Math: Question 1

The distance between two towns is 3 miles. What is the distance between these two towns, in feet? (1 mile = 5,280 feet)

A. 1,760
B. 5,283
C. 15,840
D. 21,120

Choice C is correct. It's given that the two towns are 3 miles apart. Since 1 mile is equivalent to 5,280 feet, multiplying 3 by 5,280 gives the distance, in feet, between the two towns. Thus, the distance between the two towns is $3 \times 5{,}280$, or 15,840 feet.

Choice A is incorrect and may result from dividing, not multiplying, 5,280 by 3. Choice B is incorrect and may result from adding, not multiplying, 5,280 and 3. Choice D is incorrect and may result from multiplying 5,280 by 4, instead of by 3.

Question Difficulty: Easy

Math: Question 2

During a sale, the original prices of all the items in a clothing store have been reduced by 20%. What is the sale price of a jacket with an original price of $50 ?

A. $12
B. $30
C. $36
D. $40

Choice D is correct. It's given that the original price of the jacket has been reduced by 20%. Multiplying the original price, $50, by 20% gives the amount, in dollars, that the price of the jacket is reduced by: $50 \times .20 = 10$. Subtracting this value from the original price results in the sale price of the jacket: $\$50 - \$10$, or $40.

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

Question Difficulty: Medium

Math: Question 3

Questions 3 and 4 refer to the following information.

On May 16, 2011, the space shuttle Endeavour launched for the last time. The total mass of the entire spacecraft includes the Endeavour shuttle, its external rockets, its fuel tank, and its fuel. The total mass of the entire spacecraft changed as fuel was used. The model below shows the predicted mass m, in thousands of kilograms, of the entire spacecraft t seconds after the launch.

$m = 2{,}050 - 9.75t, 0 \leq t \leq 120$

According to the given model, what was the predicted mass, in thousands of kilograms, of the entire spacecraft 60 seconds after launch?

A. 585
B. 1,465
C. 1,995
D. 2,635

Choice B is correct. The predicted mass m, in thousands of kilograms, of the entire spacecraft 60 seconds after launch is represented by the value of m when $t = 60$. Substituting 60 for t in the model yields $m = 2{,}050 - 9.75(60)$, or $m = 2{,}050 - 585$. Subtracting yields $m = 1{,}465$. Thus, 60 seconds after launch, the predicted mass of the entire spacecraft is 1,465 thousand kilograms.

Choice A is incorrect. This is the change in the predicted mass, in thousands of kilograms, of the entire spacecraft after launch based on the amount of fuel used after 60 seconds. Choices C and D are incorrect and may result from a conceptual or calculation error.

Question Difficulty: Medium

Math: Question 4

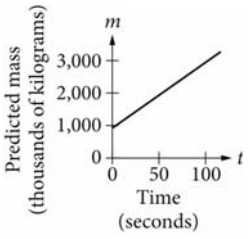
Questions 3 and 4 refer to the following information.

On May 16, 2011, the space shuttle Endeavour launched for the last time. The total mass of the entire spacecraft includes the Endeavour shuttle, its external rockets, its fuel tank, and its fuel. The total mass of the entire spacecraft changed as fuel was used. The model below shows the predicted mass m, in thousands of kilograms, of the entire spacecraft t seconds after the launch.

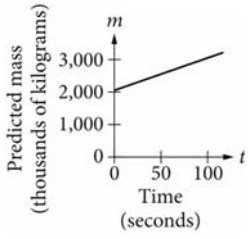
$m = 2{,}050 - 9.75t, 0 \le t \le 120$

Which of the following graphs represents the relationship between t and m ?

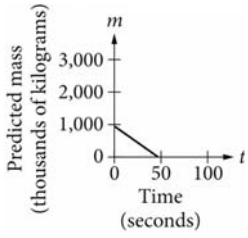
A.



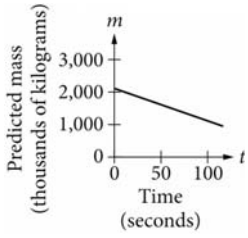
B.



C.



D.



Choice D is correct. The relationship between t and m is defined by the linear model $m = 2{,}050 - 9.75t$, where $0 \le t \le 120$, whose graph is a line in the tm-plane. According to this model, when $t = 0$, $m = 2{,}050$. It follows then that the m-intercept of the line is $(0, 2{,}050)$. Also according to this model, the value of m decreases by 9.75 for every increase of 1 in the value of t. This means that the slope of the line is -9.75 and that the line is decreasing. Of the given choices, only the graph of the line in choice D has a slope of -9.75 and an m-intercept of 2,050.

