

# Math

## Module 2

(27 questions)

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### QUESTION 1

**Choice B** is correct. It's given that there are 20 buttons in a bag and 8 of the buttons are white. If one button from the bag is selected at random, the probability of selecting a white button is the number of white buttons in the bag divided by the total number of buttons in the bag. Therefore, if one button from the bag is selected at random, the probability of selecting a white button is  $\frac{8}{20}$ .

*Choice A* is incorrect. This is the probability of selecting an orange button from the bag. *Choice C* is incorrect. This is the probability of selecting a brown button from the bag. *Choice D* is incorrect. This is the probability of selecting a button that isn't white from the bag.

### QUESTION 2

**Choice B** is correct. It's given that the employee takes 1.5 minutes to prepare a sandwich. Multiplying 1.5 by the number of sandwiches,  $x$ , yields  $1.5x$ , the amount of time the employee spends preparing  $x$  sandwiches. It's also given that the employee takes 1.9 minutes to prepare a salad. Multiplying 1.9 by the number of salads,  $y$ , yields  $1.9y$ , the amount of time the employee spends preparing  $y$  salads. It follows that the total amount of time, in minutes, the employee spends preparing  $x$  sandwiches and  $y$  salads is  $1.5x + 1.9y$ . It's given that the employee spends a total of 46.1 minutes preparing  $x$  sandwiches and  $y$  salads. Thus, the equation  $1.5x + 1.9y = 46.1$  represents this situation.

*Choice A* is incorrect. This equation represents a situation where it takes the employee 1.9 minutes, rather than 1.5 minutes, to prepare a sandwich and 1.5 minutes, rather than 1.9 minutes, to prepare a salad. *Choice C* is incorrect. This equation represents a situation where it takes the employee 1 minute, rather than 1.5 minutes, to prepare a sandwich and 1 minute, rather than 1.9 minutes, to prepare a salad. *Choice D* is incorrect. This equation represents a situation where it takes the employee 30.7 minutes, rather than 1.5 minutes, to prepare a sandwich and 24.3 minutes, rather than 1.9 minutes, to prepare a salad.

### QUESTION 3

**Choice A** is correct. It's given that the ratio of black pens to red pens is 8 to 1.

Therefore, there are  $\frac{1}{8}$  as many red pens as black pens in the box. It's also given that there are 40 black pens in the box. Therefore, the number of red pens is  $\frac{1}{8}$  of the 40 black pens. Thus, the number of red pens is  $40\left(\frac{1}{8}\right)$ , or 5.

*Choice B* is incorrect. This is the number of black pens in the box for every red pen. *Choice C* is incorrect. This is the number of black pens in the box. *Choice D* is incorrect. This is the number of red pens in the box if the ratio of black pens to red pens is 1 to 8.

### QUESTION 4

**Choice D** is correct. Substituting 9 for  $x$  in the given equation yields  $f(9) = 100(9) + 2$ , or  $f(9) = 902$ . Therefore, the value of  $f(x)$  when  $x = 9$  is 902.

*Choice A* is incorrect. This is the value of  $f(x)$  when  $x = 1.09$ . *Choice B* is incorrect. This is the value of  $f(x)$  when  $x = 1.16$ . *Choice C* is incorrect. This is the value of  $f(x)$  when  $x = 8.98$ .

### QUESTION 5

**Choice D** is correct. It's given that the length of the whale was 162 cm when it was born and that its length increased an average of 4.8 cm per month for the first 12 months after it was born. Since  $x$  represents the number of months after the whale was born, the total increase in the whale's length, in cm, is 4.8 times  $x$ , or  $4.8x$ . The length of the whale  $y$ , in cm, can be found by adding the whale's length at birth, 162 cm, to the total increase in length,  $4.8x$  cm. Therefore, the equation that best represents this situation is  $y = 4.8x + 162$ .

*Choice A* is incorrect and may result from conceptual errors. *Choice B* is incorrect and may result from conceptual errors. *Choice C* is incorrect and may result from conceptual errors.

### QUESTION 6

The correct answer is 35. It's given that the perimeter of an isosceles triangle is 83 inches and that each of the two congruent sides has a length of 24 inches. The perimeter of a triangle is the sum of the lengths of its three sides. The equation  $24 + 24 + x = 83$  can be used to represent this situation, where  $x$  is the length, in inches, of the third side. Combining like terms on the left-hand side of this equation yields  $48 + x = 83$ . Subtracting 48 from both sides of this equation yields  $x = 35$ . Therefore, the length, in inches, of the third side is 35.

