Graphing Quadratic Functions

$$y = ax^2 + bx + c$$

Quadratic Functions

- **Definition:**
  - A quadratic function is a non-linear function with a degree of two.

- **Standard Form:**
  - $y = ax^2 + bx + c$ where $a \neq 0$

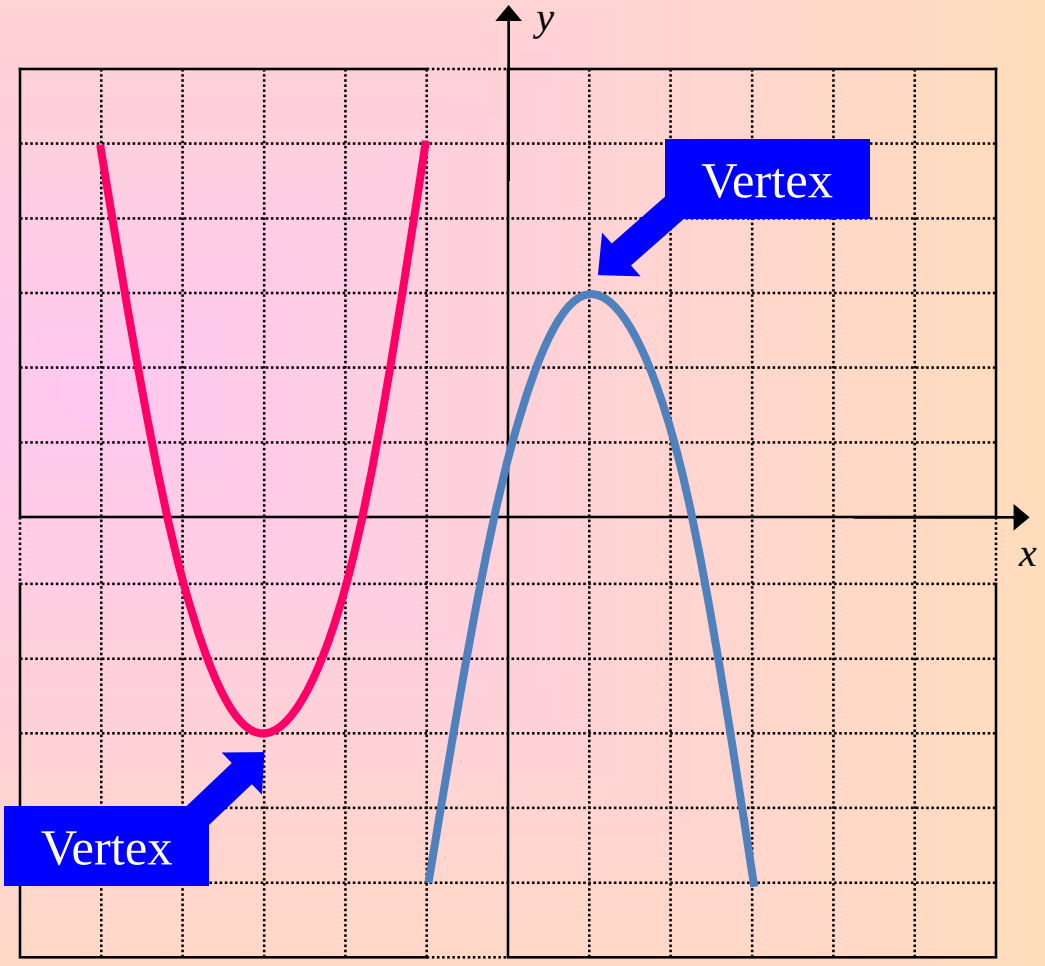
Graphs of Quadratics

The graph of a quadratic function is a ***parabola***.

A parabola can open up or down. The "turning point" is called the ***vertex***.

If the parabola opens up, the vertex is the lowest point and called the minimum.

If the parabola opens down, the vertex is the highest point and called the maximum.

