



## Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

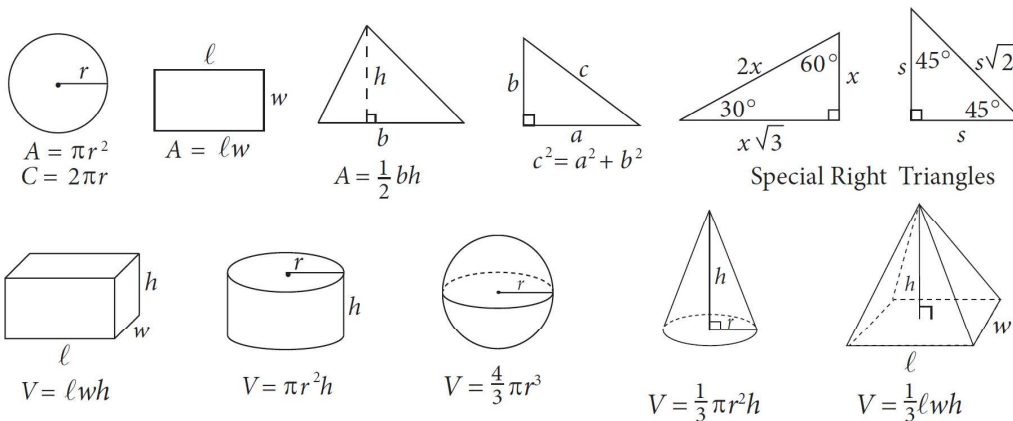
### DIRECTIONS

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

### NOTES

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

### REFERENCE



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

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

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

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1. Which of the following equations has a vertex of  $(3, -3)$  ?

A)  $y = 5(x - 3)^2 - 3$

A)  $y = 5(x + 3)^2 - 3$

B)  $y = 5(x + 3)^2 - 3$

C)  $y = 5(x - 3)^2 + 3$

D)  $y = 5(x + 3)^2 + 3$

2. A beverage store charges a base price of  $x$  dollars for one keg of root beer. A sales tax of a certain percentage is applied to the base price, and an untaxed deposit for the keg is added. If the total amount, in dollars, paid at the time of purchase for one keg is given by the expression  $1.07x + 17$ , then what is the sales tax, expressed as a percentage of the base price?

A) 0.07%

B) 1.07%

C) 7%

D) 17%

3. Syed took out a cash advance of  $d$  dollars from a financing company. The company deducts a fee of  $\frac{1}{3}$  of the original advanced amount along with a wire transfer fee of \$30.00. Which of the following represents the final advanced amount that Syed receives after all applied fees, in dollars?

A)  $\frac{1}{3}d - 30$

B)  $\frac{1}{3}(d - 30)$

C)  $\frac{2}{3}(d - 30)$

D)  $\frac{2}{3}d - 30$

4. What is the equation of a line that contains the point  $(1, 6)$  and has a  $y$ -intercept of 4 ?

A)  $y = \frac{1}{2}x + 4$

C)  $y = 2x + 4$

B)  $y = x + 4$

D)  $y = 4x + 2$

5. The number of bonus points,  $B(p)$ , that a credit card holder receives is given by the function  $B(p) = 4p + 7$ , where  $p$  represents the number of purchases made. If the number of purchases is increased by 3, by how much does the number of bonus points increase?
- A) 3  
B) 4  
C) 12  
D) 19
6. Jeff tests how the total volume occupied by a fluid contained in a graduated cylinder changes when round marbles of various sizes are added. He found that the total volume occupied by the fluid,  $V$ , in cubic centimeters, can be found using the equation below, where  $x$  equals the number of identical marbles Jeff added, one at a time, to the cylinder, and  $r$  is the radius of one of the marbles.

$$V = 24\pi + x \left( \frac{4}{3} \pi r^3 \right)$$

- If the volume of the graduated cylinder is  $96\pi$  cubic centimeters, then, what is the maximum number of marbles with a radius of 3 centimeters that Jeff can add without the volume of the fluid exceeding that of the graduated cylinder?
- A) 1  
B) 2  
C) 3  
D) 4
7. If  $b$  is two more than one-third of  $c$ , which of the following expresses the value of  $c$  in terms of  $b$ ?
- A)  $c = \frac{b - 2}{3}$   
B)  $c = \frac{b + 2}{3}$   
C)  $c = 3(b - 2)$   
D)  $c = 3(b - 6)$

8. The rotation rate of a mixing blade, in rotations per second, slows as a liquid is being added to the mixer. The blade rotates at 1,000 rotations per second when the mixer is empty. The rate at which the blade slows is four rotations per second less than three times the square of the height of the liquid. If  $h$  is the height of liquid in the mixer, which of the following represents  $R(h)$ , the rate of rotation?

- A)  $4 - 9h^2$   
B)  $1,000 - (4 - 3h)$   
C)  $1,000 - (9h - 4)$   
D)  $1,000 - (3h^2 - 4)$

9. A dental hygiene company is creating a new 24-ounce tube of toothpaste by combining its most popular toothpastes, Cavity Crusher and Bad Breath Obliterator. Cavity Crusher contains 0.25% of sodium fluoride as its active ingredient, and Bad Breath Obliterator contains 0.30% of triclosan as its active ingredient for a total of 0.069 ounces of active ingredients in both toothpastes. Solving which of the following systems of equations yields the number of ounces of Cavity Crusher,  $c$ , and the number of ounces of Bad Breath Obliterator,  $b$ , that are in the new toothpaste?

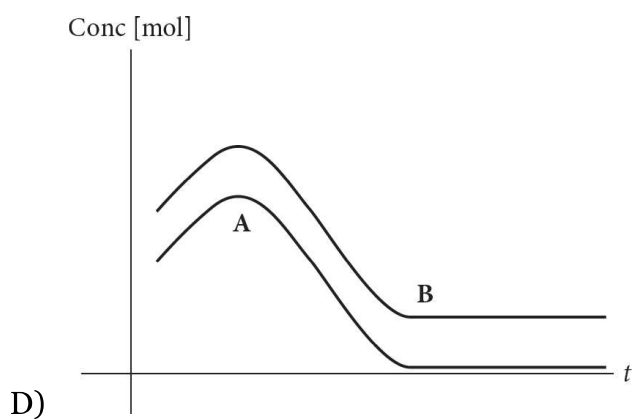
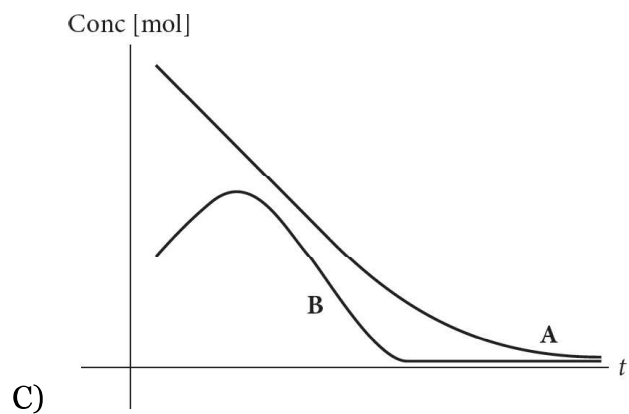
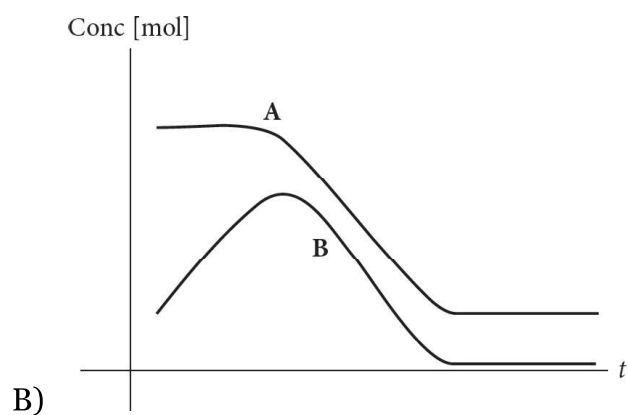
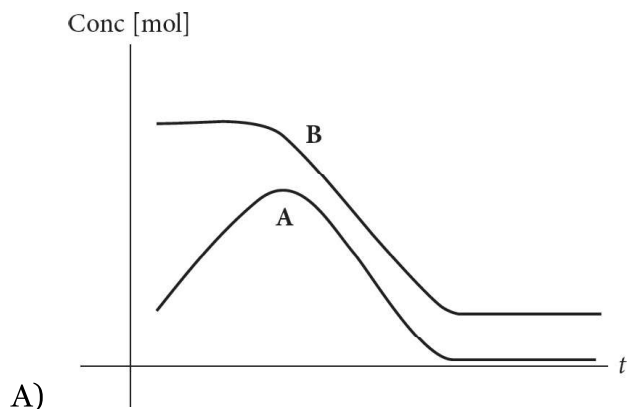
- A) 
$$\begin{aligned} c + b &= 0.069 \\ 0.25c + 0.3b &= 24 \end{aligned}$$
  
B) 
$$\begin{aligned} c + b &= 24 \\ 0.0025c + 0.003b &= 0.069 \end{aligned}$$
  
C) 
$$\begin{aligned} c + b &= 24 \\ 0.025c + 0.03b &= 0.069 \end{aligned}$$
  
D) 
$$\begin{aligned} c + b &= 24 \\ 0.25c + 0.3b &= 0.069 \end{aligned}$$

10. 
$$\frac{2d^2 - d - 10}{d^2 + 7d + 10} = \frac{d^2 - 4d + 3}{d^2 + 2d - 15}$$

In the equation above, what is the value of  $d$ ?

- A)  $-4$   
B)  $2$   
C)  $4$   
D)  $6$
11. Which of the following is a possible equation for a circle that is tangent to both the  $x$ -axis and the line  $x = 4$ ?
- A)  $(x + 2)^2 + (y + 2)^2 = 4$   
B)  $(x + 2)^2 + (y - 2)^2 = 4$   
C)  $(x - 2)^2 + (y + 4)^2 = 4$   
D)  $(x - 6)^2 + (y - 2)^2 = 4$

12. Reactant A is placed in a beaker, to which Reactant B will be added. Reactants A and B will not react unless B gets to a certain concentration. Once the reaction starts, both concentrations decrease until B has been consumed. Which of the following graphs, showing concentration in moles as a function of time in seconds, represents the reaction?



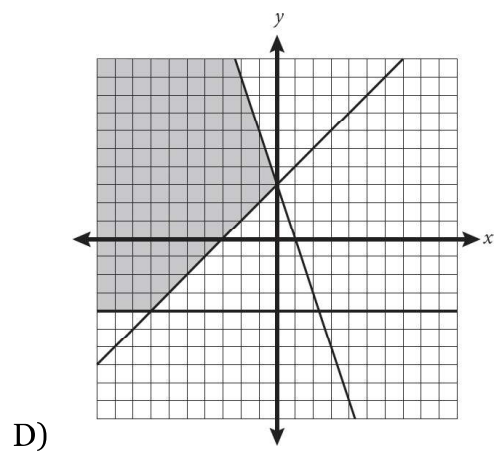
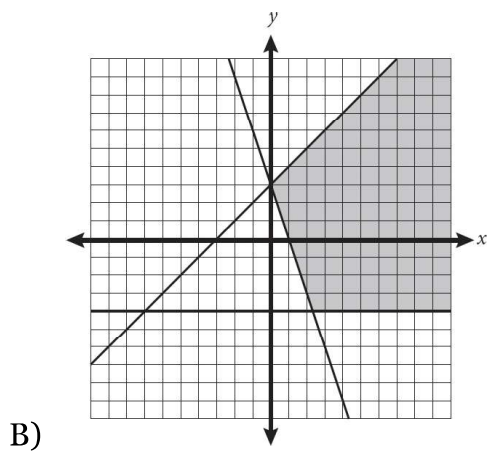
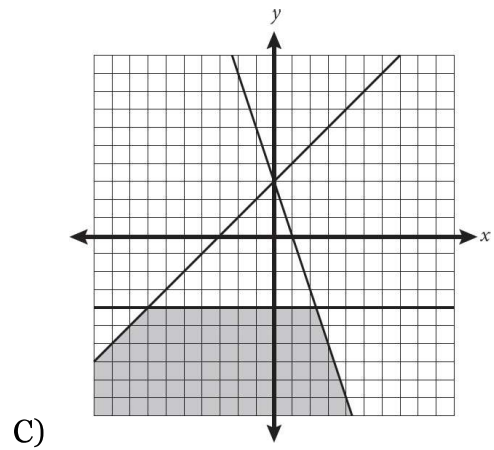
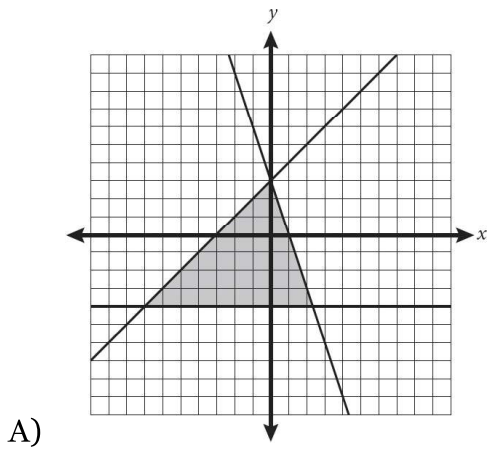
13.

$$-2y \leq 8$$

$$y - 3 \leq x$$

$$-\frac{1}{3}y + 1 \geq x$$

Which of the following graphs shows the solution to the system of inequalities above?



14.



If rectangle  $ABCD$  has an area of 324 and the tangent of  $\angle BCA$  (not shown) is  $\frac{4}{9}$ , then which of the following is closest to the length of  $\overline{BD}$  (not shown)?

- A) 9.8
- B) 27
- C) 29.5
- D) It cannot be determined from the given information.

15. Which of the following is equivalent to  $\frac{2m + 6}{4} \times \frac{6m - 36}{3m + 9}$ ?

- A)  $\frac{12m^2 - 216}{12m + 36}$
- B)  $\frac{8m - 30}{3m + 13}$
- C)  $\frac{m - 6}{4}$
- D)  $m - 6$

16. A rectangular box has sides 3, 4, and  $x$  and a volume of 18. What is the value of  $x$ ?
17. Jeanne babysits Chuy one day each week. Jeanne charges a \$20 fee for the day, plus \$5.50 for every 30 minutes of babysitting. How much has Jeanne earned after three hours of babysitting? (Disregard the \$ sign when gridding your answer.)
18. The parabola  $y = -x^2 + 5x + 6$  is intersected by the line  $y = -\frac{1}{2}x + 12$ . What is the  $y$ -coordinate of the intersection closest to the  $x$ -axis?

19.

$$\begin{aligned}13r + 8v &= 47 \\ 22v &= 63 - 17r\end{aligned}$$

Based on the system of equations above, what is the sum of  $r$  and  $v$ ?

20. A gardener has a cultivated plot that measures 4 feet by 6 feet. Next year, she wants to double the area of her plot by increasing the length and width by  $x$  feet. What is the value of  $x$ ?





## Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

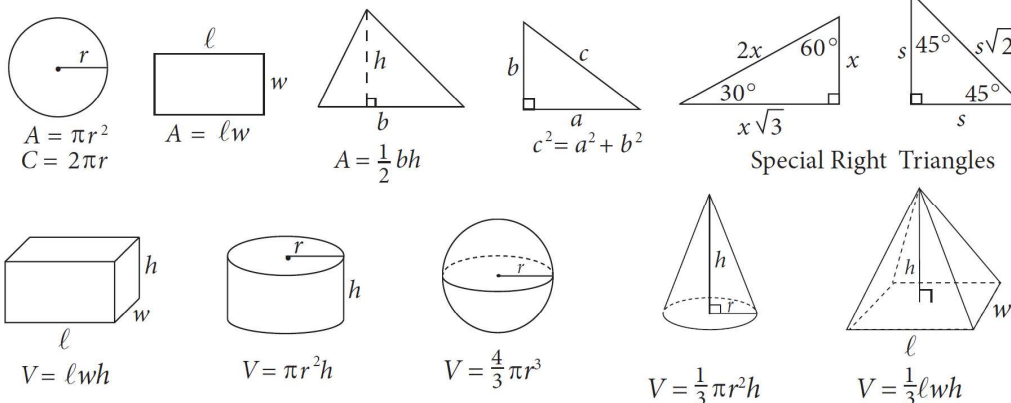
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### REFERENCE



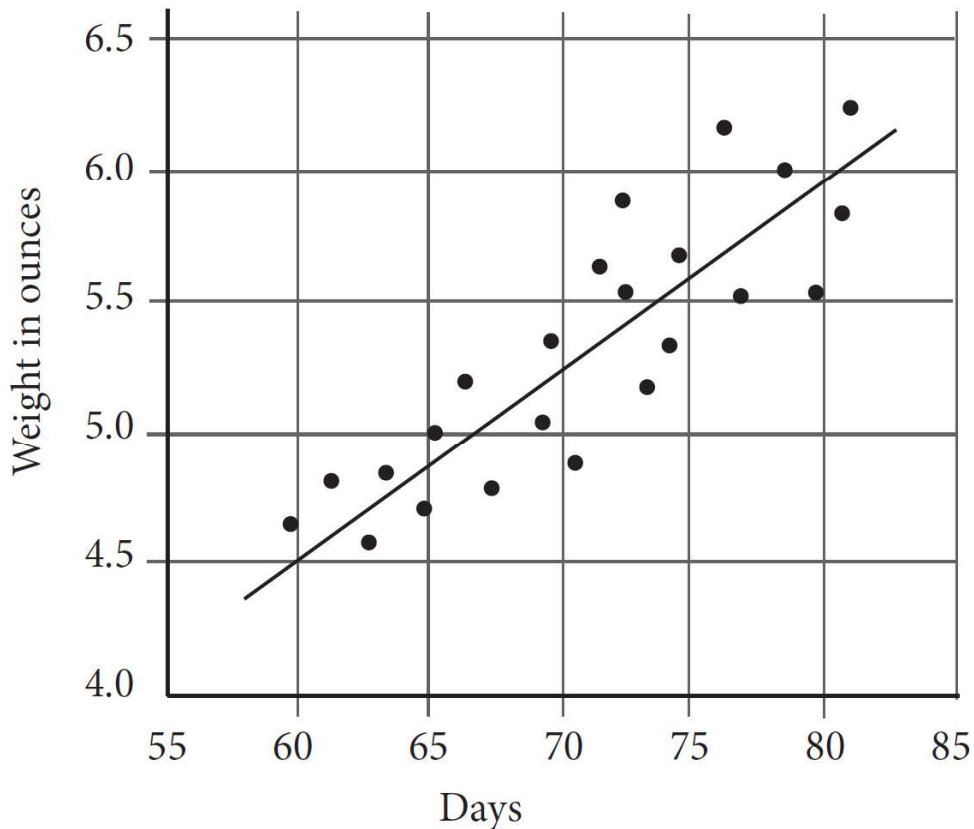
The number of degrees of arc in a circle is 360.

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

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

- 
1. The population,  $P$ , of Town  $Y$  since 1995 can be estimated by the equation  $P = 1.0635x + 3,250$ , where  $x$  is the number of years since 1995 and  $0 \leq x \leq 20$ . In the context of this equation, what does the number 1.0635 most likely represent?
- A) The estimated population of town  $Y$  in 1995
  - B) The estimated population of town  $Y$  in 2015
  - C) The factor by which the population of town  $Y$  increased yearly
  - D) The factor by which the population of town  $Y$  decreased yearly
2. If  $x^2 + 12x = 64$  and  $x > 0$ , what is the value of  $x$ ?
- A) 2
  - B) 4
  - C) 8
  - D) 16
3. Sai is ordering new shelving units for his store. Each unit is 7 feet in length and extends from floor to ceiling. Sai's store has 119 feet of wall space that includes 21 feet of windows along the walls. If the shelving units cannot be placed in front of the windows, which of the following inequalities includes all possible values of  $r$ , the number of shelving units that Sai could use?
- A)  $r \leq \frac{119 - 21}{7}$
  - B)  $r \geq \frac{119 + 21}{7}$
  - C)  $r \leq 119 - 21 + 7r$
  - D)  $r \geq 119 + 21 - 7r$

### Truffula Tree Fruit Weight



4. The scatterplot above shows the weight, in ounces, of the fruits on a certain truffula tree from days 55 to 85 after flowering. According to the line of best fit in the scatterplot above, which of the following is the closest approximation of the number of days after flowering of a truffula fruit that weighs 5.75 ounces?
- A) 63  
 B) 65  
 C) 77  
 D) 81
5. Hannah placed an online order for shirts that cost \$24.50 per shirt. A tax of 7% is added to the cost of the shirts, before a flat, untaxed shipping rate of \$6 is charged. Which of the following represents Hannah's total cost for  $s$  shirts, in dollars?
- A)  $0.07(24.50s + 6)$   
 B)  $1.07(24.50 + 6)s$   
 C)  $1.07(24.50s) + 6$   
 D)  $1.07(24.50 + s) + 6$
6. Once a certain plant begins to grow, its height increases at a linear rate. After six weeks, the plant is 54 centimeters tall. Which of the following functions best models the relationship between  $h(w)$ , the height, in centimeters, of the plant, and  $w$ , the number of weeks that the plant has been growing?
- A)  $h(w) = 6w$       B)  $h(w) = 9w$       C)  $h(w) = 54w$       D)  $h(w) = 54 + w$

7. Which of the following is equivalent to  $(12x^2 + 4x + 5y) + (3x^2 - 2x + 3y)$  ?

- A)  $2x^2 - 2x + 8y$
- B)  $2x^2 + 15x + 8y$
- C)  $15x^2 - 2x + 8y$
- D)  $15x^2 + 2x + 8y$

8. An advertisement for Royal Rat Rations states: “7 out of 8 veterinarians recommend Royal Rat Rations for your fancy rat.” No other information about the data is provided by the company.

Based on this data, which of the following inferences is most valid?

- A) Royal Rat Rations provides the best nutrition for fancy rats.
- B) If you do not feed your rat Royal Rat Rations, your rat will be unhealthy.
- C) Only one veterinarian does not recommend Royal Rat Rations for your fancy rat.
- D) Of the veterinarians surveyed by Royal Rat Rations, the majority recommend Royal Rat Rations for your fancy rat.

9.

$$\frac{1}{2}t + 4 = \frac{3}{4}t - 5$$

In the equation above, what is the value of  $t$  ?

- A) 4
- B) 9
- C) 18
- D) 36

10. Dogs need 8.5 to 17 ounces of water each day for every 10 pounds of their weight. Everett has two dogs—Ringo is a 35-pound black lab mix, and Elvis is a 55-pound beagle. Which of the following ranges represents the approximate total number of ounces of water,  $w$ , that Elvis and Ringo need in a week?

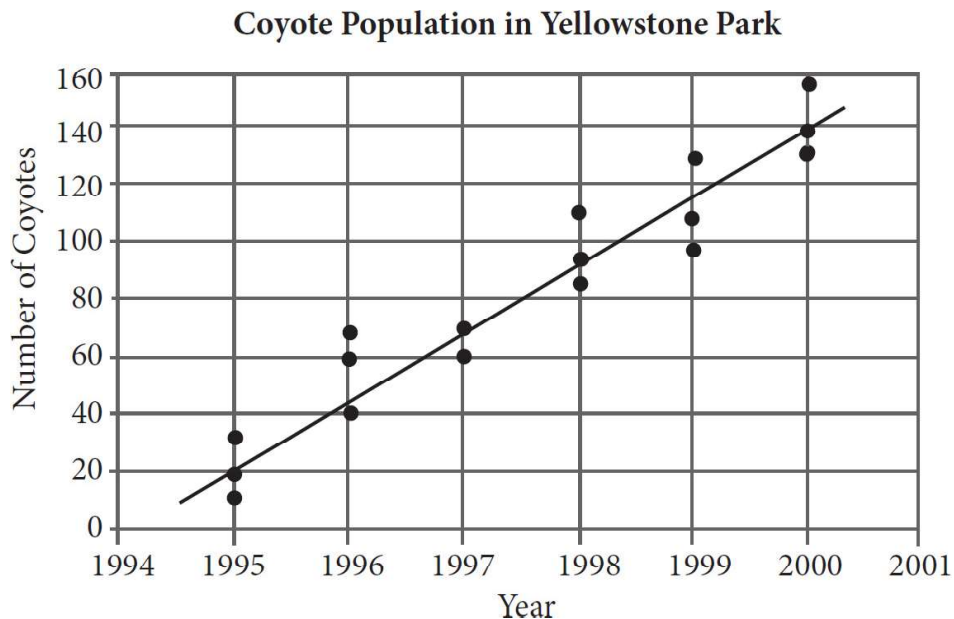
- A)  $77 \leq w \leq 153$
- B)  $109 \leq w \leq 218$
- C)  $536 \leq w \leq 1,071$
- D)  $765 \leq w \leq 1,530$

11. Priya is planning to send her favorite dry rub recipe to a friend who lives in France. Before sending the recipe, Priya wants to convert the American customary units in the instructions into metric units so that her friend will easily be able to understand the measurements. If the recipe calls for a ratio of four ounces of paprika to every seven ounces of chili powder, and if Priya's friend is planning to make a large batch of dry rub with 91 total ounces of chili powder, approximately how many total grams of paprika and chili powder will the recipe require? (1 ounce = 28.3 grams)
- A) 4,047 grams  
B) 4,521 grams  
C) 4,925 grams  
D) 5,149 grams
12. Luciano measured the amount of water that evaporated over a period of time from a container holding  $w$  ounces of water, where  $w$  is greater than 12. By the end of the first day, the cup had lost 2 ounces of water. By the end of the 7th day, the cup had lost an additional 8 ounces of water. By the end of the 11th day, the cup had lost half of the water that remained after the 7th day. Which of the following represents the remaining amount of water, in ounces, in Luciano's container at the end of the 11th day?
- A)  $\frac{w-2}{8}$   
B)  $\frac{w-2}{2} - 10$   
C)  $\frac{1}{2}w - 10$   
D)  $\frac{w-10}{2}$

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**Questions 13 and 14 refer to the following information.**

In the 1990s, the park rangers at Yellowstone National Park implemented a program aimed at increasing the dwindling coyote population in Montana. Results of studies of the coyote population in the park are shown in the scatterplot below.



13. Based on the line of best fit in the scatterplot above, which of the following is the closest to the average annual increase in coyotes in Yellowstone Park between 1995 and 2000 ?
- A) 22
  - B) 24
  - C) 26
  - D) 28
14. According to the data in the scatterplot, which of the following best represents the percent increase between the median of the results of the studies from 1995 and the median of the results of the studies from 1996 ?
- A) 50%
  - B) 100%
  - C) 150%
  - D) 200%
-

15. Bailey's Boutique Clothing is having a 20% off sale during which shirts cost \$30.00 and pants cost \$60.00. On the day of the sale, Bailey's sells  $\frac{2}{3}$  a total of 60 shirts and pants and earned a total of \$2,250. On a regular day, Bailey's sell the number of shirts and pants sold during the sale and earns a total of \$1,875. Solving which of the following systems of equations yields the number of shirts,  $s$ , and the number of pants,  $p$ , sold during a regular day?

A)  $s + p = 40$   
 $37.5s + 75p = 1,875$

B)  $s + p = 40$   
 $30s + 60p = 2,250$

C)  $s + p = 60$   
 $30s + 60p = 2,250$

D)  $s + p = 2,250$   
 $30s + 60p = 60$

16. Bryan, who works in a high-end jewelry store, earns a base pay of \$10.00 per hour plus a certain percent commission on the sales that he helps to broker in the store. Bryan worked an average of 35 hours per week over the past two weeks and helped to broker sales of \$5,000.00 worth of jewelry during that same two-week period. If Bryan's earnings for the two-week period were \$850.00, what percent commission on sales does Bryan earn?

A) 1%

B) 2%

C) 3%

D) 4%

17. If  $\frac{(C+x)}{x-3} = \frac{x+8}{3}$ , which of the following could be an expression of  $C$  in terms of  $x$ ?

A)  $3(1+x)$

B)  $x^2 + 2x - 24$

C)  $\frac{1}{3}(x+6)(x-4)$

D)  $\frac{1}{3}(x-3)(x+8)$

18. Lennon has 6 hours to spend in Ha Ha Tonka State Park. He plans to drive around the park at an average speed of 20 miles per hour, looking for a good trail to hike. Once he finds a trail he likes, he will spend the remainder of his time hiking it. He hopes to travel more than 60 miles total while in the park. If he hikes at an average speed of 1.5 miles per hour, which of the following systems of inequalities can be solved for the number of hours Lennon spends driving,  $d$ , and the number of hours he spends hiking,  $h$ , while he is at the park?

- A)  $1.5h + 20d > 60$   
 $h + d \leq 6$
- B)  $1.5h + 20d > 60$   
 $h + d \geq 6$
- C)  $1.5h + 20d < 60$   
 $h + d \geq 360$
- D)  $20h + 1.5d > 6$   
 $h + d \leq 60$

19. In a certain sporting goods manufacturing company, a quality control expert tests a randomly selected group of 1,000 tennis balls in order to determine how many contain defects. If this quality control expert discovered that 13 of the randomly selected tennis balls were defective, which of the following inferences would be most supported?

- A) 98.7% of the company's tennis balls are defective
- B) 98.7% of the company's tennis balls are not defective
- C) 9.87% of the company's tennis balls are defective
- D) 9.87% of the company's tennis balls are not defective

20. If  $-\frac{20}{7} < -3z + 6 < -\frac{11}{5}$ , what is the greatest possible integer value of  $9z - 18$  ?

- A) 6
- B) 7
- C) 8
- D) 9

21.

$$\begin{aligned} -24 - 8j &= 12k \\ 3 + \frac{5}{3}k &= -\frac{7}{6}j \end{aligned}$$

Which of the following ordered pairs  $(j, k)$  is the solution to the system of equations above?

- A) (6, -6)
- B) (3, 0)
- C) (0, 2)
- D) (-4, 1)



22.

United States Investment in  
Alternative Energy Sources

	Actual 2007 Investment	Projected 2017 Investment
Biofuels	0.31	0.34
Wind	0.40	0.32
Solar	0.27	0.30
Fuel Cells	0.02	0.04
Total	1.00	1.00

The table above shows the relative investment in alternative energy sources in the United States by type. One column shows the relative investment in 2007 of \$75 million total invested in alternative energy. The other column shows the projected relative investment in 2017 given current trends. The total projected investment in alternative energy in 2017 is \$254 million. Suppose that a new source of alternative energy, Cold Fusion, is perfected. It is projected that by 2017 that \$57 million will be invested in Cold Fusion in the United States, without any corresponding reduction in investment for any other form of alternative energy. What portion of the total investment of alternative energy in the United States will be spent on biofuels?

- A) 0.18
- B) 0.22
- C) 0.28
- D) 0.34

23.

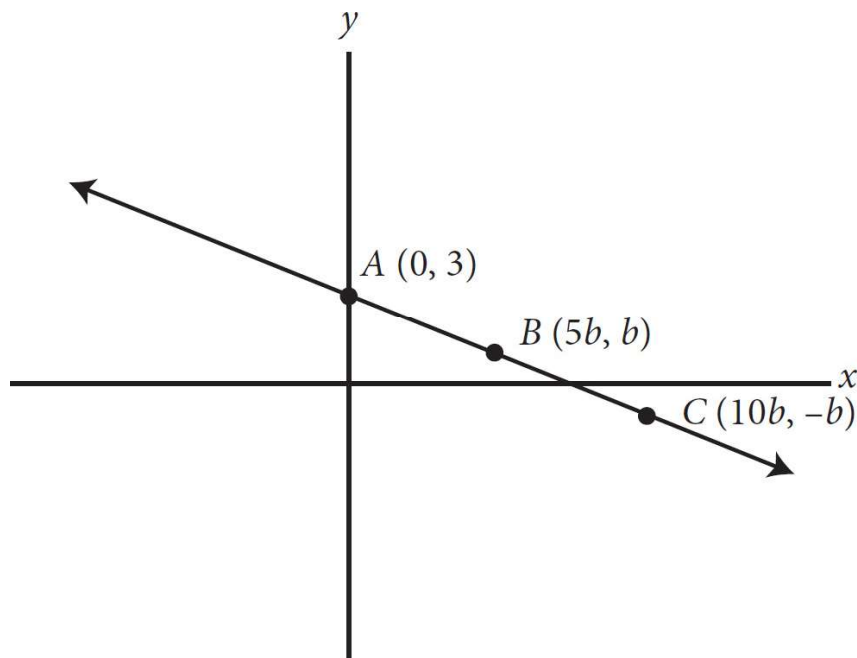
$$(x - 2)^2 + y^2 = 36$$

$$y = -x + 2$$

The equations above represent a circle and a line that intersects the circle across its diameter. What is the point of intersection of the two equations that lies in quadrant II?

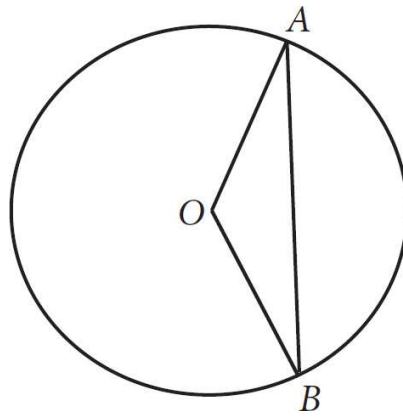
- A)  $(-3\sqrt{2}, 3\sqrt{2})$
- B)  $(-4, 2)$
- C)  $(2 + \sqrt{3}, 2)$
- D)  $(2 - 3\sqrt{2}, 3\sqrt{2})$

24.



The graph of  $f(x)$  is shown above in the  $xy$ -plane. The points  $(0, 3)$ ,  $(5b, b)$ , and  $(10b, -b)$  are on the line described by  $f(x)$ . If  $b$  is a positive constant, what are the coordinates of point  $C$ ?

- A)  $(5, 1)$
  - B)  $(10, -1)$
  - C)  $(15, -0.5)$
  - D)  $(20, -2)$
25. Melanie puts \$1,100 in an investment account that she expects will make 5% interest for each three-month period. However, after a year she realizes she was wrong about the interest rate and she has \$50 less than she expected. Assuming the interest rate the account earns is constant, which of the following equations expresses the total amount of money,  $x$ , she will have after  $t$  years using the actual rate?
- A)  $x = 1,100(1.04)^{4t}$
  - B)  $x = 1,100(1.05)^{4t - 50}$
  - C)  $x = 1,100(1.04)^{t/3}$
  - D)  $x = 1,100(1.035)^{4t}$



26. If the radius of the circle above is  $x$ ,  $\angle AOB = 120^\circ$ , and  $O$  is the center of the circle, what is the length of chord  $AB$  in terms of  $x$ ?

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

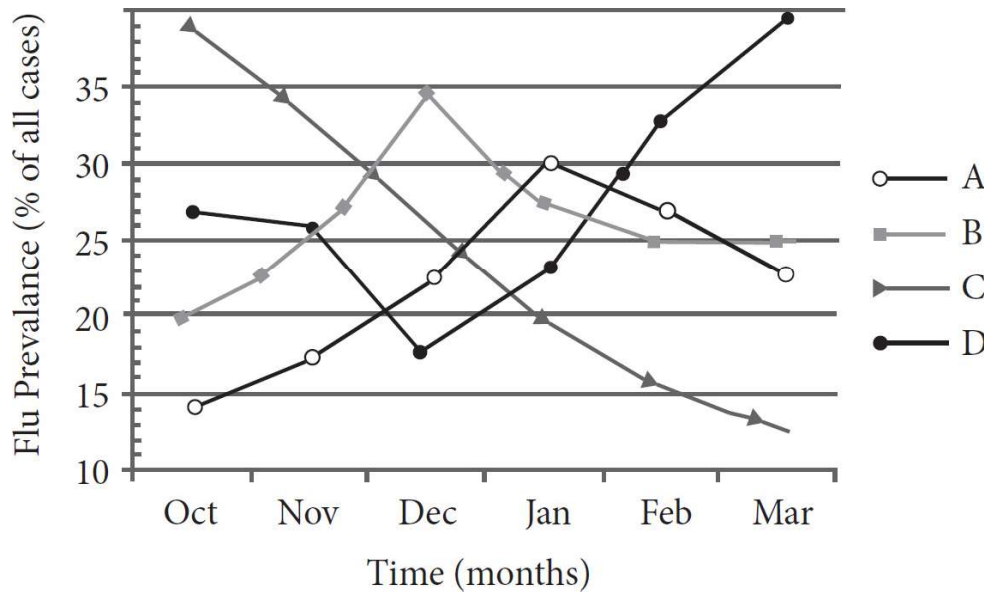
27. Students in a physics class are studying how the angle at which a projectile is launched on level ground affects the projectile's hang time and horizontal range. Hang time can be calculated using the formula  $t = \frac{2v \cdot \sin(\theta)}{g}$ , where  $t$  is the hang time in seconds,  $v$  is the initial launch velocity,  $\theta$  is the projectile angle with respect to level ground, and  $g$  is the acceleration due to gravity, defined as  $9.8 \text{ m/s}^2$ . Horizontal range can be calculated using the formula  $R = \frac{v^2 \sin(2\theta)}{g}$ , where  $R$  is the distance the projectile travels from the launch site, in feet. Which of the following gives the value of  $v$ , in terms of  $R$ ,  $t$ , and  $\theta$ ?

- A)  $v = \frac{2t \sin(\theta)}{R \sin(\theta)}$   
 B)  $v = \frac{2R \sin(\theta)}{t \sin(2\theta)}$   
 C)  $v = \frac{2R \sin(2\theta)}{t \sin(\theta)}$   
 D)  $v = \frac{2R \sin(2\theta)}{t \sin(\theta)}$

28. If  $(i^{413})(i^x) = 1$ , then what is one possible value of  $x$  ?
- A) 0
  - B) 1
  - C) 2
  - D) 3
29. The function  $g$  is defined by  $g(x) = 2x^2 - dx - 6$ , where  $d$  is a constant. If one of the zeros of  $g$  is 6, what is the value of the other zero of  $g$  ?
- A) 2
  - B)  $\frac{1}{2}$
  - C)  $-\frac{1}{2}$
  - D) -2
30. The flu shot for a flu season is created from four strains of the flu virus, named Strain A, B, C, and D, respectively. Medical researchers use the following data to determine the effectiveness of the vaccine over the flu season. Table 1 shows the effectiveness of the vaccine against each of these strains individually. The graph below the table shows the prevalence of each of these strains during each month of the flu season, represented as a percentage of the overall cases of flu that month.

Table 1

Strain	Effectiveness
A	35%
B	13%
C	76%
D	68%



For the strain against which the flu shot was the most effective, approximately how effective was the shot overall when that strain was least prevalent?

- A) 13%
- B) 20%
- C) 27%
- D) 48%

31. If  $9 > 3v - 3$ , what is the greatest possible integer value of  $v$  ?

32. In the expression  $\frac{\frac{6}{5}}{\frac{12}{2y} - \frac{5}{y}} = 1$ , what is the value of  $y$  ?

33. During a presidential election, a high school held its own mock election. Students had the option to vote for Candidate A, Candidate B, or several other candidates. They could also choose to spoil their ballot. The table below displays a summary of the election results.

	Candidate A	Candidate B	Other	Total
10 <sup>th</sup> grade	0.32	0.58	0.10	1.00
11 <sup>th</sup> grade	0.50	0.42	0.08	1.00
12 <sup>th</sup> grade	0.63	0.32	0.05	1.00
Total	0.48	0.44	0.08	1.00

614 students voted for Candidate A. Approximately how many students attend the school?

34. If  $\theta = \frac{12}{5}$ , then  $\cos \theta =$

35. Marcellus is traveling abroad in Ghana and using traveler's checks, which he has acquired from Easy Traveler's Savings Bank. Easy Traveler's Savings Bank charges a 7% fee on traveler's checks, which can then be used like cash at any location overseas at the same exchange rate, and any change will then be returned to Marcellus in local currency. For this trip, Marcellus bought a 651 Cedi traveler's check and paid a fee of 32.30 USD (United States dollars) for the check.

While in Ghana, Marcellus finds Leon's Pawnshop and Barter, which offers store credit for Marcellus's briefcase equal to its value in Cedis. If Marcellus's briefcase is worth 5,000 USD at the same exchange rate at which he bought his traveler's check, then how much store credit, to the closest Cedi, will Marcellus receive for the briefcase?

36. A square is inscribed in a circle. The area of the square is what percent of the area of the circle? (Disregard the percent symbol when gridding your answer.)

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Questions 37 and 38 refer to the following information.

Professor Malingowski, a chemist and teacher at a community college, is organizing his graduated cylinders in the hopes of keeping his office tidy and setting a good example for his students. He has beakers with diameters, in inches, of  $\frac{1}{2}$ ,  $\frac{3}{4}$ ,  $\frac{4}{5}$ , 1, and  $\frac{5}{4}$ .

37. Professor Malingowski notices one additional cylinder lying on the ground, and can recall certain facts about it, but not its actual diameter. If he knows that the value of the additional graduated cylinder's diameter,  $x$ , will not create any modes and will make the mean of the set equal to  $\frac{5}{6}$ , what is the value of the additional cylinder's diameter?
38. With his original five cylinders, Professor Malingowski realizes that he is missing a cylinder necessary for his upcoming lab demonstration for Thursday's class. He remembers that the cylinder he needs, when added to the original five, will create a median diameter value of  $\frac{9}{10}$  for the set of six total cylinders. He also knows that the measure of the sixth cylinder will exceed the value of the range of the current five cylinders by a width of anywhere from  $\frac{1}{4}$  inches to  $\frac{1}{2}$  inches, inclusive. Based on the above data, what is one possible value of  $y$ , the diameter of this missing sixth cylinder?