Choices A and B are incorrect because both show graphs of lines that are increasing, not decreasing. Additionally, choice A has an m-intercept of approximately 1,000, not 2,050. Choice C is incorrect because it has an m-intercept of approximately 1,000, not 2,050. Additionally, even though the graph of the line in choice C is decreasing, the approximate slope of the line is -20, not -9.75.

Question Difficulty: Medium

Math: Question 5

9, 9, 10.5, 11, 11.5, 12, 12

The given data show the age, in years, of 7 domesticated sheep. Based on these data, which of the following statements about these sheep is true?

A. The median age is equal to the mean age.
B. The median age is greater than the mean age.
C. The range of ages is equal to the mean age.
D. The range of ages is greater than the mean age.

Choice B is correct. The mean age of the 7 sheep is the quotient of the sum of the ages of the sheep and the number of sheep. The sum of the ages is 75. Dividing 75 by 7 gives the mean age, which is approximately 10.7 years. The median age is the middlemost value when the values are ordered from least to greatest. Thus, the median age is 11 years. The range of ages is the difference between the greatest age, 12, and the least age, 9. Thus, the range is 3 years. Since the median, 11, is greater than the mean, 10.7, it follows that of the given choices it's only true that the median age is greater than the mean age.

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

Question Difficulty: Medium

Math: Question 6

Data set A: 5, 5, 5, 5, 5, 5, 5, 5, 5, 5
Data set B: 5, 5, 5, 5, 5, 5, 5, 5, 5, 100

Which of the following statements about the means and medians of data set A and data set B is true?

A. Only the means are different.
B. Only the medians are different.
C. Both the means and the medians are different.
D. Neither the means nor the medians are different.

Choice A is correct. The mean of a data set is the sum of the values divided by the number of values. The mean of data set A is $\frac{45}{9}$, or 5. The mean of data set B is $\frac{145}{10}$, or 14.5. Thus, the means are different. The median of a data set is the middle value when the values are ordered from least to greatest. The medians of data sets A and B are both 5. Therefore, the medians are the same, so only the means are different.

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

Question Difficulty: Medium

Math: Question 7

The Danyang-Kunshan Grand Bridge in China has a length of 164.8 kilometers. Which of the following best approximates the length, in miles, of the Danyang-Kunshan Grand Bridge? (1 kilometer = 0.6214 mile)

A. 265.2
B. 165.4
C. 164.2
D. 102.4

Choice D is correct. It's given that the length of the Danyang-Kunshan Grand Bridge is 164.8 kilometers and that $1 \text{ kilometer} = 0.6214 \text{ mile}$. Therefore, the equation $\frac{164.8}{x} = \frac{1}{0.6214}$ can be used to find x, the length of the bridge, in miles. Multiplying both sides of this equation by x yields $164.8 = \frac{x}{0.6214}$. Multiplying both sides by 0.6214 yields, to the nearest tenth, $102.4 = x$.
Therefore, the length of the bridge is approximately 102.4 miles.

Choice A is incorrect and may result from dividing, not multiplying, 164.8 by 0.6214. Choice B is incorrect and may result from adding 164.8 and 0.6214. Choice C is incorrect and may result from subtracting 0.6214 from 164.8.

Question Difficulty: Medium

Math: Question 8

$(1-x)(x+2)^2(x+3)=0$

Which of the following is a solution to the equation above?

A. -2
B. -1
C. 2
D. 3

Choice A is correct. According to the properties of exponents, the expression $(x+2)^2$ in the given equation is equivalent to $(x+2)(x+2)$. Rewriting the given equation results in $(1-x)(x+2)(x+2)(x+3)=0$. Based on the zero product property, either $1-x=0$, $x+2=0$, or $x+3=0$. Solving each of these linear equations for x yields solutions of 1, -2, and -3, respectively. Of the choices, only -2 is a solution to the given equation.

Choice B is incorrect and may result from solving the equation $1-x=0$ by adding, not subtracting, 1 to both sides of the equation and then by dividing both sides by -1. Choices C and D are incorrect and may result from solving the equations $x+2=0$ and $x+3=0$ by adding, not subtracting, 2 and 3, respectively, to both sides of the equation.

Question Difficulty: Medium

Math: Question 9

A gold dredge is a machine that was used in the early 1900s to extract gold from a river or pond. The amount of dirt a gold dredge can dig in 1 minute is equal to the amount it would take 3 people, each digging at the same rate, to dig in 1 day. At this rate, how many days would it take 1 person to dig as much dirt as a gold dredge can dig in 30 minutes?

