Math: Question 1

$51 = 7 + 2x$

What value of x satisfies the equation above?

A. 58
B. 44
C. 29
D. 22

Choice D is correct. Subtracting 7 from both sides of the equation results in $44 = 2x$. Dividing both sides by 2 yields $x = 22$.

Choice A is incorrect and may result from adding 7 to, rather than subtracting 7 from, both sides of the equation and from not dividing both sides by 2. Choice B is incorrect and may result from subtracting 7 from both sides of the equation but not dividing both sides by 2. Choice C is incorrect and may result from adding 7 to, rather than subtracting 7 from, both sides of the equation and then dividing both sides by 2.

Question Difficulty: Easy

Math: Question 2

$3a+4b=25$

A shipping company charged a customer $25 to ship some small boxes and some large boxes. The equation above represents the relationship between a, the number of small boxes, and b, the number of large boxes, the customer had shipped. If the customer had 3 small boxes shipped, how many large boxes were shipped?

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

Choice B is correct. It's given that a represents the number of small boxes and b represents the number of large boxes the customer had shipped. If the customer had 3 small boxes shipped, then $a=3$. Substituting 3 for a in the equation $3a+4b=25$ yields $3(3)+4b=25$ or $9+4b=25$. Subtracting 9 from both sides of the equation yields $4b=16$. Dividing both sides of this equation by 4 yields $b=4$. Therefore, the customer had 4 large boxes shipped.

Choices A, C, and D are incorrect. If the number of large boxes shipped is 3, then $b=3$. Substituting 3 for b in the given equation yields $3a+4(3)=25$ or $3a+12=25$. Subtracting 12 from both sides of the equation and then dividing by 3 yields $a=\frac{13}{3}$. However, it's given that the number of small boxes shipped, a, is 3, not $\frac{13}{3}$, so b cannot equal 3. Similarly, if $b=5$ or $b=6$, then $a=\frac{5}{3}$ or $a=\frac{1}{3}$, respectively, which is also not true.

Question Difficulty: Easy

Math: Question 3

On January 1, 2015, a city's minimum hourly wage was $9.25. It will increase by $0.50 on the first day of the year for the next 5 years. Which of the following functions best models the minimum hourly wage, in dollars, x years after January 1, 2015, where $x = 1, 2, 3, 4, 5$?

A. $f(x) = 9.25 - 0.50x$

B. $f(x) = 9.25x - 0.50$

C. $f(x) = 9.25 + 0.50x$

D. $f(x) = 9.25x + 0.50$

Choice C is correct. It's given that the city's minimum hourly wage will increase by $0.50 on the first day of the year for the 5 years after January 1, 2015. Therefore, the total increase, in dollars, in the minimum hourly wage x years after January 1, 2015, is represented by $0.50x$. Since the minimum hourly wage on January 1, 2015, was $9.25, it follows that the minimum hourly wage, in dollars, x years after January 1, 2015, is represented by $9.25 + 0.50x$. Therefore, the function $f(x) = 9.25 + 0.50x$ best models this situation.

Choices A, B, and D are incorrect. In choice A, the function models a situation where the minimum hourly wage is $9.25 on January 1, 2015, but decreases by $0.50 on the first day of the year for the next 5 years. The functions in choices B and D both model a situation where the minimum hourly wage is increasing by $9.25 on the first day of the year for the 5 years after January 1, 2015.

Question Difficulty: Medium

Math: Question 4

$F = 2.50x + 7.00y$

In the equation above, F represents the total amount of money, in dollars, a food truck charges for x drinks and y salads. The price, in dollars, of each drink is the same, and the price, in dollars, of each salad is the same. Which of the following is the best interpretation for the number 7.00 in this context?