---

**S T O P**

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

### Section 3: Math (No Calculator)

- |      |      |       |                                    |
|------|------|-------|------------------------------------|
| 1. A | 6. B | 10. C | 16. $1.5$ or $\frac{3}{2}$         |
| 2. C | 7. C | 11. D | 17. 53                             |
| 3. D | 8. D | 12. B | 18. 10                             |
| 4. C | 9. B | 13. A | 19. $\frac{11}{3}$ or 3.66 or 3.67 |
| 5. C |      | 14. C | 20. 2                              |
|      |      | 15. D |                                    |

### Section 4: Math (Calculator)

- |       |       |       |                                      |                          |
|-------|-------|-------|--------------------------------------|--------------------------|
| 1. C  | 11. A | 21. A | 31. 3                                | 38. $1 \leq y \leq 1.25$ |
| 2. B  | 12. D | 22. C | 32. $\frac{5}{6}$ or 0.83            |                          |
| 3. A  | 13. B | 23. D | 33. 1,279                            |                          |
| 4. C  | 14. D | 24. B | 34. $\frac{5}{13}$ or 0.384 or 0.385 |                          |
| 5. C  | 15. A | 25. A | 35. 7,054                            |                          |
| 6. B  | 16. C | 26. B | 36. 63.6 or 63.7                     |                          |
| 7. D  | 17. C | 27. C | 37. $\frac{7}{10}$ or 0.7            |                          |
| 8. D  | 18. A | 28. D |                                      |                          |
| 9. D  | 19. B | 29. C |                                      |                          |
| 10. C | 20. C | 30. D |                                      |                          |



### Section 3: Math (No Calculator)

- 1. A** The vertex form of a parabola is  $y = a(x - h)^2 + k$ , where  $(h, k)$  denotes the vertex. Plug in the point  $(3, -3)$  into the vertex form to get  $y = a(x - 3)^2 - 3$ . The correct answer is (A).
- 2. C** You can plug in to make sense of this equation. Say that  $x = \$100$ . The amount of the keg would then be  $\$107 + \$17$ . The  $\$17$  must be the untaxed deposit since it is a flat fee rather than percentage based. Therefore, the tax is  $\$7$ , which is 7% of the original  $\$100$  base price. The answer is (C).
- 3. D** Whenever there are variables in the question, plug in. Be sure to plug in a number that is divisible by 3. Let  $d = 300$ .  $\frac{1}{3}$  of the original amount of  $\$300$  is  $\$100$ , and that is deducted by the company, leaving Syed with  $\$200$ . Now, subtract the wire transfer fee to get  $\$200 - \$30 = \$170$ , which is the target number. Plug in 300 for  $d$  in the answers to see which answer is equal to the target number of 170. In (A),  $\frac{1}{3}(300) - 30 = 70$ . This is not the target number, so eliminate (A). Likewise in (B),  $\frac{1}{3}(300 - 30) = 90$ , and in (C),  $\frac{2}{3}(300 - 30) = 180$ . Neither of these is the target number, so eliminate (B) and (C). In (D),  $\frac{2}{3}(300) - 30 = 170$ , which is the target number. The correct answer is (D).

4. **C** All of the answers are written in the slope-intercept form  $y = mx + b$ , where  $b$  is the  $y$ -intercept and  $x$  and  $y$  are points on the line. Eliminate (D) because the  $y$ -intercept in that equation is 2. For the remaining answer choices, plug in the  $x$ - and  $y$ -values to determine which equation works. If  $x = 1$  and  $y = 6$ , (A) becomes  $6 = \frac{1}{2}(1) + 4$ . Solve both sides of the equation to get  $6 = 4\frac{1}{2}$ . Eliminate (A). Choice (B) becomes  $6 = 1 + 4$ , so eliminate (B). Choice (C) becomes  $6 = 2(1) + 4$ , or  $6 = 6$ . Therefore, the correct answer is (C).
5. **C** Whenever there are variables in the question and the answer choices, think Plugging In. If 2 purchases were made, then  $p = 2$ , and the number of bonus points can be calculated as  $4(2) + 7 = 8 + 7 = 15$ . If the number of purchases were then increased by 3, the new  $p$  equals 5 and the number of bonus points can be calculated as  $4(5) + 7 = 27$ . The bonus points increased by  $27 - 15 = 12$ . Therefore, the correct answer is (C).
6. **B** This is a good Plug In the Answers problem. Start with (B) and plug in 2 for  $x$  and 3 for  $r$  in the equation to get  $V = 24\pi + 2\left(\frac{4}{3}\pi 3^3\right)$ , which is equal to the target amount of  $96\pi$ , so (B) is correct.
7. **C** Whenever there are variables in the question and in the answers, think Plugging In. Let  $c = 30$ . Therefore,  $b = 2 + \frac{1}{3}(30) = 2 + 10 = 12$ . Plug 12 in for  $b$  in the answers to see which answer equals the target number of 30. Choice (A) becomes  $\frac{12 - 2}{3} = \frac{10}{3} = 3.\bar{3}$ . Eliminate (A), since it does not equal the target number. Choice (B) becomes  $\frac{12 + 2}{3} = \frac{14}{3} = 4.\bar{6}$ . Eliminate (B). Choice (C) becomes  $3(12 - 2) = 3(10) = 30$ . Keep (C), but check (D) just in case it also works. Choice (D) becomes  $3(12 - 6) = 3(6) = 18$ . Eliminate (D). The correct answer is (C).
8. **D** Treat this question as a translation problem. According to the question,  $R(h) =$  four rotations per second less than three times the square of the height of the liquid. The height of the liquid is represented by  $h$ . Therefore, three times the square of the height of the liquid  $= 3h^2$ . Four less than this amount is  $3h^2 - 4$ . Since the original speed was 1,000, subtract this value from 1,000 to get the current rate of rotation. The correct answer is (D).

9. **B** Start with the easier equation and use Process of Elimination. The easier equation is related to the total number of ounces,  $c + b$ , in the tube. According to the question, the tube has 24 ounces, so  $c + b = 24$ . Eliminate (A), since it does not include this equation. The other equation in the set is related to the amount of active ingredients. According to the question,  $c$  includes 0.25% of sodium fluoride and  $b$  contains 0.30% triclosan.  $0.25\% = 0.0025$  and  $0.30\% = 0.003$ . Therefore, in the correct equation,  $c$  should be associated with 0.0025 and  $b$  should be associated with 0.003. Eliminate (C) and (D) because both of these equations get the percentages wrong. The correct answer is (B).

10. **C** Whenever the question includes variables and the answer choices are numbers, think Plugging In the Answers. In (A),  $d = -4$ , and the equation

becomes  $\frac{2(-4)^2 - (-4) - 10}{(-4)^2 + 7(-4) + 10} = \frac{(-4)^2 - 4(-4) + 3}{(-4)^2 + 2(-4) - 15}$ . Solve both sides of the equation to get  $\frac{2(16) + 4 - 10}{16 - 28 + 10} = \frac{16 + 16 + 3}{16 - 8 - 15}$ , or  $\frac{26}{-2} = \frac{35}{-7}$ . Reduce both

fractions to get  $-13 = -5$ . This is not true, so eliminate (A). In (B),  $d = 2$ , and

the equation becomes  $\frac{2(2)^2 - 2 - 10}{2^2 + 7(2) + 10} = \frac{2^2 - 4(2) + 3}{2^2 + 2(2) - 15}$ . Solve both sides of

the equation to get  $\frac{2(4) - 2 - 10}{4 + 14 + 10} = \frac{4 - 8 + 3}{4 + 4 - 15}$ , or  $\frac{-4}{28} = \frac{-1}{-7}$ . Reduce both

fractions to get  $\frac{-1}{7} = \frac{1}{7}$ . Eliminate (B). In (C),  $d = 4$  and the equation

becomes  $\frac{2(4)^2 - 4 - 10}{4^2 + 7(4) + 10} = \frac{4^2 - 4(4) + 3}{4^2 + 2(4) - 15}$ . Solve both sides of the equation

to get  $\frac{2(16) - 4 - 10}{16 + 28 + 10} = \frac{16 - 16 + 3}{16 + 8 - 15}$ , or  $\frac{18}{54} = \frac{3}{9}$ . Reduce both fractions to get

$\frac{1}{3} = \frac{1}{3}$ . The correct answer is (C).

11. **D** All the answer choices are equal to 4 (which is  $r^2$ , making  $r = 2$ ), so you need to focus on where the center of the circle lies. If the circle is tangent to both the  $x$  axis (which is equivalent to the line  $y = 0$ ) and the line  $x = 4$ , then the center must be 2 units from  $y = 0$  and 2 units from  $x = 4$ . Choices (A) and (B) both have centers with an  $x$  value of  $-2$  (remember the standard form of the circle equation is  $(x - h)^2 + (y - k)^2 = r^2$ , where  $(h, k)$  is the center and  $r$  is the radius), which is 6 units from  $x = 4$ . Eliminate (A) and (B). Choice (C) has a center at  $(2, -4)$ . The  $x$  value is 2 units from  $x = 4$ ; however, the  $y$  value is 4 units from  $y = 0$ . Eliminate (C) and choose (D).

12. **B** According to the question, Reactant A does not react unless B gets to a certain concentration. Therefore, the correct answer will have an initial flat line for A while the line for B is rising. Only graph (B) shows this initial relationship. Therefore, the correct answer is (B).
13. **A** All of the answers have the same lines graphed, so this question is really about the shading. Plugging In is probably the easiest way to approach this problem. Start with (0, 0) because this is an easy value to check. This works in all three equations since  $0 \leq 8$ ,  $-3 \leq 0$ , and  $1 \geq 0$ . Therefore, this value needs to be shaded as a possible answer. Eliminate (B), (C), and (D) because they do not include this point. The correct answer is (A).
14. **C** First draw lines  $AC$  and  $BD$ . Now, since tangent is opposite over adjacent,  $\frac{BA}{BC} = \frac{4}{9}$ . Also,  $BA \times BC = 324$ . Using these two equations as a system of equations can now help get what is needed. Rearrange the first equation by multiplying both sides by  $BC$  to get  $BA = \frac{4}{9}BC$ . Now substitute  $\frac{4}{9}BC$  into the first equation to get  $\frac{4}{9}BC (BC) = 324$ ; this simplifies to  $\frac{4}{9}BC^2 = 324$ . Multiply both sides by  $\frac{9}{4}$  to get  $BC^2 = 729$ , and then take the square root to get  $BC = 27$ . Since the diagonal has to be larger than any of the sides, (A) and (B) are out. Choice (D) can also be eliminated because our previous calculations can get the length of  $DC$ , which is used in the Pythagorean theorem to get  $BD$ . Therefore, the correct answer is (C).
15. **D** Whenever there are variables in the question and answers, think Plugging In.

If  $m = 2$ , the expression becomes

$$\frac{2(2) + 6}{4} \times \frac{6(2) - 36}{3(2) + 9} = \frac{4 + 6}{4} \times \frac{12 - 36}{6 + 9} = \frac{-24}{15} = \frac{10}{4} \times \frac{-240}{60} = -4. \text{ Plug 2}$$

in for  $m$  in the answers to see which answer equals the target number of  $-4$ .

$$\text{Choice (A) becomes } \frac{12(2)^2 - 216}{12(2) + 36} = \frac{12(4) - 216}{24 + 36} = \frac{48 - 216}{60} = \frac{-168}{60} = -$$

2.8. This does not match the target number, so eliminate (A). Choice (B)

$$\text{becomes } \frac{8(2) - 30}{3(2) + 13} = \frac{16 - 30}{6 + 13} = \frac{-14}{19}. \text{ Eliminate (B). Choice (C) becomes}$$

$$\frac{2 - 6}{4} = \frac{-4}{4} = -1. \text{ Eliminate (C). Choice (D) becomes } m - 6 = 2 - 6 = -4. \text{ The}$$

correct answer is (D).

16. **1.5**

or  $\frac{3}{2}$

Plug the given values into the equation:  $18 = (3)(4)(x)$ . Multiply the right side of the equation and you find that  $18 = 12x$ . Divide both sides by 12 and you find that  $x = \frac{18}{12}$ . Both 18 and 12 are divisible by 6, so this fraction reduces to  $\frac{3}{2}$ .

17. **53** Jean charges  $5.50 \times 2 = \$11$  per hour for babysitting. Therefore, her entire earnings for three hours can be calculated as  $(3 \times 11) + 20 = 53$ . The correct answer is 53.

18. **10** To solve the problem without a graphing calculator, set the two equations equal to each other:  $-x^2 + 5x + 6 = x + 12$ . Multiply the entire equation by 2 to get  $-2x^2 + 10x + 12 = -x + 24$ . Rewrite the equation so that it equals 0, so it becomes  $-2x^2 + 11x - 12 = 0$ . Multiply the entire equation by  $-1$  to get  $2x^2 - 11x + 12 = 0$ . Factor the quadratic to get  $(2x - 3)(x - 4) = 0$ . Solve for the two possible values of  $x$ : If  $2x - 3 = 0$ , then  $x = \frac{3}{2}$ , and if  $x - 4 = 0$ , then  $x = 4$ . Because the slope of the line is negative, the  $x$ -value of the point that is farthest to the right along the  $x$ -axis must also be closer to the  $x$ -axis. Plug 4 in for  $x$  in the second equation to get  $y = -\frac{1}{2}(4) + 12 = -2 + 12 = 10$ . The correct answer is 10.

19.  $\frac{11}{3}$

or **3.66** or

**3.67**

Whenever there are two equations with the same two variables, they can be solved simultaneously by adding or subtracting them. Take the second

equation and rewrite it so that the variables are on the left side of the equation:  $17r + 22v = 63$ . Stack the equations and add them together.

$$\begin{array}{r} 13r + 8v = 47 \\ \underline{17r + 22v = 63} \\ 30r + 30v = 110 \end{array}$$

Divide the entire equation by 30 to get  $r + v = \frac{110}{30}$ . This is too big to grid in, so reduce it to  $\frac{11}{3}$ .

20. **2** The area of the current plot is  $4 \times 6 = 24$  square feet, so the new plot will be  $24 \times 2 = 48$  square feet. According to the question,  $x$  feet will be added to each side to obtain the new area of 48 feet. Since the length is only 2 feet more than the width, you need two factors of 48 that differ by 2. You may recognize these factors are 6 and 8. So the increase was 2 feet in each direction. Alternatively, you could write a quadratic:  $(4 + x)(6 + x) = 48$ . Expand the right side of the equation to get  $x^2 + 10x + 24 = 48$ . Set the equation to 0 by subtracting 48 from both sides to get  $x^2 + 10x - 24 = 0$ . Factor the equation to get  $(x + 12)(x - 2) = 0$ . Therefore,  $x = -12$  or  $x = 2$ . Since lengths can never be negative the only possible value is  $x = 2$ . The correct answer is 2.

#### Section 4: Math (Calculator)

- 1. C** Use Process of Elimination to answer this question. According to the question,  $P$  represents the population, so the outcome of the entire equation has something to do with the population. Therefore, eliminate both (A) and (B) because 1.0635 can't represent the population if  $P$  does. In the equation given, the only operations are multiplication and addition, which means that over time the population would increase. Therefore, eliminate (D). The correct answer is (C).
- 2. B** To solve the quadratic equation, first set the equation equal to 0. The equation becomes  $x^2 + 12x - 64 = 0$ . Next, factor the equation to get  $(x + 16)(x - 4) = 0$ . Therefore, the two possible solutions for the quadratic equation are  $x + 16 = 0$  and  $x - 4 = 0$ , so  $x = -16$  or 4. Since the question states that  $x > 0$ ,  $x = 4$  is the only possible solution. Another way to approach this question is to plug in the answers. Start with (B),  $x = 4$ . Plug 4 into the equation to get  $4^2 + 12(4) = 64$ . Solve the left side of the equation to get  $16 + 48 = 64$ , or  $64 = 64$ . Since this is a true statement, the correct answer is (B).

3. **A** To figure out the total number of shelving units Sai could use, find the total available wall space and divide by the length of the units. The total amount of wall space can be calculated as  $119 - 21$ . Because the length of each unit is 7 feet, the maximum number of units Sai could put up can be calculated as  $\frac{119 - 21}{7}$ . Because this is the maximum number of units Sai could put up,  $r$  has to be less than or equal to this number. Therefore, the correct answer is (A).
4. **C** Weight is shown on the vertical axis of the graph, given in ounces. Make your own mark indicating 5.75 on this axis; then draw a horizontal line from that mark to the line of best fit. Once you hit it, draw a vertical line straight down to the horizontal axis. It should hit between 75 and 80 days, slightly closer to the mark for 75. This makes (C) the credited response. Draw your lines carefully, using your answer sheet as a straightedge if necessary.
5. **C** Whenever the question includes variables, plug in. If  $s = 2$ , the shirts cost 2 ( $\$24.50$ ) =  $\$49$ . The tax on the shirts is  $0.07(\$49) = \$3.43$ . So, the shirts with tax and the  $\$6$  shipping fee cost  $\$49 + \$3.43 + \$6 = \$58.43$ . Plug in 2 for  $s$  in the answers to see which answer equals the target number of  $\$58.43$ . In (A),  $0.07[24.50(2) + 6] = 3.85$ . This is not the target number, so eliminate (A). In (B),  $1.07(24.50 + 6)(2) = 65.25$ . Again, this is not the target number, so eliminate (B). In (C),  $1.07[24.50(2)] + 6 = 58.43$ . This is the target number, so keep it, but be sure to check the remaining answer choice. In (D),  $1.07(24.50 + 2) + 6 = 34.355$ , which is not the target number. Therefore, the correct answer is (C).
6. **B** The question states that after 6 weeks the plant is 54 centimeters tall. Therefore, when  $w = 6$ ,  $h(w) = 54$ . Plug in 6 for  $w$  in the answers to see in which answer  $h(w)$  equals the target number of 54. In (A)  $h(w) = 6(6) = 36$ . Eliminate (A). In (B),  $h(w) = 9(6) = 54$ . The correct answer is (B).
7. **D** Because the operation between the parentheses is addition, the parentheses can be removed, and the resulting expression becomes  $12x^2 + 4x + 5y + 3x^2 - 2x + 3y$ . Reorder the terms so that like terms are next to each other:  $12x^2 + 3x^2 + 4x - 2x + 5y + 3y$ . Combine like terms to get  $15x^2 + 2x + 8y$ . The correct answer is (D).
8. **D** You do not know how the survey is conducted, nor do you know how many veterinarians were surveyed (it may be the case that only 8 were surveyed). Therefore, you cannot infer that the survey accurately measures all veterinarians' beliefs about Royal Rat Rations. Choice (A) is not supported.

First, you do not know what veterinarians believe in general, and second veterinarians may be recommending Royal Rat Rations for a reason other than its nutrition. Choice (B) is similarly not supported. Besides not knowing veterinarians' beliefs, this choice assumes that no other rat food is acceptable. Choice (C) is not supported because you do not know the sample size of the survey, nor is there any indication that there is only one veterinarian who does not recommend Royal Rat Rations. Choice (D) is the credited response. You know the opinions only of the veterinarians surveyed by Royal Rat Rations.

9. **D** Use a calculator to translate the fractions into decimals.  $\frac{1}{2}t + 4 = \frac{3}{4}t - 5$  becomes  $0.5t + 4 = 0.75t - 5$ . Subtract  $0.5t$  from both sides to get  $4 = 0.25t - 5$ , and then add 5 to both sides. This results in  $9 = 0.25t$ . Use a calculator to divide!  $t = 36$ ; therefore, the correct answer is (D).
10. **C** Taking the two dogs together, Everett has  $35 + 55 = 90$  pounds of dog. Set up the following proportion to determine the lowest amount of water the dogs need per day:  $\frac{8.5 \text{ ounces}}{10 \text{ lbs}} = \frac{x}{90 \text{ lbs}}$ . Cross-multiply to get  $10x = 765$ , so  $x = 76.5$ . Multiply by 7 days to get the weekly amount of water the dogs need:  $76.5 \times 7 = 535.5$  ounces, or approximately 536 ounces. Only (C) includes 536 as the low-end amount. Therefore, the correct answer is (C).
11. **A** In order to answer this question, you need to deal with the ratio as well as the unit conversion. For the large batch of dry rub, Priya's friend is planning to use 91 ounces of chili powder. Since the paprika and the chili powder must be used in a ratio of 4 to 7, you can set up a proportion to determine how much paprika is needed:  $\frac{4}{7} = \frac{x}{91}$ . Cross-multiply and solve for  $x$  to determine that  $x$  (i.e., paprika) = 52 ounces. So you have 52 ounces of paprika and 91 ounces of chili powder for a total of 143 ounces. Multiply that by your conversion number, 28.3, to determine that this is equivalent to 4,046.9 grams, which is closest to (A).
12. **D** Whenever there are variables in the problem and in the answer choices, plug in. If  $w = 20$ , then Luciano's cup has  $20 - 2 = 18$  ounces at the end of day 1. At the end of 7 days, Luciano's cup would have  $18 - 8 = 10$  ounces. After 11



days, Luciano's cup would hold  $10 - 5 = 5$  ounces. Plug in 20 for  $w$  in the answer choices to see which answer is equal to the target number of 5. Choice (A) becomes  $\frac{20 - 2}{8} = \frac{18}{8} = 2.25$ . This does not match the target number of 5, so eliminate (A). Choice (B) becomes  $\frac{20 - 2}{2} - 10 = \frac{18}{2} - 10 = 9 - 10 = -1$ . Eliminate (B). Choice (C) becomes  $\left(\frac{1}{2}\right)(20) - 10 = 10 - 10 = 0$ . Eliminate (C). Choice (D) becomes  $\frac{20 - 10}{2} = \frac{10}{2} = 5$ . This matches the target number; therefore, the correct answer is (D).

13. **B** According to the line of best fit, in 1995 there were 20 coyotes in the park. In 2000, there were 140 coyotes in the park. This is an increase of 120 coyotes over a period of 5 years, so  $\frac{120}{5} =$  an average increase of 24 coyotes per year, which is (B).
14. **D** The median number of coyotes in the park in 1995 was 20, and the median number of coyotes in the park in 1996 was 60. (Be careful to RTFQ: the question wants median, NOT line of best fit!) In order to calculate the percent increase, it is necessary to use the percent change formula:  $\frac{\text{difference}}{\text{original}} \times 100$ . The calculation here will be  $\frac{60 - 20}{20} \times 100 = \frac{40}{20} \times 100 = 2 \times 100 = 200\%$ , which is (D).
15. **A** Start with the easier equation and use Process of Elimination. The easier equation is related to the total number of shirts and pants,  $s + p$ , sold on a regular day. The question states that on a regular day Bailey's sells  $\frac{2}{3}$  the number of pants and shirts sold during a sale.  $\frac{2}{3}(60) = 40$ . Therefore, one of the equations in the correct answer should be  $s + p = 40$ . Eliminate (C) and (D) since neither of these answers include this equation. The other equation is related to the money Bailey's earns on a regular day. According to the question, Bailey's earns a total of \$1,875 on a regular day, so the equation must equal \$1,875. Eliminate (B) because the total in the money equation is incorrect. The correct answer is (A).

16. **C** There are a few different ways to approach this question. In any approach, the best first step is to figure out how much income Bryan earned during the two-week period without the commission. Since he worked an average of 35 hours per week for two weeks, he worked a total of 70 hours. At a rate of \$10.00 per hour base pay, this would add up to \$700.00 ( $70 \times 10 = 700$ ). Since Bryan's earnings were actually \$850.00, that means he must have earned \$150.00 of commission ( $850 - 700 = 150$ ). At this point, you can calculate the percent commission algebraically or simply work backwards from the answers. Algebraically, you know that \$150.00 is equal to a certain percent of \$5,000.00 in sales, which can be represented as follows:  $150 = \frac{x}{100}(5,000)$ . Solve for  $x$ , and you get 3, which is (C). If instead you wish to work backwards from the answers, you can take the answers and calculate what 1%, 2%, etc. of \$5,000.00 would be, and then add that back to \$700.00 to see which choice matches your target of \$850.00: (C).
17. **C** Cross-multiply to get  $3(C + x) = (x - 3)(x + 8)$ . Expand the right side of the equation to get  $3(C + x) = x^2 + 5x - 24$ . Distribute the 3 to get  $3C + 3x = x^2 + 5x - 24$ . Subtract  $3x$  from both sides of the equation to get  $3C = x^2 + 2x - 24$ . Factor the right side of the equation to get  $3C = (x + 6)(x - 4)$ . Divide both sides by 3 to get  $C = \frac{(x + 6)(x - 4)}{3} = \frac{1}{3}(x + 6)(x - 4)$ . The correct answer is (C).
18. **A** Start with the easiest piece of information first, and use Process of Elimination. Given that  $h$  is the number of hours spent hiking and  $d$  is the number of hours driving, the total number of hours Lennon spends in the park can be calculated as  $h + d$ . The question states that Lennon has up to 6 hours to spend in the park—"up to" means  $\leq$ . So,  $h + d \leq 6$ . Eliminate (B), (C), and (D). The correct answer is (A).
19. **B** The quality control expert discovered that 13 out of 1,000 randomly selected tennis balls were defective.  $\frac{13}{1000} = 0.013$ , which is equivalent to 1.3%. This means that  $100 - 1.3 = 98.7\%$  of tennis balls tested were not defective, and this data most supports answer (B).

20. **C** When solving inequalities, the natural impulse is to isolate the variable. In this case, though, look at what the question is asking. The question doesn't want you to find just the value of  $z$  but rather the value of  $9z - 18$ . To get from the value of  $-3z + 6$  given in the inequality to this new value, the original inequality must be multiplied by  $-3$ . Just multiply the entire inequality by this value, making sure to flip the inequality signs when multiplying by a negative number. The equation becomes  $-3\left(-\frac{20}{7}\right) > -3(-3z + 6) > -3\left(-\frac{11}{5}\right)$  or  $\frac{60}{7} > 9z - 18 > \frac{33}{5}$ . The question asks for the greatest possible integer value, so focus on the high end of the given values. The value at that end,  $\frac{60}{7}$ , equals 8.57, so the greatest integer less than that is 8. The answer is (C).
21. **A** Whenever there are variables in the question and numbers in the answer choices, think Plugging In the Answers. In (A),  $j = 6$ , and  $k = -6$ . Plug these two values into the first equation to get  $-24 - 8(6) = 12(-6)$ . Solve for both sides of the equation to get  $-24 - 48 = -72$ , or  $-72 = -72$ . Therefore, the values work for the first equation. Plug the values into the second equation to get  $3 + \frac{5}{3}(-6) = -\frac{7}{6}(6)$ . Solve both sides of the equation to get  $3 + (-10) = -7$ , or  $-7 = -7$ . Since the values given in (A) work in both equations, the correct answer is (A).
22. **C** First, you know the new proportion must be less than the current 0.34 for biofuels (because the total amount spent on alternative energy is increasing, but the amount spent on biofuels is remaining the same), so you can eliminate (D). Next, determine the amount that will be spent on biofuels in 2017 by multiplying 0.34 by the total of \$254 million:  $0.34 \times 254 = \$86.36$  million. Because 57 million new dollars will be spent on alternative energy, the new total will be  $254 + 57 = \$311$  million. Divide \$86.36 million by \$311 million to get the new proportion:  $\frac{86.36}{311} = 0.28$ , which is (C).

23. **D** In quadrant II, the  $x$ -coordinate is negative, and the  $y$ -coordinate is positive. Therefore, eliminate (C). Whenever the question includes variables and the answers are numbers, think Plugging In the Answers. Of the remaining answers, (B) is easiest to work with. In (B), the  $x$ -value is  $-4$  and the  $y$ -value is  $2$ . Plug these values into the second equation to get  $-4 = -2 + 2$ . Given that this is not a true statement, eliminate (B). Try the values in (A) in the second equation to get  $3\sqrt{2} = -(-3\sqrt{2}) + 2$ . This is also not true, so the correct answer is (D).
24. **B** Right away, (A) can be eliminated, since point  $C$  has a negative  $y$ -coordinate. Given any two points, the slope of the line can be determined using the equation  $\frac{y_2 - y_1}{x_2 - x_1}$ . Use this formula to find the value of  $b$  by setting the slope of  $\overline{AB}$  equal to the slope of  $\overline{BC}$ . Use points  $(0, 3)$  and  $(5b, b)$  in the left side of the equation and points  $(5b, b)$  and  $(10b, -b)$  in the right side of the equation to get  $\frac{3 - b}{0 - 5b} = \frac{-b - b}{10b - 5b}$ . Simplify both sides of the equation to get  $\frac{3 - b}{-5b} = \frac{-2b}{5b}$ , or  $\frac{3 - b}{-5b} = \frac{-2}{5}$ . Cross-multiply to get  $5(3 - b) = 10b$ . Divide both sides by  $5$  get  $3 - b = 2b$ , then  $3 = 3b$ , and finally  $b = 1$ . Plug in  $b = 1$  for point  $C$  to get  $[10(1), - (1)]$ , or  $(10, -1)$ . Therefore, the correct answer is (B).
25. **A** The formula for compound interest is  $A = P(1 + r)^t$ , where  $P$  is the starting principle,  $r$  is the rate expressed as a decimal, and  $t$  is the number of times the interest is compounded. Melanie received less than 5% interest, so you can eliminate (B) because  $1.05 = 1 + 0.05$ , indicating she was receiving 5% interest. You can also eliminate (C) because over the course of a year the interest is compounded 4 times, not  $\frac{1}{3}$  of a time. Because Melanie invested \$1,100 at what she thought was 5% compounded 4 times (12 months in a year  $\div$  3 months per period), she expected  $1,100(1 + 0.05)^4 = \$1,337.06$  after a year. Instead, she has  $1,337.06 - 50 = \$1,287.06$  after one year. Because  $t$  is in years in the answer choices, make  $t = 1$  in (A) and (D) and eliminate any choice which does not equal 1,287.06. Only (A) works.
26. **B** You can start by Plugging In a value for  $x$ ; try  $x = 4$ . Because angle  $AOB$  is  $120^\circ$  and the triangle is isosceles, angles  $A$  and  $B$  are each  $30^\circ$ . Cut triangle  $AOB$  in half to make two 30-60-90 triangles with a hypotenuse of 4 and sides of 2 and  $2\sqrt{3}$ . The side with length  $2\sqrt{3}$  lies on chord  $AB$ . Double it to get the

total length:  $4\sqrt{3}$  or just  $\sqrt{3}x$ , which is (B) when you put  $x = 4$  into the answer choices.

27. **C** Whenever there are variables in the question and in the answers, think Plugging In. The question states the value of  $g$ , but it is a constant and a weird one at that. Pick numbers for all the variables that will make the math

more straightforward. If  $v = 4$  and  $g = 2$ , then

$$t = \frac{2(4) \cdot \sin(\theta)}{2} = \frac{8 \cdot \sin(\theta)}{2} = 4 \cdot \sin(\theta), \quad \text{and}$$

$$R = \frac{4^2 \cdot \sin(2\theta)}{2} = \frac{16 \cdot \sin(2\theta)}{2} = 8 \cdot \sin(2\theta). \quad \text{Plug these values into the}$$

answers to see which equation works. Choice (A) becomes

$$4 = \frac{4 \cdot \sin(\theta) \cdot \sin(\theta)}{2[8 \sin(2\theta) \sin(\theta)]}. \quad \text{Simplify the right side of the equation to get}$$

$$4 = \frac{4 \cdot \sin(\theta) \cdot \sin(\theta)}{16 \sin(2\theta) \sin(\theta)}, \quad \text{or } 4 = \frac{\sin(\theta)}{4 \sin(2\theta)}. \quad \text{This will not simplify further, so}$$

eliminate (A). Choice (B) becomes  $4 = \frac{2[4 \sin(\theta)] \sin(\theta)}{8 \sin(2\theta) (\sin(\theta))}$ . Simplify the right

side of the equation to get  $4 = \frac{8 \sin(\theta) (\sin(\theta))}{8 \sin(2\theta) (\sin(\theta))}$  or  $4 = \frac{\sin(\theta)}{\sin(2\theta)}$ . Eliminate

(B). Choice (C) becomes  $4 = \frac{2[8 \sin(2\theta)] \sin(\theta)}{(4 \sin(2\theta)) (\sin(2\theta))}$ . Distribute the 2 to get

$$4 = \frac{16 \sin(2\theta) \sin(\theta)}{(4 \sin(\theta)) (\sin(2\theta))}. \quad \text{Reduce the equation to get } 4 = \frac{16}{4} \quad \text{or } 4 = 4. \quad \text{The}$$

correct answer is (C).

28. **D**  $i^a = 1$  when  $a$  is a multiple of 4. Using your exponents rules,  $413 + x$  must also be a multiple of 4. Plug in the answers and look for what makes  $413 + x$  a multiple of 4. Only (D) works.

29. **C** The zero of  $g$  is the value of the variable, in this case  $x$ , when the equation is set to 0. This is also called the root or solution of an equation. Set the equation to 0 to get  $0 = 2x^2 - dx - 6$ . Plug 6 in for  $x$  to get  $0 = 2(6^2) - d(6) - 6$ . Simplify the equation to get  $0 = 72 - 6d - 6$ , or  $0 = 66 - 6d$ . Solve for  $d$  to get  $-66 = -6d$ , so  $11 = d$ . Plug 11 in for  $d$  and set the quadratic to 0 to get  $0 =$

$2x^2 - 11x - 6$ . Factor the equation to get  $0 = (x - 6)(2x + 1)$ . The other zero of the equation is when  $2x + 1 = 0$ . Solve for  $x$  to get  $2x = -1$ , or  $x = \frac{-1}{2}$ . The correct answer is (C).

30. **D** The flu shot is most effective against Strain C, which is least prevalent in March. To determine the overall efficacy of the flu shot at this time, multiply the prevalence of each strain of flu by the efficacy of the flu shot against that strain, and then add those products to get a weighted average of the efficacy of the shot:  $(0.23 \times 0.35) + (0.25 \times 0.13) + (0.13 \times 0.76) + (0.39 \times 0.68) = 0.477 = 47.7\%$ , which is closest to (D).

31. **3** Solve the equation for  $v$ . Take  $9 > 3v - 3$  and add 3 to both sides to get  $12 > 3v$ . Now divide both sides by 3 to find that  $4 > v$ . Therefore, the largest integer that  $v$  could be is 3. Grid in 3.

32.  $\frac{5}{6}$   
or **0.83**

Start by multiplying the second fraction in the denominator of the equation

by  $\frac{2}{2}$  to get  $\frac{\frac{6}{5}}{\frac{12}{2y} - \frac{10}{2y}} = 1$ . Combine the fractions in the denominator to get

$\frac{\frac{6}{5}}{\frac{2}{2y}} = 1$ . Reduce the fraction in the denominator to get  $\frac{\frac{6}{5}}{\frac{1}{y}} = 1$ . Dividing by a

number is the same as multiplying by its reciprocal, so the equation becomes

$\frac{6}{5} \times y = 1$ . Multiply both side of the equation by  $\frac{5}{6}$  to get  $y = \frac{5}{6}$ . The correct answer is  $\frac{5}{6}$ .

33. **1,279** 614 students voting for Candidate A represents 0.48 of the population out of

1. Set up a proportion:  $\frac{0.48}{1.00} = \frac{614}{x}$ , where  $x$  is the total number of students

in the school. Cross-multiply:  $0.48x = 614$ . Divide both sides by 0.48 and you get approximately 1,279.

34.  $\frac{5}{13}$  or **0.384** or **0.385**

Draw a right triangle and label a non-right angle  $\theta$ . SOHCAHTOA tells you that tangent is  $\frac{\text{opposite}}{\text{adjacent}}$ , so the leg opposite  $\theta$  is 12 and the leg adjacent to  $\theta$  is 5. Cosine is  $\frac{\text{adjacent}}{\text{hypotenuse}}$ , so you need to find the hypotenuse of the triangle. You can use the Pythagorean theorem, or you can recognize this as a 5-12-13 Pythagorean triplet. The hypotenuse is therefore 13. The leg adjacent to  $\theta$  is still 5, so  $\cos \theta = \frac{5}{13}$ .

35. **7,054** First, you need to determine the current exchange rate. The 7% fee is the same (relative to the exchange rate), whether it was applied to the Cedi or USD. Therefore, 7% of 651 Cedi is equal to 32.30 USD. Translate English to math:  $0.07(651) = 32.30$ , or  $45.57 \text{ Cedi} = 32.30 \text{ USD}$ . Next, you want the value of an item worth 5,000 USD in Cedi, so set up a proportion:  $\frac{45.57 \text{ Cedi}}{32.30 \text{ USD}} = \frac{x \text{ Cedi}}{5,000 \text{ USD}}$ . Cross-multiply:  $(45.57)(5,000) = 32.30x$ , or  $227,850 = 32.30x$ . Divide both sides by 32.30 and you get  $x = 7,054.18 \text{ USD}$ , which rounds to 7,054.

36.

**63.6** or

**63.7**

First, draw a square inscribed in a circle. Because the diameter of the circle is equal to the diagonal of the square, you can plug in a number like  $2\sqrt{2}$  for the length of the diameter. Because the diameter forms a  $45^\circ$ - $45^\circ$ - $90^\circ$  triangle, each side of the square has a length of 2. Using the area formula for a square ( $A = s^2$ ), plug in 2 for the  $s$  to get  $A = 2^2$ , which simplifies to  $A = 4$ . The area of the square is 4. To find the area of the circle, use the formula  $A =$

$\pi r^2$ . Because the diameter of the circle is  $2\sqrt{2}$ ,  $r = \sqrt{2}$ . Plug that into the area formula to see that  $A = \pi(\sqrt{2})^2$ , which simplifies to become  $A = 2\pi$ . To find the solution to the problem, translate what you are being asked from English into math. The area of the square is what percent of the area of the circle becomes:  $4 = \frac{x}{100} 2\pi$ . Solve for  $x$ : First, divide each side by  $2\pi$ , and then multiply each side by 100. The answer is a non-repeating decimal beginning 63.66197...When entering your answer, simply cut off the decimal (do not round) so it takes up four spaces. You should enter 63.6.

37.  $\frac{7}{10}$  or **0.7**

If the mean of the new set is  $\frac{5}{6}$ , then the sum of the diameters of the cylinders divided by the number of cylinders must equal  $\frac{5}{6}$ . Set up the

equation:  $\frac{5}{6} = \frac{\frac{1}{2} + \frac{3}{4} + \frac{4}{5} + 1 + \frac{5}{4} + x}{6}$ , where  $x$  is the unknown cylinder.

Multiply both sides by 6 to simplify:  $5 = \frac{1}{2} + \frac{3}{4} + \frac{4}{5} + 1 + \frac{5}{4} + x$ . Combine like terms (use your calculator, but be careful with parentheses!):  $5 = \frac{43}{10} + x$ .

Subtract  $\frac{43}{10}$  from both sides and you get  $\frac{7}{10}$ .

38.  **$1 \leq y \leq 1.25$**

A set with an even number of elements will have as its median the average of the middle two terms. In the current set,  $\frac{4}{5}$  and 1 have an average of  $\frac{9}{10}$ , so

the new cylinder must be equal to or greater than 1, so the median will be the average of  $\frac{4}{5}$  and 1. The range of the set of five cylinders is the greatest minus

the least:  $\frac{5}{4} - \frac{1}{2} = \frac{3}{4}$ . Because the new cylinder must be  $\frac{1}{4}$  inches to  $\frac{1}{2}$  greater than  $\frac{3}{4}$ , the cylinder must be between 1 and  $\frac{5}{4}$  inches in diameter.





## Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

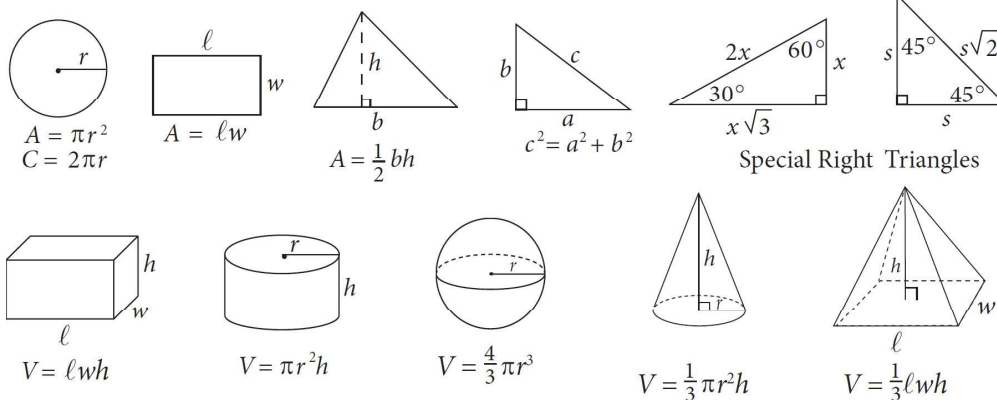
### DIRECTIONS

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



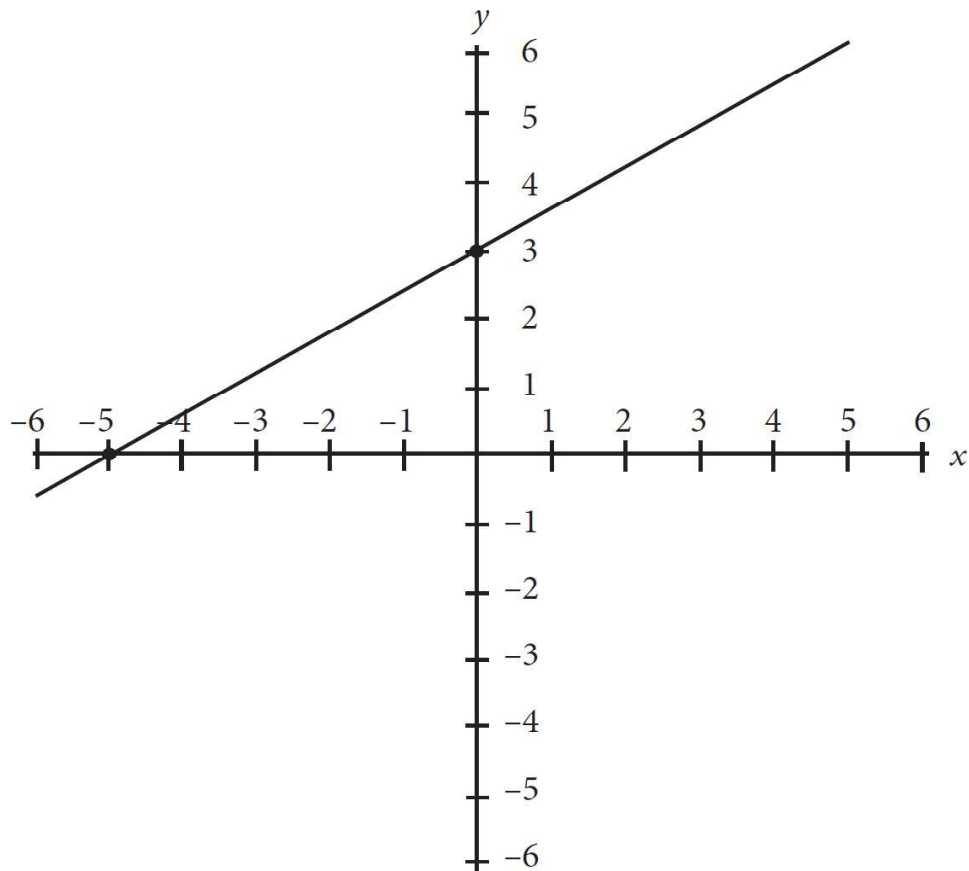
The number of degrees of arc in a circle is 360.

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

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

- 
1. If two times a number is equal to that number minus 4, what is the number?
- A) -7  
B) -6  
C) -4  
D) -3
2. The number of soil samples,  $s$ , that Sonal needs for an experiment must be greater than 6 but less than or equal to 13. Which of the following represents an acceptable number of soil samples for Sonal's experiment?
- A)  $6 < s < 13$   
B)  $6 \leq s < 13$   
C)  $6 < s \leq 13$   
D)  $6 \leq s \leq 13$

3.



In the figure above, the graph of  $y = f(x)$  is shown. Which of the following could be the equation of  $f(x)$  ?

