

1. **Level:** Easy | **Domain:** ADVANCED MATH
Skill/Knowledge: Nonlinear functions | **Testing point:** Writing exponential function equation from data

Key Explanation: Choice A is correct. The initial value of the land is \$47,890, which increases by 2% every year. This suggests that the function is exponential growth. The exponential growth formula is $f(x) = a(1 + r)^x$ where a is the initial value, r is the growth rate and x is the time. In this situation, $a = 47,890$, $r = 0.02$, and $x = t$. Substituting these values to the formula yields $f(x) = 47,890(1.02)^t$. Making A the correct option.

Distractor Explanations: Choices B and D are incorrect. These options are linear functions, however, the model equation in the question is exponential. Choice C is incorrect. This is a decreasing exponential function since the factor 0.98 is less than 1.

2. **Level:** Medium | **Domain:** ALGEBRA
Skill/Knowledge: Linear equations in one variable
Testing point: Matching coefficients

Key Explanation: Choice C is correct. Grouping the left side of the equation yields $(ax + bx) + (a - b) = 5x - 2$. Factoring out x from the first group yields $x(a + b) + (a - b) = 5x - 2$. Matching coefficients and constants on both sides of the equation yields $(a + b) = 5$ and $(a - b) = -2$. Factoring the given expression $(a^2 - b^2)$ yields $a^2 - b^2 = (a + b)(a - b)$. Substituting the values of $(a + b)$ and $(a - b)$ yields $a^2 - b^2 = (5)(-2) = -10$.

Distractor Explanations: Choice A is incorrect. This is the value of $(a + b) + (a - b)$.
 Choice B is incorrect. This is the value of $a + b$.
 Choice D is incorrect. This is the value of $a - b$.

3. **Level:** Medium | **Domain:** ADVANCED MATH
Skill/Knowledge: Nonlinear functions
Testing point: Solving for a quadratic equation using the quadratic formula

Key Explanation: To solve for this quadratic equation, use the quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a},$$

where $a = 3$, $b = -6$ and $c = -21$.

Substituting the given values yields

$$x = \frac{-(-6) \pm \sqrt{(-6)^2 - 4(3)(-21)}}{2(3)} \text{ or } x = \frac{6 \pm \sqrt{288}}{6}.$$

Simplifying the equation yields $x = 1 \pm \frac{12\sqrt{2}}{6}$ or

$$x = 1 \pm 2\sqrt{2}.$$

Matching the two expressions yields

$$1 \pm 2\sqrt{2} = 1 + 2\sqrt{k}. \text{ Therefore, } k = 2.$$

4. **Level:** Easy | **Domain:** GEOMETRY AND TRIGONOMETRY
Skill/Knowledge: Area and volume | **Testing point:** Finding the area of a rectangle

Key Explanation: Choice D is correct. The length of the rectangle is $(x - 6)$ and the width is x . The area of a rectangle is given by length $\times$ width which is $x(x - 6) = 27$.

Using distributive property yields $x^2 - 6x = 27$.

Subtracting 27 from both sides of the equation yields $x^2 - 6x - 27 = 0$. Solve the quadratic equation either by using the quadratic formula or by using the factor method.

Factoring $x^2 - 6x - 27 = 0$ yields $(x + 3)(x - 9) = 0$.

Equating $(x + 3)$ to zero yields $x + 3 = 0$ or $x = -3$.

Equating $(x - 9)$ to zero yields $x - 9 = 0$ or $x = 9$.

Since the width cannot be negative, the width would therefore be 9. Solving for the length of the rectangle yields $9 - 6 = 3$.

Distractor Explanations: **Choice A** is incorrect. This is the value of x or the width of the rectangle.
Choice B is incorrect and may result from a conceptual or calculation error.
Choice C is incorrect. This is the difference between the length and the width of the rectangle.

5. **Level:** Easy | **Domain:** ALGEBRA
Skill/Knowledge: Linear equations in one variable
Testing point: Solving for x in a linear equation

Key Explanation: **Choice A** is correct. Solve for x first in the given equation $7x + 14 = 7$. Subtracting 14 from both sides of the equation yields $7x = 7 - 14$ or $7x = -7$. Dividing both sides of the equation by 7 yields $x = -1$. The equivalent equation will also have the same value of x . Solve the value of x in choice A by subtracting 6 from both sides of the equation which yields $3x = 3 - 6$ or $3x = -3$. Dividing both sides of the equation by 3 yields $x = -1$. Therefore, $3x + 6 = 3$ is equal to $7x + 14 = 7$.

