9.2 Graphing the quadratic

GOAL **Graph general quadratic functions.**

> **Vocabulary**
> For $y = ax^2 + bx + c$, the y-coordinate of the vertex is the **minimum value** of the function if $a > 0$ and the **maximum value** of the function if $a < 0$.

Steps are the same as 9.1

STEP 1 – Make a table of values.

- Find vertex – x= -b/2a
- The answer you get is also the axis of symentry
- Find 2 numbers greater than the vertex and 2 numbers smaller
- Fill in rest of IN/OUT table

STEP 2 – Plot points on a coordinate plane

STEP 3 – Connect points with smooth curve

STEP 4 – COMPARE IF NEEDED

Common Student Errors

- Overlooking the negative sign when finding the vertex or axis of symmetry

  Tip After students sketch the graph of the quadratic function, have them use a graphing calculator to verify their graphs.

- Using the x-coordinate of the vertex as the maximum or minimum value

  Tip Remind students that when finding the maximum or minimum *value* of a graph of a quadratic function, they need to *evaluate* the function using the x-coordinate of the vertex.

Example: Find the axis of symmetry of the graph of $y = 2x^2 + 3x - 1$.

Student response: $x = \frac{3}{4}$

Example: Find the minimum or maximum value of the graph of $f(x) = 2x^2 - 4x + 6$.

Student response: minimum value = 1

EXAMPLE 1 Find the axis of symmetry and the vertex

Consider the function $y = 3x^2 - 18x + 11$.

a. Find the axis of symmetry of the graph of the function.

b. Find the vertex of the graph of the function.

Solution

a. For the function $y = 3x^2 - 18x + 11$, $a = 3$ and $b = -18$.

$$x = -\frac{b}{2a} = -\frac{(-18)}{2(3)} = 3$$

Substitute 3 for a and -18 for b. Then simplify.

The axis of symmetry is $x = 3$.

b. The x-coordinate of the vertex is $-\frac{b}{2a}$, or 3. To find the y-coordinate, substitute 3 for x in the function and find y.

$$y = 3(3)^2 - 18(3) + 11 = -16$$

Substitute 3 for x. Then simplify.

The vertex is $(3, -16)$.

EXAMPLES

Find the axis of symmetry and the vertex of the graph of the function.

1. $y = 5x^2 + 20x + 9$

2. $y = \frac{1}{3}x^2 - 4x - 19$

EXAMPLE 3 Graph $y = ax^2 + bx + c$

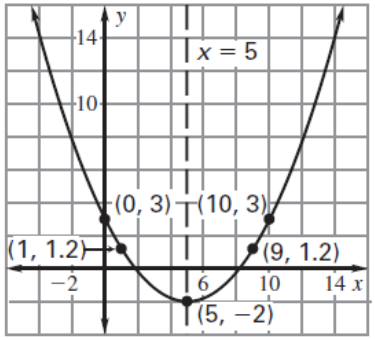
Graph $y = \frac{1}{5}x^2 - 2x + 3$.

Solution

STEP 1 **Determine** whether the parabola opens up or down.
Because $a > 0$, the parabola opens up.

STEP 2 **Find** and draw the axis of symmetry:

$$x = -\frac{b}{2a} = -\frac{(-2)}{2\left(\frac{1}{5}\right)} = 5.$$



STEP 3 **Find** and plot the vertex.

The x-coordinate of the vertex is $-\frac{b}{2a}$, or 5. To find the y-coordinate, substitute 5 for x in the function and simplify.

$$y = \frac{1}{5}(5)^2 - 2(5) + 3 = -2$$

So, the vertex is $(5, -2)$.

STEP 4 **Plot** two points. Choose two x-values less than the x-coordinate of the vertex. Then find the corresponding y-values.

x	0	1
y	3	1.2

STEP 5 **Reflect** the points plotted in Step 4 in the axis of symmetry.

STEP 6 **Draw** a parabola through the plotted points.

Exercise for Example 3

4. Graph the function $f(x) = x^2 - 4x + 7$. Label the vertex and axis of symmetry.