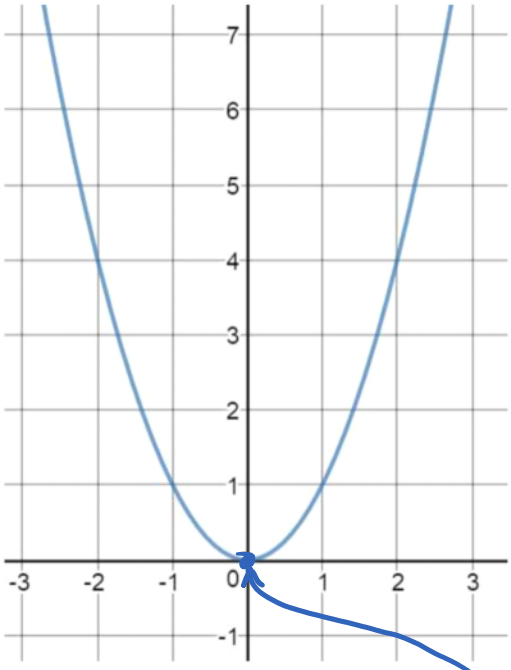
# 4.2 - Graphs of y=ax^2+bx+c

November 20, 2019 3:27 PM

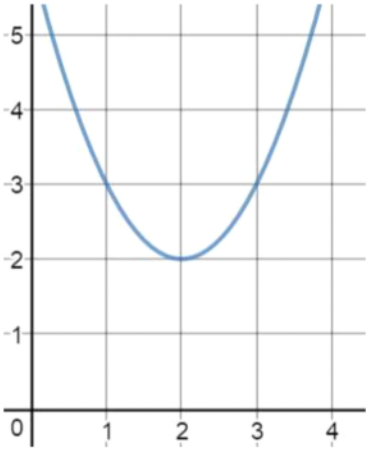
FOUNDATIONS OF MATH 11 Ch. 7 – Day 2: Graphs of $y = ax^2 + bx + c$

Recall the general shape of a quadratic equation:

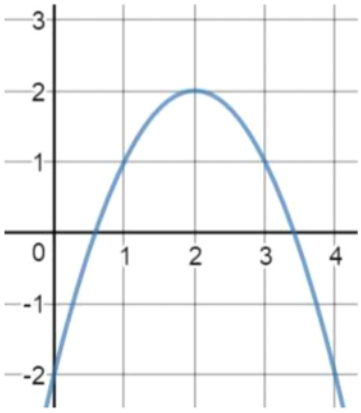



The point on a parabola where it "turns around" is called the **vertex**. The vertex on the above example is at the origin (a special name for the point (0,0) ).

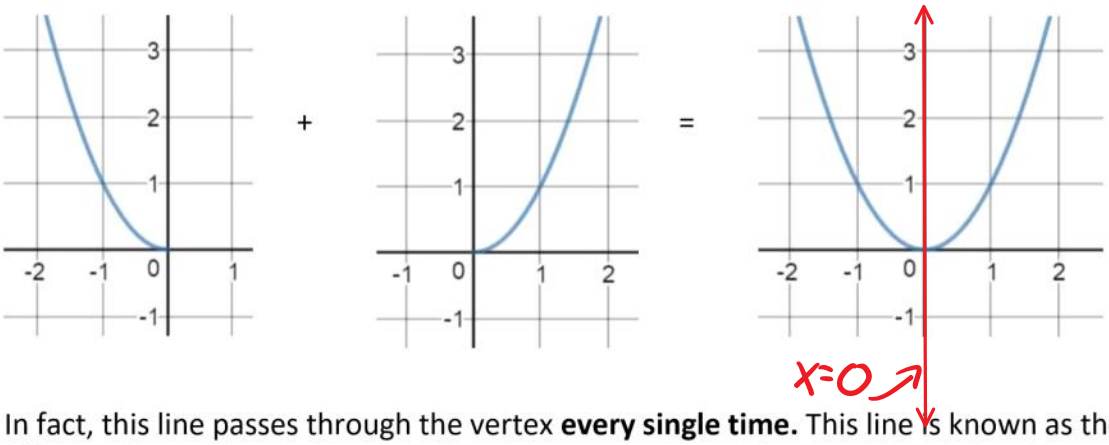
If a parabola opens up, its vertex is the **minimum,** or **minimum point** (with respect to the y-axis):




If a parabola opens down, its vertex is the **maximum**, or **maximum point**: (again, only for values of y):