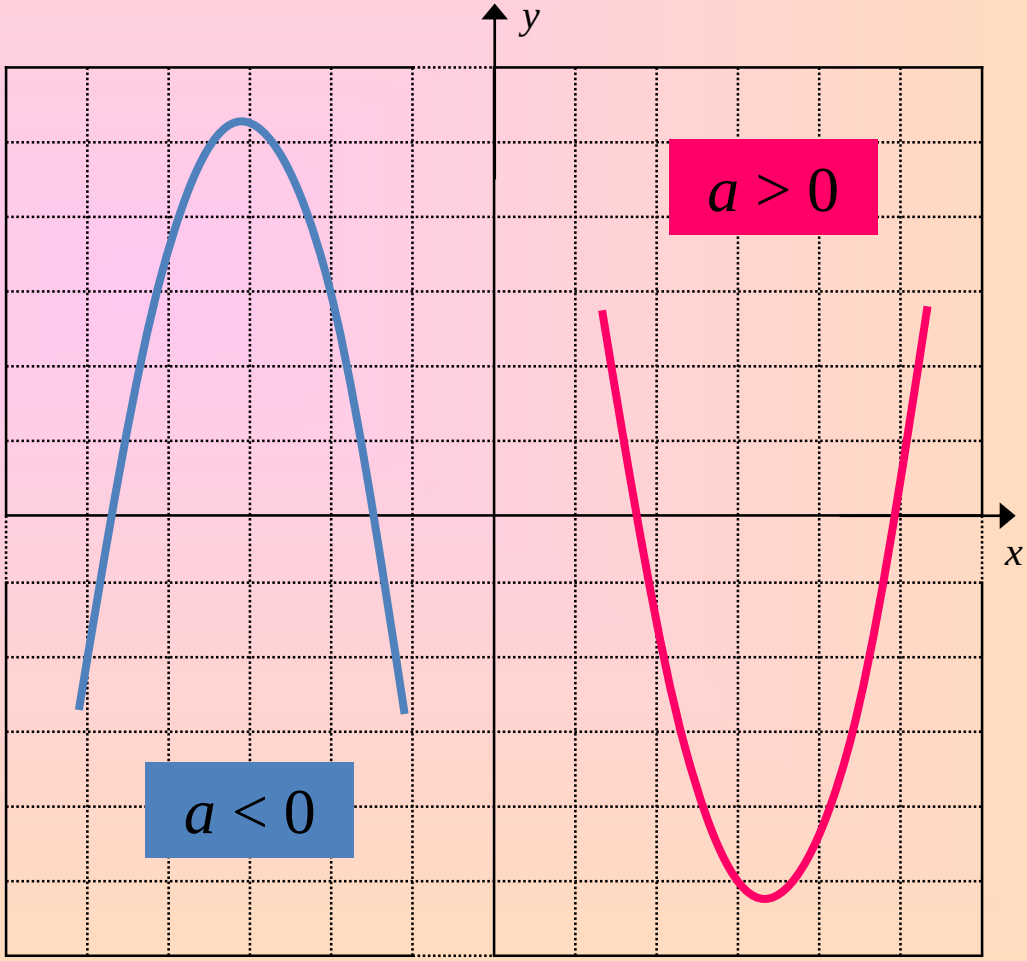


Graphs of Quadratics

$$y = ax^2 + bx + c$$

The parabola will open up when the *a* value is positive.

The parabola will open down when the *a* value is negative.