A. 30
B. 45
C. 60
D. 90

Choice D is correct. If 3 people working at the same rate can complete a job in 1 day, it follows that 1 person working at this rate can complete $\frac{1}{3}$ of the job in 1 day. Furthermore, this means that 1 person working at this rate can complete the job in 3 days. It's given that the amount of dirt a gold dredge can dig in 1 minute is equal to the same amount of dirt 3 people digging at the same rate can dig in 1 day, or 1 person digging at this rate can dig in 3 days. If 1 minute of the gold dredge digging is equivalent to 3 days of 1 person digging at this rate, then 30 minutes of gold dredge digging is equivalent to $(30)(3)$, or 90 days of 1 person digging at this rate.

Choice A is incorrect. This is the given number of minutes the gold dredge is working. Choices B and C are incorrect and may result from conceptual or calculation errors.

Question Difficulty: Medium

Math: Question 10

A store manager reviewed the receipts from 80 customers who were selected at random from all the customers who made purchases last Thursday. Of those selected, 20 receipts showed that the customer had purchased fruit. If 1,500 customers made purchases last Thursday, which of the following is the most appropriate conclusion?

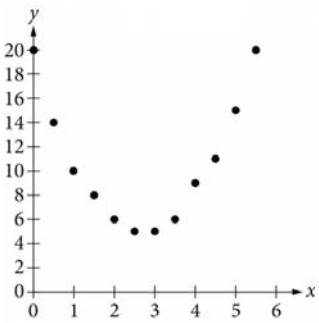
A. Exactly 75 customers must have purchased fruit last Thursday.
B. Exactly 375 customers must have purchased fruit last Thursday.
C. The best estimate for the number of customers who purchased fruit last Thursday is 75.
D. The best estimate for the number of customers who purchased fruit last Thursday is 375.

Choice D is correct. It's given that the manager took a random selection of the receipts of 80 customers from a total of 1,500. It's also given that of those 80 receipts, 20 showed that the customer had purchased fruit. This means that an appropriate estimate of the fraction of customers who purchased fruit is $\frac{20}{80}$, or $\frac{1}{4}$. Multiplying this fraction by the total number of customers yields $\left(\frac{1}{4}\right)(1{,}500) = 375$. Therefore, the best estimate for the number of customers who purchased fruit is 375.

Choices A and B are incorrect because an exact number of customers can't be known from taking a random selection. Additionally, choice A may also be the result of a calculation error. Choice C is incorrect and may result from a calculation error.

Question Difficulty: Medium

Math: Question 11



Of the following, which is the best model for the data in the scatterplot?

A. $y = 2x^2 - 11x - 20$

B. $y = 2x^2 - 11x + 20$

C. $y = 2x^2 - 5x - 3$

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

Choice B is correct. The graphical model that most closely fits the data in the scatterplot is a model in which the number of data points above and below the model are approximately balanced. Fitting a graphical model to the data shown results in an upward-facing parabola with a y-intercept near $(0,20)$ and a vertex with an approximate x-value of 2.5. Of the given choices, only choice B gives an equation of an upward-facing parabola with a y-intercept at $(0,20)$.

Furthermore, substituting 2.5 for x into the equation in choice B yields $y = 5$. This is approximately the y-value of the vertex of the model.

Choices A, C, and D are incorrect. These equations don't give a graphical model that best fits the data. At $x = 0$, they have y-values of -20, -3, and 3, respectively. At $x = 2.5$, they have y-values of -35, -3, and 3, respectively.

Question Difficulty: Medium

Math: Question 12

A right circular cylinder has a volume of 45π. If the height of the cylinder is 5, what is the radius of the cylinder?

A. 3
B. 4.5
C. 9
D. 40

Choice A is correct. The volume of a right circular cylinder with a radius of r is the product of the area of the base, πr^2, and the height, h. The volume of the right circular cylinder described is 45π and its height is 5. If the radius is r, it follows that $45\pi = \pi(r)^2(5)$. Dividing both sides of this equation by 5π yields $9 = r^2$. Taking the square root of both sides yields $r = 3$ or $r = -3$. Since r represents the radius, the value must be positive. Therefore, the radius is 3.

Choice B is incorrect and may result from finding that the square of the radius is 9, but then from dividing 9 by 2, rather than taking the square root of 9. Choice C is incorrect. This represents the square of the radius. Choice D is incorrect and may result from solving the equation $45\pi = \pi(r)^2(5)$ for r^2, not r, by dividing by π on both sides and then by subtracting, not dividing, 5 from both sides.

