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Quadratic Graphs and Their Properties

Unit 9 Lesson 1

QUADRATIC GRAPHS AND THEIR PROPERTIES

Students will be able to:

Graph quadratic equations and understand and identify the properties of quadratic graphs

Key Vocabulary:

- Quadratic Equation
- Vertex, Axis of Symmetry
- Maximum, Minimum
- Graphing Quadratic Equation
- Domain, Range of Quadratic Equation

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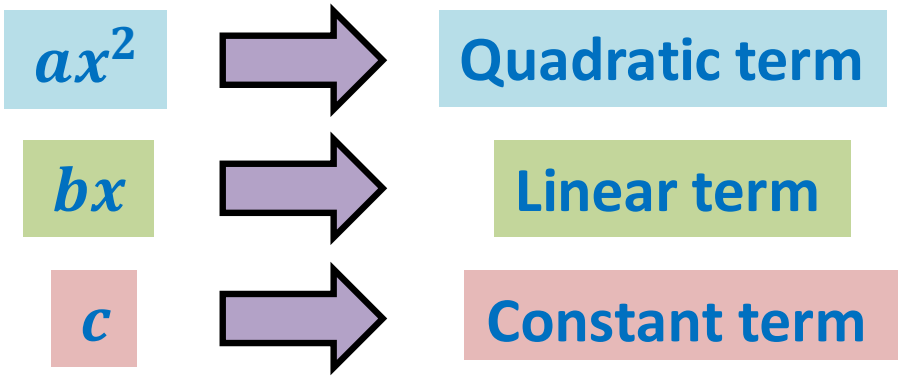
QUADRATIC GRAPHS AND THEIR PROPERTIES

A **quadratic equation** is of the form:

$$f(x) = ax^2 + bx + c$$

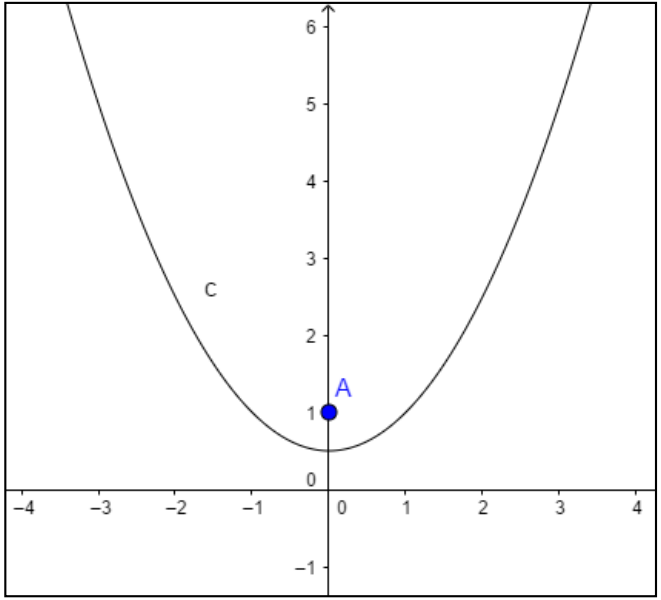
Where, $a \neq 0$.



Graph of a quadratic Equation

The graph of a quadratic equation is a U-shaped parabola.

To graph the quadratic equations, we can find the ordered pairs i.e. the pair of x, y values satisfying the quadratic equation.



Parabola

QUADRATIC GRAPHS AND THEIR PROPERTIES

Problem 1: What is the graph of $y = \frac{1}{2}x^2 + 2$?

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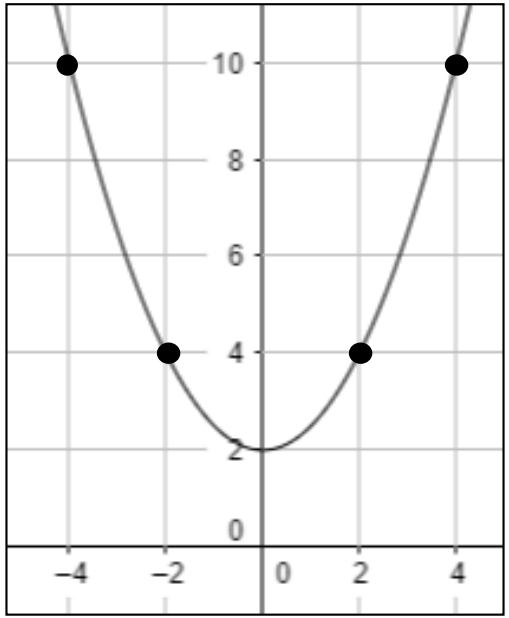
Make a table of x, y values and use them to plot the graph of the equation.