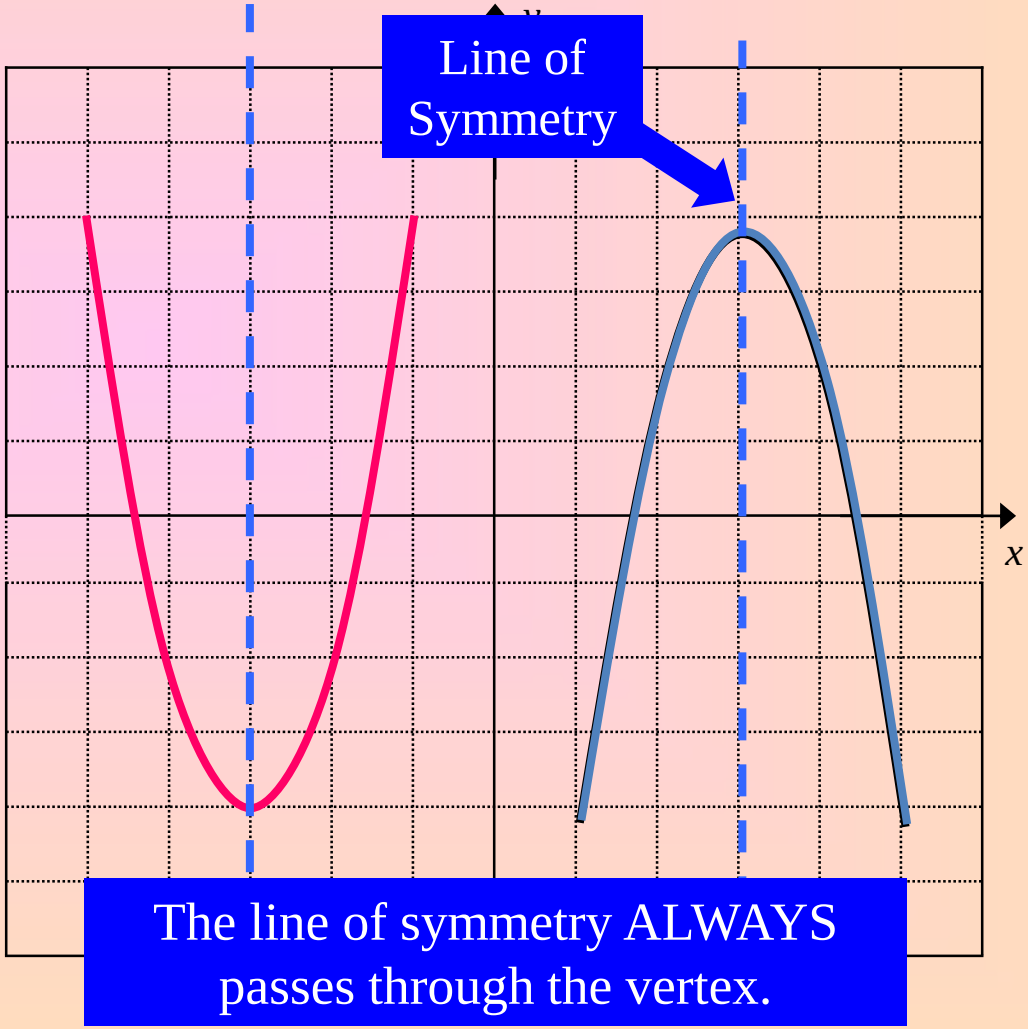


Graphs of Quadratics

Parabolas have a symmetric property to them.

We call this line the ***line of symmetry***.

- If we drew a line down the middle of the parabola, we could fold the parabola in half.
- Or, if we graphed one side of the parabola, we could "fold" (or REFLECT) it over, the line of symmetry to graph the other side.

