II. Algebra

1. **Patterns and Modeling:**
   a. Patterns in numeric, geometric, or tabular form
   b. Symbolic notation
   c. Patterns created by functions
   d. Iterative and recursive functional relationships
   e. Pascal's triangle and binomial theorem
   f. Finite and infinite sequences and series

2. **Functions and Relations:**
   a. Differences between functions and relations
   b. Multiple forms of functions
   c. Properties of functions and relations
   d. Piecewise, composite, and inverse functions
   e. Graphs of functions and their transformations

3. **Linear Functions and Relations:**
   a. Linear models and rates of change
   b. Direct variation
   c. Graphs of linear functions
   d. Slopes and intercepts of lines
   e. Equations of lines and inequalities
   f. Expressions involving absolute value
   g. Solve problems involving linear functions and systems.

II. Algebra cont.

4. **Application of linear and abstract algebra:**
   a. Properties of matrices and determinants
   b. Solving linear systems using matrices
   c. Geometric and algebraic properties of vectors
   d. Properties of vector spaces
   e. Matrix representation of linear transformation
   f. Definitions and properties of groups, rings, and fields

5. **Quadratic Functions and Relations:**
   a. Simplification of quadratic expressions
   b. Solving quadratic equations and inequalities
   c. Real and complex roots of quadratic equations
   d. Graphs of quadratic equations
   e. Graphical and symbolic representation of quadratic functions
   f. Maximum and minimum problems
   g. Modeling with quadratic relations, functions, and systems

6. **Polynomial, Rational, Radical, and Absolute Value Functions and Relations:**
   a. Inverse and joint variations
   b. Zeros of polynomial functions
   c. Simplifying polynomial and rational expressions
   d. Horizontal, vertical, and slant asymptotes
   e. Solving problems involving polynomial, rational, radical, absolute value, and step functions

GRADE 9-12 – 25 QUESTIONS

7. **Logarithmic and Exponential Functions and Relations:**
   a. Simplifying logarithmic and exponential expressions
   b. Properties of logarithmic and exponential functions
   c. Applications involving exponential growth, decay, and compound interest
   d. Inverse relationships between logarithmic and exponential functions

II. Algebra

1. **Patterns and Modeling:**
   a. Patterns in numeric, geometric, or tabular form
   b. Symbolic notation
   c. Patterns created by functions
   d. Finite and infinite sequences and series

2. **Expressions:**
   a. Concept of a variable
   b. Evaluating expressions
   c. Relationship between computational algorithms and algebraic processes
   d. Express direct and inverse relationships algebraically
   e. Expressing one variable in terms of another
   f. Manipulating and simplifying algebraic expressions
   g. Solving equations
   h. Modeling with algebraic expressions

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II. Algebra cont.

3. **Functions and Relations:**
   a. Differences between functions and relations
   b. Multiple forms of functions
   c. Generating and interpreting graphs
   d. Properties of functions and relations
   e. Piecewise and composite functions
   f. Graphs of functions and their transformation

4. **Linear Functions and Relations:**
   a. Relationships between linear models and rate of change
   b. Direct variation
   c. Graphs of linear equations
   d. Slope and intercepts of lines
   e. Equation of a line
   f. Systems of linear equations and inequalities
   g. Modeling using linear functions and systems

5. **Quadratic Functions and Relations:**
   a. Solving quadratic equations and inequalities
   b. Real and complex roots of quadratic equations
   c. Graphs of quadratic equations
   d. Maximum and minimum problems
   e. Modeling with quadratic relations, functions, and systems

6. **Polynomial, Rational, Exponential, and Absolute Value Functions and Relations:**
   a. Exponential growth and decay
   b. Inverse variation
   c. Modeling using rational functions
   d. Properties of polynomial, rational, and absolute value

GRADE 3-8 - 22 QUESTIONS

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II. Algebra cont.

   e. Numerical solutions to exponential, polynomial, rational, and absolute value functions

Q. NO 1

Choice D is correct. To find the slope and y-intercept, the given equation can be rewritten in slope-intercept form $y = mx + b$, where m represents the slope of the line and b represents the y-intercept. The given equation $2y - 3x = -4$ can be rewritten in slope-intercept form by first adding $3x$ to both sides of the equation, which yields $2y = 3x - 4$. Then, dividing both sides of the equation by 2 results in the equation $y = \frac{3}{2}x - 2$. The coefficient of x, $\frac{3}{2}$, is the slope of the graph and is positive, and the constant term, -2, is the y-intercept of the graph and is negative. Thus, the graph of the equation $2y - 3x = -4$ has a positive slope and a negative y-intercept.

Choice A is incorrect and may result from reversing the values of the slope and the y-intercept. Choices B and C are incorrect and may result from errors in calculation when determining the slope and y-intercept values.

