Today you will:

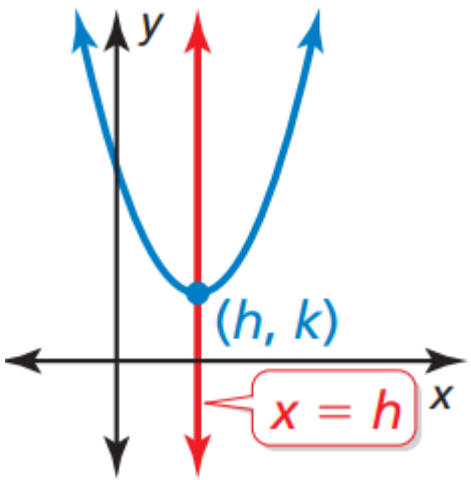
- Explore properties of parabolas
- Graph quadratic functions using symmetry
- Graph quadratic functions in standard form
- Practice using English to describe math processes and equations

Core Vocabulary:

- **Axis of Symmetry**
- **Standard form of a quadratic function**

Axis of Symmetry

- The line that divides a parabola into mirror images and passes through the vertex.
- Vertex of $f(x) = a(x - h)^2 + k$ is (h, k), the ***axis of symmetry*** is the vertical line $x = h$.
- This provides another, easy way to graph quadratic functions when they are written in vertex form.



Example 1

Graph $f(x) = -2(x + 3)^2 + 4$. Label the vertex and axis of symmetry.

SOLUTION

Step 1 Identify the constants $a = -2$, $h = -3$, and $k = 4$.

Step 2 Plot the vertex $(h, k) = (-3, 4)$ and draw the axis of symmetry $x = -3$.

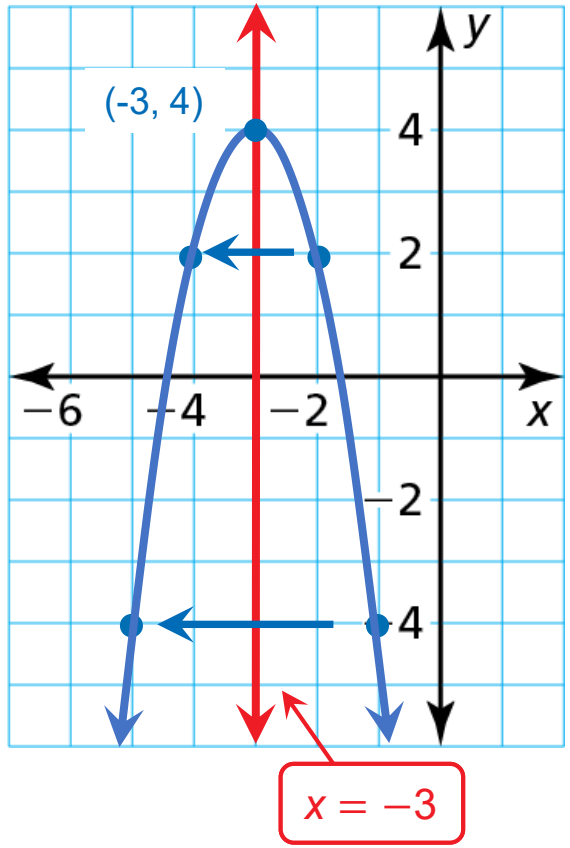
Step 3 Evaluate the function for two values of x.

$x = -2$: $f(-2) = -2(-2 + 3)^2 + 4 = 2$

$x = -1$: $f(-1) = -2(-1 + 3)^2 + 4 = -4$

Plot the points $(-2, 2)$, $(-1, -4)$, and their reflections in the axis of symmetry.

Step 4 Draw a parabola through the plotted points.



Try it yourself: $f(x) = -3(x+1)^2$ Graph the function. Label the vertex and axis of symmetry.

Which form is the equation in?

Vertex form $f(x) = a(x-h)^2 + k$

Pull out *a*, *h* and *k*:

$f(x) = -3(x-(-1)^2 + 0$

$a = -3$

h =-1

$k = 0$

Vertex:

