pi r^2h$. Therefore, the volume is twice the volume of cylinder A, or $2 \times 22 = 44$.

Choice A is incorrect and likely results from not multiplying the radius of cylinder A by 2. Choice B is incorrect and likely results from not squaring the 2 in $2r$ when applying the volume formula. Choice D is incorrect and likely results from a conceptual error.

QUESTION 12

Choice D is correct. Since 9 can be rewritten as 3^2 , $9^{\frac{3}{4}}$ is equivalent to $3^{2(\frac{3}{4})}$. Applying the properties of exponents, this can be written as $3^{\frac{3}{2}}$, which can further be rewritten as $3^{\frac{2}{2}}(3^{\frac{1}{2}})$, an expression that is equivalent to $3\sqrt{3}$.

Choice A is incorrect; it is equivalent to $9^{\frac{1}{3}}$. Choice B is incorrect; it is equivalent to $9^{\frac{1}{4}}$. Choice C is incorrect; it is equivalent to $3^{\frac{1}{2}}$.

QUESTION 13

Choice B is correct. When n is increased by 1, t increases by the coefficient of n , which is 1.

Choices A, C, and D are incorrect and likely result from a conceptual error when interpreting the equation.

QUESTION 14

Choice C is correct. The graph of $y = -f(x)$ is the graph of the equation $y = -(2^x + 1)$, or $y = -2^x - 1$. This should be the graph of a decreasing exponential function. The y -intercept of the graph can be found by substituting the value $x = 0$ into the equation, as follows: $y = -2^0 - 1 = -1 - 1 = -2$. Therefore, the graph should pass through the point $(0, -2)$. Choice C is the only function that passes through this point.

Choices A and B are incorrect because the graphed functions are increasing instead of decreasing. Choice D is incorrect because the function passes through the point $(0, -1)$ instead of $(0, -2)$.

QUESTION 15

Choice D is correct. Since gasoline costs \$4 per gallon, and since Alan’s car travels an average of 25 miles per gallon, the expression $\frac{4}{25}$ gives the cost, in dollars per mile, to drive the car.

Multiplying $\frac{4}{25}$ by m gives the cost for Alan to drive m miles in his car. Alan wants to reduce his weekly spending by \$5, so setting $\frac{4}{25}m$ equal to 5 gives the number of miles, m , by which he must reduce his driving.

Choices A, B, and C are incorrect. Choices A and B transpose the numerator and the denominator in the fraction. The fraction $\frac{25}{4}$ would result in the unit miles per dollar, but the question requires a unit of dollars per mile. Choices A and C set the expression equal to 95 instead of 5, a mistake that may result from a misconception that Alan wants to reduce his driving by 5 miles each week; instead, the question says he wants to reduce his weekly expenditure by \$5.

QUESTION 16

The correct answer is 4. The equation $60h + 10 \leq 280$, where h is the number of hours the boat has been rented, can be written to represent the situation. Subtracting 10 from both sides and then dividing by 60 yields $h \leq 4.5$. Since the boat can be rented only for whole numbers of hours, the maximum number of hours for which Maria can rent the boat is 4.

QUESTION 17

The correct answer is $\frac{6}{5}$, or 1.2. To solve the equation $2(p + 1) + 8(p - 1) = 5p$, first distribute the terms outside the parentheses to the terms inside the parentheses: $2p + 2 + 8p - 8 = 5p$. Next, combine like terms on the left side of the equal sign: $10p - 6 = 5p$. Subtracting $10p$ from both sides yields $-6 = -5p$. Finally, dividing both sides by -5 gives $p = \frac{6}{5} = 1.2$. Either $\frac{6}{5}$ or 1.2 can be gridded as the correct answer.

QUESTION 18

The correct answer is $\frac{21}{4}$, or 5.25. Use substitution to create a one-variable equation that can be solved for x . The second equation gives that $y = 2x$. Substituting $2x$ for y in the first equation gives $\frac{1}{2}(2x + 2x) = \frac{21}{2}$. Dividing both sides of this equation by $\frac{1}{2}$ yields $(2x + 2x) = 21$. Combining

like terms results in $4x = 21$. Finally, dividing both sides by 4 gives $x = \frac{21}{4} = 5.25$. Either $21/4$ or 5.25 can be gridded as the correct answer.

QUESTION 19

The correct answer is 2. The given expression can be rewritten as $\frac{2x+6}{(x+2)^2} - \frac{2x+4}{(x+2)^2}$, which is equivalent to $\frac{2x+6-2x-4}{(x+2)^2}$, or $\frac{2}{(x+2)^2}$. This is in the form $\frac{a}{(x+2)^2}$; therefore, $a = 2$.

QUESTION 20

The correct answer is 97. The intersecting lines form a triangle, and the angle with measure of x° is an exterior angle of this triangle. The measure of an exterior angle of a triangle is equal to the sum of the measures of the two nonadjacent interior angles of the triangle. One of these angles has measure of 23° and the other, which is supplementary to the angle with measure 106° , has measure of $180^\circ - 106^\circ = 74^\circ$. Therefore, the value of x is $23 + 74 = 97$.

Section 4: Math Test - Calculator

QUESTION 1

Choice D is correct. The change in the number of 3-D movies released between any two consecutive years can be found by first estimating the number of 3-D movies released for each of the two years and then finding the positive difference between these two estimates. Between 2003 and 2004, this change is approximately $2 - 2 = 0$ movies; between 2008 and 2009, this change is approximately $20 - 8 = 12$ movies; between 2009 and 2010, this change is approximately $26 - 20 = 6$ movies; and between 2010 and 2011, this change is approximately $46 - 26 = 20$ movies. Therefore, of the pairs of consecutive years in the choices, the greatest increase in the number of 3-D movies released occurred during the time period between 2010 and 2011.

Choices A, B, and C are incorrect. Between 2010 and 2011, approximately 20 more 3-D movies were released. The change in the number of 3-D movies released between any of the other pairs of consecutive years is significantly smaller than 20.

QUESTION 2

Choice C is correct. Because f is a linear function of x , the equation $f(x) = mx + b$, where m and b are constants, can be used to define the relationship between x and $f(x)$. In this equation, m represents the increase in the value of $f(x)$ for every increase in the value of x by 1. From the table, it can be determined that the value of $f(x)$ increases by 8 for every increase in the value of x by 2. In other words, for the function f the value of m is $\frac{8}{2}$, or 4. The value of b can be found by substituting the values of x and $f(x)$ from any row of the table and the value of m into the equation $f(x) = mx + b$ and solving for b . For example, using $x = 1$, $f(x) = 5$, and $m = 4$ yields $5 = 4(1) + b$. Solving for b yields $b = 1$. Therefore, the equation defining the function f can be written in the form $f(x) = 4x + 1$.

Choices A, B, and D are incorrect. Any equation defining the linear function f must give values of $f(x)$ for corresponding values of x , as shown in each row of the table. According to the table, if $x = 3$, $f(x) = 13$. However, substituting $x = 3$ into the equation given in choice A gives $f(3) = 2(3) + 3$, or $f(3) = 9$, not 13. Similarly, substituting $x = 3$ into the equation given in choice B gives $f(3) = 3(3) + 2$, or $f(3) = 11$, not 13. Lastly, substituting $x = 3$ into the equation given in choice D gives $f(3) = 5(3)$, or $f(3) = 15$, not 13. Therefore, the equations in choices A, B, and D cannot define f .

QUESTION 3

Choice A is correct. If 2.5 ounces of chocolate are needed for each muffin, then the number of ounces of chocolate needed to make 48 muffins is $48 \times 2.5 = 120$ ounces. Since 1 pound = 16 ounces, the number of pounds that is equivalent to 120 ounces is $\frac{120}{16} = 7.5$ pounds. Therefore, 7.5 pounds of chocolate are needed to make the 48 muffins.

Choice B is incorrect. If 10 pounds of chocolate were needed to make 48 muffins, then the total number of ounces of chocolate needed would be $10 \times 16 = 160$ ounces. The number of ounces of chocolate per muffin would then be $\frac{160}{48} = 3.33$ ounces per muffin, not 2.5 ounces per muffin. Choices C and D are also incorrect. Following the same procedures as used to test choice B gives 16.8 ounces per muffin for choice C and 40 ounces per muffin for choice D, not 2.5 ounces per muffin. Therefore, 50.5 and 120 pounds cannot be the number of pounds needed to make 48 signature chocolate muffins.

QUESTION 4

Choice B is correct. The value of $c + d$ can be found by dividing both sides of the given equation by 3. This yields $c + d = \frac{5}{3}$.

Choice A is incorrect. If the value of $c + d$ is $\frac{3}{5}$, then $3 \times \frac{3}{5} = \frac{9}{5}$; however, $\frac{9}{5}$ is not equal to 5.

Choice C is incorrect. If the value of $c + d$ is 3, then $3 \times 3 = 9$; however, 9 is not equal to 5.

Choice D is incorrect. If the value of $c + d$ is 5, then $3 \times 5 = 15$; however, 15 is not equal to 5.

QUESTION 5

Choice C is correct. The weight of an object on Venus is approximately $\frac{9}{10}$ of its weight on Earth. If an object weighs 100 pounds on Earth, then the object's weight on Venus is given by $\frac{9}{10}(100) = 90$ pounds. The same object's weight on Jupiter is approximately $\frac{23}{10}$ of its weight on Earth; therefore, the object weighs $\frac{23}{10}(100) = 230$ pounds on Jupiter. The difference between the object's weight on Jupiter and the object's weight on Venus is $230 - 90 = 140$ pounds. Therefore, an object that weighs 100 pounds on Earth weighs 140 more pounds on Jupiter than it weighs on Venus.

Choice A is incorrect because it is the weight, in pounds, of the object on Venus. Choice B is incorrect because it is the weight, in pounds, of an object on Earth if it weighs 100 pounds on Venus. Choice D is incorrect because it is the weight, in pounds, of the object on Jupiter.

QUESTION 6

Choice B is correct. Let n be the number of novels and m be the number of magazines that Sadie purchased. If Sadie purchased a total of 11 novels and magazines, then $n + m = 11$. It is given that the combined price of 11 novels and magazines is \$20. Since each novel sells for \$4 and each magazine sells for \$1, it follows that $4n + m = 20$. So the system of equations below must hold.

$$4n + m = 20$$

$$n + m = 11$$

Subtracting side by side the second equation from the first equation yields $3n = 9$, so $n = 3$. Therefore, Sadie purchased 3 novels.

Choice A is incorrect. If 2 novels were purchased, then a total of \$8 was spent on novels. That leaves \$12 to be spent on magazines, which means that 12 magazines would have been purchased. However, Sadie purchased a total of 11 novels and magazines. Choices C and D are incorrect. If 4 novels were purchased, then a total of \$16 was spent on novels. That leaves \$4 to be spent on magazines, which means that 4 magazines would have been purchased. By the

same logic, if Sadie purchased 5 novels, she would have no money at all (\$0) to buy magazines. However, Sadie purchased a total of 11 novels and magazines.

QUESTION 7

Choice A is correct. The DBA plans to increase its membership by n businesses each year, so x years from now, the association plans to have increased its membership by nx businesses. Since there are already b businesses at the beginning of this year, the total number of businesses, y , the DBA plans to have as members x years from now is modeled by $y = nx + b$.

Choice B is incorrect. The equation given in choice B correctly represents the increase in membership x years from now as nx . However, the number of businesses at the beginning of the year, b , has been subtracted from this amount of increase, not added to it. Choices C and D are incorrect because they use exponential models to represent the increase in membership. Since the membership increases by n businesses each year, this situation is correctly modeled by a linear relationship.

QUESTION 8

Choice C is correct. The first expression $(1.5x - 2.4)^2$ can be rewritten as $(1.5x - 2.4)(1.5x - 2.4)$. Applying the distributive property to this product yields $(2.25x^2 - 3.6x - 3.6x + 5.76) - (5.2x^2 - 6.4)$. This difference can be rewritten as $(2.25x^2 - 3.6x - 3.6x + 5.76) + (-1)(5.2x^2 - 6.4)$. Distributing the factor of -1 through the second expression yields $2.25x^2 - 3.6x - 3.6x + 5.76 - 5.2x^2 + 6.4$. Regrouping like terms, the expression becomes $(2.25x^2 - 5.2x^2) + (-3.6x - 3.6x) + (5.76 + 6.4)$. Combining like terms yields $-2.95x^2 - 7.2x + 12.16$.

Choices A, B, and D are incorrect and likely result from errors made when applying the distributive property or combining the resulting like terms.

QUESTION 9

Choice B is correct. In 1908, the marathon was lengthened by $42 - 40 = 2$ kilometers. Since 1 mile is approximately 1.6 kilometers, the increase of 2 kilometers can be converted to miles by multiplying as shown: $2 \text{ kilometers} \times \frac{1 \text{ mile}}{1.6 \text{ kilometers}} = 1.25 \text{ miles}$.

Choices A, C, and D are incorrect and may result from errors made when applying the conversion rate or other computational errors.

QUESTION 10

Choice A is correct. The density d of an object can be found by dividing the mass m of the object by its volume V . Symbolically this is expressed by the equation $d = \frac{m}{V}$. Solving this equation for m yields $m = dV$.

Choices B, C, and D are incorrect and are likely the result of errors made when translating the definition of density into an algebraic equation and errors made when solving this equation for m . If the equations given in choices B, C, and D are each solved for density d , none of the resulting equations are equivalent to $d = \frac{m}{V}$.

QUESTION 11

Choice A is correct. The equation $-2x + 3y = 6$ can be rewritten in the slope-intercept form as follows: $y = \frac{2}{3}x + 2$. So the slope of the graph of the given equation is $\frac{2}{3}$. In the xy -plane, when two nonvertical lines are perpendicular, the product of their slopes is -1 . So, if m is the slope of a line perpendicular to the line with equation $y = \frac{2}{3}x + 2$, then $m \times \frac{2}{3} = -1$, which yields $m = -\frac{3}{2}$. Of the given choices, only the equation in choice A can be rewritten in the form $y = -\frac{3}{2}x + b$, for some constant b . Therefore, the graph of the equation in choice A is perpendicular to the graph of the given equation.

Choices B, C, and D are incorrect because the graphs of the equations in these choices have slopes, respectively, of $-\frac{3}{4}$, $-\frac{1}{2}$, and $-\frac{1}{3}$, not $-\frac{3}{2}$.

QUESTION 12

Choice D is correct. Adding the two equations side by side eliminates y and yields $x = 6$, as shown.

$$\begin{array}{r} \frac{1}{2}y = 4 \\ x - \frac{1}{2}y = 2 \\ \hline x + 0 = 6 \end{array}$$

If (x, y) is a solution to the system, then (x, y) satisfies both equations in the system and any equation derived from them. Therefore, $x = 6$.

Choices A, B, and C are incorrect and may be the result of errors when solving the system.

QUESTION 13

Choice D is correct. Any point (x, y) that is a solution to the given system of inequalities must satisfy both inequalities in the system. Since the second inequality in the system can be rewritten as $y < x - 1$, the system is equivalent to the following system.

$$y \leq 3x + 1$$

$$y < x - 1$$

Since $3x + 1 > x - 1$ for $x > -1$ and $3x + 1 \leq x - 1$ for $x \leq -1$, it follows that $y < x - 1$ for $x > -1$ and $y \leq 3x + 1$ for $x \leq -1$. Of the given choices, only $(2, -1)$ satisfies these conditions because $-1 < 2 - 1 = 1$.

Alternate approach: Substituting $(2, -1)$ into the first inequality gives $-1 \leq 3(2) + 1$, or $-1 \leq 7$, which is a true statement. Substituting $(2, -1)$ into the second inequality gives $2 - (-1) > 1$, or $3 > 1$, which is a true statement. Therefore, since $(2, -1)$ satisfies both inequalities, it is a solution to the system.

Choice A is incorrect because substituting -2 for x and -1 for y in the first inequality gives $-1 \leq 3(-2) + 1$, or $-1 \leq -5$, which is false. Choice B is incorrect because substituting -1 for x and 3 for y in the first inequality gives $3 \leq 3(-1) + 1$, or $3 \leq -2$, which is false. Choice C is incorrect because substituting 1 for x and 5 for y in the first inequality gives $5 \leq 3(1) + 1$, or $5 \leq 4$, which is false.

QUESTION 14

Choice A is correct. According to the table, 74 orthopedic surgeons indicated that research is their major professional activity. Since a total of 607 surgeons completed the survey, it follows that the probability that the randomly selected surgeon is an orthopedic surgeon whose indicated major professional activity is research is 74 out of 607, or $74/607$, which is ≈ 0.122 .

Choices B, C, and D are incorrect and may be the result of finding the probability that the randomly selected surgeon is an orthopedic surgeon whose major professional activity is teaching (choice B), an orthopedic surgeon whose major professional activity is either teaching or research (choice C), or a general surgeon or orthopedic surgeon whose major professional activity is research (choice D).

QUESTION 15

Choice A is correct. Statement I need not be true. The fact that 78% of the 1,000 adults who were surveyed responded that they were satisfied with the air quality in the city does not mean that the exact same percentage of all adults in the city will be satisfied with the air quality in the city. Statement II need not be true because random samples, even when they are of the same size, are not necessarily identical with regard to percentages of people in them who have a certain opinion. Statement III need not be true for the same reason that statement II need not be true: results from different samples can vary. The variation may be even bigger for this sample since it would be selected from a different city. Therefore, none of the statements must be true.

Choices B, C, and D are incorrect because none of the statements must be true.

QUESTION 16

Choice D is correct. According to the given information, multiplying a tree species' growth factor by the tree's diameter is a method to approximate the age of the tree. Multiplying the growth factor, 4.0, of the American elm given in the table by the given diameter of 12 inches yields an approximate age of 48 years.

Choices A, B, and C are incorrect because they do not result from multiplying the given diameter of an American elm tree with that tree species' growth factor..

QUESTION 17

Choice D is correct. The growth factor of a tree species is approximated by the slope of a line of best fit that models the relationship between diameter and age. A line of best fit can be visually estimated by identifying a line that goes in the same direction of the data and where roughly half the given data points fall above and half the given data points fall below the line. Two points that fall on the line can be used to estimate the slope and y -intercept of the equation of a line of best fit. Estimating a line of best fit for the given scatterplot could give the points (11, 80) and (15, 110). Using these two points, the slope of the equation of the line of best fit can be calculated as $\frac{110-80}{15-11}$, or 7.5. The slope of the equation is interpreted as the growth factor for a species of tree. According to the table, the species of tree with a growth factor of 7.5 is shagbark hickory.

Choices A, B, and C are incorrect and likely result from errors made when estimating a line of best fit for the given scatterplot and its slope.

QUESTION 18

Choice C is correct. According to the given information, multiplying a tree species' growth factor by the tree's diameter is a method to approximate the age of the tree. A white birch with a diameter of 12 inches (or 1 foot) has a given growth factor of 5 and is approximately 60 years old. A pin oak with a diameter of 12 inches (or 1 foot) has a given growth factor of 3 and is approximately 36 years old. The diameters of the two trees 10 years from now can be found by dividing each tree's age in 10 years, 70 years, and 46 years, by its respective growth factor. This yields 14 inches and $15\frac{1}{3}$ inches. The difference between $15\frac{1}{3}$ and 14 is $1\frac{1}{3}$, or approximately 1.3 inches.

Choices A, B, and D are incorrect and a result of incorrectly calculating the diameters of the two trees in 10 years.

QUESTION 19

Choice B is correct. Triangles ADB and CDB are congruent to each other because they are both 30° - 60° - 90° triangles and share the side \overline{BD} . In triangle ADB , side \overline{AD} is opposite to the angle 30° ; therefore, the length of \overline{AD} is half the length of hypotenuse \overline{AB} . Since the triangles are congruent, $AB = BC = 12$. So the length of \overline{AD} is $\frac{12}{2} = 6$.

Choice A is incorrect. If the length of \overline{AD} were 4, then the length of \overline{AB} would be 8. However, this is incorrect because \overline{AB} is congruent to \overline{BC} , which has a length of 12. Choices C and D are also incorrect. Following the same procedures as used to test choice A gives \overline{AB} a length of $12\sqrt{2}$ for choice C and $12\sqrt{3}$ for choice D. However, these results cannot be true because \overline{AB} is congruent to \overline{BC} , which has a length of 12.

QUESTION 20

Choice D is correct. The graph on the right shows the change in distance from the ground of the mark on the rim over time. The y -intercept of the graph corresponds to the mark's position at the start of the motion ($t = 0$); at this moment, the mark is at its highest point from the ground. As the wheel rolls, the mark approaches the ground, its distance from the ground decreasing until it reaches 0—the point where it touches the ground. After that, the mark moves up and away from the ground, its distance from the ground increasing until it reaches its maximum height from the ground. This is the moment when the wheel has completed a full rotation. The remaining part of the graph shows the distance of the mark from the ground during the second rotation of the wheel. Therefore, of the given choices, only choice D is in agreement with the given information.

Choice A is incorrect because the speed at which the wheel is rolling does not change over time, meaning the graph representing the speed would be a horizontal line. Choice B is incorrect because the distance of the wheel from its starting point to its ending point increases continuously; the graph shows a quantity that changes periodically over time, alternately decreasing and increasing. Choice C is incorrect because the distance of the mark from the center of the wheel is constant and equals the radius of the wheel. The graph representing this distance would be a horizontal line, not the curved line of the graph shown.

QUESTION 21

Choice A is correct. The equation can be rewritten as $1 - \frac{b}{a} = c$, or equivalently $1 - c = \frac{b}{a}$. Since $a < 0$ and $b > 0$, it follows that $\frac{b}{a} < 0$, and so $1 - c < 0$, or equivalently $c > 1$.

Choice B is incorrect. If $c = 1$, then $a - b = a$, or $b = 0$. But it is given that $b > 0$, so $c = 1$ cannot be true. Choice C is incorrect. If $c = -1$, then $a - b = -a$, or $2a = b$. But this equation contradicts the premise that $a < 0$ and $b > 0$, so $c = -1$ cannot be true. Choice D is incorrect. For example, if $c = -2$, then $a - b = -2a$, or $3a = b$. But this contradicts the fact that a and b have opposite signs, so $c < -1$ cannot be true.

QUESTION 22

Choice C is correct. It is given that 34.6% of 26 students in Mr. Camp's class reported that they had at least two siblings. Since 34.6% of 26 is 8.996, there must have been 9 students in the class who reported having at least two siblings and 17 students who reported that they had fewer than two siblings. It is also given that the average eighth-grade class size in the state is 26 and that Mr. Camp's class is representative of all eighth-grade classes in the state. This means that in each eighth-grade class in the state there are about 17 students who have fewer than two siblings. Therefore, the best estimate of the number of eighth-grade students in the state who have fewer than two siblings is $17 \times$ (number of eighth-grade classes in the state), or $17 \times 1,800 = 30,600$.

Choice A is incorrect because 16,200 is the best estimate for the number of eighth-grade students in the state who have at least, not fewer than, two siblings. Choice B is incorrect because 23,400 is half of the estimated total number of eighth-grade students in the state; however, since the students in Mr. Camp's class are representative of students in the eighth-grade classes in the state and more than half of the students in Mr. Camp's class have fewer than two siblings, more than half of the students in each eighth-grade class in the state have fewer than two siblings, too. Choice D is incorrect because 46,800 is the estimated total number of eighth-grade students in the state.

QUESTION 23

Choice D is correct. The linear function that represents the relationship will be in the form $r(p) = ap + b$, where a and b are constants and $r(p)$ is the monthly rental price, in dollars, of a property that was purchased with p thousands of dollars. According to the table, $(70, 515)$ and $(450, 3,365)$ are ordered pairs that should satisfy the function, which leads to the system of equations below.

$$\begin{cases} 70a + b = 515 \\ 450a + b = 3,365 \end{cases}$$

Subtracting side by side the first equation from the second eliminates b and gives $380a = 2,850$; solving for a gives $a = \frac{2,850}{380} = 7.5$. Substituting 7.5 for a in the first equation of the system gives $525 + b = 515$; solving for b gives $b = -10$. Therefore, the linear function that represents the relationship is $r(p) = 7.5p - 10$.

Choices A, B, and C are incorrect because the coefficient of p , or the rate at which the rental price, in dollars, increases for every thousand-dollar increase of the purchase price is different from what is suggested by these choices. For example, the Glenview Street property was purchased for \$140,000, but the rental price that each of the functions in these choices provides is significantly off from the rental price given in the table, \$1,040.

QUESTION 24

Choice B is correct. Let x be the original price, in dollars, of the Glenview Street property. After the 40% discount, the price of the property became $0.6x$ dollars, and after the additional 20% off the discounted price, the price of the property became $0.8(0.6x)$. Thus, in terms of the original price of the property, x , the purchase price of the property is $0.48x$. It follows that $0.48x = 140,000$. Solving this equation for x gives $x = 291,666.\bar{6}$. Therefore, of the given choices, \$291,700 best approximates the original price of the Glenview Street property.

Choice A is incorrect because it is the result of dividing the purchase price of the property by 0.4, as though the purchase price were 40% of the original price. Choice C is incorrect because it is the closest to dividing the purchase price of the property by 0.6, as though the purchase price were 60% of the original price. Choice D is incorrect because it is the result of dividing the purchase price of the property by 0.8, as though the purchase price were 80% of the original price.

QUESTION 25

Choice D is correct. Of the first 150 participants, 36 chose the first picture in the set, and of the 150 remaining participants, p chose the first picture in the set. Hence, the proportion of the participants who chose the first picture in the set is $\frac{36+p}{300}$. Since more than 20% of all the participants chose the first picture, it follows that $\frac{36+p}{300} > 0.20$. This inequality can be rewritten as $p + 36 > 0.20(300)$. Since p is a number of people among the remaining 150 participants, $p \leq 150$.

Choices A, B, and C are incorrect and may be the result of some incorrect interpretations of the given information or of computational errors.

QUESTION 26

Choice B is correct. A cube has 6 faces of equal area, so if the total surface area of a cube is $6\left(\frac{a}{4}\right)^2$, then the area of one face is $\left(\frac{a}{4}\right)^2$. Likewise, the area of one face of a cube is the square of one of its sides; therefore, if the area of one face is $\left(\frac{a}{4}\right)^2$, then the length of one side of the cube is $\frac{a}{4}$. Since the perimeter of one face of a cube is four times the length of one side, the perimeter is $4\left(\frac{a}{4}\right) = a$.

Choice A is incorrect because if the perimeter of one face of the cube is $\frac{a}{4}$, then the total

surface area of the cube is $6\left(\frac{\frac{a}{4}}{4}\right)^2 = 6\left(\frac{a}{16}\right)^2$, which is not $6\left(\frac{a}{4}\right)^2$. Choice C is incorrect because if

the perimeter of one face of the cube is $4a$, then the total surface area of the cube is

$6\left(\frac{4a}{4}\right)^2 = 6a^2$, which is not $6\left(\frac{a}{4}\right)^2$. Choice D is incorrect because if the perimeter of one face of

the cube is $6a$, then the total surface area of the cube is $6\left(\frac{6a}{4}\right)^2 = 6\left(\frac{3a}{2}\right)^2$, which is not $6\left(\frac{a}{4}\right)^2$.

QUESTION 27

Choice C is correct. If the mean score of 8 players is 14.5, then the total of all 8 scores is $14.5 \times 8 = 116$. If the mean of 7 scores is 12, then the total of all 7 scores is $12 \times 7 = 84$. Since the set of 7 scores was made by removing the highest score of the set of 8 scores, then the difference between the total of all 8 scores and the total of all 7 scores is equal to the removed score: $116 - 84 = 32$.

Choice A is incorrect because if 20 is removed from the group of 8 scores, then the mean score of the remaining 7 players is $\frac{(14.5 \cdot 8) - 20}{7} \approx 13.71$, not 12. Choice B is incorrect because if 24 is removed from the group of 8 scores, then the mean score of the remaining 7 players is $\frac{(14.5 \cdot 8) - 24}{7} \approx 13.14$, not 12. Choice D is incorrect because if 36 is removed from the group of 8 scores, then the mean score of the remaining 7 players is $\frac{(14.5 \cdot 8) - 36}{7} \approx 11.43$, not 12.

QUESTION 28

Choice C is correct. The slope of a line is $\frac{\text{rise}}{\text{run}}$ and can be calculated using the coordinates of any two points on the line. For example, the graph of f passes through the points $(0, 3)$ and $(2, 4)$, so the slope of the graph of f is $\frac{4-3}{2-0} = \frac{1}{2}$. The slope of the graph of function g is 4 times the slope of the graph of f , so the slope of the graph of g is $4\left(\frac{1}{2}\right) = 2$. Since the point $(0, -4)$ is the y -intercept of g , g is defined as $g(x) = 2x - 4$. It follows that $g(9) = 2(9) - 4 = 14$.

Choice A is incorrect because if $g(9) = 5$, then the slope of the graph of function g is $\frac{-4-5}{0-9} = 1$, which is not 4 times the slope of the graph of f . Choices B and D are also incorrect. The same procedures used to test choice A yields $\frac{-4-9}{0-9} = \frac{13}{9}$ and $\frac{-4-18}{0-9} = \frac{22}{9}$ for the slope of the graph of g for choices B and D, respectively. Neither of these slopes is 4 times the slope of the graph of f .

QUESTION 29

Choice B is correct. The standard equation of a circle in the xy -plane is of the form $(x - h)^2 + (y - k)^2 = r^2$, where (h, k) are the coordinates of the center of the circle and r is the radius. To convert the given equation to the standard form, complete the squares. The first two terms need a 100 to complete the square, and the second two terms need a 64. Adding 100 and 64 to both sides of the given equation yields $(x^2 + 20x + 100) + (y^2 + 16y + 64) = -20 + 100 + 64$, which

is equivalent to $(x + 10)^2 + (y + 8)^2 = 144$. Therefore, the coordinates of the center of the circle are $(-10, -8)$.

Choice A is incorrect and is likely the result of not properly dividing when attempting to complete the square. Choice C is incorrect and is likely the result of making a sign error when evaluating the coordinates of the center. Choice D is incorrect and is likely the result of not properly dividing when attempting to complete the square and making a sign error when evaluating the coordinates of the center.

QUESTION 30

Choice B is correct. The given equation can be thought of as the difference of two squares, where one square is x^2 and the other square is $(\sqrt{a})^2$. Using the difference of squares formula, the equation can be rewritten as $y = (x + \sqrt{a})(x - \sqrt{a})$.

Choices A, C, and D are incorrect because they are not equivalent to the given equation. Choice A is incorrect because it is equivalent to $y = x^2 - a^2$. Choice C is incorrect because it is equivalent to $y = x^2 - \frac{a^2}{4}$. Choice D is incorrect because it is equivalent to $y = x^2 + 2ax + a^2$.

QUESTION 31

The correct answer is 1492. Let x be the number of watts that is equal to 2 horsepower. Since 5 horsepower is equal to 3730 watts, it follows that $\frac{2}{5} = \frac{x}{3730}$. Solving this proportion for x yields $5x = 7460$, or $x = \frac{7460}{5} = 1492$.

QUESTION 32

The correct answer is $\frac{29}{3}$. It is given that the height of the original painting is 29 inches and the reproduction's height is $\frac{1}{3}$ the original height. One-third of 29 is $\frac{29}{3}$, or $9.\bar{6}$. Either the fraction $\frac{29}{3}$ or the decimals 9.66 or 9.67 can be gridded as the correct answer.

QUESTION 33

The correct answer is 7. It is given that $PQ = RS$, and the diagram shows that $PQ = x - 1$ and $RS = 3x - 7$. Therefore, the equation $x - 1 = 3x - 7$ must be true. Solving this equation for x leads to

$2x = 6$, so $x = 3$. The length of segment PS is the sum of the lengths of PQ , QR , and RS , which is $(x - 1) + x + (3x - 7)$, or equivalently $5x - 8$. Substituting 3 for x in this expression gives $5(3) - 8 = 7$.