x	$y = \frac{1}{2}x^2 + 2$	(x, y)
2	$y = \frac{1}{2}(2)^2 + 2 = 4$	$(2, 4)$
-2	$y = \frac{1}{2}(-2)^2 + 2 = 4$	$(-2, 4)$
-4	$y = \frac{1}{2}(-4)^2 + 2 = 10$	$(-4, 10)$
4	$y = \frac{1}{2}(4)^2 + 2 = 10$	$(4, 10)$



$$y = \frac{1}{2}x^2 + 2$$

Properties of Quadratic Graphs

Consider the quadratic equation $f(x) = ax^2 + bx + c$, $a \neq 0$.

- **Axis of Symmetry** is the line that divides the parabola into parts that are mirror images of each other.
  Mathematically, it is given as:

$$x = -\frac{b}{2a}$$

- **Vertex of the parabola** is the point which intersects the axis of symmetry of the parabola.
  Mathematically, its coordinates are given as:

$$\left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right)$$

QUADRATIC GRAPHS AND THEIR PROPERTIES

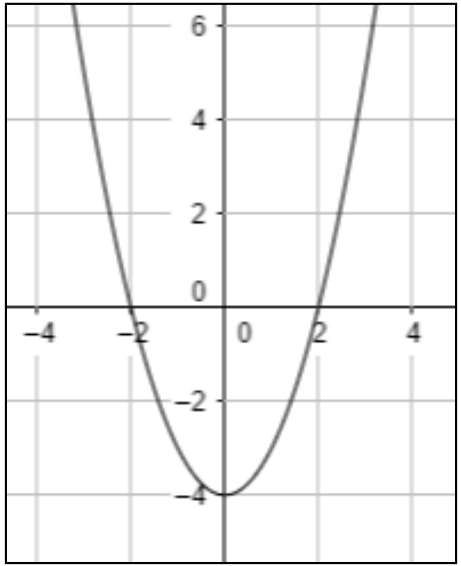
- **Maximum** of a quadratic equation is a point where the graph has the maximum value. In the equation $y = ax^2$, if $a < 0$, the graph **opens downwards** and the maximum is the vertex of the graph.

- **Minimum** of a quadratic equation is a point where the graph has the minimum value. In the equation $y = ax^2$, if $a > 0$, the graph **opens upwards** and the maximum is the vertex of the graph.

- In the equation $y = ax^2$, the larger the numeric value of a, the narrower is the graph of the equation, and the smaller the numeric value of a, the wider is the graph of the equation.

QUADRATIC GRAPHS AND THEIR PROPERTIES

Problem 2: Identify the vertex of the graph. Also tell whether it is a maximum or a minimum.



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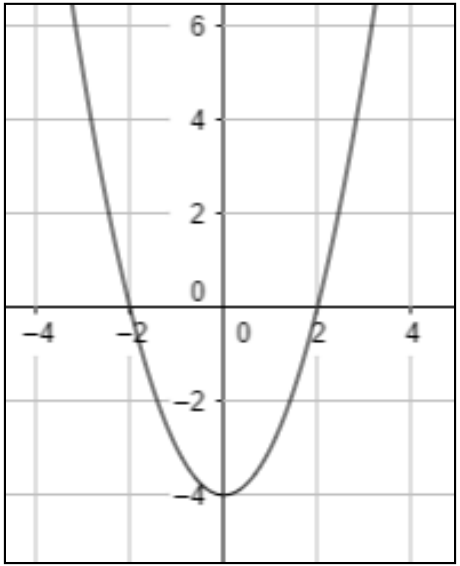

The vertex of the graph is $(\mathbf{0}, \mathbf{-4})$.

Since the graph opens upwards, so the point

$(0, -4)$ is a **minimum**.

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Problem 3: What is the domain and range of the function $y = 5x^2 - 3$?

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The domain of the function is the set of all the possible values the function can take. We see that all values of $x \in \mathbf{R}$ are possible as an input, so:

Domain: Set of all real numbers.

The range will be the set of all possible outputs. We see that for all values of x, the value of y will be greater than or equal to -3 (in case $x = 0$), so:

Range: $y \geq -3$