

1. **Level:** Easy | **Domain:** ADVANCED MATH  
**Skill/Knowledge:** Nonlinear functions | **Testing point:** Sum of the solutions

**Key Explanation:** Choice C is correct. The equation represents a quadratic in the form  $ax^2 + bx + c$ , where  $a=3$ ,  $b=9$ , and  $c=-27$ . The sum of the solutions to a quadratic equation is given by the formula  $\left(\frac{-b}{a}\right)$ . Therefore, the sum of the solutions of the quadratic equation would be  $\left(\frac{-9}{3}\right)$ , or  $-3$ .

**Distractor Explanation:** Choice A is incorrect

as it is  $\left(\frac{b}{a}\right)$ , not  $-\left(\frac{b}{a}\right)$ . Choice B is incorrect because it is the product of the solutions to the quadratic equation and not the sum of them. The product of the solutions of a quadratic equation is given by the formula  $\left(\frac{c}{a}\right)$ , which is  $\left(\frac{-27}{3}\right)$  or  $-9$ .

Choice D is incorrect as it is the negative of the product of the solutions.

2. **Level:** Easy | **Domain:** ADVANCED MATH  
**Skill/Knowledge:** Equivalent expressions | **Testing point:** Combining like terms

**Key Explanation:** Choice D is correct. First, distribute the negative to the terms in the parentheses as follows:

$3x^2y + 5x - 3x^2y^2 + 2x^2y$ . Combining like terms yields  $5x^2y + 5x - 3x^2y^2$  which is Choice D when the terms are arranged in standard form.

**Distractor Explanation:** Choices A and C are incorrect due to miscalculation or lack of concept knowledge. Choice B is incorrect. The sign changes of the terms in the parentheses when the negative sign is distributed to these terms and the parenthesis is removed.

3. **Level:** Medium | **Domain:** ALGEBRA  
**Skill/Knowledge:** Linear inequalities in one or two variables | **Testing point:** Solving for a linear inequality

**Key Explanation:** To solve the inequality, first subtract 2 from both sides to get:  $-2y + 2 - 2 < 6 - 2$

Next, divide both sides by  $-2$  to get:  $y > -2$

Note that multiplying or dividing by a negative number in an inequality flips the inequality sign.  $-1$  is the least possible integer value of  $y$  which satisfies the inequality  $y > -2$ .

4. **Level:** Easy | **Domain:** ADVANCED MATH  
**Skill/Knowledge:** Nonlinear equations in one variable and systems of equations in two variables  
**Testing point:** Discriminant and solving for linear and quadratic equations

**Key Explanation:** Choice A is correct. Using the substitution method, substitute the first equation for  $y$  in the second equation yielding  $2x - 5 = 2x^2 - 18x + 45$ .

Next, subtract the  $2x$  from both sides to get  $-5 = 2x^2 - 20x + 45$ . Add 5 to both sides of the equation to get  $0 = 2x^2 - 18x + 50$ . The discriminant of a quadratic equation is  $b^2 - 4ac$ , when the quadratic equation is in the form  $ax^2 + bx + c$ . In the quadratic equation  $a = 2$ ,  $b = -20$ , and  $c = 50$ . The value of the discriminant determines the number of solutions for a quadratic equation. Therefore, plugging in the values of  $a$ ,  $b$ , and  $c$  into the discriminant, yields  $(-20)^2 - 4(2)(50)$  which yields  $400 - 400 = 0$ . Therefore, the system will have one solution as the discriminant  $= 0$ .

**Distractor Explanation:** Choices A and C are incorrect, most likely due to a miscalculation.

**Choice D** is incorrect. Quadratic equations can't have an infinite number of solutions.

5. **Level:** Easy | **Domain:** ALGEBRA

**Skill/Knowledge:** Systems of two linear equations in two variables | **Testing point:** Solving linear systems using elimination or substitution

**Key Explanation:** **Choice A** is correct. The most efficient way to solve the system of equations is to subtract the two equations resulting in  $x + y = 9$ .