QUESTION 34

The correct answer is 9. Since the point $(2, 5)$ lies on the graph of $y = f(x)$ in the xy -plane, the ordered pair $(2, 5)$ must satisfy the equation $y = f(x)$. That is, $5 = f(2)$, or $5 = k - 2^2$. This equation simplifies to $5 = k - 4$. Therefore, the value of the constant k is 9.

QUESTION 35

The correct answer is 13. Let w represent the width of the rectangular garden, in feet. Since the length of the garden will be 5 feet longer than the width of the garden, the length of the garden will be $w + 5$ feet. Thus the area of the garden will be $w(w + 5)$. It is also given that the area of the garden will be 104 square feet. Therefore, $w(w + 5) = 104$, which is equivalent to $w^2 + 5w - 104 = 0$. The quadratic formula can be used or the equation above can be factored to result in $(w + 13)(w - 8) = 0$. Therefore, $w = 8$ and $w = -13$. Because width cannot be negative, the width of the garden must be 8 feet. This means the length of the garden must be $8 + 5 = 13$ feet.

QUESTION 36

The correct answer is 80. The measure of an angle inscribed in a circle is half the measure of the central angle that intercepts the same arc. That is, $m\angle A = \frac{x^\circ}{2}$. Also, the sum of the interior angles of quadrilateral $ABCP$ is 360° , and the measure of the obtuse angle P is $360^\circ - x^\circ$. Hence, $\frac{x^\circ}{2} + 20^\circ + (360^\circ - x^\circ) + 20^\circ = 360^\circ$. Simplifying this equation gives $\frac{x^\circ}{2} = 40^\circ$, and so $x = 80$.

Alternate approach: If points A and P are joined, then the triangles that will be formed, APB and APC , are isosceles because $PA = PB = PC$. It follows that the base angles on both triangles each have measure of 20° . Angle A consists of two base angles, and therefore, $m\angle A = 40^\circ$. Since the measure of an angle inscribed in a circle is half the measure of the central angle that intercepts the same arc, it follows that the value of x is 80° .

QUESTION 37

The correct answer is 43.5, 43, or 44. The distance from Ms. Simon's home to her workplace is $0.6 + 15.4 + 1.4 = 17.4$ miles. Ms. Simon took 24 minutes to drive this distance. Since there are 60 minutes in one hour, her average speed, in miles per hour, for this trip is $\frac{17.4}{24} \times 60 = 43.5$ miles per hour. Based on the directions, $87/2$ or 43.5 can be gridded as the correct answer. We

are accepting 43 and 44 as additional correct answers because the precision of the measurements provided does not support an answer with three significant digits.

QUESTION 38

The correct answer is 6. Ms. Simon travels 15.4 miles on the freeway, and her average speed for this portion of the trip is 50 miles per hour when there is no traffic delay. Therefore, when there is no traffic delay, Ms. Simon spends $\frac{15.4 \text{ miles}}{50 \text{ mph}} = 0.308$ hours on the freeway. Since there are 60 minutes in one hour, she spends $(0.308)(60) = 18.48$ minutes on the freeway when there is no delay. Leaving at 7:00 a.m. results in a trip that is 33% longer, and 33% of 18.48 minutes is 6.16; the travel time for each of the other two segments does not change. Therefore, rounded to the nearest minute, it takes Ms. Simon 6 more minutes to drive to her workplace when she leaves at 7:00 a.m.

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Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

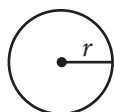
DIRECTIONS

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

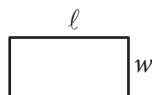
- The use of a calculator **is not permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated,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

REFERENCE

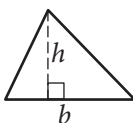


$$A = \pi r^2$$

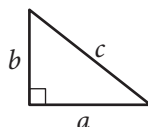
$$C = 2\pi r$$



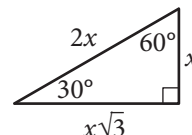
$$A = \ell w$$



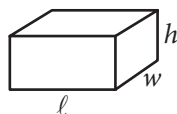
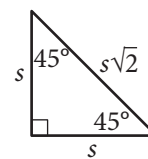
$$A = \frac{1}{2}bh$$



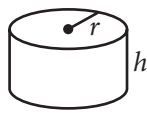
$$c^2 = a^2 + b^2$$



Special Right Triangles



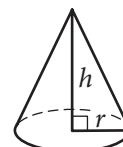
$$V = \ell wh$$



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



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



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



$$V = \frac{1}{3}\ell wh$$

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.



1

Salim wants to purchase tickets from a vendor to watch a tennis match. The vendor charges a one-time service fee for processing the purchase of the tickets. The equation $T = 15n + 12$ represents the total amount T , in dollars, Salim will pay for n tickets. What does 12 represent in the equation?

- A) The price of one ticket, in dollars
- B) The amount of the service fee, in dollars
- C) The total amount, in dollars, Salim will pay for one ticket
- D) The total amount, in dollars, Salim will pay for any number of tickets

2

A gardener buys two kinds of fertilizer. Fertilizer A contains 60% filler materials by weight and Fertilizer B contains 40% filler materials by weight. Together, the fertilizers bought by the gardener contain a total of 240 pounds of filler materials. Which equation models this relationship, where x is the number of pounds of Fertilizer A and y is the number of pounds of Fertilizer B?

- A) $0.4x + 0.6y = 240$
- B) $0.6x + 0.4y = 240$
- C) $40x + 60y = 240$
- D) $60x + 40y = 240$

3

What is the sum of the complex numbers $2 + 3i$ and $4 + 8i$, where $i = \sqrt{-1}$?

- A) 17
- B) $17i$
- C) $6 + 11i$
- D) $8 + 24i$

4

$$4x^2 - 9 = (px + t)(px - t)$$

In the equation above, p and t are constants. Which of the following could be the value of p ?

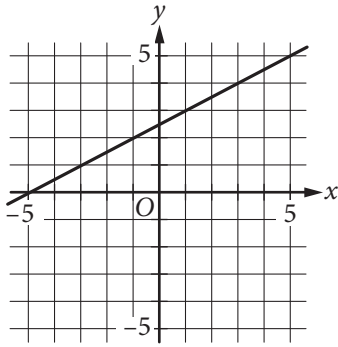
- A) 2
- B) 3
- C) 4
- D) 9



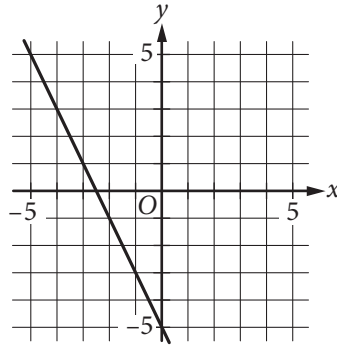
5

Which of the following is the graph of the equation $y = 2x - 5$ in the xy -plane?

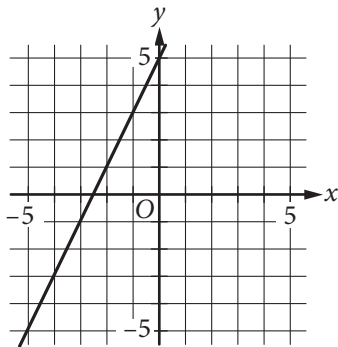
A)



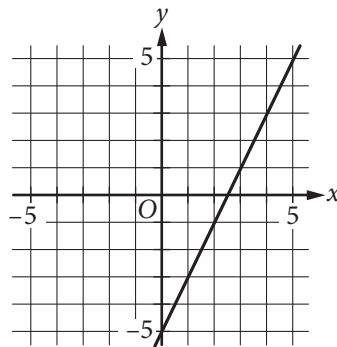
B)



C)



D)





6

If $x = \frac{2}{3}y$ and $y = 18$, what is the value of $2x - 3$?

- A) 21
- B) 15
- C) 12
- D) 10

7

A bricklayer uses the formula $n = 7\ell h$ to estimate the number of bricks, n , needed to build a wall that is ℓ feet long and h feet high. Which of the following correctly expresses ℓ in terms of n and h ?

- A) $\ell = \frac{7}{nh}$
- B) $\ell = \frac{h}{7n}$
- C) $\ell = \frac{n}{7h}$
- D) $\ell = \frac{n}{7+h}$

8

x	$w(x)$	$t(x)$
1	-1	-3
2	3	-1
3	4	1
4	3	3
5	-1	5

The table above shows some values of the functions w and t . For which value of x is $w(x) + t(x) = x$?

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

9

If $\sqrt{x} + \sqrt{9} = \sqrt{64}$, what is the value of x ?

- A) $\sqrt{5}$
- B) 5
- C) 25
- D) 55

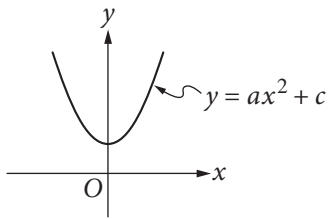


10

Jaime is preparing for a bicycle race. His goal is to bicycle an average of at least 280 miles per week for 4 weeks. He bicycled 240 miles the first week, 310 miles the second week, and 320 miles the third week. Which inequality can be used to represent the number of miles, x , Jaime could bicycle on the 4th week to meet his goal?

- A) $\frac{240 + 310 + 320}{3} + x \geq 280$
- B) $240 + 310 + 320 \geq x(280)$
- C) $\frac{240}{4} + \frac{310}{4} + \frac{320}{4} + x \geq 280$
- D) $240 + 310 + 320 + x \geq 4(280)$

11



The vertex of the parabola in the xy -plane above is $(0, c)$. Which of the following is true about the parabola with the equation $y = -a(x - b)^2 + c$?

- A) The vertex is (b, c) and the graph opens upward.
- B) The vertex is (b, c) and the graph opens downward.
- C) The vertex is $(-b, c)$ and the graph opens upward.
- D) The vertex is $(-b, c)$ and the graph opens downward.

12

Which of the following is equivalent to $\frac{4x^2 + 6x}{4x + 2}$?

- A) x
- B) $x + 4$
- C) $x - \frac{2}{4x + 2}$
- D) $x + 1 - \frac{2}{4x + 2}$

13

$$2x^2 - 4x = t$$

In the equation above, t is a constant. If the equation has no real solutions, which of the following could be the value of t ?

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



14

A laundry service is buying detergent and fabric softener from its supplier. The supplier will deliver no more than 300 pounds in a shipment. Each container of detergent weighs 7.35 pounds, and each container of fabric softener weighs 6.2 pounds. The service wants to buy at least twice as many containers of detergent as containers of fabric softener. Let d represent the number of containers of detergent, and let s represent the number of containers of fabric softener, where d and s are nonnegative integers. Which of the following systems of inequalities best represents this situation?

- A) $7.35d + 6.2s \leq 300$
 $d \geq 2s$
- B) $7.35d + 6.2s \leq 300$
 $2d \geq s$
- C) $14.7d + 6.2s \leq 300$
 $d \geq 2s$
- D) $14.7d + 6.2s \leq 300$
 $2d \geq s$

15

Which of the following is equivalent to $\left(a + \frac{b}{2}\right)^2$?

- A) $a^2 + \frac{b^2}{2}$
- B) $a^2 + \frac{b^2}{4}$
- C) $a^2 + \frac{ab}{2} + \frac{b^2}{2}$
- D) $a^2 + ab + \frac{b^2}{4}$



DIRECTIONS

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

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or $7/2$. (If $\begin{array}{|c|c|c|c|} \hline 3 & 1 & / & 2 \\ \hline \bullet & \bullet & \bullet & \bullet \\ \hline \end{array}$ is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

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

Write answer → in boxes.

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

Grid in result.

Answer: 2.5

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

← Fraction line

← Decimal point

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

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

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

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

Answer: 201 – either position is correct

	2	0	1
•	•	•	•
0	0	•	0
1	1	1	•
2	•	2	2
3	3	3	3

2	0	1	
•	•	•	•
0	•	0	0
1	1	•	1
•	2	2	2
3	3	3	3

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



16

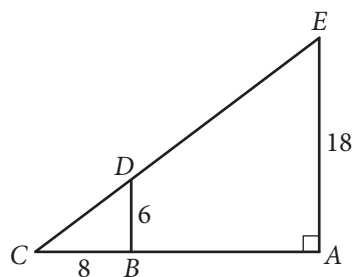
If $a^{\frac{b}{4}} = 16$ for positive integers a and b , what is one possible value of b ?

17

$$\frac{2}{3}t = \frac{5}{2}$$

What value of t is the solution of the equation above?

18



In the figure above, \overline{BD} is parallel to \overline{AE} . What is the length of \overline{CE} ?



19

How many liters of a 25% saline solution must be added to 3 liters of a 10% saline solution to obtain a 15% saline solution?

20

Points A and B lie on a circle with radius 1, and arc \widehat{AB} has length $\frac{\pi}{3}$. What fraction of the circumference of the circle is the length of arc \widehat{AB} ?

STOP

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

No Test Material On This Page



Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

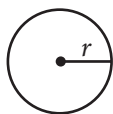
DIRECTIONS

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

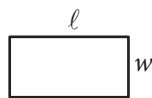
- The use of a calculator is permitted.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated, the domain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

REFERENCE

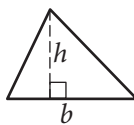


$$A = \pi r^2$$

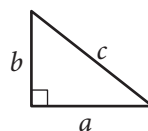
$$C = 2\pi r$$



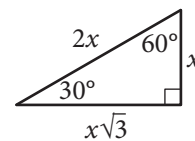
$$A = \ell w$$



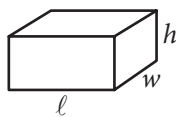
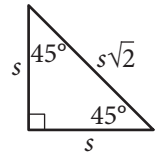
$$A = \frac{1}{2}bh$$



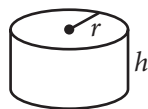
$$c^2 = a^2 + b^2$$



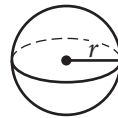
Special Right Triangles



$$V = \ell wh$$



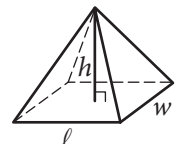
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}\ell wh$$

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.

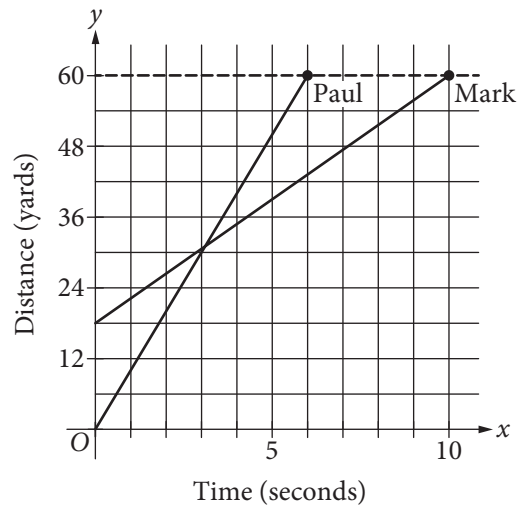


1

Which expression is equivalent to $(2x^2 - 4) - (-3x^2 + 2x - 7)$?

- A) $5x^2 - 2x + 3$
- B) $5x^2 + 2x - 3$
- C) $-x^2 - 2x - 11$
- D) $-x^2 + 2x - 11$

2



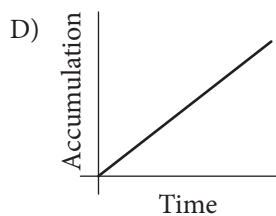
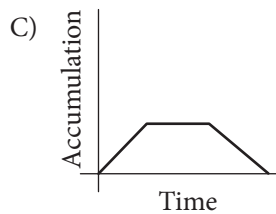
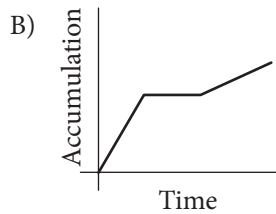
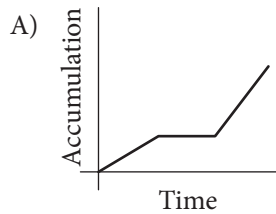
The graph above shows the positions of Paul and Mark during a race. Paul and Mark each ran at a constant rate, and Mark was given a head start to shorten the distance he needed to run. Paul finished the race in 6 seconds, and Mark finished the race in 10 seconds. According to the graph, Mark was given a head start of how many yards?

- A) 3
- B) 12
- C) 18
- D) 24



3

Snow fell and then stopped for a time. When the snow began to fall again, it fell at a faster rate than it had initially. Assuming that none of the snow melted during the time indicated, which of the following graphs could model the total accumulation of snow versus time?



4

A website-hosting service charges businesses a onetime setup fee of \$350 plus d dollars for each month. If a business owner paid \$1,010 for the first 12 months, including the setup fee, what is the value of d ?

- A) 25
- B) 35
- C) 45
- D) 55

5

$$6x - 9y > 12$$

Which of the following inequalities is equivalent to the inequality above?

- A) $x - y > 2$
- B) $2x - 3y > 4$
- C) $3x - 2y > 4$
- D) $3y - 2x > 2$



6

Where Do People Get Most of Their Medical Information?

Source	Percent of those surveyed
Doctor	63%
Internet	13%
Magazines/brochures	9%
Pharmacy	6%
Television	2%
Other/none of the above	7%

The table above shows a summary of 1,200 responses to a survey question. Based on the table, how many of those surveyed get most of their medical information from either a doctor or the Internet?

- A) 865
- B) 887
- C) 912
- D) 926

7

The members of a city council wanted to assess the opinions of all city residents about converting an open field into a dog park. The council surveyed a sample of 500 city residents who own dogs. The survey showed that the majority of those sampled were in favor of the dog park. Which of the following is true about the city council's survey?

- A) It shows that the majority of city residents are in favor of the dog park.
- B) The survey sample should have included more residents who are dog owners.
- C) The survey sample should have consisted entirely of residents who do not own dogs.
- D) The survey sample is biased because it is not representative of all city residents.



8

Ice Cream and Topping Selections

		Flavor	
		Vanilla	Chocolate
Topping	Hot fudge	8	6
	Caramel	5	6

The table above shows the flavors of ice cream and the toppings chosen by the people at a party. Each person chose one flavor of ice cream and one topping. Of the people who chose vanilla ice cream, what fraction chose hot fudge as a topping?

- A) $\frac{8}{25}$
 B) $\frac{5}{13}$
 C) $\frac{13}{25}$
 D) $\frac{8}{13}$

9

The total area of a coastal city is 92.1 square miles, of which 11.3 square miles is water. If the city had a population of 621,000 people in the year 2010, which of the following is closest to the population density, in people per square mile of land area, of the city at that time?

- A) 6,740
 B) 7,690
 C) 55,000
 D) 76,000



10

Between 1497 and 1500, Amerigo Vespucci embarked on two voyages to the New World. According to Vespucci's letters, the first voyage lasted 43 days longer than the second voyage, and the two voyages combined lasted a total of 1,003 days. How many days did the second voyage last?

- A) 460
- B) 480
- C) 520
- D) 540

11

$$7x + 3y = 8$$

$$6x - 3y = 5$$

For the solution (x, y) to the system of equations above, what is the value of $x - y$?

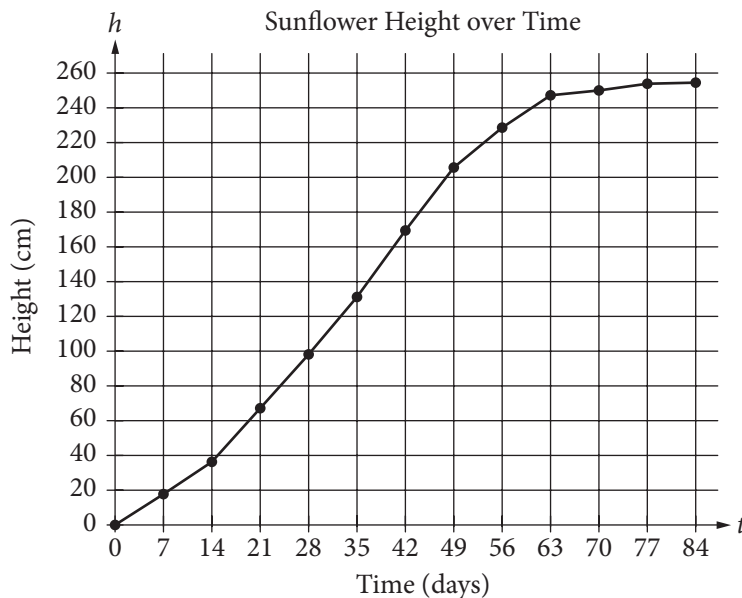
- A) $-\frac{4}{3}$
- B) $\frac{2}{3}$
- C) $\frac{4}{3}$
- D) $\frac{22}{3}$



Questions 12-14 refer to the following information.

Sunflower Growth

Day	Height (cm)
0	0.00
7	17.93
14	36.36
21	67.76
28	98.10
35	131.00
42	169.50
49	205.50
56	228.30
63	247.10
70	250.50
77	253.80
84	254.50



In 1919, H. S. Reed and R. H. Holland published a paper on the growth of sunflowers. Included in the paper were the table and graph above, which show the height h , in centimeters, of a sunflower t days after the sunflower begins to grow.

12

Over which of the following time periods is the average growth rate of the sunflower least?

- A) Day 0 to Day 21
- B) Day 21 to Day 42
- C) Day 42 to Day 63
- D) Day 63 to Day 84

13

The function h , defined by $h(t) = at + b$, where a and b are constants, models the height, in centimeters, of the sunflower after t days of growth during a time period in which the growth is approximately linear. What does a represent?

- A) The predicted number of centimeters the sunflower grows each day during the period
- B) The predicted height, in centimeters, of the sunflower at the beginning of the period
- C) The predicted height, in centimeters, of the sunflower at the end of the period
- D) The predicted total increase in the height of the sunflower, in centimeters, during the period



14

The growth rate of the sunflower from day 14 to day 35 is nearly constant. On this interval, which of the following equations best models the height h , in centimeters, of the sunflower t days after it begins to grow?

- A) $h = 2.1t - 15$
 B) $h = 4.5t - 27$
 C) $h = 6.8t - 12$
 D) $h = 13.2t - 18$

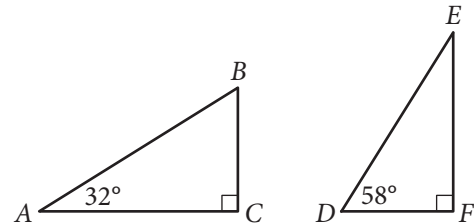
15

x	1	2	3	4	5
y	$\frac{11}{4}$	$\frac{25}{4}$	$\frac{39}{4}$	$\frac{53}{4}$	$\frac{67}{4}$

Which of the following equations relates y to x for the values in the table above?

- A) $y = \frac{1}{2} \cdot \left(\frac{5}{2}\right)^x$
 B) $y = 2 \cdot \left(\frac{3}{4}\right)^x$
 C) $y = \frac{3}{4}x + 2$
 D) $y = \frac{7}{2}x - \frac{3}{4}$

16

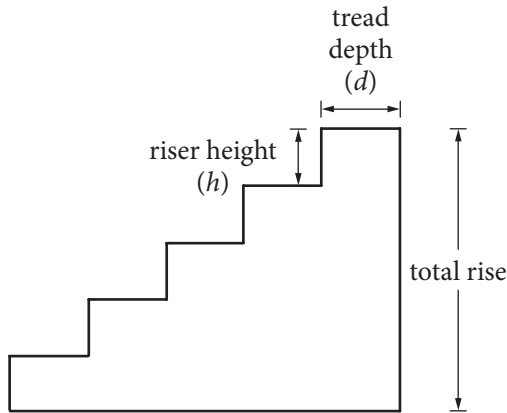


Triangles ABC and DEF are shown above. Which of the following is equal to the ratio $\frac{BC}{AB}$?

- A) $\frac{DE}{DF}$
 B) $\frac{DF}{DE}$
 C) $\frac{DF}{EF}$
 D) $\frac{EF}{DE}$



Questions 17-19 refer to the following information.



Note: Figure not drawn to scale.

When designing a stairway, an architect can use the riser-tread formula $2h + d = 25$, where h is the riser height, in inches, and d is the tread depth, in inches. For any given stairway, the riser heights are the same and the tread depths are the same for all steps in that stairway.

The number of steps in a stairway is the number of its risers. For example, there are 5 steps in the stairway in the figure above. The total rise of a stairway is the sum of the riser heights as shown in the figure.

17

Which of the following expresses the riser height in terms of the tread depth?

- A) $h = \frac{1}{2}(25 + d)$
- B) $h = \frac{1}{2}(25 - d)$
- C) $h = -\frac{1}{2}(25 + d)$
- D) $h = -\frac{1}{2}(25 - d)$

18

Some building codes require that, for indoor stairways, the tread depth must be at least 9 inches and the riser height must be at least 5 inches. According to the riser-tread formula, which of the following inequalities represents the set of all possible values for the riser height that meets this code requirement?

- A) $0 \leq h \leq 5$
- B) $h \geq 5$
- C) $5 \leq h \leq 8$
- D) $8 \leq h \leq 16$

19

An architect wants to use the riser-tread formula to design a stairway with a total rise of 9 feet, a riser height between 7 and 8 inches, and an odd number of steps. With the architect's constraints, which of the following must be the tread depth, in inches, of the stairway? (1 foot = 12 inches)

- A) 7.2
- B) 9.5
- C) 10.6
- D) 15



20

What is the sum of the solutions to $(x - 6)(x + 0.7) = 0$?

- A) -6.7
- B) -5.3
- C) 5.3
- D) 6.7

21

A study was done on the weights of different types of fish in a pond. A random sample of fish were caught and marked in order to ensure that none were weighed more than once. The sample contained 150 largemouth bass, of which 30% weighed more than 2 pounds. Which of the following conclusions is best supported by the sample data?

- A) The majority of all fish in the pond weigh less than 2 pounds.
- B) The average weight of all fish in the pond is approximately 2 pounds.
- C) Approximately 30% of all fish in the pond weigh more than 2 pounds.
- D) Approximately 30% of all largemouth bass in the pond weigh more than 2 pounds.

22

Number of States with 10 or More Electoral Votes in 2008

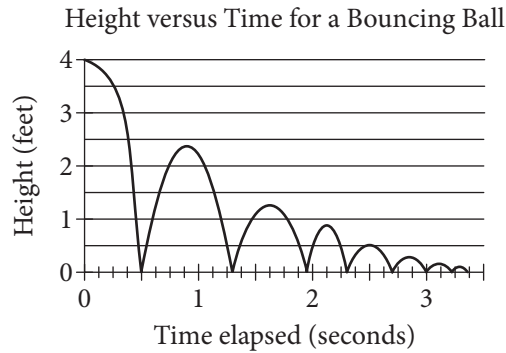
Electoral votes	Frequency
10	4
11	4
12	1
13	1
15	3
17	1
20	1
21	2
27	1
31	1
34	1
55	1

In 2008, there were 21 states with 10 or more electoral votes, as shown in the table above. Based on the table, what was the median number of electoral votes for the 21 states?

- A) 13
- B) 15
- C) 17
- D) 20



23



As part of an experiment, a ball was dropped and allowed to bounce repeatedly off the ground until it came to rest. The graph above represents the relationship between the time elapsed after the ball was dropped and the height of the ball above the ground. After it was dropped, how many times was the ball at a height of 2 feet?

- A) One
- B) Two
- C) Three
- D) Four

24

A customer's monthly water bill was \$75.74. Due to a rate increase, her monthly bill is now \$79.86. To the nearest tenth of a percent, by what percent did the amount of the customer's water bill increase?

- A) 4.1%
- B) 5.1%
- C) 5.2%
- D) 5.4%

25

x	$f(x)$
0	-2
2	4
6	16

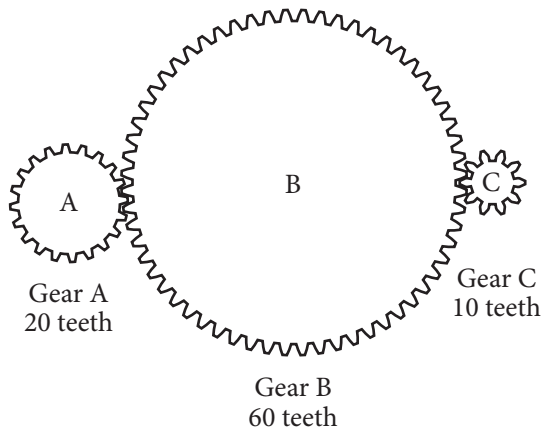
Some values of the linear function f are shown in the table above. What is the value of $f(3)$?

- A) 6
- B) 7
- C) 8
- D) 9



26

A gear ratio $r:s$ is the ratio of the number of teeth of two connected gears. The ratio of the number of revolutions per minute (rpm) of two gear wheels is $s:r$. In the diagram below, Gear A is turned by a motor. The turning of Gear A causes Gears B and C to turn as well.



If Gear A is rotated by the motor at a rate of 100 rpm, what is the number of revolutions per minute for Gear C?

- A) 50
- B) 110
- C) 200
- D) 1,000

27

In the xy -plane, the graph of $2x^2 - 6x + 2y^2 + 2y = 45$ is a circle. What is the radius of the circle?

- A) 5
- B) 6.5
- C) $\sqrt{40}$
- D) $\sqrt{50}$

28

Two different points on a number line are both 3 units from the point with coordinate -4 . The solution to which of the following equations gives the coordinates of both points?

- A) $|x + 4| = 3$
- B) $|x - 4| = 3$
- C) $|x + 3| = 4$
- D) $|x - 3| = 4$



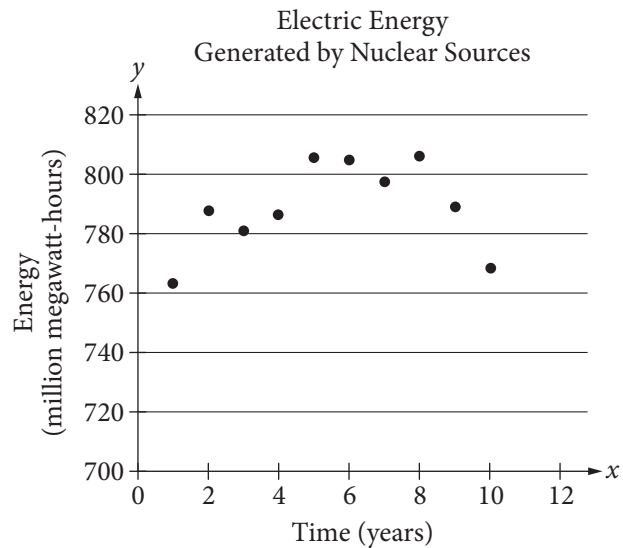
29

A motor powers a model car so that after starting from rest, the car travels s inches in t seconds, where $s = 16t\sqrt{t}$. Which of the following gives the average speed of the car, in inches per second, over the first t seconds after it starts?

- A) $4\sqrt{t}$
- B) $16\sqrt{t}$
- C) $\frac{16}{\sqrt{t}}$
- D) $16t$

30

The scatterplot below shows the amount of electric energy generated, in millions of megawatt-hours, by nuclear sources over a 10-year period.




Of the following equations, which best models the data in the scatterplot?

- A) $y = 1.674x^2 + 19.76x - 745.73$
- B) $y = -1.674x^2 - 19.76x - 745.73$
- C) $y = 1.674x^2 + 19.76x + 745.73$
- D) $y = -1.674x^2 + 19.76x + 745.73$

**DIRECTIONS**

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

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or 7/2. (If  is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Write answer in boxes. →

Grid in result. →

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

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

← Fraction line

Answer: 2.5

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

← Decimal point

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

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

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

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

Answer: 201 – either position is correct

	2	0	1
.	.	.	.
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3

2	0	1	
.	.	.	.
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



31

A group of friends decided to divide the \$800 cost of a trip equally among themselves. When two of the friends decided not to go on the trip, those remaining still divided the \$800 cost equally, but each friend's share of the cost increased by \$20. How many friends were in the group originally?