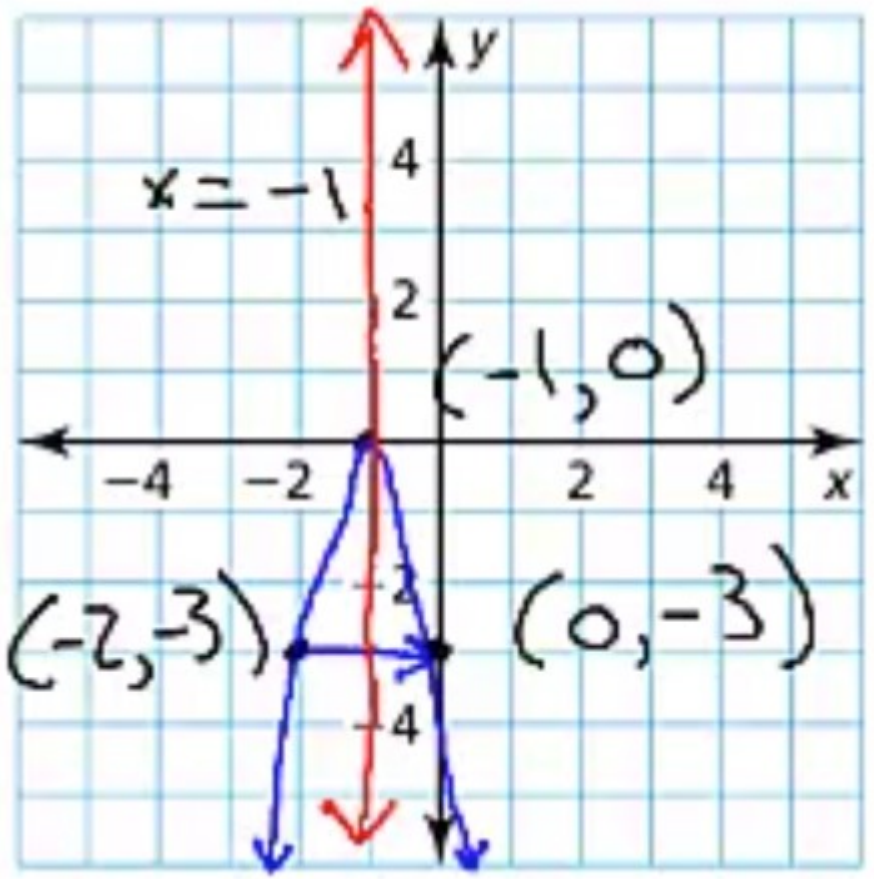
$(-1,0)$

Axis of symmetry:

$x = -1$

Evaluate the function at a point near the axis of symmetry, say $x = -2$

$f(-2) = -3(-2+1)^2 = -3$



Standard Form of quadratic functions

- $f(x) = ax^2 + bx + c$ where $a \neq 0$
- Standard form gives us a *TON* of information!
- All you have to do is pull out a, b, and c then plug them!

x-intercepts:
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

y-intercept:
…is c!

axis of symmetry:
$$x = \frac{-b}{2a}$$

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

- The parabola opens up when $a > 0$, and down when $a < 0$

Example 2

COMMON ERROR

Be sure to include the negative sign when writing the expression for the x-coordinate of the vertex.

Graph $f(x) = 3x^2 - 6x + 1$. Label the vertex and axis of symmetry.

SOLUTION

Step 1 Identify the coefficients $a = 3$, $b = -6$, and $c = 1$. Because $a > 0$, the parabola opens up.

Step 2 Find the vertex. First calculate the x-coordinate.

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

Then find the y-coordinate of the vertex.

$$f(1) = 3(1)^2 - 6(1) + 1 = -2$$

So, the vertex is $(1, -2)$. Plot this point.

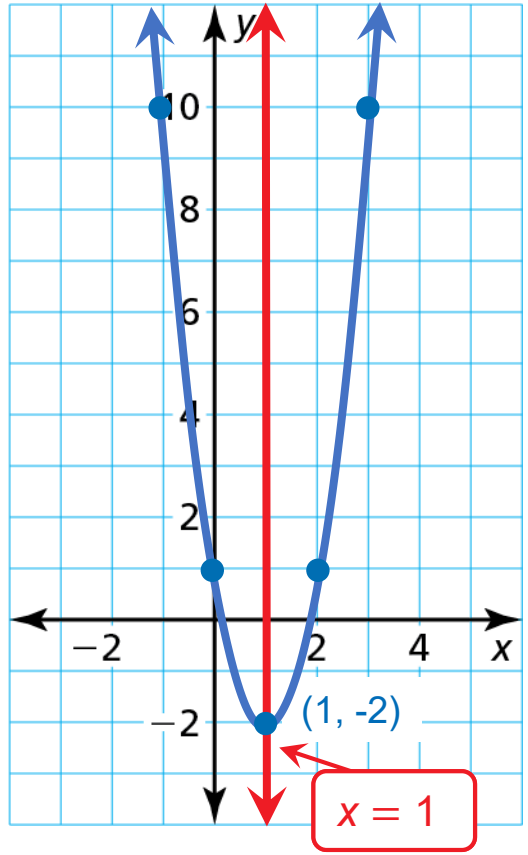
Step 3 Draw the axis of symmetry $x = 1$.

