

## Math: Question 1

The ticket revenue of a movie theater is proportional to the number of tickets the theater sells. The theater sold 300 tickets on Thursday and 600 tickets on Friday. Which of the following is true?

- A. The ticket revenue on Thursday was one-quarter the ticket revenue on Friday.
- B. The ticket revenue on Thursday was one-half the ticket revenue on Friday.
- C. The ticket revenue on Thursday was twice as great as the ticket revenue on Friday.
- D.

The ticket revenue on Thursday was four times as great as the ticket revenue on Friday.

Choice B is correct. It's given that there is a proportional relationship between the ticket revenue and the number of tickets sold. This means that the ratio of the ticket revenue to the number of tickets sold is always the same. Let  $t$  represent the ticket revenue from Thursday and let  $f$  represent the ticket revenue from Friday. Since ticket revenue is proportional to the number of tickets sold, then  $\frac{t}{300} = \frac{f}{600}$ . Cross-multiplication yields  $600t = 300f$ , and dividing both sides by 600 yields  $t = \frac{300}{600}f$ , or  $t = \frac{1}{2}f$ . Therefore, the ticket revenue on Thursday ( $t$ ) was one-half the ticket revenue on Friday ( $f$ ).

Choices A, C, and D are incorrect and may result from misinterpretations of the proportional relationship.

**Question Difficulty:** Easy

## Math: Question 2

The ratio of  $t$  to  $u$  is 1 to 2, and  $t = 10$ . What is the value of  $u$  ?

- A. 2
- B. 5
- C. 10
- D. 20

Choice D is correct. It's given that the ratio of  $t$  to  $u$  is 1 to 2. Since  $t = 10$ , it follows that the ratio of 10 to  $u$  is also 1 to 2. The relationship between these ratios can be represented by the proportion  $\frac{10}{u} = \frac{1}{2}$ . Multiplying both sides of this equation by 2 and then by  $u$  yields  $20 = u$ .

Choice A is incorrect. This is the value of  $u$  when  $t = 1$ . Choice B is incorrect. This would be the value of  $u$  if the ratio of  $t$  to  $u$  were 2 to 1. Choice C is incorrect. This is the value of  $t$ , not  $u$ .

**Question Difficulty:** Easy

### Math: Question 3

$$2(x + 3) = 8$$

If the equation above is true, what is the value of  $x + 3$ ?

- A. 4
- B. 5
- C. 13
- D. 16

Choice A is correct. Dividing both sides of the given equation  $2(x + 3) = 8$  by 2 yields  $x + 3 = 4$ .

Choice B is incorrect and may result from subtracting 3 from both sides of the equation instead of dividing both sides by 2. Choice C is incorrect and may result from calculation errors. Choice D is incorrect and may result from multiplying, not dividing, both sides of the equation by 2.

**Question Difficulty:** Easy

### Math: Question 4

A bag contains a total of 60 marbles. A marble is to be chosen at random from the bag. If the probability that a blue marble will be chosen is 0.35, how many marbles in the bag are blue?

- A. 21
- B. 25
- C. 35
- D. 39

Choice A is correct. Multiplying the number of marbles in the bag by the probability of selecting a blue marble gives the number of blue marbles in the bag. Since the bag contains a total of 60 marbles and the probability that a blue marble will be selected from the bag is 0.35, there are a total of  $(0.35)(60) = 21$  blue marbles in the bag.

Choice B is incorrect and may result from subtracting 35 from 60. Choice C is incorrect. This would be the number of blue marbles in the bag if there were a total of 100 marbles, not 60 marbles. Choice D is incorrect. This is the number of marbles in the bag that aren't blue.

**Question Difficulty:** Easy

## Math: Question 5

For a person  $m$  miles from a flash of lightning, the length of the time interval from the moment the person sees the lightning to the moment the person hears the thunder is  $k$  seconds. The ratio of  $m$  to  $k$  can be estimated to be 1 to 5. According to this estimate, the person is how many miles from a flash of lightning if the time interval is 25 seconds?

- A. 10
- B. 9
- C. 6
- D. 5

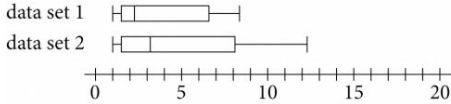
Choice D is correct. It's given that the ratio of  $m$  to  $k$  is estimated to be 1 to 5. Therefore, when  $k = 25$ , the relationship between these ratios can be expressed by the proportion  $\frac{m}{25} = \frac{1}{5}$ .

Multiplying both sides of this equation by 25 yields  $m = 5$ .

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

**Question Difficulty:** Easy

## Math: Question 6



The box plots above summarize two data sets. Based on the box plots, which of the following must be true?

- I. The range of data set 2 is greater than the range of data set 1.
- II. The median of data set 2 is greater than the median of data set 1.