Question Difficulty: Medium

Math: Question 13

$w = a + 2$

$z = a$

The equations above define w and z in terms of a. What is $2wz$ in terms of a ?

A. $2a + 2$

B. $4a + 4$

C. $2a^2 + 2$

D. $2a^2 + 4a$

Choice D is correct. It's given that w is defined as $a + 2$ and that z is defined as a. Therefore, substituting $a + 2$ for w and a for z in the expression $2wz$ yields an equivalent expression in terms of a: $2(a + 2)(a)$. By the commutative property of multiplication, this is equivalent to $2a(a + 2)$. By the distributive property, this is equivalent to $2a(a) + 2a(2)$, or $2a^2 + 4a$.

Choice A is incorrect and may result from rewriting $2w$, not $2wz$, in terms of a and then from rewriting the expression $2(a + 2)$ as $2a + 2$, not $2a + 4$. Choice B is incorrect and may result from rewriting the expression $2w + 2z$, not $2wz$, in terms of a. Choice C is incorrect and may result from rewriting the expression $2a(a + 2)$ as $2a(a) + 2$, rather than as $2a(a) + 2a(2)$.

Question Difficulty: Medium

Math: Question 14

Which of the following represents the result of increasing the quantity x by 5%, where $x > 0$?

A. $5x$

B. $1.05x$

C. $1.005x$

D. $0.5x$

Choice B is correct. Increasing the positive quantity x by 5% is the result of adding 5% of x to x. 5% of x can be represented algebraically as $\frac{5}{100}x$, or $0.05x$. Adding this expression to x yields $x + 0.05x$, or $1.05x$.

Choice A is incorrect. This represents 500% of x. Choice C is incorrect. This represents increasing x by 0.5%, not by 5%. Choice D is incorrect. This represents 50% of x.

Question Difficulty: Medium

Math: Question 15

$H = 120p + 60$

The Karvonen formula above shows the relationship between Alice's target heart rate H, in beats per minute (bpm), and the intensity level p of different activities. When $p = 0$, Alice has a resting heart rate. When $p = 1$, Alice has her maximum heart rate. It is recommended that p be between 0.5 and 0.85 for Alice when she trains. Which of the following inequalities describes Alice's target training heart rate?

A. $120 \leq H \leq 162$

B. $102 \leq H \leq 120$

C. $60 \leq H \leq 162$

D. $60 \leq H \leq 102$

Choice A is correct. When Alice trains, it's recommended that p be between 0.5 and 0.85. Therefore, her target training heart rate is represented by the values of H corresponding to $0.5 \leq p \leq 0.85$. When $p = 0.5$, $H = 120(0.5) + 60$, or $H = 120$. When $p = 0.85$, $H = 120(0.85) + 60$, or $H = 162$. Therefore, the inequality that describes Alice's target training heart rate is $120 \leq H \leq 162$.

Choice B is incorrect. This inequality describes Alice's target heart rate for $0.35 \leq p \leq 0.5$. Choice C is incorrect. This inequality describes her target heart rate for $0 \leq p \leq 0.85$. Choice D is incorrect. This inequality describes her target heart rate for $0 \leq p \leq 0.35$.

Question Difficulty: Medium

Math: Question 16

If $4x - \frac{1}{2} = -5$, what is the value of $8x - 1$?

A. 2

B. $-\frac{9}{8}$

C. $-\frac{5}{2}$

D. -10

Choice D is correct. Multiplying the given equation by 2 on each side yields $2\left(4x - \frac{1}{2}\right) = 2(-5)$.

Applying the distributive property, this equation can be rewritten as $2(4x) - 2\left(\frac{1}{2}\right) = 2(-5)$, or

$8x - 1 = -10$.

Choices A, B, and C are incorrect and may result from calculation errors in solving the given equation for x and then substituting that value of x in the expression $8x - 1$.

Question Difficulty: Medium

Math: Question 17

Questions 17 and 18 refer to the following information.

State	Power capacity			
	Low	Medium	High	Total
Texas	4	2	3	9
California	1	0	1	2
Oregon	1	0	1	2
Indiana	0	2	0	2
Colorado	1	1	0	2
Iowa	2	0	0	2
Oklahoma	1	0	0	1
Total	10	5	5	20

The table shows the distribution, by location and power capacity (maximum rate of power generation) of the twenty largest wind projects in the United States in 2013. The total power capacity of the nine wind projects located in Texas was 4,952 megawatts (MW), and the total power capacity of the twenty wind projects was 11,037 MW in 2013.