The system of equations can also be solved using the elimination or substitution methods to find  $x$  and  $y$  individually and then adding the values of  $x$  and  $y$  to find the answer.

**Distractor Explanation:** **Choice B** is incorrect as it is the value of  $x$  only and not  $x + y$ . **Choice D** is incorrect as it is found by the sum of the two equations which instead yields  $5x - 3y = 13$ , which does not give the value of  $x + y$ . **Choice C** is incorrect as it is due to a miscalculation or a conceptual error.

6. **Level:** Easy | **Domain:** GEOMETRY AND TRIGONOMETRY

**Skill/Knowledge:** Right triangles and trigonometry | **Testing point:** Trigonometric identities

**Key Explanation:** There is a trigonometric identity which states that  $\sin x = \cos(90^\circ - x)$ . Therefore,  $\sin 32^\circ = \cos 58^\circ$  and thus  $\cos 58^\circ = 0.551$ .

7. **Level:** Hard | **Domain:** GEOMETRY AND TRIGONOMETRY

**Skill/Knowledge:** Lines, angles, and triangles | **Testing point:** Conversion of measurements and area of triangles

**Key Explanation:** **Choice D** is correct. The area of a triangle is found by the formula  $A = \frac{1}{2} \times \text{base} \times \text{height}$ . Since the answer is required in *ft squared*, we will need to convert any lengths of the sides of the triangle that are in *inches* to *feet*.

Therefore, 10 *inches* can be converted to *feet* by multiplying it by  $\frac{1}{12}$ , which gives  $\frac{10}{12}$  feet. This reduces to  $\frac{5}{6}$  ft.

Using the area of a triangle formula, the area is  $\frac{1}{2} \times \frac{5}{6} \times 24 = 10$  ft.

**Distractor Explanation:** **Choice A** is incorrect as this is the area of the triangle without having converted any of the side *lengths* to *feet*. **Choice B** is incorrect as even though the measurements have been converted to feet, the formula for the area used was *base*  $\times$  *height* which is not the correct formula. **Choice C** is incorrect as this is the area if all the side lengths were in inches instead of *feet*.

8. **Level:** Hard | **Domain:** ADVANCED MATH

**Skill/Knowledge:** Equivalent expressions | **Testing point:** Subtracting fractions with variable denominators

**Key Explanation:** **Choice C** is correct. All the given answer choices have one term, and not two like the original expression. Thus, the two fractional expressions need to be combined into one fraction by getting them both over the least common denominator. The least common denominator of the two terms is  $x(x - 4)$ . To get both terms over the least common denominator

the first term needs to be multiplied by  $\frac{(x - 4)}{(x - 4)}$

and the second term needs to be multiplied by

$\frac{x}{x}$ , yielding

$$\frac{-5(x-4)}{x(x-4)} = \frac{x(x)}{x(x-4)}$$

Since the denominators of the fractions are equal, the numerators can be combined over a single fraction as follows:

$$\frac{-5(x-4) - x(x)}{x(x-4)} = \frac{-5x + 20 - x^2}{x^2 - 4x},$$

which is **Choice C**.

**Distractor Explanation:** **Choice A** is incorrect as the question asked to simplify the terms and not solve for anything. **Choices B** and **D** are incorrect and may be due to a conceptual error or miscalculation.

9. **Level:** Easy | **Domain:** ALGEBRA

**Skill/Knowledge:** Linear equations in two variables | **Testing point:** Identifying linear equations from graphs

**Key Explanation:** **Choice B** is correct. The slope-intercept equation of a line is  $y = mx + b$ , where  $m$  is the slope and  $b$  is the  $y$ -intercept of the equation. The slope  $m$  of a line can be found using the equation  $m = \frac{(y_2 - y_1)}{(x_2 - x_1)}$ , where  $(x_1, y_1)$  and  $(x_2, y_2)$  represent any two points on the line.