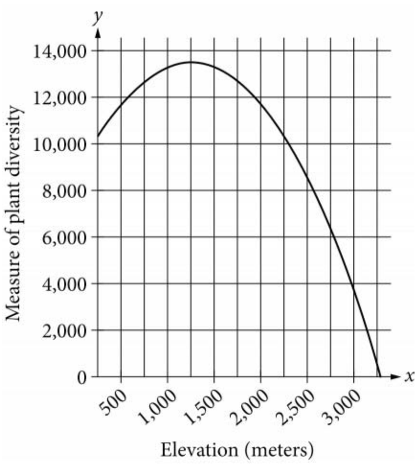
A. The price, in dollars, of one drink
B. The price, in dollars, of one salad
C. The number of drinks bought during the day
D. The number of salads bought during the day

Choice B is correct. It's given that $2.50x + 7.00y$ is equal to the total amount of money, in dollars, a food truck charges for x drinks and y salads. Since each salad has the same price, it follows that the total charge for y salads is $7.00y$ dollars. When $y = 1$, the value of the expression $7.00y$ is 7.00×1, or 7.00. Therefore, the price for one salad is 7.00 dollars.

Choice A is incorrect. Since each drink has the same price, it follows that the total charge for x drinks is $2.50x$ dollars. Therefore, the price, in dollars, for one drink is 2.50, not 7.00. Choices C and D are incorrect. In the given equation, F represents the total charge, in dollars, when x drinks and y salads are bought at the food truck. No information is provided about the number of drinks or the number of salads that are bought during the day. Therefore, 7.00 doesn't represent either of these quantities.

Question Difficulty: Medium

Math: Question 5



The quadratic function graphed above models a particular measure of plant diversity as a function of the elevation in a region of Switzerland. According to the model, which of the following is closest to the elevation, in meters, at which plant diversity is greatest?

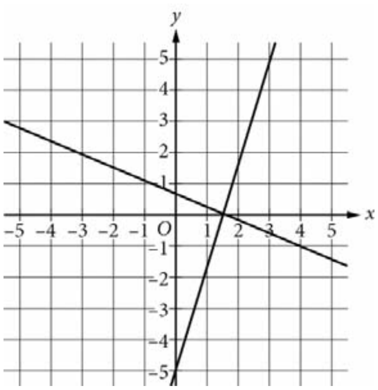
A. 13,500
B. 3,000
C. 1,250
D. 250

Choice C is correct. Each point (x, y) on the graph represents the elevation x, in meters, and the corresponding measure of plant diversity y in a region of Switzerland. Therefore, the point on the graph with the greatest y-coordinate represents the location that has the greatest measure of plant diversity in the region. The greatest y-coordinate of any point on the graph is approximately 13,500. The x-coordinate of that point is approximately 1,250. Therefore, the closest elevation at which the plant diversity is the greatest is 1,250 meters.

Choice A is incorrect. This value is closest to the greatest y-coordinate of any point on the graph and therefore represents the greatest measure of plant diversity, not the elevation where the greatest measure of plant diversity occurs. Choice B is incorrect. At an elevation of 3,000 meters the measure of plant diversity is approximately 4,000. Because there are points on the graph with greater y-coordinates, 4,000 can't be the greatest measure of plant diversity, and 3,000 meters isn't the elevation at which the greatest measure of plant diversity occurs. Choice D is incorrect. At an elevation of 250 meters, the measure of plant diversity is approximately 11,000. Because there are points on the graph with greater y-coordinates, 11,000 can't be the greatest measure of plant diversity and 250 meters isn't the elevation at which the greatest measure of plant diversity occurs.

Question Difficulty: Medium

Math: Question 6



Which of the following systems of equations has the same solution as the system of equations graphed above?

A. $y = 0$
$x = \frac{3}{2}$

B. $y = \frac{3}{2}$
$x = 0$

C. $y = 0$
$x = 1$

D. $y = 1$
$x = 0$

Choice A is correct. The solution to a system of equations is the coordinates of the intersection point of the graphs of the equations in the xy-plane. Based on the graph, the solution to the given system of equations is best approximated as $(\frac{3}{2}, 0)$. In the xy-plane, the graph of $y = 0$ is a horizontal line on which every y-coordinate is 0, and the graph of $x = \frac{3}{2}$ is a vertical line on which every x-coordinate is $\frac{3}{2}$. These graphs intersect at the point $(\frac{3}{2}, 0)$. Therefore, the system of equations in choice A has the same solution as the given system.

Choices B, C, and D are incorrect. If graphed in the xy-plane, these choices would intersect at the points $(0, \frac{3}{2})$, $(1, 0)$, and $(0, 1)$, respectively, not $(\frac{3}{2}, 0)$.