- A. I only
- B. II only
- C. I and II
- D. Neither I nor II

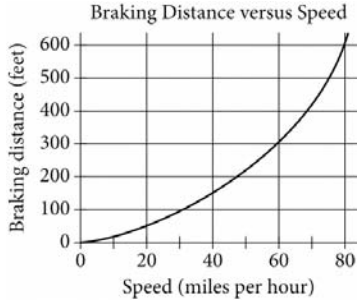
Choice C is correct. The range of a data set is calculated by subtracting the minimum value—the value represented by the end of the left whisker—from the maximum value—the value represented by the end of the right whisker. Based on the box plots, the range of data set 1 is approximately  $8.25 - 1 = 7.25$ , and the range of data set 2 is approximately  $12.25 - 1 = 11.25$ .

Since 11.25 is greater than 7.25, I is true. The median of a data set represented in a box plot is represented by the vertical line within the box. The median of data set 1 is approximately 2.25, and the median of data set 2 is approximately 3.25. Since 3.25 is greater than 2.25, II is true. Since I and II are both true, the correct choice is C.

Choices A, B, and D are incorrect and may result from misreading the box plots or misinterpreting the meanings of range and median.

**Question Difficulty:** Medium

## Math: Question 7



The graph above shows the relationship between the speed of a particular car, in miles per hour, and its corresponding braking distance, in feet. Approximately how many feet greater will the car's braking distance be when the car is traveling at 50 miles per hour than when the car is traveling at 30 miles per hour?

- A. 75
- B. 125
- C. 175
- D. 250

Choice B is correct. According to the graph, when the car is traveling at 50 miles per hour, the braking distance is approximately 225 feet, and when the car is traveling at 30 miles per hour, the braking distance is approximately 100 feet. The difference between these braking distances is  $225 - 100$ , or 125 feet.

Choice A is incorrect and may result from finding the braking distance for 20 miles per hour, the difference between the given speeds. Choice C is incorrect and may result from subtracting the speed from the braking distance at 50 miles per hour. Choice D is incorrect and may result from finding the difference in the braking distances at 60 and 20 miles per hour.

**Question Difficulty:** Medium

## Math: Question 8

The expression  $2x^2 + ax$  is equivalent to  $x(2x + 7)$  for some constant  $a$ . What is the value of  $a$  ?

- A. 2
- B. 3
- C. 4
- D. 7

Choice D is correct. It's given that  $2x^2 + ax$  is equivalent to  $x(2x + 7)$  for some constant  $a$ .

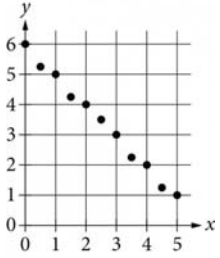
Distributing the  $x$  over each term in the parentheses gives  $2x^2 + 7x$ , which is in the same form as the first given expression,  $2x^2 + ax$ . The coefficient of the second term in  $2x^2 + 7x$  is 7. Therefore, the value of  $a$  is 7.

Choice A is incorrect. If the value of  $a$  were 2, then  $2x^2 + ax$  would be equivalent to  $2x^2 + 2x$ , which isn't equivalent to  $x(2x + 7)$ . Choice B is incorrect. If the value of  $a$  were 3, then  $2x^2 + ax$  would be equivalent to  $2x^2 + 3x$ , which isn't equivalent to  $x(2x + 7)$ . Choice C is incorrect. If the value of  $a$  were 4, then  $2x^2 + ax$  would be equivalent to  $2x^2 + 4x$ , which isn't equivalent to  $x(2x + 7)$ .

**Question Difficulty:** Medium



## Math: Question 9



Which of the following could be an equation for a line of best fit for the data in the scatterplot?

- A.  $y = -x + 6$
- B.  $y = -x - 6$
- C.  $y = 6x + 1$
- D.  $y = 6x - 1$

Choice A is correct. A line of best fit for the data in a scatterplot is a line that follows the trend of the data with approximately half the data points above and half the data points below the line. Based on the given data, a line of best fit will have a positive y-intercept on or near the point  $(0, 6)$  and a negative slope. All of the choices are in slope-intercept form  $y = mx + b$ , where  $m$  is the slope and  $b$  is the y-coordinate of the y-intercept. Only choice A is an equation of a line with a positive y-intercept at  $(0, 6)$  and a negative slope,  $-1$ .

Choice B is incorrect. This equation is for a line that has a negative y-intercept, not a positive y-intercept. Choices C and D are incorrect and may result from one or more sign errors and from switching the values of the y-intercept and the slope in the equation.

**Question Difficulty:** Medium

## Math: Question 10

At a certain time and day, the Washington Monument in Washington, DC, casts a shadow that is 300 feet long. At the same time, a nearby cherry tree casts a shadow that is 16 feet long. Given that the Washington Monument is approximately 555 feet tall, which of the following is closest to the height, in feet, of the cherry tree?

