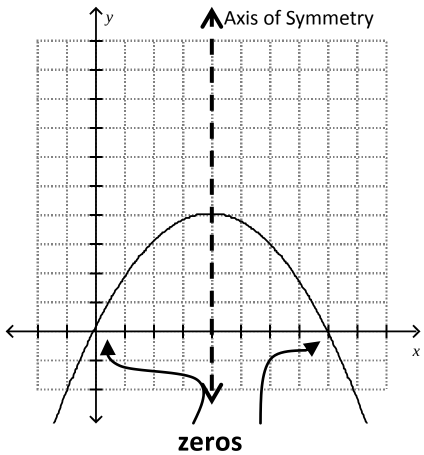
Algebra I

Lesson 9.2 – Characteristics of Quadratic Functions

Mrs. Snow, Instructor

Quadratic functions are used in many areas of study: economics, cost analysis, architecture, and engineering to name a few. If you ever need to lay siege to a castle, a quadratic function will model the trajectory of an object you may need to catapult over the castle wall!



If we look at a graph of a quadratic we see that (in this case) there are two x-intercepts - x when y=0. These x-intercepts are very important numbers. For our catapult, for example if we were to model the height (y) versus distance (x), we would be able to calculate if our projectile would make it into the castle grounds. Modeling the height (y) versus time (x) we could determine how long it would take for the projectile to hit the ground. Don't forget from last section, the vertex of the parabola will let us know the maximum height of our projectile (will it make it over the castle wall?)

Vocabulary:

Zero of a function – the value of x that makes the function equal to zero. It is the numerical value of the x-intercept.

Axis of symmetry – a vertical line that divides a parabola into two symmetrical halves. The axis of symmetry always passes through the vertex of the parabola. It may be described by the equation of a vertical line $x = n$.

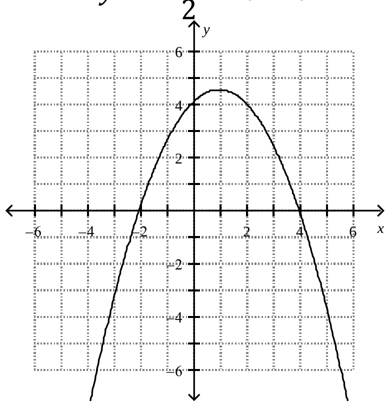
For: $y = ax^2 + bx + c$; axis of symmetry $x = -\frac{b}{2a}$.

Vertex – $(x, y) = \left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right)$

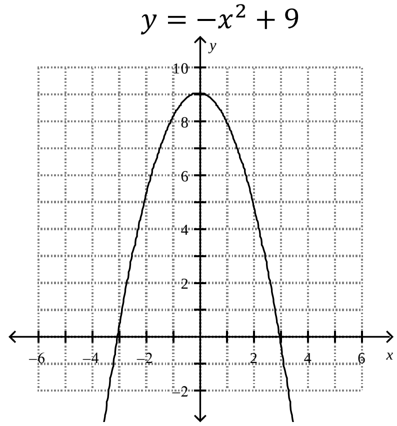
When finding the zeros of a function, there are three possible outcomes. There may be one zero, two zeros or no zeros. It all depends on where the quadratic crosses the x-axis if it ever does cross the axis.

Find the zeros of each quadratic function from its graph. State the axis of symmetry for each parabola.

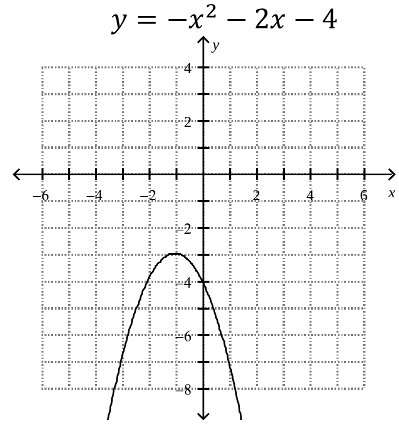
$y = -\frac{1}{2}x^2 + x + 4$



$y = -x^2 + 9$



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



How can you find the axis of symmetry and vertex without graphing? Or maybe the graph shows a rational number for part of the answer? Observe, the parabola changes shape and location on the graph when the equation changes. We learned that if the leading coefficient is negative the parabola opens downward. The values of a, b, and c in our quadratic equation can help us.

For a quadratic function $y = ax^2 + bx + c$ the axis of symmetry may be calculated by: $x = -\frac{b}{2a}$.

Since the axis of symmetry passes through the vertex, we can plug the value of **x** into the quadratic equation, solve for **y**, and find the vertex: $(x, y) = \left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right)$.

Find the axis of symmetry and vertex of:

$y = 5x^2 - 10x + 3$ $y = ax^2 + bx + c$ $a = 5, b = -10, c = 3$ $x = -\frac{b}{2a} = -\left(\frac{-10}{2(5)}\right)$ $x = -\left(\frac{-10}{10}\right) = 1$ $axis\ of\ symmetry\text{: } x = 1$ $y = 5(1)^2 - 10(1) + 3$ $y = 5 - 10 + 3 = -2$ $vertex\text{: } (1, -2)$	1. Identify the values of a and b. 2. Solve for x, the axis of symmetry 3. Using the numerical value of x solve for y and find the x-y ordered pair that is the vertex. (When x=1, what is y?)

Find the axis of symmetry and the vertex:

$y = x^2 - 4x + 10$

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

$y = -5x^2 + 10x + 3$

The height in feet above the ground of an arrow after it is shot can be modeled by $y = -16x^2 + 63x + 4$. Can the arrow pass over a tree that is 68 feet tall? Explain.