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

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

II. Algebra cont.

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

Q. NO 1

Which of the following statements is true about the graph of the equation $2y - 3x = -4$ in the xy-plane?

A) It has a negative slope and a positive y-intercept.

B) It has a negative slope and a negative y-intercept.

C) It has a positive slope and a positive y-intercept.

D) It has a positive slope and a negative y-intercept.

Q. NO 2

$$C = 75h + 125$$

The equation above gives the amount C, in dollars, an electrician charges for a job that takes h hours. Ms. Sanchez and Mr. Roland each hired this electrician. The electrician worked 2 hours longer on Ms. Sanchez's job than on Mr. Roland's job. How much more did the electrician charge Ms. Sanchez than Mr. Roland?

A) $75

B) $125

C) $150

D) $275

Q. NO 3

$$2ax - 15 = 3(x + 5) + 5(x - 1)$$

In the equation above, a is a constant. If no value of x satisfies the equation, what is the value of a ?

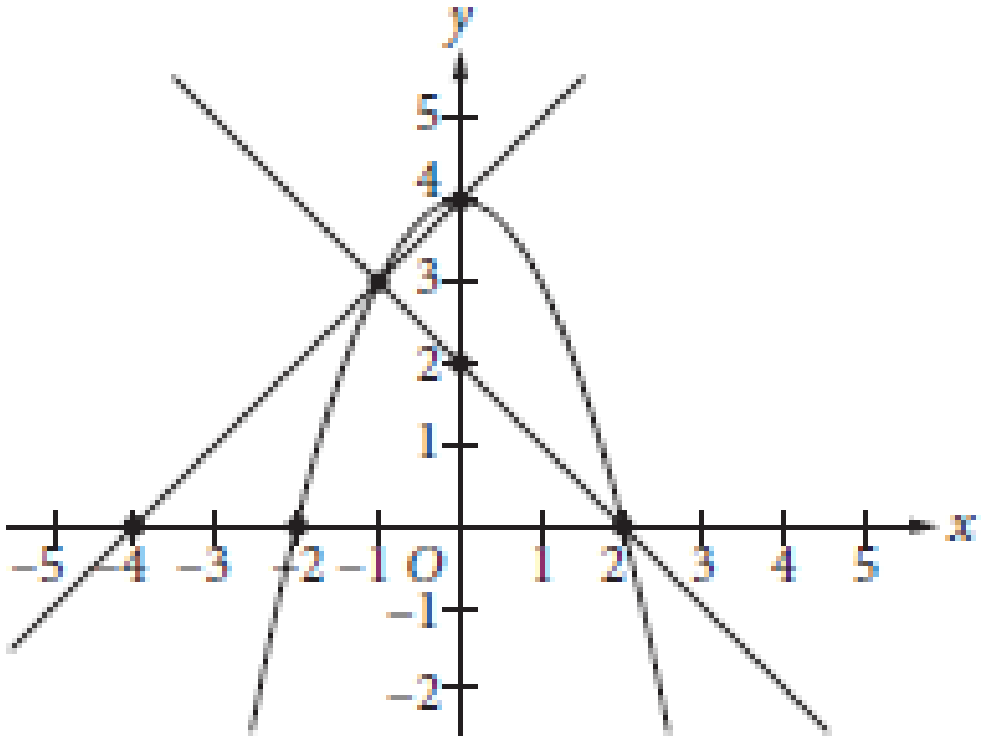
A) 1

B) 2

C) 4

D) 8

Q. NO 4



A system of three equations is graphed in the xy-plane above. How many solutions does the system have?