Pick two points on the line that are easy to find on the graph. The  $x$  and  $y$  intercepts of the line are two good points to use. Using points  $(2, 0)$  and  $(0, 6)$ , the slope of the line can be found by plugging these points into the slope formula, yielding

$$\frac{(6-0)}{(0-2)}, \text{ or } \frac{6}{-2} = -3. \text{ The } y\text{-intercept of the line}$$

is 6. Therefore  $y = -3x + 6$ . All of the answer choices are written in an offset of the standard equation of a line  $ax + by = c$ . Adding  $3x$  to both sides of the slope-intercept form of the equation gives the standard equation of the line as  $3x + y$

$= 6$ . Multiplying all terms of the equation by 3 to better match the form of the answer choices yields  $9x + 3y = 18$ , which matches **Choice B**.

**Distractor Explanation:** **Choice A** is incorrect as this equation represents a line with a positive slope. From the graph the slope of the line is negative. **Choice C** is incorrect because the slope of the line is  $-3$  and not  $2$ . **Choice D** is incorrect because the slope of the line is  $-3$  and not  $-4$ .

10. **Level:** Easy | **Domain:** ADVANCED MATH

**Skill/Knowledge:** Nonlinear functions | **Testing point:** Finding  $y$ -intercept

**Key Explanation:** The  $y$ -intercept occurs where  $x = 0$ ,  $y - 7 = 3^0 - 5$ . Anything to the power of zero  $= 1$ , so  $y - 7 = 1 - 5$ . Adding 7 to both sides of the equation to solve for  $y$  yields  $y - 7 + 7 = 1 - 5 + 7$ ,  $y = 3$ .

11. **Level:** Medium | **Domain:** ADVANCED MATH

**Skill/Knowledge:** Nonlinear functions | **Testing point:** Finding the value that makes a function undefined

**Key Explanation:** **Choice C** is correct. A function is undefined when the denominator is equal to 0. To find what values of  $x$  make this occur, solve the equation  $x^2 - 2x - 15 = 0$  for  $x$ . Use the grouping method of factoring to determine what two numbers multiply to  $-15$  but add up to  $-2$ . The two numbers would be  $-5$  and  $3$ . Thus, the middle term of the quadratic equation can be written as  $-5x + 3x$ , instead of  $-2x$  as follows:  $2 - 5x + 3x - 15 = 0$ . Grouping the terms and factoring out the greatest common factor of each group, yields  $x(x - 5) + 3(x - 5) = 0$ .  $(x+3)(x-5) = 0$ ,  $x = -3$ , and  $x = 5$ . Only the solution to the quadratic equation  $x = -3$  meets the question condition that  $x$  be less than zero. Thus, C is the correct answer.

**Distractor Explanation:** Choice A is incorrect since this is the positive  $x$  value of the solution and the value needs to be less than zero. Choice B is incorrect as it gives the negative value 5, which could be the result of factoring incorrectly. Choice D is incorrect. It may be due to a miscalculation.

12. **Level:** Medium | **Domain:** ALGEBRA

**Skill/Knowledge:** Linear functions | **Testing**

**point:** Finding the  $x$ -intercept given two points

**Key Explanation:** Choice A is correct.  $f(3) = -1$  and  $f(4) = -3$  represent the  $x$  and  $y$  values of two points on a line. The points are  $(3, -1)$  and  $(4, -3)$ . To find the  $x$ -intercept of the line represented, the equation of the line first needs to be determined. The slope-intercept form of the equation of the line,  $y = mx + b$  is easiest to use. In this equation,  $m$  represents the slope of the line and  $b$  its  $y$ -intercept. The slope of a line can be found

using the slope formula  $m = \frac{(y_2 - y_1)}{(x_2 - x_1)}$ . Plugging

in the two points into the slope formula yields

$$m = \frac{-3 - (-1)}{4 - 3} = -2.$$

Therefore the equation of the line is  $y = -2x + b$ .