### QUESTION 7

The correct answer is 480. Multiplying both sides of the given equation by 8 yields  $8(2 + x) = 8(60)$ , or  $16 + 8x = 480$ . Therefore, if  $2 + x = 60$ , the value of  $16 + 8x$  is 480.

## QUESTION 8

**Choice C** is correct. It's given that the population density of Worthington is 290 people per square mile and Worthington has a population of 92,800 people.

Therefore, the area of Worthington is 92,800 people  $\left(\frac{1 \text{ square mile}}{290 \text{ people}}\right)$ , which is equivalent to  $\frac{92,800 \text{ square miles}}{290}$ , or 320 square miles.

*Choice A* is incorrect and may result from conceptual or calculation errors.

*Choice B* is incorrect and may result from conceptual or calculation errors.

*Choice D* is incorrect and may result from conceptual or calculation errors.

## QUESTION 9

**Choice A** is correct. The  $y$ -intercept of a graph in the  $xy$ -plane is the point  $(x, y)$  on the graph where  $x = 0$ . For the graph shown, at  $x = 0$ , the corresponding value of  $y$  is  $-6$ . Therefore, the  $y$ -intercept of the graph shown is  $(0, -6)$ .

*Choice B* is incorrect and may result from conceptual errors. *Choice C* is incorrect and may result from conceptual errors. *Choice D* is incorrect and may result from conceptual errors.

## QUESTION 10

**Choice B** is correct. For the graph shown, the  $x$ -axis represents time, in seconds, and the  $y$ -axis represents the number of candy bars wrapped. The slope of a line in the  $xy$ -plane is the change in  $y$  for each 1-unit increase in  $x$ . It follows that the slope of the graph shown represents the estimated number of candy bars the machine wraps with a label per second. The slope,  $m$ , of a line in the  $xy$ -plane can be found using any two points,  $(x_1, y_1)$  and  $(x_2, y_2)$ , on the line and the slope

formula  $m = \frac{y_2 - y_1}{x_2 - x_1}$ . The graph shown passes through the points  $(0, 0)$  and  $(2, 80)$ .

Substituting these points for  $(x_1, y_1)$  and  $(x_2, y_2)$ , respectively, in the slope formula yields  $m = \frac{80 - 0}{2 - 0}$ , which is equivalent to  $m = \frac{80}{2}$ , or  $m = 40$ . Therefore, the estimated number of candy bars the machine wraps with a label per second is 40.

*Choice A* is incorrect and may result from conceptual or calculation errors.

*Choice C* is incorrect and may result from conceptual or calculation errors.

*Choice D* is incorrect and may result from conceptual or calculation errors.

## QUESTION 11

**Choice B** is correct. The sum of the measures of the interior angles of a triangle is 180 degrees. Since the triangle is a right triangle, it has one angle that measures 90 degrees. Therefore, the sum of the measures, in degrees, of the remaining two angles is  $180 - 90$ , or 90. It's given that the measure of one of the acute angles in the triangle is 51 degrees. Therefore, the measure, in degrees, of the other acute angle is  $90 - 51$ , or 39.

*Choice A* is incorrect and may result from conceptual or calculation errors.

*Choice C* is incorrect and may result from conceptual or calculation errors.

*Choice D* is incorrect. This is the measure, in degrees, of the acute angle whose measure is given.

## QUESTION 12

**Choice B** is correct. The mean of a set of data values is the sum of all the data values divided by the number of data values in the set. The sum of the data values shown is  $2 + 9 + 14 + 23 + 32$ , or 80. Since there are 5 data values in the set, the mean of the data shown is  $\frac{80}{5}$ , or 16.

*Choice A* is incorrect. This is the median, not the mean, of the data shown.

*Choice C* is incorrect and may result from conceptual or calculation errors.

*Choice D* is incorrect. This is the maximum, not the mean, of the data shown.

## QUESTION 13

The correct answer is 12. The value of  $f(36)$  is the value of  $f(x)$  when  $x = 36$ . Substituting 36 for  $x$  in the given equation yields  $f(36) = 6 + \sqrt{36}$ , which is equivalent to  $f(36) = 6 + 6$ , or  $f(36) = 12$ . Thus, the value of  $f(36)$  is 12.

## QUESTION 14

The correct answer is 18. It's given by the second equation in the system that  $3y = 11$ . Substituting 11 for  $3y$  in the first equation in the system,  $x + 3y = 29$ , yields  $x + 11 = 29$ . Subtracting 11 from both sides of this equation yields  $x = 18$ .