A)  $f(x) = -\frac{3}{5}x + 3$

B)  $f(x) = -\frac{3}{5}x - 3$

C)  $f(x) = \frac{3}{5}x - 3$

D)  $f(x) = \frac{3}{5}x + 3$

4. If  $x + y = 0$ , which of the following must be equivalent to  $x - y$  ?

A)  $-2y$

B)  $\frac{x}{y}$

C)  $x$

D)  $x^2$

5. Which of the following is equivalent to  $2x^2 - 6x - 8$  ?

A)  $2(x - 4)(x + 1)$

B)  $3(x + 4)(x - 1)$

C)  $2(x - 3)(x + 2)$

D)  $3(x - 4)(x - 2)$

6. Ryan and Allison build a ramp to help their elderly cat, Simms, walk up to their bed. They need the ramp to make a  $35^\circ$  angle with their bedroom floor. How long must the ramp be to reach the top of their bed that is exactly three feet off the ground?

A)  $\frac{\sin 35^\circ}{3}$

B)  $\frac{\sin 55^\circ}{3}$

C)  $\frac{3}{\sin 55^\circ}$

D)  $\frac{3}{\sin 35^\circ}$

7. If  $3a + 2b = 24$  and  $4a + 5b = 53$ , what is the value of  $a + b$  ?

A) 2

B) 7

C) 9

D) 11

8. Given the equation  $y = 3x^2 + 4$ , what is the function of the coefficient of 3 ?
- A) It moves the graph of  $y = 3x^2 + 4$  three units higher than the graph of  $y = x^2 + 4$ .
  - B) It moves the graph of  $y = 3x^2 + 4$  three units lower than the graph of  $y = x^2 + 4$ .
  - C) It makes the graph of  $y = 3x^2 + 4$  wider than the graph of  $y = x^2 + 4$ .
  - D) It makes the graph of  $y = 3x^2 + 4$  narrower than the graph of  $y = x^2 + 4$ .
9. Steven needs to buy  $t$  theme park tickets for himself and his family. Each ticket costs \$80, and the number of tickets he needs to buy can be modeled by the expression  $t^2 - 4t - 90 = 6$  when  $t > 0$ . What is the total cost of the theme park tickets that Steven purchased?
- A) \$640
  - B) \$800
  - C) \$960
  - D) \$1,120

10.

$$\begin{aligned}2c + 3d &= 17 \\6c + 5d &= 39\end{aligned}$$

In the system of linear equations above, what is the value of  $4c - 4d$  ?

- A) -4
  - B) 1
  - C) 4
  - D) 13
11. If  $x^2 + 2xy + y^2 = 64$  and  $y - x = 12$ , which of the following could be the value of  $x$  ?
- A) -10
  - B) -4
  - C) 2
  - D) 10

12. Samantha offers two different packages of yoga classes at her yoga studio. She offers two hot yoga sessions and three zero gravity yoga sessions at a total cost of \$400. She also offers four hot yoga sessions and two zero gravity sessions at a price of \$440. Samantha wants to offer a larger package for long-time clients in which the cost must exceed \$800. If Samantha does not wish to include more than 13 sessions for the long-time client package, will she be able to create this package for her clients?
- A) No, because the closest package that she can offer consists of three hot yoga and three zero gravity yoga sessions.
  - B) No, because the closest package that she can offer consists of four hot yoga and four zero gravity yoga sessions.
  - C) Yes, because she can offer five hot yoga and five zero gravity yoga sessions.
  - D) Yes, because she can offer six hot yoga and six zero gravity yoga sessions.
13. Cuthbert is conducting a chemistry experiment that calls for a number of chemicals to be mixed in various quantities. The one amount of which he is unsure is grams of potassium,  $p$ . If Cuthbert is certain that  $(3p^2 + 14p + 24) - 2(p^2 + 7p + 20) = 0$ , what is one possible value of  $3p + 6$ , the exact number of grams of potassium that Cuthbert would like to use for this experiment?
- A) 20
  - B) 18
  - C) 12
  - D) 10
14. What is the value of  $(2 + 8i)(1 - 4i) - (3 - 2i)(6 + 4i)$  ?  
(Note:  $i = \sqrt{-1}$ )
- A) 8
  - B) 26
  - C) 34
  - D) 50
15. If  $2\sqrt{x} = x - 3$ , which of the following is the solution set for  $x$  ?
- A)  $\{-1, 9\}$
  - B)  $\{1, -9\}$
  - C)  $\{9\}$
  - D)  $\{1, 9\}$

16. A group of students at Omega High School are using staples and popsicle sticks to build a scale model of the Great Wall of China as part of a project detailing China's military history. The number of staples the students will need is three times the number of popsicle sticks they will need. If the students determine they need 84 staples for this particular project, how many popsicle sticks will they need?
17. A standard parabola in the  $x,y$ -coordinate plane intersects the  $x$ -axis at  $(5, 0)$  and  $(-5, 0)$ . What is the value of the  $x$ -coordinate of this parabola's line of symmetry?
18. Danielle is a civil engineer for Dastis Dynamic Construction, Inc. She must create blueprints for a wheelchair accessible ramp leading up to the entrance of a mall that she and her group are building. The ramp must be exactly 100 feet in length and make a  $20^\circ$  angle with the level ground. What is the horizontal distance, in meters, from the start of the ramp to the point level with the start of the ramp immediately below the entrance of the mall, rounded to the nearest meter? (Disregard units when inputting your answer.)  
(Note:  $\sin 20^\circ \approx 0.324$ ,  $\cos 20^\circ \approx 0.939$ ,  $\tan 20^\circ \approx 0.364$ )
19. If twice a number is equal to that number minus five, what is three times that number plus seventeen minus that number?
20. Given that the equation  $3x^2 + 2x - 8 = 0$  has two distinct solutions, what is the value of the smaller solution subtracted from the larger solution?



## Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

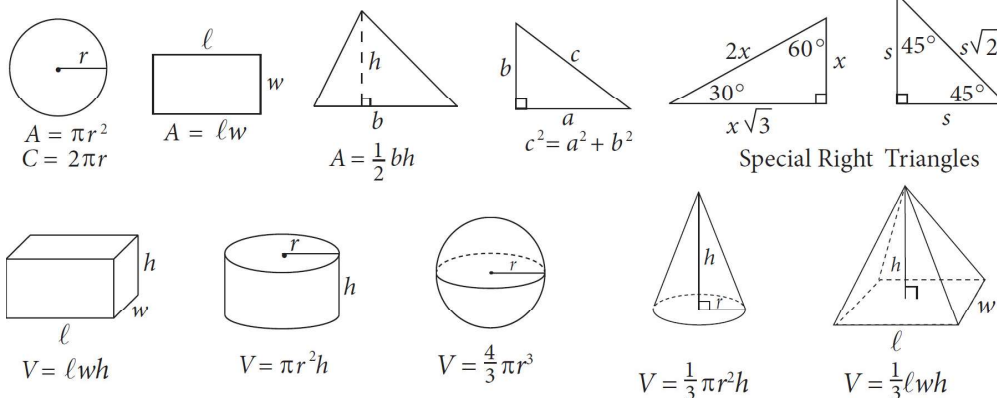
### DIRECTIONS

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

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

### REFERENCE



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

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

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

- 
1. If  $3y = y + 2$ , what is the value of  $2y$  ?
- A) 1
  - B) 2
  - C) 3
  - D) 4
2. Merry joined an online community that charges a monthly fee of \$15. A one-time enrollment fee of \$50 was charged when she joined. Which of the following represents the total amount of fees that Merry has paid to the community organizers after  $m$  months, in dollars?
- A)  $15m + 50$
  - B)  $15 + 50m$
  - C)  $15m - 50$
  - D)  $(15 + 50)m$
3. Rob has his favorite guitar tuned up and ready to bring to a performance by his cover band at a local venue Saturday. He decides at the last minute to bring  $x$  additional guitars, just in case his favorite guitar has an issue. If the total number of guitars that Robert brings to the performance can be modeled as  $x + 1$ , what does the “+ 1” account for in the expression?
- A) It accounts for an additional guitar that Rob returns to his house and picks up in the middle of the performance.
  - B) It accounts for his favorite guitar, which Rob was bringing from the beginning.
  - C) It accounts for the number of additional guitars that Rob decided to bring.
  - D) It accounts for an additional non-guitar musical instrument that Rob decided to bring.
4. A group of 24 students was polled as to whether they enjoy biology class, chemistry class, both, or neither. The results are shown in the table below:

	<b>Biology</b>	<b>Chemistry</b>
<b>Enjoy</b>	14	18
<b>Don't Enjoy</b>	10	6

Given the above data, which of the following conclusions is true?

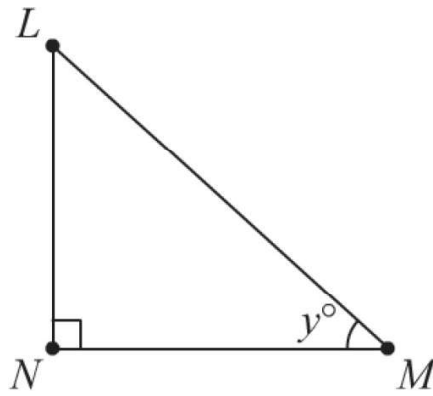
- A) The ratio of those who enjoy biology class to those who enjoy chemistry class is 7:8.
- B) The ratio of those who enjoy chemistry class to those who don't enjoy chemistry class is 9:4.
- C) The ratio of those who enjoy biology class to those who don't enjoy chemistry class is 7:2.
- D) The ratio of those who don't enjoy biology class to those who enjoy chemistry class is 5:9.



5. Dr. Goldberg, a noted dietician, mixes different solutions as part of her research into sugar substitutes. By weight, she mixes 40% of a sample of substitute A and 70% of a sample of substitute B to create substitute C. If Dr. Goldberg initially had 60 grams of substitute A and 110 grams of substitute B, then what would be the weight, in grams, of substitute C ?
- A) 24
  - B) 77
  - C) 101
  - D) 170
6. Which of the following is equivalent to the expression  $x^4 - x^3 - x^2$  ?
- A)  $x(x^2 - x - 1)$
  - B)  $x(x - x^2 - x^3)$
  - C)  $x(x^3 - x^2)$
  - D)  $x^2(x^2 - x - 1)$
7. Officer Blake drives his squad car 1 mile per minute while patrolling local highways during his shift. If he has driven 480 miles by the end of his shift, how many total hours did he drive his car at the above rate?
- A) 8
  - B) 12
  - C) 16
  - D) 20
8. In the inequality  $37 \leq -2x + 1$ , what is the appropriate order of steps needed to solve the inequality for  $x$  ?
- A) Add 1 to both sides, divide both sides by 2, and flip the inequality sign to  $\geq$ .
  - B) Subtract 1 from both sides, divide both sides by  $-2$ , and flip the inequality sign to  $\geq$ .
  - C) Add 1 to both sides, divide both sides by  $-2$ , and keep the original inequality sign.
  - D) Subtract 1 from both sides, divide both sides by 2, and keep the original inequality sign.
9. What is the value of  $(2x^2 + 4x + 8) - (2x^2 - 4x + 7)$  ?
- A)  $4x^2 + 8x + 15$
  - B)  $2x^2 + x + 1$
  - C)  $8x + 1$
  - D)  $8x + 15$

10. As part of a project for his cartography elective, Adam climbs several hills to create a relief map for the woods surrounding his house. He records the vertical heights of the five hills he climbed at 55 feet, 42 feet, 38 feet, 50 feet, and 48 feet. For his project, Adam must convert his measurements to inches. If 1 foot = 12 inches, what is the measurement, in inches, of the *tallest* hill Adam will have on his map?
- A) 660  
B) 600  
C) 576  
D) 456

11.



In the figure above, if  $y = 40$  and  $\overline{LN} = 8$ , which of the following most closely approximates the length of  $\overline{MN}$ ?

- A) 0.10  
B) 9.53  
C) 10.44  
D) 12.45
12. McCoy Max Speed, Inc. makes custom skateboards for its customers. Two wooden skateboards and three composite skateboards cost \$650. Three wooden skateboards and one composite skateboard cost \$450. How much would McCoy Max Speed charge a customer who purchases five wooden skateboards and four composite skateboards?
- A) \$500  
B) \$600  
C) \$1,000  
D) \$1,100

13. The chart below shows data about the number of employees at Cuda Cola, a popular beverage company.

	2012	2013	2014
Total Employees	1,670	1,890	2,110
Percent Male	65%	60%	55%
Percent Female	35%	40%	45%

Assuming the employee total grows at the same rate each year, and male and female percentages continue to decrease and increase by 5%, respectively, approximately how many male employees will work at Cuda Cola in 2015 ?

- A) 1,515  
B) 1,398  
C) 1,282  
D) 1,165
14. John Croxley, the mayor of Black Rock, NY, is counting the number of restaurants that have opened in his town per month for the last seven months. He compiles the seven numbers into Set F, which contains the elements 4, 5, 11, 13, 16, 18, and  $x$ . If both the median and average (arithmetic mean) of Set F equal 11, what must be the value of  $x$ , the unknown number of restaurants that opened in Mayor Croxley's town last month?
- A) 9  
B) 10  
C) 11  
D) 12

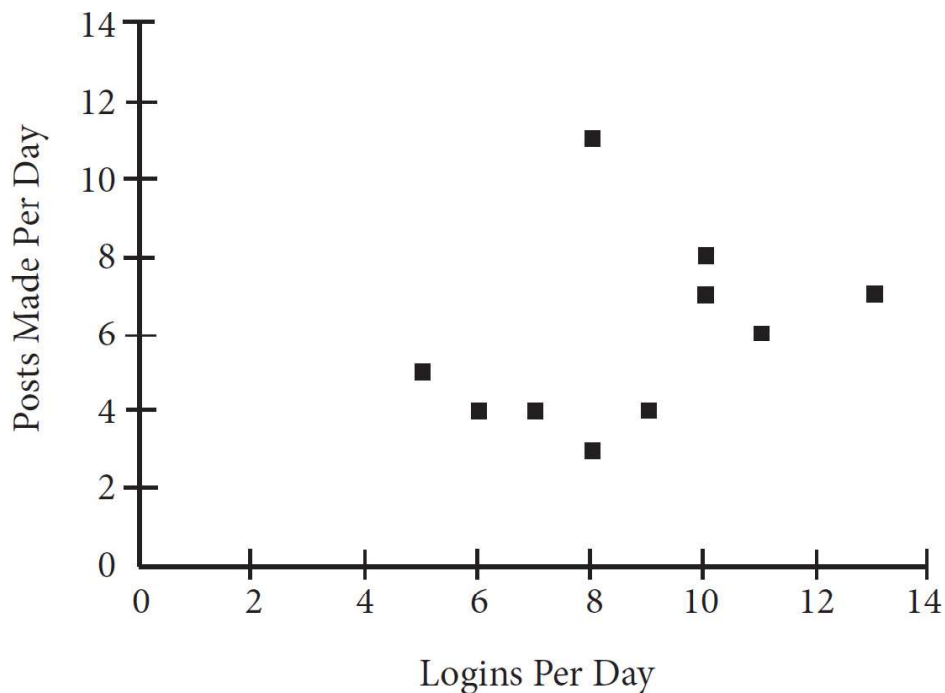
15.

$$\begin{aligned}17s + 20t &= 59 \\30s + 40t &= 110\end{aligned}$$

In the system of equations above, what is the value of  $t$  in terms of  $s$  ?

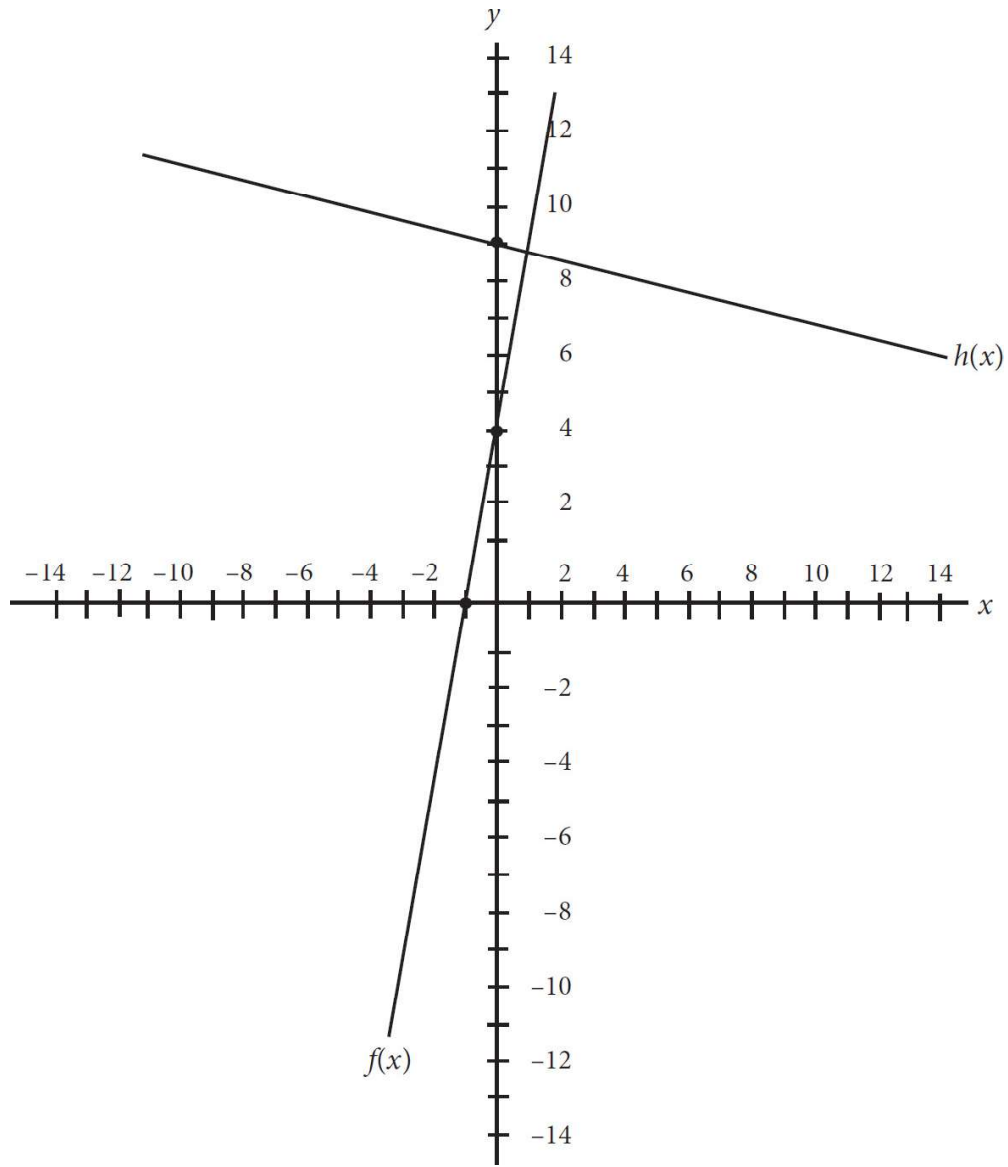
- A)  $\frac{2s}{5}$   
B)  $\frac{s}{5}$   
C)  $\frac{5}{2s}$   
D)  $\frac{5}{s}$

16.



Given the scatterplot graph above, ten students at Welton Academy were polled at random about their usage of the school's new physics-centered social media app, E = MC Shared. The app was developed to encourage students to discuss physics curricula and concepts in ways that mirrored social media trends in 2013. Students were asked how many times they logged into the app each day as well as how many posts they actually made using the app. With the given data, what conclusions can be drawn about this group of students?

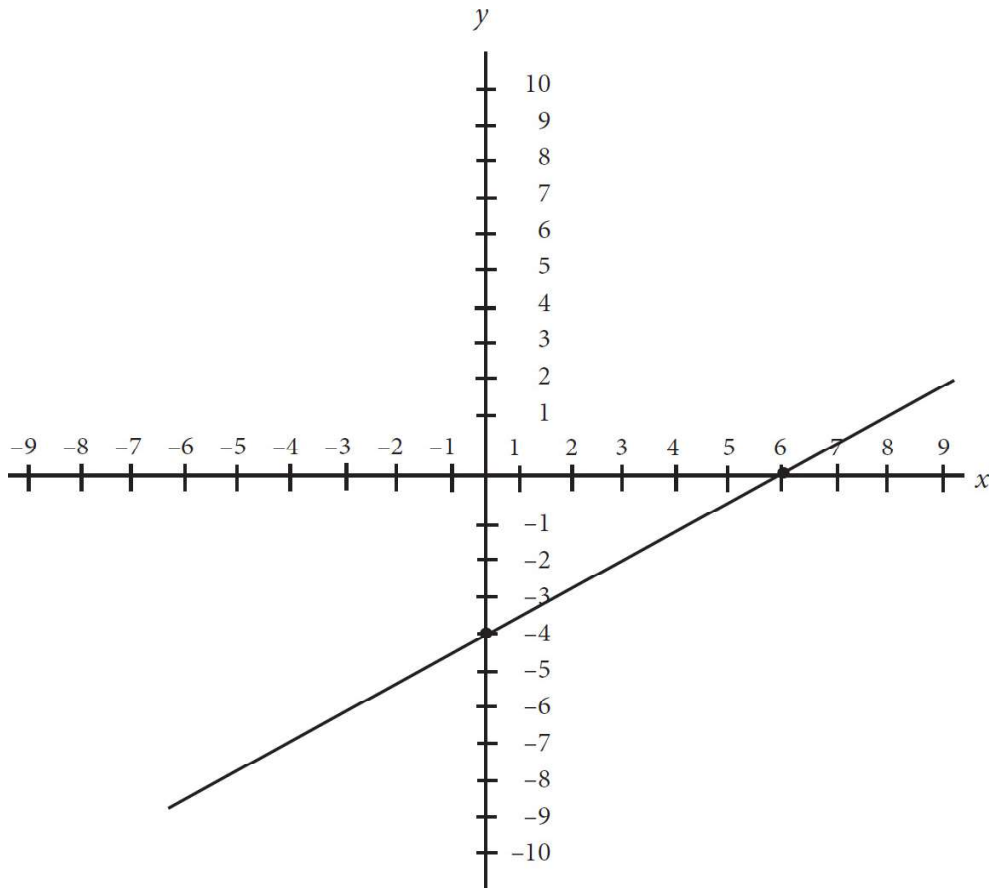
- A) The majority of students polled logged in more times per day than they posted.
- B) The majority of students polled posted more times per day than they logged in.
- C) The majority of students polled logged in and posted an equal number of times.
- D) No relationship can be drawn between logins per day and posts per day.



17. Two graphs,  $f(x)$  and  $h(x)$ , are shown above. If  $f(x) = 3x + 4$  and  $f(x)$  and  $h(x)$  are perpendicular, which of the following could be the equation of  $h(x)$  ?

- A)  $h(x) = \frac{1}{3}x + 9$
- B)  $h(x) = -\frac{1}{3}x + 9$
- C)  $h(x) = 3x + 9$
- D)  $h(x) = -3x + 9$

18. The number of eggs that Farmer Jones has in his chicken coop will grow exponentially as Farmer Jones buys more chickens to increase production. The number of eggs Farmer Jones has in the coop can be modeled by the equation  $y = 3^x$  beginning on Day 1, where  $x$  is given by  $x = 1$ , and  $y$  is the number of eggs currently in the coop. If the coop can support only 4,000 eggs, and Farmer Jones empties the coop every day, on which day will the chickens produce too many eggs for the coop to support?
- A) Day 6
  - B) Day 7
  - C) Day 8
  - D) Day 9
19. If  $a = \frac{4a^2}{16}$  and  $a$  is a nonzero integer, which of the following is equivalent to  $a$ ?
- A)  $4a$
  - B)  $4\sqrt{a}$
  - C)  $\sqrt{2a}$
  - D)  $2\sqrt{a}$
20. Three different chefs work together to prepare meals for 280 dinner guests. Each works at a different speed, and their combined output throughout the night is modeled by the equation  $8x + 4x + 2x = 280$ . If  $x$  is a positive integer, which of the following could  $8x$  represent in the equation?
- A) The total meal output by the slowest chef, who made 40 meals.
  - B) The total meal output by the fastest chef, who made 160 meals.
  - C) The total meal output by the fastest chef, who made 80 meals.
  - D) The difference between the output between the slowest and fastest chef, which would be 120 meals.



21. The graph,  $y = f(x)$ , shown above models the performance of a certain crop, where  $x$  is the nutrients subtracted or added to the soil and  $y$  is the gain or loss of pieces of fruit added to the total harvest. A more powerful fertilizer that is used causes the graph  $y = f(x)$  to be reflected over the line  $y = x$ . Which of the following best describes the behavior of the crop with the new fertilizer?
- A) For every three nutrients added to the soil, the crop loses two additional fruits for the total harvest.
  - B) For every two nutrients added to the soil, the crop loses two additional fruits for the total harvest.
  - C) For every three nutrients added to the soil, the crop adds two additional fruits to the total harvest.
  - D) For every two nutrients added to the soil, the crop adds three additional fruits to the total harvest.

22. George and Joe both interview the same 20 fellow students regarding their interest in their school's new Model UN Club. George asked the students to respond with Interested, Sort of Interested, and Not Interested. Joe asked the students to rate their interest on a scale of 1 to 5. The results of the polls are below.

**George's Poll**

<b>Response</b>	<b>Number of Students</b>
Interested	8
Sort of Interested	5
Not Interested	7

**Joe's Poll**

<b>Rating</b>	<b>Number of Students</b>
1	5
2	4
3	3
4	4
5	4

After reviewing the data, the Model UN advisors determine that Joe neglected to include whether a 1 or 5 was the best rating in his report. What additional piece of information would most help the advisor determine whether a 1 or 5 was the best rating?

- A) Requesting that George redo his poll with the same rating system as Joe's poll.
  - B) Requesting that Joe redo his poll with the same rating system as George's poll.
  - C) Polling all of the students who said "Interested" in George's Poll and asking them to choose between "Extremely Interested" and "Very Interested."
  - D) Polling all of the students who gave a "1" rating in Joe's poll and ask them if they are interested in Model UN.
23. Each winter, Captain Dan's Ski Lodge rents both pairs of skis and snowboards to its guests for a flat daily rate per pair of skis and a flat daily rate per snowboard. Five pairs of skis and two snowboards will cost a family \$370. Three pairs of skis and four snowboards will cost a family \$390. During a particularly slow season, Captain Dan announces a 10% discount on all skis and snowboards. What would be the cost of renting two pairs of skis and two snowboards if they were rented during this discount period?
- A) \$99
  - B) \$110
  - C) \$198
  - D) \$220



24. If  $8x + 8y = 18$  and  $x^2 - y^2 = -\frac{3}{8}$ , what is the value of  $2x - 2y$ ?

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

B)  $-\frac{1}{6}$

C)  $\frac{1}{3}$

D)  $\frac{1}{6}$

25. Shaun is developing a weight loss regimen, which includes both a workout plan and a calorie-restriction plan. Shaun wants to work out for no less than 30 minutes and no more than 60 minutes a day and consume no less than 2,000 and no more than 2,500 calories. If each minute,  $m$ , of his workout time burns 50 calories, which of the following inequalities represents the number of minutes,  $m$ , that Shaun can work out each day to burn off as many calories as he consumes?

A)  $30 \leq m \leq 60$

B)  $30 \leq m \leq 50$

C)  $40 \leq m < 50$

D)  $40 \leq m \leq 50$

26. A professional baseball team wishes to average 45,500 ticket purchases per game for the entire 162-game season. Through the first 60 games of the season, the team has averaged 43,000 ticket purchases per game. Which of the following most closely approximates how many ticket purchases per game the team must average for the remainder of the season in order to hit its overall goal of an average of 45,500 ticket purchases per game for the season?

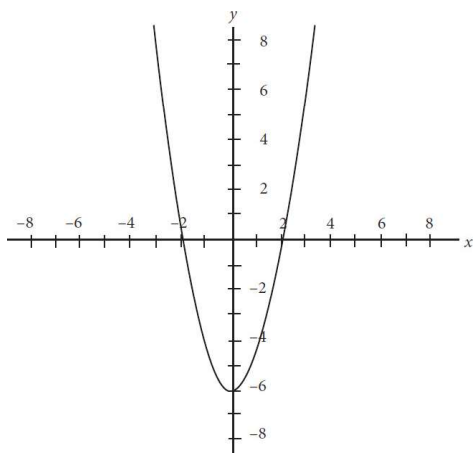
A) 46,970

B) 47,880

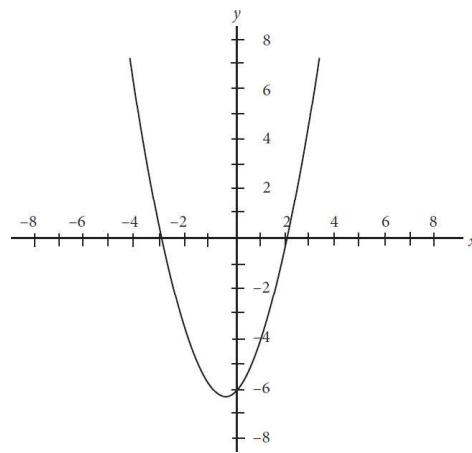
C) 48,000

D) 48,220

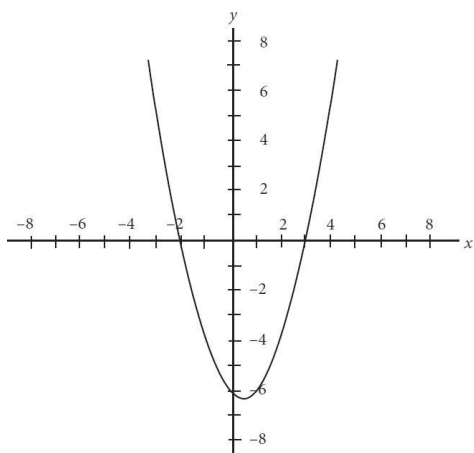
27. A certain polynomial,  $P$ , has a degree of 2. Polynomial  $P$  has zeros of 2 and  $-3$ , and  $a > 0$  when the function of polynomial  $P$  is written in the form of  $y = ax^2 + bx + c$ . Given this information, which of the following could be the graph of polynomial  $P$ ?



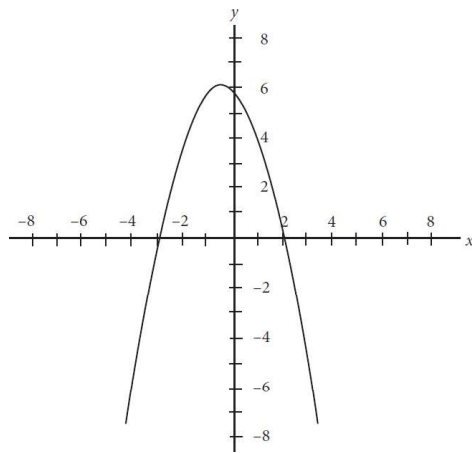
A)



B)



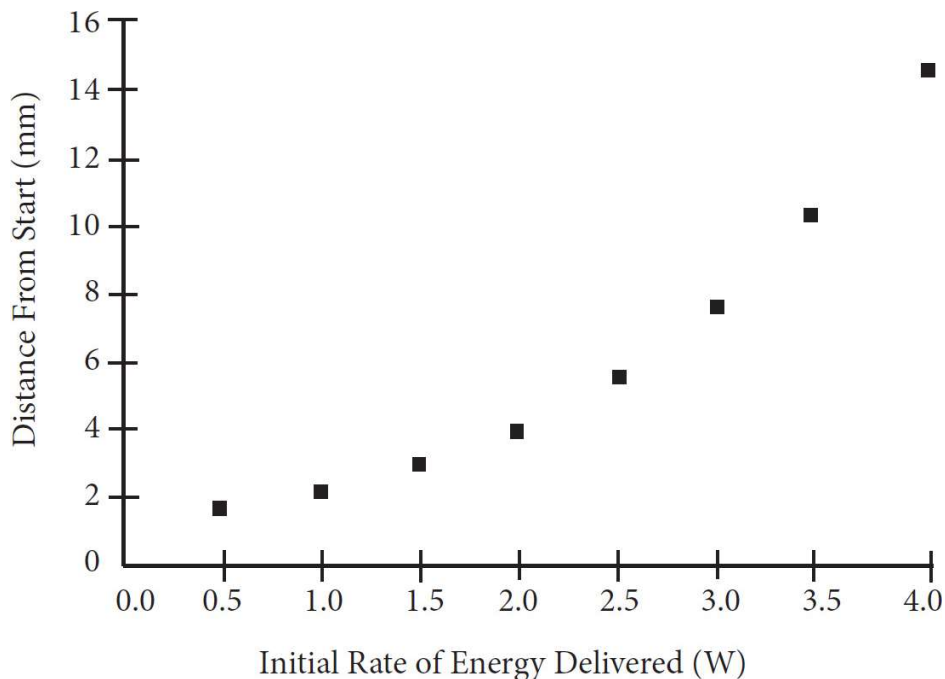
C)



D)

28. Circle  $O$  (not shown) is divided into three sectors. Points  $P$ ,  $Q$ , and  $R$  are on the circumference of the circle. Sector  $POR$  has an area of  $8\pi$ , and sector  $ROQ$  has an area of  $6\pi$ . If the radius of circle  $O$  is 4, what is the measure of the central angle of sector  $QOP$ , in degrees?
- A) 45  
B) 90  
C) 135  
D) 180
29. Medical residents at Lakewood Hospital are choosing their individual specialties. Among them, 40% choose cardiology, 16% choose oncology, 34% choose endocrinology, and the remaining  $x\%$  choose hematology. Once the doctors pick their first specialty, they are then each asked to choose a second specialty from the previous four options in case their original specialty is already filled. They may not pick their original specialty again. 20% of those who originally picked cardiology choose oncology as their second choice. If no other field chooses oncology as their second choice, and the hospital boasts 200 medical residents, then what is the total number of residents who named oncology as either their first or second choice, in terms of  $x$ ?
- A)  $8x - 128$   
B)  $8x - 144$   
C)  $x^2 + 24x - 188$   
D)  $x^2 - 24x + 188$

30. Mr. Lastorka's science class is running experiments with an energy-efficient model electric car. As the initial rate of energy delivered to the car, measured in watts, increases, the number of millimeters moved by the car from its starting position increases exponentially. The results of several trial runs are shown on the scatterplot graph below.



Based on the data, the students in Mr. Lastorka's class determine the exact equation involving Watts,  $x$ , and total distance from start,  $y$ . They call the function  $y = f(x)$ . Mr. Lastorka then instructs his class to reflect  $y = f(x)$  over the  $x$ -axis. He challenges each student to determine the new function and what it would mean from a physics perspective. Four student pairs gave their answers below. Who is correct, and for what reasons?

- A) Charles and Shannon, who identify the new equation as  $y = -2^x$  and explain that the new graph indicates that the car is still moving forward at the same rate as before.
- B) Michael and Lauren, who identify the new equation as  $y = -2^x$  and explain that the new graph indicates the car is now moving in reverse at the same rate as before.
- C) Matthew and Karen, who identify the new equation as  $y = 2^{-x}$  and explain that the new graph indicates that the car is now moving forward more rapidly than before.
- D) Andy and Joanie, who identify the new equation as  $y = 2^{-x}$  and explain that the new graph indicates that the car is no longer moving in any direction.

31. What number divided by two is equal to that same number minus 15 ?
32. The number of hours Robert spends in his game room is proportional to the number of hours he spends playing *Call of Destiny IV: Modern Battlefield*. If he plays *Call of Destiny IV* for 6 hours, he will spend 8 hours in his game room. How many hours will Robert spend in his game room if he plays *Call of Destiny IV* for only 3 hours?
33. Twelve Smooth-Glide pens and eight Easy-Write pencils cost exactly \$16.00 at Office World. Six Smooth-Glide pens and ten Easy-Write pencils cost \$11.00 at the same location. How much will nine Smooth-Glide pens and nine Easy-Write pencils cost at Office World? (Disregard the dollar sign when gridding your answer.)
34. In the equation  $3x^2 - 16x = -20$ , what is one possible value of  $x$  ?
35. In a certain ancient farming community, anthropologists determine that new dwellings were constructed monthly as modeled by the function  $f(x) = 2x + 100$ , where  $x$  is the current month of the year and  $f(x)$  is the number of dwellings constructed by the end of that month. Additionally, they determine that the population grew exponentially each month, thanks to the discovery of more fertile land for farming. This growth is modeled by the equation  $g(x) = 3^x$ , where  $g(x)$  represents the current population at the end of a given month. What is the smallest integer value of  $x$ , with 1 representing the end of January and 12 representing the end of December, at which the population surpasses the number of dwellings built?
36. In a school-wide competition held at Saul C. Tigh Memorial High School, Olympiad teams are challenged to come up with different circuits involving both real and imaginary currents. Imaginary currents exist in spots where the electrical energy encounters zero resistance, such as through a coil or wire. Real currents exist only where the electrical energy headed through the circuit encounters resistance, such as when a light bulb “resists” the current and takes up some of the energy carried throughout the circuit.

The members of Team Charlie develop a circuit in which the total current, real and imaginary, can be measured at  $50 + 12i$  amps. They then add the current together with the current produced by Team Delta’s circuit,  $40 - 9i$  amps. Finally, they decide to multiply the resulting current, in amps, by Team Epsilon’s total current,  $60 - 2i$  amps. What is the final current, in amps, after the entire process is completed?

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Questions 37 and 38 refer to the following information.

The chart below shows the population distribution for the 2,400 occupants of the city of Centre Hill.

	Adult Male	Adult Female	Child
% Living in Uptown	9	8	6
% Living in Midtown	22	20	15
% Living in Downtown	21	22	12
% Living in Suburbs	48	50	67

37. If there are an equal number of adults and children, and adult females outnumber adult males by 200, what is the sum of the women living uptown and the children living in the suburbs of Centre Hill?
38. Centre Hill plans to annex the area around a nearby lake. This new part of Centre Hill will be called, appropriately, The Annex. The Annex will add to the current population of Centre Hill. The percent of adult males living in Uptown will decrease to 6% after incorporating The Annex into Centre Hill. If the information from Part 1 holds true for the original four districts of the city of Centre Hill, then how many adult males live in The Annex?



### Section 3: Math (No Calculator)

- |       |                    |
|-------|--------------------|
| 1. C  | 11. A              |
| 2. C  | 12. D              |
| 3. D  | 13. B              |
| 4. A  | 14. A              |
| 5. A  | 15. C              |
| 6. D  | 16. 28             |
| 7. D  | 17. 0              |
| 8. D  | 18. 94             |
| 9. C  | 19. 7              |
| 10. C | 20. $\frac{10}{3}$ |

### Section 4: Math (Calculator)

- |       |       |       |                         |
|-------|-------|-------|-------------------------|
| 1. B  | 11. B | 21. D | 31. 30                  |
| 2. A  | 12. D | 22. D | 32. 4                   |
| 3. B  | 13. D | 23. C | 33. 13.5                |
| 4. D  | 14. B | 24. A | 34. 2 or $\frac{10}{3}$ |
| 5. C  | 15. C | 25. D | 35. 5                   |
| 6. D  | 16. A | 26. A | 36. 5,406               |
| 7. A  | 17. B | 27. B | 37. 860                 |
| 8. B  | 18. C | 28. A | 38. 250                 |
| 9. C  | 19. D | 29. D |                         |
| 10. A | 20. B | 30. B |                         |





### Section 3: Math (No Calculator)

1. **C** Translate the question into an equation. Let  $x$  equal the number, and then  $2x = x - 4$ . Solving for  $x$ , we find that  $x = -4$ . This is (C).
2. **C** Sonal needs  $s$  soil samples. If according to the question, he must have more than 6 samples, then  $s > 6$ . Also according to the question, he may have no more than 13 samples, so  $s \leq 13$ . Combining these two expressions, we find that  $6 < s \leq 13$ . This is (C).
3. **D** The graph of  $f(x)$  has a  $y$ -intercept at  $y = 3$ . Because of this, we know that when  $y = 3$ ,  $x = 0$ .  $f(x)$  must then satisfy the condition that  $f(0) = 3$ . This is true only for (A) and (B). Alternatively, by recognizing that each equation is in the slope-intercept form:  $f(x) = y = mx + b$ , where  $b$  is the  $y$ -intercept, we can reach the same conclusion. Next, notice that the slope of the line is positive. That is, as the value of  $x$  increases, so too does  $y$ . Returning to the slope-intercept form,  $m$  gives the slope of the line. Only (D) has a positive coefficient ( $m$ ). Choice (D), then, is the correct function.
4. **A** If  $x + y = 0$ , then  $x = -y$ . Using this relationship and substituting into the expression  $x - y$ , we find that  $x - y = -y - y = -2y$ . This is (A).
5. **A** This question requires factoring the expression  $2x^2 - 6x - 8$ . Begin by factoring 2 from the expression:  $2(x^2 - 3x - 4)$ . This expression is further factorable, giving  $2(x - 4)(x + 1)$ , which is (A).

6. **D** The question describes a ramp that forms a triangle, the length of which is the hypotenuse of the triangle. The height of the ramp (3 feet) is the length of the side of the triangle opposite the  $35^\circ$  angle. In general for some angle  $\theta$ ,  $\sin \theta = \frac{\textit{opposite}}{\textit{hypotenuse}}$ . In the question, this corresponds to  $\sin 35^\circ = \frac{\textit{opposite}}{\textit{hypotenuse}} = \frac{3}{\textit{length of ramp}} \Rightarrow \textit{length of ramp} = \frac{3}{\sin 35^\circ}$ . This is (D).
7. **D** This question requires evaluating both equations to determine the values of  $a$  and  $b$ . You could begin by solving either of the two equations for  $a$  or  $b$ , and then substituting the solution into the other equation. But note that the question asks for the value of  $a + b$ , so check to see if there's a faster way: Could you stack and add (or subtract) the equations? If you stack and add the equations, you get  $7a + 7b = 77$ . Now divide both sides of the equation by 7, resulting in  $a + b = 11$ . This is (D).
8. **D** When a function  $f(x)$  is transformed into a function of the form  $f(ax)$ , where  $a$  is a constant, if  $a > 0$ , the function will be compressed horizontally by a factor of  $a$ . Here,  $y = x^2 + 4$  can be represented as the parent function, and  $y = 3x^2 + 4$  as the transformed function compressed horizontally versus the parent function, and thus narrower, by a factor of 3. This is (D). If you're not sure, try plugging values into each equation to construct a rough graph of each equation and compare them.
9. **C** Rearranging and factoring the expression provided in the question, we have  $t^2 - 4t - 90 = 6 \Rightarrow t^2 - 4t - 96 = 0 \Rightarrow (t - 12)(t + 8) = 0$ . Therefore,  $t - 12 = 0$  and  $t + 8 = 0$ .  $t$  must then equal 12 or  $-8$ . If  $t$  represents the number of tickets Steven buys, then only  $t = 12$  is consistent with the context of the question. If each ticket costs \$80, Steven must have spent  $\$80 \cdot 12 = \$960$ . This is (C).
10. **C** We must find values of  $c$  and  $d$  by solving the system of equations in order to determine the value of  $4c - 4d$ . There are several ways to go about this. One way is to multiply the terms of the equation  $2c + 3d = 17$  by  $-3$  to get  $-6c - 9d = -51$ . If you stack and add this equation with the second equation, the result is  $-4d = -12$ , which solves to  $d = 3$ . Plug this value for  $d$  into the equation  $6c + 5d = 39$  to get  $6c + 15 = 39$ , so  $6c = 24$  and  $c = 4$ . Therefore,  $4c - 4d = 4(4) - 4(3) = 16 - 12 = 4$ . This is (C).
11. **A** Factoring the left side of the equation  $x^2 + 2xy + y^2 = 64$  gives  $(x + y)^2 = 64$ . Taking the square root of both sides of the equation, we find that  $x + y = 8$  or  $-8$ . The other equation provides that  $y - x = 12$ , so  $y = x + 12$ . Substitute this value of  $y$  into the first equation: either  $x + (x + 12) = 8$ , so  $2x + 12 = 8$ ,  $2x = -4$ , and  $x = -2$ , or else  $x + (x + 12) = -8$ , so  $2x + 12 = -8$ , so  $2x =$

$-20$ , and  $x = -10$ . Therefore,  $x$  could be either  $-2$  or  $-10$ , and only  $-10$  is an option in the answers, so (A) is correct.