Distractor Explanations: **Choices B** and **C** are incorrect. Solving the value of x from both equations yields $x = 3$. **Choice D** is incorrect. Solving the value of x from $7x = 7$ yields $x = 1$.

6. **Level:** Hard | **Domain:** ALGEBRA
Skill/Knowledge: Linear inequalities in one or two variables | **Testing point:** Solving absolute value inequalities

Key Explanation: To solve for the values of x , make two inequalities of absolute value for the positive and negative values.

$$\begin{aligned} +|x+3| &< +7 & -|x+3| &< +7 \\ x+3 &< 7 & -x-3 &< 7 \\ x+3-3 &< 7-3 & -x-3+3 &< 7+3 \\ x &< 4 & -x &< 10, \text{ divide both sides by } -1 \end{aligned}$$

$$x > -10$$

Hence, $-10 < x < 4$. The integers between -10 and 4 are $-9, -8, -7, -6, -5, -4, -3, -2, -1, 0, 1, 2$ and 3 .

Therefore, there are 13 integer solutions in the given inequality.

7. **Level:** Easy | **Domain:** ADVANCED MATH
Skill/Knowledge: Nonlinear functions | **Testing point:** Finding a value of an exponential function

Key Explanation: **Choice A** is correct.

Substituting $\frac{1}{3}$ to the given equation yields

$$p\left(\frac{1}{3}\right) = \left\{\frac{1}{8}\right\}^{\frac{-1}{3}} = 8^{\frac{1}{3}} = \sqrt[3]{8} = 2$$

$$\text{Therefore, } p\left(\frac{1}{3}\right) = 2.$$

Distractor Explanations: **Choice B** is incorrect. This option may be a result of finding $p(3)$. **Choice C** is incorrect and may result from solving the value of $p\left(-\frac{1}{3}\right)$. **Choice D** is incorrect. This option may be a result of finding $p(-3)$.

8. **Level:** Medium | **Domain:** ADVANCED MATH
Skill/Knowledge: Nonlinear functions | **Testing point:** Using the factor theorem

Key Explanation: **Choice C** is correct. Factor theorem states that if $f(a) = 0$, then $x - a$ is a factor of $f(x)$. In **Choice C**, $a = 2$. Substituting 2 to the given equation yields $f(2) = 6(2)^2 - 17(2) + 10$. Using distributive property yields $f(2) = 24 - 34 + 10$ or $f(2) = 0$. This means that $x - 2$ is a factor of $f(x)$.

Distractor Explanations: **Choice A** is incorrect.

Substituting $-\frac{5}{6}$ to the given equation yields

$$f\left(-\frac{5}{6}\right) = 6\left(-\frac{5}{6}\right)^2 - 17\left(-\frac{5}{6}\right) + 10 = \frac{25}{6} + \frac{85}{3}$$

Choice B is incorrect. Substituting -5 to the given equation yields 245. **Choice D** is incorrect. Substituting 5 to the given equation yields 75.

9. **Level:** Easy | **Domain:** PROBLEM-SOLVING AND DATA ANALYTICS

Skill/Knowledge: One-variable data: distributions and measures of center and spread | **Testing point:** Interpreting box and whisker plots

Key Explanation: **Choice D** is correct. The median in a box and whisker plot is represented by the line in the box (interquartile range). From the above, data set A has a median of data set B has a greater median compared to data set A.

Distractor Explanations: **Choice A** and **Choice B** are incorrect. The mean and number of data or frequency cannot be found from a box and whisker plot representation. **Choice C** is incorrect. This statement is false.

10. **Level:** Easy | **Domain:** ADVANCED MATH
Skill/Knowledge: Nonlinear equations in one variable and systems of equations in two variables
Testing point: Finding the vertex of a parabola through a transformation

Key Explanation: The vertex of $f(x)$ is $(-2, 5)$. Translating the parabola 3 units to the left and 1 unit up would result in $(-5, 6)$, which is the vertex of $g(x)$. Therefore, the value of h is -5 .

11. **Level:** Easy | **Domain:** PROBLEM-SOLVING AND DATA ANALYSIS
Skill/Knowledge: Two-variable data: models and scatterplots | **Testing point:** Using the line of best fit

Key Explanation: **Choice C** is correct. The points above the line of best fit have a higher value than the values predicted by the line of best fit. There are 6 points above the line.

