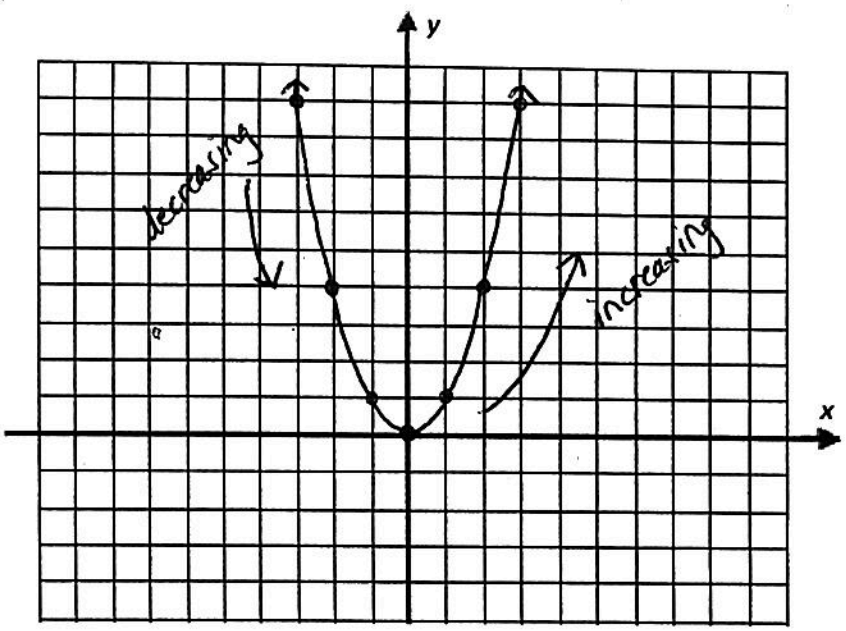
**Essential Question:** What does the graph of a quadratic function look like?

**Do Now:** Graph the following quadratic function using the domain $-3 \leq x \leq 3$ and answer the questions that follow.

$y = x^2$

| x | y |
|---|---|
| -3 | 9 |
| -2 | 4 |
| -1 | 1 |
| 0 | 0 |
| 1 | 1 |
| 2 | 4 |
| 3 | 9 |




1) Is the function linear? No, it is a quadratic.

2) Is the function increasing or decreasing? Both!

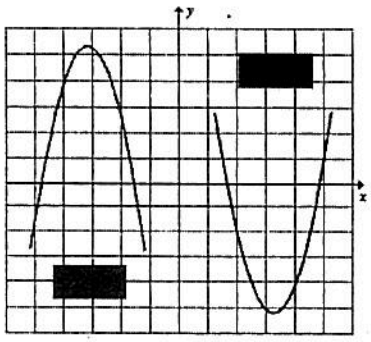
3) Does the function have a constant rate of change? No. You would look for an average rate of change.

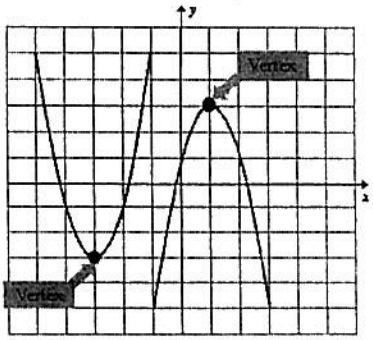
## Quadratic Functions

- The **standard form** of a quadratic function is $y = ax^2 + bx + c$.
- The graph of a quadratic function is a parabola.
- The **parabola** can open up or down.
- It opens **up** when the ***a*** value is positive and opens **down** when the ***a*** value is negative.
- The turning point of a parabola is known as the vertex.

  When parabolas open up, the **vertex** is the *minimum* point.

  When parabolas open down, the **vertex** is the *maximum* point.






- The **x-value** of the turning point (x, y) can be calculated using the formula:

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

# Graphing Quadratic Functions

- Make sure your equation is written in **standard form** ($y = ax^2 + bx + c$).
- Find the **x-coordinate** of the **vertex** (turning point) using the formula, $x = \frac{-b}{2a}$.
- Create a **table of values** using three x-values less than the x-value of the vertex, and three x-values greater than the vertex.
- **Graph** the points from the table of values and connect them with a **smooth curve**.
- **Label** the parabola with the equation.

1) Graph the quadratic function $y = x^2 - 6x + 4$

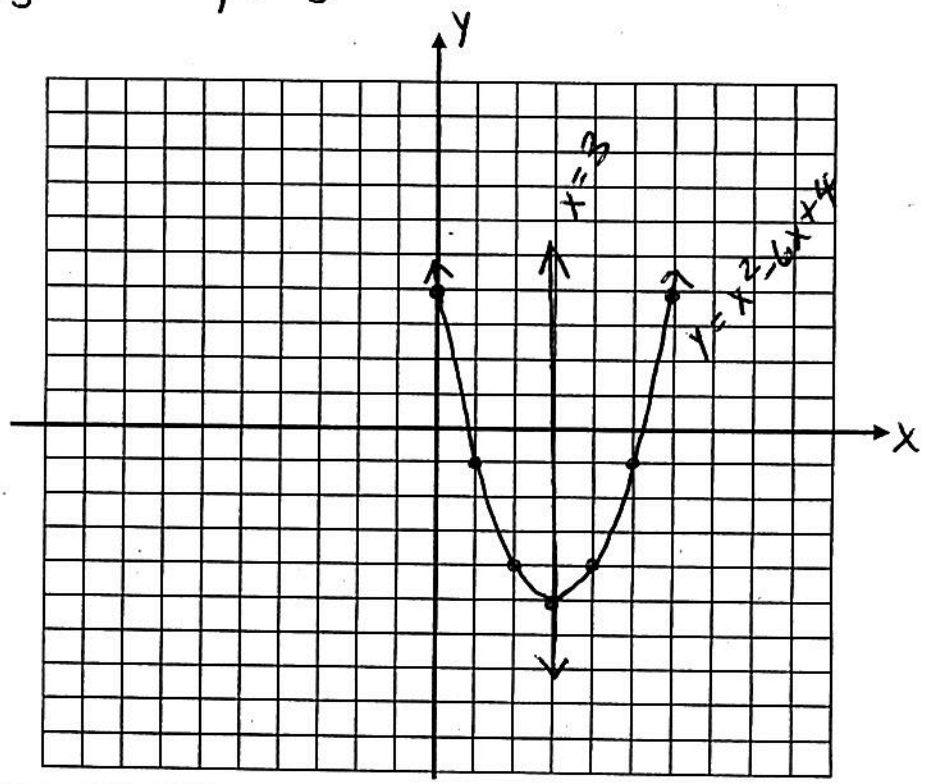
- Find the coordinates of the vertex.