- A. 10
- B. 20
- C. 30
- D. 35

Choice C is correct. There is a proportional relationship between the height of an object and the length of its shadow. Let  $c$  represent the height, in feet, of the cherry tree. The given relationship can be expressed by the proportion  $\frac{555}{300} = \frac{c}{16}$ . Multiplying both sides of this equation by 16 yields  $c = 29.6$ . This height is closest to the value given in choice C, 30.

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

**Question Difficulty:** Medium

## Math: Question 11

$$2x + 7y = 9$$

$$8x + 28y = a$$

In the given system of equations,  $a$  is a constant. If the system has infinitely many solutions, what is the value of  $a$  ?

- A. 4
- B. 9
- C. 36
- D. 54

Choice C is correct. A system of two linear equations has infinitely many solutions if one equation is equivalent to the other. This means that when the two equations are written in the same form, each coefficient or constant in one equation is equal to the corresponding coefficient or constant in the other equation multiplied by the same number. The equations in the given system of equations are written in the same form, with  $x$  and  $y$  on the left-hand side of the equation and a constant on the right-hand side of the equation. The coefficients of  $x$  and  $y$  in the second equation are equal to the coefficients of  $x$  and  $y$ , respectively, in the first equation multiplied by 4:  $8 = 2(4)$  and  $28 = 7(4)$ . Therefore, the constant in the second equation must be equal to 4 times the constant in the first equation:  $a = 9(4)$ , or  $a = 36$ .

Choices A, B, and D are incorrect. When  $a = 4$ ,  $a = 9$ , or  $a = 54$ , the given system of equations has no solution.

**Question Difficulty:** Medium

## Math: Question 12

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

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

A.  $x^3 + 3x^2 - 6x$

B.  $x^3 + 3x^2 - 3x$

C.  $x^5 + 2x^2 - 6x$

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

Choice A is correct. In the expression  $(x^3 + x^2) + 2(x^2 - 3x)$ , distributing the 2 to each term of the expression in the second set of parentheses gives  $(x^3 + x^2) + (2x^2 - 6x)$ . Using the associative property of addition gives  $x^3 + (x^2 + 2x^2) - 6x$ . Finally, combining like terms gives  $x^3 + 3x^2 - 6x$ .

Choice B is incorrect and may result from not distributing the 2 to the second term in  $(x^2 - 3x)$ .

Choice C is incorrect and may result from multiplying, not adding, the terms in  $(x^3 + x^2)$ . Choice D is incorrect and may result from multiplying, not adding, the terms in  $(x^3 + x^2)$  and from not distributing the 2 to the second term in  $(x^2 - 3x)$ .

**Question Difficulty:** Medium

## Math: Question 13

Questions 13 and 14 refer to the following information.

In an experiment, a student uses a thermometer that can read temperatures from  $-94^{\circ}\text{F}$  to  $172^{\circ}\text{F}$ . The student also converts measurements from  $^{\circ}\text{F}$  to kelvins (K) and degrees Rankine ( $^{\circ}\text{R}$ ) using the following approximate formulas.

- $T_{\text{K}} = \frac{5}{9}x + 255$ , where  $x$  is the temperature in  $^{\circ}\text{F}$  and  $T_{\text{K}}$  is the temperature in K.
- $T_{\text{R}} = x + 460$ , where  $x$  is the temperature in  $^{\circ}\text{F}$  and  $T_{\text{R}}$  is the temperature in  $^{\circ}\text{R}$ .

If a temperature was recorded as  $500^{\circ}\text{R}$ , which of the following is closest to the reading of the thermometer?

- A.  $40^{\circ}\text{F}$
- B.  $120^{\circ}\text{F}$
- C.  $710^{\circ}\text{F}$
- D.  $960^{\circ}\text{F}$

Choice A is correct. It's given that the recorded temperature is  $500^{\circ}\text{R}$ . To convert  $500^{\circ}\text{R}$  to  $^{\circ}\text{F}$ , substitute 500 for  $T_{\text{R}}$  in the given equation  $T_{\text{R}} = x + 460$ , which gives  $500 = x + 460$ . Subtracting 460 from each side of this equation gives  $x = 40$ .

Choices B and C are incorrect and may result from calculation errors. Choice D is incorrect and may result from adding 460 to, rather than subtracting from, each side of the equation.