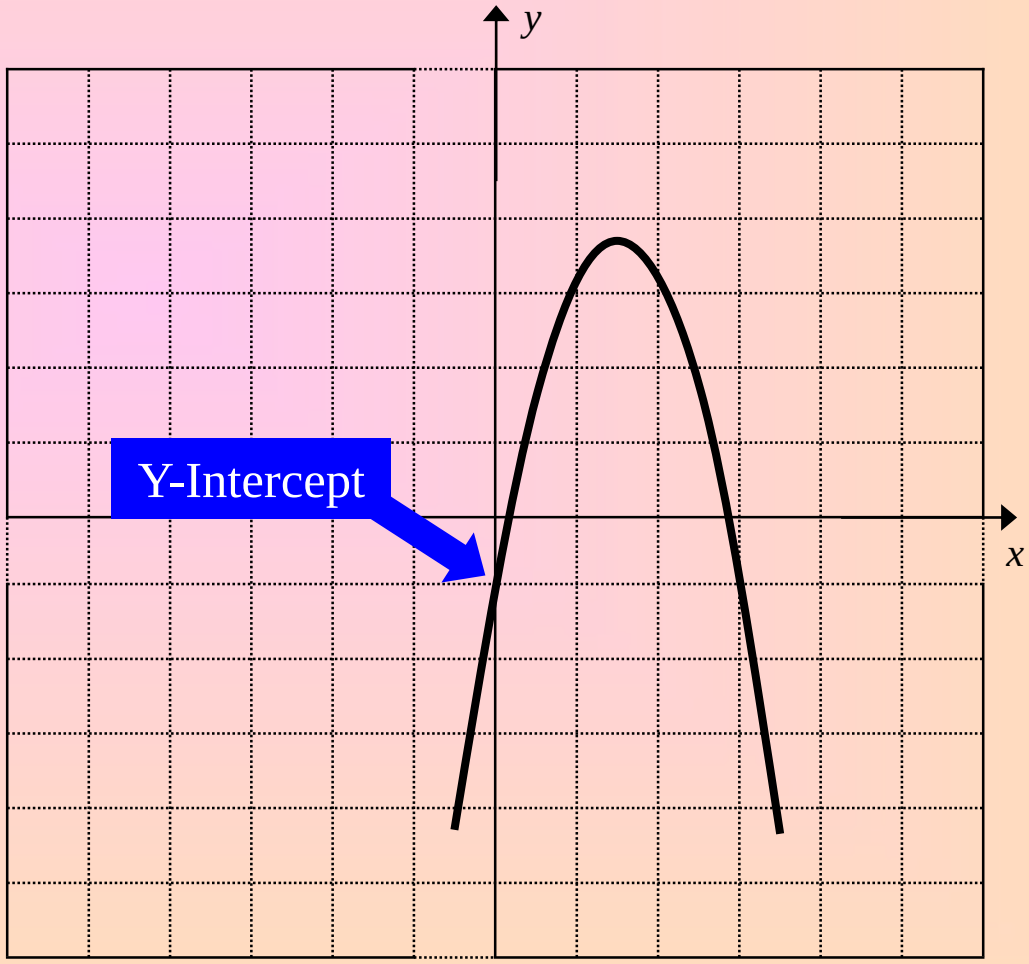


Graphs of Quadratics

The y-intercept is where the parabola will cross the y-axis.

Plug in 0 for x to solve!

In standard form, the y-intercept is our "c" value!