32

$$2(5x - 20) - (15 + 8x) = 7$$

What value of x satisfies the equation above?



33

A laboratory supply company produces graduated cylinders, each with an internal radius of 2 inches and an internal height between 7.75 inches and 8 inches. What is one possible volume, rounded to the nearest cubic inch, of a graduated cylinder produced by this company?

34

In the xy -plane, the graph of $y = 3x^2 - 14x$ intersects the graph of $y = x$ at the points $(0, 0)$ and (a, a) . What is the value of a ?



35

The line with the equation $\frac{4}{5}x + \frac{1}{3}y = 1$ is graphed in the xy -plane. What is the x -coordinate of the x -intercept of the line?

36

	Masses (kilograms)					
Andrew	2.4	2.5	3.6	3.1	2.5	2.7
Maria	x	3.1	2.7	2.9	3.3	2.8

Andrew and Maria each collected six rocks, and the masses of the rocks are shown in the table above. The mean of the masses of the rocks Maria collected is 0.1 kilogram greater than the mean of the masses of the rocks Andrew collected. What is the value of x ?



37

Jeremy deposited x dollars in his investment account on January 1, 2001. The amount of money in the account doubled each year until Jeremy had 480 dollars in his investment account on January 1, 2005. What is the value of x ?

38

A school district is forming a committee to discuss plans for the construction of a new high school. Of those invited to join the committee, 15% are parents of students, 45% are teachers from the current high school, 25% are school and district administrators, and the remaining 6 individuals are students. How many more teachers were invited to join the committee than school and district administrators?

STOP

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

QUESTION 43

Choice A is the best answer because the conjunctive adverb “then” correctly shows that given previously stated information, the conclusion that can be drawn is that the transition between the Golden and Silver Ages of comic books was more successful than others.

Choices B, C, and D are incorrect because they do not indicate the correct relationship between the information presented earlier and conclusions that can be drawn from the information. “However,” “nevertheless,” and “yet” are ordinarily used to indicate that in spite of some action, a different or unexpected result occurs.

QUESTION 44

Choice C is the best answer because the singular pronoun “that” agrees in number with its singular antecedent “transition.”

Choices A and B are incorrect because the plural pronouns “those” and “these” do not agree with the singular antecedent “transition.” Additionally, choice B is incorrect because “these” implies that whatever is being referred to is at hand, not in the past. Choice D is incorrect because a pronoun is needed to complete the comparison of transitions between comic book ages.

Section 3: Math Test - No Calculator

QUESTION 1

Choice B is correct. The total amount T , in dollars, Salim will pay for n tickets is given by $T = 15n + 12$, which consists of both a per-ticket charge and a one-time service fee. Since n represents the number of tickets that Salim purchases, it follows that $15n$ represents the price, in dollars, of n tickets. Therefore, 15 must represent the per-ticket charge. At the same time, no matter how many tickets Salim purchases, he will be charged the \$12 fee only once. Therefore, 12 must represent the amount of the service fee, in dollars.

Choice A is incorrect. Since n represents the total number of tickets that Salim purchases, it follows that $15n$ represents the price, in dollars, of n tickets, excluding the service fee. Therefore, 15, not 12, must represent the price of 1 ticket. Choice C is incorrect. If Salim purchases only 1 ticket, the total amount, in dollars, Salim will pay can be found by substituting $n = 1$ into the equation for T . If $n = 1$, $T = 15(1) + 12 = 27$. Therefore, the total amount Salim will pay for one ticket is \$27, not \$12. Choice D is incorrect. The total amount, in dollars, Salim will

pay for n tickets is given by $15n + 12$. The value 12 represents only a portion of this total amount. Therefore, the value 12 does not represent the total amount, in dollars, for any number of tickets.

QUESTION 2

Choice B is correct. Since Fertilizer A contains 60% filler materials by weight, it follows that x pounds of Fertilizer A consists of $0.6x$ pounds of filler materials. Similarly, y pounds of Fertilizer B consists of $0.4y$ pounds of filler materials. When x pounds of Fertilizer A and y pounds of Fertilizer B are combined, the result is 240 pounds of filler materials. Therefore, the total amount, in pounds, of filler materials in a mixture of x pounds of Fertilizer A and y pounds of Fertilizer B can be expressed as $0.6x + 0.4y = 240$.

Choice A is incorrect. This choice transposes the percentages of filler materials for Fertilizer A and Fertilizer B. Fertilizer A consists of $0.6x$ pounds of filler materials and Fertilizer B consists of $0.4y$ pounds of filler materials. Therefore, $0.6x + 0.4y$ is equal to 240, not $0.4x + 0.6y$. Choice C is incorrect. This choice incorrectly represents how to take the percentage of a value mathematically. Fertilizer A consists of $0.6x$ pounds of filler materials, not $60x$ pounds of filler materials, and Fertilizer B consists of $0.4y$ pounds of filler materials, not $40y$ pounds of filler materials. Choice D is incorrect. This choice transposes the percentages of filler materials for Fertilizer A and Fertilizer B and incorrectly represents how to take the percentage of a value mathematically.

QUESTION 3

Choice C is correct. For a complex number written in the form $a + bi$, a is called the real part of the complex number and b is called the imaginary part. The sum of two complex numbers, $a + bi$ and $c + di$, is found by adding real parts and imaginary parts, respectively; that is, $(a + bi) + (c + di) = (a + c) + (b + d)i$. Therefore, the sum of $2 + 3i$ and $4 + 8i$ is $(2 + 4) + (3 + 8)i = 6 + 11i$.

Choice A is incorrect and is the result of disregarding i and adding all parts of the two complex numbers together, $2 + 3 + 4 + 8 = 17$. Choice B is incorrect and is the result of adding all parts of the two complex numbers together and multiplying the sum by i . Choice D is incorrect and is the result of multiplying the real parts and imaginary parts of the two complex numbers, $(2)(4) = 8$ and $(3)(8) = 24$, instead of adding those parts together.

QUESTION 4

Choice A is correct. The right side of the equation can be multiplied using the distributive property: $(px + t)(px - t) = p^2x^2 - ptx + ptx - t^2$. Combining like terms gives $p^2x^2 - t^2$. Substituting this expression for the right side of the equation gives $4x^2 - 9 = p^2x^2 - t^2$, where p and t are

constants. This equation is true for all values of x only when $4 = p^2$ and $9 = t^2$. If $4 = p^2$, then $p = 2$ or $p = -2$. Therefore, of the given answer choices, only 2 could be the value of p .

Choices B, C, and D are incorrect. For the equation to be true for all values of x , the coefficients of x^2 on both sides of the equation must be equal; that is, $4 = p^2$. Therefore, the value of p cannot be 3, 4, or 9.

QUESTION 5

Choice D is correct. In the xy -plane, the graph of the equation $y = mx + b$, where m and b are constants, is a line with slope m and y -intercept $(0, b)$. Therefore, the graph of $y = 2x - 5$ in the xy -plane is a line with slope 2 and a y -intercept $(0, -5)$. Having a slope of 2 means that for each increase in x by 1, the value of y increases by 2. Only the graph in choice D has a slope of 2 and crosses the y -axis at $(0, -5)$. Therefore, the graph shown in choice D must be the correct answer.

Choices A, B, and C are incorrect. The graph of $y = 2x - 5$ in the xy -plane is a line with slope 2 and a y -intercept at $(0, -5)$. The graph in choice A crosses the y -axis at the point $(0, 2.5)$, not $(0, -5)$, and it has a slope of $\frac{1}{2}$, not 2. The graph in choice B crosses the y -axis at $(0, -5)$; however, the slope of this line is -2 , not 2. The graph in choice C has a slope of 2; however, the graph crosses the y -axis at $(0, 5)$, not $(0, -5)$.

QUESTION 6

Choice A is correct. Substituting the given value of $y = 18$ into the equation $x = \frac{2}{3}y$ yields $x = \left(\frac{2}{3}\right)(18)$, or $x = 12$. The value of the expression $2x - 3$ when $x = 12$ is $2(12) - 3 = 21$.

Choice B is incorrect. If $2x - 3 = 15$, then adding 3 to both sides of the equation and then dividing both sides of the equation by 2 yields $x = 9$. Substituting 9 for x and 18 for y into the equation $x = \frac{2}{3}y$ yields $9 = \frac{2}{3}18 = 12$, which is false. Therefore, the value of $2x - 3$ cannot be

15. Choices C and D are also incorrect. As with choice B, assuming the value of $2x - 3$ is 12 or 10 will lead to a false statement.

QUESTION 7

Choice C is correct. By properties of multiplication, the formula $n = 7\ell h$ can be rewritten as $n = (7h)\ell$. To solve for ℓ in terms of n and h , divide both sides of the equation by the factor $7h$.

Solving this equation for ℓ gives $\ell = \frac{n}{7h}$.

Choices A, B, and D are incorrect and may result from algebraic errors when rewriting the given equation.

QUESTION 8

Choice B is correct. This question can be answered by making a connection between the table and the algebraic equation. Each row of the table gives a value of x and its corresponding values in both $w(x)$ and $t(x)$. For instance, the first row gives $x = 1$ and the corresponding values $w(1) = -1$ and $t(1) = -3$. The row in the table where $x = 2$ is the only row that has the property $x = w(x) + t(x)$: $2 = 3 + (-1)$. Therefore, choice B is the correct answer.

Choice A is incorrect because when $x = 1$, the equation $w(x) + t(x) = x$ is not true. According to the table, $w(1) = -1$ and $t(1) = -3$. Substituting the values of each term when $x = 1$ gives $-1 + (-3) = 1$, an equation that is not true. Choice C is incorrect because when $x = 3$, the equation $w(x) + t(x) = x$ is not true. According to the table, $w(3) = 4$ and $t(3) = 1$. Substituting the values of each term when $x = 3$ gives $4 + 1 = 3$, an equation that is not true. Choice D is incorrect because when $x = 4$, the equation $w(x) + t(x) = x$ is not true. According to the table, $w(4) = 3$ and $t(4) = 3$. Substituting the values of each term when $x = 4$ gives $3 + 3 = 4$, an equation that is not true.

QUESTION 9

Choice C is correct. The two numerical expressions in the given equation can be simplified as $\sqrt{9} = 3$ and $\sqrt{64} = 8$, so the equation can be rewritten as $\sqrt{x} + 3 = 8$, or $\sqrt{x} = 5$. Squaring both sides of the equation gives $x = 25$.

Choice A is incorrect and may result from a misconception about how to square both sides of $\sqrt{x} = 5$ to determine the value of x . Choice B is incorrect. The value of \sqrt{x} , not x , is 5. Choice D is incorrect and represents a misconception about the properties of radicals. While it is true that $55 + 9 = 64$, it is not true that $\sqrt{55} + \sqrt{9} = \sqrt{64}$.

QUESTION 10

Choice D is correct. Jaime's goal is to average at least 280 miles per week for 4 weeks. If T is the total number of miles Jamie will bicycle for 4 weeks, then his goal can be represented

symbolically by the inequality: $\frac{T}{4} \geq 280$, or equivalently $T \geq 4(280)$. The total number of miles

Jamie will bicycle during this time is the sum of the distances he has completed and has yet to complete. Thus $T = 240 + 310 + 320 + x$. Substituting this expression into the inequality $T \geq 4(280)$ gives $240 + 310 + 320 + x \geq 4(280)$. Therefore, choice D is the correct answer.

Choices A, B, and C are incorrect because they do not correctly capture the relationships between the total number of miles Jaime will ride his bicycle ($240 + 310 + 320 + x$) and the minimum number of miles he is attempting to bicycle for the four weeks ($280 + 280 + 280 + 280$).

QUESTION 11

Choice B is correct. Since the shown parabola opens upward, the coefficient of x^2 in the equation $y = ax^2 + c$ must be positive. Given that a is positive, $-a$ is negative, and therefore the graph of the equation $y = -a(x - b)^2 + c$ will be a parabola that opens downward. The vertex of this parabola is (b, c) , because the maximum value of y, c , is reached when $x = b$. Therefore, the answer must be choice B.

Choices A and C are incorrect. The coefficient of x^2 in the equation $y = -a(x - b)^2 + c$ is negative. Therefore, the parabola with this equation opens downward, not upward. Choice D is incorrect because the vertex of this parabola is (b, c) , not $(-b, c)$, because the maximum value of y, c , is reached when $x = b$.

QUESTION 12

Choice D is correct. Dividing $4x^2 + 6x$ by $4x + 2$ gives:

$$\begin{array}{r} x + 1 \\ 4x + 2 \overline{) 4x^2 + 6x} \\ \underline{-(4x + 2x)} \\ 4x \\ \underline{-(4x + 2)} \\ -2 \end{array}$$

Therefore, the expression $\frac{4x^2 + 6x}{4x + 2}$ is equivalent to $x + 1 - \frac{2}{4x + 2}$.

Alternate approach: The numerator of the given expression, $4x^2 + 6x$, can be rewritten in terms of the denominator, $4x + 2$, as follows: $4x^2 + 2x + 4x + 2 - 2$, or $x(4x + 2) + (4x + 2) - 2$. So the given expression can be rewritten as

$$\frac{x(4x + 2) + (4x + 2) - 2}{4x + 2} = x + 1 - \frac{2}{4x + 2}$$

Choices A and B are incorrect and may result from incorrectly factoring the numerator and denominator of the expression $\frac{4x^2 + 6x}{4x + 2}$ and then incorrectly identifying common factors in the two factored expressions. Choice C is incorrect and may result from a variety of mistakes made when performing long division.

QUESTION 13

Choice A is correct. The number of solutions to any quadratic equation in the form $ax^2 + bx + c = 0$, where a , b , and c are constants, can be found by evaluating the expression $b^2 - 4ac$, which is called the discriminant. If the value of $b^2 - 4ac$ is a positive number, then there will be exactly two real solutions to the equation. If the value of $b^2 - 4ac$ is zero, then there will be exactly one real solution to the equation. Finally, if the value of $b^2 - 4ac$ is negative, then there will be no real solutions to the equation.

The given equation $2x^2 - 4x = t$ is a quadratic equation in one variable, where t is a constant. Subtracting t from both sides of the equation gives $2x^2 - 4x - t = 0$. In this form, $a = 2$, $b = -4$, and $c = -t$. The values of t for which the equation has no real solutions are the same values of t for which the discriminant of this equation is a negative value. The discriminant is equal to $(-4)^2 - 4(2)(-t)$; therefore, $(-4)^2 - 4(2)(-t) < 0$. Simplifying the left side of the inequality gives $16 + 8t < 0$. Subtracting 16 from both sides of the inequality and then dividing both sides by 8 gives $t < -2$. Of the values given in the options, -3 is the only value that is less than -2 . Therefore, choice A must be the correct answer.

Choices B, C, and D are incorrect and may result from a misconception about how to use the discriminant to determine the number of solutions of a quadratic equation in one variable.

QUESTION 14

Choice A is correct. The number of containers in a shipment must have a weight less than 300 pounds. The total weight, in pounds, of detergent and fabric softener that the supplier delivers can be expressed as the weight of each container multiplied by the number of each type of container, which is $7.35d$ for detergent and $6.2s$ for fabric softener. Since this total cannot exceed 300 pounds, it follows that $7.35d + 6.2s \leq 300$. Also, since the laundry service wants to buy at least twice as many containers of detergent as containers of fabric softener, the number of containers of detergent should be greater than or equal to two times the number of containers of fabric softener. This can be expressed by the inequality $d \geq 2s$.

Choice B is incorrect because it misrepresents the relationship between the numbers of each container that the laundry service wants to buy. Choice C is incorrect because the first inequality of the system incorrectly doubles the weight per container of detergent. The weight

of each container of detergent is 7.35, not 14.7 pounds. Choice D is incorrect because it doubles the weight per container of detergent and transposes the relationship between the numbers of containers.

QUESTION 15

Choice D is correct. The expression can be rewritten as $\left(a + \frac{b}{2}\right)\left(a + \frac{b}{2}\right)$. Using the distributive property, the expression yields $\left(a + \frac{b}{2}\right)\left(a + \frac{b}{2}\right) = a^2 + \frac{ab}{2} + \frac{ab}{2} + \frac{b^2}{4}$. Combining like terms gives $a^2 + ab + \frac{b^2}{4}$.

Choices A, B, and C are incorrect and may result from errors using the distributive property on the given expression or combining like terms.

QUESTION 16

The correct answers are 1, 2, 4, 8, or 16. Number 16 can be written in exponential form $a^{\frac{b}{4}}$, where a and b are positive integers as follows: 2^4 , 4^2 , 16^1 , $(16^2)^{\frac{1}{2}}$, $(16^4)^{\frac{1}{4}}$. Hence, if $a^{\frac{b}{4}} = 16$, where a and b are positive integers, then $\frac{b}{4}$ can be 4, 2, 1, $\frac{1}{2}$, or $\frac{1}{4}$. So the value of b can be 16, 8, 4, 2, or 1. Any of these values may be gridded as the correct answer.

QUESTION 17

The correct answer is $\frac{15}{4}$ or 3.75. Multiplying both sides of the equation $\frac{2}{3}t = \frac{5}{2}$ by $\frac{3}{2}$ results in $t = \frac{15}{4}$, or $t = 3.75$.

QUESTION 18

The correct answer is 30. In the figure given, since \overline{BD} is parallel to \overline{AE} and both segments are intersected by \overline{CE} , then angle BDC and angle AEC are corresponding angles and therefore congruent. Angle BCD and angle ACE are also congruent because they are the same angle. Triangle BCD and triangle ACE are similar because if two angles of one triangle are congruent to two angles of another triangle, the triangles are similar. Since triangle BCD and triangle ACE are similar, their corresponding sides are proportional. So in triangle BCD and triangle ACE , \overline{BD} corresponds to \overline{AE} and \overline{CD} corresponds to \overline{CE} . Therefore, $\frac{BD}{CD} = \frac{AE}{CE}$. Since triangle BCD is a right triangle, the Pythagorean theorem can be used to give the value of CD : $6^2 + 8^2 = CD^2$. Taking the square root of each side gives $CD = 10$. Substituting the values in the proportion $\frac{BD}{CD} = \frac{AE}{CE}$ yields

$\frac{6}{10} = \frac{18}{CE}$. Multiplying each side by CE , and then multiplying by $\frac{10}{6}$ yields $CE = 30$. Therefore, the length of \overline{CE} is 30.

QUESTION 19

The correct answer is 1.5 or $\frac{3}{2}$. The total amount, in liters, of a saline solution can be expressed as the liters of each type of saline solution multiplied by the percent of the saline solution. This gives $3(0.10)$, $x(0.25)$, and $(x + 3)(0.15)$, where x is the amount, in liters, of a 25% saline solution and 10%, 15%, and 25% are represented as 0.10, 0.15, and 0.25, respectively. Thus, the equation $3(0.10) + 0.25x = 0.15(x + 3)$ must be true. Multiplying 3 by 0.10 and distributing 0.15 to $(x + 3)$ yields $0.30 + 0.25x = 0.15x + 0.45$. Subtracting $0.15x$ and 0.30 from each side of the equation gives $0.10x = 0.15$. Dividing each side of the equation by 0.10 yields $x = 1.5$, or $x = \frac{3}{2}$.

QUESTION 20

The correct answer is $\frac{1}{6}$, .166, or .167. The circumference, C , of a circle is $C = 2\pi r$, where r is the radius of the circle. For the given circle with a radius of 1, the circumference is $C = 2(\pi)(1)$, or $C = 2\pi$. To find what fraction of the circumference the length of arc AB is, divide the length of the arc by the circumference, which gives $\frac{\pi}{3} \div 2\pi$. This division can be represented by $\frac{\pi}{3} \cdot \frac{1}{2\pi} = \frac{1}{6}$. The fraction $\frac{1}{6}$ can also be rewritten as .166 or .167.

Section 4: Math Test - Calculator

QUESTION 1

Choice A is correct. The given expression $(2x^2 - 4) - (-3x^2 + 2x - 7)$ can be rewritten as $2x^2 - 4 + 3x^2 - 2x + 7$. Combining like terms yields $5x^2 - 2x + 3$.

Choices B, C, and D are incorrect because they are the result of errors when applying the distributive property.

QUESTION 2

Choice C is correct. The lines shown on the graph give the positions of Paul and Mark during the race. At the start of the race, 0 seconds have elapsed, so the y -intercept of the line that represents Mark's position during the race represents the number of yards Mark was from Paul's position (at 0 yards) at the start of the race. Because the y -intercept of the line that

represents Mark's position is at the grid line that is halfway between 12 and 24, Mark had a head start of 18 yards.

Choices A, B, and D are incorrect. The y -intercept of the line that represents Mark's position shows that he was 18 yards from Paul's position at the start of the race, so he did not have a head start of 3, 12, or 24 yards.

QUESTION 3

Choice A is correct. The leftmost segment in choice A, which represents the first time period, shows that the snow accumulated at a certain rate; the middle segment, which represents the second time period, is horizontal, showing that the snow stopped accumulating; and the rightmost segment, which represents the third time period, is steeper than the first segment, indicating that the snow accumulated at a faster rate than it did during the first time period.

Choice B is incorrect. This graph shows snow accumulating faster during the first time period than during the third time period; however, the question says that the rate of snow accumulation in the third time period is higher than in the first time period. Choice C is incorrect. This graph shows snow accumulation increasing during the first time period, not accumulating during the second time period, and then decreasing during the third time period; however, the question says that no snow melted (accumulation did not decrease) during this time. Choice D is incorrect. This graph shows snow accumulating at a constant rate, not stopping for a period of time or accumulating at a faster rate during a third time period.

QUESTION 4

Choice D is correct. The equation $12d + 350 = 1,010$ can be used to determine d , the number of dollars charged per month. Subtracting 350 from both sides of this equation yields $12d = 660$, and then dividing both sides of the equation by 12 yields $d = 55$.

Choice A is incorrect. If d were equal to 25, the first 12 months would cost $350 + (12)(25) = 650$ dollars, not \$1,010. Choice B is incorrect. If d were equal to 35, the first 12 months would cost $350 + (12)(35) = 770$ dollars, not \$1,010. Choice C is incorrect. If d were equal to 45, the first 12 months would cost $350 + (12)(45) = 890$ dollars, not \$1,010.

QUESTION 5

Choice B is correct. Both sides of the given inequality can be divided by 3 to yield $2x - 3y > 4$.

Choices A, C, and D are incorrect because they are not equivalent to (do not have the same solution set as) the given inequality. For example, the ordered pair $(0, -1.5)$ is a solution to the given inequality, but it is not a solution to any of the inequalities in choices A, C, or D.

QUESTION 6

Choice C is correct. According to the table, 63% of survey respondents get most of their medical information from a doctor and 13% get most of their medical information from the Internet. Therefore, 76% of the 1,200 survey respondents get their information from either a doctor or the Internet, and 76% of 1,200 is 912.

Choices A, B, and D are incorrect. According to the table, 76% of survey respondents get their information from either a doctor or the Internet. Choice A is incorrect because 865 is about 72% (the percent of survey respondents who get most of their medical information from a doctor or from magazines/brochures), not 76%, of 1,200. Choice B is incorrect because 887 is about 74%, not 76%, of 1,200. Choice D is incorrect because 926 is about 77%, not 76%, of 1,200.

QUESTION 7

Choice D is correct. The members of the city council wanted to assess opinions of all city residents. To gather an unbiased sample, the council should have used a random sampling design to select subjects from all city residents. The given survey introduced a sampling bias because the 500 city residents surveyed were all dog owners. This sample is not representative of all city residents.

Choice A is incorrect because when the sampling method isn't random, there is no guarantee that the survey results will be reliable; hence, they cannot be generalized to the entire population. Choice B is incorrect because a larger sample size would not correct the sampling bias. Choice C is incorrect because a survey sample of non-dog owners would likely have a biased opinion, just as a sample of dog owners would likely have a biased opinion.

QUESTION 8

Choice D is correct. According to the table, 13 people chose vanilla ice cream. Of those people, 8 chose hot fudge as a topping. Therefore, of the people who chose vanilla ice cream, the fraction who chose hot fudge as a topping is $\frac{8}{13}$.

Choice A is incorrect because it represents the fraction of people at the party who chose hot fudge as a topping. Choice B is incorrect because it represents the fraction of people who chose vanilla ice cream with caramel as a topping. Choice C is incorrect because it represents the fraction of people at the party who chose vanilla ice cream.

QUESTION 9

Choice B is correct. The land area of the coastal city can be found by subtracting the area of the water from the total area of the coastal city; that is, $92.1 - 11.3 = 80.8$ square miles. The population density is the population divided by the land area, or $\frac{621,000}{80.8} = 7,685$, which is closest to 7,690 people per square mile.

Choice A is incorrect and may be the result of dividing the population by the total area, instead of the land area. Choice C is incorrect and may be the result of dividing the population by the area of water. Choice D is incorrect and may be the result of making a computational error with the decimal place.

QUESTION 10

Choice B is correct. Let x represent the number of days the second voyage lasted. The number of days the first voyage lasted is then $x + 43$. Since the two voyages combined lasted a total of 1,003 days, the equation $x + (x + 43) = 1,003$ must hold. Combining like terms yields $2x + 43 = 1,003$, and solving for x gives $x = 480$.

Choice A is incorrect because $460 + (460 + 43) = 963$, not 1,003 days. Choice C is incorrect because $520 + (520 + 43) = 1,083$, not 1,003 days. Choice D is incorrect because $540 + (540 + 43) = 1,123$, not 1,003 days.

QUESTION 11

Choice B is correct. Adding the equations side-by-side eliminates y , as shown below.

$$\begin{array}{r} 7x + 3y = 8 \\ \underline{6x - 3y = 5} \\ 13x + 0 = 13 \end{array}$$

Solving the obtained equation for x gives $x = 1$. Substituting 1 for x in the first equation gives $7(1) + 3y = 8$. Subtracting 7 from both sides of the equation yields $3y = 1$, so $y = \frac{1}{3}$. Therefore, the value of $x - y$ is $1 - \frac{1}{3}$, or $\frac{2}{3}$.

Choice C is incorrect because $1 + \frac{1}{3} = \frac{4}{3}$ is the value of $x + y$, not $x - y$. Choices A and D are incorrect and may be the result of some computational errors.

QUESTION 12

Choice D is correct. The average growth rate of the sunflower over a certain time period is the increase in height of the sunflower over the period divided by the time. Symbolically, this rate is $\frac{h(b)-h(a)}{b-a}$, where a and b are the first and the last day of the time period, respectively. Since the time period for each option is the same (21 days), the total growth over the period can be used to evaluate in which time period the sunflower grew the least. According to the graph, the sunflower grew the least over the period from day 63 to day 84. Therefore, the sunflower's average growth rate was the least from day 63 to day 84.

Alternate approach: The average growth rate of the sunflower over a certain time period is the slope of the line segment that joins the point on the graph at the beginning of the time period with the point on the graph at the end of the time period. Based on the graph, of the four time periods, the slope of the line segment is least between the sunflower's height on day 63 and its height on day 84.

Choices A, B, and C are incorrect. On the graph, the line segment from day 63 to 84 is less steep than each of the three other line segments representing other periods. Therefore, the average growth rate of the sunflower is the least from day 63 to 84.

QUESTION 13

Choice A is correct. Based on the definition and contextual interpretation of the function h , when the value of t increases by 1, the height of the sunflower increases by a centimeters. Therefore, a represents the predicted amount, in centimeters, by which the sunflower grows each day during the period the function models.

Choice B is incorrect. In the given model, the beginning of the period corresponds to $t = 0$, and since $h(0) = b$, the predicted height, in centimeters, of the sunflower at the beginning of the period is represented by b , not by a . Choice C is incorrect. If the period of time modeled by the function is c days long, then the predicted height, in centimeters, of the sunflower at the end of the period is represented by $ac + b$, not by a . Choice D is incorrect. If the period of time modeled by the function is c days long, the predicted total increase in the height of the sunflower, in centimeters, during that period is represented by the difference $h(c) - h(0) = (ac + b) - (a \cdot 0 + b)$, which is equivalent to ac , not a .

QUESTION 14

Choice B is correct. According to the table, the height of the sunflower is 36.36 cm on day 14 and 131.00 cm on day 35. Since the height of the sunflower between day 14 and day 35 changes at a nearly constant rate, the height of the sunflower increases by approximately

$\frac{131.00 - 36.36}{35 - 14} \approx 4.5$ cm per day. Therefore, the equation that models the height of the sunflower t days after it begins to grow is of the form $h = 4.5t + b$. Any ordered pair (t, h) from the table between day 14 and day 35 can be used to estimate the value of b . For example, substituting the ordered pair $(14, 36.36)$ for (t, h) into the equation $h = 4.5t + b$ gives $36.36 = 4.5(14) + b$. Solving this for b yields $b = -26.64$. Therefore, of the given choices, the equation $h = 4.5t - 27$ best models the height h , in centimeters, of the sunflower t days after it begins to grow.

Choices A, C, and D are incorrect because the growth rates of the sunflower from day 14 to day 35 in these choices are significantly higher or lower than the true growth rate of the sunflower as shown in the graph or the table. These choices may result from considering time periods different from the period indicated in the question or from calculation errors.

QUESTION 15

Choice D is correct. According to the table, the value of y increases by $\frac{14}{4} = \frac{7}{2}$ every time the value of x increases by 1. It follows that the simplest equation relating y to x is linear and of the form $y = \frac{7}{2}x + b$ for some constant b . Furthermore, the ordered pair $\left(1, \frac{11}{4}\right)$ from the table must satisfy this equation. Substituting 1 for x and $\frac{11}{4}$ for y in the equation $y = \frac{7}{2}x + b$ gives $\frac{11}{4} = \frac{7}{2}(1) + b$. Solving this equation for b gives $b = -\frac{3}{4}$. Therefore, the equation in choice D correctly relates y to x .

Choices A and B are incorrect. The relationship between x and y cannot be exponential because the differences, not the ratios, of y -values are the same every time the x -values change by the same amount. Choice C is incorrect because the ordered pair $\left(2, \frac{25}{4}\right)$ is not a solution to the equation $y = \frac{3}{4}x + 2$. Substituting 2 for x and $\frac{25}{4}$ for y in this equation gives $\frac{25}{4} = \frac{3}{4} + 2$, which is false.

QUESTION 16

Choice B is correct. In right triangle ABC , the measure of angle B must be 58° because the sum of the measure of angle A , which is 32° , and the measure of angle B is 90° . Angle D in the right triangle DEF has measure 58° . Hence, triangles ABC and DEF are similar. Since BC is the side

opposite to the angle with measure 32° and AB is the hypotenuse in right triangle ABC , the ratio $\frac{BC}{AB}$ is equal to $\frac{DF}{DE}$.

Alternate approach: The trigonometric ratios can be used to answer this question. In right triangle ABC , the ratio $\frac{BC}{AB} = \sin(32^\circ)$. The angle E in triangle DEF has measure 32° because

$m(\angle D) + m(\angle E) = 90^\circ$. In triangle DEF , the ratio $\frac{DF}{DE} = \sin(32^\circ)$. Therefore, $\frac{DF}{DE} = \frac{BC}{AB}$.

Choice A is incorrect because $\frac{DE}{DF}$ is the inverse of the ratio $\frac{BC}{AB}$. Choice C is incorrect because

$\frac{DF}{EF} = \frac{BC}{AC}$, not $\frac{BC}{AB}$. Choice D is incorrect because $\frac{EF}{DE} = \frac{AC}{AB}$, not $\frac{BC}{AB}$.

QUESTION 17

Choice B is correct. Isolating the term that contains the riser height, h , in the formula $2h + d = 25$ gives $2h = 25 - d$. Dividing both sides of this equation by 2 yields $h = \frac{25 - d}{2}$, or

$$h = \frac{1}{2}(25 - d).$$

Choices A, C, and D are incorrect and may result from incorrect transformations of the riser-tread formula $2h + d = 25$ when expressing h in terms of d .