12. **D** Translate from English to math in bite-sized pieces. Make the price of a hot yoga lesson  $h$  and the price of a zero gravity yoga session  $z$ . If she offers 2 hot yoga and 3 zero gravity yoga sessions for \$400, then  $2h + 3z = 400$ . Similarly, if 4 hot yoga and 2 zero gravity yoga sessions are \$440, then  $4h + 2z = 440$ . Now, be sure to Read the Full Question: You want to know whether Samantha can create a package that's greater than \$800 but has fewer than 13 sessions. If you stack the two equations and then add them together, you get  $6h + 5z = 880$ . In other words, she can offer 6 hot yoga and 5 zero gravity yoga sessions (11 total sessions) for \$880. This satisfies her requirements, so you know the answer is "Yes"; eliminate (A) and (B). For (C), because you don't know the price of each lesson individually, you don't know yet whether 5 hot yoga and 5 zero gravity yoga sessions will be over \$800; leave (C) for now. For (D), if 6 hot yoga and 5 zero gravity yoga sessions were over \$800, then adding a zero gravity yoga session will still be over \$800. Given what you already know, (D) must be true; choose (D).
13. **B** Begin by simplifying the equation given.  $(3p^2 + 14p + 24) - 2(p^2 + 7p + 20) = 3p^2 + 14p + 24 - 2p^2 - 14p - 40 = p^2 - 16 = 0$ . Factoring the left side of the simplified equation, we find that  $(p - 4)(p + 4) = 16$ . Solving for  $p$ , we find that  $p = \pm 4$ . The value of  $3p + 6$  must then be either  $3(-4) + 6 = -6$  or  $3(4) + 6 = 18$ . The latter value is (B).
14. **A** Taking note that  $i = \sqrt{-1}$ , the expression  $(2 + 8i)(1 - 4i) - (3 - 2i)(6 + 4i)$  becomes  $(2 + 8\sqrt{-1})(1 - 4\sqrt{-1}) - (3 - 2\sqrt{-1})(6 + 4\sqrt{-1})$ . Expanding, this becomes  $2 - 8\sqrt{-1} + 8\sqrt{-1} - 32(\sqrt{-1})^2 - (18 + 12\sqrt{-1} - 12\sqrt{-1} - 8(\sqrt{-1})^2) = 2 - 32(\sqrt{-1})^2 - 18 + 8(\sqrt{-1})^2 = 8(\sqrt{-1})^2 - 32(\sqrt{-1})^2 - 16$ . This further simplifies to  $-8 + 32 - 16 = 8$ . This is (A).
15. **C** Plug In the Answers! The answers aren't in order, and some numbers appear more than once, so you don't need to start in the middle. Instead, start with 9 because it is in three of the four choices. If  $x = 9$ , then  $2\sqrt{9} = 9 - 3$ .  $\sqrt{9} = 3$ , so the left side of the equation is  $2 \times 3 = 6$ , and the right side of the equation is  $9 - 3 = 6$ . This works, so 9 is part of the solution set; eliminate (B) because it doesn't include 9. Next, try  $x = 1$ :  $2\sqrt{1} = 1 - 3$ , which solves to  $2 = -2$ . This isn't true, so 1 is not part of the solution set; eliminate (D). Lastly, try  $x = -1$ :  $2\sqrt{-1} = -1 - 3$ . You cannot take the square root of a negative number, so this doesn't work. Eliminate (A) and choose (C).
16. **28** Let  $s$  equal the number of staples required by the students and let  $p$  be the number of popsicle sticks required. If the number of staples the students will need is three times the number of popsicle sticks they will need, then  $s = 3p$ . If the students need 84 staples for this project, then  $s = 84$ . Substitute 84 for

s to get  $84 = 3p$ . Divide both sides by 3 to get  $28 = p$ . The students will need 28 popsicle sticks.

17. **O** If a parabola intersects the  $x$ -axis at the points  $(5,0)$  and  $(-5,0)$ , it must be symmetric about the  $x$ -axis and centered at  $x = 0$ . The  $x$ -coordinate of its vertical axis of symmetry must then be 0.
18. **94** The question describes a 100 foot ramp that forms a triangle. The length of this ramp corresponds to the hypotenuse of a triangle. The height of the ramp is the length of the side of the triangle opposite the  $20^\circ$  angle; the horizontal distance from the start of the ramp immediately below the entrance of the mall is the side of the triangle adjacent to the  $20^\circ$  angle. The function that relates adjacent and hypotenuse is cosine:  $\cos\theta = \frac{\textit{opposite}}{\textit{hypotenuse}}$ . In this problem,  $\cos 20^\circ = \frac{x}{100}$ , where  $x$  is the horizontal distance. Solve by multiplying both sides by 100:  $\cos 20^\circ = x$ . Next, replace  $\cos 20^\circ$  with the value given in the problem, 0.939:  $100(0.939) = x$ . Multiply 100 by 0.939 to get  $x = 93.9$ , which rounds to 94.
19. **7** Let  $x$  equal the number. Then,  $2x = x - 5 \Rightarrow x = -5$ . Three times that number plus seventeen minus that number is  $3(-5) + 17 - (-5) = 7$ .
20.  **$\frac{10}{3}$**   $3x^2 + 2x - 8 = (-2 - x)(4 - 3x) = 0$ . Solving  $-2 - x = 0$  and  $4 - 3x = 0$  for  $x$ , we find that the two solutions for  $x$  are  $-2$  and  $\frac{4}{3}$ . The question asks us to subtract the value of the smaller solution from the larger solution. This difference is  $\frac{4}{3} - (-2) = \frac{4}{3} + \frac{6}{3} = \frac{10}{3}$ .

## Section 4: Math (Calculator)

1. **B** To solve this question, simply subtract  $y$  from both sides of the equation to get  $2y = 2$ , which is (B).
2. **A** Whenever the question includes variables, plug in. If  $m = 2$ , then Merry would pay the one-time enrollment fee plus 2 months' worth of monthly fees, which is  $50 + 15(2) = 80$ . Plug in 2 for  $m$  in the answer choices to see which answer equals the target number of 80. In (A),  $15(2) + 50 = 80$ . This is the target number, so leave this answer, but be sure to check the other

choices just in case. In (B),  $15 + 50(2) = 115$ . In (C),  $15(2) - 50 = -20$ , and in (D),  $(15 + 50)(2) = 130$ . Since none of the other answer choices equals the target number, the correct answer is (A).

3. **B** Since the question states that Rob is planning to bring his favorite guitar plus  $x$  additional guitars, he will have a total of  $x + 1$  guitars. The question states that the variable  $x$  represents the number of additional guitars, so the number 1 must represent Rob's favorite guitar, which is (B).
4. **D** The best way to approach this question is through POE. According to the data in the table, the ratio of those who enjoy biology to those who enjoy chemistry is 14 to 18, which can be reduced to a ratio of 7 to 9; eliminate (A). The ratio of those who enjoy chemistry to those who don't enjoy chemistry is 18 to 6, which can be reduced to a ratio of 3 to 1; eliminate (B). The ratio of those who enjoy biology to those who don't enjoy chemistry is 14 to 6, which can be reduced to a ratio of 7 to 3; eliminate (C). The ratio of those who don't enjoy biology to those who enjoy chemistry is 10 to 18, which can be reduced to a ratio of 5 to 9; this matches (D).
5. **C** Dr. Goldberg takes 40% of substitute A, which consists of 60 grams. Mathematically, this can be expressed as  $\frac{40}{100}(60)$  or  $(0.4)(60) = 24$  grams. She takes 70% of substitute B, which consists of 110 grams. Mathematically, this can be expressed as  $\frac{70}{100}(110)$  or  $(0.7)(110) = 77$  grams. Substitute C will therefore consist of 24 grams + 77 grams = 101 grams, which is (C).
6. **D** To solve this question, simply factor out the largest value that fits within each of the terms in the expression provided. In this case,  $x^4$ ,  $x^3$ , and  $x^2$  are all divisible by  $x^2$ , so that is what you will want to factor out. Doing so will leave you with  $x^2(x^2 - x - 1)$ , which is (D).
7. **A** Since Officer Blake drives 480 miles at a rate of 1 mile per minute, his total drive time was 480 minutes. The question asks for Officer Blake's driving time in hours, so you need to convert those minutes into hours. Since there are 60 minutes in 1 hour, you can divide 480 minutes by 60 to determine that Officer Blake drove for 8 hours, which is (A).
8. **B** The goal here is to isolate  $x$ . Since the right-hand side of the equation is  $-2x + 1$ , you will want to subtract 1 from both sides, so eliminate (A) and (C). To get  $x$  by itself, you will want to divide by  $-2$ , not 2, so eliminate (D) and choose (B). Remember that when you multiply or divide across an inequality sign using a negative number, you need to flip the inequality sign in the opposite direction, as reflected in (B).

9. **C** To solve this question, rearrange the expressions  $(2x^2 + 4x + 8)$  and  $(2x^2 - 4x + 7)$  in order to place the similar terms next to each other. Doing so will give you  $2x^2 - 2x^2 + 4x - (-4x) + 8 - 7$  (remember to distribute the negative sign for each of the terms in the second expression). Simplifying this new expression will yield  $0 + 8x + 1$ , or  $8x + 1$ , (C). Another way to approach this question would be to plug in a simple number for  $x$ , such as  $x = 2$ , and match your target value with the values in the answer choices.
10. **A** The tallest hill that Adam measures is 55 feet high. Since 1 foot is equivalent to 12 inches, simply multiply  $55 \times 12 = 660$  inches, (A).
11. **B** Triangle legs  $LN$  and  $MN$  are opposite and adjacent, respectively, to  $\angle y$ . Therefore, from SOHCAHTOA, we need to use the tangent trigonometric function. Plugging in the values that the question gives us into the equation for tangent, we get  $\tan 40^\circ = \frac{8}{MN}$ . Now, use your calculator to determine that the length of  $MN$  most closely approximates 9.53, which is (B).
12. **D** If you represent the wooden skateboards with a  $w$  and the composite skateboards with a  $c$ , you can write two equations based on the information given in the question:  $2w + 3c = 650$  and  $3w + c = 450$ . It is possible to isolate one of the variables and solve these two equations by substitution, but in this case it is easier simply to stack the equations on top of each other and add them together as follows:

$$\begin{array}{r} 2w + 3c = 650 \\ + 3w + c = 450 \\ \hline 5w + 4c = 1,100 \end{array}$$

Since the question asks for the price of five wooden skateboards and four composite skateboards, the answer is (D).

13. **D** The question states that the number of employees increases at the same rate per year, so you can determine this numerical increase by subtracting one year's total from the next year's total. Subtracting the 2013 total from the 2014 total gives  $2,110 - 1,890 = 220$ . To find the total in 2015, add 220 to the 2014 total:  $2,110 + 220 = 2,330$ . The question also states that the male percentages continue to decrease at the same rate, which, based on the data in the table, is 5% per year. The percent male in 2014 was 55%, so the

percent male in 2015 will be 50%. 50% of 2,330 can be expressed as or  $\frac{50}{100}$  (2330) = 1,165, which is (D).

14. **B** The formula for determining an average can be expressed by  $Average = \frac{Total}{\# \text{ of things}}$ . Plug the values provided into the equation as follows:  $11 = \frac{4 + 5 + 11 + 13 + 16 + 18 + x}{7}$ , or  $11 = \frac{67 + x}{7}$ . Multiply both sides by 7 to get  $77 = 67 + x$ . Subtract 67 from both sides to get  $x = 10$ , which is (B).

15. **C** There are a variety of ways to approach this question. You could solve one equation for  $s$  or  $t$  and substitute it into the other equation, but look to see if you can do it more simply by stacking and adding (or subtracting) the equations. If you double the first equation to get  $34s + 40t = 118$ , you can then stack and subtract the equations to eliminate  $t$  and solve for  $s$ , as follows:

$$\begin{array}{r} 34s + 40t = 118 \\ - (30s + 40t = 110) \\ \hline 4s \qquad = \quad 8 \end{array}$$

So,  $4s = 8$  and therefore  $s = 2$ . Now plug in 2 for the value of  $s$  in one of the equations:  $30(2) + 40t = 110$ , so  $40t = 110 - 60$ , so  $40t = 50$  and  $t = \frac{5}{4} = 1.25$ .

Next, plug  $s = 2$  into the answer choices to determine which one matches your target of 1.25: (C),  $\frac{5}{2s} = \frac{5}{2(2)} = \frac{5}{4} = 1.25$ .

16. **A** The best way to approach this question is through POE. Choice (A) states that the majority of students polled logged in more times than they posted. The values along the  $x$ -axis of the graph are, for most of the data points, higher than the values along the  $y$ -axis of the graph, and thus (A) is true according to the data provided. This same data contradicts (B) and (C). You can eliminate (D) because the data does, in fact, allow you to draw a conclusion about the relationship between the variables.
17. **B** Don't get too thrown off by the graph. All you need to know to solve this question is that perpendicular lines have slopes that are the negative reciprocals of each other. Since the standard equation for a line is  $y = mx +$

$b$ , the slope of the  $f(x)$  line is 3. The slope of the  $h(x)$  line must therefore be  $-\frac{1}{3}$ . The only answer choice that matches is (B).

18. **C** The best way to deal with this question is to Plug in the Answers (PITA), starting with (A). If  $x = 6$ , then  $y = 3^6 = 729$ . This is less than 4,000, so eliminate (A) and move to the next answer choice. If  $x = 7$ , then  $y = 3^7 = 2,187$ . This is still less than 4,000, so eliminate (B). If  $x = 8$ , then  $y = 3^8 = 6,561$ . This is greater than 4,000, so (C) must be the correct answer.
19. **D** The first step here is to simplify the equation and solve for  $a$ . Start by multiplying both sides by 16 to get  $16a = 4a^2$ . Divide both sides by 4 to get  $4a = a^2$ . Divide both sides by  $a$  to get  $4 = a$ . This is now your target answer. Plug  $a = 4$  into the values of  $a$  in the answer choices to determine which one matches 4. Choice (D) is the answer, since  $2\sqrt{a} = 2\sqrt{4} = 2(2) = 4$ .
20. **B** Since work = rate  $\times$  time, the 280 in the equation must represent the total number of meals (i.e. the “work”). All three chefs are working together, so they work for the same amount of time, and  $x$  must represent that time. The coefficients 8, 4, and 2 must therefore represent the chefs’ respective rates, or how many meals each prepares in a set amount of time. Since 8 is the greatest of these three coefficients,  $8x$  must be the meal output of the fastest chef, either (B) or (C). Now you need to solve the equation:  $8x + 4x + 2x = 280$ . Combining like terms gives you  $14x = 280$ . Divide both sides by 14 to determine that  $x = 20$ . This number represents the amount of time that the chefs worked, so the actual number of meals prepared by the fastest chef would be  $8 \times 20 = 160$  meals, which is (B).
21. **D** Start by finding the slope of the line provided on the graph using the points  $(0,-4)$  and  $(6,0)$  and the point-slope formula:  $\frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - (-4)}{6 - 0} = \frac{4}{6} = \frac{2}{3}$ . When this line is reflected across the line  $y = x$ , the  $x$  and  $y$  values switch, so the new slope would be the reciprocal of the original slope. Since our original slope was  $\frac{2}{3}$ , our new slope will be  $\frac{3}{2}$ . The numerator here reflects the gain or loss of pieces of fruit in the harvest, and the denominator reflects the nutrients subtracted or added. This means that for every two nutrients added, there will be a harvest gain of three pieces of fruit, which is (D).
22. **D** The issue that needs clarification here is whether the students polled by Joe thought that a score of 1 or a score of 5 was good. Since (A) and (C) deal with George’s poll, they would do nothing to help clarify this ambiguity. Choice



(B) might help us to figure out which of the students Joe polled were interested in the Model UN Club; it would not help to determine whether 1 or 5 was the best rating. Choice (D) is thus the best answer.

23. **C** In order to determine the normal cost for renting skis and snowboards, you need to write two equations and then manipulate and solve those equations. If you call skis  $x$  and snowboards  $y$ , your two equations will be  $5x + 2y = 370$  and  $3x + 4y = 390$ . Look for a way to stack and add the equations to eliminate one of the variables. For instance, multiply the first equation by 2 to get  $10x + 4y = 740$ , and then stack and subtract the equations, as follows:

$$\begin{array}{r} 10x + 4y = 740 \\ - (3x + 4y = 390) \\ \hline 7x \qquad = 350 \end{array}$$

So,  $7x = 350$  and  $x = 50$ , so the price of a pair of skis is \$50. Plug this number back into either equation to find the cost of a snowboard:  $10(50) + 4y = 740$ , so  $4y = 740 - 500$  and  $4y = 240$ . Therefore,  $y = 60$ , the cost of a snowboard. So, the cost of two pairs of skis and two snowboards would normally be  $2(50) + 2(60) = 100 + 120 = 220$ . Finally, remember that prices are discounted by 10%, so multiply the price of \$220 by 10% to get \$22, and subtract \$22 from the price. The final cost of two pairs of skis and two snowboards is  $220 - 22 = 198$ , which is (C).

24. **A** Start by simplifying  $8x + 8y = 18$  by dividing each term by 8:  $x + y = \frac{18}{8}$  or  $x + y = \frac{9}{4}$ . The second equation provided in the question can be factored:  $x^2 - y^2$  is the same as  $(x + y)(x - y)$ , so the second equation can also be written  $(x + y)(x - y) = -\frac{3}{8}$ . Since you know that  $x + y = \frac{9}{4}$ , you can rewrite the second equation as  $\frac{9}{4}(x - y) = -\frac{3}{8}$ . Multiply both sides by  $\frac{4}{9}$ :  $x - y = -\frac{3}{8}(\frac{4}{9})$  or  $x - y = -\frac{1}{6}$ . Since the question asks for the value of  $2x - 2y$ , simply multiply everything by 2:  $2(x - y) = 2(-\frac{1}{6}) = -\frac{1}{3}$ , which is (A).

25. **D** If each minute of his workout time burns 50 calories, and he wants to consume no fewer than 2,000 calories, Shaun must work out for a minimum of  $\frac{2,000}{50} = 40$  minutes. If he wants to consume no more than 2,500 calories, Shaun must work out for a maximum of  $\frac{2,000}{50} = 50$  minutes. Since the question asks for the inequality that represents the number of minutes for

which Shaun will burn off as many calories as he consumes, (D) is correct, as it includes both the minimum (40 minutes) and maximum (50 minutes) amount of time that he can work out. Choice (C) is incorrect because the answer should include 50 (he can work out for a “maximum” of 50 minutes, so he could work out for 50 minutes), but the lesser than sign (“<”) excludes 50.

26. **A** There are 162 games in the season, so the team needs a total of  $162 \times 45,500 = 7,371,000$  ticket purchases to have a mean of 45,500 ticket purchases per game for the season. The 60 games with an average total ticket purchase of 43,000 gives a total of 2,580,000 ticket purchases, leaving 4,791,000 ticket purchases left for the team to reach its goal. Dividing 4,791,000 by 102 makes (A) the closest value to the average of 46,971 ticket purchases per game the team needs to make.
27. **B** The best way to deal with this question is through POE. If the polynomial has zeroes of 2 and  $-3$ , then that means you have two points: (2,0) and  $(-3,0)$ —eliminate (A) and (C). Since it is given in the question that  $a > 0$  when the parabola is in the form  $y = ax^2 + bx + c$ , the parabola must be pointed upwards—eliminate (D) and choose (B).
28. **A** Since the radius of the circle is 4, the area of the entire circle is  $\pi r^2 = \pi(4^2) = 16\pi$ . Sector  $POR$  has an area of  $8\pi$  and sector  $ROQ$  has an area of  $6\pi$ , so the remaining sector ( $QOP$ ) has an area of  $16\pi - 8\pi - 6\pi = 2\pi$ . You can set up a proportion to determine the associated angle using the following formula:  $\frac{\text{sector area}}{\text{total area}} = \frac{\text{sector angle}}{360^\circ}$ . Using the numbers you now have, your calculation will look like this:  $\frac{2\pi}{16\pi} = \frac{\text{sector angle}}{360^\circ}$  or  $\frac{1}{8} = \frac{\text{sector angle}}{360}$ . Multiply both sides of the equation by 360 to determine that the sector angle is  $45^\circ$ , which is (A).
29. **D** 16% of the 200 medical residents named oncology as their first choice:  $\frac{16}{100}(200)$  or  $(0.16)(200) = 32$  residents. 40% of the 200 medical residents named cardiology as their first choice:  $\frac{40}{100}(200)$  or  $(0.4)(200) = 80$  residents. Of these 80 residents, 20% chose oncology as their second choice:  $\frac{20}{100}(80)$  or  $(0.2)(80) = 16$  residents. The total number of residents who named oncology as either their first or second choice was therefore  $32 + 16 =$

48 residents. To find the value of  $x$ , you need to subtract the percentages given in the question from the total, 100%:  $100 - 40 - 16 - 34 = x = 10\%$ . Now, plug  $x = 10$  into the answer choices in order to determine which one matches your target of 48 residents. Only (D) works:  $x^2 - 24x + 188 = 100 - 24(10) + 188 = 100 - 240 + 188 = 48$ .

30. **B** If the original graph is reflected across the  $x$ -axis, the  $x$ -values will remain the same but the  $y$ -values will switch signs. Since the  $y$ -axis represents distance from start, negative  $y$ -values means that the car is now going in reverse. The only answer that matches this information is (B).

31. **30** Translate English to math. "What number divided by two is equal to that same number minus 15?" can be written as an equation, with  $x$  representing the missing number:  $\frac{x}{2} = x - 15$ . Add 15 to both sides of the equation to get  $\frac{x}{2} + 15 = x$ . Subtract  $\frac{x}{2}$  from both sides to get  $15 = \frac{x}{2}$ . Multiply both sides by 2 to get  $x = 30$ .

32. **4** When dealing with values that are directly proportional, you can use the equation  $\frac{x_1}{y_1} = \frac{x_2}{y_2}$ . For this question, you can call the number of hours spent playing *Call of Destiny*  $x$  and the number of hours spent in the game room  $y$ . Your equation will then look like this:  $\frac{6}{8} = \frac{3}{y_2}$ . Cross-multiply to get  $6y_2 = 3(8)$  or  $6y_2 = 24$ . Divide both sides of the equation by 6 to get  $y_2 = 4$ .

33. **13.5** Start by translating English to math. Make  $s$  the price of Smooth-Glide pens and  $e$  the price of Easy-Write pencils. If 12 pens and 8 pencils cost \$16, then  $12s + 8e = 16$ . Similarly, if 6 pens and 10 pencils cost \$11, then  $6s + 10e = 11$ . Remember to Read the Full Question! The question wants the price of 9 pens and 9 pencils. If you stack the equations and add, you get  $18s + 18e = 27$ . This is exactly double the number of pens and pencils you want, so divide the entire equation by 2 to get  $9s + 9e = 13.5$ .

34. **2** or  $\frac{10}{3}$

There are a few different ways to approach this question. Since the calculator is permitted on this section of the test, you can put the equation into the standard  $ax^2 + bx + c = 0$  form and plug that equation into the " $y =$ " button

on your graphing calculator. The equation, once rearranged, is  $3x^2 - 16x + 20 = 0$ . You can trace the graph or use the “calc” feature to calculate the zeroes, which are the same as the values of  $x$ . Doing so will yield values of  $x = 2$  and  $x = 3.33$ . Alternatively, you can factor the equation the long way or use the quadratic formula,  $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ . In this equation,  $a = 3$ ,  $b = -16$ , and  $c = 20$ . Plugging those values into the equation, you get  $\frac{-(-16) \pm \sqrt{(-16)^2 - 4(3)(20)}}{2(3)} = \frac{16 \pm \sqrt{16}}{6} = \frac{16 \pm 4}{6}$ . Therefore, the solutions are  $\frac{16+4}{6} = \frac{20}{6} = \frac{10}{3}$  and  $\frac{16-4}{6} = \frac{12}{6} = 2$ . Either value ( $\frac{10}{3}$  or 2) is a valid answer.

35. **5** Since you are looking for the value of  $x$  for which the population surpassed the number of dwellings, you can set up an inequality:  $3^x > 2x + 100$ . Now, simply plug in values for  $x$  starting with  $x = 1$  until the left-hand side of the inequality is larger than the right-hand side. Using the values  $x = 1$ ,  $x = 2$ ,  $x = 3$ , and  $x = 4$ , you will find that the left-hand side of the inequality is less than the right-hand side. Using  $x = 5$ ,  $3^5 = 243$ , and  $2(5) + 100 = 110$ , making the left-hand of the inequality greater than the right-hand side. Therefore, the answer is 5.

36. **5,406** The first step here is to add Team Charlie’s and Team Delta’s total currents together as follows:

$$\begin{array}{r} 50 + 12i \\ + \underline{40 - 9i} \\ 90 + 3i \end{array}$$

Next, use FOIL to multiply this value by the total current from Team Epsilon:  $(90 + 3i)(60 - 2i) = 5,400 - 90(2i) + 60(3i) - 2i(3i) = 5,400 - 180i + 180i - 6i^2 = 5,400 - 6i^2$ . Since  $i^2 = -1$ , this is equivalent to  $5,400 - 6(-1) = 5,400 + 6 = 5,406$ . If you have a calculator that is able to deal with imaginary numbers, you can simply type the expressions into your calculator, which will solve everything for you.

37. **860** The question states that there are 2,400 total inhabitants of Centre Hill, so if there are an equal number of adults and children, then there are 1,200 of each. Since there are 200 more adult females than adult males, you can set up two equations:  $f + m = 1,200$  and  $f = m + 200$ . You can rewrite the second

equation by subtracting  $m$  from both sides:  $f - m = 200$ . Next, stack and add the two equations as follows:

$$\begin{array}{r} f + m = 1,200 \\ + f - m = \quad 200 \\ \hline 2f \quad = 1,400 \end{array}$$

Divide both sides of the equation by 2 to determine that  $f = 700$ . The number of women living uptown is therefore 8% of 700:  $\frac{8}{100}(700)$  or  $(0.08)(700) = 56$ . The number of children living in the suburbs is 67% of 1,200:  $\frac{67}{100}(1,200)$  or  $(0.67)(1,200) = 804$ . The sum of these two figures is  $56 + 804 = 860$ .

38. **250** Using your information from question 37, you can determine that the total number of adult males prior to the addition of the annex is  $1,200 - 700 = 500$ . The original percentage of adult males living Uptown is 9% of 500:  $\frac{9}{100}(500)$  or  $(0.09)(500) = 45$ . Since the question states that the percentage of adult males living Uptown decreases to 6%, you can conclude that the 45 adult males living Uptown after the annexation constitute 6% of the total adult male population:  $45 = \frac{6}{100}(x)$  or  $45 = (0.06)x$ . Divide both sides of the equation by 0.06 to determine that  $x = 750$ . Since the original number of adult males was 500,  $750 - 500 = 250$  additional adult males live in The Annex.



## Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

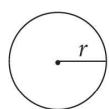
### DIRECTIONS

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

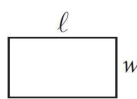
- The use of a calculator is **not permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated,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

### REFERENCE

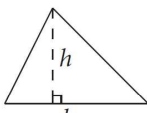


$$A = \pi r^2$$

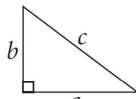
$$C = 2\pi r$$



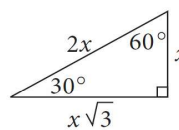
$$A = \ell w$$



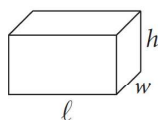
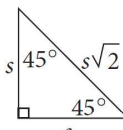
$$A = \frac{1}{2}bh$$



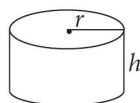
$$c^2 = a^2 + b^2$$



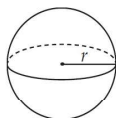
Special Right Triangles



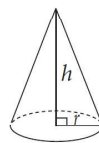
$$V = \ell wh$$



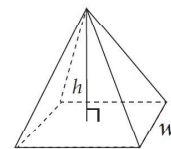
$$V = \pi r^2 h$$



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



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



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

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

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

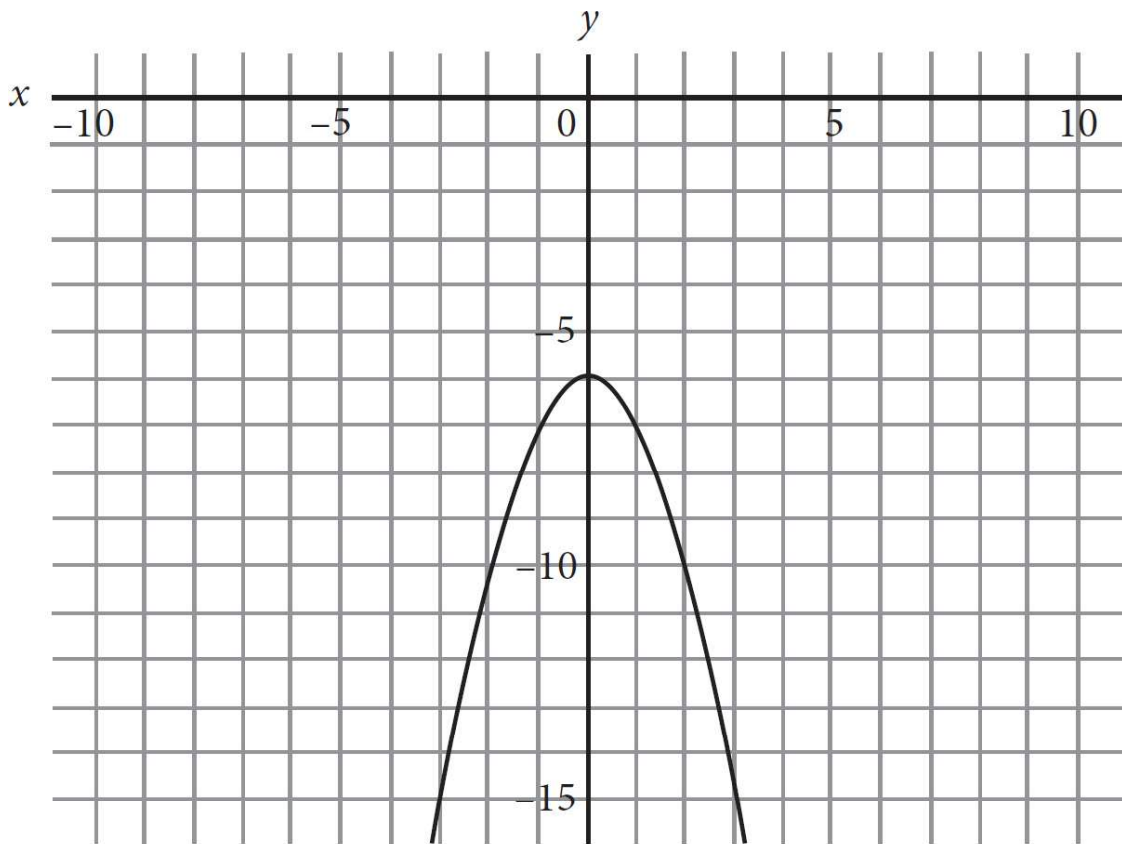
The sum of the measures in degrees of the angles of a triangle is 180.

1. Marco is ordering salt, which is only sold in 30-pound bags. He currently has 75 pounds of salt, and he needs to have a minimum of 200 pounds. Which of the following inequalities shows all possible values for the number of bags,  $b$ , that Marco needs to order to meet his minimum requirement?
  - A)  $b \geq 4$
  - B)  $b \geq 5$
  - C)  $b \geq 6$
  - D)  $b \geq 7$
2. A website hopes to sign up 100,000 subscribers. So far, the website has signed up an average of 500 subscribers per day for  $d$  days. Which of the following represents the number of additional subscribers,  $W$ , the website must sign up to reach its goal?
  - A)  $W = 500d$
  - B)  $W = 99,500d$
  - C)  $W = 100,000 - 500d$
  - D)  $W = 100,000 + 500d$
3. If  $f$  is a function and  $f(4) = 5$ , which of the following CANNOT be the definition of  $f$ ?
  - A)  $f(x) = x + 1$
  - B)  $f(x) = 2x - 3$
  - C)  $f(x) = 3x - 2$
  - D)  $f(x) = 4x - 11$
4. Which of the following is equivalent to the expression  $\frac{x^3 + x^2}{x^4 + x^3}$ ?
  - A)  $\frac{x^5}{x^7}$
  - B)  $\frac{2}{x}$
  - C)  $\frac{5x}{7x}$
  - D)  $x^{-1}$

5. Régine is measuring how many solutions from Batch  $x$  and Batch  $y$  are acidic. She measured a total of 100 solutions from both batches. 40% of the solutions from Batch  $x$  and 70% of the solutions from Batch  $y$  were acidic, for a total of 48 acidic solutions. Solving which of the following systems of equations yields the number of solutions in Batch  $x$  and Batch  $y$  ?

- A)  $x + y = 100$   
 $0.4x + 0.7y = 48$
- B)  $x + y = 48$   
 $0.4x + 0.7y = 100$
- C)  $x + y = 100 \times 2$   
 $0.4x + 0.7y = 48$
- D)  $x + y = 100$   
 $40x + 70y = 48$

6.

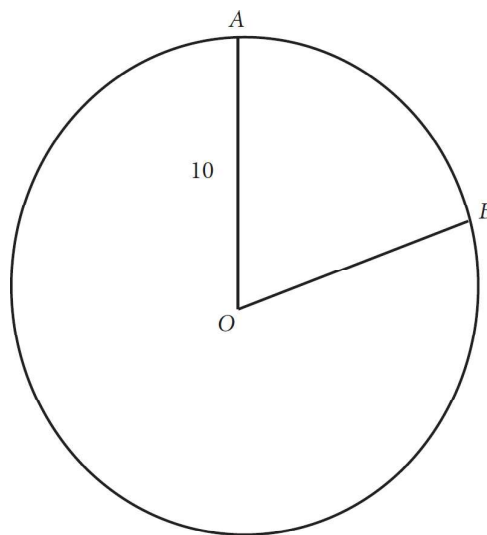


Which of the following equations best describes the figure above?

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



7. The price of an item that cost \$43 in 2010 always increases by \$3 per year. The current price in dollars,  $P$ , of the item can be represented by the equation  $P = 3t + 10$ , where  $t$  is the number of years since the item was first manufactured. Which of the following best explains the meaning of the number 10 in the equation?
- A) It is the price of the item in 1999.
  - B) It is the price of the item in 2000.
  - C) It is the price of the item in 2001.
  - D) It is the annual increase in the price of the item.



8. In the circle with center  $O$  and radius 10 shown above,  $\angle AOB = \frac{2\pi}{5}$ . What is the length of minor arc  $AB$ ?
- A)  $\pi$
  - B)  $2\pi$
  - C)  $4\pi$
  - D)  $20\pi$
9. Clark's Rule is a formula used to determine the correct dosage of adult over-the-counter medicine a child can receive. The child's weight, in pounds, is divided by 150, and the result is multiplied by the adult dose of the medicine. A mother needs to give her daughter acetaminophen, which has an adult dose of 1,000 milligrams. She does not know her daughter's exact weight, but she knows the weight is between 75 and 90 pounds. Which of the following gives the range of correct dosage,  $d$ , in milligrams of acetaminophen the daughter could receive?
- A)  $50 < d < 60$
  - B)  $500 < d < 600$
  - C)  $1,000 < d < 1,200$
  - D)  $1,600 < d < 2,000$

10. Ohm's Law, which can be written as  $IR = V$ , relates the current  $I$  in amperes that flows through a conductive material with resistance  $R$  ohms to the voltage  $V$  between the two ends. The power  $P$  in watts can be related to  $I$  and  $R$  by the equation  $I = \sqrt{\frac{P}{R}}$ . Which of the following gives  $P$  in terms of  $V$  and  $R$ ?

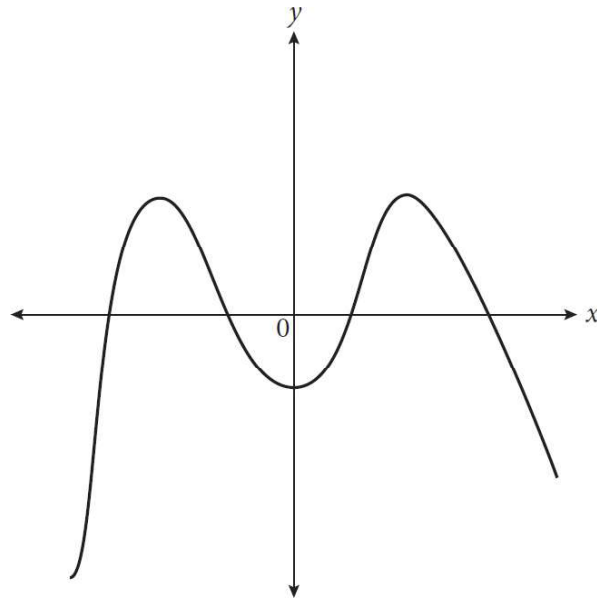
A)  $p = \frac{R}{V^2}$

B)  $p = \frac{V}{R}$

C)  $p = \frac{V^2}{R}$

D)  $P = V^2R^3$

11.



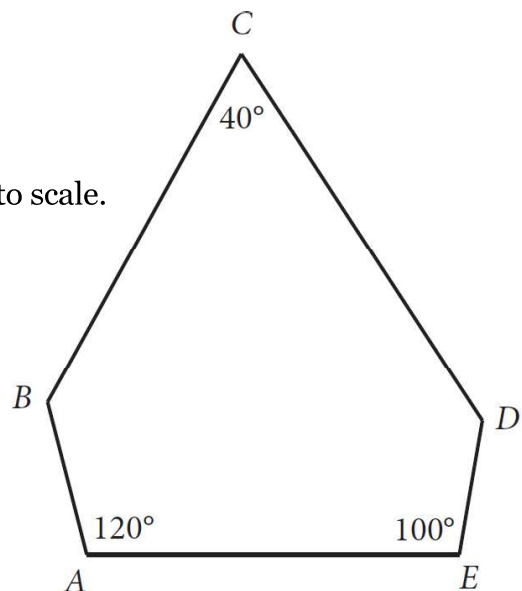
The figure above shows the graph in the  $xy$ -plane of the function  $g$ . How many distinct real roots does  $g$  have?

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

12. In the figure above,  $\angle ABC \cong \angle CDE$ . Which of the following is true?

- A)  $\overline{AB} \parallel \overline{CD}$
- B)  $\overline{BC} \parallel \overline{AE}$
- C)  $\overline{CD} \parallel \overline{AE}$
- D)  $\overline{BC} \cong \overline{AE}$

Note: Figure not drawn to scale.



13. For which of the following values of  $w$  does  $\sqrt[4]{16w^3x^{\frac{9}{w}}} = (2)\left(\frac{3}{3^4}\right)\left(x^{\frac{3}{4}}\right)$ ?

- A) 2
- B) 3
- C) 4
- D) 6

14. If  $r = \left(\frac{1}{2}a + b\right)^2$  and  $s = -4ab + 3b$ , what is  $r - 2s$  in terms of  $a$  and  $b$ ?

- A)  $\frac{1}{4}a^2 + b^2 - 7ab - 6b$
- B)  $\frac{1}{4}a^2 + b^2 - 7ab + 6b$
- C)  $\frac{1}{4}a^2 + b^2 + 9ab - 6b$
- D)  $\frac{1}{2}a^2 + b^2 + 9ab - 6b$

15. Which of the following lines contains all points equidistant from the points  $(0, 4)$  and  $(8, 0)$  in the  $xy$ -plane?

- A)  $2y = -x + 8$
- B)  $2y = x$
- C)  $y = 2x - 6$
- D)  $y = -2x$

16. 
$$\frac{p}{3} + \frac{q}{2} = 1$$

$$p - 3q = 1$$

Based on the system of equations above, what is the value of  $p$  ?

17.

$$y = x$$
$$(y - 2)^2 - 4 = -x$$

The system of equations above intersects at two points. What is the sum of the coordinates of the point of intersection in quadrant I?

18.

$$1 < (c - 1)^2 < 36$$

What is the greatest integer solution to the inequality above?

19.

$$2y - x \leq 4$$
$$-2x + y \geq -4$$

If  $s$  is the sum of the  $x$ - and  $y$ -coordinates of any point in the solution to the system of inequalities above as graphed in the  $xy$ -plane, what is the greatest possible value of  $s$  ?

20. Squares  $ABCD$  and  $WXYZ$  define two parallel planes such that  $AW = BX = CY = DZ = 5$ . Additionally,  $AB = WX = 4$ . Point  $Q$  lies between the two parallel planes such that it is equidistant from points  $A$ ,  $B$ ,  $C$ , and  $D$  and also equidistant from points  $W$ ,  $X$ ,  $Y$ , and  $Z$ . Lines  $AQY$ ,  $BQZ$ ,  $CQW$ , and  $DQX$  are drawn to create two pyramids. What is the total volume of the two pyramids?



# Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

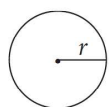
## DIRECTIONS

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

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

## REFERENCE

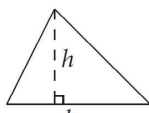


$$A = \pi r^2$$

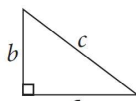
$$C = 2\pi r$$



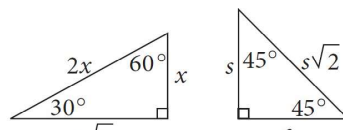
$$A = \ell w$$



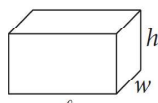
$$A = \frac{1}{2}bh$$



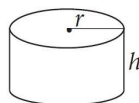
$$c^2 = a^2 + b^2$$



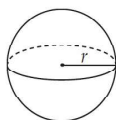
Special Right Triangles



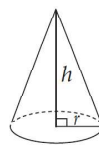
$$V = \ell wh$$



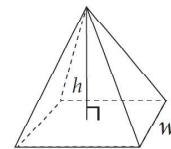
$$V = \pi r^2 h$$



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



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



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

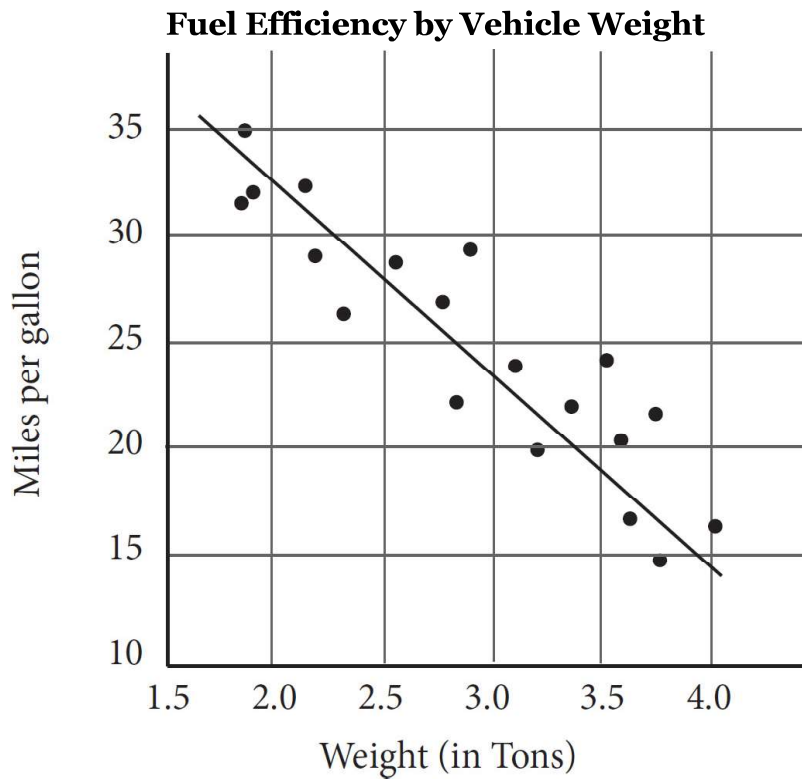
The number of degrees of arc in a circle is 360.

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

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

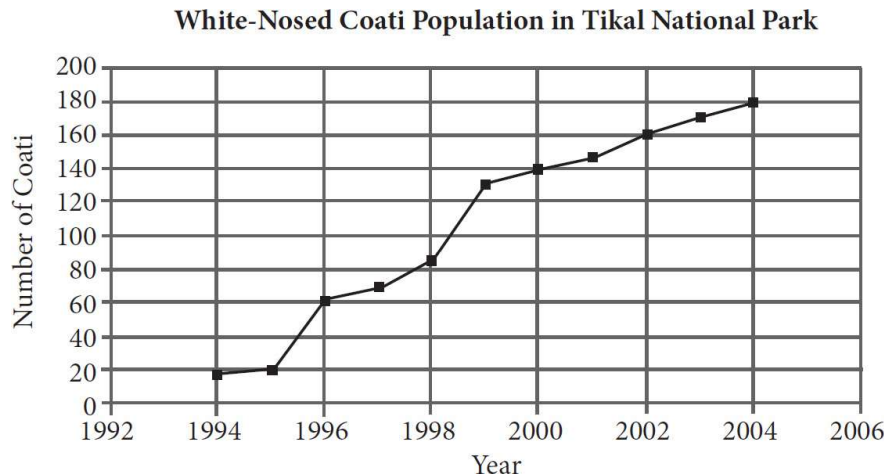
- 
1. An air pump at a gas station dispenses 90 pounds of air for \$0.25. Which of the following expressions gives the number of pounds of air dispensed,  $P$ , for  $d$  dollars?
- A)  $P = d + 90$
  - B)  $P = d + 360$
  - C)  $P = 90d$
  - D)  $P = 360d$
2. Taylor is 6 feet tall. If 1 foot is equal to approximately 0.3 meters, then which of the following is closest to Taylor's height in meters?
- A) 1.8
  - B) 2
  - C) 18
  - D) 20
3. A developer is creating a plan for a 44-acre park that includes a 4-acre lake that cannot be developed. If 8 to 10 acres, inclusive, must be reserved for soccer fields, which of the following inequalities shows all possible values for  $p$ , the amount of land that within the park that is available for development?
- A)  $26 \leq p \leq 40$
  - B)  $30 \leq p \leq 32$
  - C)  $34 \leq p \leq 36$
  - D)  $36 \leq p \leq 40$

4.



The scatterplot above shows the fuel efficiency, in miles per gallon, of a variety of vehicles weighing between 1.5 and 4 tons. Based on the line of best fit to the data represented, which of the following is the closest to the expected miles per gallon of a vehicle that weighs 3 tons?

- A) 20
- B) 24
- C) 27
- D) 28



5. As part of a recent wildlife conservation effort in Guatemala, park rangers in Tikal National Park have tracked the growing number of white-nosed coati living within a certain protected region over the period 1994-2004.

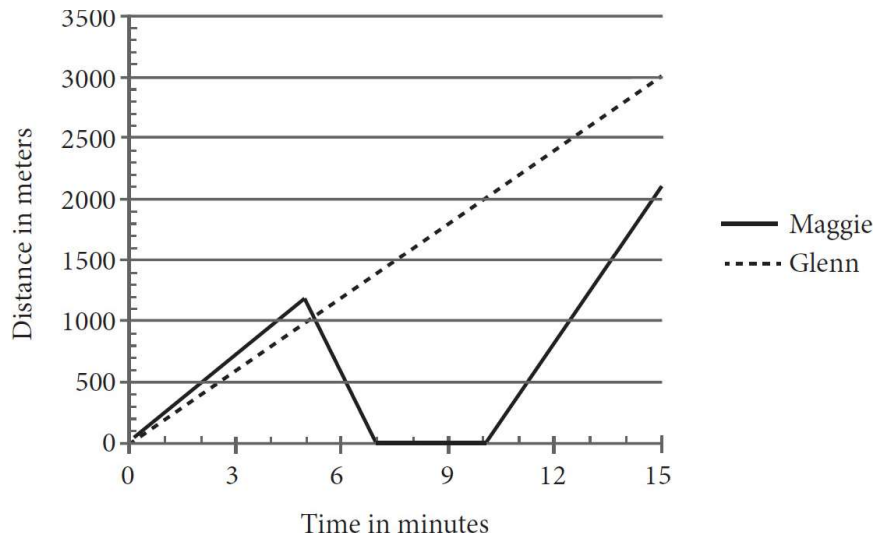
According to the data above, if the population of coati in the protected region of Tikal National Park increased at the same rate from 2004-2006 as it did from 2000-2004, then what was the number of coati in the park in 2006 ?

- A) 180
- B) 190
- C) 200
- D) 210

$$\frac{8d + 10 - d}{3} = \frac{d(3 + 4) + a}{3}$$

6. If the equation above has infinitely many solutions for  $d$ , what is the value of  $a$  ?
- A) -10  
 B) 10  
 C) 15  
 D) 20

**Maggie's and Glenn's Distances from Home During Jog**



7. Maggie and Glenn both leave from the same house to go for a jog along a trail. Shortly after leaving, Maggie realizes she forgot her iPod and returns home to find it before heading back out onto the same trail. The graph above shows how far each of them is from home for the first fifteen minutes of their jogs.

What is Glenn's approximate average speed in meters per second for the portion of his jog shown?

- A) 3.3                      B) 15                      C) 200                      D) 12,000
8. Environmentalists have been monitoring the area of a glacier in Canada. The glacier is slowly shrinking. The glacier originally occupied 15,000 square miles, but after two years of monitoring the glacier, the scientists document that the area of the glacier is now 14,910 square miles. If  $y$  is the number of years since monitoring began, which equation best describes the glacier's area,  $G(y)$ , as a function of time?

- A)  $G(y) = 15,000 \frac{1}{y}$                       C)  $G(y) = 15,000(0.997)^y$   
 B)  $G(y) = 15,000 (0.003)^y$                       D)  $G(y) = 0.997^y$



9. Mike consumes an average of 1,680 calories per day. Each day he has finals, Mike consumes 12% more calories per day than he usually does. During the last day of finals, he celebrates by consuming an additional 900 calories. Which of the following represents the total number of calories Mike consumes during  $d$  days of finals?
- A)  $1.12(1,680d + 900)$   
B)  $1.12(1,680d) + 900$   
C)  $1.12(1,680 + 900)d$   
D)  $(1,680 + 0.12d) + 900$
10. The varsity swim team at Northwest High is planning a team trip and needs to choose between Austin, TX, and Pensacola, FL. The team takes a vote and the results of the vote are shown in the table below.

	<b>Juniors</b>	<b>Seniors</b>
Austin, TX	14	19
Pensacola, FL	7	23

- Given the information shown above, which of the following statements is true?
- A) The number of juniors that prefer Pensacola, FL, is twice the number of juniors that prefer Austin, TX.  
B) The seniors are more than three times as likely to prefer Pensacola, FL, than are the juniors.  
C) The number of seniors that prefer Austin, TX, is 5% more than the number of juniors that prefer Austin.  
D) One-third of the juniors prefer Pensacola, FL.

11. The 2013 U.S. Census recorded the highest educational attainment of all adults aged 25 years or older in county  $T$ , one of the most educated parts of the country. The results are given in the two-way table below.

	Men	Women	Total
High School Diploma	7,535	7,234	14,769
Bachelor's Degree	17,170	23,455	40,625
Master's Degree	45,105	41,078	86,183
Professional Degree	23,501	23,405	46,906
Doctoral Degree	16,232	15,817	32,049
Total	109,543	110,989	220,532

According to the data presented in the table above, if you were to choose a person at random out of the entire population aged 25 years or older in county  $T$ , what is the approximate probability that the person you chose is a man with a doctoral degree (given as a percent)?

- A) 2%  
B) 7%  
C) 28%  
D) 51%
12. The cost in dollars,  $C$ , of producing a custom-made T-shirt with a team logo is given by the formula  $C = 110 + \frac{x}{2}$ , where  $x$  is the number of T-shirts produced. When every T-shirt produced is sold, the revenue from selling the customized T-shirts is given by  $R = 15x - \frac{x^2}{10}$ . Which one of the following would be the formula for the profit from producing and selling  $x$  T-shirts?

(Profit = Revenue - Cost)

- A)  $-\frac{x^2}{10} - \frac{31}{2}x + 110$   
B)  $-\frac{x^2}{10} - \frac{29}{2}x + 110$   
C)  $-\frac{x^2}{10} + \frac{29}{2}x - 110$   
D)  $-\frac{x^2}{10} + \frac{31}{2}x - 110$

13. While on vacation in Morocco, Erik decided to splurge on a fancy hotel that cost 2,000 Moroccan dirhams per night. If he stayed in that particular hotel for three nights, but his bank only lets him withdraw \$200 at a time, how many visits to the ATM must Erik have made in order to cover the cost of his hotel stay?

(Note: 1 Moroccan dirham = \$0.11)

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

14. Peter's Petrol Station is selling regular unleaded gas for \$3.49 a gallon and premium gas for \$3.79 a gallon. If a car wash is purchased, then a discount of \$0.10 per gallon is applied. During one morning, a total of 850 gallons of gas was sold, and 100 gallons were sold at the discounted rate. The total collected in sales was \$3,016.50. Solving which of the following systems of equations yields the number of regular unleaded gallons of gas,  $u$ , and the number of premium gallons of gas,  $p$ , that were sold during that morning?

- |    |                            |    |                            |
|----|----------------------------|----|----------------------------|
| A) | $u + p = 850$              | C) | $u + p = 850$              |
|    | $3.49u + 3.79p = 3016.50$  |    | $3.49u + 3.79p = 3,026.50$ |
| B) | $u + p = 850$              | D) | $u + p = 3,016.50$         |
|    | $3.49u + 3.79p = 3,016.50$ |    | $3.49u + 3.79p = 850$      |

15. Of the 784 juniors and seniors at Abingdon High School, 319 are currently enrolled in one or more Advanced Placement (AP) courses. Of these AP students, 75 are enrolled in AP Biology, 58 are enrolled in AP U.S. History, and 22 are enrolled in both AP Biology and AP U.S. History. Approximately what percent of the juniors and seniors at Abingdon High School are enrolled in AP courses other than Biology and U.S. History?

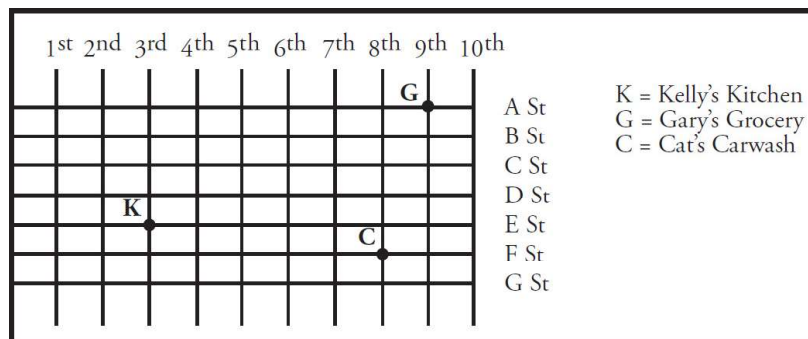
- A) 17%                      C) 37%  
B) 27%                      D) 47%

16. To receive a B in his chemistry class, Mateo needs to earn an average score from 80 to 89, inclusive. His grade is based only on 3 tests. The highest possible score on each of these tests is 100 points. He scored 79 on his first test and 95 on his second test. If  $y$  represents his score on the third test, which of the inequalities below shows all values of  $y$  that would earn Mateo a B in his chemistry class?

- A)  $66 \leq y \leq 93$   
B)  $66 \leq y \leq 100$   
C)  $80 \leq y \leq 89$   
D)  $80 \leq y \leq 93$

$$Y = \frac{A}{A + W}$$

17. A gardener prepares a mixture of fertilizer with concentration, by volume, equal to  $Y$ . It is prepared by mixing a volume of fertilizer given by  $A$  with a volume of water given by  $W$ . The expression above represents the mixture described. What physical quantity does the term  $A + W$  represent in the equation above?
- A) The volume of the mixture  
 B) The mass of fertilizer added  
 C) The volume of the fertilizer in the mixture  
 D) The concentration of the fertilizer
18. Two groups of subjects are combined in a psychological research experiment. The mode score for group A is 7 and the mode score for group B is 6. Which of the following conclusions can be made?
- A) The mode for the whole group is 6.  
 B) The mode for the whole group is between 6 and 7.  
 C) The mode for the whole group is 7.  
 D) The mode cannot be determined from the given information.
19. The map below shows the layout of streets in a city and the location of several places. Each horizontal or vertical line between two adjacent streets represents a city block, and each city block represents 0.6 miles.



- Josh needs to drive from Kelly's Kitchen to Gary's Grocery. If Josh drives the shortest distance possible on the roads shown above at a constant speed of 30 miles per hour, how long does it take him to make the trip from Kelly's Kitchen to Gary's Grocery?
- A) 6 minutes  
 B) 10 minutes  
 C) 12 minutes  
 D) 20 minutes

20.

$$2s - \frac{1}{3}t = 10$$
$$5s = t + 12 - s$$

Which of the following is a true statement about the system of equations above?

- A) There are infinitely many solutions to the system of equations.
  - B) When the system is solved for  $s$ , the result is 5.
  - C) When the system is solved for  $t$ , the result is 6.
  - D) There are no solutions to the system of equations.
21. The student council at Shermer High School wants to use student opinion to decide on one of three possible homecoming themes for the year. President Peterson thinks that the best way to determine popular opinion is for each of the 10 members of the student council to poll 10 of their friends and select the theme that receives the most votes. Vice President Vaidya wants to go to the cafeteria during lunch and poll 100 students to determine the winner. Treasurer Thompson says the best method would be to assign numbers to each of the 1,000 students in the school, randomly select 100 of them to poll, and select the winner based on the results. Secretary Stephens argues that they must poll each of the 250 members of the senior class to find the most popular theme. Whose method is most likely to accurately determine overall student opinion regarding the most popular homecoming theme?
- A) President Peterson
  - B) Secretary Stephens
  - C) Treasurer Thompson
  - D) Vice-President Vaidya
22. Is the point  $(-2, -2)$  located inside, on, or outside the circle with equation  $(x + 3)^2 + (y - 1)^2 = 9$ ?
- A) Inside the circle
  - B) On the circle
  - C) Outside the circle
  - D) It cannot be determined from the given information.
23. If the expression  $\frac{x-12}{\sqrt{8}}$  is most nearly equal to  $\frac{x\sqrt{2}}{4} - C$ , then what is the value of  $C$ ?
- A)  $-3$
  - B)  $-\sqrt{3}$
  - C)  $2$
  - D)  $3\sqrt{2}$

24. A survey was conducted among a randomly chosen sample of full-time salaried workers about satisfaction in their current jobs. The table below shows a summary of the survey results.

**Reported Job Satisfaction by Education Level (in thousands)**

Highest Level of Education	Satisfied	Not Satisfied	No Response	Total
High School Diploma	17,880	12,053	2,575	32,508
Bachelor's Degree	24,236	8,496	3,442	36,174
Master's Degree	17,605	5,324	1,861	24,790
Doctoral Degree	12,210	2,081	972	15,263
Total	71,931	27,954	8,850	108,735

Of the people whose highest level of education was a bachelor's degree who reported job satisfaction, 1,000 people were randomly selected to complete a follow-up survey in which they were asked about their salary satisfaction. There were 658 people in this follow-up sample who said that they were satisfied with their salaries, and the other 342 people were not satisfied. Using the data from both the initial survey and the follow-up survey, which of the following statements is most likely true?

- A) Approximately 16 million people with bachelor's degrees would report salary satisfaction.
- B) Approximately 24 million people with bachelor's degrees would report salary satisfaction.
- C) Approximately 47 million people with bachelor's degrees would report salary satisfaction.
- D) Approximately 72 million people with bachelor's degrees would report salary satisfaction.
25. Line  $d$  has a slope of  $\frac{4}{5}$  and passes through the point  $(1, 1)$ . Line  $e$  is parallel to line  $d$  and has a  $y$ -intercept 3 times that of line  $d$ . Which of the following is the equation of line  $e$  ?
- A)  $5y - 4x = 3$
- B)  $5y - x = 4$
- C)  $10y - 8x = 30$
- D)  $20y + 25x = 12$

$$\frac{q^2 - q - 42}{q + 6} = \sqrt{q - 5}$$

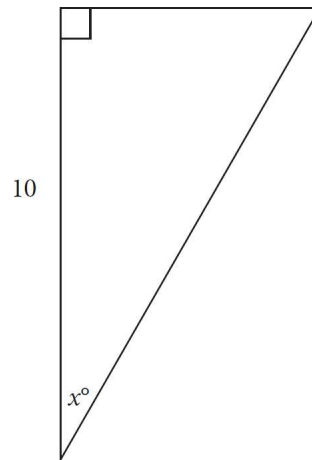
26. The equation above can be solved for two solutions, one of which is extraneous. What is the value of the extraneous solution?
- A) 5  
 B) 6  
 C) 8  
 D) 9
27. A gaming company conducted a study to find out what age groups preferred which types of games. The table below outlines the survey results.

Age Group	First Person Shooters	Sports Games	Adventure Games	Total
9- to 13-year olds	16,000,000	9,000,000	25,000,000	50,000,000
14- to 18-year olds	48,000,000	13,000,000	31,000,000	82,000,000
19- to 22-year olds	38,000,000	27,000,000	19,000,000	84,000,000
23- to 60-year olds	8,000,000	3,000,000	10,000,000	21,000,000

According to the information provided in the table, the gaming company concludes that if they can double the number of 19- to 22-year olds playing sports games, and increase the number of sports gamers in the 9- to 13-year old age group, they will have equal total numbers of players for each game type if they double the number of players of adventure games in which age group?

- A) 23- to 60-year olds  
 B) 19- to 22-year olds  
 C) 14- to 18-year olds  
 D) 9- to 13-year olds
28.  $V(t) = at + k$
- At a certain manufacturing plant, the total number of vacation days,  $V(t)$ , an employee has accrued is given by the function above, where  $t$  is the number of years the employee has worked at the plant, and  $a$  and  $k$  are constants. If Martin has accrued 9 more vacation days than Emilio has, how many more years has Martin worked than Emilio?
- A)  $\frac{9}{a}$   
 B)  $9 - a$   
 C)  $9 + a$   
 D)  $9a$

29.



In the figure above,  $\sin x^\circ = \frac{2\sqrt{29}}{29}$ . What is the perimeter of the figure?

A)  $10 + \frac{2\sqrt{29}}{29}$

B)  $7 + \sqrt{29}$

C)  $14 + 2\sqrt{29}$

D)  $39 + 2\sqrt{29}$

30. At Santa Monica High School, the ratio of juniors to seniors is 4 to 3, the ratio of seniors to sophomores is 5 to 4, and the ratio of freshmen to sophomores is 7 to 6. What is the ratio of freshmen to seniors?

A)  $\frac{7}{3}$

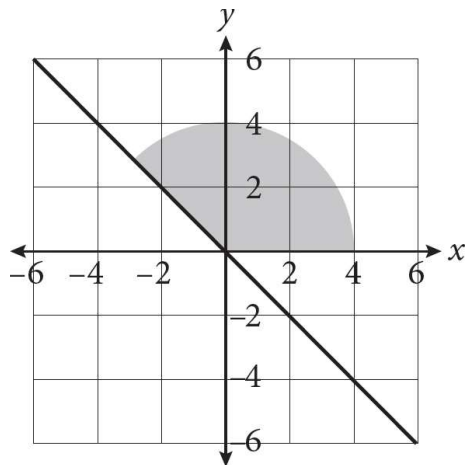
B)  $\frac{5}{3}$

C)  $\frac{9}{7}$

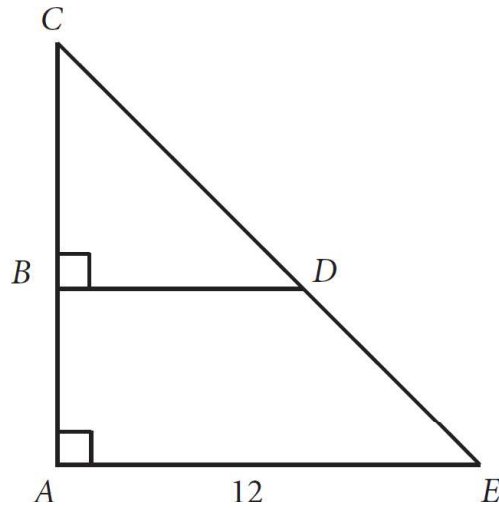
D)  $\frac{14}{15}$



31. Hayoung is competing in a triathlon comprised of swimming, running, and biking. She starts by swimming  $m$  miles. Next, she runs 11 times the distance that she swims. Finally, she bikes 18 times the distance that she swims. If Hayoung swims 2.5 miles, what is the total distance, in miles, Hayoung travels as she competes?
32. At the local mall, Casey's Card Cart sells cards à la carte. Casey's revenue  $R$ , in dollars, for  $x$  days is given by the function  $R(x) = 250x - 20$ . If Casey earned \$1,230, how many days has she sold cards?
33. Marty is planning which crops to plant on his farm for the upcoming season. He has enough seed to plant 4 acres of wheat and 7 acres of soybeans, but the total area of farmland he owns is only 9 acres. He earns \$90 per acre for every acre of wheat planted and \$120 for every acre of soybeans planted, and he must pay a 10% tax on all money he earns from selling his crops. What is the maximum profit, in dollars, that Marty can earn from planting wheat and soybeans this season?
- 34.



What is the area of the shaded region of the circle, bound by the  $x$ -axis and the line  $y = -x$ , rounded to the nearest whole number?



35. In the figure,  $\overline{AC}$  is bisected by  $\overline{BD}$ . If  $\overline{BC}$  is 7, then what is the length of  $\overline{BD}$  ?
36. The daily recommended serving of protein is 50 grams. A nutritional bar contains 32% of the daily recommended serving of protein and 10% of the daily recommended serving of fat. If the nutritional bar contains 700% more grams of protein than grams of fat, what is the daily recommended serving of fat, in grams? (Disregard units when gridding your answer.)



**Questions 37 and 38 refer to the following information.**

Set  $R$  consists of all the one-digit prime numbers. Set  $S$  contains all of the elements of Set  $R$ , as well as an additional positive integer,  $x$ .

37. If the sum of all of the elements of Set  $S$  is 30, what is the value of  $x^2 - 11x - 25$  ?
38. Michael wants to change the value of  $x$  so that the mean of Set  $S$  is equal to the median of Set  $S$  and for Set  $S$  to have no mode. What value of  $x$  would accomplish his goal?



### Section 3: Math (No Calculator)

- |      |       |       |                                    |
|------|-------|-------|------------------------------------|
| 1. B | 7. A  | 11. D | 16. $\frac{7}{3}$ or 2.33          |
| 2. C | 8. C  | 12. A | 17. 6                              |
| 3. C | 9. B  | 13. B | 18. 6                              |
| 4. D | 10. C | 14. C | 19. 8                              |
| 5. A |       | 15. C | 20. $\frac{80}{3}$ or 26.6 or 26.7 |
| 6. B |       |       |                                    |

### Section 4 : Math (No Calculator)

- |      |       |       |         |
|------|-------|-------|---------|
| 1. D | 10. D | 20. D | 30. D   |
| 2. A | 11. B | 21. C | 31. 75  |
| 3. B | 12. C | 22. C | 32. 5   |
| 4. B | 13. D | 23. D | 33. 918 |
| 5. C | 14. C | 24. A | 34. 19  |
| 6. B | 15. B | 25. A | 35. 6   |
| 7. A | 16. A | 26. B | 36. 20  |
| 8. C | 17. A | 27. D | 37. 1   |
| 9. B | 18. D | 28. A | 38. 8   |
|      | 19. C | 29. C |         |

### Section 3: Math (No Calculator)

- 1. B** Because Marco already has 75 pounds of salt, he needs  $200 - 75 = 125$  additional pounds. Estimate the number of bags he needs. 125 is close to 120, and  $120 \div 30 = 4$ , so he must need more than 4 bags (because 125 is more than 120). This means that Marco needs at least 5 more bags. Therefore, the correct answer is (B).
- 2. C** Whenever there are variables in the question and in the answers, think Plugging In. Let  $d = 2$ . The number of subscribers the website has signed up so far can be calculated as  $500(2) = 1,000$ . Therefore, the website needs to sign up  $100,000 - 1,000 = 99,000$  additional subscribers. Plug 2 in for  $w$  in the answers to see which answer equals the target number of 99,000. Choice (A) becomes  $W = 500(2) = 1,000$ . This doesn't match the target number, so eliminate (A). Choice (B) becomes  $W = 99,500(2) = 199,000$ . Eliminate (B). Choice (C) becomes  $W = 100,000 - 500(2) = 100,000 - 1,000 = 99,000$ . Keep (C), but check (D) just in case it also works. Choice (D) becomes  $W = 100,000 + 500(2) = 100,000 + 1,000 = 101,000$ . Eliminate (D). The correct answer is (C).
- 3. C** Since the question states  $f(4) = 5$ , then when  $x = 4$ , the result should be 5. Plug in  $x = 4$  into each answer choice to see which equation does NOT equal 5. Choice (A) becomes  $f(4) = 4 + 1 = 5$ . This works, so eliminate (A). Choice (B) becomes  $f(4) = 2(4) - 3 = 8 - 3 = 5$ . Eliminate (B). Choice (C) becomes  $f(4) = 3(4) - 2 = 12 - 2 = 10$ . The correct answer is (C).
- 4. D** Factor the expression to get  $\frac{x^2(x+1)}{x^3(x+1)}$ . Reduce the fraction to get  $\frac{x^2}{x^3}$ , or  $\frac{1}{x}$ . Another way of writing  $\frac{1}{x}$  is  $x^{-1}$ . Therefore, the correct answer is (D).

5. **A** Start with the easier equation first and use Process of Elimination. The easier equation has to do with the total number of solutions. According to the question, Régine measures a total of 100 solutions. This information can be expressed as  $x + y = 100$ . Eliminate (B) and (C) because neither of these answers includes this equation. Remember that percentage means divided by 100. Therefore,  $40\% = 0.4$  and  $70\% = 0.7$ . Given this information,  $x$  should be associated with 0.4 and  $y$  should be associated with 0.7. On this basis eliminate (D). The correct answer is (A).
6. **B** The graph shown is a regular parabola that has been turned upside down and moved down 6. The equation of a regular parabola that points upward is  $y = x^2$ . Therefore, the graph of a parabola that points downwards is  $y = -x^2$ . Eliminate (D) because that answer is missing the negative sign. To move a parabola down 6 units, a 6 must be subtracted from the equation of the parabola. Eliminate (A) and (C), which add 6 instead. Choice (B) can be rewritten as  $y = -x^2 - 6$ . The correct answer is (B).
7. **A** Use Process of Elimination to solve this question. According to (A), the price of the item in 1999 was \$10. According to the question, the price of the item in 2010 was \$43, and the price of the item increased by \$3 every year. 1999 is 11 years before 2010. Therefore, the price of the item in 1999 can be calculated as  $43 - 11(3) = 10$ . Keep (A) but check the other answer choices just in case. Eliminate (B) and (C), since these answers could not also be correct. Eliminate (D) because the annual price increase is given as \$3 in the question. Therefore, the correct answer is (A).
8. **C** Use the formula  $\text{arc} = r\theta$ , where  $r$  is the radius and  $\theta$  is the measure of the central angle in radians. Because the angle is already in radians, you just need to plug in 10 for the radius and the angle  $\frac{2\pi}{5}$  into the formula. You then get  $s = (10)\frac{2\pi}{5}$  or  $4\pi$ , which is (C).
9. **B** Start by calculating the least amount of acetaminophen the child needs. If the child is 75 pounds, then the amount of acetaminophen needed can be calculated as  $\frac{75}{150} \times 1,000 = \frac{1}{2} \times 1,000 = 500$ . Since, only (B) gives 500 as the low-end value, the correct answer is (B).
10. **C** Whenever there are variables in the question and in the answer choices, think Plugging In, picking numbers that ensure that  $I$  is an integer. If  $P = 18$  and  $R = 2$ , then  $I = \sqrt{\frac{P}{R}} = \sqrt{\frac{18}{2}} = \sqrt{9} = 3$ . Because  $V = IR$ ,  $V = 3 \times 2 = 6$ . Plug

$P = 18$ ,  $R = 2$ , and  $V = 6$  into the answers to see which answer works. Choice (A) becomes  $18 = \frac{2}{6^2}$ . Solve the right side of the equation to get  $18 = \frac{2}{36}$ . This statement is not true, so eliminate (A). Choice (B) becomes  $18 = \frac{36}{6^2}$ . This statement is not true, so eliminate (B). Choice (C) becomes  $18 = \frac{6^2 \cdot 2}{2}$ . Solve the left side of the equation to get  $18 = \frac{36}{2}$ . This statement is true, so keep (C), but check the remaining answer just in case. Choice (D) becomes  $18 = (6^2)(2^3)$  or  $18 = 36 \times 8$ . This statement is not true, so eliminate (D). The correct answer is (C).

11. **D** A root of the equation is the same as an  $x$ -intercept. In the graph, the function crosses the  $x$ -axis at 4 points. Therefore, the correct answer is (D).

12. **A** Label the congruent angles,  $\angle ABC$  and  $\angle CDE$ , as such. In order to find the measure of those angles, use the formula  $180(n - 2)$ , where  $n$  is the number of sides, to determine the sum of the interior angles of the figure. Because the figure has five sides, plug 5 in for  $n$  to get  $180(5 - 2)$ , or  $180(3)$ , which equals 540. Subtract 120 to get 420. Subtract 100 to get 320. Subtract 40 to get 280. Since the two remaining angles are congruent, divide by 2 to find that the two unlabeled angles are both equal to 140. Because  $\angle ABC$  and  $\angle BCD$  have a combined measure of 180,  $\overline{AB}$  and  $\overline{CD}$  are parallel. Therefore, (A) accurately describes the relationships in the figure.

13. **B** Taking the 4th root of a number is the same as taking the number to the  $\frac{1}{4}$  power. Therefore, the equation can be rewritten as  $2w^{\frac{3}{4}}x^{\frac{9}{4w}} = 2\left(3^{\frac{3}{4}}\right)\left(x^{\frac{3}{4}}\right)$ .

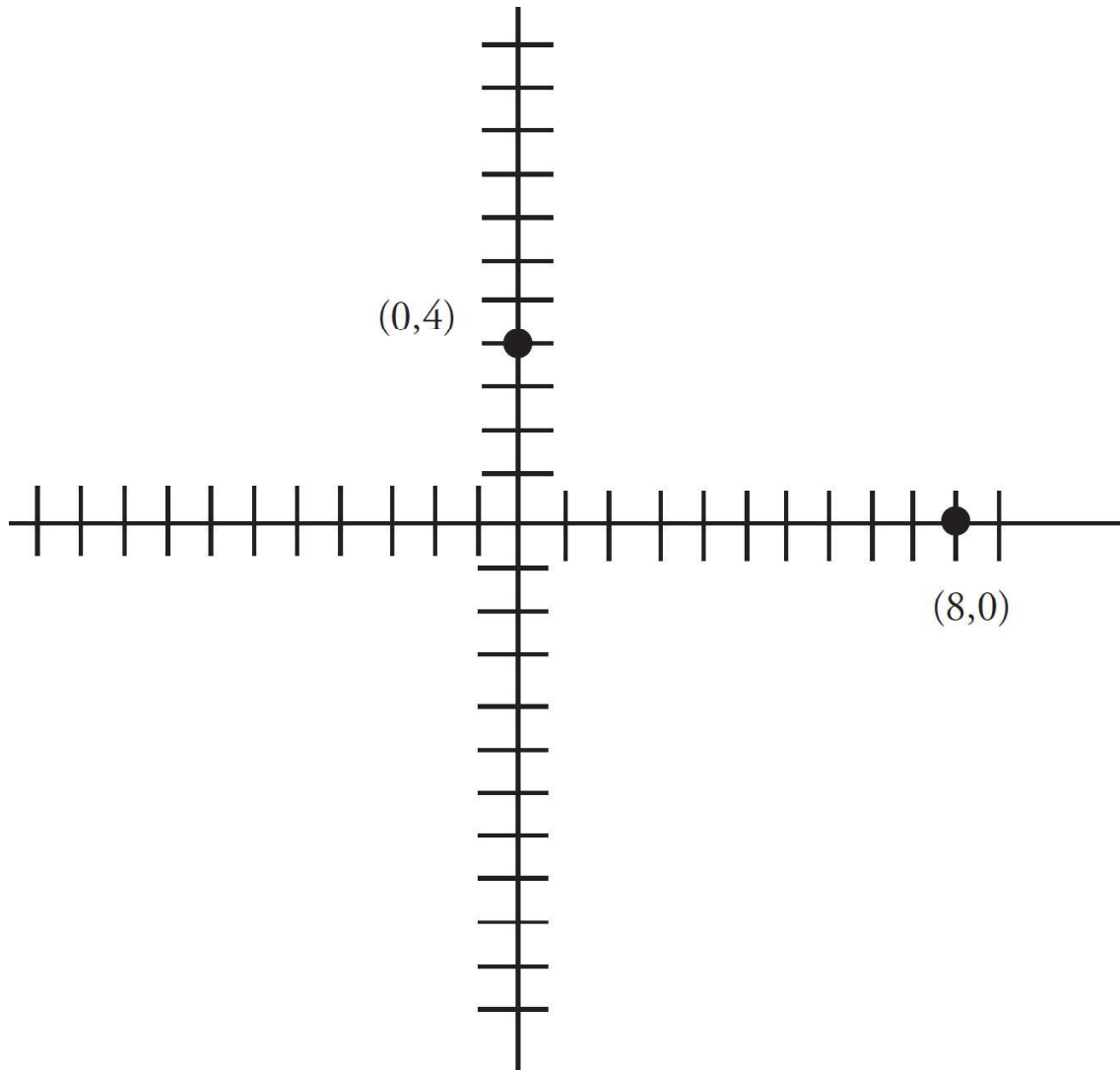
Divide both sides by 2 to get  $w^{\frac{3}{4}}x^{\frac{9}{4w}} = \left(3^{\frac{3}{4}}\right)\left(x^{\frac{3}{4}}\right)$ . Therefore, in the equation

$w^{\frac{3}{4}} = 3^{\frac{3}{4}}$  and  $x^{\frac{9}{4w}} = x^{\frac{3}{4}}$ , so  $w = 3$ . The correct answer is (B).

14. **C** Whenever there are variables in the question and in the answers, think Plugging In. If  $a = 2$  and  $b = 3$ ,  $r = \left[\frac{1}{2}(2) + 3\right]^2 = (1 + 3)^2 = 16$ , and  $s = -4(2)(3) + 3(3) = -24 + 9 = -15$ . The expression  $r - 2s$  becomes  $16 - 2(-15) = 16 + 30 = 46$ . Plug 2 in for  $a$  and 3 in for  $b$  in each of the answers to see which answer equals the target number of 46. Choice (A) becomes  $\frac{1}{4}(2^2) + 3^2 - 7(2)(3) - 6(3) = 1 + 9 - 42 - 18 = -50$ . This does not match the target number,

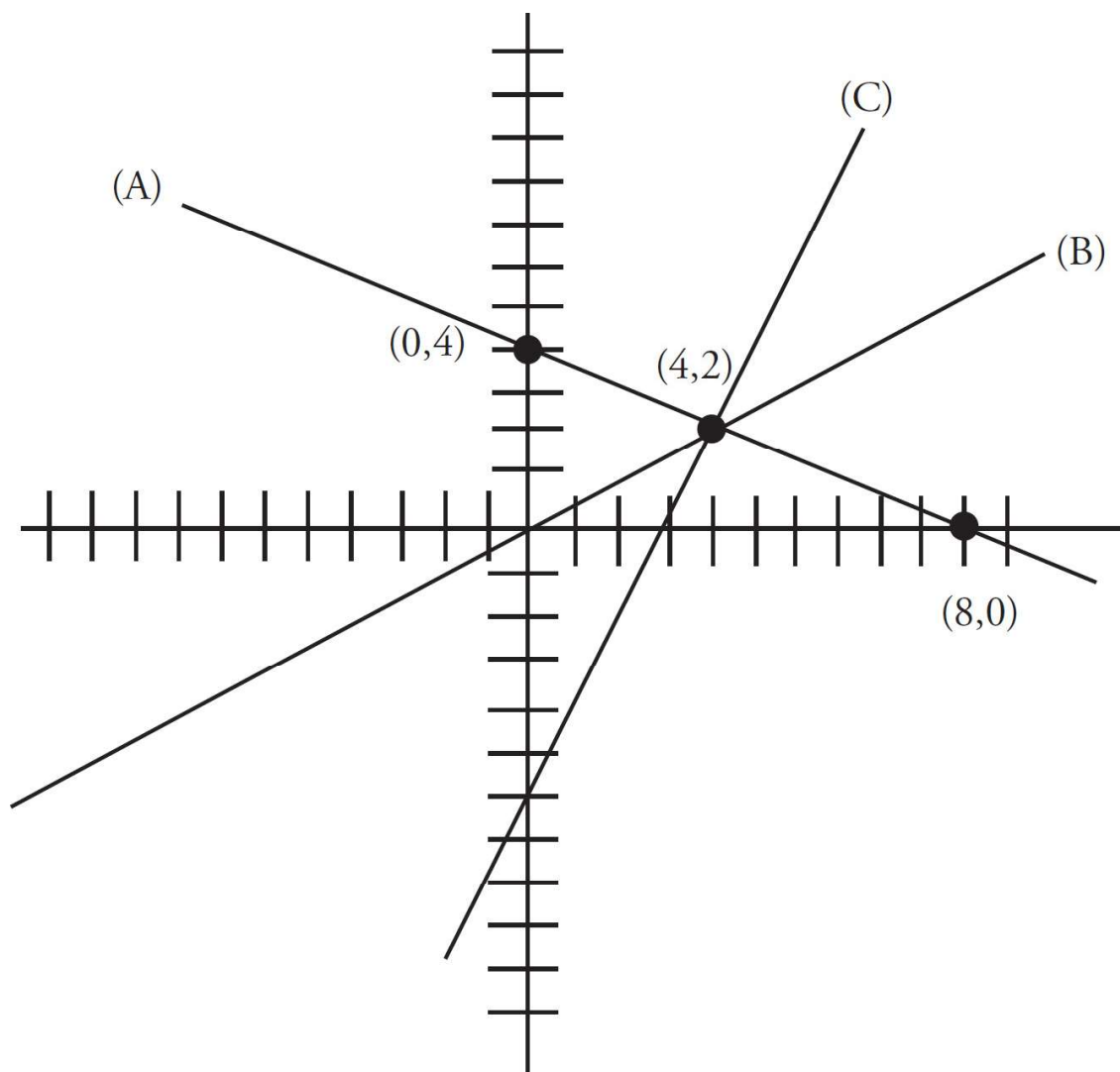
so eliminate (A). Choice (B) becomes  $\frac{1}{4}(2^2) + 3^2 - 7(2)(3) + 6(3) = 1 + 9 - 42 + 18 = -14$ . Eliminate (B). Choice (C) becomes  $\frac{1}{4}(2^2) + 3^2 + 9(2)(3) - 6(3) = 1 + 9 + 54 - 18 = 46$ . Keep (C), but check (D) just in case it also works. Choice (D) is the same as (C) except for the coefficient on the  $a^2$  term, so it can't equal 46. Eliminate (D). The correct answer is (C).

15. **C** First, start with a sketch of the two points to see what the line in question might look like.



The point directly between the two points will definitely be on the line, so find the midpoint of the two points. Midpoint  $= \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) = \left( \frac{0 + 8}{2}, \frac{4 + 0}{2} \right) = (4, 2)$ . Check this point in the answer choices and eliminate any that do not contain it. Choice (A) becomes  $2(2) =$

$-4 + 8$  or  $4 = 4$ , which is true. Choice (B) becomes  $2(2) = 4$ , and (C) becomes  $2 = 2(4) - 6$  or  $2 = 8 - 6$ . These are also true, but (D) becomes  $2 = -2(4)$ , which is false. Eliminate (D). To sketch the remaining equations, rewrite them in slope-intercept form of the equation  $y = mx + b$ , where  $m$  is the slope and  $b$  is the  $y$ -intercept. Choice (A) becomes  $y = -\frac{1}{2}x + 4$ , (B) becomes  $y = \frac{1}{2}x$ , and (C) is already in the right form. Now sketch the graphs of each of these on the  $xy$ -plane.



The line in (A) contains both the given points, but all the points to the left of  $(0, 4)$  are closer to that point and all those to the right of  $(8, 0)$  are closer to it. So eliminate (A). Many points on line (B) are also clearly closer to one or the other of the given points, so eliminate (B). Line (C) appears to be perpendicular to the line formed by the two given points, and this is in fact what will make all the points on a line equidistant from 2 given points. Therefore, the correct answer is (C).