**Question Difficulty:** Medium

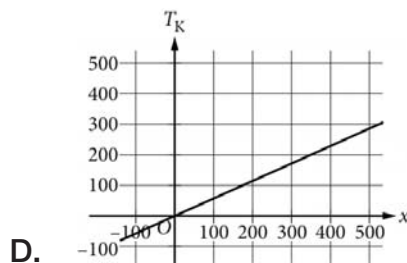
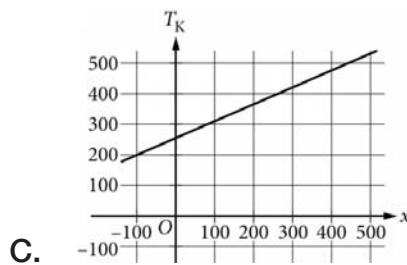
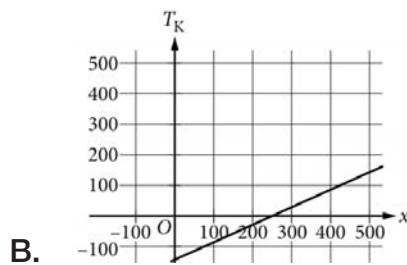
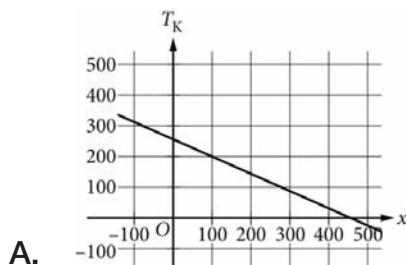
## Math: Question 14

Questions 13 and 14 refer to the following information.

In an experiment, a student uses a thermometer that can read temperatures from  $-94^{\circ}\text{F}$  to  $172^{\circ}\text{F}$ . The student also converts measurements from  $^{\circ}\text{F}$  to kelvins (K) and degrees Rankine ( $^{\circ}\text{R}$ ) using the following approximate formulas.

- $T_K = \frac{5}{9}x + 255$ , where  $x$  is the temperature in  $^{\circ}\text{F}$  and  $T_K$  is the temperature in K.
- $T_R = x + 460$ , where  $x$  is the temperature in  $^{\circ}\text{F}$  and  $T_R$  is the temperature in  $^{\circ}\text{R}$ .

Which of the following graphs shows the relationship between  $T_K$ , the temperature in K, and  $x$ , the temperature in  $^{\circ}\text{F}$ ?



Choice C is correct. It's given that  $T_K = \frac{5}{9}x + 255$ . This equation is in slope-intercept form,  $y = mx + b$ , where  $m$  is the slope of the line and  $b$  is the  $y$ -coordinate of the  $y$ -intercept of the line.

The graph of the equation  $T_K = \frac{5}{9}x + 255$  is a line with a slope of  $\frac{5}{9}$  and a y-intercept of  $(0,255)$ .

The lines in choices A and C pass through the point  $(0,255)$ . Only choice C has a positive slope.

Calculating the slope using  $(0,255)$  and  $(100,310)$  yields  $\frac{310-255}{100-0}$ , or 0.55, which is

approximately equal to  $\frac{5}{9}$ . Thus, only the line in choice C could show the relationship between

$T_K$  and  $x$ .

Choice A is incorrect. The slope of this line is negative and therefore can't be equal to  $\frac{5}{9}$ .

Choices B and D are incorrect. Neither of these lines passes through the point  $(0,255)$ .

**Question Difficulty:** Medium

## Math: Question 15

### Fiction Books Borrowed in January

Type	Number of books
Science fiction	175
Mystery	100
Fantasy	225
Adventure	125
Other	25

The table above shows the distribution of fiction books, by type, borrowed from Central Library in January. In February, the number of fantasy books borrowed and the number of adventure books borrowed each increased by 20% of their respective January values. How many more fantasy books than adventure books were borrowed from the library in February?

- A. 70
- B. 120
- C. 125
- D. 150

Choice B is correct. It's given that 225 fantasy books and 125 adventure books were borrowed in January and that in February the number of books borrowed for both types increased by 20%.

This means that in February the number of fantasy books borrowed was  $225\left(1 + \frac{20}{100}\right) = 270$ , and

the number of adventure books borrowed was  $125\left(1 + \frac{20}{100}\right) = 150$ . Therefore,  $270 - 150 = 120$

more fantasy books than adventure books were borrowed in February.

Choice A is incorrect and may result from multiplying the respective January numbers by  $\frac{20}{100}$

instead of  $\left(1 + \frac{20}{100}\right)$  and from finding the sum, instead of the difference, of the numbers of books

borrowed in February. Choice C is incorrect. This is the number of adventure books borrowed in January. Choice D is incorrect. This is the number of adventure books borrowed in February.

**Question Difficulty:** Medium



## Math: Question 16

In the  $xy$ -plane, the graph of the quadratic function  $g$  intersects the  $x$ -axis at  $x = 5$  and  $x = 9$ . Which of the following could be an equation of  $g$  ?