Distractor Explanations: **Choice A** is incorrect and may result from counting the total points in the scatter plot. **Choice B** is incorrect and may result from counting the points below the line. **Choice D** is incorrect. This option may result from conceptual errors.

12. **Level:** Easy | **Domain:** ADVANCED MATH
Skill/Knowledge: Equivalent expressions | **Testing point:** Using the difference of two squared with binomial expressions

Key Explanation: **Choice D** is correct. Rewriting the expression $(x + \sqrt{2})^2(x - \sqrt{2})^2$ yields $\left[(x + \sqrt{2})(x - \sqrt{2})\right]^2$.

Using $(a + b)(a - b) = a^2 - b^2$ yields $\left[(x + \sqrt{2})(x - \sqrt{2})\right]^2 = (x^2 - (\sqrt{2})^2)^2$. Simplifying the radicals yields $(x^2 - 2)^2$. Expanding the expression yields $x^4 - 4x^2 + 4$.

Distractor Explanations: **Choices A, B, and C** are incorrect and may result from a conceptual or calculation error

13. **Level:** Easy | **Domain:** ALGEBRA
Skill/Knowledge: Linear functions | **Testing point:** Finding the equation of a line from a graph

Key Explanation: **Choice A** is correct. The graph decreases from left to right. This means that the line has a negative slope. Looking at the choices, only **Choice A** has a negative slope of -4.85 . Therefore, $y = 231 - 4.85x$ is the equation of the graph.

Distractor Explanations: Choices B, C, and D are incorrect. These equations have positive values of slopes.

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

Skill/Knowledge: Percentages | **Testing point:** Using proportions and percentages

Key Explanation:

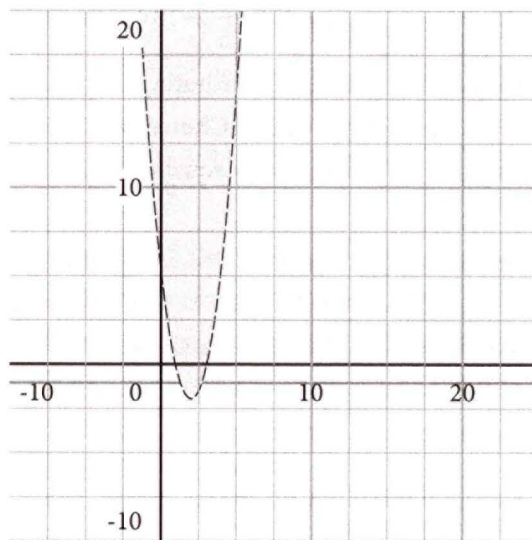
	Girls	Boys
On the track team	6	$\frac{3}{5} \times 20 = 12$
Not on the track team	$\frac{3}{4} \times 24 = 18$	8
	24	20

From the table, the number of students on the track team would be $6 + 12 = 18$ out of the 44 students. In percentage form this would be

$\frac{18}{44} \times 100 = 40.909\%$ or 41% rounded off to the nearest whole number.

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

Key Explanation: Choice D is correct. The inequality $y > 2(x - 2)^2 - 2$ has a graph of parabola. This means that it is in the form $y > a(x - h)^2 + k$ where (h, k) is the vertex. Hence, the vertex is at $(2, -2)$. Since the value a is positive, the parabola opens upwards. This means that the lowest point of the graph is the vertex. Hence, the value of y must be greater than -2 .



However, the second inequality states that $y \geq -1$, making -1 the least value of y .

Distractor Explanations: Choices A and C are incorrect. These are solutions to the system. However, they are not the least value of y . Choice B is incorrect. The option is not part of the solutions of the system.

16. **Level:** Hard | **Domain:** ADVANCED MATH
Skill/Knowledge: Equivalent expressions |
Testing point: Factoring a quadratic

Key Explanation: Choice A is correct. Adding 98 to both sides of the equation yields $2x^2 + 28x + 98 = 0$. Factoring out 2 yields $2(x^2 + 14x + 49) = 0$. Using the model $(a + b)^2 = a^2 + 2ab + b^2$, the expression $(x^2 + 14x + 49)$ can be written as $(x + 7)^2$. Hence, the equation becomes $2(x + 7)^2 = 0$. Therefore, only equation 1 is equal to the given equation.