Q. NO 2

Choice C is correct. Since the variable h represents the number of hours a job took, the coefficient of h, 75, represents the electrician's charge per hour, in dollars, after an initial fixed charge of \$125. It's given that the electrician worked 2 hours longer on Ms. Sanchez's job than on Mr. Roland's job; therefore, the additional charge for Ms. Sanchez's job is $\$75 \times 2 = \$150$.

Alternate approach: The amounts the electrician charged for Mr. Roland's job and Ms. Sanchez's job can be expressed in terms of t. If Mr. Roland's job took t hours, then it cost $75t + 125$ dollars. Ms. Sanchez's job must then have taken $t + 2$ hours, so it cost $75(t + 2) + 125 = 75t + 275$ dollars. The difference between the two costs is $(75t + 275) - (75t + 125) = \$150$.

Choice A is incorrect. This is the electrician's charge per hour, not the difference between what Ms. Sanchez was charged and what Mr. Roland was charged. Choice B is incorrect. This is the fixed charge for each job, not the difference between the two. Choice D is incorrect and may result from finding the total charge for a 2-hour job.

Q. NO 3

Choice C is correct. Applying the distributive property of multiplication to the right-hand side of the given equation gives $(3x + 15) + (5x - 5)$, or $8x + 10$. An equation in the form $cx + d = rx + s$ will have no solutions if $c = r$ and $d \neq s$. Therefore, it follows that the equation $2ax - 15 = 8x + 10$ will have no solutions if $2a = 8$, or $a = 4$.

Choice A is incorrect. If $a = 1$, then the given equation could be written as $2x - 15 = 8x + 10$. Since $2 \neq 8$, this equation has exactly one solution. Choice B is incorrect. If $a = 2$, then the given equation could be written as $4x - 15 = 8x + 10$. Since $4 \neq 8$, this equation has exactly one solution. Choice D is incorrect. If $a = 8$, then the given equation could be written as $16x - 15 = 8x + 10$. Since $16 \neq 8$, this equation has exactly one solution.

Q. NO 4

Choice B is correct. A solution to the system of three equations is any ordered pair (x, y) that is a solution to each of the three equations. Such an ordered pair (x, y) must lie on the graph of each equation in the xy-plane; in other words, it must be a point where all three graphs intersect. The graphs of all three equations intersect at exactly one point, $(-1, 3)$. Therefore, the system of equations has one solution.

Choice A is incorrect. A system of equations has no solutions when there is no point at which all the graphs intersect. Because the graphs of all three equations intersect at the point $(-1, 3)$, there is a solution. Choice C is incorrect. The graphs of all three equations intersect at only one point, $(-1, 3)$. Since there is no other such point, there cannot be two solutions. Choice D is incorrect and may result from counting the number of points of intersection of the graphs of any two equations, including the point of intersection of all three equations.

Q. NO 5

Choice A is correct. The equation of a parabola in vertex form is $f(x) = a(x - h)^2 + k$, where the point (h, k) is the vertex of the parabola and a is a constant. The graph shows that the coordinates of the vertex are (3, 1), so $h = 3$ and $k = 1$. Therefore, an equation that defines f can be written as $f(x) = a(x - 3)^2 + 1$. To find a, substitute a value for x and its corresponding value for y, or $f(x)$. For example, (4, 5) is a point on the graph of f. So a must satisfy the equation $5 = a(4 - 3)^2 + 1$, which can be rewritten as $4 = a(1)^2$, or $a = 4$. An equation that defines f is therefore $f(x) = 4(x - 3)^2 + 1$.

Choice B is incorrect and may result from a sign error when writing the equation of the parabola in vertex form. Choice C is incorrect and may result from omitting the constant a from the vertex form of the equation of the parabola. Choice D is incorrect and may result from a sign error when writing the equation of the parabola in vertex form as well as by miscalculating the value of a.

Q. NO 6

Choice B is correct. The solutions of the first inequality, $y \geq x + 2$, lie on or above the line $y = x + 2$, which is the line that passes through $(-2, 0)$ and $(0, 2)$. The second inequality can be rewritten in slope-intercept form by dividing the second inequality, $2x + 3y \leq 6$, by 3 on both sides, which yields $\frac{2}{3}x + y \leq 2$, and then subtracting $\frac{2}{3}x$ from both sides, which yields $y \leq -\frac{2}{3}x + 2$. The solutions to this inequality lie on or below the line $y = -\frac{2}{3}x + 2$, which is the line that passes through $(0, 2)$ and $(3, 0)$. The only graph in which the shaded region meets these criteria is choice B.

Choice A is incorrect and may result from reversing the inequality sign in the first inequality. Choice C is incorrect and may result from reversing the inequality sign in the second inequality. Choice D is incorrect and may result from reversing the inequality signs in both inequalities.