- A.  $g(x) = (x - 5)(x - 9)$
- B.  $g(x) = (x + 5)(x + 9)$
- C.  $g(x) = (x - 7)^2 + 4$
- D.  $g(x) = (x + 7)^2 + 4$

Choice A is correct. Since the graph of  $g$  crosses the  $x$ -axis at  $x = 5$  and  $x = 9$ , it passes through the points  $(5, 0)$  and  $(9, 0)$ . It follows that  $g(5) = 0$  and  $g(9) = 0$ . If  $g(x) = (x - 5)(x - 9)$ , then  $g(5) = (5 - 5)(5 - 9)$ , which is equal to  $(0)(-4)$ , or 0. Similarly,  $g(9) = (9 - 5)(9 - 9)$ , which is equal to  $(4)(0)$ , or 0. Therefore,  $g(x) = (x - 5)(x - 9)$  could be an equation of  $g$ .

Choice B is incorrect. If  $g(x) = (x + 5)(x + 9)$ , then the graph would intersect the  $x$ -axis at  $-5$  and  $-9$ , not at 5 and 9. Choices C and D are incorrect. The graphs of these functions do not intersect the  $x$ -axis.

**Question Difficulty:** Medium

## Math: Question 17

If  $\sqrt{17 + (x - y)^3} = 9$ , what is the value of  $(x - y)^2$ ?

- A. 4
- B. 9
- C. 16
- D. 25

Choice C is correct. Squaring both sides of the given equation yields  $17 + (x - y)^3 = 81$ . Subtracting 17 from both sides of this equation yields  $(x - y)^3 = 64$ . Taking the cube root of both sides of this equation yields  $(x - y) = 4$ . It follows that the value of  $(x - y)^2 = 4^2$ , or 16.

Choice A is incorrect and is the value of  $(x - y)$ , not  $(x - y)^2$ . Choice B is incorrect and may result from a computational or conceptual error leading to  $(x - y) = 3$  instead of  $(x - y) = 4$ . Choice D is incorrect and may result from a computational or conceptual error leading to  $(x - y) = 5$  instead of  $(x - y) = 4$ .

**Question Difficulty:** Medium

## Math: Question 18

The boiling point of water at sea level is 212 degrees Fahrenheit ( $^{\circ}\text{F}$ ). For every 550 feet above sea level, the boiling point of water is lowered by about  $1^{\circ}\text{F}$ . Which of the following equations can be used to find the boiling point  $B$  of water, in  $^{\circ}\text{F}$ ,  $x$  feet above sea level?

A.  $B = 550 + \frac{x}{212}$

B.  $B = 550 - \frac{x}{212}$

C.  $B = 212 + \frac{x}{550}$

D.  $B = 212 - \frac{x}{550}$

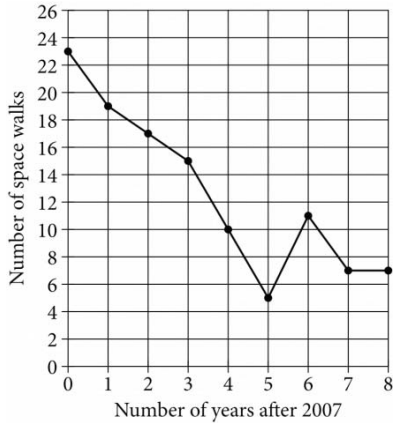
Choice D is correct. It's given that the boiling point of water at sea level is  $212^{\circ}\text{F}$  and that for every 550 feet above sea level, the boiling point of water is lowered by about  $1^{\circ}\text{F}$ . Therefore, the change in the boiling point of water  $x$  feet above sea level is represented by the expression  $-\frac{x}{550}$ . Adding this expression to the boiling point of water at sea level gives the equation for the

boiling point  $B$  of water, in  $^{\circ}\text{F}$ ,  $x$  feet above sea level:  $B = -\frac{x}{550} + 212$ , or  $B = 212 - \frac{x}{550}$ .

Choices A and B are incorrect and may result from using the boiling point of water at sea level as the rate of change and the rate of change as the initial boiling point of water at sea level. Choice C is incorrect and may result from representing the change in the boiling point of water as an increase rather than a decrease.

**Question Difficulty:** Medium

## Math: Question 19



A space walk is a physical activity by an astronaut outside a spacecraft in space. The line graph displays the number of space walks that occurred each year at the International Space Station (ISS) from 2007 to 2015. What is the average rate of change of the number of space walks per year from 2007 to 2012?

- A.  $-3$
- B.  $-2$
- C.  $-\frac{18}{5}$
- D.  $-\frac{7}{2}$

Choice C is correct. The average rate of change of the number of space walks per year from 2007 to 2012 can be found by dividing the difference in the number of space walks by the number of years elapsed during this time period. According to the graph, the number of space walks that occurred in the year 2007, or 0 years after 2007, was 23. Likewise, the number of space walks that occurred in the year 2012, or 5 years after 2007, was 5. Thus, the change in the number of space walks over this 5-year period is  $23 - 5 = 18$ . Dividing this quantity by the number of years elapsed from 2007 to 2012, or 5, yields  $\frac{18}{5}$ . Since the number of space walks decreased from 2007 to 2012, it follows that the average rate of change is negative. Therefore, the average rate of change of the number of space walks per year from 2007 to 2012 is  $-\frac{18}{5}$ .