To find  $b$ , plug either point into the equation and solve for  $b$ . Using the point  $(3, -1)$  yields

$$-1 = -2(3) + b, -1 = -6 + b, b = 5.$$

Therefore the equation of the line is  $y = -2x + 5$ . The  $x$ -intercept of a line occurs where  $y = 0$ . Plugging in zero for  $y$  into the equation and solving for  $x$  gives the following  $x$ -intercept:

$$0 = -2x + 5, 2x = 5, x = 2.5 \text{ or } \frac{5}{2}.$$

**Distractor Explanation:** Choice B is incorrect as this is the  $y$ -intercept. Choice C is incorrect as this is the slope of the line. Choice D is incorrect and

is the result of a miscalculation in solving for the  $x$ -intercept.

13. **Level:** Hard | **Domain:** ALGEBRA

**Skill/Knowledge:** Linear functions | **Testing**

**point:** Transformations and Solving for function values

**Key Explanation:** The function  $f(x + 3)$  is moved to the left by 3 units, therefore we should also move the  $x$  value in  $f(x)$  to the left by 3 units to get  $2 - 3$  or  $f(-1)$

Therefore  $f(-1)$  is found by substituting  $-1$  into the equation for  $x$  as follows:

$$5(-1) - 17 = -22.$$

14. **Level:** Hard | **Domain:** PROBLEM-SOLVING AND DATA ANALYSIS

**Skill/Knowledge:** Ratios, rates, proportional relationships, and units | **Testing point:**

Calculating average speed with unknown variable

**Key Explanation:** Choice B is correct. Average speed is calculated by taking the total distance traveled divided by the total time to travel that distance.

The total distance traveled would be  $x + x = 2x$

The total time taken would be  $2.5 \text{ hrs} + 1.5 \text{ hrs} = 4 \text{ hrs}$

$$\text{Therefore, the average speed} = \frac{2x}{4} = \frac{x}{2}$$

**Distractor Explanation:** Choice A is incorrect as it does not account for the fact that there is a return trip. Choice C is incorrect as it incorrectly accounts for the time it took Amber to do her errands. Choice D is incorrect as it may be due to a conceptual error or the student incorrectly found the total distance traveled.

15. **Level:** Easy | **Domain:** GEOMETRY AND TRIGONOMETRY

**Skill/Knowledge:** Area and volume | **Testing point:** Perimeter of a rectangle

**Key Explanation:** Choice B is correct. If the width of the rectangle is  $w$ , the length would be  $w + 3$ . The area of a rectangle can be found by multiplying the width of the rectangle by its length.

Therefore the area of the rectangle would be  $w(w + 3) = 28$ . Using the distributive property, the equation can be expanded out to:

$$w^2 + 3w = 28$$

$$w^2 + 3w - 28 = 0$$

Factoring the equation yields  $(w + 7)(w - 4) = 0$

Setting both factors of the equation equal to 0 results in  $w = -7$  and  $w = 4$ . Since the width of a rectangle cannot be negative,  $-7$  is not a valid width for the rectangle. Therefore the width of the rectangle would be 4 and the length would be  $4 + 3$  or 7. The perimeter of a rectangle is found by the formula  $P = 2(l + w)$ . Plugging in the determined values for  $w$  and  $l$  yields

$$2(7 + 4) = 22 \text{ or Choice B.}$$

**Distractor Explanation:** Choice A is incorrect as this value is the sum of the length and the width and not two times the sum. Choice C is incorrect as this is half the area. Choice D is incorrect and may be due to conceptual error.

16. **Level:** Easy | **Domain:** PROBLEM-SOLVING AND DATA ANALYSIS

**Skill/Knowledge:** Inference from sample statistics and margin of error | **Testing point:** Inference from sample statistics

**Key Explanation:** The students surveyed who do not practice sanitary routines are  $(48 - 23) =$

25. It can therefore be extrapolated that  $\frac{25}{48}$  of all the students in the school do not practice sanitary routines. Therefore  $\left(\frac{25}{48}\right) \times 2,280$  or 1,187.5 students. This rounds up to 1,188 students.

