Math: Question 1

Which expression is equivalent to $7x^3-(5x^3+2x)$?

A. $2-2x$

B. $2+2x$

C. $2x^3-2x$

D. $2x^3+2x$

Choice C is correct. The given expression $7x^3-(5x^3+2x)$ can be rewritten as $7x^3+(-1)(5x^3+2x)$. Applying the distributive property yields $7x^3-5x^3-2x$. Combining like terms yields $2x^3-2x$.

Choice A is incorrect and may result from an error when combining the like terms $7x^3$ and $-5x^3$ in the expression $7x^3-5x^3-2x$. Choice B is incorrect and may result from distributing the factor -1 in the given expression to the $5x^3$ term but not to the $2x$ term, and a calculation error when combining the like terms $7x^3$and $-5x^3$. Choice D is incorrect and may result from distributing the factor -1 in the given expression to the $5x^3$ term but not to the $2x$ term.

Question Difficulty: Easy

Math: Question 2

$1.5m + 5s = 30$

Rose bushes will not grow properly if they are planted too close together. The equation shown models the number of miniature rose bushes, m, and the number of shrub rose bushes, s, that can be planted in a 30-foot-long row. If 3 shrub rose bushes are planted in this row, what is the maximum number of miniature rose bushes that can also be planted in the row?

A. 5
B. 10
C. 15
D. 20

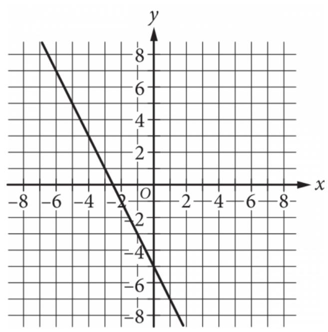
Choice B is correct. It's given that s represents the number of shrub rose bushes and m represents the number of miniature rose bushes. It's also given that 3 shrub rose bushes are planted in a 30-foot-long row. Therefore, $s = 3$. Substituting 3 for s in the given equation yields $1.5m + 5(3) = 30$, or $1.5m + 15 = 30$. Subtracting 15 from each side of this equation and then dividing each side by 1.5 yields $m = 10$. Therefore, the maximum number of miniature rose bushes that can also be planted in the row is 10.

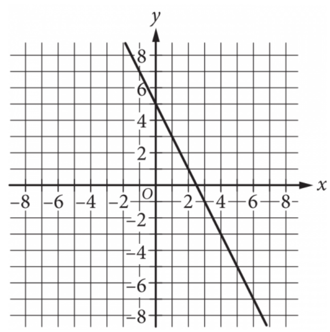
Choice A is incorrect and may result from finding the maximum number of shrub rose bushes if 3 miniature rose bushes are planted in a 30-foot-long row. Choice C is incorrect and may result from a calculation error. Choice D is incorrect and may result from finding the maximum number of miniature rose bushes that can be planted if no shrub rose bushes are planted.

Question Difficulty: Easy

Math: Question 3

The function g is defined by $g(x) = -2x - 5$. What is the graph of $y = g(x)$?


A.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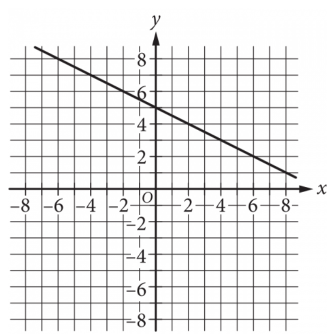
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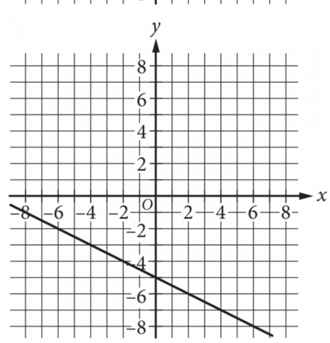

D.