Q. NO 7

Choice B is correct. Squaring both sides of the given equation yields $x + 2 = x^2$. Subtracting x and 2 from both sides of $x + 2 = x^2$ yields $x^2 - x - 2 = 0$. Factoring the left-hand side of this equation yields $(x - 2)(x + 1) = 0$. Applying the zero product property, the solutions to $(x - 2)(x + 1) = 0$ are $x - 2 = 0$, or $x = 2$ and $x + 1 = 0$, or $x = -1$. Substituting $x = 2$ in the given equation gives $\sqrt{4} = -2$, which is false because $\sqrt{4} = 2$ by the definition of a principal square root. So, $x = 2$ isn't a solution. Substituting $x = -1$ into the given equation gives $\sqrt{1} = -(-1)$, which is true because $-(-1) = 1$. So $x = -1$ is the only solution.

Choices A and C are incorrect. The square root symbol represents the principal, or nonnegative, square root. Therefore, in the equation $\sqrt{x + 2} = -x$, the value of $-x$ must be zero or positive. If $x = 2$, then $-x = -2$, which is negative, so 2 can't be in the set of solutions. Choice D is incorrect and may result from incorrectly reasoning that $-x$ always has a negative value and therefore can't be equal to a value of a principal square root, which cannot be negative.

Q. NO 8

The correct answer is 8. The graph shows that the maximum value of $f(x)$ is 2. Since $g(x) = f(x) + 6$, the graph of g is the graph of f shifted up by 6 units. Therefore, the maximum value of $g(x)$ is $2 + 6 = 8$.

Q. NO 9

The correct answer is 2.5. The graph of the linear function f passes through the points (0, 3) and (1, 1). The slope of the graph of the function f is therefore $\frac{1-3}{1-0} = -2$. It's given that the graph of the linear function g is perpendicular to the graph of the function f. Therefore, the slope of the graph of the function g is the negative reciprocal of -2, which is $-\frac{1}{-2} = \frac{1}{2}$, and an equation that defines the function g is $g(x) = \frac{1}{2}x + b$, where b is a constant. Since it's given that the graph of the function g passes through the point (1, 3), the value of b can be found using the equation $3 = \frac{1}{2}(1) + b$. Solving this equation for b yields $b = \frac{5}{2}$, so an equation that defines the function g is $g(x) = \frac{1}{2}x + \frac{5}{2}$. Finding the value of $g(0)$ by substituting 0 for x into this equation yields $g(0) = \frac{1}{2}(0) + \frac{5}{2}$, or $\frac{5}{2}$. Either 2.5 or 5/2 may be entered as the correct answer.

Q. NO 10

Choice A is correct. The cost of each additional mile traveled is represented by the slope of the given line. The slope of the line can be calculated by identifying two points on the line and then calculating the ratio of the change in *y* to the change in *x* between the two points. Using the points (1, 5) and (2, 7), the slope is equal to $\frac{7-5}{2-1}$, or 2. Therefore, the cost for each additional mile traveled of the cab ride is \$2.00.

Choice B is incorrect and may result from calculating the slope of the line that passes through the points (5, 13) and (0, 0). However, (0, 0) does not lie on the line shown. Choice C is incorrect. This is the *y*-coordinate of the *y*-intercept of the graph and represents the flat fee for a cab ride before the charge for any miles traveled is added. Choice D is incorrect. This value represents the total cost of a 1-mile cab ride.

Choice D is correct. The slope-intercept form of a linear equation is $y = ax + b$, where a is the slope of the graph of the equation and b is the y-coordinate of the y-intercept of the graph. Two ordered pairs (x_1, y_1) and (x_2, y_2) can be used to compute the slope of the line with the formula $a = \frac{y_2 - y_1}{x_2 - x_1}$. Substituting the two ordered pairs (2, 4) and (0, 1) into this formula gives $a = \frac{4 - 1}{2 - 0}$, which simplifies to $\frac{3}{2}$. Substituting this value for a in the slope-intercept form of the equation yields $y = \frac{3}{2}x + b$. Substituting values from the ordered pair (0, 1) into this equation yields $1 = \frac{3}{2}(0) + b$, so $b = 1$. Substituting this value for b in the slope-intercept equation yields $y = \frac{3}{2}x + 1$.

Choice A is incorrect. This may result from misinterpreting the change in x-values as the slope and misinterpreting the change in y-values as the y-coordinate of the y-intercept of the graph. Choice B is incorrect and may result from using the x- and y-values of one of the given points as the slope and y-coordinate of the y-intercept, respectively. Choice C is incorrect. This equation has the correct slope but the incorrect y-coordinate of the y-intercept.