If one of the projects in Texas that is represented in the table is selected at random, what is the probability that the project selected had a medium or high power capacity?

A. $\frac{2}{9}$

B. $\frac{3}{9}$

C. $\frac{4}{9}$

D. $\frac{5}{9}$

Choice D is correct. In the table, it's given that Texas has 9 of the wind projects. Of those projects, 2 are medium power capacity and 3 are high power capacity, so a total of 5 Texas projects are medium or high power capacity. If one of the Texas projects is selected at random, the probability can be calculated as the total number of projects that satisfy the criteria (medium or high power capacity) divided by the total number of projects in the selection group (Texas projects), or $\frac{5}{9}$.

Choice A is incorrect. This is the probability of selecting only a medium power capacity project.
Choice B is incorrect. This is the probability of selecting only a high power capacity project.
Choice C is incorrect. This is the probability of selecting a low power capacity project.

Question Difficulty: Medium

Math: Question 18

Questions 17 and 18 refer to the following information.

State	Power capacity			
	Low	Medium	High	Total
Texas	4	2	3	9
California	1	0	1	2
Oregon	1	0	1	2
Indiana	0	2	0	2
Colorado	1	1	0	2
Iowa	2	0	0	2
Oklahoma	1	0	0	1
Total	10	5	5	20

The table shows the distribution, by location and power capacity (maximum rate of power generation) of the twenty largest wind projects in the United States in 2013. The total power capacity of the nine wind projects located in Texas was 4,952 megawatts (MW), and the total power capacity of the twenty wind projects was 11,037 MW in 2013.

The amount of energy produced in one hour at a rate of one megawatt is one megawatt-hour. If each of the nine Texas wind projects in 2013 had operated continuously for 24 hours at the maximum rate of power generation, approximately how many megawatt-hours of energy would the nine projects have produced?

A. 200
B. 5,000
C. 11,000
D. 120,000

Choice D is correct. It's given that the total power capacity of the nine wind projects in Texas was 4,952 megawatts. Therefore, if all nine Texas projects operated continuously for 1 hour, the amount of energy produced would be 4,952 megawatt-hours. It follows that, if all nine Texas projects operated continuously for 24 hours, the amount of energy produced, in megawatt-hours, would be $(4{,}952)(24) = 118{,}848$, which is closest to 120,000.

Choice A is incorrect. This is approximately the amount of energy produced for the nine projects divided by 24 hours. Choice B is incorrect. This is approximately the amount of energy produced for the nine projects. Choice C is incorrect. This is approximately the given amount of energy produced for all twenty projects in the table.

Question Difficulty: Hard

Math: Question 19

$f(x) = x^2 + bx + 5$

In the given function, b is a constant. If $f(1) = 0$, what is the value of $f(3)$?

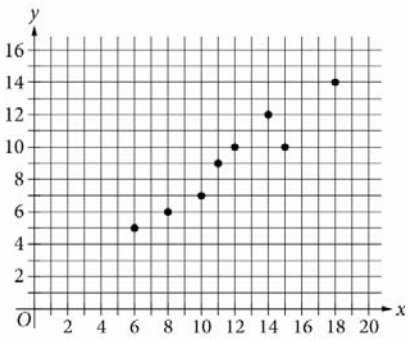
A. -6
B. -4
C. -3
D. 5

Choice B is correct. If $f(1) = 0$, then $f(x) = 0$ when $x = 1$. Substituting 1 for x and 0 for $f(x)$ in the given equation yields $0 = (1)^2 + b(1) + 5$, or $0 = b + 6$. Subtracting 6 from both sides of this equation yields $-6 = b$. Substituting -6 for b in the given equation yields $f(x) = x^2 - 6x + 5$. The expression $f(3)$represents the value of $f(x)$ when $x = 3$. Substituting 3 for x in the equation $f(x) = x^2 - 6x + 5$ yields $f(3) = (3)^2 - 6(3) + 5$, or -4. Therefore, $f(3) = -4$.

Choice A is incorrect. This is the value of b in the given equation. Choice C is incorrect. This is the value of $f(2)$ and $f(4)$, not $f(3)$. Choice D is incorrect. This is the value of $f(0)$, not $f(3)$.

Question Difficulty: Hard

Math: Question 20



Of the following equations, which could be an equation of a line of best fit for the data points shown in the xy-plane above?