QUESTION 18

Choice C is correct. Since the tread depth, d , must be at least 9 inches, and the riser height, h , must be at least 5 inches, it follows that $d \geq 9$ and $h \geq 5$, respectively. Solving for d in the riser-tread formula $2h + d = 25$ gives $d = 25 - 2h$. Thus the first inequality, $d \geq 9$, is equivalent to $25 - 2h \geq 9$. This inequality can be solved for h as follows:

$$-2h \geq 9 - 25$$

$$2h \leq 25 - 9$$

$$2h \leq 16$$

$$h \leq 8$$

Therefore, the inequality $5 \leq h \leq 8$, derived from combining the inequalities $h \geq 5$ and $h \leq 8$, represents the set of all possible values for the riser height that meets the code requirement.

Choice A is incorrect because the riser height, h , cannot be less than 5 inches. Choices B and D are incorrect because the riser height, h , cannot be greater than 8. For example, if $h = 10$, then according to the riser-tread formula $2h + d = 25$, it follows that $d = 5$ inches. However, d must be at least 9 inches according to the building codes, so h cannot be 10.

QUESTION 19

Choice C is correct. Let h be the riser height, in inches, and n be the number of the steps in the stairway. According to the architect's design, the total rise of the stairway is 9 feet, or $9 \times 12 = 108$ inches. Hence, $nh = 108$, and solving for n gives $n = \frac{108}{h}$. It is given that $7 < h < 8$. It follows

that $\frac{108}{8} < \frac{108}{h} < \frac{108}{7}$, or equivalently, $\frac{108}{8} < n < \frac{108}{7}$. Since $\frac{108}{8} < 14$ and $\frac{108}{7} > 15$ and n is an integer, it follows that $14 \leq n \leq 15$. Since n can be an odd number, n can only be 15; therefore, $h = \frac{108}{15} = 7.2$ inches. Substituting 7.2 for h in the riser-tread formula $2h + d = 25$ gives $14.4 + d =$

25. Solving for d gives $d = 10.6$ inches.

Choice A is incorrect because 7.2 inches is the riser height, not the tread depth of the stairs.

Choice B is incorrect and may be the result of calculation errors. Choice D is incorrect because 15 is the number of steps, not the tread depth of the stairs.

QUESTION 20

Choice C is correct. Since the product of $x - 6$ and $x + 0.7$ equals 0, by the zero product property either $x - 6 = 0$ or $x + 0.7 = 0$. Therefore, the solutions to the equation are 6 and -0.7 . The sum of 6 and -0.7 is 5.3.

Choice A is incorrect and is the result of subtracting 6 from -0.7 instead of adding. Choice B is incorrect and may be the result of erroneously calculating the sum of -6 and 0.7 instead of 6 and -0.7 . Choice D is incorrect and is the sum of 6 and 0.7 , not 6 and -0.7 .

QUESTION 21

Choice D is correct. The sample of 150 largemouth bass was selected at random from all the largemouth bass in the pond, and since 30% of them weighed more than 2 pounds, it can be concluded that approximately 30% of all largemouth bass in the pond weigh more than 2 pounds.

Choices A, B, and C are incorrect. Since the sample contained 150 largemouth bass, of which 30% weighed more than 2 pounds, the largest population to which this result can be generalized is the population of the largemouth bass in the pond.

QUESTION 22

Choice B is correct. The median of a list of numbers is the middle value when the numbers are listed in order from least to greatest. For the electoral votes shown in the table, their frequency should also be taken into account. Since there are 21 states represented in the table, the middle number will be the eleventh number in the ordered list. Counting the frequencies from the top of the table ($4 + 4 + 1 + 1 + 3 = 13$) shows that the median number of electoral votes for the 21 states is 15.

Choice A is incorrect. If the electoral votes are ordered from least to greatest taking into account the frequency, 13 will be in the tenth position, not the middle. Choice C is incorrect because 17 is in the fourteenth position, not in the middle, of the ordered list. D is incorrect because 20 is in the fifteenth position, not in the middle, of the ordered list.

QUESTION 23

Choice C is correct. Since the graph shows the height of the ball above the ground after it was dropped, the number of times the ball was at a height of 2 feet is equal to the number of times the graph crosses the horizontal grid line that corresponds to a height of 2 feet. The graph crosses this grid line three times.

Choices A, B, and D are incorrect. According to the graph, the ball was at a height of 2 feet three times, not one, two, or four times.

QUESTION 24

Choice D is correct. To find the percent increase of the customer's water bill, the absolute increase of the bill, in dollars, is divided by the original amount of the bill, and the result is multiplied by 100%, as follows: $\frac{79.86 - 75.74}{75.74} \approx 0.054$; $0.054 \times 100\% = 5.4\%$.

Choice A is incorrect. This choice is the difference $79.86 - 75.74$ rounded to the nearest tenth, which is the (absolute) increase of the bill's amount, not its percent increase. Choice B is incorrect and may be the result of some calculation errors. Choice C is incorrect and is the result of dividing the difference between the two bill amounts by the new bill amount instead of the original bill amount.

QUESTION 25

Choice B is correct. A linear function has a constant rate of change, and any two rows of the shown table can be used to calculate this rate. From the first row to the second, the value of x is increased by 2 and the value of $f(x)$ is increased by 6 = 4 - (-2). So the values of $f(x)$ increase by 3 for every increase by 1 in the value of x . Since $f(2) = 4$, it follows that $f(2 + 1) = 4 + 3 = 7$. Therefore, $f(3) = 7$.

Choice A is incorrect. This is the third x -value in the table, not $f(3)$. Choices C and D are incorrect and may result from errors when calculating the function's rate of change.

QUESTION 26

Choice C is correct. Since Gear A has 20 teeth and Gear B has 60 teeth, the gear ratio for Gears A and B is 20:60. Thus the ratio of the number of revolutions per minute (rpm) for the two gears is 60:20, or 3:1. That is, when Gear A turns at 3 rpm, Gear B turns at 1 rpm. Similarly, since Gear B has 60 teeth and Gear C has 10 teeth, the gear ratio for Gears B and C is 60:10, and the ratio of the rpms for the two gears is 10:60. That is, when Gear B turns at 1 rpm, Gear C turns at 6 rpm. Therefore, if Gear A turns at 100 rpm, then Gear B turns at $\frac{100}{3}$ rpm, and Gear C turns at $\frac{100}{3} \times 6 = 200$ rpm.

Alternate approach: Gear A and Gear C can be considered as directly connected since their "contact" speeds are the same. Gear A has twice as many teeth as Gear C, and since the ratios of the number of teeth are equal to the reverse of the ratios of rotation speeds, in rpm, Gear C would be rotated at a rate that is twice the rate of Gear A. Therefore, Gear C will be rotated at a rate of 200 rpm since Gear A is rotated at 100 rpm.

Choice A is incorrect and may result from using the gear ratio instead of the ratio of the rpm when calculating the rotational speed of Gear C. Choice B is incorrect and may result from comparing the rpm of the gears using addition instead of multiplication. Choice D is incorrect and may be the result of multiplying the 100 rpm for Gear A by the number of teeth in Gear C.

QUESTION 27

Choice A is correct. One way to find the radius of the circle is to put the given equation in standard form, $(x - h)^2 + (y - k)^2 = r^2$, where (h, k) is the center of the circle and the radius of the circle is r . To do this, divide the original equation, $2x^2 - 6x + 2y^2 + 2y = 45$, by 2 to make the leading coefficients of x^2 and y^2 each equal to 1: $x^2 - 3x + y^2 + y = 22.5$. Then complete the square to put the equation in standard form. To do so, first rewrite $x^2 - 3x + y^2 + y = 22.5$ as $(x^2 - 3x + 2.25) - 2.25 + (y^2 + y + 0.25) - 0.25 = 22.5$. Second, add 2.25 and 0.25 to both sides of the equation: $(x^2 - 3x + 2.25) + (y^2 + y + 0.25) = 25$. Since $x^2 - 3x + 2.25 = (x - 1.5)^2$, $y^2 + y + 0.25 = (y$

$-0.5)^2$, and $25 = 5^2$, it follows that $(x - 1.5)^2 + (y - 0.5)^2 = 5^2$. Therefore, the radius of the circle is 5.

Choices B, C, and D are incorrect and may be the result of errors in manipulating the equation or of a misconception about the standard form of the equation of a circle in the xy -plane.

QUESTION 28

Choice A is correct. The coordinates of the points at a distance d units from the point with coordinate a on the number line are the solutions to the equation $|x - a| = d$. Therefore, the coordinates of the points at a distance of 3 units from the point with coordinate -4 on the number line are the solutions to the equation $|x - (-4)| = 3$, which is equivalent to $|x + 4| = 3$.

Choice B is incorrect. The solutions of $|x - 4| = 3$ are the coordinates of the points on the number line at a distance of 3 units from the point with coordinate 4. Choice C is incorrect. The solutions of $|x + 3| = 4$ are the coordinates of the points on the number line at a distance of 4 units from the point with coordinate -3 . Choice D is incorrect. The solutions of $|x - 3| = 4$ are the coordinates of the points on the number line at a distance of 4 units from the point with coordinate 3.

QUESTION 29

Choice B is correct. The average speed of the model car is found by dividing the total distance traveled by the car by the total time the car traveled. In the first t seconds after the car starts, the time changes from 0 to t seconds. So the total distance the car traveled is the distance it traveled at t seconds minus the distance it traveled at 0 seconds. At 0 seconds, the car has traveled $16(0)\sqrt{0}$ inches, which is equal to 0 inches. According to the equation given, after t seconds, the car has traveled $16t\sqrt{t}$ inches. In other words, after the car starts, it travels a total of $16t\sqrt{t}$ inches in t seconds. Dividing this total distance traveled by the total time shows the car's average speed: $\frac{16t\sqrt{t}}{t} = 16\sqrt{t}$ inches per second.

Choices A, C, and D are incorrect and may result from misconceptions about how average speed is calculated.

QUESTION 30

Choice D is correct. The data in the scatterplot roughly fall in the shape of a downward-opening parabola; therefore, the coefficient for the x^2 term must be negative. Based on the location of

the data points, the y -intercept of the parabola should be somewhere between 740 and 760. Therefore, of the equations given, the best model is $y = -1.674x^2 + 19.76x + 745.73$.

Choices A and C are incorrect. The positive coefficient of the x^2 term means that these these equations each define upward-opening parabolas, whereas a parabola that fits the data in the scatterplot must open downward. Choice B is incorrect because it defines a parabola with a y -intercept that has a negative y -coordinate, whereas a parabola that fits the data in the scatterplot must have a y -intercept with a positive y -coordinate.

QUESTION 31

The correct answer is 10. Let n be the number of friends originally in the group. Since the cost of the trip was \$800, the share, in dollars, for each friend was originally $\frac{800}{n}$. When two friends decided not to go on the trip, the number of friends who split the \$800 cost became $n - 2$, and each friend's cost became $\frac{800}{n - 2}$. Since this share represented a \$20 increase over the original share, the equation $\frac{800}{n} + 20 = \frac{800}{n - 2}$ must be true. Multiplying each side of $\frac{800}{n} + 20 = \frac{800}{n - 2}$ by $n(n - 2)$ to clear all the denominators gives

$$800(n - 2) + 20n(n - 2) = 800n$$

This is a quadratic equation and can be rewritten in the standard form by expanding, simplifying, and then collecting like terms on one side, as shown below:

$$800n - 1600 + 20n^2 - 40n = 800n$$

$$40n - 80 + n^2 - 2n = 40n$$

$$n^2 - 2n - 80 = 0$$

After factoring, this becomes $(n + 8)(n - 10) = 0$.

The solutions of this equation are -8 and 10 . Since a negative solution makes no sense for the number of people in a group, the number of friends originally in the group was 10 .

QUESTION 32

The correct answer is 31. The equation can be solved using the steps shown below.

$$2(5x - 20) - 15 - 8x = 7$$

$$2(5x) - 2(20) - 15 - 8x = 7 \text{ (Apply the distributive property.)}$$

$$10x - 40 - 15 - 8x = 7 \text{ (Multiply.)}$$

$$2x - 55 = 7 \text{ (Combine like terms.)}$$

$$2x = 62 \text{ (Add 55 to both sides of the equation.)}$$

$$x = 31 \text{ (Divide both sides of the equation by 2.)}$$

QUESTION 33

The possible correct answers are 97, 98, 99, 100, and 101. The volume of a cylinder can be found by using the formula $V = \pi r^2 h$, where r is the radius of the circular base and h is the height of the cylinder. The smallest possible volume, in cubic inches, of a graduated cylinder produced by the laboratory supply company can be found by substituting 2 for r and 7.75 for h , giving $V = \pi(2^2)(7.75)$. This gives a volume of approximately 97.39 cubic inches, which rounds to 97 cubic inches. The largest possible volume, in cubic inches, can be found by substituting 2 for r and 8 for h , giving $V = \pi(2^2)(8)$. This gives a volume of approximately 100.53 cubic inches, which rounds to 101 cubic inches. Therefore, the possible volumes are all the integers greater than or equal to 97 and less than or equal to 101, which are 97, 98, 99, 100, and 101. Any of these numbers may be gridded as the correct answer.

QUESTION 34

The correct answer is 5. The intersection points of the graphs of $y = 3x^2 - 14x$ and $y = x$ can be found by solving the system consisting of these two equations. To solve the system, substitute x for y in the first equation. This gives $x = 3x^2 - 14x$. Subtracting x from both sides of the equation gives $0 = 3x^2 - 15x$. Factoring $3x$ out of each term on the left-hand side of the equation gives $0 = 3x(x - 5)$. Therefore, the possible values for x are 0 and 5. Since $y = x$, the two intersection points are $(0, 0)$ and $(5, 5)$. Therefore, $a = 5$.

QUESTION 35

The correct answer is 1.25 or $\frac{5}{4}$. The y -coordinate of the x -intercept is 0, so 0 can be

substituted for y , giving $\frac{4}{5}x + \frac{1}{3}(0) = 1$. This simplifies to $\frac{4}{5}x = 1$. Multiplying both sides of $\frac{4}{5}x$

= 1 by 5 gives $4x = 5$. Dividing both sides of $4x = 5$ by 4 gives $x = \frac{5}{4}$, which is equivalent to 1.25.

Either $5/4$ or 1.25 may be gridded as the correct answer.

QUESTION 36

The correct answer is 2.6 or $\frac{13}{5}$. Since the mean of a set of numbers can be found by adding the numbers together and dividing by how many numbers there are in the set, the mean mass, in kilograms, of the rocks Andrew collected is $\frac{2.4+2.5+3.6+3.1+2.5+2.7}{6} = \frac{16.8}{6} = 2.8$. Since the mean mass of the rocks Maria collected is 0.1 kilogram greater than the mean mass of rocks Andrew collected, the mean mass of the rocks Maria collected is $2.8 + 0.1 = 2.9$ kilograms. The value of x can be found by using the algorithm for finding the mean:

$\frac{x+3.1+2.7+2.9+3.3+2.8}{6} = 2.9$. Solving this equation gives $x = 2.6$, which is equivalent to $\frac{13}{5}$.

. Either 2.6 or $13/5$ may be gridded as the correct answer.

QUESTION 37

The correct answer is 30. The situation can be represented by the equation $x(2^4) = 480$, where the 2 represents the fact that the amount of money in the account doubled each year and the 4 represents the fact that there are 4 years between January 1, 2001, and January 1, 2005. Simplifying $x(2^4) = 480$ gives $16x = 480$. Therefore, $x = 30$.

QUESTION 38

The correct answer is 8. The 6 students represent $(100 - 15 - 45 - 25)\% = 15\%$ of those invited to join the committee. If x people were invited to join the committee, then $0.15x = 6$. Thus, there were $\frac{6}{0.15} = 40$ people invited to join the committee. It follows that there were $0.45(40) = 18$ teachers and $0.25(40) = 10$ school and district administrators invited to join the committee. Therefore, there were 8 more teachers than school and district administrators invited to join the committee.

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Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

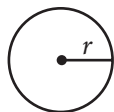
DIRECTIONS

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

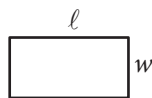
- The use of a calculator **is not permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated,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

REFERENCE

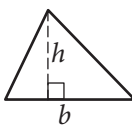


$$A = \pi r^2$$

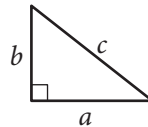
$$C = 2\pi r$$



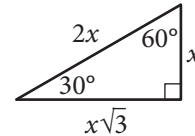
$$A = \ell w$$



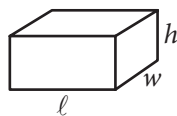
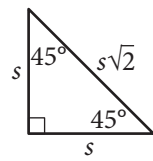
$$A = \frac{1}{2}bh$$



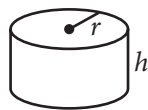
$$c^2 = a^2 + b^2$$



Special Right Triangles



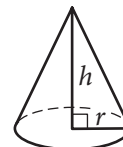
$$V = \ell wh$$



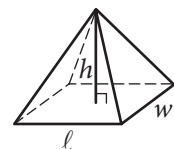
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}\ell wh$$

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.



1

$$x + y = 75$$

The equation above relates the number of minutes, x , Maria spends running each day and the number of minutes, y , she spends biking each day. In the equation, what does the number 75 represent?

- A) The number of minutes spent running each day
- B) The number of minutes spent biking each day
- C) The total number of minutes spent running and biking each day
- D) The number of minutes spent biking for each minute spent running

2

Which of the following is equivalent to $3(x + 5) - 6$?

- A) $3x - 3$
- B) $3x - 1$
- C) $3x + 9$
- D) $15x - 6$

3

$$x = y - 3$$

$$\frac{x}{2} + 2y = 6$$

Which ordered pair (x, y) satisfies the system of equations shown above?

- A) $(-3, 0)$
- B) $(0, 3)$
- C) $(6, -3)$
- D) $(36, -6)$

4

Which of the following complex numbers is equal to $(5 + 12i) - (9i^2 - 6i)$, for $i = \sqrt{-1}$?

- A) $-14 - 18i$
- B) $-4 - 6i$
- C) $4 + 6i$
- D) $14 + 18i$



5

If $f(x) = \frac{x^2 - 6x + 3}{x - 1}$, what is $f(-1)$?

- A) -5
- B) -2
- C) 2
- D) 5

6

A company that makes wildlife videos purchases camera equipment for \$32,400. The equipment depreciates in value at a constant rate for 12 years, after which it is considered to have no monetary value. How much is the camera equipment worth 4 years after it is purchased?

- A) \$10,800
- B) \$16,200
- C) \$21,600
- D) \$29,700

7

$$x^2 + 6x + 4$$

Which of the following is equivalent to the expression above?

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

8

Ken is working this summer as part of a crew on a farm. He earned \$8 per hour for the first 10 hours he worked this week. Because of his performance, his crew leader raised his salary to \$10 per hour for the rest of the week. Ken saves 90% of his earnings from each week. What is the least number of hours he must work the rest of the week to save at least \$270 for the week?

- A) 38
- B) 33
- C) 22
- D) 16



9

Marisa needs to hire at least 10 staff members for an upcoming project. The staff members will be made up of junior directors, who will be paid \$640 per week, and senior directors, who will be paid \$880 per week. Her budget for paying the staff members is no more than \$9,700 per week. She must hire at least 3 junior directors and at least 1 senior director. Which of the following systems of inequalities represents the conditions described if x is the number of junior directors and y is the number of senior directors?

- A) $640x + 880y \geq 9,700$
 $x + y \leq 10$
 $x \geq 3$
 $y \geq 1$
- B) $640x + 880y \leq 9,700$
 $x + y \geq 10$
 $x \geq 3$
 $y \geq 1$
- C) $640x + 880y \geq 9,700$
 $x + y \geq 10$
 $x \leq 3$
 $y \leq 1$
- D) $640x + 880y \leq 9,700$
 $x + y \leq 10$
 $x \leq 3$
 $y \leq 1$

10

$$ax^3 + bx^2 + cx + d = 0$$

In the equation above, a , b , c , and d are constants. If the equation has roots -1 , -3 , and 5 , which of the following is a factor of $ax^3 + bx^2 + cx + d$?

- A) $x - 1$
B) $x + 1$
C) $x - 3$
D) $x + 5$



11

The expression $\frac{x^{-2}y^{\frac{1}{2}}}{x^{\frac{1}{3}}y^{-1}}$, where $x > 1$ and $y > 1$, is

equivalent to which of the following?

- A) $\frac{\sqrt{y}}{\sqrt[3]{x^2}}$
- B) $\frac{y\sqrt{y}}{\sqrt[3]{x^2}}$
- C) $\frac{y\sqrt{y}}{x\sqrt{x}}$
- D) $\frac{y\sqrt{y}}{x^2\sqrt[3]{x}}$

12

The function f is defined by $f(x) = (x + 3)(x + 1)$. The graph of f in the xy -plane is a parabola. Which of the following intervals contains the x -coordinate of the vertex of the graph of f ?

- A) $-4 < x < -3$
- B) $-3 < x < 1$
- C) $1 < x < 3$
- D) $3 < x < 4$



13

Which of the following expressions is equivalent to

$$\frac{x^2 - 2x - 5}{x - 3} ?$$

- A) $x - 5 - \frac{20}{x - 3}$
- B) $x - 5 - \frac{10}{x - 3}$
- C) $x + 1 - \frac{8}{x - 3}$
- D) $x + 1 - \frac{2}{x - 3}$

14

A shipping service restricts the dimensions of the boxes it will ship for a certain type of service. The restriction states that for boxes shaped like rectangular prisms, the sum of the perimeter of the base of the box and the height of the box cannot exceed 130 inches. The perimeter of the base is determined using the width and length of the box. If a box has a height of 60 inches and its length is 2.5 times the width, which inequality shows the allowable width x , in inches, of the box?

- A) $0 < x \leq 10$
- B) $0 < x \leq 11\frac{2}{3}$
- C) $0 < x \leq 17\frac{1}{2}$
- D) $0 < x \leq 20$

15

The expression $\frac{1}{3}x^2 - 2$ can be rewritten as $\frac{1}{3}(x - k)(x + k)$, where k is a positive constant.

What is the value of k ?

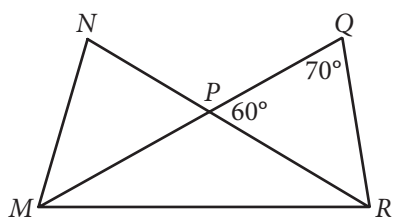
- A) 2
- B) 6
- C) $\sqrt{2}$
- D) $\sqrt{6}$



16

If $2x + 8 = 16$, what is the value of $x + 4$?

17



In the figure above, \overline{MQ} and \overline{NR} intersect at point P , $NP = QP$, and $MP = PR$. What is the measure, in degrees, of $\angle QMR$? (Disregard the degree symbol when gridding your answer.)

18

The number of radians in a 720-degree angle can be written as $a\pi$, where a is a constant. What is the value of a ?



19

The graph of a line in the xy -plane passes through the point $(1, 4)$ and crosses the x -axis at the point $(2, 0)$. The line crosses the y -axis at the point $(0, b)$. What is the value of b ?

20

$$(7532 + 100y^2) + 10(10y^2 - 110)$$

The expression above can be written in the form $ay^2 + b$, where a and b are constants. What is the value of $a + b$?

STOP

If you finish before time is called, you may check your work on this section only.

Do not turn to any other section.



Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

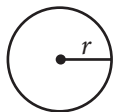
DIRECTIONS

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

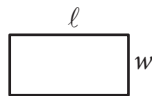
- The use of a calculator is permitted.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated, the domain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

REFERENCE

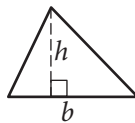


$$A = \pi r^2$$

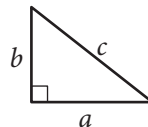
$$C = 2\pi r$$



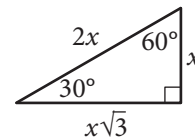
$$A = \ell w$$



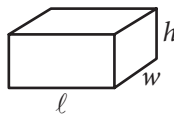
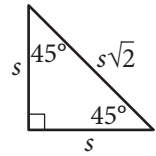
$$A = \frac{1}{2}bh$$



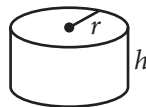
$$c^2 = a^2 + b^2$$



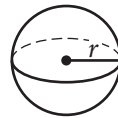
Special Right Triangles



$$V = \ell wh$$



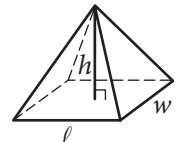
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}\ell wh$$

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.



1

Feeding Information for Boarded Pets

	Fed only dry food	Fed both wet and dry food	Total
Cats	5	11	16
Dogs	2	23	25
Total	7	34	41

The table above shows the kinds of foods that are fed to the cats and dogs currently boarded at a pet care facility. What fraction of the dogs are fed only dry food?

- A) $\frac{2}{41}$
 B) $\frac{2}{25}$
 C) $\frac{7}{41}$
 D) $\frac{2}{7}$

2

$$(x^2 - 3) - (-3x^2 + 5)$$

Which of the following expressions is equivalent to the one above?

- A) $4x^2 - 8$
 B) $4x^2 - 2$
 C) $-2x^2 - 8$
 D) $-2x^2 - 2$

3

A certain package requires 3 centimeters of tape to be closed securely. What is the maximum number of packages of this type that can be secured with 6 meters of tape? (1 meter = 100 cm)

- A) 100
 B) 150
 C) 200
 D) 300

4

A market researcher selected 200 people at random from a group of people who indicated that they liked a certain book. The 200 people were shown a movie based on the book and then asked whether they liked or disliked the movie. Of those surveyed, 95% said they disliked the movie. Which of the following inferences can appropriately be drawn from this survey result?

- A) At least 95% of people who go see movies will dislike this movie.
 B) At least 95% of people who read books will dislike this movie.
 C) Most people who dislike this book will like this movie.
 D) Most people who like this book will dislike this movie.



5

Which of the following ordered pairs (x, y) satisfies the inequality $5x - 3y < 4$?

- I. $(1, 1)$
- II. $(2, 5)$
- III. $(3, 2)$

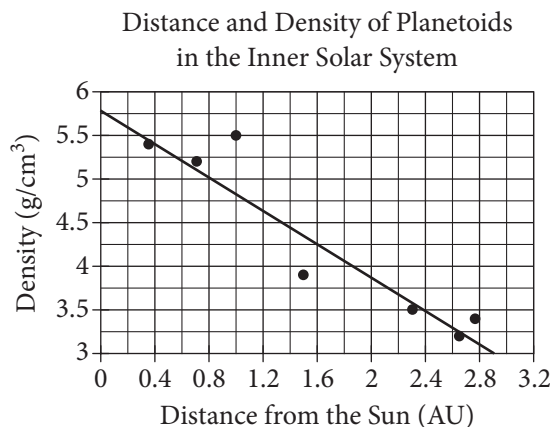
- A) I only
- B) II only
- C) I and II only
- D) I and III only

6

In the equation $(ax + 3)^2 = 36$, a is a constant. If $x = -3$ is one solution to the equation, what is a possible value of a ?

- A) -11
- B) -5
- C) -1
- D) 0

Questions 7 and 8 refer to the following information.



The scatterplot above shows the densities of 7 planetoids, in grams per cubic centimeter, with respect to their average distances from the Sun in astronomical units (AU). The line of best fit is also shown.

7

According to the scatterplot, which of the following statements is true about the relationship between a planetoid's average distance from the Sun and its density?

- A) Planetoids that are more distant from the Sun tend to have lesser densities.
- B) Planetoids that are more distant from the Sun tend to have greater densities.
- C) The density of a planetoid that is twice as far from the Sun as another planetoid is half the density of that other planetoid.
- D) The distance from a planetoid to the Sun is unrelated to its density.



8

An astronomer has discovered a new planetoid about 1.2 AU from the Sun. According to the line of best fit, which of the following best approximates the density of the planetoid, in grams per cubic centimeter?

- A) 3.6
- B) 4.1
- C) 4.6
- D) 5.5

9

$$9ax + 9b - 6 = 21$$

Based on the equation above, what is the value of $ax + b$?

- A) 3
- B) 6
- C) 8
- D) 12

10

Lani spent 15% of her 8-hour workday in meetings. How many minutes of her workday did she spend in meetings?

- A) 1.2
- B) 15
- C) 48
- D) 72

11

A software company is selling a new game in a standard edition and a collector's edition. The box for the standard edition has a volume of 20 cubic inches, and the box for the collector's edition has a volume of 30 cubic inches. The company receives an order for 75 copies of the game, and the total volume of the order to be shipped is 1,870 cubic inches. Which of the following systems of equations can be used to determine the number of standard edition games, s , and collector's edition games, c , that were ordered?

- A) $75 - s = c$
 $20s + 30c = 1,870$
- B) $75 - s = c$
 $30s + 20c = 1,870$
- C) $s - c = 75$
 $25(s + c) = 1,870$
- D) $s - c = 75$
 $30s + 20c = 1,870$



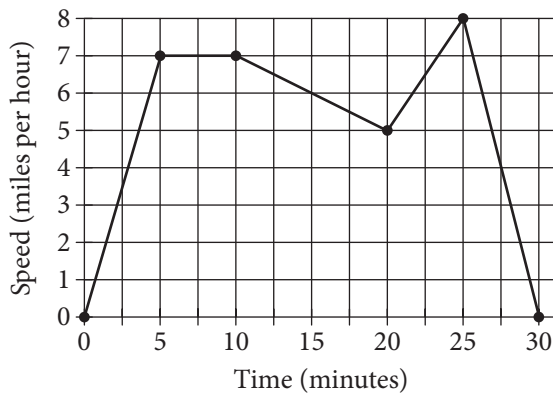
12

A customer paid \$53.00 for a jacket after a 6 percent sales tax was added. What was the price of the jacket before the sales tax was added?

- A) \$47.60
- B) \$50.00
- C) \$52.60
- D) \$52.84

13

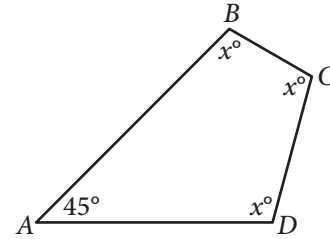
Theresa's Running Speed and Time



Theresa ran on a treadmill for thirty minutes, and her time and speed are shown on the graph above. According to the graph, which of the following statements is NOT true concerning Theresa's run?

- A) Theresa ran at a constant speed for five minutes.
- B) Theresa's speed was increasing for a longer period of time than it was decreasing.
- C) Theresa's speed decreased at a constant rate during the last five minutes.
- D) Theresa's speed reached its maximum during the last ten minutes.

14



In the figure above, what is the value of x ?

- A) 45
- B) 90
- C) 100
- D) 105

15

If 50 one-cent coins were stacked on top of each other in a column, the column would be approximately $3\frac{7}{8}$ inches tall. At this rate, which of the following is closest to the number of one-cent coins it would take to make an 8-inch-tall column?

- A) 75
- B) 100
- C) 200
- D) 390



16

If $a - b = 12$ and $\frac{b}{2} = 10$, what is the value of $a + b$?

- A) 2
- B) 12
- C) 32
- D) 52

17

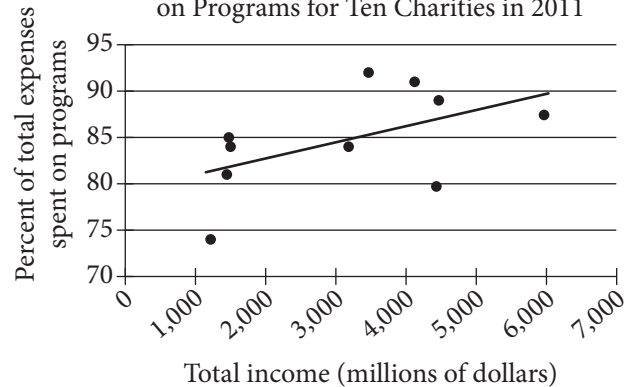
$$y = 19.99 + 1.50x$$

The equation above models the total cost y , in dollars, that a company charges a customer to rent a truck for one day and drive the truck x miles. The total cost consists of a flat fee plus a charge per mile driven. When the equation is graphed in the xy -plane, what does the y -intercept of the graph represent in terms of the model?