Question Difficulty: Medium

Math: Question 7

The function f defined by $f(x)=x^2$ is graphed in the xy-plane. The graph of the function g in the xy-plane is the graph of f shifted 4 units upward. Which of the following defines $g(x)$?

A. $g(x)=f(x+4)$

B. $g(x)=f(x-4)$

C. $g(x)=f(x)+4$

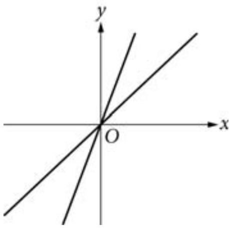
D. $g(x)=f(x)-4$

Choice C is correct. In the xy-plane, the graph of the function f is the set of all ordered pairs $(x, f(x))$. The graph of f is shifted up 4 units when the output of each of these ordered pairs is increased by 4, resulting in the set of ordered pairs $(x, f(x)+4)$. Since the function g is the function f shifted up 4 units in the xy-plane, it follows that $g(x)=f(x)+4$.

Choices A, B, and D are incorrect. In the xy-plane, the graph of $g(x)=f(x+4)$ is the graph of the function f shifted 4 units left, the graph of $g(x)=f(x-4)$ is the graph of f shifted 4 units right, and the graph of $g(x)=f(x)-4$ is the graph of f shifted 4 units down.

Question Difficulty: Medium

Math: Question 8



In the xy-plane above, two lines intersect at the origin. Which of the following pairs of equations could represent these lines, where a and b are positive constants?

A. $y = ax$
$y = bx$

B. $y = ax$
$y = -bx$

C. $y = -ax$
$y = -bx$

D. $y = ax$
$y = ax + b$

Choice A is correct. Any line in the xy-plane can be represented by an equation in the form $y = hx + k$, where h is the slope and k is the y-intercept of the line. Each of the graphed lines shown has positive slope and a y-intercept of zero. Since a and b are positive constants, of the equations given in the options, only $y = ax$ and $y = bx$ could represent the graphed lines shown.

Choices B, C, and D are incorrect. Each of the graphed lines shown has a positive slope and intersects the origin, and it is given that a and b are positive constants. In choice B the equation $y = ax$ represents a line with a positive slope that intersects the origin; however, $y = -bx$ represents a line with a negative slope that intersects the origin. In choice C each equation $y = -ax$ and $y = -bx$ represents a line with a negative slope that intersects the origin. Therefore, the equations in choice C cannot represent the graphed lines. In choice D the equation $y = ax$ represents a line with positive slope that intersects the origin; however, $y = ax + b$ represents a line with positive slope and a positive y-intercept. Therefore, the equations in choice D cannot represent the graphed lines.

Question Difficulty: Medium

Math: Question 9

$3x^2+4x-2-(x^2+2x-1)$

Which of the following is equivalent to the expression above?

A. $2x^2+2x-1$

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

C. $4x^2+2x-1$

D. $4x^2+6x-3$

Choice A is correct. The given expression $3x^2+4x-2-(x^2+2x-1)$ can be rewritten as $3x^2+4x-2+(-1)(x^2+2x-1)$. Distributing the factor of -1 yields $3x^2+4x-2-x^2-2x+1$. Regrouping like terms, this expression can be rewritten as $(3x^2-x^2)+(4x-2x)+(-2+1)$, which is equivalent to $2x^2+2x-1$.

Choices B, C, and D are incorrect and may result from errors made when applying the distributive property or errors made when adding like terms.

Question Difficulty: Medium

Math: Question 10

Which of the following expressions is equivalent to the sum of (r^3+5r^2+7) and $(r^2+8r+12)$?

A. r^5+13r^3+19

B. $2r^3+13r^2+19$

C. $r^3+5r^2+7r+12$

D. $r^3+6r^2+8r+19$

Choice D is correct. Grouping like terms, the given expressions can be rewritten as $r^3+(5r^2+r^2)+8r+(7+12)$. This can be rewritten as $r^3+6r^2+8r+19$.

Choice A is incorrect and may result from adding the two sets of unlike terms, r^3 and r^2 as well as $5r^2$ and $8r$, and then adding the respective exponents. Choice B is incorrect and may result from adding the unlike terms r^3 and r^2 as if they were r^3 and r^3 and adding the unlike terms $5r^2$ and $8r$ as if they were $5r^2$ and $8r^2$. Choice C is incorrect and may result from errors when combining like terms.