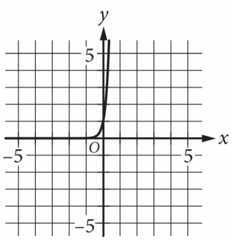
Choice A is correct. Since the function g is defined by a linear equation, the graph of $y = g(x)$ is a line in the xy-plane. The equation defining this function is in the form $g(x) = mx + b$, where m is the slope and b is the y-coordinate of the y-intercept of the line. Since $g(x) = -2x - 5$, the graph of $y = g(x)$ is a line whose slope is -2 and whose y-intercept is $(0, -5)$. Since the line in choice A passes through the points $(-3,1)$ and $(0,-5)$, it has a slope of $\frac{(-5)-(1)}{(0)-(-3)}$, or -2, and a y-intercept of $(0,-5)$. Therefore, choice A shows the graph of $y=g(x)$.

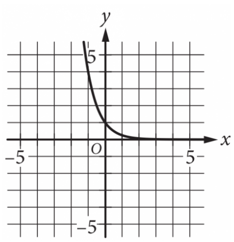
Choices B and C are incorrect. The y-intercept of each of these lines is $(0,5)$, not $(0,-5)$. Choice D is incorrect. The slope of the line is $-\frac{1}{2}$, not -2.

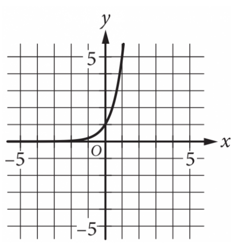
Question Difficulty: Easy

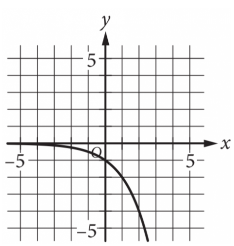
Math: Question 4

What is the graph of $y = -2^x$?

A. 

B. 

C. 

D. 

Choice D is correct. The graph of $y = -2^x$ is the set of all points (x, y) that satisfy $y = -2^x$. Substituting values of 0, 1, and 2 for x in the equation $y = -2^x$ yields values of -1, -2, and -4 , respectively, for y. Therefore, the graph of $y = -2^x$ contains the points $(0, -1)$, $(1, -2)$, and $(2, -4)$. Only the graph in choice D contains these points. Therefore, the graph in choice D is the graph of $y = -2^x$.

Alternate approach: The equation $y = -2^x$ defines a decreasing exponential function. Since 2^x is positive for any value of x, it follows that -2^x is negative for any value of x and that the graph of $y = -2^x$ must lie entirely below the x-axis. Only the graph in choice D is a decreasing function whose graph lies entirely below the x-axis.

Choices A, B, and C are incorrect. The graph of $y = -2^x$ contains the point $(0, -1)$, but each of these graphs contains the point $(0, 1)$ rather than $(0, -1)$.

Question Difficulty: Medium

Math: Question 5

$$\frac{1-z}{7}=-15$$

What value of z is the solution to the given equation?

A. 106

B. 104

C. -104

D. -106

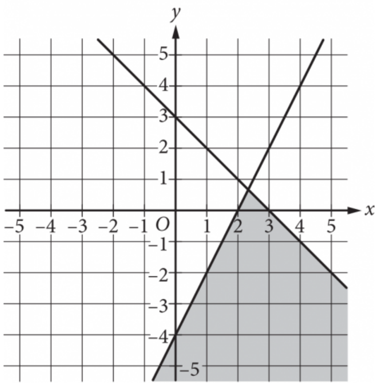
Choice A is correct. Multiplying each side of the given equation by 7 yields $1-z=-105$. Subtracting 1 from each side of this equation yields $-z=-106$. Dividing both sides of this equation by -1 yields $z=106$.

Choice B is incorrect and may result from adding 1 to, instead of subtracting 1 from, the right-hand side of the equation $1-z=-105$. Choice C is incorrect and may result from adding 1 to, instead of subtracting 1 from, the right-hand side of the equation $1-z=-105$ and dividing only the left-hand side of the resulting equation $-z=-104$ by -1. Choice D is incorrect and may result from only dividing the left-hand side of the equation $-z=-106$ by -1.

Question Difficulty: Medium

☐	Math without Calculator	6	N/A	**Unscorable Question**	N

Math: Question 7



The shaded region shown represents the solutions to which system of inequalities?