17. **Level:** Medium | **Domain:** ALGEBRA

**Skill/Knowledge:** Linear functions | **Testing point:** Linear transformations

**Key Explanation:** Choice D is correct. To move one unit up, 1 is added to the equation. To move 1 unit to the left, 1 is added to the  $x$  term in the equation as follows

$$y = 2(x + 1) + 1$$

$$y = 2x + 2 + 1$$

$$y = 2x + 3$$

**Distractor Explanation:** Choice A is incorrect as this is moving the line to the right 1 unit and up by 1 unit. Choice B is incorrect as this is moving the line only up by one unit and not moving it to the left. Choice C is incorrect as this answer may be due to a conceptual issue.

18. **Level:** Medium | **Domain:** ADVANCED MATH

**Skill/Knowledge:** Nonlinear equation in one variable and systems of equations in two variables  
**Testing point:** Finding the vertex of a parabola

**Key Explanation:** Choice D is correct. The standard form of a parabola is represented by the equation  $y = ax^2 + bx + c$ . In the equation given,  $a = 2$ ,  $b = 8$ , and  $c = 12$ . The  $x$  coordinate of the vertex is found using the formula  $\left(\frac{-b}{2a}\right)$ . Thus,  $\left(\frac{-8}{2(2)}\right) = -2$

**Distractor Explanation:** Choice A is incorrect as this is the product of the solutions to the quadratic equation. Choice B is incorrect as this is the sum of the solutions to the quadratic equation. Choice C is incorrect and is found by incorrectly using

$$\left(\frac{b}{a}\right).$$

19. **Level:** Easy | **Domain:** ADVANCED MATH  
**Skill/Knowledge:** Equivalent expressions | **Testing point:** Long division and remainder theorem

**Key Explanation:** B is the remainder when  $x^2 - 6x + 10$  is divided by  $x + 2$ . When the divisor is equated to 0, we find  $x = -2$ , we can then find the remainder by substitute  $-2$  in place of  $x$   
 $(-2^2 - 6(-2) + 10)$  which yields 26, this is the value of B.

20. **Level:** Easy | **Domain:** GEOMETRY AND TRIGONOMETRY  
**Skill/Knowledge:** Lines, angles, and triangles | **Testing point:** The pythagorean theorem

**Key Explanation:** Choice B is correct. The Pythagorean theorem states that the sum of the squares of the lengths of the sides of a right triangle is equal to the square of the length of the hypotenuse of the triangle, or  $a^2 + b^2 = c$ . Plugging in 11 for  $a$  and 61 for  $c$  yields  $11^2 + b^2 = 61^2$

$$b^2 = 61^2 - 11^2$$

$$b^2 = 3,721 - 121$$

$$b^2 = 3,600$$

Therefore,  $b = 60$ .

**Distractor Explanation:** Choices A and D are incorrect and may be due to conceptual or calculation errors. Choice C is incorrect and can be found by adding  $61^2 + 11^2$  and finding the square root instead of subtracting the two numbers.

21. **Level:** Easy | **Domain:** PROBLEM-SOLVING AND DATA ANALYSIS

**Skill/Knowledge:** Evaluating statistical claims: observational studies, and experiments |

**Testing point:** Observational experiments

**Key Explanation:** Choice D is correct. This statement is true because it is not certain that taking supplements would directly equate to an improvement in student performance. It is not known if all other variables were kept constant. Therefore, a direct cause-and-effect relationship cannot be determined. Also, the sample size is too small to generalize to a larger population.

**Distractor Explanation:** Choices A, B, and C are incorrect. These statements are false and imply that there is a relationship between student performance and taking supplements.

22. **Level:** Easy | **Domain:** ALGEBRA  
**Skill/Knowledge:** Systems of two linear equations in two variables | **Testing point:** Solving for system of linear equations

**Key Explanation:** Choice A is correct. The most efficient way to answer this question is to not solve the system of equations for  $x$  and  $y$  individually, but rather to subtract the second equation from the first, yielding  $-x + y = -5$ . Therefore  $y - x = -5$ .

**Distractor Explanation:** Choice B is incorrect. This is the negative value of option A and is due to a calculation mistake. Choice C is incorrect. This is the value of  $y$ . Choice D is incorrect. This is the value of  $x$ .