## QUESTION 15

**Choice B** is correct. It's given that Rhett drove at an average speed of 35 miles per hour and that he drove for  $r$  hours. Multiplying 35 miles per hour by  $r$  hours yields  $35r$  miles, or the distance that Rhett drove. It's also given that Jessica drove at an average speed of 40 miles per hour and that she drove for  $j$  hours. Multiplying 40 miles per hour by  $j$  hours yields  $40j$  miles, or the distance that Jessica drove. The total distance, in miles, that Rhett and Jessica drove can be represented by the expression  $35r + 40j$ . It's given that the total distance they drove was under 220 miles. Therefore, the inequality  $35r + 40j < 220$  represents this situation.

*Choice A* is incorrect. This inequality represents a situation in which the total distance Rhett and Jessica drove was over, rather than under, 220 miles.

*Choice C* is incorrect. This inequality represents a situation in which Rhett drove at an average speed of 40, rather than 35, miles per hour, Jessica drove at an average speed of 35, rather than 40, miles per hour, and the total distance they drove was over, rather than under, 220 miles. *Choice D* is incorrect. This inequality represents a situation in which Rhett drove at an average speed of 40, rather than 35, miles per hour, and Jessica drove at an average speed of 35, rather than 40, miles per hour.

## QUESTION 16

**Choice A** is correct. It's given that the equation  $b = 42cf$  relates the positive numbers  $b$ ,  $c$ , and  $f$ . Dividing each side of the given equation by  $42f$  yields  $\frac{b}{42f} = c$ , or  $c = \frac{b}{42f}$ . Thus, the equation  $c = \frac{b}{42f}$  correctly expresses  $c$  in terms of  $b$  and  $f$ .

**Choice B** is incorrect. This equation can be rewritten as  $b = cf + 42$ . **Choice C** is incorrect. This equation can be rewritten as  $b = \frac{c}{42f}$ . **Choice D** is incorrect. This equation can be rewritten as  $b = 42 - c - f$ .

## QUESTION 17

**Choice D** is correct. Let  $p$  represent the number of pounds of potatoes and let  $c$  represent the number of pounds of celery that Davio bought. It's given that potatoes cost \$0.69 per pound and celery costs \$0.99 per pound. If Davio spent \$5.34 in total, then the equation  $0.69p + 0.99c = 5.34$  represents this situation. It's also given that Davio bought twice as many pounds of celery as pounds of potatoes; therefore,  $c = 2p$ . Substituting  $2p$  for  $c$  in the equation  $0.69p + 0.99c = 5.34$  yields  $0.69p + 0.99(2p) = 5.34$ , which is equivalent to  $0.69p + 1.98p = 5.34$ , or  $2.67p = 5.34$ . Dividing both sides of this equation by 2.67 yields  $p = 2$ . Substituting 2 for  $p$  in the equation  $c = 2p$  yields  $c = 2(2)$ , or  $c = 4$ . Therefore, Davio bought 4 pounds of celery.

**Choice A** is incorrect. This is the number of pounds of potatoes, not the number of pounds of celery, Davio bought. **Choice B** is incorrect and may result from conceptual or calculation errors. **Choice C** is incorrect and may result from conceptual or calculation errors.

## QUESTION 18

**Choice C** is correct. A line of best fit is shown in the scatterplot such that as the value of  $x$  increases, the value of  $y$  decreases. It follows that the slope of the line of best fit shown is negative. The slope of a line in the  $xy$ -plane that passes through the points  $(x_1, y_1)$  and  $(x_2, y_2)$  can be calculated as  $\frac{y_2 - y_1}{x_2 - x_1}$ . The line of best fit shown passes approximately through the points  $(0, 8)$  and  $(10, 1)$ . Substituting  $(0, 8)$  for  $(x_1, y_1)$  and  $(10, 1)$  for  $(x_2, y_2)$  in  $\frac{y_2 - y_1}{x_2 - x_1}$  yields the slope of the line being approximately  $\frac{1-8}{10-0}$ , which is equivalent to  $\frac{-7}{10}$ , or  $-0.7$ . Therefore, of the given choices,  $-0.7$  is the closest to the slope of this line of best fit.

**Choice A** is incorrect. The line of best fit shown has a negative slope, not a positive slope. **Choice B** is incorrect. The line of best fit shown has a negative slope, not a positive slope. **Choice D** is incorrect and may result from conceptual or calculation errors.