A. $y \leq -x+3$
$y \geq 2x-4$

B. $y \leq -x+3$
$y \leq 2x-4$

C. $y \geq -x+3$
$y \leq 2x-4$

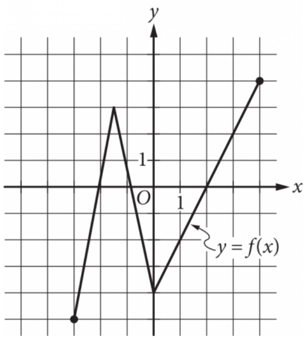
D. $y \geq -x+3$
$y \geq 2x-4$

Choice B is correct. The lines in the graph represent the equations $y = -x+3$ and $y = 2x-4$. For each line, the shaded region lies on and below the line, or where the value of y is equal to or less than the corresponding expression in x on the right-hand side of the equation. Therefore, the shaded region represents the solutions to the system of inequalities $y \leq -x+3$ and $y \leq 2x-4$.

Choice A is incorrect. The solutions to this system of inequalities are represented by the points that lie on and above, not on and below, the line with equation $y = 2x-4$. Choice C is incorrect. The solutions to this system of inequalities are represented by the points that lie on and above, not on and below, the line with equation $y = -x+3$. Choice D is incorrect. The solutions to this system of inequalities are represented by the points that lie on and above, not on and below, the lines with equations $y = -x+3$ and $y = 2x-4$.

Question Difficulty: Medium

Math: Question 8



The complete graph of the function f is shown in the xy-plane above. Which of the following is a value of x for which $f(x) = 0$?

A. 2
B. 0
-3
C.
D. -4

Choice A is correct. If $f(x) = 0$, then the point $(x, 0)$ lies on the x-axis; that is, $f(x) = 0$ for those values of x where the graph of f intersects the x-axis. The graph shown intersects the x-axis near $x = -2$, near $x = -1$, and at $x = 2$. Therefore, 2 is a value of x for which $f(x) = 0$.

Choice B is incorrect and may result from finding the value of $f(x)$ rather than the value of x for which $f(x) = 0$. Choice C is incorrect and may result from a conceptual error. Choice D is incorrect and may result from finding the value of $f(0)$ rather than the value of x for which $f(x) = 0$.

Question Difficulty: Medium

Math: Question 9

$$y = 150\left(\frac{1}{2}\right)^{\frac{t}{8}}$$

The half-life of a radioactive substance is the time it takes for half of the substance to decay into another form. In the given equation, y represents the number of milligrams of iodine-131 remaining after t days. What is the best interpretation of 150 in this context?

A. It will take 150 days for the iodine-131 to totally decay.
B. The half-life of iodine-131 is 150 days.
C. After t days, 150 milligrams of the iodine-131 will have decayed.
D. The original mass of the iodine-131 was 150 milligrams.

Choice D is correct. The given equation is in the form $y = A\left(\frac{1}{2}\right)^{\frac{t}{h}}$, where A represents the original mass, in milligrams, of the substance and h represents the half-life, in days, of the substance. In the given equation, the value of A is 150. Therefore, the original mass of the iodine-131 was 150 milligrams.

Alternate approach: In the equation $y = 150\left(\frac{1}{2}\right)^{\frac{t}{8}}$, the value of y when $t = 0$ is $150\left(\frac{1}{2}\right)^{0}$, which is equal to $(150)(1)$, or 150. Thus, 150 is the mass, in milligrams, of iodine-131 at time $t = 0$, or the original mass, in milligrams, of iodine-131.

Choice A is incorrect. The expression $150\left(\frac{1}{2}\right)^{\frac{t}{8}}$ isn't equal to 0 for any value of t, so the equation doesn't indicate any time when the iodine-131 has totally decayed. Choice B is incorrect. The half-life, in days, of iodine-131 is represented by 8, not 150, in the given equation. Choice C is incorrect. After t days, $150 - 150\left(\frac{1}{2}\right)^{\frac{t}{8}}$ milligrams of the iodine-131 will have decayed, which isn't equal to 150 for any value of t.

Question Difficulty: Medium

Math: Question 10

Which of the following equations has no solution?