16.  $\frac{7}{3}$  or

**2.33**

Get rid of the fractions in the first equation by multiplying the entire equation by 6, to get  $2p + 3q = 6$ . Whenever there are two equations with the same two variables, they can be solved simultaneously by adding or subtracting them. The key is to get one variable to disappear. Stack the equations and add them.

$$\begin{array}{r} 2p + 3q = 6 \\ \underline{p - 3q = 1} \\ 3p \qquad = 7 \end{array}$$

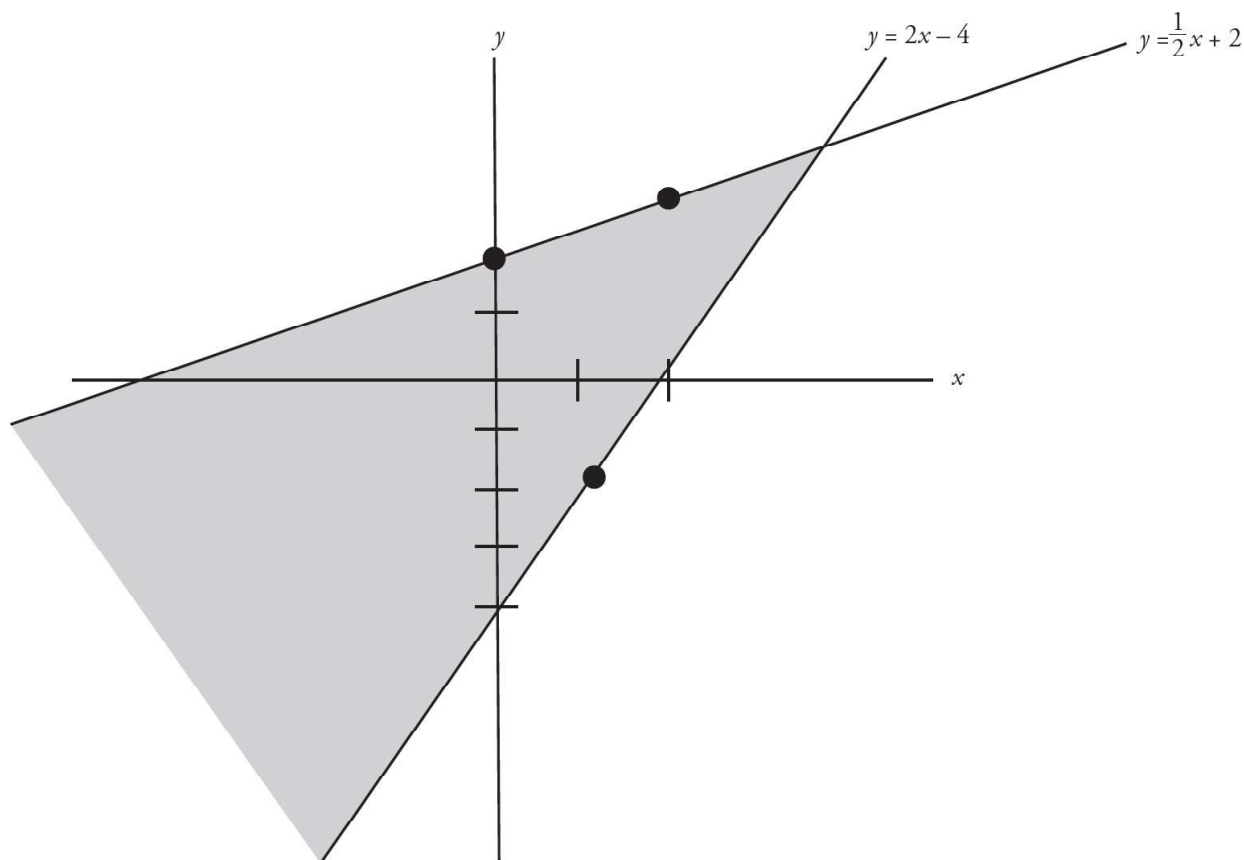
Therefore,  $p = \frac{7}{3}$ .

17. **6** Substitute  $x$  for  $y$  in the second equation to get  $(x - 2)^2 - 4 = -x$ . Expand the left side of the equation to get  $(x - 2)(x - 2) - 4 = -x$  or  $x^2 - 4x + 4 - 4 = -x$ . Simplify the equation to get  $x^2 - 4x = -x$ . Set the equation to 0 to get  $x^2 - 3x = 0$ . Factor an  $x$  out of the equation to get  $x(x - 3) = 0$ . Therefore, either  $x = 0$  or  $x - 3 = 0$ , and  $x = 3$ . According to the question, the point of intersection is in quadrant I, where the  $x$  and  $y$  values are both positive. Therefore,  $x = 3$  and  $y = 3$ . The sum of  $3 + 3 = 6$ . The correct answer is 6.
18. **6** Try Plugging In different values of  $c$  to see which ones work. Make a table to keep track of all the numbers.

$c =$	$(c - 1)^2 =$
1	$(1 - 1)^2 = 0$
2	$(2 - 1)^2 = 1$
3	$(3 - 1)^2 = 4$
4	$(4 - 1)^2 = 9$
5	$(5 - 1)^2 = 16$
6	$(6 - 1)^2 = 25$
7	$(7 - 1)^2 = 36$

The largest value of  $c$  that works without hitting the boundaries of the inequality is 6, so the correct answer is 6.

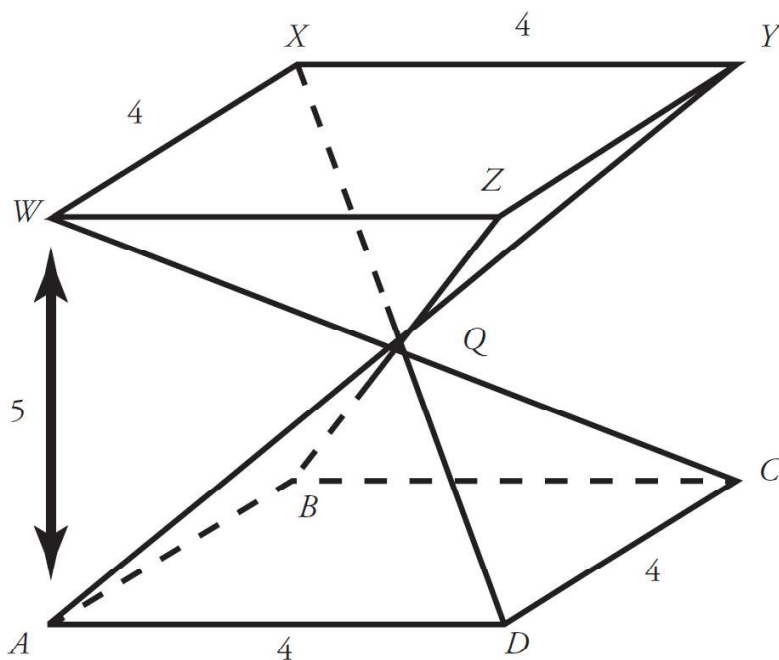
19. **8** When no picture is provided, it helps to draw one. First, rewrite each equation so that it is in the slope-intercept form of a line, which is  $y = mx + b$ , where  $m$  is the slope and  $b$  is the  $y$ -intercept of the line. The first equation becomes  $2y \leq x + 4$ , or  $y \leq \frac{1}{2}x + 2$ . The second equation becomes  $y \geq 2x - 4$ . The resulting graph looks as follows:



As the graph shows, the greatest  $x + y$  is the point at which the two lines intersect. Set the equations of the two lines,  $y = \frac{1}{2}x + 2$  and  $y = 2x - 4$ , equal to each other and solve for  $x$ . The resulting equation is  $\frac{1}{2}x + 2 = 2x - 4$ . Solve for  $x$  to get  $-\frac{3}{2}x + 2 = -4$  or  $-\frac{3}{2}x = -6$ , so  $x = 4$ . Next, plug 4 into one of the two equations to solve for  $y$ . Therefore,  $y = 2(4) - 4 = 4$  and  $x + y = 4 + 4 = 8$ . The correct answer is 8.

20.  $\frac{80}{3}$   
 or **26.6** or  
**26.7**

Start by drawing the figure and labeling what you know. Because you know  $ABCD$  and  $WXYZ$  are both squares, you know all the sides:



To find the areas of the two pyramids, you need the area of the bases and the heights. Because  $Q$  is equidistant from the points in each square and all the lines between the squares go through point  $Q$ ,  $Q$  must itself be equidistant from the two planes. That makes  $Q$  2.5 units from the middle of square  $ABCD$  and also 2.5 units from the middle of square  $WXYZ$ . This distance is the height of each pyramid.

Because the pyramids are equal, you can solve for the volume of one pyramid and double that for the answer.

#### Section 4: Math (Calculator)

- D** Whenever there are variables in the question and in the answers, think Plugging In. Let  $d = 2$ . For \$1 the air pump dispenses  $90 \times 4 = 360$  pounds of air. Therefore, for \$2 the air pump will dispense  $360 \times 2 = 720$  pounds of air. Plug in 2 for  $d$  in the answer choices to see which answer equals 720. Choice (A) becomes  $P = 2 + 90 = 92$ . Eliminate (A). Choice (B) becomes  $P = 2 + 360 = 362$ . Eliminate (B). Choice (C) becomes  $P = 90(2) = 180$ . Eliminate (C). Choice (D) becomes  $P = 360(2) = 720$ . Therefore, the correct answer is (D).
- A** Set up a proportion:  $\frac{1 \text{ foot}}{0.30 \text{ meters}} = \frac{6 \text{ feet}}{x \text{ meters}}$ . Cross-multiply to get  $x = 6 \times 0.30 = 1.8$  meters. Therefore, the correct answer is (A).

3. **B** In order to find the undeveloped area, take the entire area of the park and subtract the area of the developed portions. Subtract the 4 acre lake to get  $44 - 4 = 40$  undeveloped acres. Next, subtract the largest and smallest possible soccer field area:  $40 - 10 = 30$ , and  $40 - 8 = 32$ . Therefore, the correct answer is (B).
4. **B** Weight is shown on the horizontal axis of the graph, given in tons. Look for the mark indicating 3 on this axis; then draw a vertical line from that mark to the line of best fit. Once you hit it, draw a horizontal line over to the vertical axis. It should hit between 20 and 25 miles per gallon, slightly closer to the mark for 25. This makes (B) the credited response. Draw your lines carefully, using your answer sheet as a straightedge if necessary, to avoid trap answers like the close-but-not-quite (C).
5. **C** You can see from the graph that from 2000 to 2002, the number of coati increased from 140 to 160. From 2002 to 2004, the number increased from 160 to 180. Therefore, the number of coati is increasing at a rate of 20 every 2 years. In 2006, if the rate of increase remains the same, the number of coati should be  $180 + 20 = 200$ , which is (C).
6. **B** The question states that there are infinitely many solutions to the equation. That means any real number should work for  $d$ . Plug in an easy number like 0 for every  $d$  in the equation to get  $\frac{0+10-0}{3} = \frac{0+a}{3}$ . Simplify the equation to  $\frac{10}{3} = \frac{a}{3}$ , so  $a = 10$ , which is (B).
7. **A** First, convert the minutes shown in the graph to seconds. Multiply 15 minutes by 60 seconds to get 900 seconds. Then, since speed is distance divided by time, simply divide 3,000 meters by 900 seconds. The answer is 3.3 m/s, which is (A).
8. **C** Plug 2 in for  $y$  in the answers to see which function most closely equals the area of 14,910. Choice (A) becomes  $15,000 \left( \frac{1}{2} \right) = 7,500$ . This does not match the target number, so eliminate (A). Choice (B) becomes  $15,000 (0.003)^2 = 0.135$ . Eliminate (B). Choice (C) becomes  $15,000(0.997)^2 \approx 14,910$ . The correct answer is (C).
9. **B** First, calculate what Mike's daily calorie consumption is during finals. 12% of 1,680 is  $0.12 \times 1,680 = 201.6$ . During finals Mike consumes  $1,680 + 201.6 = 1,881.6$  calories per day. Whenever the question includes variables, Plug in. Let  $d = 2$ . Over 2 days Mike consumes  $2 \times 1,881.6 = 3,763.2$  calories. He also

adds 900 calories at the end of finals. His total consumption over the entire finals period is  $3,763.2 + 900 = 4,663.2$  calories, so 4,663.2 is the target number. Plug in 2 for  $d$  in each of the answer choices. In (A),  $1.12[1,680(2) + 900] = 4,771.2$ , which is not the target number. Eliminate (A). In (B),  $1.12[1,680(2)] + 900 = 4,663.2$ , which is the target. Leave (B), but check the other answer choices just in case. In (C),  $1.12(1,680 + 900)(2) = 5,779.2$ , and in (D),  $[1,680 + (0.12)(2)] + 900 = 2,580.24$ . Eliminate both (C) and (D). The correct answer is (B).

10. **D** Use Process of Elimination on this question. Choice (A) cannot be correct because more juniors prefer Austin to Pensacola. Choice (B) sounds appealing, but “more than three times as likely” means the seniors as a whole need to prefer Pensacola more than three times as much as the juniors do as a whole. Seniors prefer Pensacola 23 out of 42, or 55%. Juniors prefer it 7 out of 21, or 33%. So, seniors do not prefer Pensacola more than three times as much as juniors do. You can also eliminate (C) because more than half of all juniors prefer Austin, while less than half of all seniors prefer Austin. The statement in (D) is correct since 7 is one-third of the total of 21 juniors.
11. **B** We are looking for the probability that a randomly selected person is a man with a doctoral degree. There are 16,232 men with doctoral degrees, and 220,532 total adults aged 25 years or older. So the probability that a randomly selected person fits the category we are looking for is  $\frac{16,232}{220,532} = 0.07 = 7\%$ , which is (B).
12. **C** Whenever there are variables in the question and in the answers, think Plugging In. If  $x = 10$ , then  $C = 110 + \frac{10}{2} = 110 + 5 = 115$  and  $R = 15(10) - \frac{10^2}{10} = 150 - \frac{100}{10} = 150 - 10 = 140$ . Therefore, the profit can be calculated as  $140 - 115 = 25$ . Plug 10 in for  $x$  in the answers to see which answer equals the target number of 25. Choice (A) becomes  $-\frac{10^2}{10} - \frac{31}{2}(10) + 110 = -\frac{100}{10} - 31(5) + 110 = -10 - 155 + 110 = -55$ . This doesn't match the target number, so eliminate (A). Choice (B) becomes  $-\frac{10^2}{10} - \frac{29}{2}(10) + 110 = -\frac{100}{10} - 29(5) + 110 = -10 - 145 + 110 = -45$ . Eliminate (B). Choice (C) becomes  $-\frac{10^2}{10} + \frac{29}{2}(10) - 110 = -\frac{100}{10} + 29(5) - 110 = -10 + 145 - 110 = 25$ . Keep (C), but check

(D) just in case it also works. Choice (D) becomes  $-\frac{10^2}{10} + \frac{31}{2}(10) - 110 = -\frac{100}{10} + 31(5) - 110 = -10 + 155 - 110 = 35$ . Eliminate (D) and choose (C).

13. **D** To stay at his fancy hotel for three nights at 2,000 Moroccan dirhams per night, Erik will need 6,000 dirhams. Using the currency conversion rate of 1 dirham = \$0.11, we can multiply  $6,000 \times 0.11$  to determine that Erik's hotel stay will cost \$660. Since his bank allows him to withdraw only \$200 at a time, Erik must go to the ATM four times: (D).
14. **C** Start with the easier equation first and use Process of Elimination. The easier equation involves the total amount of gas sold. According to the question, 850 gallons of gasoline were sold, which can be expressed as  $u + p = 850$ . Eliminate (D) since it does not include this equation. The other equation in the answers is related to the amount of money collected. According to the question, \$3,016.50 was collected; however, this sum included a discount of \$0.10 per gallon for 100 of the gallons that were purchased or  $\$0.10 \times 100 = \$10$ . Without the discount unleaded gas costs \$3.49 and premium gas costs \$3.79 a gallon, and the amount of money collected would have been  $\$3,016.50 + \$10 = \$3,026.50$ . Only (C) provides the correct total. Therefore, the correct answer is (C).
15. **B** First, let's figure out how many students are enrolled in AP courses other than Biology and U.S. History. We know that 319 students are enrolled in at least one AP course, and of those,  $75 + 58 = 133$  are enrolled in Biology and U.S. History. However, since 22 students are enrolled in both of those courses, we need to subtract 22 from 133 (so as not to double-count the students taking both courses). That leaves us with  $133 - 22 = 111$  total students who are taking AP Biology and AP U.S. History. Of the 319 students taking AP courses, that means there are  $319 - 111 = 208$  students taking AP courses other than Biology and U.S. History. We know that there are 784 juniors and seniors total, so  $\frac{208}{784} = 0.265$ , or approximately 27% of all juniors and seniors, which is (B).
16. **A** Total score = average score  $\times$  the number of tests. In order for Mateo to receive a B, he needs his total score over the 3 tests to be between  $3 \times 80 = 240$  points and  $3 \times 89 = 267$  points. On his first and second tests, Mateo scored a total of  $79 + 95 = 174$  points. Therefore, on his third test Mateo

must score between  $240 - 174 = 66$  and  $267 - 174 = 93$  points in order to receive a B. The correct answer is (A).

17. **A** Use Process of Elimination to solve this question. Choice (A) is possible so leave it. Choice (B) discusses the mass of the fertilizer, but no reference to mass is made in the question. Eliminate (B). According to the question, the quantity described in (C) is represented by  $A$ , so eliminate (C). According to the question, the quantity described in (D) is represented by  $Y$ , so eliminate (D). The correct answer is (A).
18. **D** The mode of the combined groups cannot be determined without knowing exactly what scores each group received. To illustrate this, plug in! Let's say that the scores of Group A were  $\{1, 1, 7, 7, 7\}$ , and the scores for Group B were  $\{1, 1, 6, 6, 6\}$ . The scores of the whole group would, therefore, be  $\{1, 1, 1, 1, 6, 6, 6, 7, 7, 7\}$ . This set has a mode of 1, so eliminate (A), (B), and (C) and choose (D).
19. **C** First, count the number of blocks that Josh needs to drive. He needs to drive 4 blocks north and 6 blocks east for a total of 10 blocks. You need to convert this into miles, which can be done with the following proportion:  $\frac{10 \text{ blocks}}{x \text{ miles}} = \frac{1 \text{ block}}{.6 \text{ miles}}$ . The drive is a total of 6 miles. Since Josh drives at 30 miles per hour, you can set up a second proportion:  $\frac{30 \text{ miles}}{1 \text{ hour}} = \frac{6 \text{ miles}}{x \text{ hours}}$ . Cross-multiply and solve to get that  $x = \frac{6}{30}$  or  $\frac{1}{5}$  of an hour. This equals 12 minutes in (C).
20. **D** The first step is to rewrite the bottom equation so that it is in the same format as the first equation. Move all of the variables in the bottom equation to the left side of the equation to get  $6s - t = 12$ . If the answer is (A) and there are infinitely many solutions to the system of equations, then the two equations must be the same equation. To determine whether this is the case, multiply the top equation through by 3 to get  $6s - t = 30$ . Since it cannot be the case that the equation  $6s - t$  equals both 12 and 30, the correct answer is (D). There are no solutions to the system of equations.
21. **C** Two factors are important in determining how to poll a group: the size of the sample and how that sample is selected. Secretary Stephens's plan has the largest sample with 250 students, but all those students belong to the senior class. Perhaps the senior class would prefer a theme that the other three classes would not. The sample is skewed and not necessarily representative of the entire student body, so eliminate (B). The other three plans all poll

100 students, so the manner in which those students are selected becomes more important. President Peterson's plan is also skewed specifically to friends of the student council members, whose opinions might not reflect the majority, so eliminate (A). Vice President Vaiyda's plan has more potential for a varied sample, but it is still not as good as Treasurer Thompson's plan, which guarantees that a random assortment of people will be chosen for the poll. Eliminate (D), and choose (C).

22. **C** Since  $x$  and  $y$  are points on the circle, plug in the point  $(-2, -2)$  into the left side of the equation. This gives you  $(-2 + 3)^2 + (-2 - 1)^2$ , which equals  $1^2 + (-3)^2$ . Simplifying, you get 10. Because 10 is greater than  $r^2$  (which is 9), the point must be outside the circle, which is (C).
23. **D** Whenever the question includes variables, think Plugging In. According to the question,  $\frac{x - 12}{\sqrt{8}} = \frac{x\sqrt{2}}{4} - C$ . Plug in 12 for  $x$  to get  $\frac{12 - 12}{\sqrt{8}} = \frac{12\sqrt{2}}{4} - C$ , or  $\frac{0}{\sqrt{8}} = \frac{12\sqrt{2}}{4} - C$ . Solve for  $C$  to get  $0 = \frac{12\sqrt{2}}{4} - C$ , then  $0 = 3\sqrt{2} - C$ , and finally  $3\sqrt{2} = C$ . The correct answer is (D).
24. **A** All of the answer choices refer to the number of salary-satisfied bachelor's-degree-holders, so you must use the follow-up survey results to calculate that number. First, find the percent of bachelor's-degree-holders who reported also being salary-satisfied in the follow-up survey. This number was 658 out of the 1,000 people, so divide 658 by 1,000 and then multiply by 100 to get the percent. The result is 65.8% salary-satisfied bachelor's-degree-holders for the follow-up survey. Since the people in the follow-up were randomly selected, you can assume that they are generally representative of the bachelor's-degree-holding population at large. Therefore, the 65.8% of salary-satisfied individuals should be true of all 24,236,000 job-satisfied bachelor's-degree-holders. Watch the units on charts—this one is in the thousands, so there are 24,236,000 not 24,236 job-satisfied bachelor's-degree-holders. Multiply 65.8%, or .658, by the total number of bachelor's-degree-holders, 24,236,000, to find that there should be 15,947,288 salary-satisfied, job-satisfied bachelor's-degree-holders. Choice (A) is the closest to this and is the credited response.
25. **A** The equation of a line expressed in slope-intercept form is  $y = mx + b$ , where  $m$  is the slope and  $b$  is the  $y$ -intercept. One way to find the  $y$ -intercept of line  $d$  is to plug in the slope and given point and solve for  $b$ . The equation  $y = mx + b$  becomes  $1 = \frac{4}{5}(1) + b$ . Subtract  $\frac{4}{5}$  from both sides to get  $b = \frac{1}{5}$ . Another



approach is to use the slope formula to find  $b$ . The  $y$ -intercept of a line is where the line crosses the  $y$ -axis; at that point  $x = 0$ . Therefore, in addition to the point  $(1, 1)$ , there is another point  $(0, b)$  that lies on line  $d$ . The equation for finding the slope of the line given two points is  $\frac{y_2 - y_1}{x_2 - x_1}$ . Therefore  $\frac{b-1}{0-1} = \frac{4}{5}$  or  $\frac{b-1}{-1} = \frac{4}{5}$ . Cross-multiply to get  $5(b - 1) = -4$ . Distribute the 5 to get  $5b - 5 = -4$ . Solve for  $b$  to get  $5b = 1$ , and  $b = \frac{1}{5}$ . The  $y$ -intercept of line  $e$  is 3 times  $\frac{1}{5}$ , so the  $y$ -intercept of line  $e$  is  $\frac{3}{5}$ . Additionally, parallel lines have slopes that are equal to each other. Therefore, line  $e$  will also have a slope equal to  $\frac{4}{5}$ . Rewrite the equation in (A) in the slope-intercept form of the equation to get  $5y = 4x + 3$ , or  $y = \frac{4}{5}x + \frac{3}{5}$ . The slope of this line is  $\frac{4}{5}$  and the  $y$  intercept is  $\frac{3}{5}$ . Therefore, the correct answer is (A).

26. **B** An extraneous solution is an answer that when plugged back into the equation causes the equation to be false. Begin by factoring and reducing the fraction on the left side of the equation to get  $\frac{(q-7)(q+6)}{q+6} = \sqrt{q-5}$  or  $q - 7 = \sqrt{q-5}$ . Square both sides of the equation to get  $q^2 - 14q + 49 = q - 5$ . Set the equation to 0 to get  $q^2 - 15q + 54 = 0$ . Factor the quadratic to get  $(q - 9)(q - 6) = 0$ . Therefore,  $q = 9$  or  $q = 6$ . Eliminate (A) and (C) because neither of these answers is a possible solution for  $q$ . Plug 6 in for  $q$  in the equation to see if this value of  $q$  works. The equation becomes  $\frac{6^2 - 6 - 42}{6 + 6} = \sqrt{6 - 5}$ . Solve both sides of the equation to get  $\frac{-12}{12} = 1$ . Since this statement is not true, 6 is the extraneous solution. The correct answer is (B).
27. **D** First, determine the total number of gamers in each game type by adding up the columns. There are 110,000,000 gamers preferring first person shooters, 52,000,000 preferring sports games, and 85,000,000 preferring adventure games. You don't know by how much the 9- to 13-year old group will increase in sport game preference, but presumably the increase will be made to match the currently largest group, first person shooters. Therefore, in

order to raise adventure games to the level of first person shooters, you need to add  $110,000,000 - 85,000,000 = 25,000,000$  gamers to the adventure games group. If you are going to do so by doubling one of the age groups, then 25,000,000 is equal to the size of the current group. 9- to 13-year olds currently have 25,000,000 preferring adventure games, so (D) is your answer.

28. **A** Whenever there are variables in the question and in the answers, think Plugging In. Let's say that for Emilio  $a = 2$ ,  $t = 4$ , and  $k = 10$ . Then Emilio's accrued vacation days can be calculated as  $V(t) = 2(4) + 10 = 18$ . This means that Martin has accrued  $18 + 9 = 27$  vacation days. Because  $a$  and  $k$  are constants, their values do not change. The number of years that Martin has worked at the manufacturing plant can therefore be calculated as  $27 = 2t + 10$ . Solve for  $t$  to get  $17 = 2t$  or  $t = \frac{17}{2} = 8.5$ . Therefore, Martin has worked  $8.5 - 4 = 4.5$  more years than Emilio. Plug 2 in for  $a$  in the answers to see which answer equals 4.5. Choice (A) becomes  $\frac{9}{2} = 4.5$ . Keep (A) but check the remaining answers just in case. Choice (B) becomes  $9 - 2 = 7$ , (C) becomes  $9 + 2 = 11$ , and (D) becomes  $9(2) = 19$ . Eliminate (B), (C), and (D). The correct answer is (A).

29. **C** SOHCAHTOA tells you that sine is  $\frac{\text{opposite}}{\text{hypotenuse}}$ , so if the side opposite the angle with measure  $x^\circ$  is  $O$  and the hypotenuse is  $H$ , then  $\frac{O}{H} = \frac{2\sqrt{29}}{29}$ . Solve for  $O$ , and you get  $\frac{2H\sqrt{29}}{29}$ . Now, you can use the Pythagorean theorem with the given side and substituting  $\frac{2H\sqrt{29}}{29}$  for  $O$  in order to solve for  $H$ :  $10^2 + \left(\frac{2H\sqrt{29}}{29}\right)^2 = H^2$ . Solve the exponents, and then reduce the fraction:  $100 + \frac{116H^2}{841} = H^2$ ;  $100 + \frac{4H^2}{29} = H^2$ . Subtract  $\frac{4H^2}{29}$  from both sides:  $100 = \frac{25H^2}{29}$ . Divide both sides by  $\frac{25}{29}$ , so  $116 = H^2$ . Square root both sides, and you find that  $H = 2\sqrt{29}$ . Using  $O = \frac{2H\sqrt{29}}{29}$  from above, you can solve for  $O$ :  $O = \frac{2(2\sqrt{29})\sqrt{29}}{29} = 4$ . Add the sides and you get  $14 + 2\sqrt{29}$ , which is (C).

30. **D** A good approach to this question would be to plug in some numbers. Start with the number of juniors and plug in a number that is easy to deal with, such as 200. Then you can set up a proportion using the ratio given in the question stem:  $\frac{\text{juniors}}{\text{seniors}} = \frac{4}{3} = \frac{200}{x}$ . Cross-multiply and solve for  $x$  to determine that the number of seniors would be 150. Next, use the relationship  $\frac{\text{seniors}}{\text{sophomores}} = \frac{5}{4}$ . Using 150 for seniors, you get  $\frac{\text{seniors}}{\text{sophomores}} = \frac{5}{4} = \frac{150}{x}$ . Cross-multiply and solve for  $x$  to determine that the number of sophomores would be 120. Next, use the relationship  $\frac{\text{freshmen}}{\text{sophomores}} = \frac{7}{6}$ . Using 120 for sophomores, you get  $\frac{\text{freshmen}}{\text{sophomores}} = \frac{7}{6} = \frac{x}{120}$ . Cross-multiply and solve for  $x$  to determine that the number of freshmen would be 140. The ratio of freshmen to seniors, therefore, would be  $\frac{\text{freshmen}}{\text{seniors}} = \frac{140}{150} = \frac{14}{15}$ , which is (D).
31. **75** Hayoung swims 2.5 miles. She runs  $11 \times 2.5 = 27.5$  miles, and she bikes  $18 \times 2.5 = 45$  miles. Her total triathlon mileage =  $2.5 + 27.5 + 45 = 75$  miles. The correct answer is 75.
32. **5** Plug 1,230 in for the value of the function to get  $1,230 = 250x - 20$ . Solve for  $x$  to get  $1,250 = 250x$  and  $x = 5$ . The correct answer is 5.
33. **918** In order to find the greatest profit, maximize the number of acres of soybeans Marty plants, since soybeans bring in more money per acre than does wheat. At most, Marty can plant 7 acres of soybeans. Therefore, the most money he can make on soybeans is  $7 \times 120 = 840$ . He then has  $9 - 7 = 2$  acres left on which to plant wheat. The money he makes from this wheat is  $2 \times 90 = 180$ . The total amount Marty makes before taxes is therefore  $840 + 180 = 1,020$ . The tax on this money equals  $1,020 \times 0.10 = 102$ . Subtract the amount Marty pays in taxes to get  $1,020 - 102 = 918$  profit. The correct answer is 918.
34. **19** The formula for the area of a circle is  $A = \pi r^2$ . If a full circle were shown, its radius would be 4, so the area of the full circle would be  $A = \pi 4^2 = 16\pi$ . The interior angle of the fraction of the circle shown can be calculated as  $90 + 45 = 135$  degrees. Therefore, the figure shown is  $\frac{135}{360}$  of the area of a full circle.

The area of the figure can be calculated as  $\frac{135}{360}(16\pi) = 0.375(16\pi) = 6\pi \approx 18.8 \approx 19$ . The correct answer is 19.

35. **6** The two triangles share three angles; thus they are similar.  $\overline{AC}$  is twice the length of  $\overline{BC}$ , because it is bisected by  $\overline{BD}$ . This relationship is constant between the two similar triangles. Therefore,  $\overline{BD}$  is half of  $\overline{AE}$ :  $12 \div 2 = 6$ .
36. **20** First, determine the grams of protein in the bar. If the bar contains 32% of the daily recommended serving of protein, and the daily recommended serving of protein is 50 grams, then the bar contains  $0.32 \times 50 = 16$  grams of protein. Next, determine the grams of fat in the bar by using the percent change equation: percent change =  $\frac{\text{difference}}{\text{original}} \times 100$ . The percent change is 700, and the original is the grams of fat (because percent more means the original is the smaller number), which means  $700 = \frac{16 - x}{x} \times 100$ . Divide both sides by 100:  $7 = \frac{16 - x}{x}$ . Multiply both sides by  $x$  to get  $7x = 16 - x$ . Add  $x$  to both sides to get  $8x = 16$ . Divide both sides by 8 and you find  $x = 2$ . That is the number of grams of fat in the bar. To find the daily recommended serving of fat, translate English to math. 2 is 10% of the daily recommended serving, so if the daily recommended serving is  $y$ ,  $2 = 0.10y$ . Divide both sides by 0.10, and you find that the daily recommended serving of fat is 20.
37. **1** First, you need to determine the content of Set  $R$ . If Set  $R$  consists of all the one-digit prime numbers, then  $R = \{2, 3, 5, 7\}$ . The sum of the elements of Set  $S$  would therefore be  $2 + 3 + 5 + 7 + x = 30$ . Combine like terms:  $17 + x = 30$ . Subtract 17 from both sides, and you find  $x = 13$ . Plug  $x = 13$  into the equation and solve:  $(13)^2 - 11(13) - 25 = 1$ .
38. **8** The additional positive integer  $x$  cannot equal 2, 3, 5, or 7 (otherwise there would be a mode). Next, determine what the median could be for various ranges of  $x$ . If  $x$  is less than 2, then the set would be, in consecutive order,  $\{x, 2, 3, 5, 7\}$ , making the median 3. Try this set. If the median equals the mean, then the sum of the elements divided by 5 (the number of elements) must equal 3:  $\frac{x + 2 + 3 + 5 + 7}{5} = 3$ . Multiply both sides by 5 and combine like

terms:  $x + 17 = 15$ . Subtract 17 from both sides, and you find  $x = -2$ .

However,  $x$  must be a positive integer, so this doesn't work. Try a new median. If  $x = 4$ , then the set is  $\{2, 3, 4 (x), 5, 7\}$ , with a median of 4.

However, the mean is  $\frac{2 + 3 + 4 + 5 + 7}{5} = 5.25$ , not 4, so this doesn't work.

If  $x$  is 6 or greater, the set would either be  $\{2, 3, 5, 6 (x), 7\}$  or  $\{2, 3, 5, 7, x\}$ .

In either case, the median is 5. Set up the average equal to the median of 5:

$\frac{2 + 3 + 5 + 7 + x}{5} = 5$ . Multiply both sides by 5 and combine like terms:  $17 +$

$x = 25$ . Subtract 17 from both sides, and you find that  $x = 8$ .



# Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

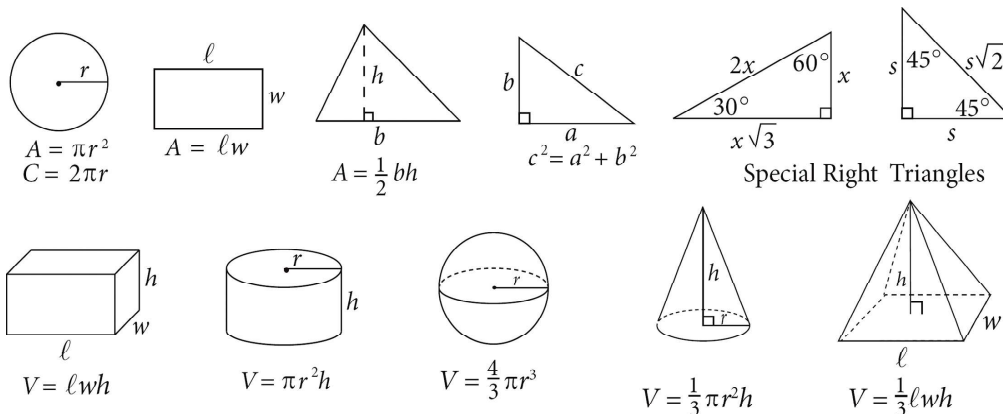
## DIRECTIONS

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

## NOTES

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

## REFERENCE



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

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

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

- 
1. David is planning a dinner for his birthday. At one restaurant, the cost per person for dinner is \$15, with an additional one-time set-up charge of \$35. David has a maximum budget of \$150. If  $p$  represents the number of people (including David) who will attend the dinner, which of the following inequalities represents the number of people who can attend within budget?
- A)  $15p \leq 150 + 35$   
B)  $35 \leq 150 - 15p$   
C)  $15p \geq 150 - 35$   
D)  $35 \geq 150 - 15p$
2. When a virus breaks out, each infected person can infect multiple new people. In a particularly bad flu outbreak at an elementary school, the number of infected people triples each day in the first school week of January. If 5 people were sick with the flu on Monday, which of the following equations best predicts the number of infected people,  $I(d)$ ,  $d$  days after Monday?
- A)  $I(d) = 5 \times 3d^2$   
B)  $I(d) = 5d^3$   
C)  $I(d) = 5 \times 3^d$   
D)  $I(d) = 5 \times 9d$
3. During the month of July, the number of units,  $y$ , of a certain product sold per day can be modeled by the function  $y = -3.65x + 915$ , where  $x$  is the average daily temperature in degrees Fahrenheit. Which of the following statements must be true?
- A) As the temperature increases, the number of units sold decreases.  
B) As the temperature increases, the number of units sold remains constant.  
C) As the temperature increases, the number of units sold increases.  
D) There is no linear relationship between temperature and the number of units sold.
4. Newton's law of gravitation describes the strength of the force  $F$  between two objects with masses  $M$  and  $m$  separated by a distance of  $r$  units and is defined as  $F = \frac{GMm}{r^2}$ . Which of the following gives the value of Newton's gravitational constant  $G$ , in terms of  $F$ ,  $M$ ,  $m$ , and  $r$ ?
- A)  $G = Fr^2Mm$   
B)  $G = \frac{Fr^2}{Mm}$   
C)  $G = \frac{FMm}{r^2}$   
D)  $G = \frac{F}{r^2Mm}$

5. Which of the following expressions is equivalent to  $(4s)^{\frac{1}{3}}$ ?
- A)  $\frac{2}{\sqrt{s}}$
- B)  $\frac{1}{12s^3}$
- C)  $2\sqrt{s}$
- D)  $\sqrt[3]{4s}$
6. If  $A$  and  $B$  both lie on a circle with an area of  $16\pi$ , and the length of  $\widehat{AB}$  is  $2\pi$ , what is the radian measure of the central angle between  $A$  and  $B$ ?
- A)  $\frac{\pi}{8}$
- B)  $\frac{\pi}{4}$
- C)  $\frac{\pi}{2}$
- D)  $\frac{2\pi}{3}$
7. Oil is being drained from an oil tank at a constant linear rate. Four hours after draining of the tank began, the volume of oil in the tank was 740 gallons, and seven hours after draining of the tank began, the volume was 545 gallons. Which of the following functions best models  $v(t)$ , the volume of oil in the tank, in gallons,  $t$  hours after draining of the tank began?
- A)  $v(t) = 740 - t$
- B)  $v(t) = 740 - 65t$
- C)  $v(t) = 1000 - 195t$
- D)  $v(t) = 1000 - 65t$
8. What is the result of multiplying  $8s^2 - 6s + 2$  by  $4s - 1$ ?
- A)  $14s - 2$
- B)  $16s^2 + 2s + 2$
- C)  $32s^3 - 16s^2 + 2s + 2$
- D)  $32s^3 - 32s^2 + 14s - 2$



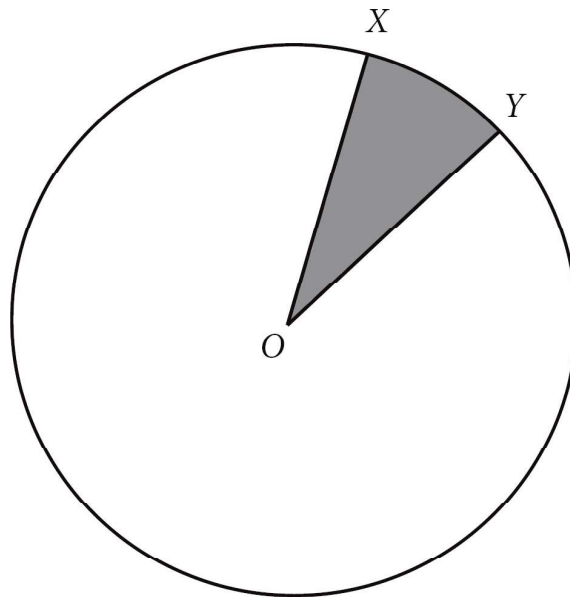
9. If the equation for a parabola is  $y = 5(x - 3)^2 - 3$ , which of the following points represents the parabola's vertex?
- A) (3, -3)
  - B) (3, 0)
  - C) (0, -3)
  - D) (-3, 3)

10.

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

In the equation above, what is the value of  $c$ ?

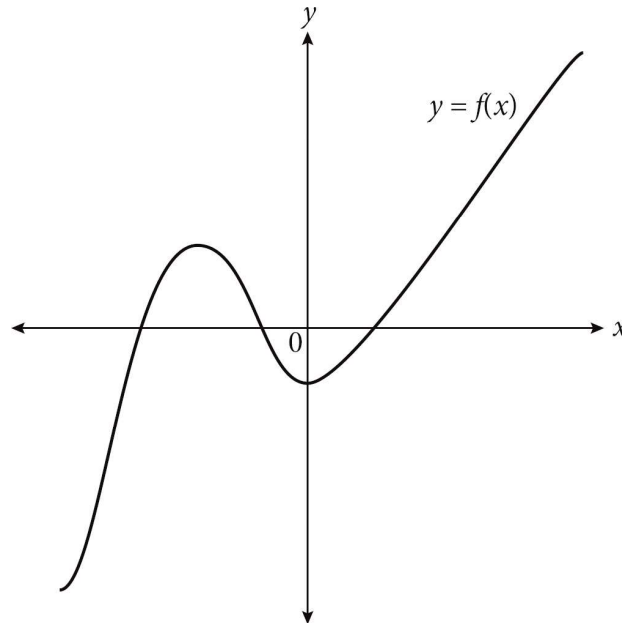
- A) -4
- B)  $-\frac{7}{4}$
- C)  $-\frac{7}{5}$
- D)  $\frac{1}{5}$



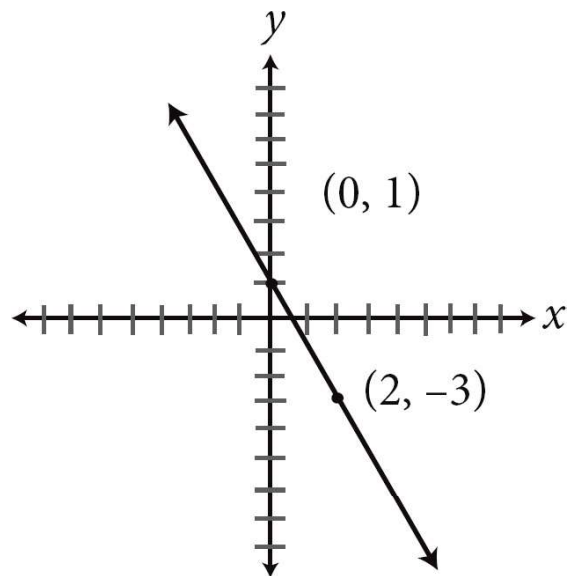
11. In the figure above,  $O$  is the center of the circle and the diameter is 10. If the area of the shaded region is  $\pi$ , what is the length of minor arc  $XY$ ?
- A)  $\frac{2\pi}{5}$
  - B)  $\frac{4\pi}{5}$
  - C)  $\frac{5\pi}{2}$
  - D)  $5\pi$

$$\begin{aligned}x + 3y &= 42 \\ 3x - y &= 8\end{aligned}$$

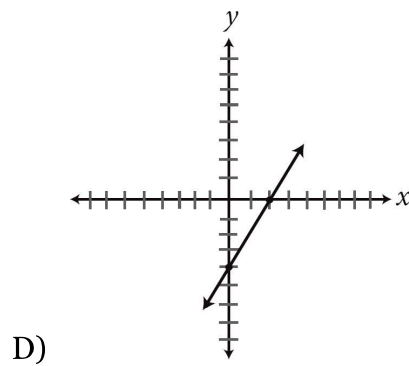
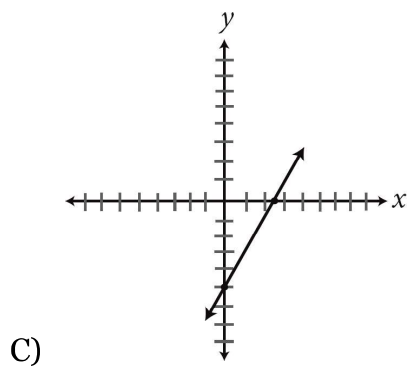
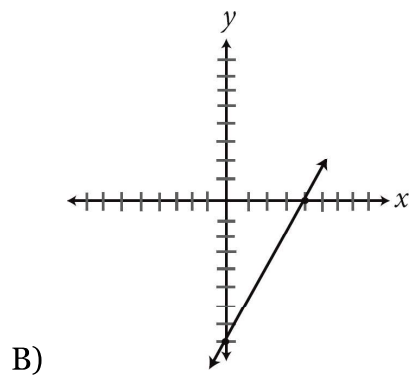
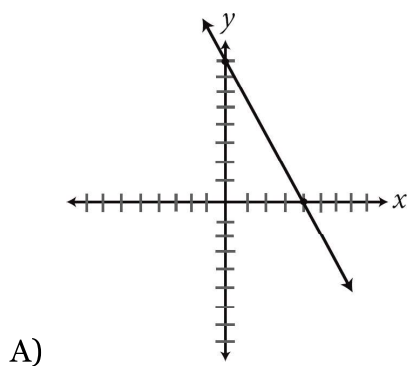
12. In the system of equations above, how many points of intersection do the equations share and what is their relationship, if any?
- A) Zero, and the lines are parallel.
  - B) Infinitely many, and the lines are the same line.
  - C) One, and the lines have no relationship.
  - D) One, and the lines are perpendicular.