$x = \frac{-b}{2a}$ $\quad x = \frac{6}{2(1)}$ $\quad x = 3$

$y = 3^2 - 6(3) + 4$ $\quad y = 9 - 18 + 4$ $\quad y = -5$ $\quad (3, -5)$

- Create a table of values.

| x | y |
|---|---|
| 0 | 4 |
| 1 | -1 |
| 2 | -4 |
| 3 (vertex / middle value in table) | -5 |
| 4 | -4 |
| 5 | -1 |
| 6 | 4 |




**IMPORTANT NOTE**

Every parabola is **symmetrical**. If a *vertical line* were drawn through the vertex, it would divide the parabola into two equal halves.

This *vertical line* is known as the **axis of symmetry**.

*Graph the axis of symmetry in the above example and state the equation of the line.*

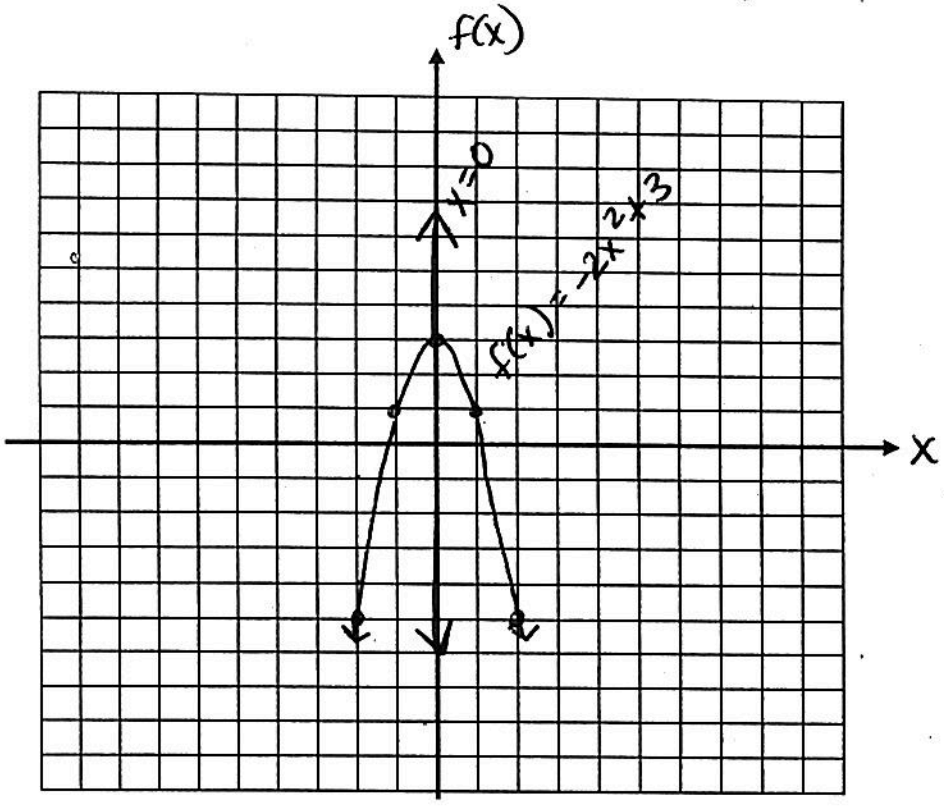
2) Graph the function $f(x) = -2x^2 + 3$

- Find the coordinates of the vertex.

$x = \frac{-b}{2a}$ $\quad x = \frac{0}{2(-2)}$ $\quad x = 0$ $\quad f(x) = -2(0)^2 + 3$ $\quad f(x) = 3$ $\quad (0, 3)$

- Create a table of values.

| x | f(x) |
|---|---|
| -3 | -15 |
| -2 | -5 |
| -1 | 1 |
| vertex → 0 | 3 |
| 1 | 1 |
| 2 | -5 |
| 3 | -15 |




- Graph the **axis of symmetry** and state the equation of the line.

- The value of ___a___ in $y = ax^2 + bx + c$ causes the quadratic to open upward or downward.
- A positive value of ___a___ tells us that the graph will open ___up___.
- A negative value of ___a___ tells us that the graph will open ___down___.
- The turning point of a parabola is known as the ___vertex___.
- This vertex is either the ___maximum___ point or ___minimum___ point of the graph depending on whether the parabola opens up or down.
- The x-coordinate of the vertex can be found using the formula $x = \frac{-b}{2a}$.
- The ___axis of symmetry___ is a vertical line that divides the parabola into two equal halves.