Graphs of Quadratics

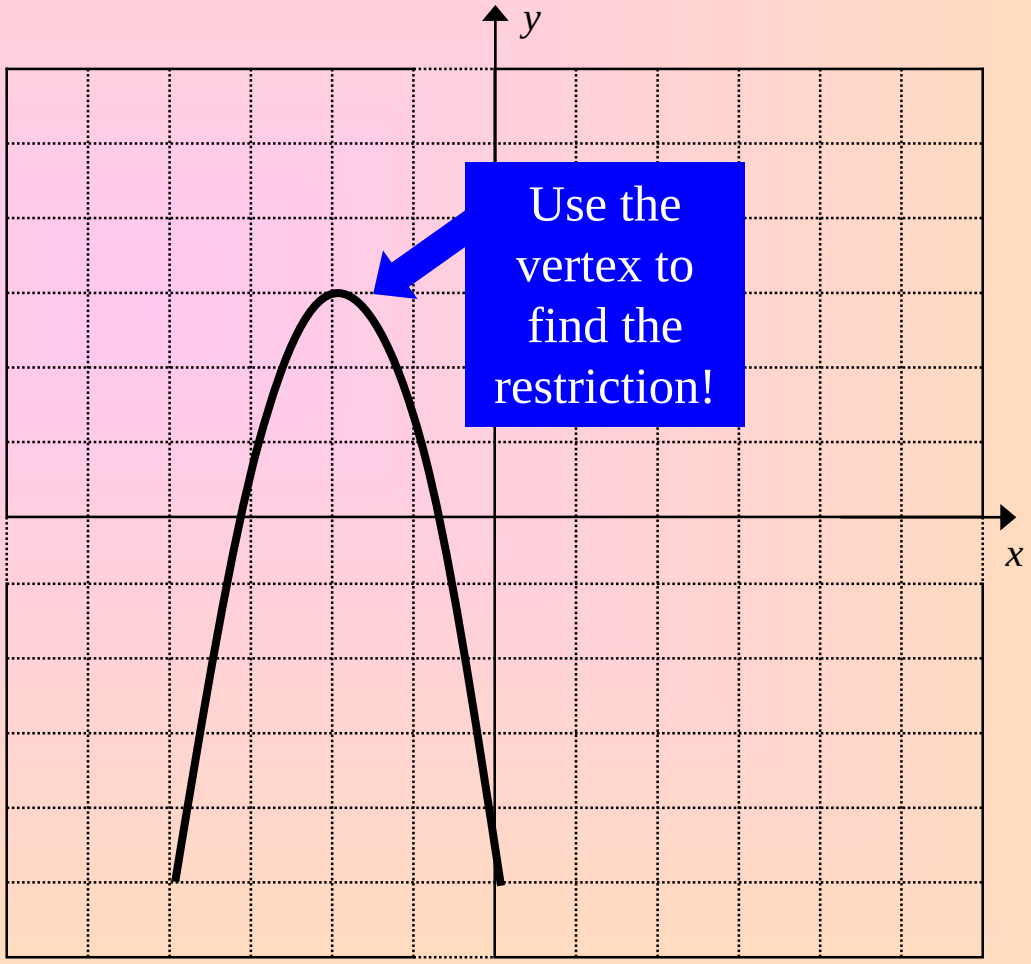
Remember: **Domain** is the set of all x-values for the function. **Range** is the set of all y-values for the function.

Are there any restrictions on the domain?

No! $(-\infty, \infty)$

Are there any restrictions on the range?

Yes! $(-\infty, 3]$



Finding the Line of Symmetry

When a quadratic function is in standard form

$$y = ax^2 + bx + c,$$

The **equation of the line of symmetry** is:

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

For example…

Find the line of symmetry of

$$y = 3x^2 - 18x + 7$$

Using the formula…

$$x = \frac{18}{2(3)} = \frac{18}{6} = 3$$

Thus, the line of symmetry is $x = 3$.

Finding the Vertex

We know the line of symmetry always goes through the vertex.

Therefore, the line of symmetry gives us the x – coordinate of the vertex.

To find the y – coordinate of the vertex, we need to plug the x – value into the original equation.

$$y = -2x^2 + 8x - 3$$

STEP 1: Find the line of symmetry

$$x = \frac{-b}{2a} = \frac{-8}{2(-2)} = \frac{-8}{-4} = 2$$

STEP 2: Plug the x – value into the original equation to find the y value.

$$y = -2(2)^2 + 8(2) - 3$$

$$y = -2(4) + 8(2) - 3$$

$$y = -8 + 16 - 3$$

$$y = 5$$

Therefore, the vertex is (2 , 5)