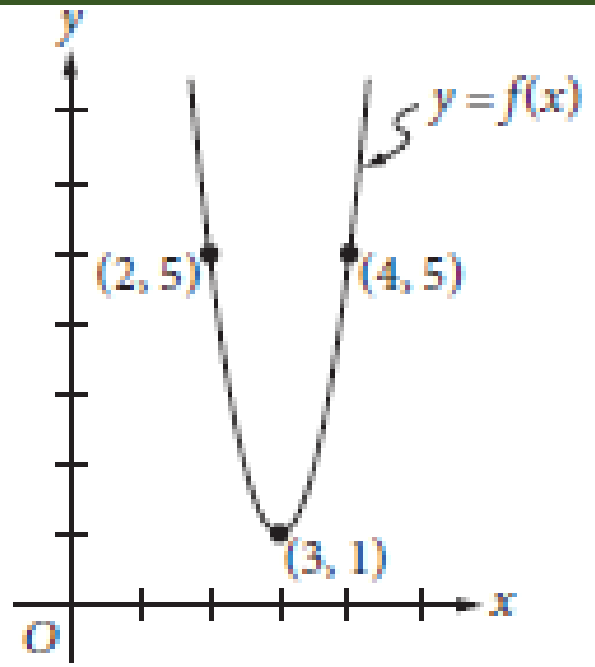
A) None

B) One

C) Two

D) Three

Q. NO 5



The graph of the function f in the xy-plane above is a parabola. Which of the following defines f ?

A) $f(x) = 4(x-3)^2 + 1$

B) $f(x) = 4(x+3)^2 + 1$

C) $f(x) = (x-3)^2 + 1$

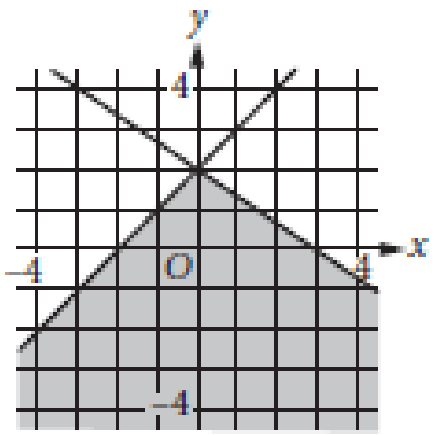
D) $f(x) = 3(x+3)^2 + 1$

Q. NO 6

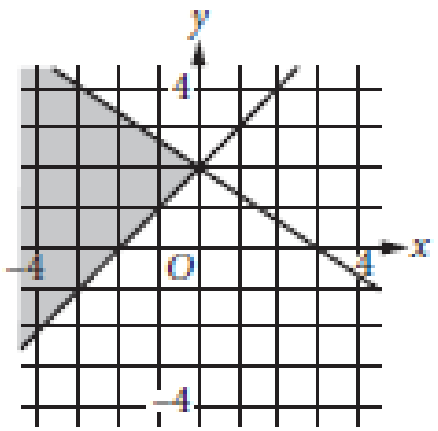
$$y \geq x + 2$$
$$2x + 3y \leq 6$$

In which of the following does the shaded region represent the solution set in the xy-plane to the system of inequalities above?

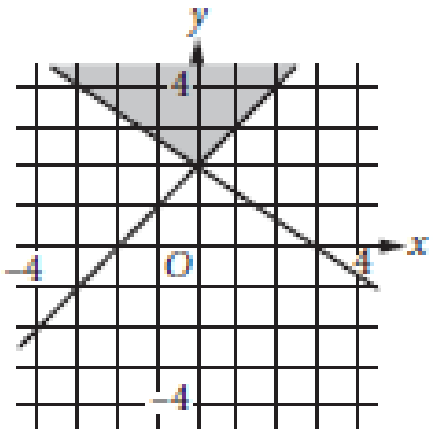
A)



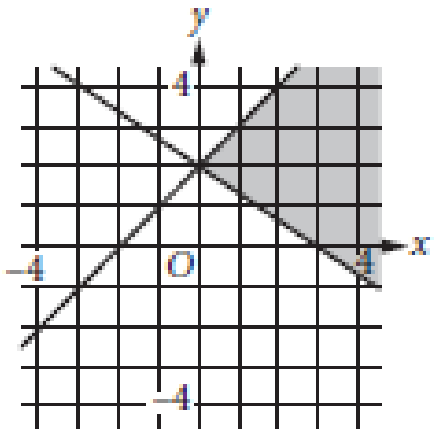
B)



C)



D)



Q. NO 7

What is the set of all solutions to the equation $\sqrt{x+2} = -x$?