Choice A is incorrect and may result from dividing the change in the number of space walks over this time period by 6, instead of by 5. Choice B is incorrect and may result from dividing the change in the number of space walks over this time period by 9, the total number of years represented in the line graph. Choice D is incorrect. This is the average rate of change of the number of space walks per year from 2008 to 2012.

**Question Difficulty:** Hard

## Math: Question 20

x	h(x)
0	1
1	7

The table shown gives two values of  $x$  and the corresponding values of  $h(x)$  for the linear function  $h$ . If  $y = h(x)$  is graphed in the  $xy$ -plane, what is the slope of the graph?

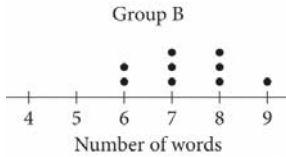
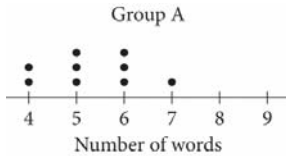
- A. 0
- B. 2
- C. 6
- D. 7

Choice C is correct. It's given that  $y = h(x)$ ; therefore, the  $h(x)$  values in the table correspond to  $y$ -values in the  $xy$ -plane. Finding the difference of the  $y$ -values divided by the difference of the  $x$ -values gives the slope:  $\frac{7-1}{1-0}$ , which is equivalent to  $\frac{6}{1}$ . Therefore, the slope of the line is 6.

Choices A and D are incorrect. These are values in the table, not the slope of the graph of  $y = h(x)$ . Choice B is incorrect. This is the number of points represented in the table.

**Question Difficulty:** Medium

## Math: Question 21



In a psychology experiment, students in two groups were given a word and asked to list words that rhyme with it. The number of words for the two groups of people are summarized in the dot plots shown. Which of the following statements is true?

- A. The standard deviation is greater for group B than for group A.
- B. The standard deviation is greater for group A than for group B.
- C. The standard deviation for group A is equal to the standard deviation for group B.
- D. The standard deviation for either group cannot be determined from the dot plots.

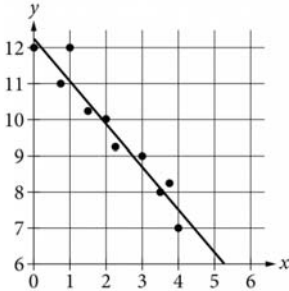
Choice C is correct. The standard deviation is a measure of how far the values in the data set are from the mean. By visual inspection, both dot plots show the same distribution of 9 data values in terms of shape, but not in terms of value. For example, the lowest data value has a frequency of 2 on each dot plot. Then, the data value that is 1 greater has a frequency of 3 on each dot plot. The data value that is 1 greater than that has a frequency of 3 on each dot plot, and the data value that is 1 greater than that has a frequency of 1 on each dot plot. Thus, the data values for both groups show the same amount of spread from their respective means. Therefore, the standard deviation for group A is equal to the standard deviation for group B.

Choices A, B, and D are incorrect and may result from misconceptions about standard deviation.

**Question Difficulty: Hard**

## Math: Question 22

The scatterplot shows the relationship between two variables,  $x$  and  $y$ . A line of best fit for the data is also shown. Which of the following is closest to the difference between the  $y$ -coordinate of the data point with  $x = 1$  and the  $y$ -value predicted by the line of best fit at  $x = 1$ ?



- A. 1
- B. 2
- C. 5
- D. 12

Choice A is correct. The data point with  $x = 1$  has a  $y$ -coordinate of 12. The  $y$ -value predicted by the line of best fit at  $x = 1$  is approximately 11. The difference between the  $y$ -coordinate of the data point and the  $y$ -value predicted by the line of best fit at  $x = 1$  is  $12 - 11$ , or 1.

Choices B and C are incorrect and may result from incorrectly reading the scatterplot. Choice D is incorrect. This is the  $y$ -coordinate of the data point at  $x = 1$ .

**Question Difficulty:** Hard

## Math: Question 23

The total land area of Honduras is approximately 11.2 million hectares, of which 15% is suitable for agriculture, including land used for coffee growing. If 310,000 hectares are used for coffee growing, which of the following best approximates the percent of Honduras's land area that is suitable for agriculture that is used for coffee growing? (1 million = 1,000,000)

- A. 2.8%
- B. 9.8%
- C. 18.5%
- D. 27.7%

Choice C is correct. Finding 15% of the total land area of Honduras results in the amount of land area suitable for agriculture: 15% of 11.2 million hectares is  $(0.15)(11.2) = 1.68$  million hectares, or 1,680,000 hectares. Since 310,000 of the 1,680,000 hectares are used for coffee growing, the percent of Honduras's land area suitable for agriculture that is used for coffee growing can be expressed as  $\frac{310,000}{1,680,000} \cdot \frac{1}{100}$  percent. Evaluating this percentage yields approximately 18.5%.