Graphing a Quadratic

There are **3** steps to graphing a parabola in standard form…

STEP 1: Find the line of symmetry

STEP 2: Find the vertex

STEP 3: Graph at least four others points using squares

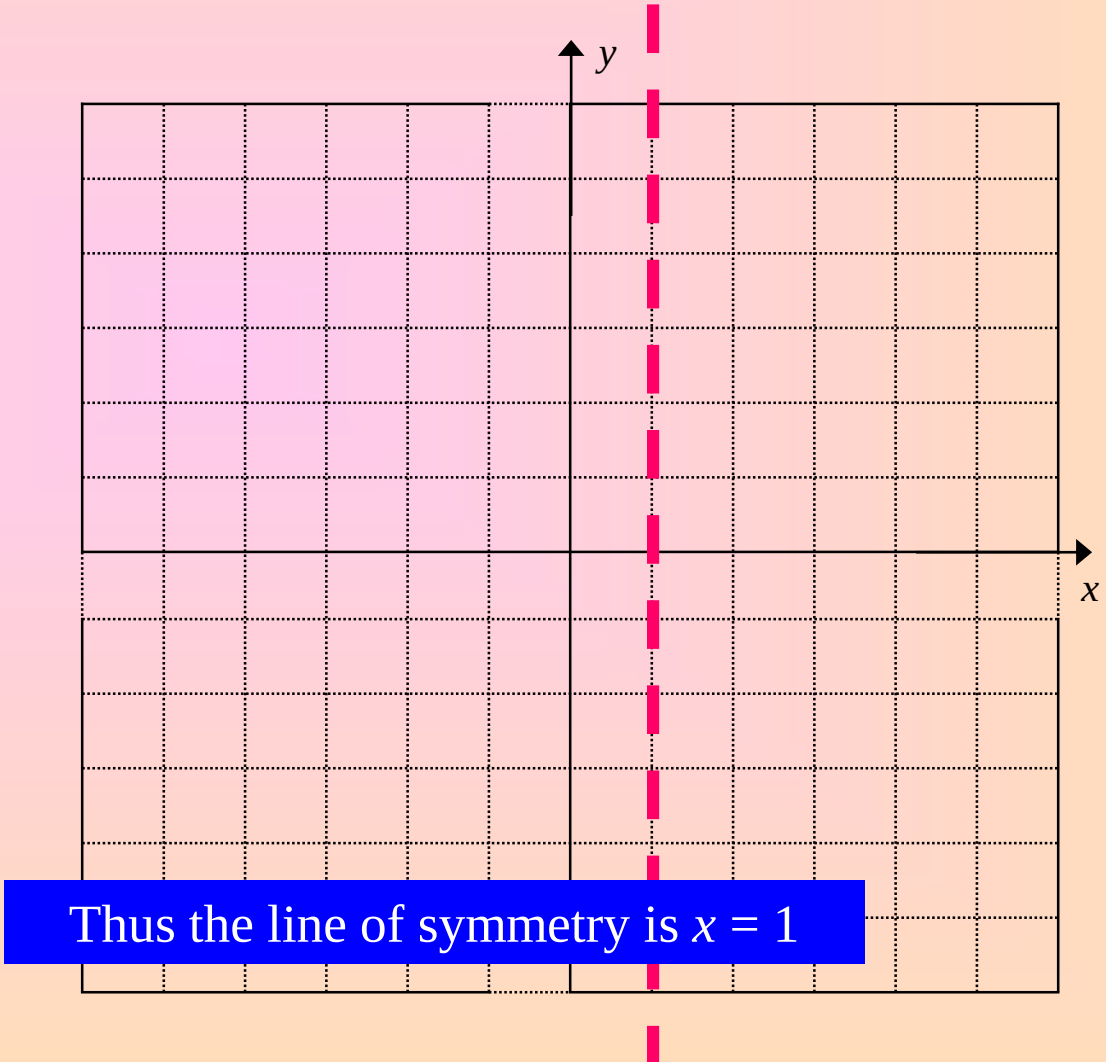
Graphing a Quadratic

Example:

$$y = 2x^2 - 4x - 1$$

STEP 1: Find the line of symmetry

$$x = \frac{-b}{2a} = \frac{4}{2(2)} = 1$$



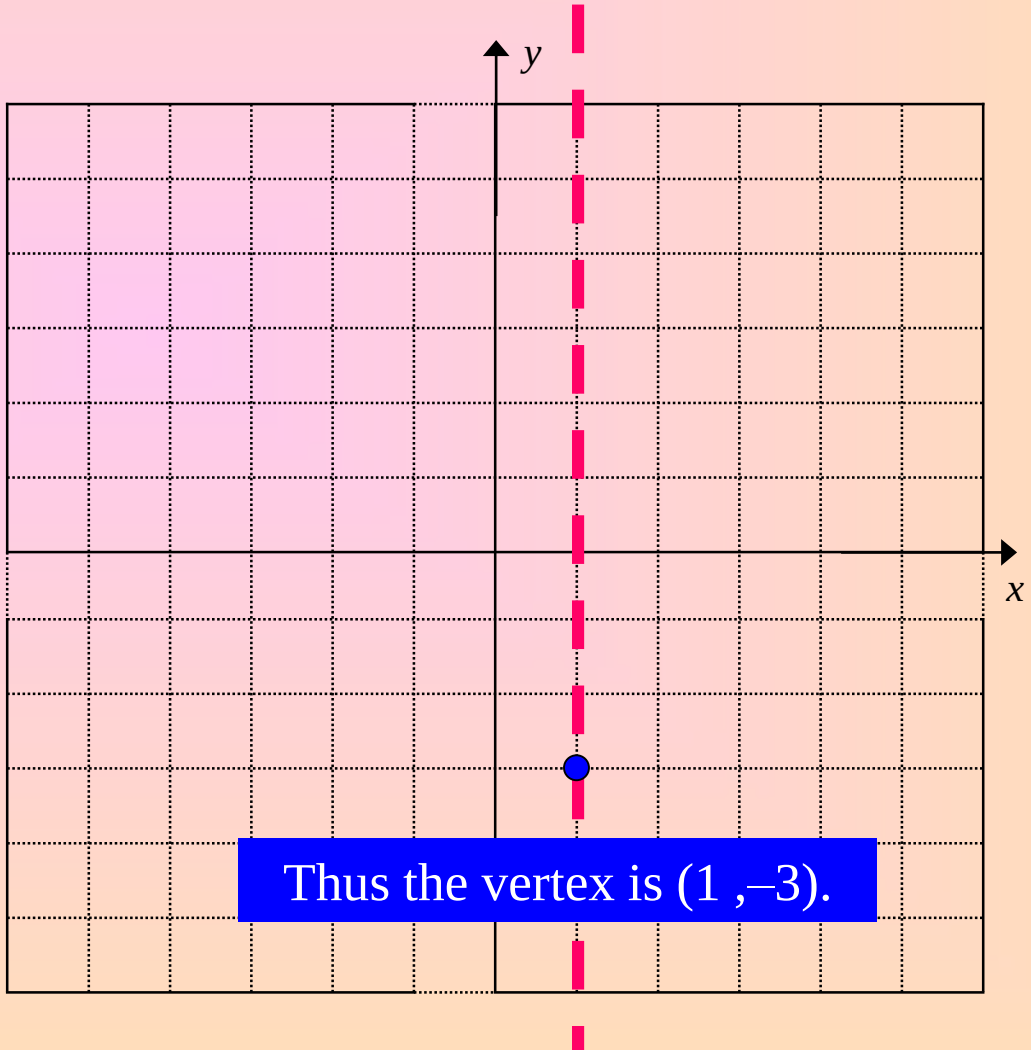
Graphing a Quadratic

$y = 2x^2 - 4x - 1$

STEP 2: Find the vertex

Since the x – value of the vertex is given by the line of symmetry, we need to plug in $x = 1$ to find the y – value of the vertex.

$y = 2(1)^2 - 4(1) - 1 = -3$



Graphing a Quadratic

$y = 2x^2 - 4x - 1$

STEP 3: Find at least four other points using squares. Then connect the five points with a smooth curve.