A. $10x+1=5x+1$

B. $10x+7=-10x-7$

C. $10x+2=5(2x+1)$

D. $10x+20=5(2x+4)$

Choice C is correct. Applying the distributive property to the right-hand side of the equation $10x+2=5(2x+1)$ yields $10x+2=10x+5$. Subtracting $10x$ from both sides of this equation yields $2=5$, which isn't true. Therefore, the equation $10x+2=5(2x+1)$ has no solution.

Choice A is incorrect. This equation has one solution, $x=0$. Choice B is incorrect. This equation has one solution, $x=-\frac{7}{10}$. Choice D is incorrect. This equation has infinitely many solutions.

Question Difficulty: Medium

Math: Question 11

$x^2 - 8x + 12 = 0$

What is the product of the solutions to the given equation?

A. 4
B. 6
C. 8
D. 12

Choice D is correct. The left-hand side of the given equation can be factored to rewrite the equation as $(x-6)(x-2)=0$. Using the zero product property, $x-6=0$ or $x-2=0$. Adding 6 to each side of the equation $x-6=0$ yields $x=6$. Adding 2 to each side of the equation $x-2=0$ yields $x=2$. Therefore, the solutions to the given equation are 6 and 2. The product of the solutions is $(6)(2)$, or 12.

Choice A is incorrect and may result from calculating the difference between, rather than the product of, the solutions to the given equation. Choice B is incorrect and may result from calculating one of the solutions to the given equation rather than the product of the solutions. Choice C is incorrect and may result from calculating the sum, rather than the product, of the solutions to the given equation.

Question Difficulty: Medium

Math: Question 12

$y = x^2 + 2x + 12$

What is the minimum value of y for the given equation?

A. 2
B. 10
C. 11
D. 12

Choice C is correct. The equation $y = x^2 + 2x + 12$ can be rewritten as $y = (x^2 + 2x + 1) + 11$. Since the expression $x^2 + 2x + 1$ factors to $(x+1)^2$, the equation can be rewritten as $y = (x+1)^2 + 11$.

Since the square of 0 is 0 and the square of any positive or negative number is positive, the minimum value of y must occur when $x + 1 = 0$ and be equal to $0^2 + 11$, or 11.

Alternate approach: For a quadratic equation in the form $y = ax^2 + bx + c$, where a, b, and c are constants and $a > 0$, the minimum value of y occurs when $x = \frac{-b}{2a}$. In the given equation, $a = 1$ and $b = 2$, so the minimum value of y occurs when $x = \frac{-(2)}{2(1)}$, or $x = -1$. Substituting -1 for x in the given equation yields $y = (-1)^2 + 2(-1) + 12$, or $y = 11$. Therefore, the minimum value of y for the given equation is 11.

Choices A and B are incorrect and may result from conceptual errors. Choice D is incorrect. This value represents the y-coordinate of the y-intercept of the graph of the given equation in the xy-plane.

Question Difficulty: Hard

Math: Question 13

$x^2 - 12x + k = 0$

In the equation above, k is a constant. For which of the following values of k does the equation have only one solution?

A. 0
B. 12
C. 24
D. 36

Choice D is correct. A quadratic equation in the form $ax^2 + bx + c = 0$ has only one solution if the discriminant, which is equal to $b^2 - 4ac$, is equal to 0. In the given equation, $a = 1$, $b = -12$, and $c = k$. Substituting these values for a, b, and c in the equation $b^2 - 4ac = 0$ yields $(-12)^2 - 4(1)(k) = 0$, or $144 - 4k = 0$. Subtracting 144 from each side of this equation and then dividing each side by -4 yields $k = 36$. Therefore, the given equation has only one solution when k is equal to 36.

Alternate approach: Since $(x-6)^2 = x^2 - 12x + 36$, the given equation can be rewritten as $(x-6)^2 - 36 + k = 0$, or $(x-6)^2 = 36 - k$. This equation has two solutions if $36 - k$ is positive, one solution if $36 - k$ is 0, and no solution if $36 - k$ is negative. Therefore, the given equation has only one solution if $36 - k = 0$, or $k = 36$.