Choice A is incorrect and may result from using the total land area of Honduras, 11.2 million, instead of the 15% that is suitable for agriculture. Choice B is incorrect and may result from calculation errors. Choice D is incorrect and may result from finding the percentage of the total land area of Honduras that is used for coffee growing, and then making a calculation error.

**Question Difficulty:** Hard



## Math: Question 24

A factory produces only one type of product. To estimate the mean weight of the product produced by the factory on a particular day, a sample of the product produced that day from the factory was selected at random. The mean weight of the products in the sample was 19.8 ounces (oz). The margin of error for the estimate was 0.2 oz. Based on the sample mean and margin of error, which of the following is the most appropriate conclusion?

- A.  
The actual weights of all products produced that day at the factory are between 19.6 oz and 20 oz.
- B. The actual weights of all products from the sample are between 19.6 oz and 20 oz.
- C. The mean weight of all products produced that day at the factory must be 19.8 oz.
- D.  
The mean weight of all products produced that day at the factory is between 19.6 oz and 20 oz.

Choice D is correct. The mean weight of all products produced by the factory on a particular day can be estimated using the sample of products that was selected at random. It's given that the mean weight of the products in this sample was 19.8 ounces (oz), with a margin of error for this estimate of 0.2 oz. Thus, the range of likely values for the mean weight of all products produced that day at the factory is estimated to be  $19.8 \pm 0.2$ , or between 19.6 oz and 20 oz.

Choices A and B are incorrect. The margin of error can only be applied to the original sample statistic. In this case, it is the mean weight of all products produced by the factory on a particular day. Thus, it wouldn't be appropriate to conclude that the actual weights of all products can be estimated to be within this margin of error. Choice C is incorrect. Based on the sample mean and margin of error, it is more appropriate to conclude that the mean weight of all products produced that day falls within an interval of values rather than to conclude that it must be a certain value.

**Question Difficulty:** Hard

### Math: Question 25

In the  $xy$ -plane, line  $\ell$  is parallel to the line with equation  $4x - y = 1$ . If line  $\ell$  contains the point  $(0,2)$ , which of the following is an equation of line  $\ell$ ?

- A.  $4x - y = -2$
- B.  $4x - y = 2$
- C.  $4x + y = -2$
- D.  $4x + y = 2$

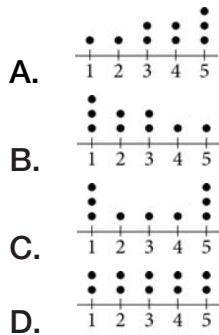
Choice A is correct. Parallel lines have equal slopes. The slope of a line can be found by writing its equation in slope-intercept form  $y = mx + b$ , where  $m$  is the slope and  $b$  is the  $y$ -coordinate of the  $y$ -intercept. The given equation  $4x - y = 1$  can be rearranged in the form  $y = 4x - 1$ . Thus the slope of this line and line  $\ell$  must be 4. It's given that line  $\ell$  contains the point  $(0,2)$ , so the  $y$ -value of the  $y$ -intercept of line  $\ell$  is 2. Therefore, an equation of line  $\ell$  is  $y = 4x + 2$ , or  $4x - y = -2$ .

Choices B, C, and D are incorrect and may result from errors made rearranging the given equation.

**Question Difficulty:** Hard

## Math: Question 26

Which of the following dot plots represents a data set for which the mean of the values is greater than the median of the values?



Choice B is correct. The data represented by the dot plot in choice B has a mean of  $\frac{1+1+1+2+2+3+3+4+5}{9}$ , or approximately 2.44. For this data set, the median, or the middle value when the data is ordered from least to greatest, is 2. Therefore, the mean is greater than the median.

Choice A is incorrect. For this data set, the mean is approximately 3.56 and the median is 4. Therefore, the mean is less than the median. Choices C and D are incorrect. These dot plots are symmetric, so the mean and median are equal in each of these data sets.

**Question Difficulty: Hard**

## Math: Question 27

A new savings account was opened with an initial deposit of \$1,000. Each year, the account earns 2% interest on the amount of money in the account the previous year, and this interest is added to the account. If no additional deposits or withdrawals are made, which of the following functions gives the account value  $A(t)$ , in dollars, after  $t$  years?