13. The figure above shows the graph in the  $xy$ -plane of the function  $f$ . If  $q$ ,  $r$ ,  $s$  and  $t$  are distinct real numbers, which of the following could be  $f(x)$  ?
- A)  $f(x) = (x - q)^2$
  - B)  $f(x) = (x - r)(x + s)$
  - C)  $f(x) = (x - r)(x + s)(x + t)$
  - D)  $f(x) = (x - q)(x - r)(x + s)(x + t)$
14. A 40-foot tall arch with a parabolic shape has a line drawn between the bases of the two legs of the arch. If the height above the ground,  $y$ , of the arch can be written as the function  $y(x) = a(x - 20)(x + 20)$ , where  $x$  represents the horizontal distance along the line between the bases from a point on the ground directly under the highest point of the arch, then what is the value of negative constant  $a$  ?
- A)  $-\frac{1}{40}$
  - B)  $-\frac{1}{20}$
  - C)  $-\frac{1}{10}$
  - D)  $-20$



15. The graph of  $f(x)$  is shown in the  $xy$ -plane above. Which of the following could be the graph of  $-[f(x - 2) + 3]$ ?



$$h(t) = \frac{1}{2} at^2$$

16. As a space probe descends to the surface of Mars, its distance in meters above the surface can be modeled by the equation above. If  $t$  is the time in seconds it will take the probe to reach the surface, and it takes the probe 8 seconds to descend the final 120 meters to the surface, what is the value of the deceleration constant  $a$ ?

17.

$$\begin{aligned} 3h - j &= 7 \\ 2h + 3j &= 1 \end{aligned}$$

Based on the system of equations above, what is the value of  $h$  ?

18. A rectangular box has a volume of 24. If the length is halved and the height is tripled, what will be the new volume of the box?
19. If  $6e(e + 3) = 3e(2e + 4) + 5$ , what is the value of  $e$  ?
20. Abeena is making punch for a winter party in a punch bowl that can hold at most 9 quarts. She wants to get as much vitamin C in her punch as possible, so she is using only orange juice and grape juice. She has 6 quarts of orange juice, which has 2 grams of vitamin C per quart, and 7 quarts of grape juice, which has 1 gram of vitamin C per quart. If there are 4 cups in a quart, what is the greatest possible amount of vitamin C, in grams, that Abeena can have in one cup of her punch?



# Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

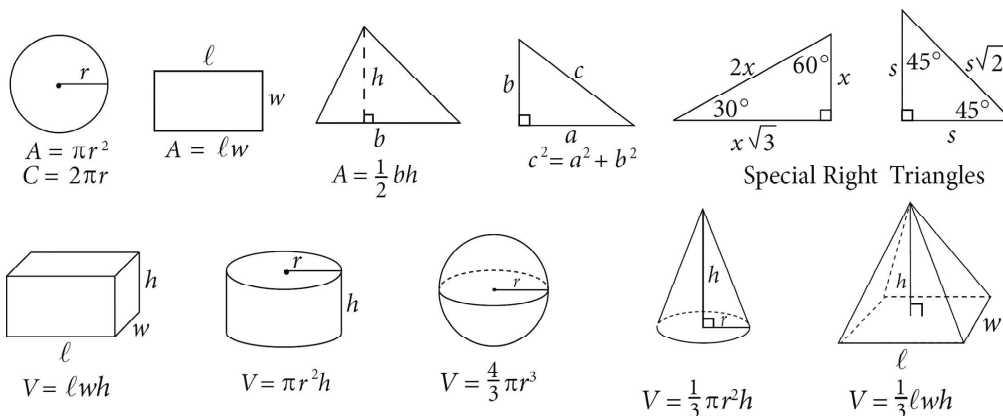
## DIRECTIONS

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

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

## REFERENCE



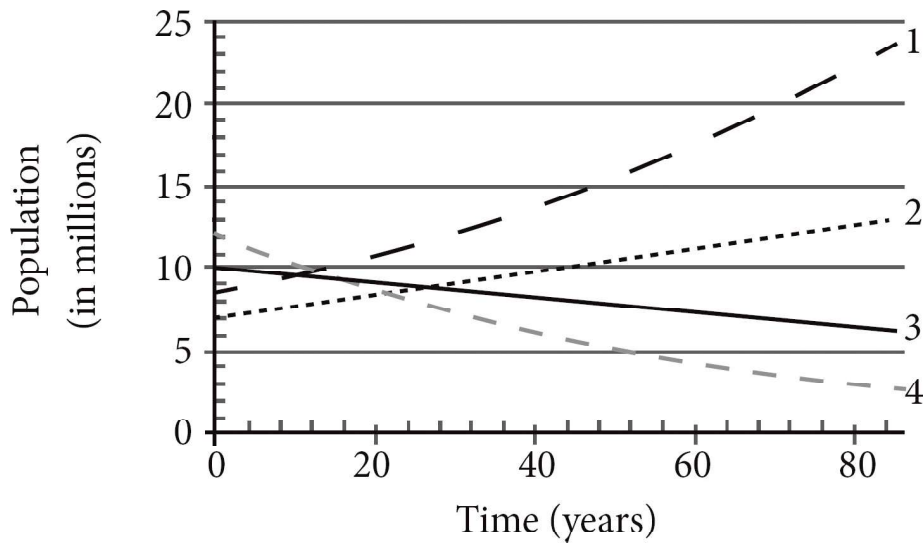
The number of degrees of arc in a circle is 360.

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

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

- 
1. If  $16a^2 + 4a - 6 = 0$ , what is a possible value of  $a$  ?
- A)  $-0.75$   
B)  $-0.5$   
C)  $0$   
D)  $1$
2. In order to make a profit, a zoo needs to sell at least 350 admission tickets each day. Four student groups, each of which includes 48 students, have purchased tickets for admission. If  $z$  represents the number of additional tickets sold today, and the zoo made its daily profit goal, which of the following inequalities could represent all possible values for  $z$  ?
- A)  $4(48) + z \leq 350$   
B)  $4(48) + z \geq 350$   
C)  $4(48) - z \leq 350$   
D)  $4(48) - z \geq 350$
3. A country's birth rate is the number of births per year per 1,000 people in the country, and a country's death rate is the number of deaths per year per 1,000 people. Immigration refers to the number of people who move into a country each year, and emigration refers to the number of people who move out of the country each year. A country's population growth is determined by these four variables. Table 1 gives birth, death, immigration, and emigration rates in four countries and lines 1-4 in Figure 1 model the population for the four countries shown over time.

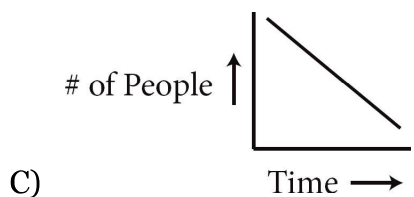
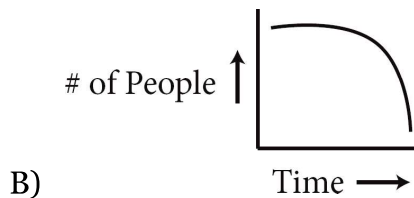
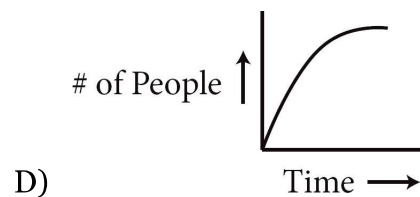
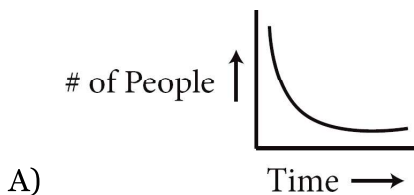
	<b>Birth</b>	<b>Death</b>	<b>Immigration</b>	<b>Emigration</b>
East Zealand	20	$x$	1,000	1,000
West Zealand	21	21	12,100	$y$
South Zealand	36	24	$z$	500
North Zealand	13	13	82,000	9,600



Line 1 represents which country's population?

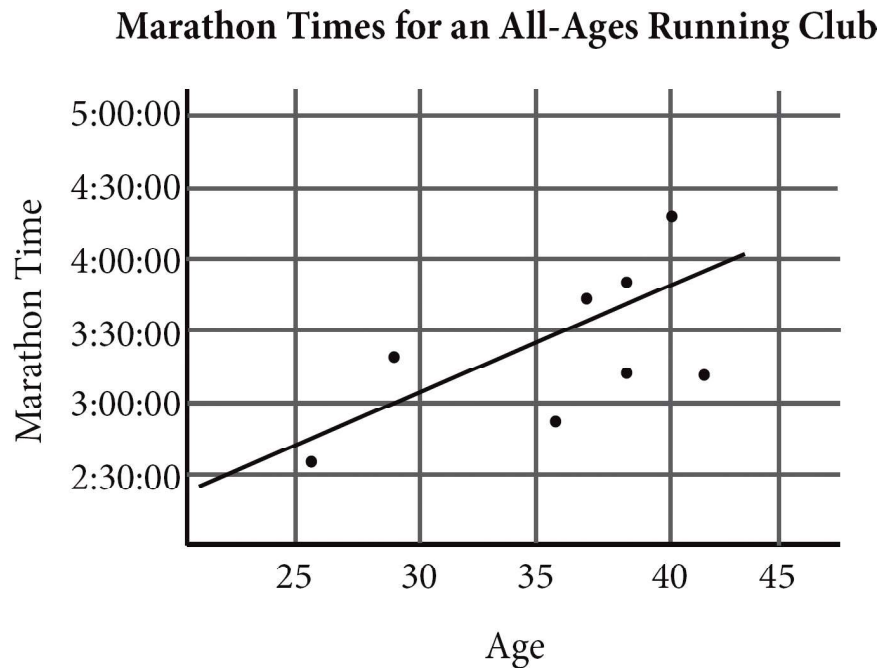
- A) East Zealand
- B) West Zealand
- C) North Zealand
- D) South Zealand

4. At the start of a new movie at the Cineplex 16, there are 250 people in the theater. However, 10% of the people walk out of the theater within the first 15 minutes of the movie starting. If another 10% leave in the next 15 minutes and this rate continues for the duration of the movie, which of the following graphs correctly models the number of people in the theater during the movie?



$$\frac{6}{2y} = \frac{y}{12}$$

5. Which of the following includes all possible values of  $y$  in the equation above?
- A)  $\{-6\}$
  - B)  $\{-6, 6\}$
  - C)  $\{6\}$
  - D)  $\{6, 36\}$



6. The scatterplot above displays the marathon times of the eight members of a running club in relation to their ages and the line of best fit. How many people have times at least fifteen minutes faster than what would be expected based on the line of best fit?
- A) One
  - B) Two
  - C) Three
  - D) Four



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Questions 7 and 8 refer to the following information.

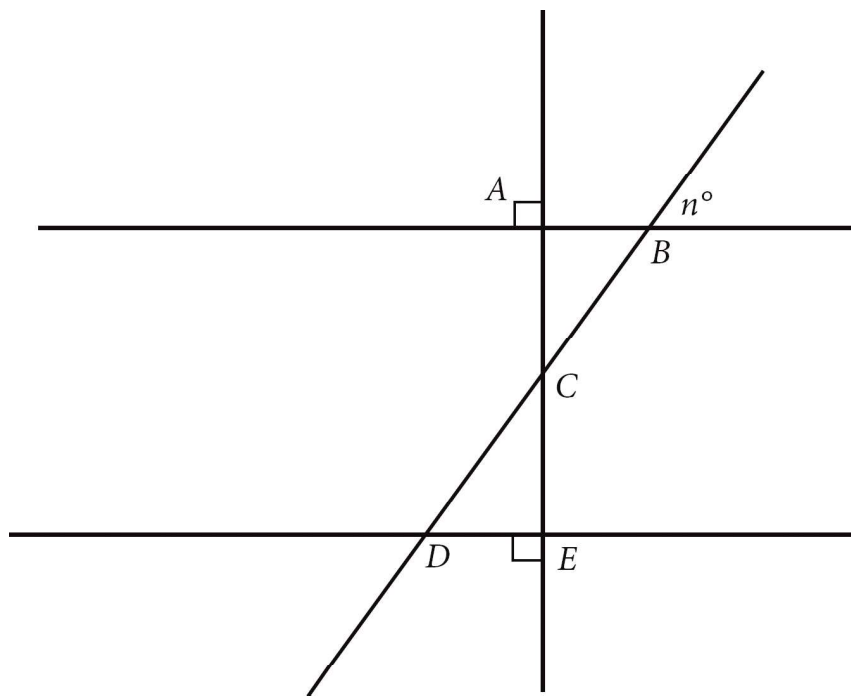
The table below shows the relative investment in alternative energy sources in the United States by type. One column shows the relative investment in 2007 of \$75 million total invested in alternative energy. The other column shows the projected relative investment in 2017 given current trends. The total projected investment in alternative energy in 2017 is \$254 million.

**United States Investment in Alternative Energy Sources**

	<b>Actual 2007 Investment</b>	<b>Projected 2017 Investment</b>
<b>Biofuels</b>	0.31	0.34
<b>Wind</b>	0.40	0.32
<b>Solar</b>	0.27	0.30
<b>Fuel Cells</b>	0.02	0.04
<b>Total</b>	1.00	1.00

7. Based on the information in the table, if an investment was made in alternative energy in 2007, what is the probability that the money was invested in wind resources?
- A)  $\frac{1}{25}$
- B)  $\frac{3}{10}$
- C)  $\frac{2}{5}$
- D)  $\frac{3}{5}$
8. Based on the information in the table, which of the following statements is the most accurate?
- A) The value of the 2007 investment in biofuels was approximately \$50 million.
- B) The portion of total alternative energy investment focused on wind sources is projected to decrease by 8% in 2017.
- C) The dollar amount invested in fuel cells in 2007 is projected to double in 2017.
- D) The top three types of alternative energy were invested in more equally in 2007 than they are projected to be in 2017.
-

9. Monster Truck Inc. leases a new truck for a down payment of \$3,200 plus monthly payments of \$380 per month for 36 months. Which of the following functions  $f$  represents the total amount paid, in dollars, after  $m$  months, where  $0 \leq m \leq 36$  ?
- A)  $f(m) = 380 + 3,200m$
  - B)  $f(m) = 3,200 + 36m$
  - C)  $f(m) = 3,200 + 380m$
  - D)  $f(m) = 10,480 - 380m$
10. What is the equation of a line that contains the point  $(6, -5)$  and has an  $x$ -intercept of 3 ?
- A)  $y = -\frac{5}{3}x + 5$
  - B)  $y = -\frac{4}{3}x + 3$
  - C)  $y = -\frac{3}{5}x + 3$
  - D)  $y = \frac{5}{3}x + 5$
11. A single frame of 35 mm film is about three-quarters of an inch long. A film reel holds up to 1,000 feet of film. How many reels are required for a two-hour, forty-seven minute film shot at 24 frames per second?
- A) 13
  - B) 14
  - C) 15
  - D) 16
12. Hua needs to receive completed surveys from at least 3,800 potential voters in her city. She has noticed that for every 5 surveys she sends out, only 1 survey is completed. Last week she received 1,350 completed surveys, and this week she received 900 completed surveys. Hua plans to send out  $s$  additional surveys. Which of the following inequalities shows all possible values for  $s$  that would ensure that Hua receives 3,800 completed surveys?
- A)  $s \geq 1,550$
  - B)  $s \geq 2,250$
  - C)  $s \geq 7,750$
  - D)  $s \geq 12,250$

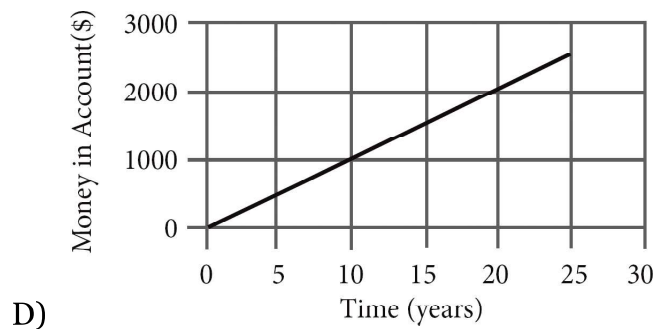
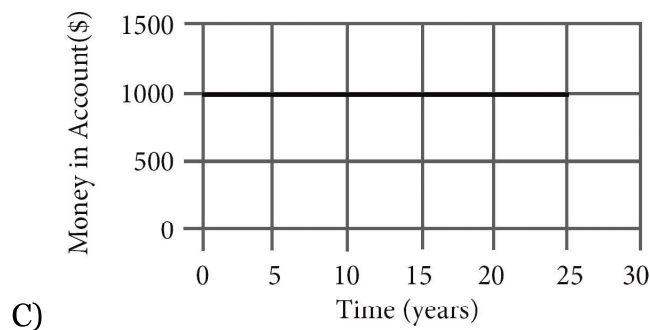
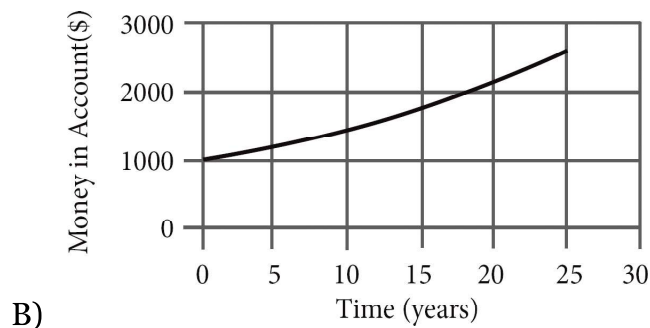
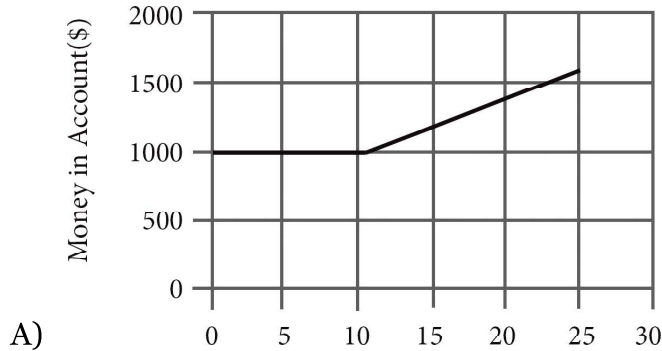


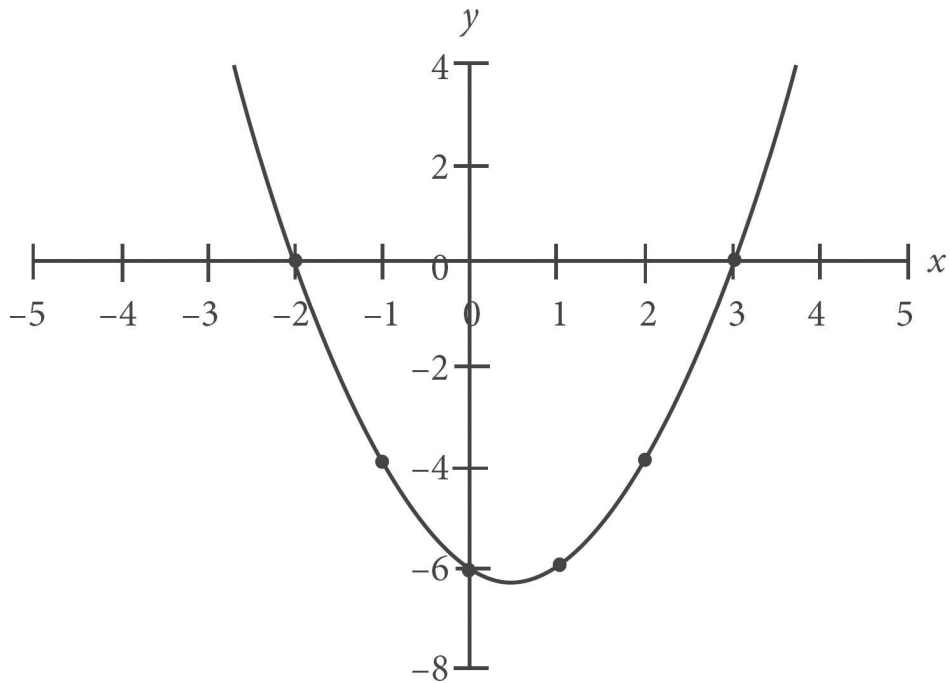
13. In the figure above  $C$  is the midpoint of  $\overline{BD}$  and  $\overline{AC} = \overline{CE}$ . What is the value of  $n$  ?
- A) 30  
 B) 45  
 C) 60  
 D) Cannot be determined from the information given
14. Allie is a caterer who is building 4 sandwich platters. Each sandwich platter contains turkey slices that weigh 2 ounces each and bread slices that weigh 1 ounce each. In each platter, she has a total of 100 slices of turkey and bread that weigh a total of 160 ounces. Solving which of the following system of equations yields the number of turkey slices,  $t$ , and the number of bread slices,  $b$ , that are in the 4 sandwich platters?
- A)  $t + b = 100$   
 $2t + b = 160$   
 B)  $t + b = 160$   
 $2t + b = 100$   
 C)  $t + b = 400$   
 $2t + b = 160$   
 D)  $t + b = 400$   
 $2t + b = 640$

$$\begin{aligned} 4a + 2z &= 10 \\ -3a + z &= -10 \end{aligned}$$

15. Based on the system of equations above, what is the value of  $10a$  ?
- A) -10  
 B) -1  
 C) 3  
 D) 30

16. Isabella has \$1,000 to invest and explores a number of options at her local bank. After learning about her options, she decides to deposit her \$1,000 into a high-yield savings account that compounds at an annual rate of 4%, compounded quarterly. The banker tells Isabella that her projected earnings in dollars,  $P$ , as a function of time in years,  $t$ , can best be represented by the equation  $P(t) = 1000(1.01)^{4t}$ . Which of the following graphs best illustrates Isabella's projected earnings over time?





17. Which of the following quadratic equations is represented in the graph above?
- A)  $y = x^2 - x - 6$   
 B)  $y = x^2 + x - 12$   
 C)  $y = x^2 + 6x + 9$   
 D)  $y = x^2 + 5x + 6$
18. Dahlia is competing in a group stair-climbing relay challenge with two of her friends. They will take turns climbing the stairs of two of Metropolis's tallest buildings. The three of them each plan to climb an equal number of stairs, and Dahlia will go first. The first building has  $s$  stairs, and the second building has 3,639 stairs. During the race, Dahlia runs out of energy and is only able to complete 75% of her goal. What is the total number of stairs that Dahlia climbs?
- A)  $0.75\left(\frac{1}{3}s + 1,213\right)$   
 B)  $0.75\left(\frac{1}{3}s + 3,639\right)$   
 C)  $75\left(\frac{1}{3}s + 1,213\right)$   
 D)  $75\left(\frac{1}{3}s + 3,639\right)$
19. Thirty-six percent of the 315 million people residing in the United States currently hold a passport. Of these passport-holding individuals, 8% travel internationally every year. Of those who travel internationally every year, approximately 10% visit European countries. How many U.S. residents visit European countries every year?
- A) 9,072  
 B) 90,720  
 C) 907,200  
 D) 9,072,000

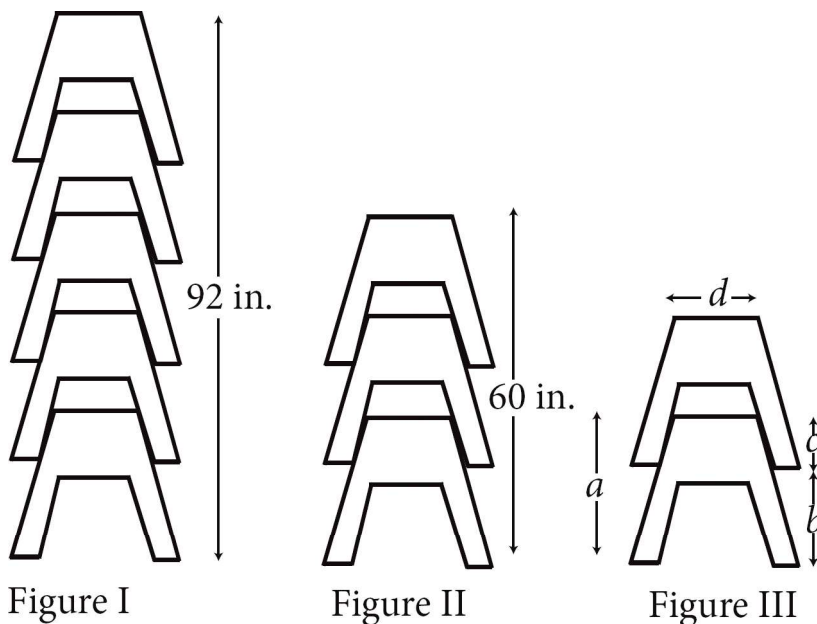
20. If the third degree polynomial  $x^3 - 10x^2 + 12x + 72$  can be factored to  $(x + 2) \cdot y^2$ , what is  $y$  in terms of  $x$ ?
- A)  $x - 6$   
 B)  $x - 3$   
 C)  $x - 1$   
 D)  $x + 1$

Year	North District	Central District	South District
2000	565	495	1023
2002	552	445	980
2004	503	376	924
2006	455	365	887
2008	406	278	842
2010	354	225	757
2012	343	201	624
2014	364	176	596

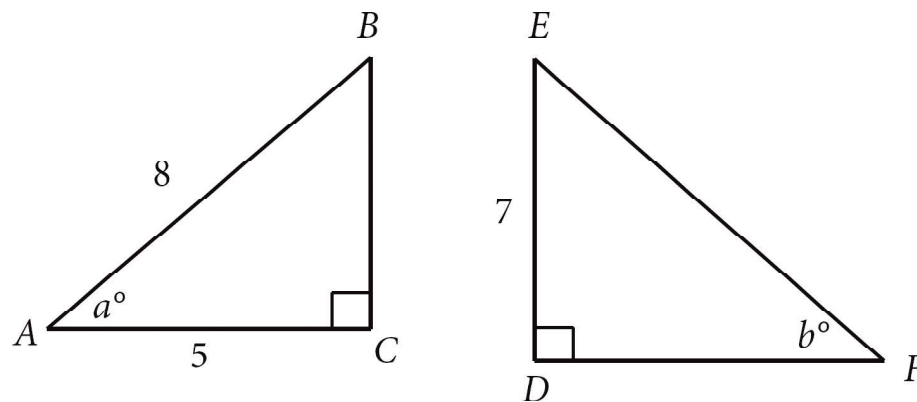
21. To better measure the effects of increases in poaching, the nation of Wakanda began a study in 2000 to track the number of elephants in each of the country's three administrative districts. Every two years, researchers performed a count of the number of elephants in each region; these counts were performed in January. The table above shows the results of the study.

Researchers determine that at a 95% confidence level, their margin of error for the population of elephants in 2010 was 17.4. If the actual population in 2010 is within the confidence interval, what is the lowest possible population of elephants in Wakanda in 2010?

- A) 1,317  
 B) 1,318  
 C) 1,319  
 D) 1,320



22. In figures I and II above, two stacks of identical carpenter's sawhorses are shown, with heights of 92 and 60 inches, respectively. The height, in inches, of a stack of  $k$  sawhorses is given by the function  $h(k) = 16k + 12$ , where  $k$  is a positive integer and  $k \geq 1$ . The number 12 in the function represents which of the dimensions shown in Figure III ?
- A)  $a$ , the height of one sawhorse
  - B)  $b$ , the distance from the bottom of one sawhorse to the bottom of the next highest sawhorse
  - C)  $c$ , the distance from the top of one sawhorse to the bottom of the next highest sawhorse
  - D)  $d$ , the width of a sawhorse at the top



23. In the figure above, if  $\sin a = \cos b$ , which of the following is closest to the length of  $\overline{DF}$  ?
- A) 5.6
  - B) 8.7
  - C) 11.2
  - D) 12

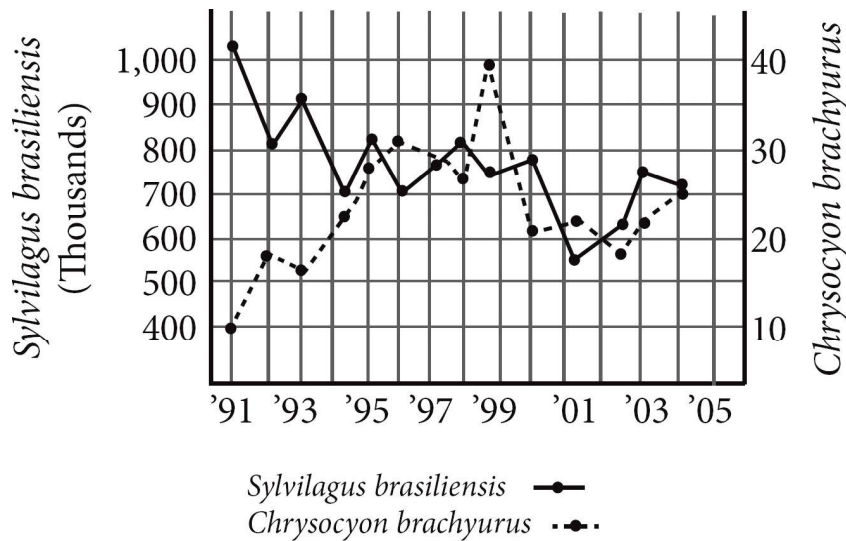
24.

	Widgets	Hours	Breaks
Rick	28	4	2
Darryl	42	6	4
Shane	27	5	2

Rick, Shane, and Darryl work at a widget factory. The table above shows the number of hours they each spent at the factory on a given day, the number of widgets they produced, and the number of 15-minute breaks they took while they were at the factory. Each man works at a constant rate.

Rick and Shane are each assigned an equal number of widgets. Neither will take breaks in order to complete this assignment as quickly as possible. Rick offers to do a certain percentage of Shane's assignment so that they both finish at the same time. What percentage of Shane's original assignment does Rick do?

- A) 12.5%
- B) 14.3%
- C) 16.7%
- D) 25%



25. The graph above represents the effect of efforts to reintroduce *Chrysocyon brachyurus*, a wolf-like predator, to Uruguay. It tracks the population of both *Chrysocyon brachyurus* and *Sylvilagus brasiliensis*, the rabbit species that is a primary food-source.

For which of the following periods did the *Sylvilagus brasiliensis* population undergo the greatest percent decrease?

- A) '91-'92
- B) '93-'95
- C) '99-'00
- D) '00-'01



$$y = x^2 - 2x$$

$$y = 2x - 1$$

26. This system has two solutions for  $(x, y)$ . What is the larger value of  $x$ ?

A)  $2 - \sqrt{3}$

B)  $\sqrt{3}$

C)  $2 + \sqrt{3}$

D) 5

27. If  $\csc \theta = 1.66$ , then  $\tan \theta =$

A) 0.60

B) 0.76

C) 1.32

D) 1.76

184	176	181	157	168
154	148	165	190	162

28. A group of patients is recruited for a clinical trial. Their heights, recorded in centimeters, are listed in the table above. Two more patients are recruited to the study. After these patients join, the mean height is 169 cm. Which of the following could be the heights of the two new patients?

A) 146 cm and 177 cm

B) 150 cm and 188 cm

C) 165 cm and 177 cm

D) 157 cm and 186 cm

29. What is the equation of the line that passes through the point  $(2.75, 0.975)$  and has an  $x$ -intercept of 2?

A)  $y + 5.9 = 2.5x$

B)  $4y + 12x = 29.1$

C)  $6y + 27.15 = 12x$

D)  $10y - 13x = -26$

30. A bacteria population,  $P$ , can be modeled by the equation  $P = P_0 10^{kt}$ , where  $P_0$  is the bacteria population at the beginning of the experiment,  $t$  is the time in hours since the beginning of the experiment, and  $k$  is a positive constant. Which of the following gives the time,  $t$ , in terms of  $k$ ,  $P$ , and  $P_0$ ?

A)  $t = \frac{\log\left(\frac{P_0}{P}\right)}{k}$

B)  $t = \frac{\log\left(\frac{P}{P_0}\right)}{k}$

C)  $t = \frac{\log(P \times P_0)}{k}$

D)  $t = k \log\left(\frac{P}{P_0}\right)$

31. Dan orders a soccer jersey online. If the jersey costs 40 euros and one euro is worth 1.2 dollars, how many dollars did Dan pay for the jersey?
32. An ice cream cart vendor sells 50 popsicles on an average fall day. During the summer, the ice cream cart vendor sells 7 less than twice as many popsicles per day than he does on the average fall day. How many popsicles does the ice cream cart vendor sell in 6 summer days?

33.

$$\begin{aligned} 1.3g + 1.7h &= 5 \\ 3h &= 20 + 13g \end{aligned}$$

Based on the system of equations above, what is the value of  $h$  ?

	Candidate A	Candidate B	Undecided	Total
Democrat	24	56	70	150
Republican	117	70	50	237
Independent	15	18	80	113
Total	156	144	200	500

34. The table above illustrates the results of a political poll. Five hundred voters were first asked whether they were registered as Democrat, Republican, or Independent. The voters were then asked whether they planned to vote for Candidate A, for Candidate B, or were Undecided. What percent of the registered Democrats plan to vote for Candidate A ? (Disregard the percent symbol when gridding your answer.)

35.

$$\begin{aligned} x &\geq 0 \\ 3y - 2x &\geq -12 \\ 2x + 5y &\leq 20 \end{aligned}$$

What is the area of the triangle formed in the  $xy$ -plane by the system of inequalities above?

36. When  $(x^2 + 2x - 3)(2x + 5) - (x + 1)(x - 1)(x + 3)$  is expressed in the form  $ax^3 + bx^2 + cx + d$ , what is the value of  $a + b + c + d$  ?

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**Questions 37 and 38 refer to the following information.**

Nile is a track & field athlete at North Sherahan High School. He hopes to qualify for the Olympic Games in his best field event, the javelin throw. He experiments with different javelin weights to build his arm strength and currently measures the results in feet.

37. The distance at which Nile can throw a javelin is inversely proportional to the weight of that javelin. Nile can throw a 1.5 pound javelin exactly 260 feet. How far would Nile be able to throw a two pound javelin, in feet, assuming all other factors remain constant? (Disregard units when inputting your answer.)
38. During his preparations, Nile realizes that the upcoming Olympic qualifying competition will be judged in meters, rather than feet or yards. Nile wants to make sure he can throw the javelin the minimum required distance so he can advance in the competition. If his current best throw is 60 yards, and one yard is approximately 0.9144 meters, how much further, to the nearest yard, must he throw in order to achieve the minimum required distance of 68.58 meters to qualify for the Olympics? (Disregard units when gridding your answer.)

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**S T O P**

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

### Section 3: Math (No Calculator)

1. B
2. C
3. A
4. B
5. D
6. C
7. D
8. D
9. A
10. B
11. A
12. D
13. C
14. C
15. B
16.  $\frac{15}{4}$  or 3.75
17. 2
18. 36
19.  $\frac{5}{6}$  or 0.833
20.  $\frac{5}{12}$  or 0.416 or 0.417

### Section 4: Math (Calculator)

1. A
2. B
3. D
4. A
5. B
6. C
7. C
8. B
9. C
10. A
11. D
12. C
13. B
14. D
15. D
16. B
17. A
18. A
19. C
20. A
21. C
22. C
23. B
24. B
25. D
26. C
27. B
28. D
29. D
30. B
31. 48
32. 558
33.  $\frac{7}{2}$  or 3.5
34. 16
35. 30
36. 0
37. 195
38. 15

### Section 3: Math (No Calculator)

- 1. B** Subtract the one-time set-up charge from David's budget first:  $150 - 35 = 115$ . Calculate the number of people David can invite as follows:  $115 \div 15 = 7.\overline{6}$ . David can invite at most 7 people (including himself), so  $p \leq 7$ . In (A),  $15p \leq 185$ , so  $p \leq 12.\overline{3}$  or  $p \leq 12.3$ . Eliminate (A). Solve for  $p$  in (B) as follows: add  $15p$  to both sides to get  $15p + 35 \leq 150$ , so  $15p \leq 115$  and  $p \leq 7.\overline{6}$ . The correct answer is (B).
- 2. C** Whenever there are variables in the question and in the answer choices, think Plugging In. Let  $d = 2$ . On the first day after Monday,  $5 \times 3 = 15$  people will be infected. On the second day after Monday,  $15 \times 3 = 45$  people will be infected. Therefore, when  $d = 2$ , the result is 45. Plug 2 in for  $d$  in the answer choices to see which answer equals the target number of 45. Choice (A)

becomes  $5 \times 3(2^2) = 5 \times 12 = 60$ . This does not match the target number, so eliminate (A). Choice (B) becomes  $5 \times 2^3 = 40$ . Eliminate (B). Choice (C) becomes  $5 \times 3^2 = 45$ . Keep (C), but check the remaining choice just in case. Choice (D) becomes  $5 \times 9(5) = 225$ . Eliminate (D), and choose (C).

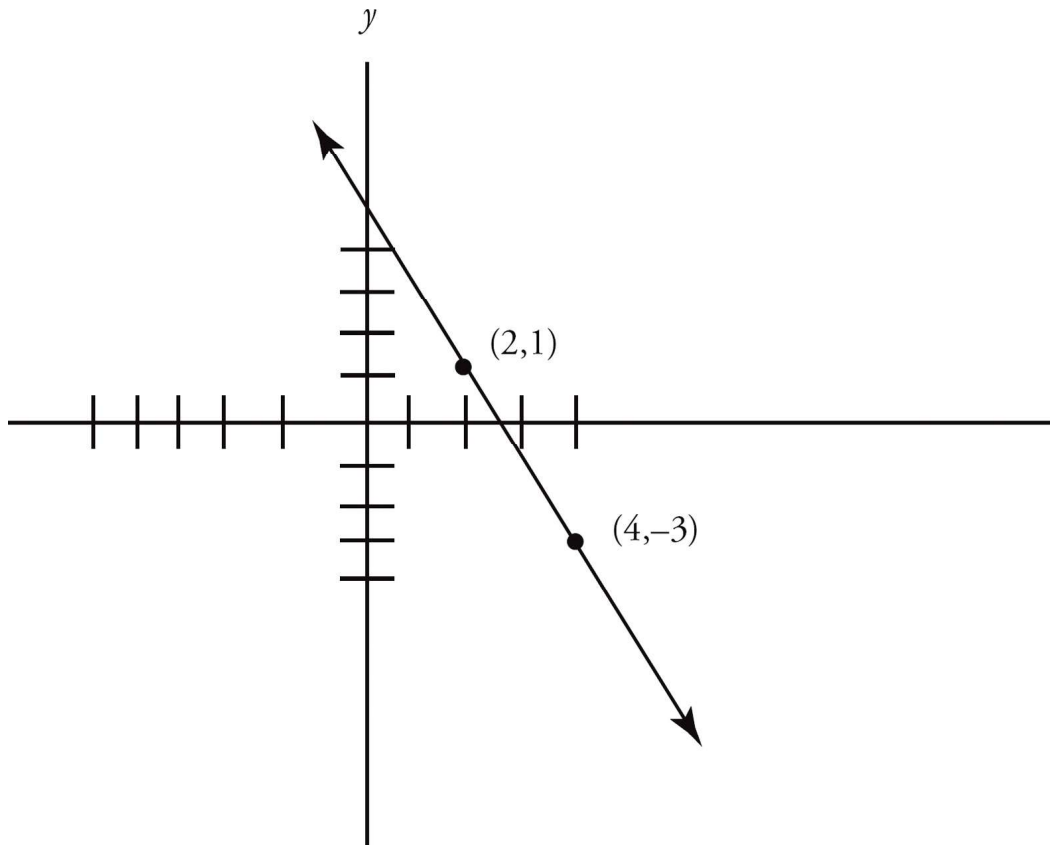
3. **A** Whenever there are variables in the question, think Plugging In. The answers refer to what happens when the temperature,  $x$ , increases, so plug in more than one value of  $x$ . Plug in  $x = 1$  into the equation to get  $y = -3.65(1) + 915 = -3.65 + 915 = 911.35$ . Next plug in  $x = 2$  to get  $y = -3.65(2) + 915 = -7.3 + 915 = 907.7$ . As average daily temperature,  $x$ , increased, the number of units sold,  $y$ , decreased. Therefore, the correct answer is (A).
4. **B** Plugging In could work on this one, but calculators aren't permitted. Since the equation is fairly simple, solving may be a better approach. Multiply both sides of the equation by  $r^2$  to get  $Fr^2 = GMm$ . Divide both sides of the equation by  $Mm$  to get  $\frac{Fr^2}{Mm} = G$ . The correct answer is (B).
5. **D** Taking a number to the  $\frac{1}{3}$  power is the same as taking the cube root of the number. Therefore,  $(4s)^{\frac{1}{3}} = \sqrt[3]{4s}$ . The correct answer is (D). A shortcut is to just raise the coefficient to the power, and then use POE. Since only one answer starts with  $\sqrt[3]{4}$ , that one must be correct. Another approach is to plug in a number for  $s$  and let the calculator do the hard work, though that would not help in this section since calculator use is not permitted.
6. **C** Sketch a picture and write the formulas for arc length and area:  $s = r\theta$ ,  $A = \pi r^2$ . Start by finding the radius. If the circle has an area of  $16\pi$ , then  $16\pi = \pi r^2$ ; divide both sides by  $\pi$  to get  $16 = r^2$ . The radius must be 4. So plug in the arc length and radius into your formula:  $2\pi = 4\theta$ . Divide both sides by 4 to get  $\frac{\pi}{2} = \theta$ . Choice (C) is correct.
7. **D** According to the question, if  $t = 4$ , then  $v(t) = 740$ . Plug 4 in for  $t$  in the answer choices and see if  $v(t)$  comes out to the target number 740. In (A) if  $t = 4$ , then  $v(t) = 740 - 4 = 736$ . Eliminate (A). In (B), if  $t = 4$ , then  $v(t) = 740 - 65(4) = 740 - 260 = 480$ . Eliminate (B). In (C), if  $t = 4$ , then  $v(t) = 1,000 - 195(4) = 1,000 - 780 = 220$ . Eliminate (C). The correct answer must therefore be (D).