- A) A flat fee of \$19.99
- B) A charge per mile of \$1.50
- C) A charge per mile of \$19.99
- D) Total daily charges of \$21.49

18

Income and Percent of Total Expenses Spent on Programs for Ten Charities in 2011



The scatterplot above shows data for ten charities along with the line of best fit. For the charity with the greatest percent of total expenses spent on programs, which of the following is closest to the difference of the actual percent and the percent predicted by the line of best fit?

- A) 10%
- B) 7%
- C) 4%
- D) 1%



Questions 19 and 20 refer to the following information.

$$\text{Mosteller's formula: } A = \frac{\sqrt{hw}}{60}$$

$$\text{Current's formula: } A = \frac{4 + w}{30}$$

The formulas above are used in medicine to estimate the body surface area A , in square meters, of infants and children whose weight w ranges between 3 and 30 kilograms and whose height h is measured in centimeters.

19

Based on Current's formula, what is w in terms of A ?

- A) $w = 30A - 4$
- B) $w = 30A + 4$
- C) $w = 30(A - 4)$
- D) $w = 30(A + 4)$

20

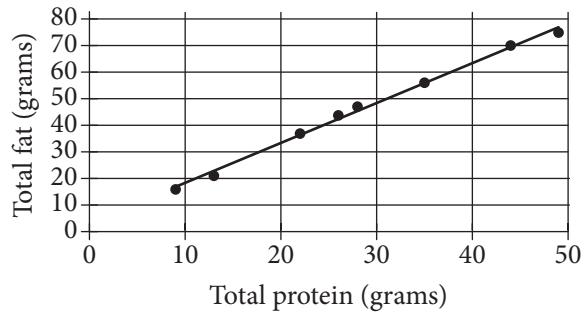
If Mosteller's and Current's formulas give the same estimate for A , which of the following expressions is equivalent to \sqrt{hw} ?

- A) $\frac{4 + w}{2}$
- B) $\frac{4 + w}{1,800}$
- C) $2(4 + w)$
- D) $\frac{(4 + w)^2}{2}$



21

Total Protein and Total Fat
for Eight Sandwiches



The scatterplot above shows the numbers of grams of both total protein and total fat for eight sandwiches on a restaurant menu. The line of best fit for the data is also shown. According to the line of best fit, which of the following is closest to the predicted increase in total fat, in grams, for every increase of 1 gram in total protein?

- A) 2.5
- B) 2.0
- C) 1.5
- D) 1.0

22

Percent of Residents Who Earned
a Bachelor's Degree or Higher

State	Percent of residents
State A	21.9%
State B	27.9%
State C	25.9%
State D	19.5%
State E	30.1%
State F	36.4%
State G	35.5%

A survey was given to residents of all 50 states asking if they had earned a bachelor's degree or higher. The results from 7 of the states are given in the table above. The median percent of residents who earned a bachelor's degree or higher for all 50 states was 26.95%. What is the difference between the median percent of residents who earned a bachelor's degree or higher for these 7 states and the median for all 50 states?

- A) 0.05%
- B) 0.95%
- C) 1.22%
- D) 7.45%



23

A cylindrical can containing pieces of fruit is filled to the top with syrup before being sealed. The base of the can has an area of 75 cm^2 , and the height of the can is 10 cm. If 110 cm^3 of syrup is needed to fill the can to the top, which of the following is closest to the total volume of the pieces of fruit in the can?

- A) 7.5 cm^3
- B) 185 cm^3
- C) 640 cm^3
- D) 750 cm^3

24

$$h(t) = -16t^2 + 110t + 72$$

The function above models the height h , in feet, of an object above ground t seconds after being launched straight up in the air. What does the number 72 represent in the function?

- A) The initial height, in feet, of the object
- B) The maximum height, in feet, of the object
- C) The initial speed, in feet per second, of the object
- D) The maximum speed, in feet per second, of the object

Questions 25 and 26 refer to the following information.

Energy per Gram of Typical Macronutrients

Macronutrient	Food calories	Kilojoules
Protein	4.0	16.7
Fat	9.0	37.7
Carbohydrate	4.0	16.7

The table above gives the typical amounts of energy per gram, expressed in both food calories and kilojoules, of the three macronutrients in food.

25

If x food calories is equivalent to k kilojoules, of the following, which best represents the relationship between x and k ?

- A) $k = 0.24x$
- B) $k = 4.2x$
- C) $x = 4.2k$
- D) $xk = 4.2$



26

If the 180 food calories in a granola bar come entirely from p grams of protein, f grams of fat, and c grams of carbohydrate, which of the following expresses f in terms of p and c ?

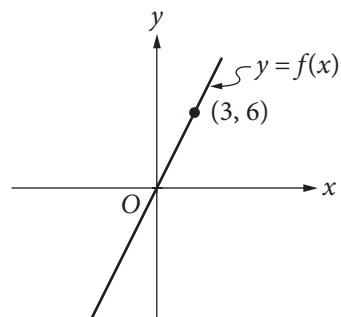
- A) $f = 20 + \frac{4}{9}(p + c)$
 B) $f = 20 - \frac{4}{9}(p + c)$
 C) $f = 20 - \frac{4}{9}(p - c)$
 D) $f = 20 + \frac{9}{4}(p + c)$

27

The world's population has grown at an average rate of 1.9 percent per year since 1945. There were approximately 4 billion people in the world in 1975. Which of the following functions represents the world's population P , in billions of people, t years since 1975? (1 billion = 1,000,000,000)

- A) $P(t) = 4(1.019)^t$
 B) $P(t) = 4(1.9)^t$
 C) $P(t) = 1.19t + 4$
 D) $P(t) = 1.019t + 4$

28



In the xy -plane above, a point (not shown) with coordinates (s, t) lies on the graph of the linear function f . If s and t are positive integers, what is the ratio of t to s ?

- A) 1 to 3
 B) 1 to 2
 C) 2 to 1
 D) 3 to 1



29

A circle in the xy -plane has equation $(x + 3)^2 + (y - 1)^2 = 25$. Which of the following points does NOT lie in the interior of the circle?

- A) $(-7, 3)$
- B) $(-3, 1)$
- C) $(0, 0)$
- D) $(3, 2)$

30

Year	Subscriptions sold
2012	5,600
2013	5,880

The manager of an online news service received the report above on the number of subscriptions sold by the service. The manager estimated that the percent increase from 2012 to 2013 would be double the percent increase from 2013 to 2014. How many subscriptions did the manager expect would be sold in 2014?

- A) 6,020
- B) 6,027
- C) 6,440
- D) 6,468

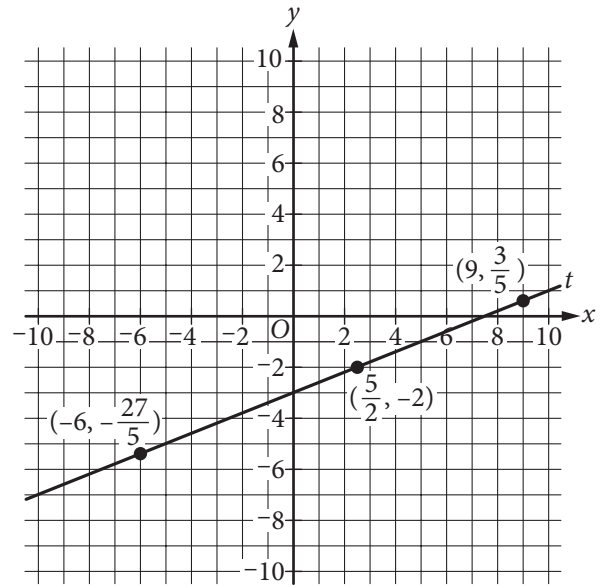


31

In 1854, during the California gold rush, each ounce of gold was worth \$20, and the largest known mass of gold found in California was worth \$62,400 in that year. What was the weight, in pounds, of this mass of gold? (16 ounces = 1 pound)

32

Line t is shown in the xy -plane below.



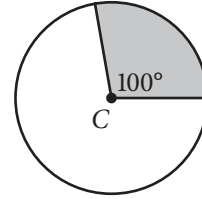
What is the slope of line t ?



33

The score on a trivia game is obtained by subtracting the number of incorrect answers from twice the number of correct answers. If a player answered 40 questions and obtained a score of 50, how many questions did the player answer correctly?

34



Point C is the center of the circle above. What fraction of the area of the circle is the area of the shaded region?



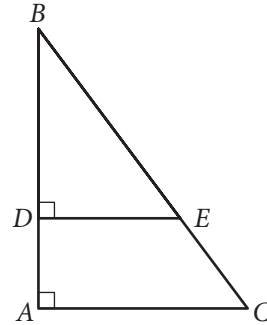
35

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

$$y = 4 - x$$

If the ordered pair (x, y) satisfies the system of equations above, what is one possible value of x ?

36



In the figure above, $\tan B = \frac{3}{4}$. If $BC = 15$ and

$DA = 4$, what is the length of \overline{DE} ?



Questions 37 and 38 refer to the following information.

Number of Contestants by Score and Day

	5 out of 5	4 out of 5	3 out of 5	2 out of 5	1 out of 5	0 out of 5	Total
Day 1	2	3	4	6	2	3	20
Day 2	2	3	5	5	4	1	20
Day 3	3	3	4	5	3	2	20
Total	7	9	13	16	9	6	60

The same 20 contestants, on each of 3 days, answered 5 questions in order to win a prize. Each contestant received 1 point for each correct answer. The number of contestants receiving a given score on each day is shown in the table above.

37

What was the mean score of the contestants on Day 1?

38

No contestant received the same score on two different days. If a contestant is selected at random, what is the probability that the selected contestant received a score of 5 on Day 2 or Day 3, given that the contestant received a score of 5 on one of the three days?

STOP

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



Answer Explanations

SAT[®] Practice Test #7

Section 3: Math Test — No Calculator

QUESTION 1.

Choice C is correct. Maria spends x minutes running each day and y minutes biking each day. Therefore, $x + y$ represents the total number of minutes Maria spent running and biking each day. Because $x + y = 75$, it follows that 75 is the total number of minutes that Maria spent running and biking each day.

Choices A and B are incorrect. The problem states that Maria spends time in both activities each day, therefore x and y must be positive. If 75 represents the number of minutes Maria spent running each day, then Maria spent no minutes biking each day. Similarly, if 75 represents the number of minutes Maria spent biking each day, then Maria spent no minutes running each day. The number of minutes Maria spends running each day and biking each day may vary; however, the total number of minutes she spends each day on these activities is constant and equal to 75. Choice D is incorrect. The number of minutes Maria spent biking for each minute spent running cannot be determined from the information provided.

QUESTION 2.

Choice C is correct. Using the distributive property to multiply 3 and $(x + 5)$ gives $3x + 15 - 6$, which can be rewritten as $3x + 9$.

Choice A is incorrect and may result from rewriting the given expression as $3(x + 5 - 6)$. Choice B is incorrect and may result from incorrectly rewriting the expression as $(3x + 5) - 6$. Choice D is incorrect and may result from incorrectly rewriting the expression as $3(5x) - 6$.

Alternatively, evaluating the given expression and each answer choice for the same value of x , for example $x = 0$, will reveal which of the expressions is equivalent to the given expression.

QUESTION 3.

Choice B is correct. The first equation can be rewritten as $y - x = 3$ and the second as $\frac{x}{4} + y = 3$, which implies that $-x = \frac{x}{4}$, and so $x = 0$. The ordered pair $(0, 3)$ satisfies the first equation and also the second, since $0 + 2(3) = 6$ is a true equality.

Alternatively, the first equation can be rewritten as $y = x + 3$.

Substituting $x + 3$ for y in the second equation gives $\frac{x}{2} + 2(x + 3) = 6$.

This can be rewritten using the distributive property as $\frac{x}{2} + 2x + 6 = 6$.

It follows that $2x + \frac{x}{2}$ must be 0. Thus, $x = 0$. Substituting 0 for x in the equation $y = x + 3$ gives $y = 3$. Therefore, the ordered pair $(0, 3)$ is the solution to the system of equations shown.

Choice A is incorrect; it satisfies the first equation but not the second. Choices C and D are incorrect because neither satisfies the first equation, $x = y - 3$.

QUESTION 4.

Choice D is correct. Applying the distributive property, the original expression is equivalent to $5 + 12i - 9i^2 + 6i$. Since $i = \sqrt{-1}$, it follows that $i^2 = -1$. Substituting -1 for i^2 into the expression and simplifying yields $5 + 12i + 9 + 6i$, which is equal to $14 + 18i$.

Choices A, B, and C are incorrect and may result from substituting 1 for i^2 or errors made when rewriting the given expression.

QUESTION 5.

Choice A is correct. Substituting -1 for x in the equation that defines

f gives $f(-1) = \frac{(-1)^2 - 6(-1) + 3}{(-1) - 1}$. Simplifying the expressions in the numerator and denominator yields $\frac{1 + 6 + 3}{-2}$, which is equal to $\frac{10}{-2}$ or -5 .

Choices B, C, and D are incorrect and may result from misapplying the order of operations when substituting -1 for x .

QUESTION 6.

Choice C is correct. The value of the camera equipment depreciates from its original purchase value at a constant rate for 12 years. So if x is the amount, in dollars, by which the value of the equipment depreciates each year, the value of the camera equipment, in dollars, t years after it is purchased would be $32,400 - xt$. Since the value of the camera equipment after 12 years is \$0, it follows that $32,400 - 12x = 0$. To solve for x , rewrite the equation as $32,400 = 12x$. Dividing both sides of the equation by 12 gives $x = 2,700$. It follows that the value of the camera equipment depreciates by \$2,700 each year. Therefore, the value of the equipment after 4 years, represented by the expression $32,400 - 2,700(4)$, is \$21,600.

Choice A is incorrect. The value given in choice A is equivalent to $\$2,700 \times 4$. This is the amount, in dollars, by which the value of the camera equipment depreciates 4 years after it is purchased, not the dollar value of the camera equipment 4 years after it is purchased.

Choice B is incorrect. The value given in choice B is equal to $\$2,700 \times 6$, which is the amount, in dollars, by which the value of the camera equipment depreciates 6 years after it is purchased, not the dollar value of the camera equipment 4 years after it is purchased.

Choice D is incorrect. The value given in choice D is equal to $\$32,400 - \$2,700$. This is the dollar value of the camera equipment 1 year after it is purchased.

QUESTION 7.

Choice B is correct. Each of the options is a quadratic expression in vertex form. To rewrite the given expression in this form, the number 9 needs to be added to the first two terms, because $x^2 + 6x + 9$ is equivalent to $(x + 3)^2$. Rewriting the number 4 as $9 - 5$ in the given expression yields $x^2 + 6x + 9 - 5$, which is equivalent to $(x + 3)^2 - 5$.

Choice A is incorrect. Squaring the binomial and simplifying the expression in option A gives $x^2 + 6x + 9 + 5$. Combining like terms gives $x^2 + 6x + 14$, not $x^2 + 6x + 4$. Choice C is incorrect. Squaring the binomial and simplifying the expression in choice C gives $x^2 - 6x + 9 + 5$.

Combining like terms gives $x^2 - 6x + 14$, not $x^2 + 6x + 4$. Choice D is incorrect. Squaring the binomial and simplifying the expression in choice D gives $x^2 - 6x + 9 - 5$. Combining like terms gives $x^2 - 6x + 4$, not $x^2 + 6x + 4$.

QUESTION 8.

Choice C is correct. Ken earned \$8 per hour for the first 10 hours he worked, so he earned a total of \$80 for the first 10 hours he worked. For the rest of the week, Ken was paid at the rate of \$10 per hour. Let x be the number of hours he will work for the rest of the week. The total of Ken's earnings, in dollars, for the week will be $10x + 80$. He saves

90% of his earnings each week, so this week he will save $0.9(10x + 80)$ dollars. The inequality $0.9(10x + 80) \geq 270$ represents the condition that he will save at least \$270 for the week. Factoring 10 out of the expression $10x + 80$ gives $10(x + 8)$. The product of 10 and 0.9 is 9, so the inequality can be rewritten as $9(x + 8) \geq 270$. Dividing both sides of this inequality by 9 yields $x + 8 \geq 30$, so $x \geq 22$. Therefore, the least number of hours Ken must work the rest of the week to save at least \$270 for the week is 22.

Choices A and B are incorrect because Ken can save \$270 by working fewer hours than 38 or 33 for the rest of the week. Choice D is incorrect. If Ken worked 16 hours for the rest of the week, his total earnings for the week will be $\$80 + \$160 = \$240$, which is less than \$270. Since he saves only 90% of his earnings each week, he would save even less than \$240 for the week.

QUESTION 9.

Choice B is correct. Marisa will hire x junior directors and y senior directors. Since she needs to hire at least 10 staff members, $x + y \geq 10$. Each junior director will be paid \$640 per week, and each senior director will be paid \$880 per week. Marisa's budget for paying the new staff is no more than \$9,700 per week; in terms of x and y , this condition is $640x + 880y \leq 9,700$. Since Marisa must hire at least 3 junior directors and at least 1 senior director, it follows that $x \geq 3$ and $y \geq 1$. All four of these conditions are represented correctly in choice B.

Choices A and C are incorrect. For example, the first condition, $640x + 880y \geq 9,700$, in each of these options implies that Marisa can pay the new staff members more than her budget of \$9,700. Choice D is incorrect because Marisa needs to hire at least 10 staff members, not at most 10 staff members, as the inequality $x + y \leq 10$ implies.

QUESTION 10.

Choice B is correct. In general, a binomial of the form $x + f$, where f is a constant, is a factor of a polynomial when the remainder of dividing the polynomial by $x + f$ is 0. Let R be the remainder resulting from the division of the polynomial $P(x) = ax^3 + bx^2 + cx + d$ by $x + 1$. So the polynomial $P(x)$ can be rewritten as $P(x) = (x + 1)q(x) + R$, where $q(x)$ is a polynomial of second degree and R is a constant. Since -1 is a root of the equation $P(x) = 0$, it follows that $P(-1) = 0$.

Since $P(-1) = 0$ and $P(-1) = R$, it follows that $R = 0$. This means that $x + 1$ is a factor of $P(x)$.

Choices A, C, and D are incorrect because none of these choices can be a factor of the polynomial $P(x) = ax^3 + bx^2 + cx + d$. For example, if $x - 1$ were a factor (choice A), then $P(x) = (x - 1)h(x)$, for some polynomial function h . It follows that $P(1) = (1 - 1)h(1) = 0$, so 1 would be another root of the given equation, and thus the given equation would have at least 4 roots. However, a third-degree equation cannot have more than three roots. Therefore, $x - 1$ cannot be a factor of $P(x)$.

QUESTION 11.

Choice D is correct. For $x > 1$ and $y > 1$, $x^{\frac{1}{3}}$ and $y^{\frac{1}{2}}$ are equivalent to $\sqrt[3]{x}$ and \sqrt{y} , respectively. Also, x^{-2} and y^{-1} are equivalent to $\frac{1}{x^2}$ and $\frac{1}{y}$, respectively. Using these equivalences, the given expression can be rewritten as $\frac{y\sqrt{y}}{x^2 \sqrt[3]{x}}$.

Choices A, B, and C are incorrect because these choices are not equivalent to the given expression for $x > 1$ and $y > 1$.

For example, for $x = 2$ and $y = 2$, the value of the given expression is $2^{-\frac{5}{6}}$; the values of the choices, however, are $2^{-\frac{1}{3}}$, $2^{\frac{5}{6}}$, and 1, respectively.

QUESTION 12.

Choice B is correct. The graph of a quadratic function in the xy -plane is a parabola. The axis of symmetry of the parabola passes through the vertex of the parabola. Therefore, the vertex of the parabola and the midpoint of the segment between the two x -intercepts of the graph have the same x -coordinate. Since $f(-3) = f(-1) = 0$, the x -coordinate of the vertex is $\frac{(-3) + (-1)}{2} = -2$. Of the shown intervals, only the interval in choice B contains -2 .

Choices A, C, and D are incorrect and may result from either calculation errors or misidentification of the graph's x -intercepts.

QUESTION 13.

Choice D is correct. The numerator of the given expression can be rewritten in terms of the denominator, $x - 3$, as follows:

$x^2 - 2x - 5 = x^2 - 3x + x - 3 - 2$, which is equivalent to $x(x - 3) + (x - 3) - 2$. So the given expression is equivalent to $\frac{x(x - 3) + (x - 3) - 2}{x - 3} = \frac{x(x - 3)}{x - 3} + \frac{x - 3}{x - 3} - \frac{2}{x - 3}$. Since the given expression is defined for $x \neq 3$, the expression can be rewritten as $x + 1 - \frac{2}{x - 3}$.

Long division can also be used as an alternate approach.

Choices A, B, and C are incorrect and may result from errors made when dividing the two polynomials or making use of structure.

QUESTION 14.

Choice A is correct. If x is the width, in inches, of the box, then the length of the box is $2.5x$ inches. It follows that the perimeter of the base is $2(2.5x + x)$, or $7x$ inches. The height of the box is given to be 60 inches. According to the restriction, the sum of the perimeter of the base and the height of the box should not exceed 130 inches. Algebraically, that is $7x + 60 \leq 130$, or $7x \leq 70$. Dividing both sides of the inequality by 7 gives $x \leq 10$. Since x represents the width of the box, x must also be a positive number. Therefore, the inequality $0 < x \leq 10$ represents all the allowable values of x that satisfy the given conditions.

Choices B, C, and D are incorrect and may result from calculation errors or misreading the given information.

QUESTION 15.

Choice D is correct. Factoring out the coefficient $\frac{1}{3}$, the given expression can be rewritten as $\frac{1}{3}(x^2 - 6)$. The expression $x^2 - 6$ can be approached as a difference of squares and rewritten as $(x - \sqrt{6})(x + \sqrt{6})$. Therefore, k must be $\sqrt{6}$.

Choice A is incorrect. If k were 2, then the expression given would be rewritten as $\frac{1}{3}(x - 2)(x + 2)$, which is equivalent to $\frac{1}{3}x^2 - \frac{4}{3}$, not $\frac{1}{3}x^2 - 2$.

Choice B is incorrect. This may result from incorrectly factoring the expression and finding $(x - 6)(x + 6)$ as the factored form of the expression. Choice C is incorrect. This may result from incorrectly distributing the $\frac{1}{3}$ and rewriting the expression as $\frac{1}{3}(x^2 - 2)$.

QUESTION 16.

The correct answer is 8. The expression $2x + 8$ contains a factor of $x + 4$. It follows that the original equation can be rewritten as $2(x + 4) = 16$. Dividing both sides of the equation by 2 gives $x + 4 = 8$.

QUESTION 17.

The correct answer is 30. It is given that the measure of $\angle QPR$ is 60° . Angle MPR and $\angle QPR$ are collinear and therefore are supplementary angles. This means that the sum of the two angle measures is 180° , and so the measure of $\angle MPR$ is 120° . The sum of the angles in a triangle is 180° . Subtracting the measure of $\angle MPR$ from 180° yields the sum of the other angles in the triangle MPR . Since $180 - 120 = 60$, the sum of the measures of $\angle QMR$ and $\angle NRM$ is 60° . It is given that $MP = PR$, so it follows that triangle MPR is isosceles. Therefore $\angle QMR$ and $\angle NRM$ must be congruent. Since the sum of the measure of these two angles is 60° , it follows that the measure of each angle is 30° .

An alternate approach would be to use the exterior angle theorem, noting that the measure of $\angle QPR$ is equal to the sum of the measures of $\angle QMR$ and $\angle NRM$. Since both angles are equal, each of them has a measure of 30° .

QUESTION 18.

The correct answer is 4. There are π radians in a 180° angle. A 720° angle is 4 times greater than a 180° angle. Therefore, the number of radians in a 720° angle is 4π .

QUESTION 19.

The correct answer is 8. Since the line passes through the point $(2, 0)$, its equation is of the form $y = m(x - 2)$. The coordinates of the point $(1, 4)$ must also satisfy this equation. So $4 = m(1 - 2)$, or $m = -4$. Substituting -4 for m in the equation of the line gives $y = -4(x - 2)$, or equivalently $y = -4x + 8$. Therefore, $b = 8$.

Alternate approach: Given the coordinates of two points through which the line passes, the slope of the line is $\frac{4 - 0}{1 - 2} = -4$. So, the equation of the line is of the form $y = -4x + b$. Since $(2, 0)$ satisfies this equation, $0 = -4(2) + b$ must be true. Solving this equation for b gives $b = 8$.

QUESTION 20.

The correct answer is 6632. Applying the distributive property to the expression yields $7532 + 100y^2 + 100y^2 - 1100$. Then adding together $7532 + 100y^2$ and $100y^2 - 1100$ and collecting like terms results in $200y^2 + 6432$. This is written in the form $ay^2 + b$, where $a = 200$ and $b = 6432$. Therefore $a + b = 200 + 6432 = 6632$.

Section 4: Math Test - Calculator

QUESTION 1.

Choice B is correct. There are 2 dogs that are fed only dry food and a total of 25 dogs. Therefore, the fraction of dogs fed only dry food is $\frac{2}{25}$.

Choice A is incorrect. This fraction is the number of dogs fed only dry food divided by the total number of pets instead of the total number of dogs. Choice C is incorrect because it is the fraction of all pets fed only dry food. Choice D is incorrect. This fraction is the number of dogs fed only dry food divided by the total number of pets fed only dry food.

QUESTION 2.

Choice A is correct. Applying the distributive property, the given expression can be rewritten as $x^2 - 3 + 3x^2 - 5$. Combining like terms yields $4x^2 - 8$.

Choice B is incorrect and is the result of disregarding the negative sign in front of the first 3 before combining like terms. Choice C is incorrect and is the result of not multiplying $-3x^2$ by -1 before combining like terms. Choice D is incorrect and is the result of disregarding the negative sign in front of the first 3 and not multiplying $-3x^2$ by -1 before combining like terms.

QUESTION 3.

Choice C is correct. Multiplying each side of 1 meter = 100 cm by 6 gives 6 meters = 600 cm. Each package requires 3 centimeters of tape. The number of packages that can be secured with 600 cm of tape is $\frac{600}{3}$, or 200 packages.

Choices A, B, and D are incorrect and may be the result of incorrect interpretations of the given information or of computation errors.

QUESTION 4.

Choice D is correct. The survey was given to a group of people who liked the book, and therefore, the survey results can be applied only to the population of people who liked the book. Choice D is the most appropriate inference from the survey results because it describes a conclusion about people who liked the book, and the results of the survey indicate that most people who like the book disliked the movie.

Choices A, B, and C are incorrect because none of these inferences can be drawn from the survey results. Choices A and B need not be true. The people surveyed all liked the book on which the movie was based, which is not true of all people who go see movies or all people who read books. Thus, the people surveyed are not representative of all people who go see movies or all people who read books. Therefore, the results of this survey cannot appropriately be extended to at least 95% of people who go see movies or to at least 95% of people who read books. Choice C need not be true because the sample includes only people who liked the book, and so the results do not extend to people who dislike the book.

QUESTION 5.

Choice C is correct. Substituting (1, 1) into the inequality gives $5(1) - 3(1) < 4$, or $2 < 4$, which is a true statement. Substituting (2, 5) into the inequality gives $5(2) - 3(5) < 4$, or $-5 < 4$, which is a true statement. Substituting (3, 2) into the inequality gives $5(3) - 3(2) < 4$, or $9 < 4$, which is not a true statement. Therefore, (1, 1) and (2, 5) are the only ordered pairs that satisfy the given inequality.

Choice A is incorrect because the ordered pair (2, 5) also satisfies the inequality. Choice B is incorrect because the ordered pair (1, 1) also satisfies the inequality. Choice D is incorrect because the ordered pair (3, 2) does not satisfy the inequality.

QUESTION 6.

Choice C is correct. Since $x = -3$ is a solution to the equation, substituting -3 for x gives $(-3a + 3)^2 = 36$. Taking the square root of each side of this equation gives the two equations $-3a + 3 = 6$ and $-3a + 3 = -6$. Solving each of these for a yields $a = -1$ and $a = 3$. Therefore, -1 is a possible value of a .

Choice A is incorrect and may be the result of ignoring the squared expression and solving $-3a + 3 = 36$ for a . Choice B is incorrect and may be the result of dividing 36 by 2 instead of taking the square root of 36 when solving for a . Choice D is incorrect and may be the result of taking the sum of the value of x , -3 , and the constant, 3.

QUESTION 7.

Choice A is correct. The slope of the line of best fit is negative, meaning as the distance of planetoids from the Sun increases, the density of the planetoids decreases. Therefore, planetoids that are more distant from the Sun tend to have lesser densities.

Choice B is incorrect because as the distance of planetoids from the sun increases, the density of the planetoids decreases. Choice C is incorrect. For example, according to the line of best fit, a planetoid that is 0.8 AU from the Sun has a density of 5 g/cm^3 , but a planetoid that is twice as far from the Sun with a distance of 1.6 AU has a density of 4.25 g/cm^3 . However, the density of 4.25 g/cm^3 is not half the density of 5 g/cm^3 . Choice D is incorrect because there is a relationship between the distance from a planetoid to the Sun and density, as shown by the line of best fit.

QUESTION 8.

Choice C is correct. According to the line of best fit, a planetoid with a distance from the Sun of 1.2 AU has a density between 4.5 g/cm^3 and 4.75 g/cm^3 . The only choice in this range is 4.6.

Choices A, B, and D are incorrect and may result from misreading the information in the scatterplot.

QUESTION 9.

Choice A is correct. To isolate the terms that contain ax and b , 6 can be added to both sides of the equation, which gives $9ax + 9b = 27$. Then, both sides of this equation can be divided by 9, which gives $ax + b = 3$.

Choices B, C, and D are incorrect and may result from computation errors.

QUESTION 10.

Choice D is correct. There are 60 minutes in one hour, so an 8-hour workday has $(60)(8) = 480$ minutes. To calculate 15% of 480, multiply 0.15 by 480: $(0.15)(480) = 72$. Therefore, Lani spent 72 minutes of her workday in meetings.

Choice A is incorrect because 1.2 is 15% of 8, which gives the time Lani spent of her workday in meetings in hours, not minutes. Choices B and C are incorrect and may be the result of computation errors.

QUESTION 11.

Choice A is correct. The total number of copies of the game the company will ship is 75, so one equation in the system is $s + c = 75$, which can be written as $75 - s = c$. Because each standard edition of the game has a volume of 20 cubic inches and s represents the number of standard edition games, the expression $20s$ represents the volume of the shipment that comes from standard edition copies of the game. Similarly, the expression $30c$ represents the volume of the shipment that comes from collector's edition copies of the games. Because these volumes combined are 1,870 cubic inches, the equation $20s + 30c = 1,870$ represents this situation. Therefore, the correct answer is choice A.

Choice B is incorrect. This equation gives the volume of each standard edition game as 30 cubic inches and the volume of each collector's edition game as 20 cubic inches. Choice C is incorrect. This is the result of finding the average volume of the two types of games, using that average volume (25) for both types of games, and assuming that there are 75 more standard editions of the game than there are collector's editions of the game. Choice D is incorrect. This is the result of assuming that the volume of each standard edition game is 30 cubic inches, that the volume of each collector's edition game is 20 cubic inches, and that there are 75 more standard editions than there are collector's editions.

QUESTION 12.

Choice B is correct. Let x be the price, in dollars, of the jacket before sales tax. The price of the jacket after the 6% sales tax is added was \$53. This can be expressed by the equation $x + 0.06x = 53$, or $1.06x = 53$. Dividing each side of this equation by 1.06 gives $x = 50$. Therefore, the price of the jacket before sales tax was \$50.