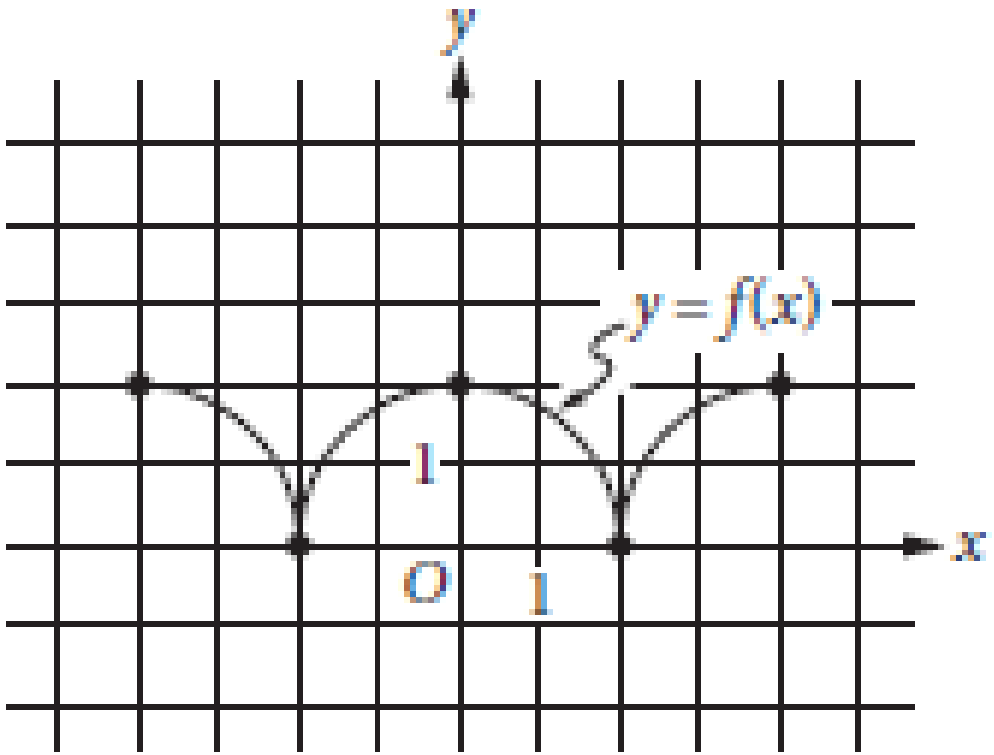
A) $\{-1, 2\}$

B) $\{-1\}$

C) $\{2\}$

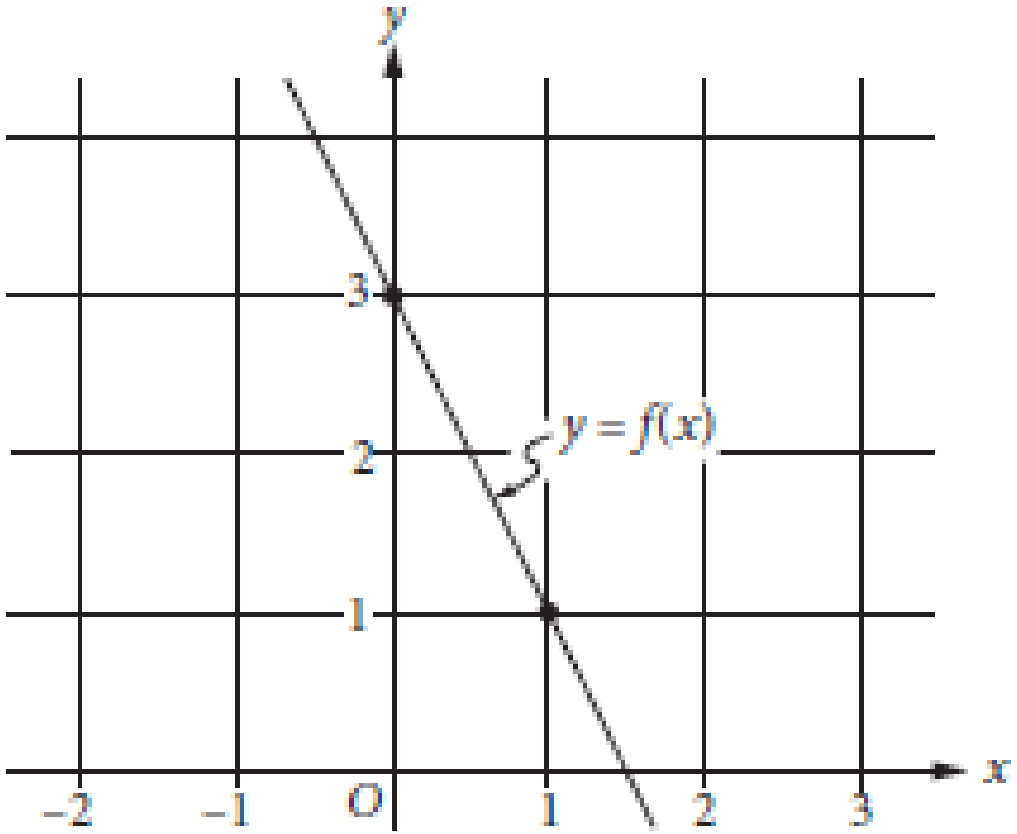
D) There are no solutions to the given equation.

Q. NO 8



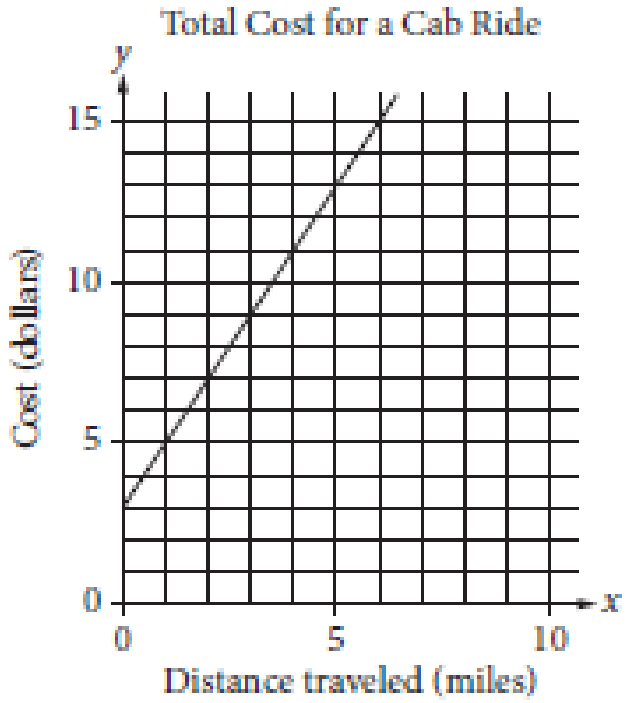
The figure above shows the complete graph of the function f in the xy-plane. The function g (not shown) is defined by $g(x) = f(x) + 6$. What is the maximum value of the function g ?

Q. NO 9



The graph of the linear function f is shown in the xy-plane above. The graph of the linear function g (not shown) is perpendicular to the graph of f and passes through the point $(1, 3)$. What is the value of $g(0)$?

The line graphed in the xy-plane below models the total cost, in dollars, for a cab ride, y, in a certain city during nonpeak hours based on the number of miles traveled, x.



According to the graph, what is the cost for each additional mile traveled, in dollars, of a cab ride?

A) $2.00

B) $2.60

C) $3.00

D) $5.00

Q. NO 10

Q. NO 11

Line m in the xy-plane contains the points $(2, 4)$ and $(0, 1)$. Which of the following is an equation of line m ?