8. **D** Whenever there are variables in the question and in the answers, think Plugging In. If  $s = 2$ , the first expression becomes  $8(2^2) - 6(2) + 2 = 8(4) - 12 + 2 = 32 - 12 + 2 = 22$ . Therefore, the first expression multiplied by the second expression is  $22(7) = 154$ . Plug in 2 for  $s$  in the answers to see which choice equals the target number of 154. Choices (A), (B), and (C) yield 26, 70, and 198 respectively. Choice (D) yields 154 and is the correct answer.
9. **A** Whenever the question includes variables and the answers are numbers, think Plugging In the Answers. In (A),  $x = 3$  and  $y = -3$ . Plug these numbers into the equation to get  $-3 = 5(3 - 3)^2 - 3$ . Solve the right side of the equation to get  $-3 = 5(0)^2 - 3$  or  $-3 = 0 - 3$ . The correct answer is (A). None of the other points work when plugged into the equation, so eliminate (B), (C), and (D).
10. **B** Plugging In would not be straightforward for this problem, given the fractions and negative numbers. A better approach would be to simplify the expressions first and then plug in or solve. Distribute the  $(c + 2)$  term to both sides of the equation. On the left side, this will cancel out with the  $(c + 2)$  term in the denominator. On the right side, make sure to distribute the  $(c + 2)$  to both terms inside the parentheses. The equation becomes  $\frac{3(c + 2)}{c + 2} = 5(c + 2) - \frac{c(c + 2)}{c + 2}$  or  $3 = 5c + 10 - c$ . Combine the  $c$  terms and subtract 10 from both sides to get  $-7 = 4c$ . Divide both sides by 4 to find that  $c = -\frac{7}{4}$ . The answer is (B).
11. **A** Since the diameter is 10, the radius must be 5.  $A = \pi r^2$ , so  $A = 25\pi$ . The shaded region takes up  $\frac{\pi}{25\pi}$  or  $\frac{1}{25}$  of the area, so minor arc  $XY$  must take up  $\frac{1}{25}$  of the circumference.  $C = \pi d$  so  $C = 10\pi$ . Therefore, the length of minor arc  $XY$  is  $\frac{1}{25}(10\pi)$ , or  $\frac{2\pi}{5}$ , which is (A).
12. **D** First, rewrite the equations so that they are in the slope-intercept form of a line,  $y = mx + b$ , where  $m = \text{slope}$ . The first equation becomes  $3y = -x + 42$  or  $y = -\frac{1}{3}x + 14$ . The slope of this first line is therefore  $-\frac{1}{3}$ . The second equation becomes  $-y = -3x + 8$  or  $y = 3x - 8$ . The slope of this line is therefore 3. The slopes of the two lines are negative reciprocals of each other,

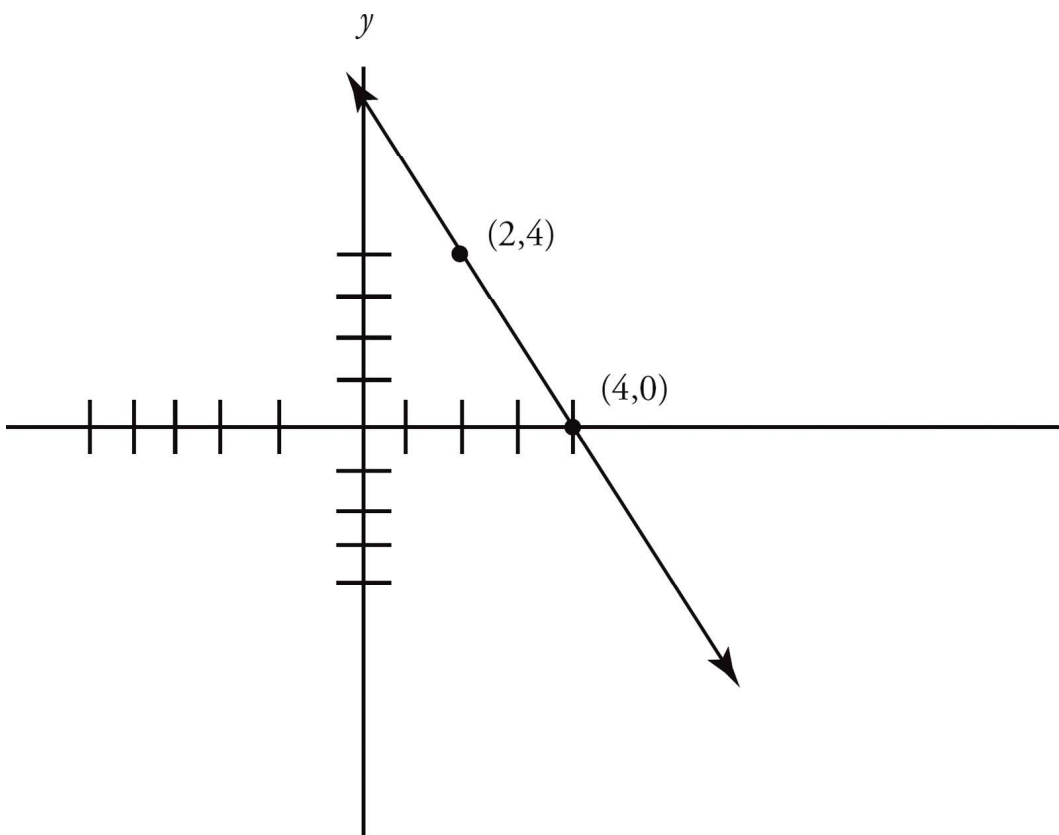


which means that the two lines are perpendicular to each other. The correct answer is (D).

13. **C** The graph crosses the  $x$ -axis at three distinct points. When the function is set to 0, there should be three real solutions for  $x$ . Use Process of Elimination to solve this question. Set the equation in (A) to 0 to get  $0 = (x - q)^2$ . In this equation, the root is at  $x = q$ , thereby providing only one real value for  $x$ . Eliminate (A). Set the equation in (B) to 0 to get  $0 = (x - q)(x + s)$ . The solutions for this equation are  $x = q$  or  $x = -s$ . Therefore, there are only two real solutions for  $x$ . Eliminate (B). Set the equation in (C) to 0 to get  $0 = (x - r)(x + s)(x + t)$ . The solutions for this equation are  $x = r$ ,  $x = -s$ , and  $x = -t$ . Therefore, there are three real solutions for  $x$ . The correct answer is (C).
14. **C** When the quadratic is set to 0 the parabola crosses the  $x$ -axis at  $(-20, 0)$  and  $(20, 0)$ . Because parabolas are symmetrical, the vertex of the parabola is at  $(0, 40)$ . Plug this point into the equation to get  $40 = a(0 - 20)(0 + 20)$ . Simplify the right side of the equation to get  $40 = a(-20)(20)$  or  $40 = -400a$ . Solve for  $a$  to get  $a = -\frac{40}{400} = -\frac{1}{10}$ . Therefore, the correct answer is (C).
15. **B** The line shown has a negative slope. Because the graph transformation asks for the negative value of the transformed function, the resulting graph must have a positive slope. Therefore, eliminate (A). Graph transformation rules state that if the number is within the parentheses, then the graph moves left or right in the opposite direction of the sign, and if the number is outside the parentheses, the graph moves up or down in the same direction of the sign. Therefore, this line will move 2 to the right, and up 3. To follow the proper order of operations, draw out the graph transformation first, and then deal with the negative outside the brackets. Move the line two units to the right to get:



Move the line up 3 to get:



The negative sign outside the brackets means to reflect, or flip, the line over the  $x$ -axis. When the line is flipped from a positive to a negative slope, it will still go through point  $(4, 0)$ . Therefore, the correct answer is (B).

16.  $\frac{15}{4}$

or 3.75

According to the question,  $h(t) = 120$  and  $t = 8$ . Plug these values into the function to get  $120 = \frac{1}{2} a(8^2)$ . Simplify the equation to get  $120 = \frac{1}{2} a(64)$  and  $120 = 32a$ . Solve for  $a$  to get  $a = 3.75$ . The correct answer is 3.75.

17. **2** Whenever there are two equations with the same two variables, they can be solved simultaneously by adding or subtracting them. The key is to get one variable to disappear. Multiply the first equation by 3 to get  $9h - 3j = 21$ . Stack the equations and add them.

$$\begin{array}{r} 9h - 3j = 21 \\ \underline{2h + 3j = 1} \\ 11h \qquad = 22 \end{array}$$

Therefore  $h = 2$ , and the correct answer is 2.

18. **36** Plug in. Pick any values for the length, width, and height that will give you a volume of 24. If you say the length is 2, the height is 3, and the width is 4, then the new length, height, and width will be 1, 9, and 4 respectively. The new volume is 36. No matter what numbers you set for the initial length, width, and height, you will always get 36 for the new volume.

19.  $\frac{5}{6}$  or 0.833

Distribute the  $6e$  on the left side of the equation and the  $3e$  on the right side of the equation to get  $6e^2 + 18e = 6e^2 + 12e + 5$ . Subtract  $6e^2$  from both sides of the equation to get  $18e = 12e + 5$ . Solve for  $e$  to get  $6e = 5$ , so  $e = \frac{5}{6}$ . The correct answer is  $\frac{5}{6}$ .

20.  $\frac{5}{12}$  or 0.416 or 0.417

Start by calculating the amount of vitamin C in the entire punch bowl and then calculate what the equivalent in only one cup would be. To maximize the amount of vitamin C in the punch bowl, Abeena will need to add as much orange juice, which has the highest concentration of vitamin C, as she can.

Given that the punch bowl holds 9 quarts, she will pour in 6 quarts of orange juice (which is all she has) and 3 quarts of grape juice. The amount of vitamin C can be calculated as follows:

	Orange Juice	Grape Juice	Total
# of quarts	6	3	9
Amount of vitamin C per quart	2	1	
Total vitamin C	12	3	15

Therefore, the 9 quarts of punch contains 15 grams of vitamin C. Next, convert the quarts to cups. The question tells us that there are 4 cups in 1 quart. Therefore,  $9 \times 4 = 36$  cups in 9 quarts. To figure out how much vitamin C is in one cup, set up the following proportion:  $\frac{15 \text{ grams}}{36 \text{ cups}} = \frac{x \text{ grams}}{1 \text{ cup}}$ . Cross-multiply to get  $36x = 15$ , or  $x = \frac{15}{36} = \frac{5}{12}$ . The correct answer is  $\frac{5}{12}$ .

Only reduce a fraction if it is necessary to make it fit in the grid-in box.

## Section 4: Math (Calculator)

- A** Whenever the question asks for a specific value and the answer choices are numbers, think Plugging In the Answers. In (A),  $a = -0.75$ . Plug  $-0.75$  in for  $a$  in the equation to get  $16(-0.75)^2 + 4(-0.75) - 6 = 0$ . Solve the left side of the equation to get  $16(0.5625) + (-3) - 6 = 0$ , or  $9 - 3 - 6 = 0$ . Since, this statement is true, the correct answer is (A).
- B** So far the zoo has sold  $4 \times 48 = 192$  tickets. To make a profit, the zoo will need to sell at least  $350 - 192 = 158$  additional tickets. So,  $z$  needs to be at least 158. Calculate  $z$  in each of the answers to see which gives you a value of  $z \geq 158$ . In (A),  $z \leq 350 - 4(48)$ , so  $z \leq 158$ . Eliminate (A). Choice (B) gives you  $z \geq 158$ . Keep (B). Choice (C) gives you  $z \geq -158$ . Eliminate (C). Choice (D) gives you  $z \leq -158$ . Eliminate (D). Choice (B) is the correct answer.
- D** Line 1 shows exponential growth, because the line curves upward. Because birth rate and death rate are per 1,000 people, a birth rate higher than a death rate will result in exponential growth (because births—deaths will increase as the population increases). Immigration and emigration numbers are per year and therefore have a linear effect on the graph (as the absolute change in the population due to immigration—emigration is constant). South Zealand has more births per 1,000 than deaths per 1,000, so (D) accurately reflects line 1.

4. **A** You can start with Process of Elimination. Since the number of people in the theater decreases over time, you can eliminate (D). Choices (A) and (B) are exponential functions, whereas (C) is linear. The number of people that leave the theater every 15 minutes is not constant, since it is proportional to the number of people currently in the theater; therefore, this function is not linear, and you can eliminate (C). Choice (A) must be correct since the function decreases quickly and then the number leaving every successive 15 minutes is less than the time before (10% of 250 is more than 10% of 225).
5. **B** Cross-multiply to get  $2y^2 = 72$ . Solve for  $y$  to get  $y^2 = 36$ , so  $y \pm 6$ . Another way to solve would be to Plug In the Answers, since the question asks for a specific value and there are numbers in the answer choices. In (A),  $y = -6$ . Plug  $-6$  into the equation and see if it works:  $\frac{6}{2(-6)} = \frac{-6}{12}$ , or  $\frac{6}{-12} = \frac{-6}{12}$ . Because this statement is true, one of the possible solutions for the equation is  $y = -6$ . Eliminate (C) and (D) because neither of these answers includes  $-6$ . According to (B), another possible value for  $y$  is 6. Plug 6 into the equation to see if it works:  $\frac{6}{2(6)} = \frac{6}{12}$ , or  $\frac{6}{12} = \frac{6}{12}$ . Since this statement is also true, the correct answer is (B).
6. **C** The 36-year-old runner ran under 3:00:00 when almost 3:30:00 is expected. The 39-year-old runner ran slightly above 3:00:00 when 3:30:00 is expected. The 41-year-old runner ran slightly above 3:00:00 when about 3:45:00 was expected. Therefore, three runners ran at least 15 minutes faster than predicted, which matches (C). If you chose (B), you may have based your choice on the number of runners who ran more than 15 minutes *slower* than their predicted time.
7. **C** According to the table, the relative investment in wind resources in 2007 was 0.40 of the total 1.00. Probability is defined by the number of things that fit the requirements divided by the total number of things. In this case, that would be  $\frac{0.40}{1.00}$ . You don't need to worry about the actual dollar values, because these numbers both relate to the same total of \$75 million. You do, however, need to simplify this fraction. You can multiply it by  $\frac{10}{10}$  to get  $\frac{4}{10}$ , which then reduces to  $\frac{2}{5}$ . You could also divide it on your calculator to get

0.4, and then divide each fraction in the answer choices to see which one is also equal to 0.4. Either way, the correct answer is (C).

8. **B** Examine each answer choice and use Process of Elimination. For (A), the 2007 investment in biofuels was 0.31 out of 1.00, or about one-third of the total, according to the chart. The total that year was \$75 million, so the Ballpark value would be about \$25 million. The \$50 million value in (A) is too high, so eliminate it. Choice (B) refers to percents, but the chart is in “relative” investment. If the 2007 relative investment in wind is 0.40 out of 1.00, it is equivalent to 40% of the total. The wind investment in 2017 is projected to be .32 or 32% of the total, which is a decrease of 8%. Check out (C) and (D) just to be certain. For fuel cells, the percent of the total is projected to double, but the total in 2017 is projected to be much higher. So the total dollar amount invested in wind in 2017 will be much more than double the 2007 investment. For (D), the top three energy types—biofuels, wind, and solar—are projected to be more equally invested in for 2017 than they were in 2007, so (D) is the opposite of what the chart shows. Eliminate (C) and (D), and choose (B).
9. **C** Whenever there are variables in the question and in the answers, think Plugging In. If  $m = 10$ , then Monster Truck Inc., receives a down payment of \$3,200 plus 10 months’ worth of monthly payments. This can be calculated as  $3,200 + 10(380) = 3,200 + 3,800 = \$7,000$ . Plug in 10 for  $m$  in the answers to see which function equals 7,000. Choice (A) becomes  $f(m) = 380 + 3,200(10) = 380 + 32,000 = 32,380$ . Eliminate (A). Choice (B) becomes  $f(m) = 3,200 + 36(10) = 3,200 + 360 = 3,560$ . Eliminate (B). Choice (C) becomes  $f(m) = 3,200 + 380(10) = 3,200 + 3,800 = 7,000$ . Keep (C), but check (D) just in case it also works. Choice (D) becomes  $f(m) = 10,480 - 380(10) = 10,480 - 3,800 = 6,680$ . Eliminate (D). The correct answer is (C).
10. **A** Plugging In the point  $(6, -5)$  in the answer choices could work, but it will likely make more than one equation true. The  $x$ -intercept is where the line crosses the  $x$ -axis, at the point where  $y = 0$ . Therefore, one point on the line is  $(3, 0)$ . The choices are all in the slope-intercept form,  $y = mx + b$ , where  $m$  is the slope. To find the correct answer, calculate the slope of the line with the two points known to be on the line. The slope of a line is determined by the equation  $\frac{y_2 - y_1}{x_2 - x_1}$ . Therefore, the slope of the line shown can be calculated as follows:  $\frac{-5 - 0}{6 - 3} = \frac{-5}{3}$ . Only (A) has a slope of  $\frac{-5}{3}$ , so that is the correct answer.

11. **D** There are 12 inches in one foot, so a reel is  $12 \times 1,000 = 12,000$  inches long. Set up a proportion to determine how many frames per reel:  $\frac{1 \text{ frame}}{\frac{3}{4} \text{ inch}} = \frac{x \text{ frames}}{12,000 \text{ inches}}$ . Cross-multiply to get  $\frac{3}{4}x = 12,000$ . Divide both sides by  $\frac{3}{4}$  to get  $x = 16,000$  frames per reel. Next, find the number of frames the film requires. Convert the time to seconds. There are 60 minutes in an hour, so 2 hours and 47 minutes is equal to  $(2 \times 60) + 47 = 167$  minutes. There are 60 seconds in a minute, so there are  $60 \times 167 = 10,020$  seconds in this film. If each second consists of 24 frames, then there are  $24 \times 10,020 = 240,480$  frames in this film. To determine the number of reels, divide by the number of frames per reel:  $\frac{240,480}{16,000} = 15.03$  reels. Because 15 reels does not hold quite enough frames, the film requires 16 reels, which is (D).
12. **C** So far, Hua has received  $1,350 + 900 = 2,250$  surveys. Hua needs  $3,800 - 2,250 = 1,550$  additional surveys. Given that Hua receives 1 completed survey for every 5 she sends out, she will need to send out at least  $5 \times 1,550 = 7,750$  surveys. Therefore, the correct answer is (C).
13. **B** Since line  $AE$  is perpendicular to the line containing segment  $AB$  and the line containing segment  $DE$ , these two lines must be parallel. Therefore,  $\angle ABC$  is equal to  $\angle CDE$  because they are both small angles created by a line crossing two parallel lines. Since  $\angle DCE$  and  $\angle ACB$  are opposite each other, they must be equal as well, so these are two similar right triangles. The question also tells you that  $C$  is the midpoint of  $BD$ , which means that  $BC$  and  $CD$  are equal. When you have two sides and the included angle of one triangle congruent to two sides and the included angle of a second triangle, you know that the triangles are congruent. This means that  $AB = DE$  and  $AC = CE$ . Lastly, the question states that  $AC = DE$ , which means that  $AB = AC$ , and these must be isosceles right triangles. Angle  $ABC$  is therefore  $45^\circ$ , and  $n$ , which is opposite  $\angle ABC$ , must be  $45^\circ$  as well. The correct answer is (B).
14. **D** Start with the easier equation and use Process of Elimination. The easier equation is related to the total number of turkey and bread slices,  $t + b$ , on the 4 platters. According to the question, each platter contains 100 slices, so the 4 platters contain  $100 \times 4 = 400$  slices. Therefore, one of the equations in the correct answer must be  $t + b = 400$ . Eliminate (A) and (B) since neither of these answers contains that equation. The second equation deals with the weight of the slices. According to the problem, the slices on each platter

weigh 160 ounces. Therefore, the total weight of the slices on all 4 platters is  $160 \times 4 = 640$ . Eliminate (C) because the total is wrong in the weight equation. The correct answer is (D).

15. **D** Whenever there are two equations with the same two variables, they can be solved simultaneously by adding or subtracting them. The key is to get one variable to disappear. Multiply the second equation by  $-2$ , to get  $6a - 2z = 20$ . Stack the two equations and add them.

$$\begin{array}{r} 4a + 2z = 10 \\ \underline{6a - 2z = 20} \\ 10a \qquad = 30 \end{array}$$

Therefore, the correct answer is (D). Be careful of (C)—the question did NOT ask for the value of  $a$ .

16. **B** We know that Isabella starts with \$1,000 in her account, so this eliminates (D). She is earning money from the interest, so the line must have a positive slope, eliminating (C), which has a constant slope. The two best choices are (A) and (B), but in (A) Isabella's money doesn't begin to increase until the 5-year mark, which doesn't make sense—thus (B) is the best choice.
17. **A** Find a point on the graph and plug that point into each of the answers to see which equation works. The graph goes through the point  $(0, -6)$ . Using that point, (A) becomes  $-6 = 0^2 - 0 - 6$ . Solve the right side of the equation to get  $-6 = -6$ . Keep (A), but check the remaining answer choices just in case. Choice (B) becomes  $-6 = 0 + 0 - 12$ . Solve the right side of the equation to get  $-6 = -12$ . This is not true, so eliminate (B). Choice (C) becomes  $-6 = 0^2 + 6(0) + 9$ . Solve the right side of the equation to get  $-6 = 9$ . Eliminate (C). Choice (D) becomes  $-6 = 0^2 + 5(0) + 6$ . Solve the right side of the equation to get  $-6 = 6$ . Eliminate (D). The correct answer is (A).
18. **A** The key to this problem is understanding that the three friends plan to climb an equal number of stairs. Start with the building for which we know the number of stairs. The friends are each planning to climb  $3,639 \div 3 = 1,213$  stairs. Since 1,213 must be a part of the correct answer, eliminate (B) and (D). Given that Dalia will complete only 75% of her goal, Dalia's total must be multiplied by 75% or 0.75. This eliminates (C). The correct answer is (A).
19. **C** Let's break this question into smaller pieces. First, to find the number of U.S. residents who visit European countries every year, we will need to determine how many residents hold passports: 36% of 315 million =  $0.36 \times 315 = 113.4$  million. Next, we can calculate how many of those passport-holders travel internationally each year: 8% of 113.4 million =  $0.08 \times 113.4 = 9.072$  million.



Finally, we can calculate how many of those international travelers visit Europe each year:  $10\%$  of  $9.072$  million =  $0.1 \times 9.072 = 0.9072$  million.  $0.9072$  million is equivalent to  $907,200$ , which is (C). The percentage calculations can also be done in one step:  $0.1 \times 0.08 \times 0.36 \times 315 = 0.9072$  million.

20. **A** Given that all of the answer choices are possible values for  $y$ , plug in the answers. In (A),  $y = x - 6$ . Plug this value into  $(x + 2)y^2$  to get  $(x + 2)(x - 6)(x - 6)$ . Multiply the last two factors together to get  $(x + 2)(x^2 - 12x + 36)$ . Multiply the two resulting factors together to get  $x^3 - 12x^2 + 36x + 2x^2 - 24x + 72$ . Combine like terms to get  $x^3 - 10x^2 + 12x + 72$ . This is the same as the third degree polynomial in the question. Therefore, the correct answer is (A).
21. **C** In 2010, as counted, there were  $354 + 225 + 757 = 1,336$  elephants in Wakanda. If the margin of error was  $17.4$ , the lowest population of elephants that could fit within the margin of error would be  $1,336 - 17.4 = 1,318.6$  elephants. Because there cannot be fractional elephants,  $1,319$  is the smallest value that would be within the margin of error.
22. **C** Start by using Process of Elimination to eliminate (D) because the entire question is about finding the height, and (D) has nothing to do with height. The difference between the left and middle stacks is 2 stacked sawhorses. The height added to the stack of sawhorses by adding two to the stack can therefore be calculated as  $92 - 60 = 32$ . Therefore, the added height of one stacked sawhorse is  $32 \div 2 = 16$ . From this information, keep subtracting the 16 inches added to the top of a stack by each additional sawhorse until you get down to one sawhorse in the stack. If three sawhorses are 60 inches tall, two will be  $60 - 16 = 44$  inches tall and one sawhorse will be  $44 - 16 = 28$  inches tall. Choice (A), the height of one sawhorse, can now be eliminated. Another way to think about the height added to the stack of sawhorses by each additional sawhorse is to think of it as the distance between the top of one sawhorse and the top of the next. Since all the sawhorses are the same height, this distance is also the distance from the bottom of one sawhorse to the bottom of the next. Since this distance is 16, eliminate (B). Therefore, the answer must be (C). The height of one sawhorse is 28, which is  $b + c$ , so the overlap,  $c$ , is  $28 - 16 = 12$ .
23. **B** Remember that  $\sin a = \cos b$  means that  $a$  and  $b$  are complementary angles. Therefore, the two triangles are similar and  $\cos a = \sin b$  as well and you can set up the following equation:  $\frac{5}{8} = \frac{7}{EF}$  Now that you have solved for  $EF$  (11.2), you can use the Pythagorean theorem ( $a^2 + b^2 = c^2$ ) to solve for  $DF$ .  $11.2^2 = 7^2 + DF^2$ . The correct answer is (B). Alternatively, you could have used

the Pythagorean theorem to solve for  $BC$  and then set up a proportion between the similar triangles. Just make sure that you recognize that  $AC$  corresponds to  $DE$  rather than  $DF$ .

24. **B** First, solve for Rick's hourly rate and Shane's hourly rate. Since  $\text{Work} = \text{Rate} \times \text{Time}$ , Rick produces 8 widgets per hour (28 widgets  $\div$  3.5 hours without breaks) and Shane produces  $27 \div 3.5 = 6$  widgets per hour. Now plug in. Since you know they have a combined rate of 14 widgets per hour, choose a total amount that is divisible by 14. Let's say they were each assigned 14. This means that the total produced is 28, and at a total rate of 14 per hour. Therefore, it takes them 2 hours to finish. During this time Rick would produce 16 widgets and Shane would produce 12 widgets. Therefore, Rick must have done 2 of Shane's originally assigned 14 widgets, which is 14.3% of 14. This matches (B).

25. **D** To answer this question, you need the formula for percent change:  $\frac{\text{difference}}{\text{original}} \cdot 100$ . For choice (A), plug in a difference of about 200,000 and an original of about 1,000,000:  $\frac{200,000}{1,000,000} \cdot 100$ . This simplifies to 20%. For (B), plug in a difference of about 200,000 and an original of about 900,000:  $\frac{200,000}{900,000} \cdot 100$ . This simplifies to about 22%, so you can eliminate (A). Choice (C) is incorrect because the *Sylvilagus brasiliensis* population increased during that time. If you chose (C), you may have calculated the percent change of the *Chrysocyon brachyurus* population. For (D), plug in a difference of about 200,000 and an original of about 800,000:  $\frac{200,000}{800,000} \cdot 100$ . This simplifies to approximately 31%. This is the greatest percent decrease; therefore, (D) is correct.

26. **C** Start by setting the two equations equal to each other to get  $x^2 - 2x = 2x - 1$ . Manipulate the equation into the  $ax^2 + bx + c = 0$  form, which is  $x^2 - 4x + 1 = 0$ . Use the quadratic equation, which states that  $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$  to get  $x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(1)(1)}}{2(1)}$ . Solve for  $x$  to get  $x = \frac{4 \pm \sqrt{16 - 4}}{2}$ , then  $x =$

$\frac{4 \pm \sqrt{12}}{2}$  or  $x = \frac{4 \pm 2\sqrt{3}}{2}$ , so  $x = 2 \pm \sqrt{3}$ . The greater of the two possible values for  $x$  is  $x = 2 + \sqrt{3}$ . Therefore, the correct answer is (C).

27. **B** Cosecant is  $\frac{1}{\sin}$  or  $\frac{\text{hypotenuse}}{\text{opposite}}$ . Make a right triangle and plug in for the side lengths. Because  $\frac{\text{hypotenuse}}{\text{opposite}}$ , make the hypotenuse 1.66 and the side opposite the angle measure  $\theta$  equal to 1. Use the Pythagorean theorem to solve for the missing side:  $1^2 + x^2 = 1.66^2$ ;  $1 + x^2 = 2.7556$ ;  $x^2 = 1.7556$ ;  $x \approx 1.32$ . Make this the other leg of the triangle. To find  $\tan \theta$ , use  $\frac{\text{opposite}}{\text{adjacent}}$ :  $\frac{1}{1.32}$ , which is (B).
28. **D** If two patients are added to the trial, there will be 12 total patients. If the mean height of 12 patients is 169 cm, then the 12 patients have a total height of  $12 \times 169 = 2,028$  cm. The total height of the first 10 patients is  $184 + 176 + 181 + 157 + 168 + 154 + 148 + 165 + 190 + 162 = 1,685$  cm, so the two new patients must have a total height of  $2,028 - 1,685 = 343$  cm. Add up the heights and eliminate any choice that does not equal 343. Only (D) works.
29. **D** Plugging in the given point to see which equation is true is not easy on this one, since both values have weird decimals. The answer choices are also likely written so that more than one is true for that point, so try to find another point on the line. The  $x$ -intercept of a line is where the line crosses the  $x$ -axis. At that point, the value of  $y$  is 0. Therefore, (2, 0) is also a point on the line. Plug this point into the answers, since it is easier to calculate. If it works in more than one equation, plugging in the ugly point will determine the correct answer, which must work for both points work. Plug point (2, 0) into (A) to get  $0 + 5.9 = 2.5(2)$ . Solve both sides of the equation to get  $5.9 = 5$ . Eliminate (A). Plug (2, 0) into (B) to get  $4(0) + 12(2) = 29.1$ . Solve both sides of the equation to get  $4 + 24 = 29.1$ , or  $28 = 29.1$ . Eliminate (B). Plug (2, 0) into (C) to get  $6(0) + 27.15 = 12(2)$ . Solve both sides of the equation to get  $0 + 27.15 = 24$ . Since this is clearly not a true statement, eliminate (C). Plug (2, 0) into (D) to get  $10(0) - 13(2) = -26$ . Solve both sides of the equation to get  $-26 = -26$ . Since (D) is the only answer for which the point (2, 0) works, the correct answer is (D).
30. **B** Whenever there are variables in the question and in the answers, think Plugging In. If  $P_0 = 4$ ,  $k = 2$ , and  $t = 3$ , then  $P = (4)(10)^6 = 4,000,000$ . Plug these values into the answer choices to see which answer works. Choice (A)

becomes  $3 = \frac{\log\left(\frac{4}{4,000,000}\right)}{2}$ . Simplify the right side of the equation to get  $3 = \frac{\log\left(\frac{1}{1,000,000}\right)}{2}$ , then  $3 = \frac{-6}{2}$ , and finally  $3 = -3$ . This isn't true, so eliminate (A). Choice (B) becomes  $3 = \frac{\log\left(\frac{4,000,000}{4}\right)}{2}$ . Simplify the right side of the equation to get  $3 = \frac{\log(1,000,000)}{2}$ , then  $3 = \frac{6}{2}$ , and finally  $3 = 3$ . Keep (B), but check the remaining answer choices just in case. Choice (C) becomes  $3 = \frac{\log(4,000,000 \times 4)}{2}$ . Simplify the right side of the equation to get  $3 = \frac{\log(16,000,000)}{2}$ , or  $3 \approx 3.6$ . Eliminate (C). Choice (D) becomes  $3 = 2\log\left(\frac{4}{4,000,000}\right)$ . Simplify the right side of the equation to get  $3 = 2\log\left(\frac{1}{1,000,000}\right)$ , then  $3 = 2(-6)$ , and finally  $3 = -12$ . Eliminate (D). The correct answer is (B).

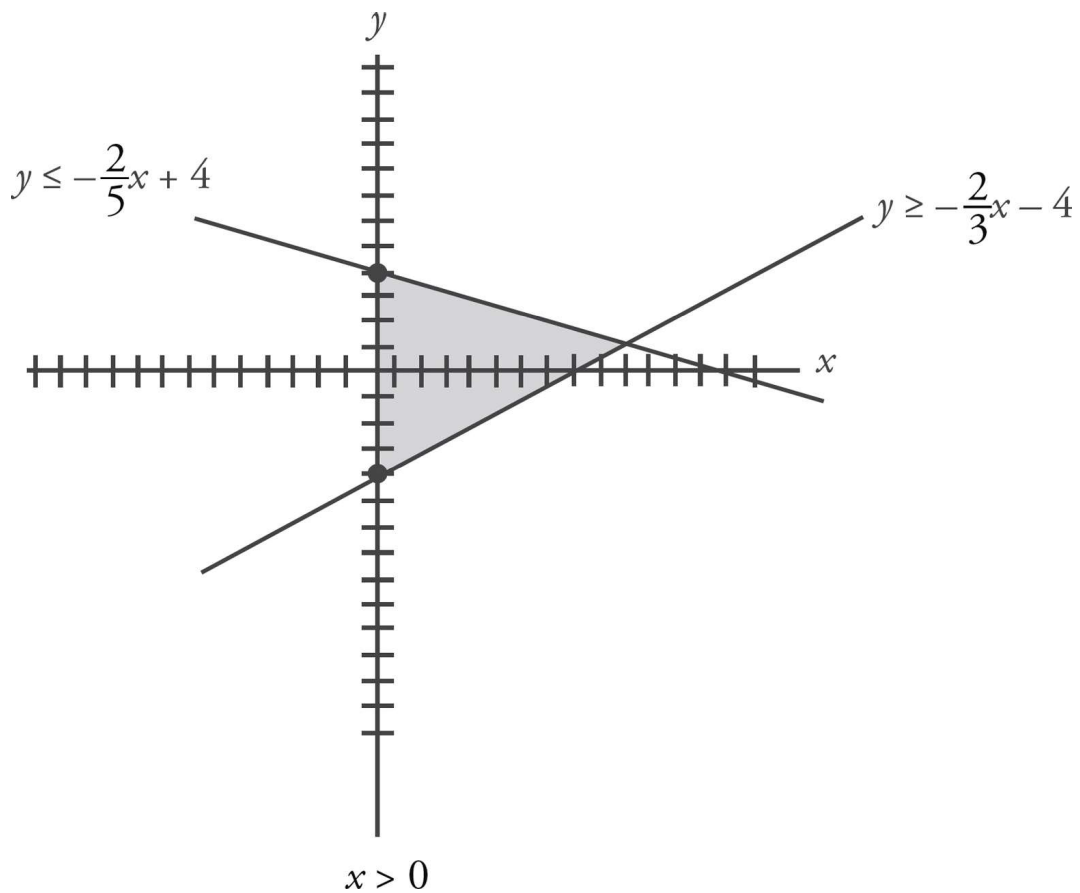
31. **48** Set up a proportion:  $\frac{1 \text{ euro}}{1.2 \text{ dollars}} = \frac{40 \text{ euros}}{x \text{ dollars}}$ . Cross-multiply and get  $x = 1.2 \times 40 = 48$ .
32. **558** During the summer the ice cream vendor sells an average of  $2(50) - 7 = 93$  popsicles per day. Over 6 summer days,  $93 \times 6 = 558$  popsicles are sold. The correct answer is 558.
33.  $\frac{7}{2}$  or **3.5**

First, get rid of the decimals in the first equation by multiplying the first equation through by 10 to get  $13g + 17h = 50$ . In the second equation, move all the variables to the left of the equal sign to get  $-13g + 3h = 20$ . Whenever there are two equations with the same two variables, they can be solved simultaneously by adding or subtracting them. The key is to get one variable to disappear. Stack the equations on top of each other and add them.

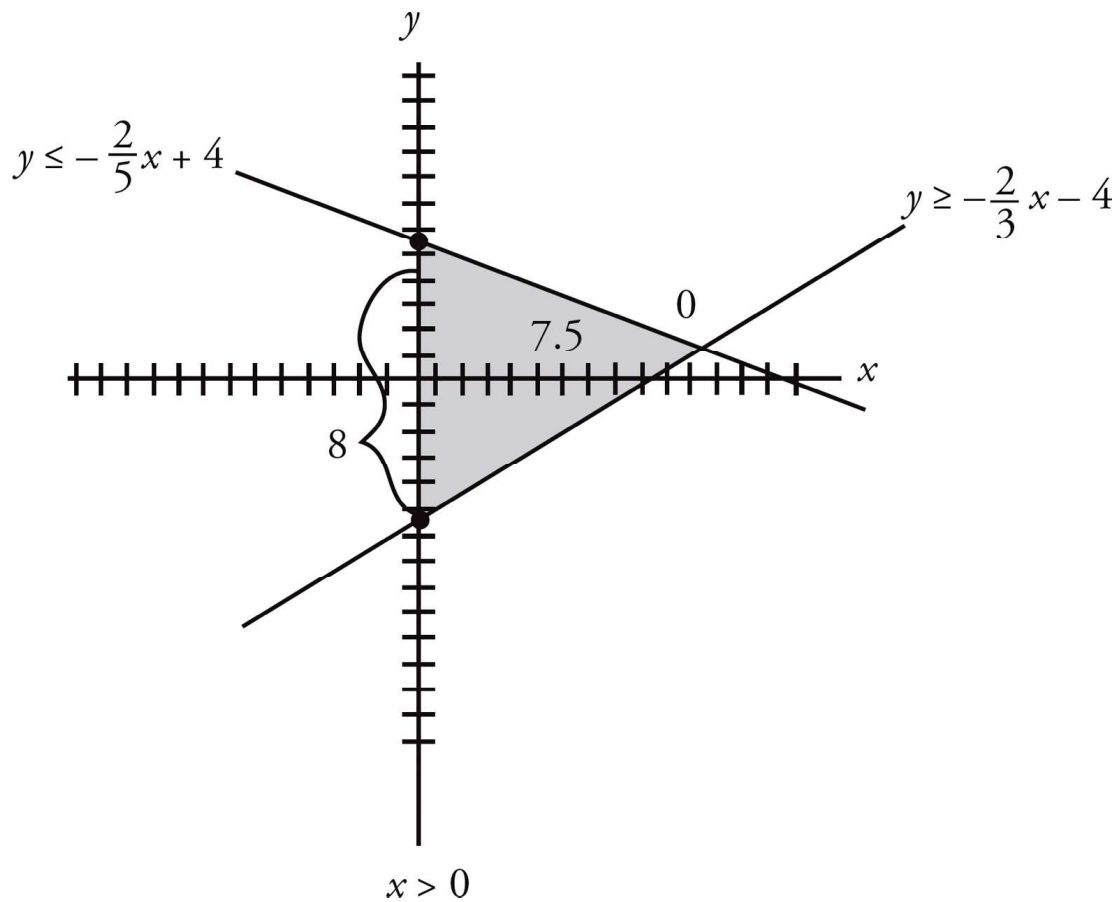
$$\begin{array}{r} 13g + 17h = 50 \\ -13g + 3h = 20 \\ \hline 20h = 70 \end{array}$$

Therefore,  $h = \frac{70}{20}$ . Because this number is too large to grid in, either reduce the fraction to  $\frac{7}{2}$ , or convert the fraction to the decimal 3.5.

34. **16** To find the percent of registered Democrats planning to vote for Candidate A, divide the number of Democrats planning to vote for Candidate A by the total number of registered Democrats:  $\frac{24}{150} = 0.16 = 16\%$ , which makes 16 the correct answer.
35. **30** Since no picture has been provided, start by drawing the picture. To do so, change each of the equations into the slope-intercept form of an equation  $y = mx + b$ , where  $m$  is the slope and  $b$  is the  $y$ -intercept. The second equation becomes  $3y \geq 2x - 12$ , or  $y \geq \frac{2}{3}x - 4$ . The third equation becomes  $5y \leq -2x + 20$ , or  $y \leq -\frac{2}{5}x + 4$ . The  $\geq$  sign in the second equation means that everything above the line should be shaded, and the  $\leq$  sign in the third equation means that everything below that line should be shaded. To graph the first equation  $x \geq 0$ , shade everything to the right of the  $y$ -axis. The resulting picture should look like this:



The formula for the area of a triangle is  $A = \frac{1}{2} b \times h$ . It is easiest to think of the side that is along the  $y$ -axis as the base. That side goes from a  $y$ -coordinate of 4 to  $-4$ , for a length of 8. The height of the triangle is the  $x$ -coordinate of the point where the two slanted lines meet; set the two equations equal to find it. Start with  $\frac{2}{3}x - 4 = -\frac{2}{5}x + 4$  and multiply everything by 15 to get  $10x - 60 = -6x + 60$ . Then add  $6x$  and  $60$  to both sides to get  $16x = 120$ , so  $x = 7.5$ , and the height is 7.5. The resulting figure should look like this:



Plug the measurements for the base and the height into the area formula to get  $A = \frac{1}{2}(8)(7.5) = 30$ . The correct answer is 30.

36. **o** Start by multiplying the terms together. To multiply  $(x^2 + 2x - 3)(2x + 5)$ , multiply each term in the left parenthesis by each term in the right parenthesis to get  $2x^3 + 5x^2 + 4x^2 + 10x - 6x - 15$ . Combine like terms to get  $2x^3 + 9x^2 + 4x - 15$ . To multiply  $(x + 1)(x - 1)(x + 3)$ , do one set of parentheses first; then multiply that product by the remaining parenthesis. You may notice that  $(x + 1)(x - 1)$  is a common quadratic, which equals  $x^2 - 1$ . Then you need to multiply  $x^2 - 1$  by  $(x + 3)$ . As you did before, multiply each term in the first parenthesis by each term in the second to get  $x^3 + 3x^2 - x - 3$ . Now you can do  $(2x^3 + 9x^2 + 4x - 15) - (x^3 + 3x^2 - x - 3)$ . It is easiest to distribute the negative sign into the second parenthesis:  $(2x^3 + 9x^2 + 4x - 15) + (-x^3 - 3x^2 + x + 3)$ . Now you can combine like terms to get  $x^3 + 6x^2 + 5x - 12$ . This is in the form  $ax^3 + bx^2 + cx + d$ , so  $a = 1$ ,  $b = 6$ ,  $c = 5$ , and  $d = -12$ . This means  $a + b + c + d = 1 + 6 + 5 + (-12) = 0$ .
37. **195** Use the definition of inverse proportion:  $x_1 y_1 = x_2 y_2$ . Plug in 1.5 for  $x_1$ , 260 for  $y_1$ , 2 for  $x_2$ , and solve for  $y_2$ :  $(1.5)(260) = (2)(y_2)$ ;  $390 = 2y_2$ . Divide both sides by 2, and you find  $y_2 = 195$ .

38. **15** Start by converting the qualifying distance of 68.58 meters into yards. Set up a proportion:  $\frac{1 \text{ yard}}{0.9144 \text{ meters}} = \frac{x \text{ yards}}{68.58 \text{ meters}}$ . Cross-multiply to get  $0.9144x = 68.58$ . Divide both sides by 0.9144 to find that the qualifying distance is 75 yards. If his current best is 60 yards, he needs to throw  $75 - 60 = 15$  more yards.