A. $y = 0.3 + 0.8x$

B. $y = 0.8 + 0.3x$

C. $y = 0.8 + 4x$

D. $y = 4 + 0.8x$

Choice A is correct. A line of best fit for the data displayed in a scatterplot is one that is closest to the data points. A line that closely fits the given data would have a y-intercept around $(0,0)$, and extend upward toward a point around $(16,12)$. The slope of the line is found by calculating the ratio of the change in y to the change in x between these two points. So the slope is about $\frac{12-0}{16-0} = \frac{12}{16}$, or 0.75. Each of the given choices is in the form $y = b + mx$, where b is the y-coordinate of the y-intercept and m is the slope. The equation in choice A represents a line with a slope closest to 0.75 and a y-coordinate of the y-intercept closest to 0.

Choice B is incorrect because this line isn't steep enough for the data. Choice C is incorrect because this line is too steep for the data. Choice D is incorrect because this line has a y-coordinate of the y-intercept that is too great for the data.

Question Difficulty: Hard

Math: Question 21

In an article about exercise, it is estimated that a 160-pound adult uses 200 calories for every 30 minutes of hiking and 150 calories for every 30 minutes of bicycling. An adult who weighs 160 pounds has completed 1 hour of bicycling. Based on the article, how many hours should the adult hike to use a total of 1,900 calories from bicycling and hiking?

A. 9.5
B. 8.75
C. 6
D. 4

Choice D is correct. Since a 160-pound adult uses 200 calories for every 30 minutes of hiking, then the same adult uses $200h$ calories after hiking for h 30-minute periods. Similarly, the same adult uses $150b$ calories after bicycling for b 30-minute periods. Therefore, the equation $200h + 150b = 1{,}900$ represents the situation where a 160-pound adult uses a total of 1,900 calories from hiking for h 30-minute periods and bicycling for b 30-minute periods. It's given that the adult completes 1 hour, or 2 30-minute periods, of bicycling. Substituting 2 for b in the equation $200h + 150b = 1{,}900$ yields $200h + 150(2) = 1{,}900$, or $200h + 300 = 1{,}900$. Subtracting 300 from both sides of this equation yields $200h = 1{,}600$. Dividing both sides by 200 yields $h = 8$. Since h represents the number of 30-minute periods spent hiking and there are 2 30-minute periods in every hour, it follows that the adult will need to hike for $\frac{8}{2}$, or 4 hours to use a total of 1,900 calories from bicycling and hiking.

Choice A is incorrect and may result from solving the equation $200h = 1{,}900$. This represents 0 30-minute periods bicycling instead of 2. Choice B is incorrect and may result from solving the equation $200h + 150 = 1{,}900$. This represents 1 30-minute period of bicycling instead of 2. Choice C is incorrect. This may result from determining that the number of 30-minute periods the adult should hike is 8, but then subtracting 2 from 8, rather than dividing 8 by 2, to find the number of hours the adult should hike.

Question Difficulty: Hard

Math: Question 22

In the xy-plane, the graph of $y = x^2 - 9$ intersects line p at $(1, a)$ and $(5, b)$, where a and b are constants. What is the slope of line p ?

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

Choice A is correct. It's given that the graph of $y = x^2 - 9$ and line p intersect at $(1, a)$ and $(5, b)$. Therefore, the value of y when $x = 1$ is the value of a, and the value of y when $x = 5$ is the value of b. Substituting 1 for x in the given equation yields $y = (1)^2 - 9$, or $y = -8$. Similarly, substituting 5 for x in the given equation yields $y = (5)^2 - 9$, or $y = 16$. Therefore, the intersection points are $(1, -8)$ and $(5, 16)$. The slope of line p is the ratio of the change in y to the change in x between these two points: $\frac{16 - (-8)}{5 - 1} = \frac{24}{4}$, or 6.

Choices B, C, and D are incorrect and may result from conceptual or calculation errors in determining the values of a, b, or the slope of line p.

Question Difficulty: Hard

Math: Question 23

What is the minimum value of the function f defined by $f(x) = (x-2)^2 - 4$?

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

Choice A is correct. The given quadratic function f is in vertex form, $f(x) = (x-h)^2 + k$, where (h,k) is the vertex of the graph of $y = f(x)$ in the xy-plane. Therefore, the vertex of the graph of $y = f(x)$ is $(2,-4)$. In addition, the y-coordinate of the vertex represents either the minimum or maximum value of a quadratic function, depending on whether the graph of the function opens upward or downward. Since the leading coefficient of f (the coefficient of the term $(x-2)^2$) is 1, which is positive, the graph of $y = f(x)$ opens upward. It follows that at $x = 2$, the minimum value of the function f is -4.