A) $y = 2x + 3$

B) $y = 2x + 4$

C) $y = \frac{3}{2}x + 3$

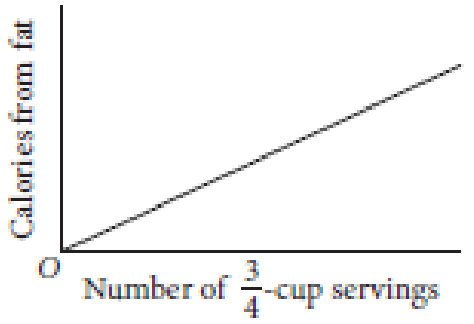
D) $y = \frac{3}{2}x + 1$

Q. NO 12

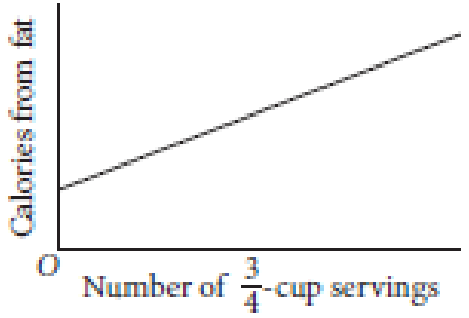
Jennifer bought a box of Crunchy Grain cereal. The nutrition facts on the box state that a serving size of the cereal is $\frac{3}{4}$ cup and provides 210 calories, 50 of which are calories from fat. In addition, each serving of the cereal provides 180 milligrams of potassium, which is 5% of the daily allowance for adults.

Which of the following could be the graph of the number of calories from fat in Crunchy Grain cereal as a function of the number of $\frac{3}{4}$-cup servings of the cereal?

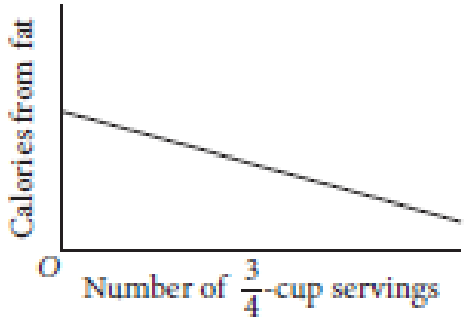
A)



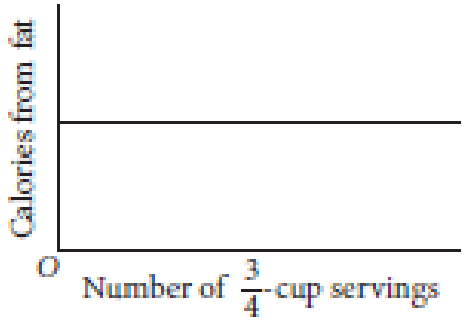
B)



C)



D)



Q. NO 13

The graph of the exponential function h in the xy-plane, where $y = h(x)$, has a y-intercept of d, where d is a positive constant. Which of the following could define the function h ?

A) $h(x) = -3(d)^x$

B) $h(x) = 3(x)\,d$

C) $h(x) = d(-x)^3$

D) $h(x) = d(3)^x$

Q. NO 14

If $f(x) = 5x^2 - 3$ and $f(x + a) = 5x^2 + 30x + 42$, what is the value of a ?

A) -30

B) -3

C) 3

D) 30

Q. NO 15

$$h(x) = -16x^2 + 100x + 10$$

The quadratic function above models the height above the ground h, in feet, of a projectile x seconds after it had been launched vertically. If $y = h(x)$ is graphed in the xy-plane, which of the following represents the real-life meaning of the positive x-intercept of the graph?

A) The initial height of the projectile

B) The maximum height of the projectile

C) The time at which the projectile reaches its maximum height

D) The time at which the projectile hits the ground

Q. NO 16

In the xy-plane, line ℓ has a y-intercept of -13 and is perpendicular to the line with equation $y = -\frac{2}{3}x$. If the point $(10, b)$ is on line ℓ, what is the value of b ?