Question Difficulty: Medium

Math: Question 11

According to Moore's law, the number of transistors included on microprocessors doubles every 2 years. In 1985, a microprocessor was introduced that had 275,000 transistors. Based on this information, in which of the following years does Moore's law estimate the number of transistors to reach 1.1 million?

A. 1987
B. 1989
C. 1991
D. 1994

Choice B is correct. Let x be the number of years after 1985. It follows that $\frac{x}{2}$ represents the number of 2-year periods that will occur within an x-year period. According to Moore's law, every 2 years, the number of transistors included on microprocessors is estimated to double. Therefore, x years after 1985, the number of transistors will double $\frac{x}{2}$ times. Since the number of transistors included on a microprocessor was 275,000, or .275 million, in 1985, the estimated number of transistors, in millions, included x years after 1985 can be modeled as $0.275 \cdot 2^{\frac{x}{2}}$. The year in which the number of transistors is estimated to be 1.1 million is represented by the value of x when $1.1 = 0.275 \cdot 2^{\frac{x}{2}}$. Dividing both sides of this equation by .275 yields $4 = 2^{\frac{x}{2}}$, which can be rewritten as $2^2 = 2^{\frac{x}{2}}$. Since the exponential equation has equal bases on each side, it follows that the exponents must also be equal: $2 = \frac{x}{2}$. Multiplying both sides of the equation $2 = \frac{x}{2}$ by 2 yields $x = 4$. Therefore, according to Moore's law, 4 years after 1985, or in 1989, the number of transistors included on microprocessors is estimated to reach 1.1 million.

Alternate approach: According to Moore's law, 2 years after 1985 (in 1987), the number of transistors included on a microprocessor is estimated to be $2 \cdot 275{,}000$, or 550,000, and 2 years after 1987 (in 1989), the number of transistors included on microprocessors is estimated to be $2 \cdot 550{,}000$, or 1,100,000. Therefore, the year that Moore's law estimates the number of transistors on microprocessors to reach 1.1 million is 1989.

Choices A, C, and D are incorrect. According to Moore's law, the number of transistors included on microprocessors is estimated to reach 550,000 in 1987, 2.2 million in 1991, and about 6.2 million in 1994.

Question Difficulty: Medium

Math: Question 12

x	$f(x)$
2	7
3	5
4	7

For the quadratic function f, the table above gives some values of x and their corresponding values of $f(x)$. Which of the following could define f ?

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

B. $f(x)=(x-3)^2+9$

C. $f(x)=2(x-2)^2+7$

D. $f(x)=2(x-3)^2+5$

Choice D is correct. For the quadratic function f, the table shows $f(2)=7$, $f(3)=5$, and $f(4)=7$. For the quadratic equation $f(x)=2(x-3)^2+5$, $f(2)=2(2-3)^2+5=7$, $f(3)=2(3-3)^2+5=5$, and $f(4)=2(4-3)^2+5=7$, as shown in the table. Therefore, $f(x)=2(x-3)^2+5$ could define f.

Choices A, B, and C are incorrect. For the quadratic equation $f(x)=(x-3)^2+5$, $f(2)=6$, $f(3)=5$, and $f(4)=6$. For the quadratic equation, $f(x)=(x-3)^2+9$, $f(2)=10$, $f(3)=9$, and $f(4)=10$. For the quadratic equation, $f(x)=2(x-2)^2+7$, $f(2)=7$, $f(3)=9$, and $f(4)=15$. However, the table shows that for the quadratic function f, $f(2)=7$, $f(3)=5$, and $f(4)=7$. Therefore, the equations in choices A, B, and C cannot define the quadratic function f.

Question Difficulty: Medium

Math: Question 13

$3(x-5)^2+11=59$

What is the smallest value of x that satisfies the equation above?

A. 9
B. 7
C. 5
D. 1

Choice D is correct. Subtracting 11 from both sides of the given equation yields $3(x-5)^2=48$. Dividing both sides by 3 results in $(x-5)^2=16$. Taking the square root of both sides yields $x-5=-4$ or $x-5=4$. Adding 5 to both sides of each equation yields $x=1$ or $x=9$. It follows that the smallest possible value of x is 1.