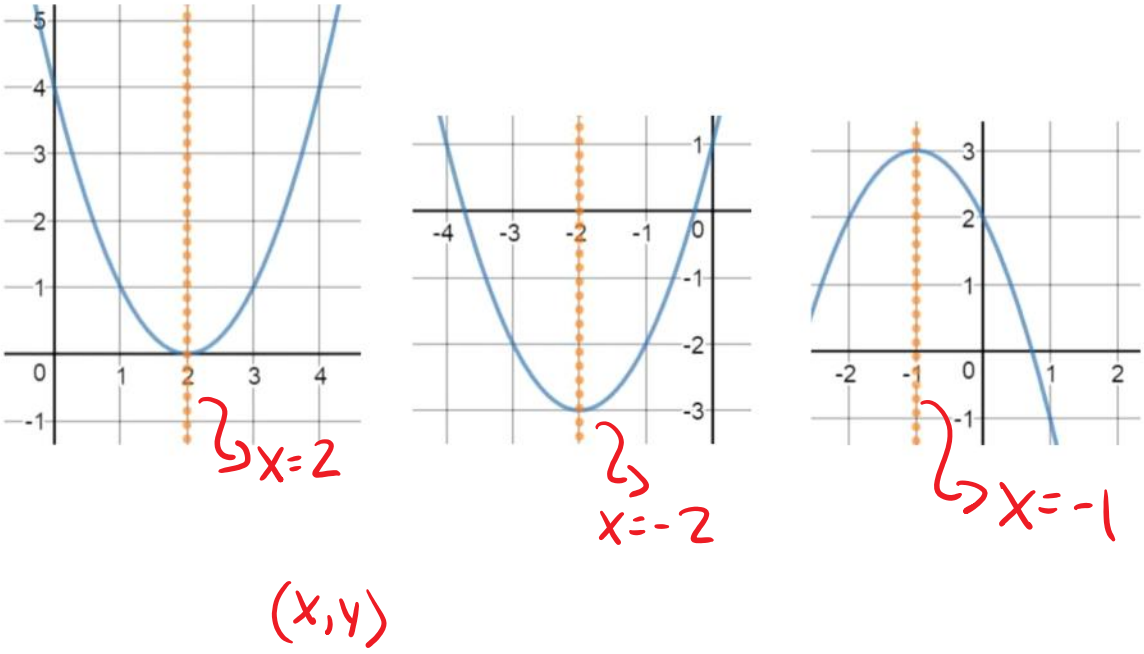
By now you've probably noticed that parabolas are **symmetrical,** as in there is a vertical line where the left of the graph is the **reflection** of the right, and vice-versa:




In fact, this line passes through the vertex **every single time.** This line is known as the **axis of symmetry**.

Recall that vertical lines of equations are written as x = *h* where *h* is the value on the x-axis the line passes through. In the above example, the axis of symmetry would be "x = 0".

**Example: What is the line of symmetry of the following quadratic functions?**



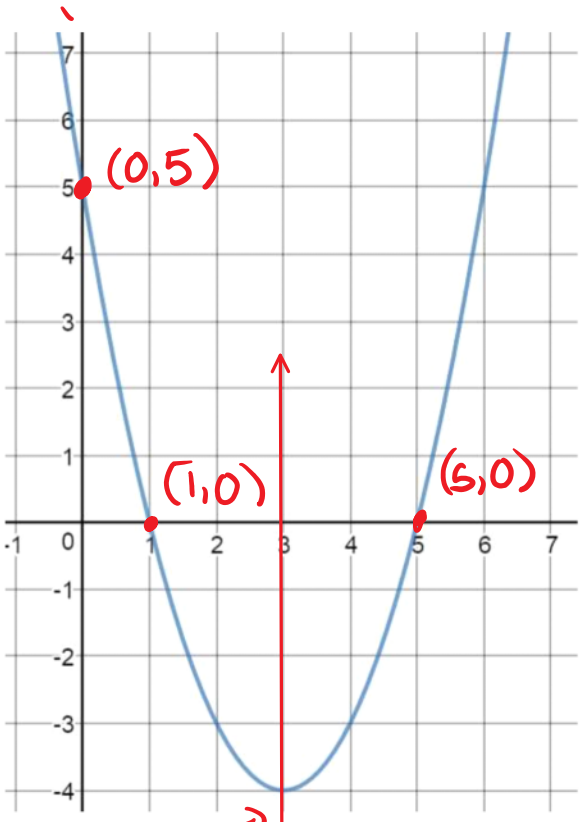

(x,y)

Also, the line of symmetry will **always** be the x-coordinate of the vertex. Ie. if you know the vertex of a quadratic is (4, -5), the line of symmetry will be x = 4.

Recall from previous years that the **x-intercept** is the point where the graph touches the x-axis. Parabolas can have 0, 1, or 2 x-intercepts.

Also, that the **y-intercept** is the point where the graph touches the y-axis.

Consider the following parabola. What are the x and y-intercepts?




X-int:
(1,0), (5,0)
-OR-
x-int: 1, 5

y-int:
(0,5)
-OR-
y-int: 5

What pattern do you notice between the x-intercepts and the axis of symmetry?

AOS: $x = 3$

The axis of symmetry is exactly in the middle (equidistant) of the x-intercepts.

$$\Rightarrow x = \frac{(\text{x-int}_1) + (\text{x-int}_2)}{2}$$

**Example: Determining the vertex given the axis of symmetry, and the equation of the quadratic.**

$y = ax^2 + bx + c \Rightarrow$ "General Form"

Consider the parabola $y = 4x^2 - 16x - 9$ . If it's axis of symmetry is $x = 2$, what is the coordinate of its vertex?

We know that the axis of symmetry is always the x-coordinate of the vertex, so right away we know that our vertex is going to look like:

$(2, y)$

Since we know that the vertex lies on the line of the parabola, we can substitute $x = 2$ in to our quadratic equation to algebraically solve for our y-coordinate:

$y = 4x^2 - 16x - 9$

$y = 4(2)^2 - 16(2) - 9$

$y = 16 - 32 - 9$

$y = -25$

$\Rightarrow$ This means when $x = 2$, then $y = -25$

Also, we know the vertex happens when $x = 2$, so the vertex is:

$(2, -25)$

Conclude this lesson with "Desmos Activity 7.1"