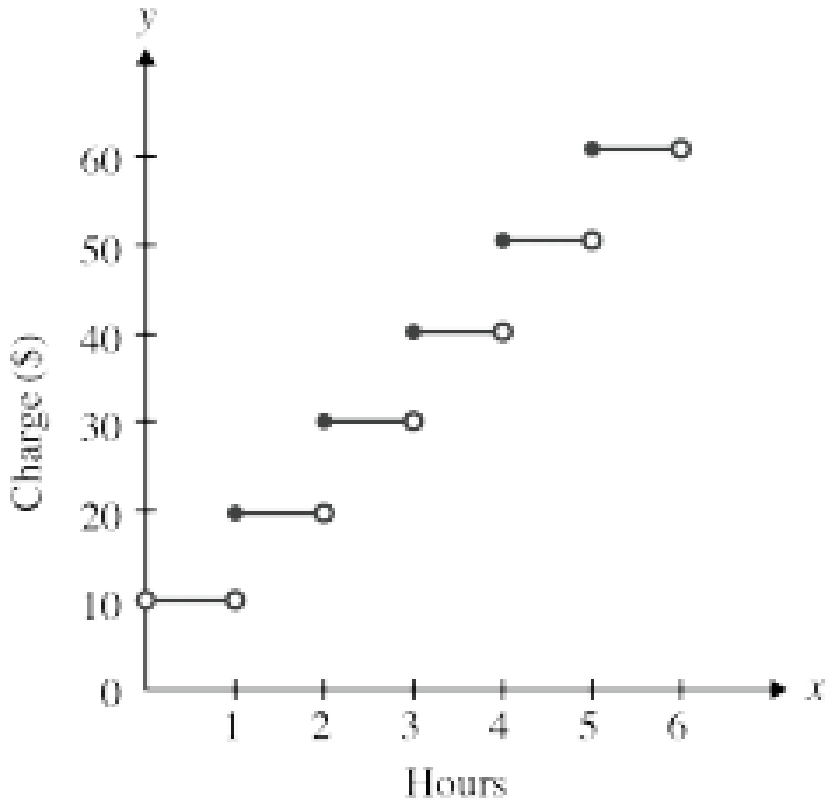
Q. NO 17

$$\frac{3}{4}x - \frac{1}{2}y = 12$$

$$ax - by = 9$$

The system of equations above has no solutions. If a and b are constants, what is the value of $\frac{a}{b}$?

Q. NO 18



. A lawn mowing company charges its customers according to the step function $y = 10\lceil x + 1 \rceil$, for all $x > 0$, as shown in the graph above. If a customer's lawn takes 2 hours and 17 minutes to mow, how much does the company charge?

(A) $32.83

(B) $30.00

(C) $22.83

(D) $22.00

(E) $20.00

Q. NO 19

If $g(x) = f(-x)$ for all real numbers x, and if $(3, 2)$ is a point on the graph of g, which of the following points MUST be on the graph of f?

(A) $(3, 2)$

(B) $(3, -2)$

(C) $(-3, 2)$

(D) $(-3, -2)$

(E) $(2, 3)$

Q. NO 20

If $f(x) = x^3 + 2x^2 - 9x - 18$, which of the following statements is true?

(A) $f(x) = 0$ has three real solutions.