Choices A, B, and C are incorrect. If the value of k is 0, 12, or 24, the discriminant is equal to 144, 96, or 48, respectively. A quadratic equation with a positive discriminant has two real solutions.

Question Difficulty: Hard

Math: Question 14

$$x - y = 4$$
$$2x + 3y = 3$$

The solution to the given system of equations is (x, y). What is the value of x ?

The correct answer is 3. Multiplying each side of the equation $x - y = 4$ by 3 yields $3(x - y) = 3(4)$, or $3x - 3y = 12$. Adding this equation to the equation $2x + 3y = 3$ yields $2x + 3x + 3y - 3y = 3 + 12$. Combining like terms yields $5x = 15$. Dividing each side of this equation by 5 yields $x = 3$.

Question Difficulty: Medium

Math: Question 15

A tank holding 500 gallons of water is being emptied at a constant rate. After 5 minutes, there are 400 gallons of water left in the tank; after 10 minutes, there are 300 gallons. After how many minutes would there be exactly 140 gallons left in the tank?

The correct answer is 18. It's given that the tank is being emptied at a constant rate. Therefore, in the decreasing linear equation $y = -mx + b$, y represents the amount of water, in gallons, left in the tank after x minutes, where water is being emptied at m gallons per minute and there were initially b gallons of water in the tank. It's given that the tank initially holds 500 gallons of water, so $b = 500$. Substituting 500 for b in the equation $y = -mx + b$ yields $y = -mx + 500$. It's also given that after 5 minutes there are 400 gallons of water remaining in the tank. Substituting 5 for x and 400 for y in the equation $y = -mx + 500$ yields $400 = -m(5) + 500$. Subtracting 500 from each side of this equation and then dividing each side by -5 yields $m = 20$. Substituting 20 for m in the equation $y = -mx + 500$ yields $y = -20x + 500$. In this equation, y represents the amount of water, in gallons, left in the tank after x minutes, so the number of minutes after which there would be exactly 140 gallons left in the tank can be represented by $140 = -20x + 500$. Subtracting 500 from each side of this equation and then dividing each side by -20 yields $18 = x$. Thus, there are exactly 140 gallons left in the tank after 18 minutes.

Question Difficulty: Medium

Math: Question 16

Rectangle *ABCD* is similar to rectangle *EFGH*. The area of rectangle *ABCD* is 80 square inches, and the area of rectangle *EFGH* is 20 square inches. The measure of the longest side of rectangle *ABCD* is 10 inches. What is the measure, in inches, of the longest side of rectangle *EFGH*?

The correct answer is 5. For similar two-dimensional figures, if the side lengths of the first figure are k times the corresponding side lengths of the second figure, then the area of the first figure is k^2 times the area of the second figure. It's given that for similar rectangles ABCD and EFGH, the area of ABCD is 80 square inches and the area of EFGH is 20 square inches. Since $80 = 4 \cdot 20$, the area of ABCD is 4 times the area of EFGH, or $k^2 = 4$. Therefore, $k = \sqrt{4}$, or $k = 2$, which means that the measure or length of each side of ABCD is 2 times the measure or length of the corresponding side of EFGH. Since the longest sides of the two rectangles correspond, the length of the longest side of ABCD is 2 times the length of the longest side of EFGH. It's given that the longest side of ABCD has a measure or length of 10 inches, so the measure or length of the longest side of EFGH is $\frac{10}{2}$ or 5 inches.

Question Difficulty: Medium

Math: Question 17

$$x^2 - y^2 = 900$$
$$x - y = 10$$

In the system of equations above, what is the value of $x + y$?

The correct answer is 90. Since the left-hand side of the equation $x^2 - y^2 = 900$ is a difference of squares, the equation can be rewritten as $(x + y)(x - y) = 900$. It's given by the second equation in the system that $x - y = 10$. Substituting 10 for $x - y$ in the equation $(x + y)(x - y) = 900$ yields $(x + y)(10) = 900$. Dividing each side of this equation by 10 yields $x + y = 90$.

Question Difficulty: Medium