## QUESTION 19

**Choice A** is correct. It's given that the equation  $y = 0.67x + 2.6$ , where  $20 \leq x \leq 110$ , gives the predicted number of larvae,  $y$ , in a colony of ants if the colony has  $x$  worker ants. If one of these colonies has 58 worker ants, the predicted number of larvae in that colony can be found by substituting 58 for  $x$  in the given equation. Substituting 58 for  $x$  in the given equation yields  $y = 0.67(58) + 2.6$ , or  $y = 41.46$ . Of the given choices, 41 is closest to the predicted number of larvae in the colony.

**Choice B** is incorrect. This is closest to the predicted number of larvae in a colony with 87 worker ants. **Choice C** is incorrect. This is closest to the number of worker ants for which the predicted number of larvae in a colony is 58. **Choice D** is incorrect. This is closest to the predicted number of larvae in a colony with 280 worker ants.

## QUESTION 20

The correct answer is 161. For a number to be 40% greater than 115, it follows that the number is  $(100\% \text{ of } 115) + (40\% \text{ of } 115)$ , which can be written as

$\frac{100}{100}(115) + \frac{40}{100}(115)$ . This expression is equivalent to  $1(115) + 0.4(115)$ , or  $1.4(115)$ , which is equal to 161. Therefore, 161 is 40% greater than 115.

## QUESTION 21

The correct answer is 17. If one value is multiplied by a number, then the other value must be multiplied by the same number in order to maintain the same ratio. It's given that  $j$  is multiplied by 17. Therefore, in order to maintain the same ratio,  $k$  must also be multiplied by 17.

## QUESTION 22

**Choice D** is correct. It's given that the function  $f(x) = 65(1.03)^x$  gives the predicted value, in dollars, of a certain rare coin  $x$  years after Immanuel purchased it. It follows that  $f(x)$  represents the predicted value, in dollars, of the coin  $x$  years after Immanuel purchased it. Since the value of  $f(8)$  is the value of  $f(x)$  when  $x = 8$ , it follows that " $f(8)$  is approximately equal to 82" means that  $f(x)$  is approximately equal to 82 when  $x = 8$ . Therefore, the best interpretation of the statement " $f(8)$  is approximately equal to 82" in this context is 8 years after Immanuel purchased the rare coin, its predicted value is approximately 82 dollars.

**Choice A** is incorrect and may result from conceptual errors. **Choice B** is incorrect and may result from conceptual errors. **Choice C** is incorrect and may result from conceptual errors.

## QUESTION 23

**Choice A** is correct. The slope,  $m$ , of a line in the  $xy$ -plane can be found using two points on the line,  $(x_1, y_1)$  and  $(x_2, y_2)$ , and the slope formula  $m = \frac{y_2 - y_1}{x_2 - x_1}$ . Based on the given table, the line representing the relationship between  $x$  and  $y$  in the  $xy$ -plane passes through the points  $(-6, n + 184)$ ,  $(-3, n + 92)$ , and  $(0, n)$ , where  $n$  is a constant. Substituting two of these points,  $(-3, n + 92)$  and  $(0, n)$ , for  $(x_1, y_1)$  and  $(x_2, y_2)$ , respectively, in the slope formula yields  $m = \frac{n - (n + 92)}{0 - (-3)}$ , which is equivalent to  $m = \frac{n - n - 92}{0 + 3}$ , or  $m = -\frac{92}{3}$ . Therefore, the slope of the line that represents this relationship in the  $xy$ -plane is  $-\frac{92}{3}$ .

**Choice B** is incorrect and may result from conceptual or calculation errors.

**Choice C** is incorrect and may result from conceptual or calculation errors.

**Choice D** is incorrect and may result from conceptual or calculation errors.

## QUESTION 24

**Choice C** is correct. The volume of a right circular cylinder is equal to  $\pi a^2 b$ , where  $a$  is the radius of a base of the cylinder and  $b$  is the height of the cylinder. It's given that the cylinder shown has a radius of  $r$  and a height of  $h$ . It follows that the volume of the cylinder shown is equal to  $\pi r^2 h$ . It's given that the second right circular cylinder has a radius of  $R$  and a height of  $H$ . It follows that the volume of the second cylinder is equal to  $\pi R^2 H$ . Choice C gives  $R = 7r$  and  $H = 8h$ . Substituting  $7r$  for  $R$  and  $8h$  for  $H$  in the expression that represents the volume of the second cylinder yields  $\pi(7r)^2(8h)$ , or  $\pi(49r^2)(8h)$ , which is equivalent to  $\pi(392r^2h)$ , or  $392(\pi r^2 h)$ . This expression is equal to 392 times the volume of the cylinder shown,  $\pi r^2 h$ . Therefore,  $R = 7r$  and  $H = 8h$  could represent the radius  $R$ , in terms of  $r$ , and the height  $H$ , in terms of  $h$ , of the second cylinder.