Distractor Explanations: Choices B and C are incorrect. This is because equation two is not equivalent to the given equation. Choice D is incorrect. This is because only equation 2 is not equivalent and not both of them.

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

Skill/Knowledge: Systems of two linear equations in two variables | **Testing point:** Solving simultaneous equations

Key Explanation: The system of equations above can be solved either by substitution or elimination. Using elimination method, the 1st equation is multiplied by 2 which yields $2(3y - 2x = 6)$ or $6y - 4x = 12$.

Subtract the two equations yields $y = 4$.

Substituting the value of y to the first equation yields $3(4) - 2x = 6$ or $12 - 2x = 6$.

Adding $2x$ and subtracting 6 from both sides of the equation yields $12 - 6 = 2x$ or $6 = 2x$.

Dividing both sides of the equation by 2 yields $3 = x$ or $x = 3$.

Therefore, $2x + y$ is $2(3) + 4 = 6 + 4 = 10$.

18. **Level :** Medium | **Domain:** PROBLEM SOLVING AND DATA ANALYSIS

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

Key Explanation: Choice B is correct. From the survey, $\frac{53}{97}$ of the students surveyed are in favor of changing the school uniform. This means that $97 - 53 = 44$ or 44 of 97 students are not in favor of changing the school uniform. To approximate the number of students in school that are not in favor of the change would be $\frac{44}{97} \times 2,300 = 1,043$.

Distractor Explanations: Choice A is incorrect. This would be the approximate number of students in school that are in favor of the change in uniform. Choice C is incorrect. This is the total number of students in the school. Choice D is incorrect. This option may result from miscalculation or conceptual error.

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

Skill/Knowledge: Systems of two linear equations in two variables | **Testing point:** Working with systems of linear equations with no solution

Key Explanation: Choice B is correct. A system of equations with no solutions means that the lines are parallel. They have the same slope but different y intercepts. Using distributive property yields

$$3x + 5 - \frac{8}{3}x - 8 = px + 4$$

Simplifying the left side of the equation yields

$$\frac{1}{3}x - 3 = px + 4. \text{ Matching the coefficients of } x \text{ yields } p = \frac{1}{3}.$$

Distractor Explanations: Choices A, C and D are incorrect. These options would result in having a system of equations with one solution.

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

Skill/Knowledge: Linear equations in two variables | **Testing point:** Solving a system of equations with Infinite solutions

Key Explanation: A system of equations with infinite solutions are equations of the same line and have both the same slope and y -intercept. Using distributive property yields $5x - 10 + x + 3 = kx - 2k + 2x + 1$.

Combining and grouping like terms yields $6x - 7 = (kx + 2x) + (-2k + 1)$.

Matching the constants yields $-7 = -2k + 1$.

Adding 7 and $2k$ to both sides of the equation yields $2k = 8$.

Dividing both sides of the equation by 2 yields $k = 4$.

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

Skill/Knowledge: Lines, angles, and triangles |

Testing point: Working with inscribed shapes and special triangles

Key Explanation: Choice D is correct. The diameter of the circle is equal to the diagonal length of the square. The diameter is $12 \times 2 = 24$ cm, which means that the diagonal of the square is also 24. And since the diagonal length is equal to $s\sqrt{2}$ where s is the side length of the square, then $s\sqrt{2} = 24$. Solving for s by dividing both sides of the equation by $\sqrt{2}$ yields

$s = \frac{24}{\sqrt{2}}$ Rationalizing the denominator yields

$$s = \frac{24}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{24\sqrt{2}}{2} = 12\sqrt{2} . \text{ Therefore, } s = 12\sqrt{2}$$

Distractor Explanations: Choice A is incorrect. This is the value of the diameter of the circle.

Choice B is incorrect. This is the value of the radius of the circle. Choice C is incorrect. This option would be a result of misconception and conceptual error.

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

Skill/Knowledge: Linear equations in two variables | **Testing point:** Determining the equation of a line from data

Key Explanation: Choice B is correct. The value is constant for all values of x given; thus the equation of the line would be $y = 4$. Substituting the value of y to the given equation yields $4 = 2k$. Dividing both sides of the equation by 2 yields $2 = k$ or $k = 2$.

Distractor Explanations: Choice A is incorrect. This is the value of the constant $2k$. Choices C

and D are incorrect. These options may be due to conceptual and miscalculation errors.