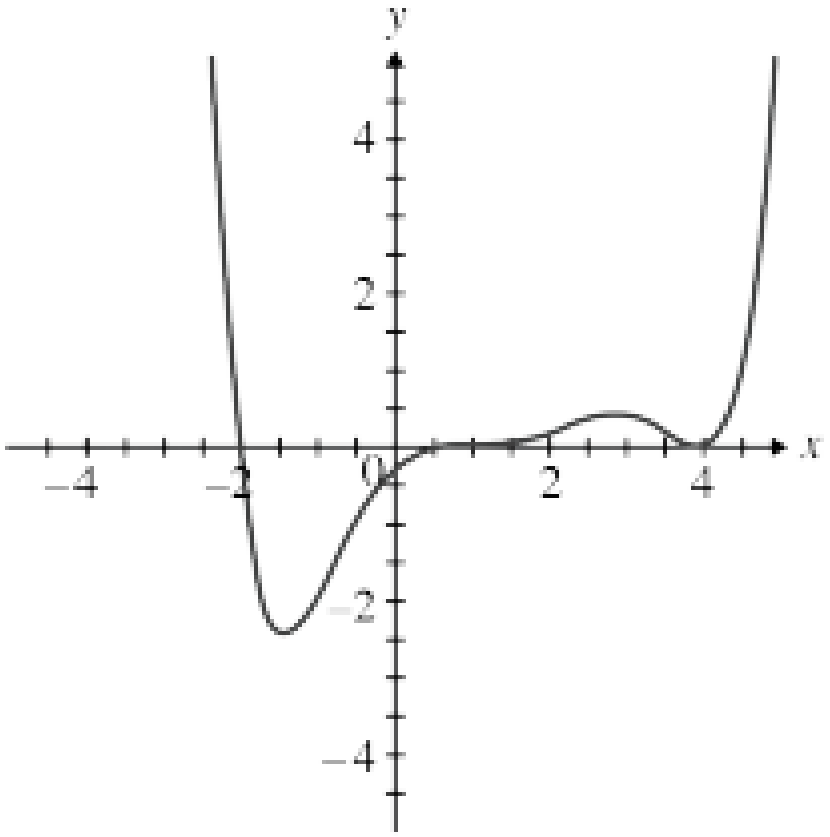
(B) $f(x) \geq -18$ for all $x \geq 0$.

(C) $f(x) \leq -18$ for all $x \leq 0$.

(D) The function $f(x)$ is decreasing for $x \leq -3$.

(E) The function $f(x)$ is increasing for $x \geq -3$.

Q. NO 21



Which of the following functions could produce the graph above?

(A) $f(x) = 0.01(x-1)(x-4)(x+2)$

(B) $f(x) = 0.01(x+1)^3(x+4)^2(x-2)$

(C) $f(x) = 0.01(x+1)^2(x+4)^3(x-2)^2$

(D) $f(x) = 0.01(x-1)^3(x-4)^2(x+2)$

(E) $f(x) = 0.01(x-1)^2(x-4)^3(x+2)^2$

Q. NO 22

What expression can replace a in the equation $(\sqrt[x]{64})(\sqrt[y]{64}) = \sqrt[a]{64}$?

(A) $x + y$

(B) $x - y$

(C) $\frac{1}{x + y}$

(D) $\frac{1}{\frac{1}{x} + \frac{1}{y}}$

(E) $\frac{1}{x} + \frac{1}{y}$

Q. NO 23

At what value of x does the function $f(x) = x + 5 - \frac{x-3}{x^2-1}$ intersect its oblique asymptote?

(A) -3

(B) 1

(C) 3

(D) 5

(E) $f(x)$ does not cross any of its asymptotes.

Q. NO 24

The first three terms of a geometric sequence are $a_1 = 1$, $a_2 = -3$, and $a_3 = 9$. What is the formula for the n^{th} term in the sequence?

(A) $a_n = 3^n$

(B) $a_n = 3^{n-1}$

(C) $a_n = (-3)^n$

(D) $a_n = (-3)^{n-1}$

(E) $a_n = (-3)^{2n-1}$

Q. NO 25

For which of the following functions is the range equal to all real numbers?

(A) $f(x) = \frac{1}{2}x\left(x^3 - \frac{1}{5}x\right)$

(B) $f(x) = x(3x^5 + 2x)$

(C) $f(x) = 112x^{14} - 23x^8 - 14x$

(D) $f(x) = \frac{2}{3}x^3(10x^3)(12x^3)$

(E) $f(x) = (3x^2 - x)\left(\frac{5}{13}x^2\right)$