Q. NO 11

Q. NO 12

Choice A is correct. There are 0 calories in 0 servings of Crunchy Grain cereal so the line must begin at the point (0, 0). Point (0, 0) is the origin, labeled O. Additionally, each serving increases the calories by 250. Therefore, the number of calories increases as the number of servings increases, so the line must have a positive slope. Of the choices, only choice A shows a graph with a line that begins at the origin and has a positive slope.

Choices B, C, and D are incorrect. These graphs don't show a line that passes through the origin. Additionally, choices C and D may result from misidentifying the slope of the graph.

Q. NO 13

Choice D is correct. Since the function h is exponential, it can be written as $h(x) = ab^x$, where a is the y-coordinate of the y-intercept and b is the growth rate. Since it's given that the y-coordinate of the y-intercept is d, the exponential function can be written as $h(x) = db^x$. These conditions are only met by the equation in choice D.

Choice A is incorrect. For this function, the value of $h(x)$ when $x = 0$ is -3, not d. Choice B is incorrect. This function is a linear function, not an exponential function. Choice C is incorrect. This function is a polynomial function, not an exponential function.

Q. NO 14

Choice C is correct. Substituting $x + a$ for x in $f(x) = 5x^2 - 3$ yields $f(x + a) = 5(x + a)^2 - 3$. Expanding the expression $5(x + a)^2$ by multiplication yields $5x^2 + 10ax + 5a^2$, and thus $f(x + a) = 5x^2 + 10ax + 5a^2 - 3$. Setting the expression on the right-hand side of this equation equal to the given expression for $f(x + a)$ yields $5x^2 + 30x + 42 = 5x^2 + 10ax + 5a^2 - 3$. Because this equality must be true for all values of x, the coefficients of each power of x are equal. Setting the coefficients of x equal to each other gives $10a = 30$. Dividing each side of this equation by 10 yields $a = 3$.

Choices A, B, and D are incorrect and may result from a calculation error.

Q. NO 15

Choice D is correct. The positive x-intercept of the graph of $y = h(x)$ is a point (x, y) for which $y = 0$. Since $y = h(x)$ models the height above the ground, in feet, of the projectile, a y-value of 0 must correspond to the height of the projectile when it is 0 feet above ground or, in other words, when the projectile is on the ground. Since x represents the time since the projectile was launched, it follows that the positive x-intercept, $(x, 0)$, represents the time at which the projectile hits the ground.

Choice A is incorrect and may result from misidentifying the y-intercept as a positive x-intercept. Choice B is incorrect and may result from misidentifying the y-value of the vertex of the graph of the function as an x-intercept. Choice C is incorrect and may result from misidentifying the x-value of the vertex of the graph of the function as an x-intercept.

Q. NO 16

The correct answer is 2. It's given that line ℓ is perpendicular to the line with equation $y = -\frac{2}{3}x$. Since the equation $y = -\frac{2}{3}x$ is written in slope-intercept form, the slope of the line is $-\frac{2}{3}$. The slope of line ℓ must be the negative reciprocal of $-\frac{2}{3}$, which is $\frac{3}{2}$. It's also given that

the y-coordinate of the y-intercept of line ℓ is -13, so the equation of line ℓ in slope-intercept form is $y = \frac{3}{2}x - 13$. If $y = b$ when $x = 10$, $b = \frac{3}{2}(10) - 13$, which is equivalent to $b = 15 - 13$, or $b = 2$.

Q. NO 17

The correct answer is 1.5. It's given that the system of linear equations has no solutions. Therefore, the lines represented by the two equations are parallel. Each of the equations can be written in slope-intercept form, or $y = mx + b$, where m is the slope of the line and b is the y-coordinate of the line's y-intercept. Subtracting $\frac{3}{4}x$ from both sides of $\frac{3}{4}x - \frac{1}{2}y = 12$ yields $-\frac{1}{2}y = -\frac{3}{4}x + 12$. Dividing both sides of this equation by $-\frac{1}{2}$ yields $y = \frac{-\frac{3}{4}}{-\frac{1}{2}}x + \frac{12}{-\frac{1}{2}}$, or $y = \frac{3}{2}x - 24$. Therefore, the slope of the line represented by the first equation in the system is $\frac{3}{2}$. The second equation in the system can be put into slope-intercept form by first subtracting ax from both sides of $ax - by = 9$, then dividing both sides of the equation by $-b$, which yields $y = \frac{a}{b}x - \frac{9}{b}$. Therefore, the slope of the line represented by the second equation in the system is $\frac{a}{b}$. Parallel lines have equal slopes. Therefore, $\frac{a}{b} = \frac{3}{2}$. Either 3/2 or 1.5 may be entered as the correct answer.

Q. NO 18

ANSWER B

Q. NO 19

ANSWER C

Q. NO 20

ANSWER A

Q. NO 21

ANSWER D

Q. NO 22

ANSWER D

Q. NO 23

ANSWER C

Q. NO 24

ANSWER D

Q. NO 25

ANSWER D