Choice A is incorrect and may result from finding the greatest value of x. Choice B is incorrect. If $x=7$, then the left-hand side of the given equation becomes $3(7-5)^2+11$, which is equal to 23, not 59. Choice C is incorrect. If $x=5$, then the left-hand side of the given equation becomes $3(5-5)^2+11$, which is equal to 11, not 59.

Question Difficulty: Hard

Math: Question 14

$$x + y = 17$$
$$xy = 72$$

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

The correct answer is 8 or 9. The first equation can be rewritten as $y = 17 - x$. Substituting $17 - x$ for y in the second equation gives $x(17 - x) = 72$. By applying the distributive property, this can be rewritten as $17x - x^2 = 72$. Subtracting 72 from both sides of the equation yields $x^2 - 17x + 72 = 0$. Factoring the left-hand side of this equation yields $(x - 8)(x - 9) = 0$. Applying the Zero Product Property, it follows that $x - 8 = 0$ and $x - 9 = 0$. Solving each equation for x yields $x = 8$ and $x = 9$ respectively. Either 8 or 9 may be entered as the correct answer.

Question Difficulty: Medium

Math: Question 15

If $\frac{3x+3x}{6}=24$, what is the value of $6x$?

The correct answer is 144. Multiplying both sides of the equation by 6 results in $3x + 3x = 144$. Adding like terms yields $6x = 144$.

Question Difficulty: Medium

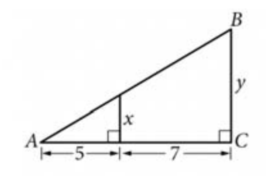
Math: Question 16

According to a model, the head width, in millimeters, of a worker bumblebee can be estimated by adding 0.6 to four times the body weight of the bee, in grams. According to the model, what would be the head width, in millimeters, of a worker bumblebee that has a body weight of 0.5 grams?

The correct answer is 2.6 or $\frac{13}{5}$. According to the model, the head width, in millimeters, of a worker bumblebee can be estimated by adding 0.6 to 4 times the body weight, in grams, of the bee. Let x represent the body weight, in grams, of a worker bumblebee and let y represent the head width, in millimeters. Translating the verbal description of the model into an equation yields $y = 0.6 + 4x$. Substituting 0.5 grams for x in this equation yields $y = 0.6 + 4(0.5) = 2.6$. Therefore, a worker bumblebee with a body weight of 0.5 grams has an estimated head width of 2.6 millimeters. Either 2.6 or the equivalent fraction 13/5 may be entered as the correct answer.

Question Difficulty: Hard

Math: Question 17



Note: Figure not drawn to scale.

The area of triangle ABC above is at least 48 but no more than 60. If y is an integer, what is one possible value of x ?

The correct answer is $\frac{10}{3}$, $\frac{15}{4}$, or $\frac{25}{6}$. The area of triangle ABC can be expressed as $\frac{1}{2}(5+7)y$ or $6y$. It's given that the area of triangle ABC is at least 48 but no more than 60. It follows that $48 \le 6y \le 60$. Dividing by 6 to isolate y in this compound inequality yields $8 \le y \le 10$. Since y is an integer, $y = 8, 9,$ or 10. In the given figure, the two right triangles shown are similar because they have two pairs of congruent angles: their respective right angles and angle A. Therefore, the following proportion is true: $\frac{x}{y} = \frac{5}{12}$. Substituting 8 for y in the proportion results in $\frac{x}{8} = \frac{5}{12}$. Cross multiplying and solving for x yields $\frac{10}{3}$, which is approximately equivalent to 3.33. Substituting 9 for y in the proportion results in $\frac{x}{9} = \frac{5}{12}$. Cross multiplying and solving for x yields $\frac{15}{4}$, which is equivalent to 3.75. Substituting 10 for y in the proportion results in $\frac{x}{10} = \frac{5}{12}$. Cross multiplying and solving for x yields $\frac{25}{6}$, which is approximately equivalent to 4.16 or 4.17. Either 10/3, 15/4, or 25/6, or the equivalent decimals 3.33, 3.75, 4.16, or 4.17 may be entered as the correct answer.

Question Difficulty: Hard