Step 4 Identify the y-intercept c, which is 1. Plot the point $(0, 1)$ and its reflection in the axis of symmetry, $(2, 1)$.

Step 5 Evaluate the function for another value of x, such as $x = 3$.

$$f(3) = 3(3)^2 - 6(3) + 1 = 10$$

Plot the point $(3, 10)$ and its reflection in the axis of symmetry, $(-1, 10)$.



Step 6 Draw a parabola through the plotted points.

Try it yourself: $\mathrm{p}(x) = -2x^2 - 8x + 1$ Graph the function. Label the vertex and axis of symmetry.

Which form is the equation in?

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

Pull out a, b and c:

$\mathrm{p}(x) = -2x^2 - 8x + 1$

$a = -2$

$b = -8$

$c = +1$

Vertex:

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

$$y = p(2) = -2(-2)^2 - 8(-2) + 1 = 9$$

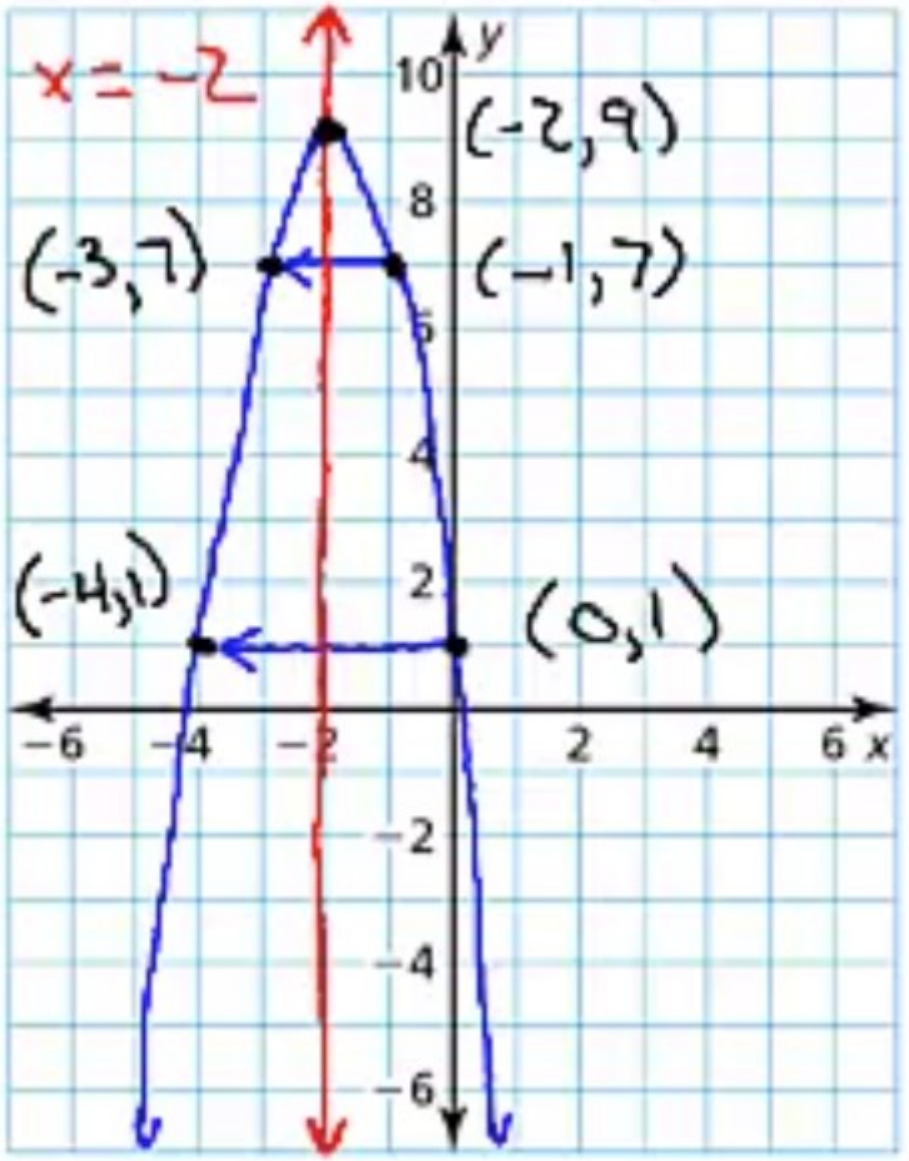
$(-2,9)$

Axis of symmetry:

$x = -2$

Evaluate the function at a point near the axis of symmetry, say $x = -2$

$p(-1) = -2(-1)^2 - 8(-1) + 1 = 7$



Homework:

- Pg 61, #1-35 odd (answers in back of book)