- A.  $A(t) = 1,000(1 + 0.02t)$
- B.  $A(t) = 1,000(1 + 1.02t)$
- C.  $A(t) = 1,000(0.02)^t$
- D.  $A(t) = 1,000(1.02)^t$

Choice D is correct. A model for a quantity that increases by a certain percentage per time period  $t$  is an exponential function in the form  $A(t) = I\left(1 + \frac{r}{100}\right)^t$ , where  $I$  is the initial value at time  $t = 0$  for  $r\%$  annual interest. It's given that  $A(t)$  is the account value, in dollars, and  $t$  is the number of years after the account was opened. There was an initial deposit of \$1,000 at time  $t = 0$ , so  $I = 1,000$ . This number increases 2% per year after year  $t = 0$ , so  $r = 2$ . Substituting these values into the function equation produces  $A(t) = 1,000(1.02)^t$ .

Choices A and B are incorrect and may result from setting up a linear function rather than an exponential function. Choice C is incorrect and may result from representing the exponential function as a decreasing function instead of an increasing function.

**Question Difficulty:** Hard

## Math: Question 28

$$2x + y = 13$$

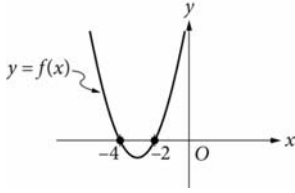
$$x + 2y = 11$$

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

The correct answer is 5. A solution to a system of two equations in two variables is an ordered pair  $(x,y)$  that satisfies both equations in the system. The given system can be solved by elimination. Multiplying the first equation by  $-2$  yields  $-4x - 2y = -26$ . Adding this equation to the second equation in the system yields  $(-4x + x) + (-2y + 2y) = -26 + 11$ , or  $-3x = -15$ . Dividing both sides of  $-3x = -15$  by  $-3$  yields  $x = 5$ . Therefore, the value of  $x$  in the solution  $(x,y)$  is 5.

**Question Difficulty:** Hard

## Math: Question 29



The function  $f$  is graphed in the  $xy$ -plane above. If  $f(x) = x^2 + kx + 8$ , where  $k$  is a constant, what is the value of  $k$  ?

The correct answer is 6. An equation of the graph shown can be written using the given  $x$ -intercepts as  $y = (x + 4)(x + 2)$ . It's given that  $y = f(x)$ . Substituting  $f(x)$  for  $y$  yields

$f(x) = (x + 4)(x + 2)$ . Expanding the right-hand side of the equation yields  $f(x) = x^2 + 4x + 2x + 8$ , or  $f(x) = x^2 + 6x + 8$ . Since it is given that the equation of the graph can be written as  $f(x) = x^2 + kx + 8$ , the value of  $k$  is equal to 6.

**Question Difficulty:** Hard

## Math: Question 30

Questions 30 and 31 refer to the following information.

On May 10, 2015, there were 83 million Internet subscribers in Nigeria. The major Internet providers were MTN, Globacom, Airtel, Etisalat, and Visafone. By September 30, 2015, the number of Internet subscribers in Nigeria had increased to 97 million.

If an Internet subscriber in Nigeria on September 30, 2015, is selected at random, the probability that the person selected was an MTN subscriber is 0.43. There were  $p$  million MTN subscribers in Nigeria on September 30, 2015. To the nearest integer, what is the value of  $p$  ?

The correct answer is 42. It's given that in Nigeria on September 30, 2015, the probability of selecting an MTN subscriber from all Internet subscribers is 0.43, that there were  $p$  million, or  $p(1,000,000)$ , MTN subscribers, and that there were 97 million, or 97,000,000, Internet subscribers. The probability of selecting an MTN subscriber from all Internet subscribers can be found by dividing the number of MTN subscribers by the total number of Internet subscribers.

Therefore, the equation  $\frac{p(1,000,000)}{97,000,000} = 0.43$  can be used to solve for  $p$ . Dividing 1,000,000 from

the numerator and denominator of the expression on the left-hand side yields  $\frac{p}{97} = 0.43$ .

Multiplying both sides of this equation by 97 yields  $p = (0.43)(97) = 41.71$ , which, to the nearest integer, is 42.

**Question Difficulty:** Hard

## Math: Question 31

Questions 30 and 31 refer to the following information.

On May 10, 2015, there were 83 million Internet subscribers in Nigeria. The major Internet providers were MTN, Globacom, Airtel, Etisalat, and Visafone. By September 30, 2015, the number of Internet subscribers in Nigeria had increased to 97 million.

The number of Internet subscribers increased by  $k$  percent from May 10, 2015, to September 30, 2015. To the nearest integer, what is the value of  $k$  ?

The correct answer is 17. Percent increase is calculated by subtracting the initial value from the new value, dividing this difference by the initial value, and then multiplying by 100. Therefore, the percent increase from May 10, 2015, to September 30, 2015, is

$$\frac{97,000,000 - 83,000,000}{83,000,000}(100) = 16.87\%. \text{ Thus, the value of } k \text{ to the nearest integer is } 17.$$

Question Difficulty: Hard