Choice B is incorrect and may result from making a sign error and from using the x-coordinate of the vertex. Choice C is incorrect and may result from using the x-coordinate of the vertex. Choice D is incorrect and may result from making a sign error.

Question Difficulty: Hard

Math: Question 24

Which of the following is true about the values of 2^x and $2x+2$ for $x>0$?

A. For all $x>0$, it is true that $2^x<2x+2$.

B. For all $x>0$, it is true that $2^x>2x+2$.

C. There is a constant c such that if $0<x<c$, then $2^x<2x+2$, but if $x>c$, then $2^x>2x+2$.

D. There is a constant c such that if $0<x<c$, then $2^x>2x+2$, but if $x>c$, then $2^x<2x+2$.

Choice C is correct. At $x=0$, the value of 2^x is less than the value of $2x+2$: $2^0<2(0)+2$, which is equivalent to $1<2$. As the value of x increases, the value of 2^x remains less than the value of $2x+2$ until $x=3$, which is when the two values are equal: $2^3=2(3)+2$, which is equivalent to $8=8$. Then, for $x>3$, the value of 2^x is greater than the value of $2x+2$. So there is a constant, 3, such that when $0<x<3$, then $2^x<2x+2$, but when $x>3$, then $2^x>2x+2$.

Choice A is incorrect because $2^x>2x+2$ when $x>3$. Choice B is incorrect because $2^x<2x+2$ when $0<x<3$. Choice D is incorrect because $2^x<2x+2$ when $0<x<3$ and $2^x>2x+2$ when $x>3$.

Question Difficulty: Hard

Math: Question 25

During a month, Morgan ran r miles at 5 miles per hour and biked b miles at 10 miles per hour. She ran and biked a total of 200 miles that month, and she biked for twice as many hours as she ran. What is the total number of miles that Morgan biked during the month?

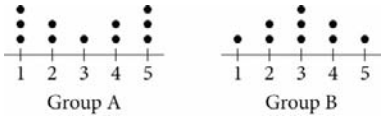
A. 80
B. 100
C. 120
D. 160

Choice D is correct. The number of hours Morgan spent running or biking can be calculated by dividing the distance she traveled during that activity by her speed, in miles per hour, for that activity. So the number of hours she ran can be represented by the expression $\frac{r}{5}$, and the number of hours she biked can be represented by the expression $\frac{b}{10}$. It's given that she biked for twice as many hours as she ran, so this can be represented by the equation $\frac{b}{10} = 2\left(\frac{r}{5}\right)$, which can be rewritten as $b = 4r$. It's also given that she ran r miles and biked b miles, and that she ran and biked a total of 200 miles. This can be represented by the equation $r + b = 200$. Substituting $4r$ for b in this equation yields $r + 4r = 200$, or $5r = 200$. Solving for r yields $r = 40$. Determining the number of miles she biked, b, can be found by substituting 40 for r in $r + b = 200$, which yields $40 + b = 200$. Solving for b yields $b = 160$.

Choices A, B, and C are incorrect because they don't satisfy that Morgan biked for twice as many hours as she ran. In choice A, if she biked 80 miles, then she ran 120 miles, which means she biked for 8 hours and ran for 24 hours. In choice B, if she biked 100 miles, then she ran 100 miles, which means she biked for 10 hours and ran for 20 hours. In choice C, if she biked 120 miles, then she ran for 80 miles, which means she biked for 12 hours and ran for 16 hours.

Question Difficulty: Hard

Math: Question 26



The dot plots summarize two data sets. How does the mean of group A compare to the mean of group B?

A. The mean of group A is greater than the mean of group B.
B. The mean of group A is less than the mean of group B.
C. The mean of group A is equal to the mean of group B.
D. There is not enough information given to compare the means.

Choice C is correct. The mean of each data set can be calculated by dividing the sum of the values by the number of values. For group A this yields $\frac{1+1+1+2+2+3+4+4+5+5+5}{11}=3$. For group B this yields $\frac{1+2+2+3+3+3+4+4+5}{9}=3$. Also, in both groups, the distribution of dots around the value of 3 is symmetrical, which indicates that both groups have a mean of 3. So, the mean of group A is equal to the mean of group B.

Choices A and B are incorrect and may result from a conceptual or calculation error. Choice D is incorrect because the values of each data set are given and the means can be compared.

Question Difficulty: Hard

Math: Question 27

$$\frac{x}{2}+2y=14$$

$$x-\frac{y}{2}=1$$

In the system of equations above, what is the value of $\frac{x}{2}$?