Choices A, C, and D are incorrect and may be the result of computation errors.

QUESTION 13.

Choice B is correct. Theresa's speed was increasing from 0 to 5 minutes and from 20 to 25 minutes, which is a total of 10 minutes. Theresa's speed was decreasing from 10 minutes to 20 minutes and from 25 to 30 minutes, which is a total of 15 minutes. Therefore, Theresa's speed was NOT increasing for a longer period of time than it was decreasing.

Choice A is incorrect. Theresa ran at a constant speed for the 5-minute period from 5 to 10 minutes. Choice C is incorrect. Theresa's speed decreased at a constant rate during the last 5 minutes. Choice D is incorrect. Theresa's speed reached its maximum at 25 minutes, which is within the last 10 minutes.

QUESTION 14.

Choice D is correct. The figure is a quadrilateral, so the sum of the measures of its interior angles is 360° . The value of x can be found by using the equation $45 + 3x = 360$. Subtracting 45 from both sides of the equation results in $3x = 315$, and dividing both sides of the resulting equation by 3 yields $x = 105$. Therefore, the value of x in the figure is 105.

Choice A is incorrect. If the value of x were 45, the sum of the measures of the angles in the figure would be $45 + 3(45)$, or 180° , but the sum of the measures of the angles in a quadrilateral is 360° .

Choice B is incorrect. If the value of x were 90, the sum of the measures of the angles in the figure would be $45 + 3(90)$, or 315° , but the sum of the measures of the angles in a quadrilateral is 360° .

Choice C is incorrect. If the value of x were 100, the sum of the measures of the angles in the figure would be $45 + 3(100)$, or 345° , but the sum of the measures of the angles in a quadrilateral is 360° .

QUESTION 15.

Choice B is correct. A column of 50 stacked one-cent coins is about $3\frac{7}{8}$ inches tall, which is slightly less than 4 inches tall. Therefore a column of stacked one-cent coins that is 4 inches tall would contain slightly more than 50 one-cent coins. It can then be reasoned that because 8 inches is twice 4 inches, a column of stacked one-cent coins that is 8 inches tall would contain slightly more than twice as many coins; that is, slightly more than 100 one-cent coins. An alternate approach is to set up a proportion comparing the column height to the

number of one-cent coins, or $\frac{3\frac{7}{8} \text{ inches}}{50 \text{ coins}} = \frac{8 \text{ inches}}{x \text{ coins}}$, where x is the

number of coins in an 8-inch-tall column. Multiplying each side of the proportion by $50x$ gives $3\frac{7}{8}x = 400$. Solving for x gives $x = \frac{400 \times 8}{31}$, which is approximately 103. Therefore, of the given choices, 100 is closest to the number of one-cent coins it would take to build an 8-inch-tall column.

Choice A is incorrect. A column of 75 stacked one-cent coins would be slightly less than 6 inches tall. Choice C is incorrect. A column of 200 stacked one-cent coins would be more than 15 inches tall. Choice D is incorrect. A column of 390 stacked one-cent coins would be over 30 inches tall.

QUESTION 16.

Choice D is correct. If $\frac{b}{2} = 10$, then multiplying each side of this equation by 2 gives $b = 20$. Substituting 20 for b in the equation $a - b = 12$ gives $a - 20 = 12$. Adding 20 to each side of this equation gives $a = 32$. Since $a = 32$ and $b = 20$, it follows that the value of $a + b$ is $32 + 20$, or 52.

Choice A is incorrect. If the value of $a + b$ were less than the value of $a - b$, it would follow that b is negative. But if $\frac{b}{2} = 10$, then b must be positive. This contradiction shows that the value of $a + b$ cannot be 2. Choice B is incorrect. If the value of $a + b$ were equal to the value of $a - b$, then it would follow that $b = 0$. However, b cannot equal zero because it is given that $\frac{b}{2} = 10$. Choice C is incorrect. This is the value of a , but the question asks for the value of $a + b$.

QUESTION 17.

Choice A is correct. The y -intercept of the graph of $y = 19.99 + 1.50x$ in the xy -plane is the point on the graph with an x -coordinate equal to 0. In the model represented by the equation, the x -coordinate represents the number of miles a rental truck is driven during a one-day rental, and so the y -intercept represents the charge, in dollars, for the rental when the truck is driven 0 miles; that is, the y -intercept represents the cost, in dollars, of the flat fee. Since the y -intercept of the graph of $y = 19.99 + 1.50x$ is $(0, 19.99)$, the y -intercept represents a flat fee of \$19.99 in terms of the model.

Choice B is incorrect. The slope of the graph of $y = 19.99 + 1.50x$ in the xy -plane, not the y -intercept, represents a driving charge per mile of \$1.50 in terms of the model. Choice C is incorrect. Since the coefficient of x in the equation is 1.50, the charge per mile for driving the rental truck is \$1.50, not \$19.99. Choice D is incorrect. The sum of 19.99 and 1.50, which is 21.49, represents the cost, in dollars, for renting the truck for one day and driving the truck 1 mile; however, the total daily charges for renting the truck does not need to be \$21.49.

QUESTION 18.

Choice B is correct. The charity with the greatest percent of total expenses spent on programs is represented by the highest point on the scatterplot; this is the point that has a vertical coordinate slightly less than halfway between 90 and 95 and a horizontal coordinate slightly less than halfway between 3,000 and 4,000. Thus, the charity represented by this point has a total income of about \$3,400 million and spends about 92% of its total expenses on programs. The percent predicted by the line of best fit is the vertical coordinate of the point on the line of best fit with horizontal coordinate \$3,400 million; this vertical coordinate is very slightly more than 85. Thus, the line of best fit predicts that the charity with the greatest percent of total expenses spent on programs will spend slightly more than 85% on programs. Therefore, the difference between the actual percent (92%) and the prediction (slightly more than 85%) is slightly less than 7%.

Choice A is incorrect. There is no charity represented in the scatterplot for which the difference between the actual percent of total expenses spent on programs and the percent predicted by the line of best fit is as much as 10%. Choices C and D are incorrect. These choices may result

from misidentifying in the scatterplot the point that represents the charity with the greatest percent of total expenses spent on programs.

QUESTION 19.

Choice A is correct. Current's formula is $A = \frac{4 + w}{30}$. Multiplying each side of the equation by 30 gives $30A = 4 + w$. Subtracting 4 from each side of $30A = 4 + w$ gives $w = 30A - 4$.

Choices B, C, and D are incorrect and may result from errors in choosing and applying operations to isolate w as one side of the equation in Current's formula.

QUESTION 20.

Choice C is correct. If Mosteller's and Current's formulas give the same estimate for A , then the right-hand sides of these two equations are equal; that is, $\frac{\sqrt{hw}}{60} = \frac{4 + w}{30}$. Multiplying each side of this equation by 60 to isolate the expression \sqrt{hw} gives $\sqrt{hw} = 60\left(\frac{4 + w}{30}\right)$ or $\sqrt{hw} = 2(4 + w)$. Therefore, if Mosteller's and Current's formulas give the same estimate for A , then \sqrt{hw} is equivalent to $2(4 + w)$.

An alternate approach is to multiply the numerator and denominator of Current's formula by 2, which gives $\frac{2(4 + w)}{60}$. Since it is given that Mosteller's and Current's formulas give the same estimate for A , $\frac{2(4 + w)}{60} = \frac{\sqrt{hw}}{60}$. Therefore, $\sqrt{hw} = 2(4 + w)$.

Choices A, B, and D are incorrect and may result from errors in the algebraic manipulation of the equations.

QUESTION 21.

Option C is correct. The predicted increase in total fat, in grams, for every increase of 1 gram in total protein is represented by the slope of the line of best fit. Any two points on the line can be used to calculate the slope of the line as the change in total fat over the change in total protein. For instance, it can be estimated that the points (20, 34) and (30, 48) are on the line of best fit, and the slope of the line that passes through them is $\frac{48 - 34}{30 - 20} = \frac{14}{10}$, or 1.4. Of the choices given, 1.5 is the closest to the slope of the line of best fit.

Choices A, B, and D are incorrect and may be the result of incorrectly finding ordered pairs that lie on the line of best fit or of incorrectly calculating the slope.

QUESTION 22.

Choice B is correct. The median of a set of numbers is the middle value of the set values when ordered from least to greatest. If the percents in the table are ordered from least to greatest, the middle value is 27.9%. The difference between 27.9% and 26.95% is 0.95%.

Choice A is incorrect and may be the result of calculation errors or not finding the median of the data in the table correctly. Choice C is incorrect and may be the result of finding the mean instead of the median. Choice D is incorrect and may be the result of using the middle value of the unordered list.

QUESTION 23.

Choice C is correct. The total volume of the cylindrical can is found by multiplying the area of the base of the can, 75 cm^2 , by the height of the can, 10 cm , which yields 750 cm^3 . If the syrup needed to fill the can has a volume of 110 cm^3 , then the remaining volume for the pieces of fruit is $750 - 110 = 640 \text{ cm}^3$.

Choice A is incorrect because if the fruit had a volume of 7.5 cm^3 , there would be $750 - 7.5 = 742.5 \text{ cm}^3$ of syrup needed to fill the can to the top. Choice B is incorrect because if the fruit had a volume of 185 cm^3 , there would be $750 - 185 = 565 \text{ cm}^3$ of syrup needed to fill the can to the top. Choice D is incorrect because it is the total volume of the can, not just of the pieces of fruit.

QUESTION 24.

Choice A is correct. The variable t represents the seconds after the object is launched. Since $h(0) = 72$, this, means that the height, in feet, at 0 seconds, or the initial height, is 72 feet.

Choices B, C, and D are incorrect and may be the result of misinterpreting the function in context.

QUESTION 25.

Choice B is correct. The relationship between x food calories and k kilojoules can be modeled as a proportional relationship. Let (x_1, k_1) and (x_2, k_2) represent the values in the first two rows in the table:

$(4.0, 16.7)$ and $(9.0, 37.7)$. The rate of change, or $\frac{(k_2 - k_1)}{(x_2 - x_1)}$, is $\frac{21}{5} = 4.2$;

therefore, the equation that best represents the relationship between x and k is $k = 4.2x$.

Choice A is incorrect and may be the result of calculating the rate of change using $\frac{(x_2 - x_1)}{(k_2 - k_1)}$. Choice C is incorrect and may be the result of confusing the independent and dependent variables. Choice D is incorrect and may be the result of an error when setting up the equation.

QUESTION 26.

Choice B is correct. It is given that there are 4.0 food calories per gram of protein, 9.0 food calories per gram of fat, and 4.0 food calories per gram of carbohydrate. If 180 food calories in a granola bar came from p grams of protein, f grams of fat, and c grams of carbohydrate, then the situation can be represented by the equation $180 = 4p + 9f + 4c$. The equation can then be rewritten in terms of f by subtracting $4p$ and $4c$ from both sides of the equation and then dividing both sides of the equation by 9. The result is the equation $f = 20 - \frac{4}{9}(p + c)$.

Choices A, C, and D are incorrect and may be the result of not representing the situation with the correct equation or incorrectly rewriting the equation in terms of f .

QUESTION 27.

Choice A is correct. Because the world's population has grown at an average rate of 1.9% per year since 1945, it follows that the world's population has been growing by a constant factor of 1.019 since 1945. If the world's population in 1975 was about 4 billion, in 1976 the world's population would have been about $4(1.019)$; in 1977 the world's population would have been about $4(1.019)(1.019)$, or $4(1.019)^2$; and so forth. Therefore, the world's population, $P(t)$, t years since 1975 could be represented by the function $P(t) = 4(1.019)^t$.

Choice B is incorrect because it represents a 90% increase in population each year. Choices C and D are incorrect because they are linear models, which represent situations that have a constant growth.

QUESTION 28.

Choice C is correct. The line shown has a slope of $\frac{6-0}{3-0} = 2$ and a y -intercept of $(0, 0)$; therefore, the equation of the line is $y = 2x$. This means that for each point on the line, the value of the y -coordinate is twice the value of the x -coordinate. Therefore, for the point (s, t) , the ratio of t to s is 2 to 1.

Choice A is incorrect and would be the ratio of t to s if the slope of the line were $\frac{1}{3}$. Choice B is incorrect and would be the ratio of t to s if the slope of the line were $\frac{1}{2}$. Choice D is incorrect and would be the ratio of t to s if the slope of the line were 3.

QUESTION 29.

Choice D is correct. The circle with equation $(x + 3)^2 + (y - 1)^2 = 25$ has center $(-3, 1)$ and radius 5. For a point to be inside of the circle, the distance from that point to the center must be less than the radius, 5. The distance between $(3, 2)$ and $(-3, 1)$ is $\sqrt{(-3 - 3)^2 + (1 - 2)^2} = \sqrt{(-6)^2 + (-1)^2} = \sqrt{37}$, which is greater than 5. Therefore, $(3, 2)$ does NOT lie in the interior of the circle.

Choice A is incorrect. The distance between $(-7, 3)$ and $(-3, 1)$ is $\sqrt{(-7 + 3)^2 + (3 - 1)^2} = \sqrt{(-4)^2 + (2)^2} = \sqrt{20}$, which is less than 5, and therefore $(-7, 3)$ lies in the interior of the circle. Choice B is incorrect because it is the center of the circle. Choice C is incorrect because the distance between $(0, 0)$ and $(-3, 1)$ is $\sqrt{(0 + 3)^2 + (0 - 1)^2} = \sqrt{(3)^2 + (1)^2} = \sqrt{8}$, which is less than 5, and therefore $(0, 0)$ lies in the interior of the circle.

QUESTION 30.

Choice B is correct. The percent increase from 2012 to 2013 was $\frac{5,880 - 5,600}{5,600} = 0.05$, or 5%. Since the percent increase from 2012 to 2013 was estimated to be double the percent increase from 2013 to 2014, the percent increase from 2013 to 2014 was expected to be 2.5%. Therefore, the number of subscriptions sold in 2014 is expected to be the number of subscriptions sold in 2013 multiplied by $(1 + 0.025)$, or $5,880(1.025) = 6,027$.

Choices A and C are incorrect and may be the result of a conceptual or calculation error. Choice D is incorrect and is the result of interpreting the percent increase from 2013 to 2014 as double the percent increase from 2012 to 2013.

QUESTION 31.

The correct answer is 195. Since the mass of gold was worth \$62,400 and each ounce of gold was worth \$20, the mass of the gold was $\frac{62,400}{20} = 3120$ ounces. Since 1 pound = 16 ounces, 3120 ounces is equivalent to $\frac{3120}{16} = 195$ pounds.

QUESTION 32.

The correct answer is $\frac{2}{5}$. The slope of the line can be found by selecting any two points (x_1, y_1) and (x_2, y_2) on the line and then dividing the difference of the y -coordinates $(y_2 - y_1)$ by the difference of the x -coordinates $(x_2 - x_1)$. Using the points $(-6, -\frac{27}{5})$ and $(9, \frac{3}{5})$, the slope is $\frac{\frac{3}{5} - (-\frac{27}{5})}{9 - (-6)} = \frac{\frac{30}{5}}{15}$. This can be rewritten as $\frac{6}{15}$, which reduces to $\frac{2}{5}$. Any of the following equivalent expressions can be gridded as the correct answer: $\frac{2}{5}$, .4, .40, .400, $\frac{4}{10}$, $\frac{8}{20}$.

QUESTION 33.

The correct answer is 30. Let x represent the number of correct answers from the player and y represent the number of incorrect answers from the player. Since the player answered 40 questions in total, the equation $x + y = 40$ represents this situation. Also, since the score is found by subtracting the number of incorrect answers from twice the number of correct answers and the player received a score of 50, the equation $2x - y = 50$ represents this situation. Adding the system of

two equations together yields $(x + y) + (2x - y) = 40 + 50$. This can be rewritten as $3x = 90$. Finally, solving for x by dividing both sides of the equation by 3 yields $x = 30$.

QUESTION 34.

The correct answer is $\frac{5}{18}$. There are 360° in a circle, and it is shown that the central angle of the shaded region is 100° . Therefore, the area of the shaded region can be represented as a fraction of the area of the entire circle, $\frac{100}{360}$, which can be reduced to $\frac{5}{18}$. Either $5/18$, $.277$, or $.288$ can be gridded as the correct answer.

QUESTION 35.

The correct answer is 0 or 3. For an ordered pair to satisfy a system of equations, both the x - and y -values of the ordered pair must satisfy each equation in the system. Both expressions on the right-hand side of the given equations are equal to y , therefore it follows that both expressions on the right-hand side of the equations are equal to each other: $x^2 - 4x + 4 = 4 - x$. This equation can be rewritten as $x^2 - 3x = 0$, and then through factoring, the equation becomes $x(x - 3) = 0$. Because the product of the two factors is equal to 0, it can be concluded that either $x = 0$ or $x - 3 = 0$, or rather, $x = 0$ or $x = 3$.

QUESTION 36.

The correct answer is 6. Since $\tan B = \frac{3}{4}$, $\triangle ABC$ and $\triangle DBE$ are both 3-4-5 triangles. This means that they are both similar to the right triangle with sides of lengths 3, 4, and 5. Since $BC = 15$, which is 3 times as long as the hypotenuse of the 3-4-5 triangle, the similarity ratio of $\triangle ABC$ to the 3-4-5 triangle is 3:1. Therefore, the length of \overline{AC} (the side opposite to B) is $3 \times 3 = 9$, and the length of \overline{AB} (the side adjacent to angle B) is $4 \times 3 = 12$. It is also given that $DA = 4$. Since $AB = DA + DB$ and $AB = 12$, it follows that $DB = 8$, which means that the similarity ratio of $\triangle DBE$ to the 3-4-5 triangle is 2:1 (\overline{DB} is the side adjacent to angle B). Therefore, the length of \overline{DE} , which is the side opposite to angle B , is $3 \times 2 = 6$.

QUESTION 37.

The correct answer is 2.4. The mean score of the 20 contestants on Day 1 is found by dividing the sum of the total scores of the contestants by the number of contestants. It is given that each contestant received 1 point for each correct answer. The table shows that on Day 1, 2 contestants each answered 5 questions correctly, so those 2 contestants scored 10 points in total ($2 \times 5 = 10$). Similarly, the table shows 3 contestants each answered 4 questions correctly, so those 3 contestants scored 12 points in total ($3 \times 4 = 12$). Continuing these calculations reveals that the 4 contestants who answered 3 questions correctly scored 12 points in total ($4 \times 3 = 12$);

the 6 contestants who answered 2 questions correctly scored 12 points in total ($6 \times 2 = 12$); the 2 contestants who answered 1 question correctly scored 2 points in total ($2 \times 1 = 2$); and the 3 contestants who answered 0 questions correctly scored 0 points in total ($3 \times 0 = 0$). Adding up the total of points scored by these 20 contestants gives $10 + 12 + 12 + 2 + 0 = 48$. Therefore, the mean score of the contestants is $\frac{48}{20} = 2.4$. Either $12/5$, 2.4, or 2.40 can be gridded as the correct answer.

QUESTION 38.

The correct answer is $\frac{5}{7}$. It is given that no contestant received the same score on two different days, so each of the contestants who received a score of 5 is represented in the “5 out of 5” column of the table exactly once. Therefore, the probability of selecting a contestant who received a score of 5 on Day 2 or Day 3, given that the contestant received a score of 5 on one of the three days, is found by dividing the total number of contestants who received a score of 5 on Day 2 or Day 3 ($2 + 3 = 5$) by the total number of contestants who received a score of 5, which is given in the table as 7. So the probability is $\frac{5}{7}$. Either $5/7$ or .714 can be gridded as the correct answer.

The SAT[®]

Practice Test #8

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K-5MSA15



Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

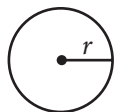
DIRECTIONS

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

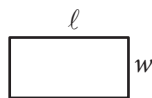
- The use of a calculator **is not permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated,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

REFERENCE

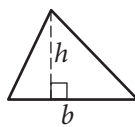


$$A = \pi r^2$$

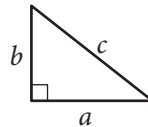
$$C = 2\pi r$$



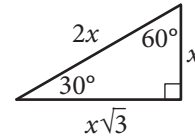
$$A = \ell w$$



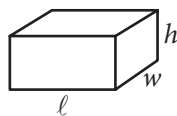
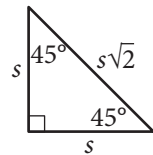
$$A = \frac{1}{2}bh$$



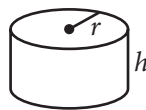
$$c^2 = a^2 + b^2$$



Special Right Triangles



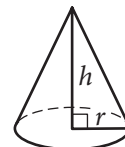
$$V = \ell wh$$



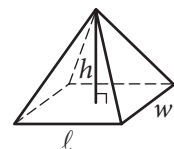
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}\ell wh$$

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.



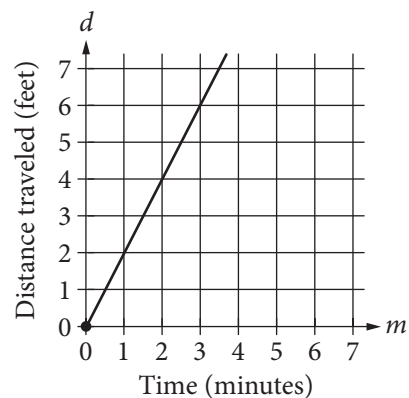
1

$$3x + x + x + x - 3 - 2 = 7 + x + x$$

In the equation above, what is the value of x ?

- A) $-\frac{5}{7}$
- B) 1
- C) $\frac{12}{7}$
- D) 3

2



The graph above shows the distance traveled d , in feet, by a product on a conveyor belt m minutes after the product is placed on the belt. Which of the following equations correctly relates d and m ?

- A) $d = 2m$
- B) $d = \frac{1}{2}m$
- C) $d = m + 2$
- D) $d = 2m + 2$



3

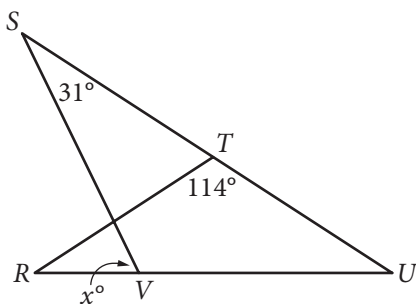
The formula below is often used by project managers to compute E , the estimated time to complete a job, where O is the shortest completion time, P is the longest completion time, and M is the most likely completion time.

$$E = \frac{O + 4M + P}{6}$$

Which of the following correctly gives P in terms of E , O , and M ?

- A) $P = 6E - O - 4M$
- B) $P = -6E + O + 4M$
- C) $P = \frac{O + 4M + E}{6}$
- D) $P = \frac{O + 4M - E}{6}$

4



In the figure above, $RT = TU$. What is the value of x ?

- A) 72
- B) 66
- C) 64
- D) 58

5

The width of a rectangular dance floor is w feet. The length of the floor is 6 feet longer than its width. Which of the following expresses the perimeter, in feet, of the dance floor in terms of w ?

- A) $2w + 6$
- B) $4w + 12$
- C) $w^2 + 6$
- D) $w^2 + 6w$

6

$$y > 2x - 1$$

$$2x > 5$$

Which of the following consists of the y -coordinates of all the points that satisfy the system of inequalities above?

- A) $y > 6$
- B) $y > 4$
- C) $y > \frac{5}{2}$
- D) $y > \frac{3}{2}$



7

$$\sqrt{2x+6} + 4 = x + 3$$

What is the solution set of the equation above?

- A) $\{-1\}$
- B) $\{5\}$
- C) $\{-1, 5\}$
- D) $\{0, -1, 5\}$

8

$$f(x) = x^3 - 9x$$

$$g(x) = x^2 - 2x - 3$$

Which of the following expressions is equivalent to

$$\frac{f(x)}{g(x)}, \text{ for } x > 3 ?$$

- A) $\frac{1}{x+1}$
- B) $\frac{x+3}{x+1}$
- C) $\frac{x(x-3)}{x+1}$
- D) $\frac{x(x+3)}{x+1}$

9

$$(x-6)^2 + (y+5)^2 = 16$$

In the xy -plane, the graph of the equation above is a circle. Point P is on the circle and has coordinates $(10, -5)$. If \overline{PQ} is a diameter of the circle, what are the coordinates of point Q ?

- A) $(2, -5)$
- B) $(6, -1)$
- C) $(6, -5)$
- D) $(6, -9)$

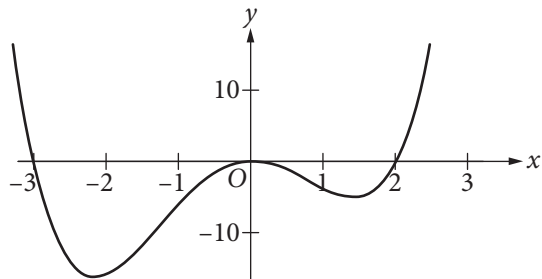
10

A group of 202 people went on an overnight camping trip, taking 60 tents with them. Some of the tents held 2 people each, and the rest held 4 people each. Assuming all the tents were filled to capacity and every person got to sleep in a tent, exactly how many of the tents were 2-person tents?

- A) 30
- B) 20
- C) 19
- D) 18



11



Which of the following could be the equation of the graph above?

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

12

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

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

13

Oil and gas production in a certain area dropped from 4 million barrels in 2000 to 1.9 million barrels in 2013. Assuming that the oil and gas production decreased at a constant rate, which of the following linear functions f best models the production, in millions of barrels, t years after the year 2000?

- A) $f(t) = \frac{21}{130}t + 4$
- B) $f(t) = \frac{19}{130}t + 4$
- C) $f(t) = -\frac{21}{130}t + 4$
- D) $f(t) = -\frac{19}{130}t + 4$



14

$$y = x^2 + 3x - 7$$
$$y - 5x + 8 = 0$$

How many solutions are there to the system of equations above?

- A) There are exactly 4 solutions.
- B) There are exactly 2 solutions.
- C) There is exactly 1 solution.
- D) There are no solutions.

15

$$g(x) = 2x - 1$$
$$h(x) = 1 - g(x)$$

The functions g and h are defined above. What is the value of $h(0)$?

- A) -2
- B) 0
- C) 1
- D) 2



DIRECTIONS

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

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or $7/2$. (If $\begin{array}{|c|c|c|c|} \hline 3 & 1 & / & 2 \\ \hline \bullet & \bullet & / & \bullet \\ \hline \end{array}$ is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

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

Write answer → in boxes.

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

Grid in result.

Answer: 2.5

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

← Fraction line

← Decimal point

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

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

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

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

Answer: 201 – either position is correct

	2	0	1
•	•	•	•
0	0	•	0
1	1	1	•
2	•	2	2
3	3	3	3

2	0	1	
•	•	•	•
0	•	0	0
1	1	•	1
•	2	2	2
3	3	3	3

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



16

$$x^2 + x - 12 = 0$$

If a is a solution of the equation above and $a > 0$, what is the value of a ?

17

The sum of $-2x^2 + x + 31$ and $3x^2 + 7x - 8$ can be written in the form $ax^2 + bx + c$, where a , b , and c are constants. What is the value of $a + b + c$?

18

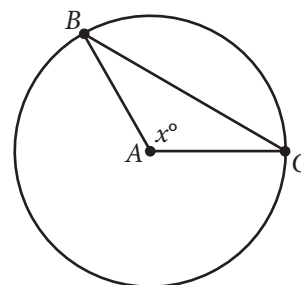
$$\begin{aligned} -x + y &= -3.5 \\ x + 3y &= 9.5 \end{aligned}$$

If (x, y) satisfies the system of equations above, what is the value of y ?

19

A start-up company opened with 8 employees. The company's growth plan assumes that 2 new employees will be hired each quarter (every 3 months) for the first 5 years. If an equation is written in the form $y = ax + b$ to represent the number of employees, y , employed by the company x quarters after the company opened, what is the value of b ?

20



Note: Figure not drawn to scale.

In the circle above, point A is the center and the length of arc \widehat{BC} is $\frac{2}{5}$ of the circumference of the circle. What is the value of x ?

STOP

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



Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

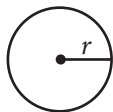
DIRECTIONS

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

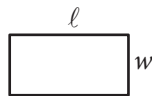
- The use of a calculator is permitted.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated, the domain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

REFERENCE

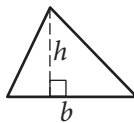


$$A = \pi r^2$$

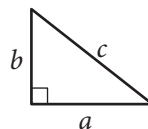
$$C = 2\pi r$$



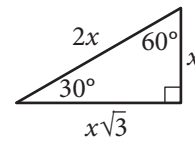
$$A = \ell w$$



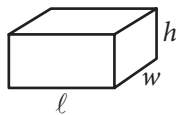
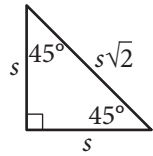
$$A = \frac{1}{2}bh$$



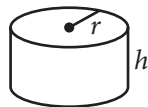
$$c^2 = a^2 + b^2$$



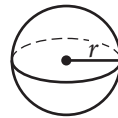
Special Right Triangles



$$V = \ell wh$$



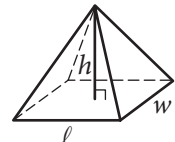
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}\ell wh$$

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.



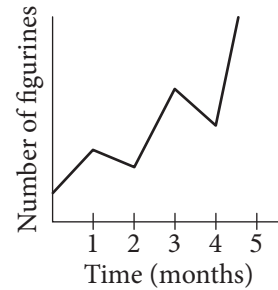
1

One pound of grapes costs \$2. At this rate, how many dollars will c pounds of grapes cost?

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

2

Tracy collects, sells, and trades figurines, and she tracks the number of figurines in her collection on the graph below.



On what interval did the number of figurines decrease the fastest?

- A) Between 1 and 2 months
- B) Between 2 and 3 months
- C) Between 3 and 4 months
- D) Between 4 and 5 months

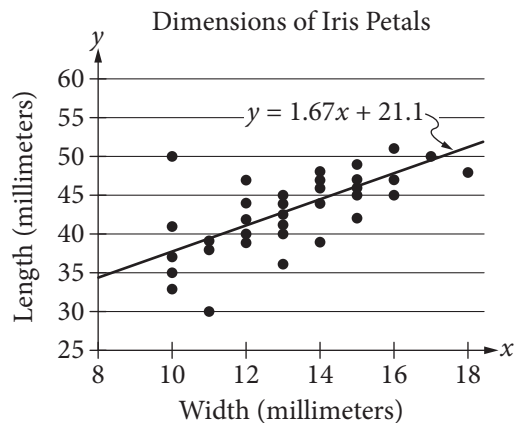


3

In a random sample of 200 cars of a particular model, 3 have a manufacturing defect. At this rate, how many of 10,000 cars of the same model will have a manufacturing defect?

- A) 150
- B) 200
- C) 250
- D) 300

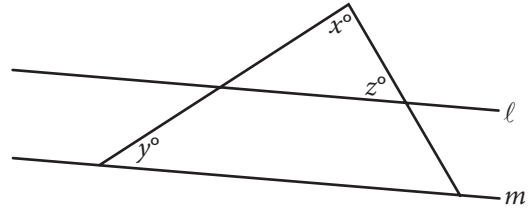
4



The scatterplot above shows data collected on the lengths and widths of *Iris setosa* petals. A line of best fit for the data is also shown. Based on the line of best fit, if the width of an *Iris setosa* petal is 19 millimeters, what is the predicted length, in millimeters, of the petal?

- A) 21.10
- B) 31.73
- C) 52.83
- D) 55.27

5



Note: Figure not drawn to scale.

In the figure above, lines l and m are parallel, $y = 20$, and $z = 60$. What is the value of x ?

- A) 120
- B) 100
- C) 90
- D) 80



6

Two types of tickets were sold for a concert held at an amphitheater. Tickets to sit on a bench during the concert cost \$75 each, and tickets to sit on the lawn during the concert cost \$40 each. Organizers of the concert announced that 350 tickets had been sold and that \$19,250 had been raised through ticket sales alone. Which of the following systems of equations could be used to find the number of tickets for bench seats, B , and the number of tickets for lawn seats, L , that were sold for the concert?