**Choice A** is incorrect. Substituting  $8r$  for  $R$  and  $7h$  for  $H$  in the expression that represents the volume of the second cylinder yields  $\pi(8r)^2(7h)$ , or  $\pi(64r^2)(7h)$ , which is equivalent to  $\pi(448r^2h)$ , or  $448(\pi r^2 h)$ . This expression is equal to 448, not 392, times the volume of the cylinder shown. **Choice B** is incorrect.

Substituting  $8r$  for  $R$  and  $49h$  for  $H$  in the expression that represents the volume of the second cylinder yields  $\pi(8r)^2(49h)$ , or  $\pi(64r^2)(49h)$ , which is equivalent to  $\pi(3,136r^2h)$ , or  $3,136(\pi r^2 h)$ . This expression is equal to 3,136, not 392, times the volume of the cylinder shown. **Choice D** is incorrect. Substituting  $49r$  for  $R$  and  $8h$  for  $H$  in the expression that represents the volume of the second cylinder yields  $\pi(49r)^2(8h)$ , or  $\pi(2,401r^2)(8h)$ , which is equivalent to  $\pi(19,208r^2h)$ , or  $19,208(\pi r^2 h)$ . This expression is equal to 19,208, not 392, times the volume of the cylinder shown.

## QUESTION 25

**Choice B** is correct. It's given that each side of a 30-sided polygon has one of three lengths. It's also given that the number of sides with length 8 centimeters (cm) is 5 times the number of sides  $n$  with length 3 cm. Therefore, there are  $5 \times n$ , or  $5n$ , sides with length 8 cm. It's also given that there are 6 sides with length 4 cm. Therefore, the number of 3 cm, 4 cm, and 8 cm sides are  $n$ , 6, and  $5n$ , respectively. Since there are a total of 30 sides, the equation  $n + 6 + 5n = 30$  represents this situation. Combining like terms on the left-hand side of this equation yields  $6n + 6 = 30$ . Therefore, the equation that must be true for the value of  $n$  is  $6n + 6 = 30$ .

*Choice A* is incorrect and may result from conceptual or calculation errors.

*Choice C* is incorrect and may result from conceptual or calculation errors.

*Choice D* is incorrect and may result from conceptual or calculation errors.

## QUESTION 26

**Choice D** is correct. It's given that data set F consists of 55 integers between 170 and 290 and data set G consists of all the integers in data set F as well as the integer 10. Since the integer 10 is less than all the integers in data set F, the mean of data set G must be less than the mean of data set F. Thus, the mean of data set F isn't less than the mean of data set G. When a data set is in ascending order, the median is between the two middle values when there is an even number of values and the median is the middle value when there is an odd number of values. It follows that the median of data set F is either greater than or equal to the median of data set G. Therefore, the median of data set F isn't less than the median of data set G. Thus, neither the mean nor the median must be less for data set F than for data set G.

*Choice A* is incorrect and may result from conceptual or calculation errors.

*Choice B* is incorrect and may result from conceptual or calculation errors.

*Choice C* is incorrect and may result from conceptual or calculation errors.

## QUESTION 27

The correct answer is 66. It's given that the right circular cone has a height of 22 centimeters (cm) and a base with a diameter of 6 cm. Since the diameter of the base of the cone is 6 cm, the radius of the base is 3 cm. The volume  $V$ , in  $\text{cm}^3$ , of a right circular cone can be found using the formula  $V = \frac{1}{3}\pi r^2 h$ , where  $h$  is the height, in cm, and  $r$  is the radius, in cm, of the base of the cone. Substituting 22 for  $h$  and 3 for  $r$  in this formula yields  $V = \frac{1}{3}\pi(3)^2(22)$ , or  $V = 66\pi$ . Therefore, the volume of the cone is  $66\pi \text{ cm}^3$ . It's given that the volume of the cone is  $n\pi \text{ cm}^3$ . Therefore, the value of  $n$  is 66.