A. $\frac{1}{2}$

B. 1

C. $\frac{3}{2}$

D. 2

Choice D is correct. One approach to find the value of $\frac{x}{2}$ is the elimination method. Multiplying both sides of $x-\frac{y}{2}=1$ by 4 yields $4x-2y=4$. Adding $4x-2y=4$ to $\frac{x}{2}+2y=14$ yields $\left(4x+\frac{x}{2}\right)+(-2y+2y)=(14+4)$, or $\frac{9x}{2}=18$. Dividing both sides of this equation by 9 yields $\frac{x}{2}=2$.

Choices A, B, and C are incorrect and may result from a calculation or computational error.

Question Difficulty: Hard

Math: Question 28

x	$f(x)$
1	a
2	a^5
3	a^9

For the exponential function f, the table above shows several values of x and their corresponding values of $f(x)$, where a is a constant greater than 1. If k is a constant and $f(k) = a^{29}$, what is the value of k ?

The correct answer is 8. The values of $f(x)$ for the exponential function f shown in the table increase by a factor of a^4 for each increase of 1 in x. This relationship can be represented by the equation $f(x) = a^{4x+b}$, where b is a constant. It's given that when $x = 2$, $f(x) = a^5$. Substituting 2 for x and a^5 for $f(x)$ into $f(x) = a^{4x+b}$ yields $a^5 = a^{4(2)+b}$. Since $4(2)+b = 5$, it follows that $b = -3$. Thus, an equation that defines the function f is $f(x) = a^{4x-3}$. It follows that the value of k such that $f(k) = a^{29}$ can be found by solving the equation $4k-3 = 29$, which yields $k = 8$.

Question Difficulty: Hard

Math: Question 29

$(a-12)x=a+8$

In the equation above, a is a constant. If the equation has no solutions, what is the value of a ?

The correct answer is 12. Dividing both sides of the given equation by $(a-12)$ yields $x=\frac{a+8}{a-12}$. Therefore, the equation has no solutions if the expression $a-12$ is equal to 0. Solving $a-12=0$ for a yields $a=12$. Thus, if the equation has no solutions, the value of a is 12.

Question Difficulty: Hard

Math: Question 30

Questions 30 and 31 refer to the following information.

	Phone	Email
Dinner dance	55%	80%
Football game	20%	10%
Picnic	20%	5%
Pool party	5%	5%
Total	100%	100%

An alumni association survey asked each high school graduate to select the one activity he or she preferred for the association's next event. Some of the people responded by phone, and the others responded by email. The table above shows the distribution of preferred activity, in percent, for each response type used.

If 40 of the people who responded by phone preferred a picnic, how many of the people who responded by phone preferred a dinner dance?

The correct answer is 110. The table shows that 20% of people who responded by phone preferred a picnic. If 20% represents 40 people, then solving $0.20x = 40$ for x gives the total number of people who responded by phone. Dividing both sides of this equation by 0.20 yields $x = 200$. Therefore, 200 people responded by phone. The table also shows that 55% of these 200 people preferred a dinner dance. It follows that of the people who responded by phone, $(0.55)(200)$, or 110, preferred a dinner dance.

Question Difficulty: Hard

Math: Question 31

Questions 30 and 31 refer to the following information.

	Phone	Email
Dinner dance	55%	80%
Football game	20%	10%
Picnic	20%	5%
Pool party	5%	5%
Total	100%	100%

An alumni association survey asked each high school graduate to select the one activity he or she preferred for the association's next event. Some of the people responded by phone, and the others responded by email. The table above shows the distribution of preferred activity, in percent, for each response type used.

For the survey, the number of email responses was twice the number of phone responses. If a person who preferred a picnic is selected at random, what is the probability that the person responded by email?

The correct answer is .333. It's given that the number of email responses is twice the number of phone responses. Therefore, if the number of phone responses is p, then the number of email responses is $2p$. The table shows that 20% of people who responded by phone preferred a picnic. It follows that the expression $0.20p$ represents the number of these people. The table also shows that 5% of the people who responded by email preferred a picnic. The expression $0.05(2p)$, or $0.1p$, represents the number of these people. Therefore, a total of $0.20p + 0.1p$, or $0.3p$ people preferred a picnic. Thus, the probability of selecting at random a person who responded by email from the people who preferred a picnic is $\frac{0.1p}{0.3p}$, or .333. Either .333 or 1/3 may be entered as correct answers.

Question Difficulty: Hard