- A) $(75B)(40L) = 1,950$
 $B + L = 350$
- B) $40B + 75L = 19,250$
 $B + L = 350$
- C) $75B + 40L = 350$
 $B + L = 19,250$
- D) $75B + 40L = 19,250$
 $B + L = 350$

7

In the xy -plane, the graph of which of the following equations is a line with a slope of 3?

- A) $y = \frac{1}{3}x$
- B) $y = x - 3$
- C) $y = 3x + 2$
- D) $y = 6x + 3$

8

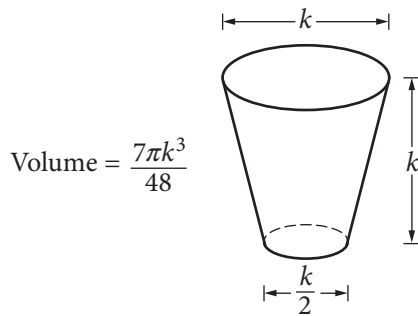
$$x + 1 = \frac{2}{x + 1}$$

In the equation above, which of the following is a possible value of $x + 1$?

- A) $1 - \sqrt{2}$
- B) $\sqrt{2}$
- C) 2
- D) 4



Questions 9-11 refer to the following information.



The glass pictured above can hold a maximum volume of 473 cubic centimeters, which is approximately 16 fluid ounces.

9

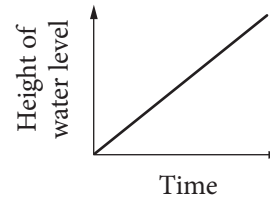
What is the value of k , in centimeters?

- A) 2.52
- B) 7.67
- C) 7.79
- D) 10.11

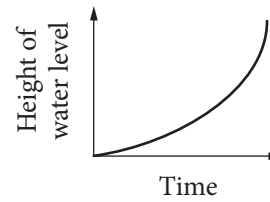
10

Water pours into the glass slowly and at a constant rate. Which of the following graphs best illustrates the height of the water level in the glass as it fills?

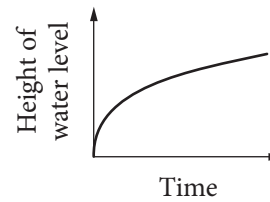
A)



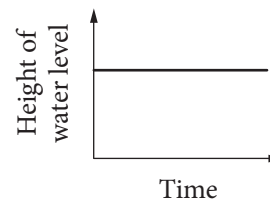
B)



C)



D)





11

Jenny has a pitcher that contains 1 gallon of water. How many times could Jenny completely fill the glass with 1 gallon of water? (1 gallon = 128 fluid ounces)

- A) 16
- B) 8
- C) 4
- D) 3

12

Roberto is an insurance agent who sells two types of policies: a \$50,000 policy and a \$100,000 policy. Last month, his goal was to sell at least 57 insurance policies. While he did not meet his goal, the total value of the policies he sold was over \$3,000,000. Which of the following systems of inequalities describes x , the possible number of \$50,000 policies, and y , the possible number of \$100,000 policies, that Roberto sold last month?

- A) $x + y < 57$
 $50,000x + 100,000y < 3,000,000$
- B) $x + y > 57$
 $50,000x + 100,000y > 3,000,000$
- C) $x + y < 57$
 $50,000x + 100,000y > 3,000,000$
- D) $x + y > 57$
 $50,000x + 100,000y < 3,000,000$

13

If $a^{-\frac{1}{2}} = x$, where $a > 0$, what is a in terms of x ?

- A) \sqrt{x}
- B) $-\sqrt{x}$
- C) $\frac{1}{x^2}$
- D) $-\frac{1}{x^2}$

14

Which of the following is a value of x for which the expression $\frac{-3}{x^2 + 3x - 10}$ is undefined?

- A) -3
- B) -2
- C) 0
- D) 2



15

A granite block in the shape of a right rectangular prism has dimensions 30 centimeters by 40 centimeters by 50 centimeters. The block has a density of 2.8 grams per cubic centimeter. What is the mass of the block, in grams? (Density is mass per unit volume.)

- A) 336
- B) 3,360
- C) 16,800
- D) 168,000

16

Number of Adults Contracting Colds

	Cold	No cold	Total
Vitamin C	21	129	150
Sugar pill	33	117	150
Total	54	246	300

The table shows the results of a research study that investigated the therapeutic value of vitamin C in preventing colds. A random sample of 300 adults received either a vitamin C pill or a sugar pill each day during a 2-week period, and the adults reported whether they contracted a cold during that time period. What proportion of adults who received a sugar pill reported contracting a cold?

- A) $\frac{11}{18}$
- B) $\frac{11}{50}$
- C) $\frac{9}{50}$
- D) $\frac{11}{100}$

17

Ages of 20 Students Enrolled in a College Class

Age	Frequency
18	6
19	5
20	4
21	2
22	1
23	1
30	1

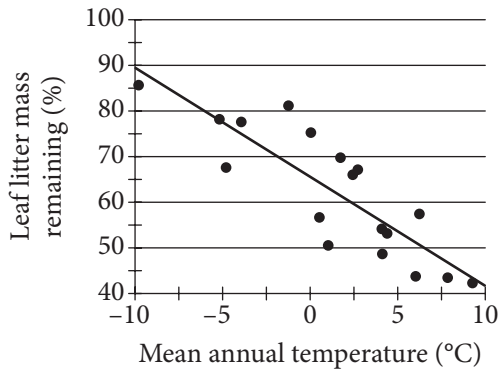
The table above shows the distribution of ages of the 20 students enrolled in a college class. Which of the following gives the correct order of the mean, median, and mode of the ages?

- A) mode < median < mean
- B) mode < mean < median
- C) median < mode < mean
- D) mean < mode < median



18

The figure below shows the relationship between the percent of leaf litter mass remaining after decomposing for 3 years and the mean annual temperature, in degrees Celsius ($^{\circ}\text{C}$), in 18 forests in Canada. A line of best fit is also shown.



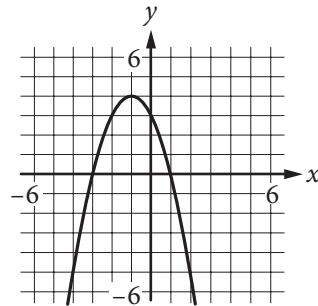
A particular forest in Canada, whose data is not included in the figure, had a mean annual temperature of -2°C . Based on the line of best fit, which of the following is closest to the predicted percent of leaf litter mass remaining in this particular forest after decomposing for 3 years?

- A) 50%
- B) 63%
- C) 70%
- D) 82%

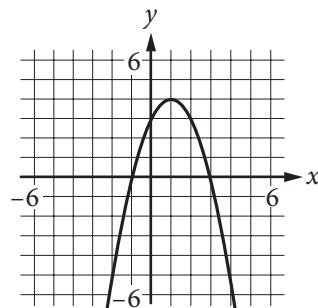
19

The range of the polynomial function f is the set of real numbers less than or equal to 4. If the zeros of f are -3 and 1 , which of the following could be the graph of $y = f(x)$ in the xy -plane?

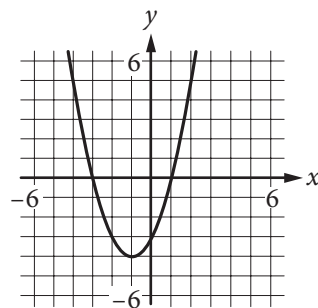
A)



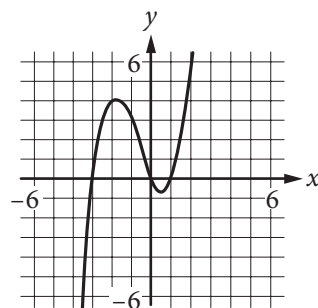
B)



C)



D)





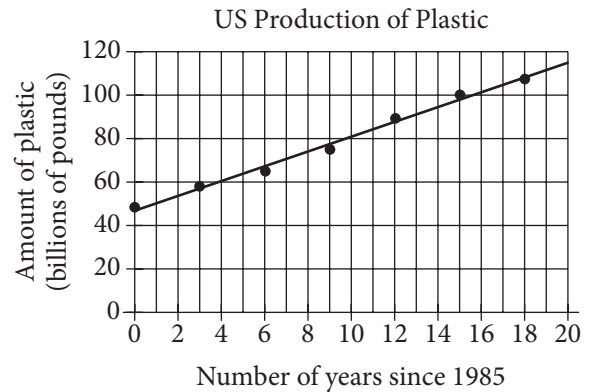
20

The average annual energy cost for a certain home is \$4,334. The homeowner plans to spend \$25,000 to install a geothermal heating system. The homeowner estimates that the average annual energy cost will then be \$2,712. Which of the following inequalities can be solved to find t , the number of years after installation at which the total amount of energy cost savings will exceed the installation cost?

- A) $25,000 > (4,334 - 2,712)t$
- B) $25,000 < (4,334 - 2,712)t$
- C) $25,000 - 4,334 > 2,712t$
- D) $25,000 > \frac{4,332}{2,712}t$

Questions 21 and 22 refer to the following information.

Between 1985 and 2003, data were collected every three years on the amount of plastic produced annually in the United States, in billions of pounds. The graph below shows the data and a line of best fit. The equation of the line of best fit is $y = 3.39x + 46.89$, where x is the number of years since 1985 and y is the amount of plastic produced annually, in billions of pounds.



21

Which of the following is the best interpretation of the number 3.39 in the context of the problem?

- A) The amount of plastic, in billions of pounds, produced in the United States during the year 1985
- B) The number of years it took the United States to produce 1 billion pounds of plastic
- C) The average annual plastic production, in billions of pounds, in the United States from 1985 to 2003
- D) The average annual increase, in billions of pounds, of plastic produced per year in the United States from 1985 to 2003



22

Which of the following is closest to the percent increase in the billions of pounds of plastic produced in the United States from 2000 to 2003?

- A) 10%
- B) 44%
- C) 77%
- D) 110%

23

$$M = 1,800(1.02)^t$$

The equation above models the number of members, M , of a gym t years after the gym opens. Of the following, which equation models the number of members of the gym q quarter years after the gym opens?

- A) $M = 1,800(1.02)^{\frac{q}{4}}$
- B) $M = 1,800(1.02)^{4q}$
- C) $M = 1,800(1.005)^{4q}$
- D) $M = 1,800(1.082)^q$

24

For the finale of a TV show, viewers could use either social media or a text message to vote for their favorite of two contestants. The contestant receiving more than 50% of the vote won. An estimated 10% of the viewers voted, and 30% of the votes were cast on social media. Contestant 2 earned 70% of the votes cast using social media and 40% of the votes cast using a text message. Based on this information, which of the following is an accurate conclusion?

- A) If all viewers had voted, Contestant 2 would have won.
- B) Viewers voting by social media were likely to be younger than viewers voting by text message.
- C) If all viewers who voted had voted by social media instead of by text message, Contestant 2 would have won.
- D) Viewers voting by social media were more likely to prefer Contestant 2 than were viewers voting by text message.



25

Population of Greenleaf, Idaho

Year	Population
2000	862
2010	846

The table above shows the population of Greenleaf, Idaho, for the years 2000 and 2010. If the relationship between population and year is linear, which of the following functions P models the population of Greenleaf t years after 2000?

- A) $P(t) = 862 - 1.6t$
- B) $P(t) = 862 - 16t$
- C) $P(t) = 862 + 16(t - 2,000)$
- D) $P(t) = 862 - 1.6(t - 2,000)$

26

To determine the mean number of children per household in a community, Tabitha surveyed 20 families at a playground. For the 20 families surveyed, the mean number of children per household was 2.4. Which of the following statements must be true?

- A) The mean number of children per household in the community is 2.4.
- B) A determination about the mean number of children per household in the community should not be made because the sample size is too small.
- C) The sampling method is flawed and may produce a biased estimate of the mean number of children per household in the community.
- D) The sampling method is not flawed and is likely to produce an unbiased estimate of the mean number of children per household in the community.



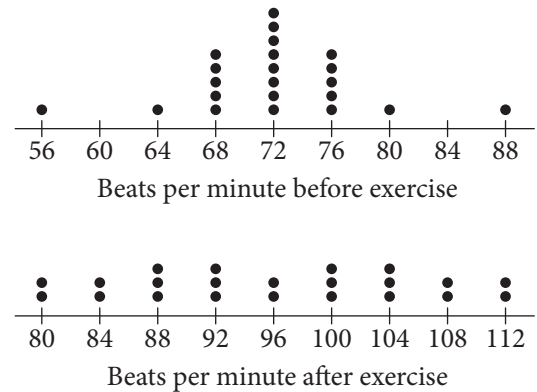
27

In the xy -plane, the point (p, r) lies on the line with equation $y = x + b$, where b is a constant. The point with coordinates $(2p, 5r)$ lies on the line with equation $y = 2x + b$. If $p \neq 0$, what is the value of $\frac{r}{p}$?

- A) $\frac{2}{5}$
 B) $\frac{3}{4}$
 C) $\frac{4}{3}$
 D) $\frac{5}{2}$

28

The 22 students in a health class conducted an experiment in which they each recorded their pulse rates, in beats per minute, before and after completing a light exercise routine. The dot plots below display the results.



Let s_1 and r_1 be the standard deviation and range, respectively, of the data before exercise, and let s_2 and r_2 be the standard deviation and range, respectively, of the data after exercise. Which of the following is true?

- A) $s_1 = s_2$ and $r_1 = r_2$
 B) $s_1 < s_2$ and $r_1 < r_2$
 C) $s_1 > s_2$ and $r_1 > r_2$
 D) $s_1 \neq s_2$ and $r_1 = r_2$

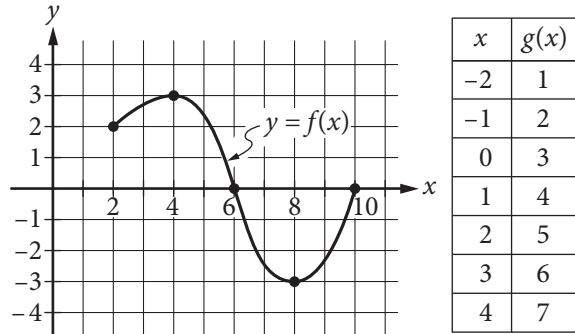


29

A photocopy machine is initially loaded with 5,000 sheets of paper. The machine starts a large job and copies at a constant rate. After 20 minutes, it has used 30% of the paper. Which of the following equations models the number of sheets of paper, p , remaining in the machine m minutes after the machine started printing?

- A) $p = 5,000 - 20m$
- B) $p = 5,000 - 75m$
- C) $p = 5,000(0.3)^{\frac{m}{20}}$
- D) $p = 5,000(0.7)^{\frac{m}{20}}$

30



The complete graph of the function f and a table of values for the function g are shown above. The maximum value of f is k . What is the value of $g(k)$?

- A) 7
- B) 6
- C) 3
- D) 0

**DIRECTIONS**

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

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or $7/2$. (If $\begin{array}{|c|c|c|c|} \hline 3 & 1 & / & 2 \\ \hline \bullet & \circ & \circ & \circ \\ \hline \end{array}$ is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Write answer in boxes. →

Grid in result. →

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

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

← Fraction line

Answer: 2.5

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

← Decimal point

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

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

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

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

Answer: 201 – either position is correct

	2	0	1
•	•	•	•
	0	•	0
①	①	①	•
②	•	②	②
③	③	③	③

2	0	1	
•	•	•	•
	•	0	0
①	①	•	①
•	②	②	②
③	③	③	③

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



31

There are two atoms of hydrogen and one atom of oxygen in one molecule of water. How many atoms of hydrogen are there in 51 molecules of water?

32

$$x - \frac{1}{2}a = 0$$

If $x = 1$ in the equation above, what is the value of a ?

33

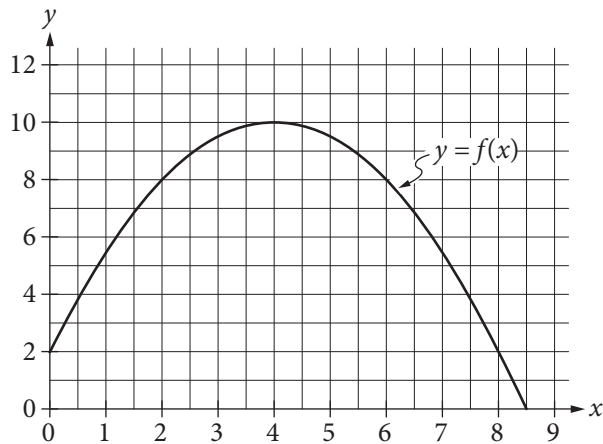
In the xy -plane, the equations $x + 2y = 10$ and $3x + 6y = c$ represent the same line for some constant c . What is the value of c ?

34

On April 18, 1775, Paul Revere set off on his midnight ride from Charlestown to Lexington. If he had ridden straight to Lexington without stopping, he would have traveled 11 miles in 26 minutes. In such a ride, what would the average speed of his horse have been, to the nearest tenth of a mile per hour?



35



The graph of the function f , defined by

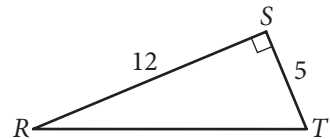
$$f(x) = -\frac{1}{2}(x - 4)^2 + 10,$$

is shown in the xy -plane above. If the function g (not shown) is defined by

$$g(x) = -x + 10,$$

what is one possible value of a such that $f(a) = g(a)$?

36

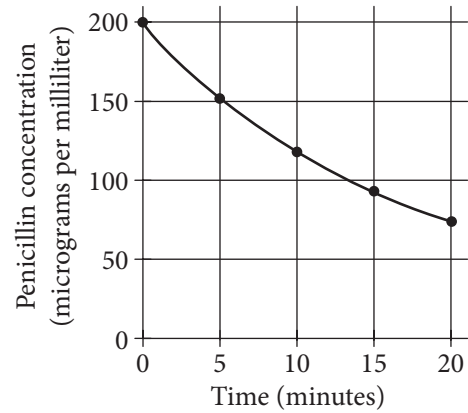


In triangle RST above, point W (not shown) lies on \overline{RT} . What is the value of $\cos(\angle RSW) - \sin(\angle WST)$?



Questions 37 and 38 refer to the following information.

Minutes after injection	Penicillin concentration (micrograms per milliliter)
0	200
5	152
10	118
15	93
20	74



When a patient receives a penicillin injection, the kidneys begin removing the penicillin from the body. The table and graph above show the penicillin concentration in a patient's bloodstream at 5-minute intervals for the 20 minutes immediately following a one-time penicillin injection.



37

According to the table, how many more micrograms of penicillin are present in 10 milliliters of blood drawn from the patient 5 minutes after the injection than are present in 8 milliliters of blood drawn 10 minutes after the injection?

38

The penicillin concentration, in micrograms per milliliter, in the patient's bloodstream t minutes after the penicillin injection is modeled by the function P defined by $P(t) = 200b^{\frac{t}{5}}$. If P approximates the values in the table to within 10 micrograms per milliliter, what is the value of b , rounded to the nearest tenth?

STOP

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

SAT Practice Test #8: Worksheets

ANSWER KEY

Reading Test Answers

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

Writing and Language Test Answers

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

READING TEST
RAW SCORE
(NUMBER OF
CORRECT ANSWERS)

WRITING AND
LANGUAGE TEST
RAW SCORE
(NUMBER OF
CORRECT ANSWERS)

Math Test – No Calculator Answers

1 D	11 B
2 A	12 D
3 A	13 C
4 C	14 C
5 B	15 D
6 B	16 3
7 B	17 32
8 D	18 1.5, 3/2
9 A	19 8
10 C	20 144

Math Test – Calculator Answers

1 A	11 B	21 D	31 102
2 C	12 C	22 A	32 2
3 A	13 C	23 A	33 30
4 C	14 D	24 D	34 25.4, 127/5
5 B	15 D	25 A	35 2, 8
6 D	16 B	26 C	36 0
7 C	17 A	27 B	37 576
8 B	18 C	28 D	38 .8, 4/5
9 D	19 A	29 B	
10 C	20 B	30 B	

MATH TEST –
NO CALCULATOR
RAW SCORE
(NUMBER OF
CORRECT ANSWERS)

MATH TEST –
CALCULATOR
RAW SCORE
(NUMBER OF
CORRECT ANSWERS)

Section 3: Math Test – No Calculator

QUESTION 1

Choice D is correct. Combining like terms on each side of the given equation yields $6x - 5 = 7 + 2x$. Adding 5 to both sides of $6x - 5 = 7 + 2x$ and subtracting $2x$ from both sides yields $4x = 12$. Dividing both sides of $4x = 12$ by 4 yields $x = 3$.

Choices A, B, and C are incorrect because substituting those values into the equation $3x + x + x + x - 3 - 2 = 7 + x + x$ will result in a false statement. For example, in choice B, substituting 1 for x in the equation would give $3(1) + 1 + 1 + 1 - 3 - 2 = 7 + 1 + 1$, which yields the false statement $1 = 9$; therefore, x cannot equal 1.

QUESTION 2

Choice A is correct. The line passes through the origin. Therefore, this is a relationship of the form $d = km$, where k is a constant representing the slope of the graph. To find the value of k , choose a point (m, d) on the graph of the line other than the origin and substitute the values of m and d into the equation. For example, if the point $(2, 4)$ is chosen, then $4 = k(2)$, and $k = 2$. Therefore, the equation of the line is $d = 2m$.

Choice B is incorrect and may result from calculating the slope of the line as the change in time over the change in distance traveled instead of the change in distance traveled over the change in time. Choices C and D are incorrect because each of these equations represents a line with a d -intercept of 2. However, the graph shows a line with a d -intercept of 0.

QUESTION 3

Choice A is correct. Multiplying both sides of the equation by 6 results in $6E = O + 4M + P$. Then, subtracting $O + 4M$ from both sides of $6E = O + 4M + P$ gives $P = 6E - O - 4M$.

Choice B is incorrect. This choice may result from solving for $-P$ instead of for P . Choice C is incorrect and may result from transposing P with E in the given equation rather than solving for P . Choice D is incorrect and may result from transposing P with E and changing the sign of E rather than solving for P .

QUESTION 4

Choice C is correct. Since $RT = TU$, it follows that $\triangle RTU$ is an isosceles triangle with base RU . Therefore, $\angle TRU$ and $\angle TUR$ are the base angles of an isosceles triangle and are congruent. Let the measures of both $\angle TRU$ and $\angle TUR$ be t° . According to the triangle sum theorem, the sum of the measures of the three angles of a triangle is 180° . Therefore, $114^\circ + 2t^\circ = 180^\circ$, so $t = 33$.

Note that $\angle TUR$ is the same angle as $\angle SUV$. Thus, the measure of $\angle SUV$ is 33° . According to the triangle exterior angle theorem, an external angle of a triangle is equal to the sum of the opposite interior angles. Therefore, x° is equal to the sum of the measures of $\angle VSU$ and $\angle SUV$; that is, $31^\circ + 33^\circ = 64^\circ$. Thus, the value of x is 64.

Choice B is incorrect. This is the measure of $\angle STR$, but $\angle STR$ is not congruent to $\angle SVR$. Choices A and D are incorrect and may result from a calculation error.

QUESTION 5

Choice B is correct. It is given that the width of the dance floor is w feet. The length is 6 feet longer than the width; therefore, the length of the dance floor is $w + 6$. So the perimeter is $w + w + (w + 6) + (w + 6) = 4w + 12$.

Choice A is incorrect because it is the sum of one length and one width, which is only half the perimeter. Choice C is incorrect and may result from using the formula for the area instead of the formula for the perimeter and making a calculation error. Choice D is incorrect because this is the area, not the perimeter, of the dance floor.

QUESTION 6

Choice B is correct. Subtracting the same number from each side of an inequality gives an equivalent inequality. Hence, subtracting 1 from each side of the inequality $2x > 5$ gives $2x - 1 > 4$. So the given system of inequalities is equivalent to the system of inequalities $y > 2x - 1$ and $2x - 1 > 4$, which can be rewritten as $y > 2x - 1 > 4$. Using the transitive property of inequalities, it follows that $y > 4$.

Choice A is incorrect because there are points with a y -coordinate less than 6 that satisfy the given system of inequalities. For example, $(3, 5.5)$ satisfies both inequalities. Choice C is incorrect. This may result from solving the inequality $2x > 5$ for x , then replacing x with y . Choice D is incorrect because this inequality allows y -values that are not the y -coordinate of any point that satisfies both inequalities. For example, $y = 2$ is contained in the set $y > \frac{3}{2}$; however, if 2 is substituted into the first inequality for y , the result is $x < \frac{3}{2}$. This cannot be true because the second inequality gives $x > \frac{5}{2}$.

QUESTION 7

Choice B is correct. Subtracting 4 from both sides of $\sqrt{2x+6} + 4 = x + 3$ isolates the radical expression on the left side of the equation as follows: $\sqrt{2x+6} = x - 1$. Squaring both sides of $\sqrt{2x+6} = x - 1$ yields $2x + 6 = x^2 - 2x + 1$. This equation can be rewritten as a quadratic equation in standard form: $x^2 - 4x - 5 = 0$. One way to solve this quadratic equation is to factor the expression $x^2 - 4x - 5$ by identifying two numbers with a sum of -4 and a product of -5 . These numbers are -5 and 1 . So the quadratic equation can be factored as $(x - 5)(x + 1) = 0$. It follows that 5 and -1 are the solutions to the quadratic equation. However, the solutions must be verified by checking whether 5 and -1 satisfy the original equation, $\sqrt{2x+6} + 4 = x + 3$. When $x = -1$, the original equation gives $\sqrt{2(-1)+6} + 4 = (-1) + 3$, or $6 = 2$, which is false. Therefore, -1 does not satisfy the original equation. When $x = 5$, the original equation gives $\sqrt{2(5)+6} + 4 = 5 + 3$, or $8 = 8$, which is true. Therefore, $x = 5$ is the only solution to the original equation, and so the solution set is $\{5\}$.

Choices A, C, and D are incorrect because each of these sets contains at least one value that results in a false statement when substituted into the given equation. For instance, in choice D, when 0 is substituted for x into the given equation, the result is $\sqrt{2(0)+6} + 4 = (0) + 3$, or $\sqrt{6} + 4 = 3$. This is not a true statement, so 0 is not a solution to the given equation.

QUESTION 8

Choice D is correct. Since $x^3 - 9x = x(x+3)(x-3)$ and $x^2 - 2x - 3 = (x+1)(x-3)$, the fraction $\frac{f(x)}{g(x)}$ can be written as $\frac{x(x+3)(x-3)}{(x+1)(x-3)}$. It is given that $x > 3$, so the common factor $x - 3$ is not equal to 0 . Therefore, the fraction can be further simplified to $\frac{x(x+3)}{x+1}$.

Choice A is incorrect. The expression $\frac{1}{x+1}$ is not equivalent to $\frac{f(x)}{g(x)}$ because at $x = 0$, $\frac{1}{x+1}$ has a value of 1 and $\frac{f(x)}{g(x)}$ has a value of 0.

Choice B is incorrect and results from omitting the factor x in the factorization of $f(x)$. Choice C is incorrect and may result from incorrectly factoring $g(x)$ as $(x+1)(x+3)$ instead of $(x+1)(x-3)$.

QUESTION 9

Choice A is correct. The standard form for the equation of a circle is $(x-h)^2 + (y-k)^2 = r^2$, where (h, k) are the coordinates of the center and r is the length of the radius. According to the given equation, the center of the circle is $(6, -5)$. Let (x_1, y_1) represent the coordinates of point Q . Since point $P(10, -5)$ and point $Q(x_1, y_1)$ are the endpoints of a diameter of the circle, the center $(6, -5)$ lies on the diameter, halfway between P and Q . Therefore, the following relationships hold: $\frac{x_1 + 10}{2} = 6$ and $\frac{y_1 + (-5)}{2} = -5$. Solving the equations for x_1 and y_1 , respectively, yields $x_1 = 2$ and $y_1 = -5$. Therefore, the coordinates of point Q are $(2, -5)$.

Alternate approach: Since point $P(10, -5)$ on the circle and the center of the circle $(6, -5)$ have the same y -coordinate, it follows that the radius of the circle is $10 - 6 = 4$. In addition, the opposite end of the diameter \overline{PQ} must have the same y -coordinate as P and be 4 units away from the center. Hence, the coordinates of point Q must be $(2, -5)$.

Choices B and D are incorrect because the points given in these choices lie on a diameter that is perpendicular to the diameter \overline{PQ} . If either of these points were point Q , then \overline{PQ} would not be the diameter of the circle. Choice C is incorrect because $(6, -5)$ is the center of the circle and does not lie on the circle.

QUESTION 10

Choice C is correct. Let x represent the number of 2-person tents and let y represent the number of 4-person tents. It is given that the total number of tents was 60 and the total number of people in the group was 202. This situation can be expressed as a system of two equations, $x + y = 60$ and $2x + 4y = 202$. The first equation can be rewritten as $y = -x + 60$. Substituting $-x + 60$ for y in the equation $2x + 4y = 202$ yields $2x + 4(-x + 60) = 202$. Distributing and combining like terms gives $-2x + 240 = 202$. Subtracting 240 from both sides of $-2x + 240 = 202$ and then dividing both sides by -2 gives $x = 19$. Therefore, the number of 2-person tents is 19.

Alternate approach: If each of the 60 tents held 4 people, the total number of people that could be accommodated in tents would be 240. However, the actual number of people who slept in tents was 202. The difference of 38 accounts for the 2-person tents. Since each of these tents holds 2 people fewer than a 4-person tent, $\frac{38}{2} = 19$ gives the number of 2-person tents.

Choice A is incorrect. This choice may result from assuming exactly half of the tents hold 2 people. If that were true, then the total number of people who slept in tents would be $2(30) + 4(30) = 180$; however, the total number of people who slept in tents was 202, not 180.

Choice B is incorrect. If 20 tents were 2-person tents, then the remaining 40 tents would be 4-person tents. Since all the tents were filled to capacity, the total number of people who slept in tents would be $2(20) + 4(40) = 40 + 160 = 200$; however, the total number of people who slept in tents was 202, not 200. Choice D is incorrect. If 18 tents were 2-person tents, then the remaining 42 tents would be 4-person tents. Since all the tents were filled to capacity, the total number of people who slept in tents would be $2(18) + 4(42) = 36 + 168 = 204$; however, the total number of people who slept in tents was 202, not 204.

QUESTION 11

Choice B is correct. The x -coordinates of the x -intercepts of the graph are -3 , 0 , and 2 . This means that if $y = f(x)$ is the equation of the graph, where f is a polynomial function, then $(x + 3)$, x , and $(x - 2)$ are factors of f . Of the choices given, A and B have the correct factors. However, in choice A, x is raised to the first power, and in choice B, x is raised to the second power. At $x = 0$, the graph touches the x -axis but doesn't cross it. This means that x , as a factor of f , is raised to an even power. If x were raised to an odd power, then the graph would cross the x -axis. Alternatively, in choice A, f is a third-degree polynomial, and in choice B, f is a fourth-degree polynomial. The y -coordinates of points on the graph become large and positive as x becomes large and negative; this is consistent with a fourth-degree polynomial, but not with a third-degree polynomial. Therefore, of the choices given, only choice B could be the equation of the graph.

Choice A is incorrect. The graph of the equation in this answer choice has the correct factors. However, at $x = 0$ the graph of the equation in this choice crosses the x -axis; the graph shown touches the x -axis but doesn't cross it. Choices C and D are incorrect and are likely the result of misinterpreting the relationship between the x -intercepts of a graph of a polynomial function and the factors of the polynomial expression.

QUESTION 12

Choice D is correct. Dividing both sides of equation $\frac{2a}{b} = \frac{1}{2}$ by 2 gives $\frac{a}{b} = \frac{1}{4}$. Taking the reciprocal of both sides yields $\frac{b}{a} = 4$.

Choice A is incorrect. This is the value of $\frac{a}{2b}$, not $\frac{b}{a}$. Choice B is incorrect. This is the value of $\frac{a}{b}$, not $\frac{b}{a}$. Choice C is incorrect. This is the value of $\frac{b}{2a}$, not $\frac{b}{a}$.

QUESTION 13

Choice C is correct. It is assumed that the oil and gas production decreased at a constant rate. Therefore, the function f that best models the production t years after the year 2000 can be written as a linear function, $f(t) = mt + b$, where m is the rate of change of the oil and gas production and b is the oil and gas production, in millions of barrels, in the year 2000. Since there were 4 million barrels of oil and gas produced in 2000, $b = 4$. The rate of change, m , can be calculated as $\frac{4 - 1.9}{0 - 13} = -\frac{2.1}{13}$, which is equivalent to $-\frac{21}{130}$, the rate of change in choice C.

Choices A and B are incorrect because each of these functions has a positive rate of change. Since the oil and gas production decreased over time, the rate of change must be negative. Choice D is incorrect. This model may result from misinterpreting 1.9 million barrels as the amount by which the production decreased.

QUESTION 14

Choice C is correct. The second equation of the system can be rewritten as $y = 5x - 8$. Substituting $5x - 8$ for y in the first equation gives $5x - 8 = x^2 + 3x - 7$. This equation can be solved as shown below:

$$x^2 + 3x - 7 - 5x + 8 = 0$$

$$x^2 - 2x + 1 = 0$$

$$(x - 1)^2 = 0$$

$$x = 1$$

Substituting 1 for x in the equation $y = 5x - 8$ gives $y = -3$. Therefore, $(1, -3)$ is the only solution to the system of equations.

Choice A is incorrect. In the xy -plane, a parabola and a line can intersect at no more than two points. Since the graph of the first equation is a parabola and the graph of the second equation is a line, the system cannot have more than 2 solutions. Choice B is incorrect. There is a single ordered pair (x, y) that satisfies both equations of the system. Choice D is incorrect because the ordered pair $(1, -3)$ satisfies both equations of the system.

QUESTION 15

Choice D is correct. Since $h(x) = 1 - g(x)$, substituting 0 for x yields $h(0) = 1 - g(0)$. Evaluating $g(0)$ gives $g(0) = 2(0) - 1 = -1$. Therefore, $h(0) = 1 - (-1) = 2$.

Choice A is incorrect. This choice may result from an arithmetic error. Choice B is incorrect. This choice may result from incorrectly evaluating $g(0)$ to be 1. Choice C is incorrect. This choice may result from evaluating $1 - 0$ instead of $1 - g(0)$.

QUESTION 16

The correct answer is 3. The solution to the given equation can be found by factoring the quadratic expression. The factors can be determined by finding two numbers with a sum of 1 and a product of -12 . The two numbers that meet these constraints are 4 and -3 . Therefore, the given equation can be rewritten as $(x + 4)(x - 3) = 0$. It follows that the solutions to the equation are $x = -4$ or $x = 3$. Since it is given that $a > 0$, a must equal 3.

QUESTION 17

The correct answer is 32. The sum of the given expressions is $(-2x^2 + x + 31) + (3x^2 + 7x - 8)$. Combining like terms yields $x^2 + 8x + 23$. Based on the form of the given equation, $a = 1$, $b = 8$, and $c = 23$. Therefore, $a + b + c = 32$.

Alternate approach: Because $a + b + c$ is the value of $ax^2 + bx + c$ when $x = 1$, it is possible to first make that substitution into each polynomial before adding them. When $x = 1$, the first polynomial is equal to $-2 + 1 + 31 = 30$ and the second polynomial is equal to $3 + 7 - 8 = 2$. The sum of 30 and 2 is 32.

QUESTION 18

The correct answer is $\frac{3}{2}$. One method for solving the system of equations for y is to add corresponding sides of the two equations. Adding the left-hand sides gives $(-x + y) + (x + 3y)$, or $4y$. Adding the right-hand sides yields $-3.5 + 9.5 = 6$. It follows that $4y = 6$. Finally, dividing both sides of $4y = 6$ by 4 yields $y = \frac{6}{4}$ or $\frac{3}{2}$. Any of $3/2$, $6/4$, $9/6$, $12/8$ or the decimal equivalent 1.5 will be scored as correct.

QUESTION 19

The correct answer is 8. The number of employees, y , expected to be employed by the company x quarters after the company opened can be modeled by the equation $y = ax + b$, where a represents the constant rate of change in the number of employees each quarter and b represents the number of employees with which the company opened. The company's growth plan assumes that 2 employees will be hired each quarter, so $a = 2$. The number of employees the company opened with was 8, so $b = 8$.

QUESTION 20

The correct answer is 144. In a circle, the ratio of the length of a given arc to the circle's circumference is equal to the ratio of the measure of the arc, in degrees, to 360° . The ratio between the arc length and the circle's circumference is given as $\frac{2}{5}$. It follows that $\frac{2}{5} = \frac{x}{360}$. Solving this proportion for x gives $x = 144$.

Section 4: Math Test – Calculator

QUESTION 1

Choice A is correct. If one pound of grapes costs \$2, two pounds of grapes will cost 2 times \$2, three pounds of grapes will cost 3 times \$2, and so on. Therefore, c pounds of grapes will cost c times \$2, which is $2c$ dollars.

Choice B is incorrect and may result from incorrectly adding instead of multiplying. Choice C is incorrect and may result from assuming that c pounds cost \$2, and then finding the cost per pound. Choice D is incorrect and could result from incorrectly assuming that 2 pounds cost \$ c , and then finding the cost per pound.

QUESTION 2

Choice C is correct. According to the graph, the number of figurines decreased between 1 and 2 months and between 3 and 4 months. Because the line segment between 3 and 4 months is steeper than the line segment between 1 and 2 months, it follows that the number of figurines decreased the fastest between 3 and 4 months.

Choice A is incorrect. Between 1 and 2 months, the number of figurines decreased. However, the number of figurines decreased faster during the interval between 3 and 4 months. Choices B and D are incorrect. The number of figurines during these intervals was increasing, not decreasing.

QUESTION 3

Choice A is correct. The fraction of the cars in the random sample that have a manufacturing defect is $\frac{3}{200} = 0.015$. At this rate, out of 10,000 cars there would be $0.015 \times 10,000 = 150$ cars that have a manufacturing defect.

Choices B, C, and D are incorrect because the fractions of cars in the population that have a defect, $\frac{200}{10,000} = 0.02$ in choice B, $\frac{250}{10,000} = 0.025$ in choice C, and $\frac{300}{10,000} = 0.03$ in choice D, are all different from the fraction of cars in the sample with a manufacturing defect, which is 0.015.

QUESTION 4

Choice C is correct. The given line of best fit can be used to predict the length when the width is known. The equation of the line of best fit is given as $y = 1.67x + 21.1$, where x is the width in millimeters and y is the predicted length in millimeters. If the width of the petal is 19 millimeters, then $x = 19$ and $y = 1.67(19) + 21.1 = 52.83$.

Choice A is incorrect and may result from incorrectly using $x = 0$ in the equation. Choice B is incorrect and may result from neglecting to add 21.1 in the computation. Choice D is incorrect and may result from an arithmetic error.

QUESTION 5

Choice B is correct. Let the measure of the third angle in the smaller triangle be a° . Since lines ℓ and m are parallel and cut by transversals, it follows that the corresponding angles formed are congruent.

So $a^\circ = y^\circ = 20^\circ$. The sum of the measures of the interior angles of a triangle is 180° , which for the interior angles in the smaller triangle yields $a + x + z = 180$. Given that $z = 60$ and $a = 20$, it follows that $20 + x + 60 = 180$. Solving for x gives $x = 180 - 60 - 20$, or $x = 100$.

Choice A is incorrect and may result from incorrectly assuming that angles $x + z = 180$. Choice C is incorrect and may result from incorrectly assuming that the smaller triangle is a right triangle, with x as the right angle. Choice D is incorrect and may result from a misunderstanding of the exterior angle theorem and incorrectly assuming that $x = y + z$.

QUESTION 6

Choice D is correct. Since only two types of tickets were sold and a total of 350 tickets were sold, the sum of the numbers of both types of ticket sold must be 350. Therefore, $B + L = 350$. Since the bench tickets were \$75 each, the income from B bench tickets was $75B$. Similarly, since the lawn tickets were \$40 each, the income from L lawn tickets sold was $40L$. The total income from all tickets was \$19,250. So the sum of the income from bench tickets and lawn tickets sold must equal 19,250. Therefore, $75B + 40L = 19,250$. Only choice D has both correct equations.

Choice A is incorrect and may result from incorrectly multiplying the income from each type of ticket instead of adding them. It also incorrectly uses 1,950 instead of 19,250. Choice B is incorrect and may result from confusing the cost of bench tickets with the cost of lawn tickets. Choice C is incorrect and may result from confusing the total number of tickets sold with the total amount raised.

QUESTION 7

Choice C is correct. The graph of an equation given in the form $y = mx + b$ has slope m . The equation in choice C is $y = 3x + 2$, so the slope of its graph is 3.

Choices A, B, and D are incorrect. They are all given in the form $y = mx + b$, where m is the slope. Therefore, choice A has a graph with a slope of $\frac{1}{3}$, choice B has a graph with a slope of 1 (because $x = 1 \cdot x$), and choice D has a graph with a slope of 6.

QUESTION 8

Choice B is correct. Multiplying both sides of the equation by $x + 1$ gives $(x + 1)^2 = 2$. This means $x + 1$ is a number whose square is 2, so $(x + 1)$ is either $\sqrt{2}$ or $-\sqrt{2}$. Therefore, $\sqrt{2}$ is a possible value for $x + 1$.

Choice A is incorrect and may result from trying to find the value of x instead of $x + 1$ and making a sign error. Choice C is incorrect and may result from solving for $(x + 1)^2$ instead of $x + 1$. Choice D is incorrect and may result from squaring instead of taking the square root to find the value of $x + 1$.

QUESTION 9

Choice D is correct. Using the volume formula $V = \frac{7\pi k^3}{48}$ and the given information that the volume of the glass is 473 cubic centimeters, the value of k can be found as follows:

$$473 = \frac{7\pi k^3}{48}$$

$$k^3 = \frac{473(48)}{7\pi}$$

$$k = \sqrt[3]{\frac{473(48)}{7\pi}} \approx 10.10690$$

Therefore, the value of k is approximately 10.11 centimeters.

Choices A, B, and C are incorrect. Substituting the values of k from these choices in the formula results in volumes of approximately 7 cubic centimeters, 207 cubic centimeters, and 217 cubic centimeters, respectively, all of which contradict the given information that the volume of the glass is 473 cubic centimeters.

QUESTION 10

Choice C is correct. Due to the shape of the glass, if the water is poured at a constant rate, the height of the water level will increase faster initially, where the diameter of the glass is smaller, and increase more slowly later, as the diameter of the glass increases. Choice C is the only graph that shows this behavior: it is steeper initially and then gets less steep.

Choice A is incorrect since it shows the height of the water level increasing at a constant rate over time. Choice B is incorrect since it shows the height of the water level increasing slowly at first and faster later. Choice D is incorrect since it shows the height of the water level staying constant even as water is being poured into the glass.

QUESTION 11

Choice B is correct. It is given that the volume of the glass is approximately 16 fluid ounces. If Jenny has 1 gallon of water, which is 128 fluid ounces, she could fill the glass $\frac{128}{16} = 8$ times.

Choice A is incorrect because Jenny would need 16×16 fluid ounces = 256 fluid ounces, or 2 gallons, of water to fill the glass 16 times. Choice C is incorrect because Jenny would need only 4×16 fluid ounces = 64 fluid ounces of water to fill the glass 4 times. Choice D is incorrect because Jenny would need only 3×16 fluid ounces = 48 fluid ounces to fill the glass 3 times.

QUESTION 12

Choice C is correct. Since Roberto sells only two types of policies and he didn't meet his goal of selling at least 57 policies, the sum of x , the number of \$50,000 policies, and y , the number of \$100,000 policies, must be less than 57. Symbolically, that is $x + y < 57$. The total value, in dollars, from selling x number of \$50,000 policies is $50,000x$. The total value, in dollars, from selling y number of \$100,000 policies is $100,000y$. Since the total value of the policies he sold was over \$3,000,000, it follows that $50,000x + 100,000y > 3,000,000$. Only choice C has both correct inequalities.

Choice A is incorrect because the total value, in dollars, of the policies Roberto sold was greater than, not less than, 3,000,000. Choice B is incorrect because Roberto didn't meet his goal, so $x + y$ should be less than, not greater than, 57. Choice D is incorrect because both inequalities misrepresent the situation.

QUESTION 13

Choice C is correct. Since a has the exponent $-\frac{1}{2}$, a can be isolated by raising both sides of the equation to the -2 power.

$$a^{(-\frac{1}{2})(-2)} = x^{-2}$$

$$a = x^{-2}$$

$$a = \frac{1}{x^2}$$

Alternate method:

$$a^{\frac{1}{2}} = \frac{1}{a^{\frac{1}{2}}} = \frac{1}{\sqrt{a}}$$

So,

$$\frac{1}{\sqrt{a}} = x$$

Square both sides of the equation:

$$\frac{1}{a} = x^2$$

Then take the reciprocal of both sides:

$$a = \frac{1}{x^2}$$

Choice A is incorrect and may result from incorrectly taking the square root of both sides to eliminate the exponent of a . Choice B is incorrect and may result from incorrectly taking the square root of both sides to eliminate the exponent of a , and incorrectly multiplying by -1 to make the exponent positive. Choice D is incorrect and may result from incorrectly multiplying by -1 to make the exponent positive.

QUESTION 14

Choice D is correct. A rational expression is undefined when the denominator is 0. To determine the values of x that result in a denominator of 0, set the denominator equal to 0 and solve for x :

$$x^2 + 3x - 10 = 0$$

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

$$x + 5 = 0 \text{ or } x - 2 = 0$$

$$x = -5 \text{ or } x = 2$$

Among the answer choices, only the value $x = 2$ is listed, so choice D is correct.

Choice A is incorrect. When $x = -3$, the denominator is

$$(-3)^2 + 3(-3) - 10 = -10, \text{ so the given expression is not undefined.}$$

Choice B is incorrect and may result from incorrectly factoring the denominator or incorrectly assuming that if $(x - 2)$ is a factor, then $x = -2$ is a solution. Choice C is incorrect and may result from giving the value of the denominator that makes the given expression undefined rather than the value of x that makes the denominator equal to 0.

QUESTION 15

Choice D is correct. Since density is mass per unit volume, the mass is the density times volume. The volume of a right rectangular prism is the product of the lengths of the sides. Therefore:

$$\begin{aligned} \text{mass} &= (2.8 \text{ grams per cubic centimeter}) \times \\ &(30 \text{ centimeters} \times 40 \text{ centimeters} \times 50 \text{ centimeters}) \end{aligned}$$

$$\text{mass} = (2.8 \text{ grams per cubic centimeter}) \times (60,000 \text{ cubic centimeters})$$

$$\text{mass} = 168,000 \text{ grams}$$

Choice A is incorrect and may result from adding, instead of multiplying, the lengths of the sides to find the volume. Choice B is incorrect and may result from the same error as in choice A, as well as a place value error. Choice C is incorrect and may result from a place value error when finding the volume.

QUESTION 16

Choice B is correct. A total of 150 adults received the sugar pill.

Of those, 33 reported contracting a cold. Therefore, $\frac{33}{150}$, or the equivalent $\frac{11}{50}$, is the proportion of adults receiving a sugar pill who reported contracting a cold.

Choice A is incorrect. This is the proportion of adults receiving a sugar pill and contracting a cold to all adults contracting a cold $\left(\frac{33}{54}\right)$.
Choice C is incorrect. This is the proportion of adults who reported contracting a cold to all the participants in the study $\left(\frac{54}{300} = \frac{9}{50}\right)$.
Choice D is incorrect. This is the proportion of adults who received a sugar pill and reported contracting a cold to all the participants in the study $\left(\frac{33}{300} = \frac{11}{100}\right)$.

QUESTION 17

Choice A is correct. The mode is the data value with the highest frequency. So for the data shown, the mode is 18. The median is the middle data value when the data values are sorted from least to greatest. Since there are 20 ages ordered, the median is the average of the two middle values, the 10th and 11th, which for these data are both 19. Therefore, the median is 19. The mean is the sum of the data values divided by the number of the data values. So for these data, the mean is
$$\frac{(18 \times 6) + (19 \times 5) + (20 \times 4) + (21 \times 2) + (22 \times 1) + (23 \times 1) + (30 \times 1)}{20} = 20.$$

Since the mode is 18, the median is 19, and the mean is 20,
mode < median < mean.

Choice B and D are incorrect because the mean is greater than the median. Choice C is incorrect because the median is greater than the mode.

Alternate approach: After determining the mode, 18, and the median, 19, it remains to determine whether the mean is less than 19 or more than 19. Because the mean is a balancing point, there is as much deviation below the mean as above the mean. It is possible to compare the data to 19 to determine the balance of deviation above and below the mean. There is a total deviation of only 6 below 19 (the 6 values of 18); however, the data value 30 alone deviates by 11 above 19. Thus the mean must be greater than 19.

QUESTION 18

Choice C is correct. Based on the line of best fit shown, the predicted percent of leaf litter mass remaining for a forest with a mean annual temperature of -2°C is about 70%.

Choice A is incorrect; it is the predicted percent of leaf litter mass remaining at about 6.5°C . Choice B is incorrect; it is the predicted percent of leaf litter mass remaining at 2°C instead of at -2°C .
Choice D is incorrect; it is the predicted percent of leaf litter mass remaining at about -7°C .

QUESTION 19

Choice A is correct. Since zeros of f correspond to the x -intercepts of the graph of f , and the range of f gives all the possible y -values on the graph of the function, the correct graph of the function has only points with y -values less than or equal to 4, and crosses the x -axis at only $(-3, 0)$ and $(1, 0)$. The graph in choice A satisfies both of these conditions.

Choice B is incorrect. The graph of the function matches the range given, but the zeros are at -1 and 3 , not -3 and 1 . Choice C is incorrect. The graph has y -values greater than 4. Choice D is incorrect. Even though the graph has zeros at -3 and 1 , it has an additional zero at 0 , and the range of the graph is the set of all real numbers.

QUESTION 20

Choice B is correct. The savings each year from installing the geothermal heating system will be the average annual energy cost for the home before the geothermal heating system installation minus the average annual energy cost after the geothermal heating system installation, which is $(4,334 - 2,712)$ dollars. In t years, the savings will be $(4,334 - 2,712)t$ dollars. Therefore, the inequality that can be solved to find the number of years after installation at which the total amount of energy cost savings will exceed (be greater than) the installation cost, \$25,000, is $25,000 < (4,334 - 2,712)t$.

Choice A is incorrect. It gives the number of years after installation at which the total amount of energy cost savings will be less than the installation cost. Choice C is incorrect and may result from subtracting the average annual energy cost for the home from the onetime cost of the geothermal heating system installation. To find the predicted total savings, the predicted average cost should be subtracted from the average annual energy cost before the installation, and the result should be multiplied by the number of years, t . Choice D is incorrect and may result from misunderstanding the context. The ratio $\frac{4,332}{2,712}$ compares the average energy cost before installation and the average energy cost after installation; it does not represent the savings.

QUESTION 21

Choice D is correct. The number 3.39 in the equation $y = 3.39x + 46.89$ is the slope, which is the change in y per unit change in x . Because y represents the amount of plastic produced annually, in billions of pounds, and x represents the number of years since 1985, the number 3.39 represents the rate of change of the amount of plastic produced with respect to time, in units of billions of pounds per year. The change is an increase since 3.39 is positive, and it is described as an average change because the data show increases that are sometimes more and sometimes less than 3.39.

Choice A is incorrect. It is the interpretation of the number 46.89 in the line of best fit equation, $y = 3.39x + 46.89$. Choices B and C are incorrect because they are expressed in the wrong units. The number 3.39 has units of billions of pounds per year, but choice B has units of years and choice C has units of billions of pounds.

QUESTION 22

Choice A is correct. Since x is the number of years since 1985, the year 2000 corresponds to $x = 15$ and the year 2003 corresponds to $x = 18$. The corresponding points on the line of best fit are approximately (15, 98) and (18, 107). This means that approximately 98 billion pounds of plastic were produced in 2000 and approximately 107 billion pounds of plastic were produced in 2003. To calculate the percent increase, subtract the amount of plastic produced in 2000 from the amount of plastic produced in 2003 and then divide the result by the amount of plastic produced in 2000 and multiply by 100. This yields $\left(\frac{107 - 98}{98}\right) \cdot 100 = 9.2$, or approximately 10%.

Choices B and C are incorrect and may be the result of misreading the graph or making an arithmetic error. Choice D is incorrect and may be the result of approximating the amount of plastic produced, in billions of pounds, in the year 2003 ($x = 18$).

QUESTION 23

Choice A is correct. In 1 year, there are 4 quarter years, so the number of quarter years, q , is 4 times the number of years, t ; that is, $q = 4t$. This is equivalent to $t = \frac{q}{4}$, and substituting this into the expression for M in terms of t gives $M = 1,800(1.02)^{\frac{q}{4}}$.

Choices B and D are incorrect and may be the result of incorrectly using $t = 4q$. In choice D, $1.02^{4q} = 1.02^{4(q)}$, which is approximately 1.082^q . Choice C is incorrect and may be the result of incorrectly using $t = 4q$ and unnecessarily dividing 0.02 by 4.

QUESTION 24

Choice D is correct. It is given that Contestant 2 earned 70% of the votes cast using social media and 40% of the votes cast using a text message. Based on this information, viewers voting by social media were more likely to prefer Contestant 2 than were viewers voting by text message.

Choices A, B, and C are incorrect. There is not enough information about the viewers to reach these conclusions.

QUESTION 25

Choice A is correct. It is given that the relationship between population and year is linear; therefore, the function that models the population t years after 2000 is of the form $P(t) = mt + b$, where m is the slope and b is the population when $t = 0$. In the year 2000, $t = 0$. Therefore, $b = 862$. The slope is given by $m = \frac{P(10) - P(0)}{10 - 0} = \frac{846 - 862}{10 - 0} = \frac{-16}{10} = -1.6$. Therefore, $P(t) = -1.6t + 862$, which is equivalent to the equation in choice A.

Choice B is incorrect and may be the result of incorrectly calculating the slope as just the change in the value of P . Choice C is incorrect and may be the result of the same error as in choice B, in addition to incorrectly using t to represent the year, instead of the number of years after 2000. Choice D is incorrect and may be the result of incorrectly using t to represent the year instead of the number of years after 2000.

QUESTION 26

Choice C is correct. In order to use a sample mean to estimate the mean for a population, the sample must be representative of the population (for example, a simple random sample). In this case, Tabitha surveyed 20 families in a playground. Families in the playground are more likely to have children than other households in the community. Therefore, the sample isn't representative of the population. Hence, the sampling method is flawed and may produce a biased estimate.

Choices A and D are incorrect because they incorrectly assume the sampling method is unbiased. Choice B is incorrect because a sample of size 20 could be large enough to make an estimate if the sample had been representative of all the families in the community.

QUESTION 27

Choice B is correct. Since the point (p, r) lies on the line with equation $y = x + b$, the point must satisfy the equation. Substituting p for x and r for y in the equation $y = x + b$ gives $r = p + b$. Similarly, since the point $(2p, 5r)$ lies on the line with the equation $y = 2x + b$, the point must satisfy the equation. Substituting $2p$ for x and $5r$ for y in the equation $y = 2x + b$ gives $5r = 2(2p) + b$, or $5r = 4p + b$. Solving each equation for b gives $b = r - p$ and $b = 5r - 4p$, respectively. Substituting $r - p$ for b in the equation $b = 5r - 4p$ gives $r - p = 5r - 4p$. Subtracting r from each side of the equation and adding $4p$ to each side of the equation gives $3p = 4r$. Dividing each side of the equation by p and dividing each side of the equation by 4 gives $\frac{3}{4} = \frac{r}{p}$.

Choices A, C, and D are incorrect. Choices A and D may be the result of incorrectly forming the answer out of the coefficients in the point $(2p, 5r)$. Choice C may be the result of confusing r and p .

QUESTION 28

Choice D is correct. The two data sets have the same range. The first data set has a range of $88 - 56 = 32$, and the second data set has a range of $112 - 80 = 32$. Alternatively, it can be seen visually that the ranges are the same because the two dot plots are aligned, the scales of the graphs are the same, and the graphs have the same width. The two data sets have different standard deviations. Both dot plots show distributions that have a mean near the center value of the dot plot. The first dot plot shows most values clustered near the mean, while the second dot plot shows most values farther from the mean. Therefore, the standard deviations of the two data sets are not equal—the data represented by the second dot plot has a greater standard deviation.

Choices A, B, and C are incorrect because they incorrectly assert either that the standard deviations are the same or that the ranges are different.

QUESTION 29

Choice B is correct. Since the machine copies at a constant rate, the relationship between p , the number of sheets of paper remaining, and m , the time in minutes since the machine started printing, is modeled by a linear equation. The initial number of sheets of paper is given as 5,000. It is also given that the machine used 30% of those 5,000 sheets in 20 minutes, so it used $0.30 \times 5,000 = 1,500$ sheets in 20 minutes. Therefore, the number of sheets used per minute is $\frac{1,500}{20} = 75$. To determine the number of sheets of paper used m minutes after the machine started printing, multiply 75 by m , which gives $75m$. Therefore, a linear equation modeling this relationship is the number of sheets remaining equals the initial number of sheets of paper minus the number of sheets of paper used m minutes after the machine started printing, which is $p = 5,000 - 75m$.

Choice A is incorrect and may be the result of using the given number of minutes, 20, as the rate at which the copy machine uses paper. However, the rate is 75, not 20, sheets per minute. Choices C and D are incorrect because they aren't linear equations; they assume that the copy machine prints at a nonconstant rate.

QUESTION 30

Choice B is correct. The maximum value of the function f occurs at the highest point on the graph of $y = f(x)$; the highest point on the graph is $(4, 3)$. For any point on the graph of f , the y -coordinate gives the value of the function at the x -coordinate; therefore, the maximum value of the function f is 3. It is stated that k is the maximum value of f , so $k = 3$. Thus, $g(k) = g(3)$. From the table of values for g , it can be seen that when $x = 3$, $g(3) = 6$.

Choice A is incorrect and may result from using the x -coordinate of the maximum point as the value of k . Choice C is incorrect; it is the value of k , not of $g(k)$. Choice D is incorrect and may be the result of giving the value of x that makes $g(x) = 3$ instead of finding the value of $g(x)$ when $x = 3$.

QUESTION 31

The correct answer is 102. Since each molecule of water has 2 atoms of hydrogen, 51 molecules of water have a total of $(51)(2) = 102$ atoms of hydrogen.

QUESTION 32

The correct answer is 2. Substituting $x = 1$ in the equation $x - \frac{1}{2}a = 0$ gives $1 - \frac{1}{2}a = 0$. Adding $\frac{1}{2}a$ to both sides of this equation gives $1 = \frac{1}{2}a$. Multiplying both sides of this last equation by 2 gives $2 = a$.

QUESTION 33

The correct answer is 30. Since the equations $x + 2y = 10$ and $3x + 6y = c$ represent the same line in the xy -plane, they must be equivalent equations. The expression $3x + 6y$ on the left-hand side of the second equation is equivalent to $3(x + 2y)$, which is 3 times the left-hand side of the first equation. Thus, to be equivalent, the right-hand side of the second equation, c , must be 3 times the right-hand side of the first equation, 10. Therefore, $c = 30$.

QUESTION 34

The correct answer is 25.4. The average speed is the total distance divided by the total time. The total distance is 11 miles and the total time is 26 minutes. Thus, the average speed is $\frac{11}{26}$ miles per minute. The question asks for the average speed in miles per hour, and there are 60 minutes in an hour; converting miles per minute to miles per hour gives the following:

$$\begin{aligned} \text{Average speed} &= \frac{11 \text{ miles}}{26 \text{ minutes}} \times \frac{60 \text{ minutes}}{1 \text{ hour}} \\ &= \frac{660}{26} \text{ miles per hour} \\ &\approx 25.38 \text{ miles per hour} \end{aligned}$$

Therefore, to the nearest tenth of a mile per hour, the average speed of Paul Revere's ride would have been 25.4 miles per hour.

QUESTION 35

The correct answers are 2 and 8. Substituting $x = a$ in the definitions for f and g gives $f(a) = -\frac{1}{2}(a - 4)^2 + 10$ and $g(a) = -a + 10$, respectively. If $f(a) = g(a)$, then $-\frac{1}{2}(a - 4)^2 + 10 = -a + 10$. Subtracting 10 from both sides of this equation gives $-\frac{1}{2}(a - 4)^2 = -a$. Multiplying both sides by -2 gives $(a - 4)^2 = 2a$. Expanding $(a - 4)^2$ gives $a^2 - 8a + 16 = 2a$. Combining the like terms on one side of the equation gives $a^2 - 10a + 16 = 0$. One way to solve this equation is to factor $a^2 - 10a + 16$ by identifying two numbers with a sum of -10 and a product of 16 . These numbers are -2 and -8 , so the quadratic equation can be factored as $(a - 2)(a - 8) = 0$. Therefore, the possible values of a are either 2 or 8. Either 2 or 8 will be scored as a correct answer.

Alternate approach: Graphically, the condition $f(a) = g(a)$ implies the graphs of the functions $y = f(x)$ and $y = g(x)$ intersect at $x = a$. The graph $y = f(x)$ is given, and the graph of $y = g(x)$ may be sketched as a line with y -intercept 10 and a slope of -1 (taking care to note the different scales on each axis). These two graphs intersect at $x = 2$ and $x = 8$.

QUESTION 36

The correct answer is 0. Note that no matter where point W is on \overline{RT} , the sum of the measures of $\angle RSW$ and $\angle WST$ is equal to the measure of $\angle RST$, which is 90° . Thus, $\angle RSW$ and $\angle WST$ are complementary angles. Since the cosine of an angle is equal to the sine of its complementary angle, $\cos(\angle RSW) = \sin(\angle WST)$. Therefore, $\cos(\angle RSW) - \sin(\angle WST) = 0$.

QUESTION 37

The correct answer is 576. According to the table, 5 minutes after the injection, the penicillin in the patient's bloodstream is 152 micrograms per milliliter. Thus, there are $10 \times 152 = 1520$ micrograms of penicillin in 10 milliliters of blood drawn 5 minutes after the injection. Similarly, 10 minutes after the injection, the penicillin concentration is 118 micrograms per milliliter. Thus, there are $8 \times 118 = 944$ micrograms of penicillin in 8 milliliters of blood drawn 10 minutes after the injection. Therefore, there are $1520 - 944 = 576$ more micrograms of penicillin in 10 milliliters of blood drawn 5 minutes after the injection than in 8 milliliters of blood drawn 10 minutes after the injection.

QUESTION 38

The correct answer is 0.8. The value of b in the equation $P(t) = 200b^t$ can be estimated using any row of the table other than the first one. Substituting $t = 5$ and $P(5) = 152$ from the second row of the table into the definition of P yields $152 = 200b^5$, or $152 = 200b$. Dividing both sides of this equation by 200 yields $b = \frac{152}{200}$. The fraction can be rewritten as $\frac{76}{100}$, or its decimal equivalent .76. Rounded to the nearest tenth, this value is .8. Other rows of the table also give a value of b that rounds to .8. Therefore, the value of b , rounded to the nearest tenth, is .8. Either .8, or its fractional equivalents, $\frac{4}{5}$ or $\frac{8}{10}$, can be gridded as the correct answer.