Name _____ Date _____

LESSON 9.2

Study Guide

For use with the lesson "Graph $y = ax^2 + bx + c$"

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 $a < 0$.

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 $(3, -16)$.

EXAMPLE 2 Find the minimum or maximum value

Tell whether the function $f(x) = x^2 + 14x - 3$ has a *minimum value* or a *maximum value*. Then find the minimum or maximum value.

Solution

Because $a = 1$ and $1 > 0$, the parabola opens up and the function has a minimum value. To find the minimum value, find the vertex.

$x = -\frac{b}{2a} = -\frac{14}{2(1)} = -7$ The x-coordinate is $-\frac{b}{2a}$.

$f(-7) = (-7)^2 + 14(-7) - 3 = -52$ Substitute -7 for x. Then simplify.

The minimum value of the function is $f(x) = -52$.

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Study Guide *continued*

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Exercises for Examples 1 and 2

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

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

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

3. Tell whether the function $f(x) = \frac{1}{2}x^2 - 8x + 13$ has a *minimum value* or a *maximum value*. Then find the minimum value or maximum value.

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

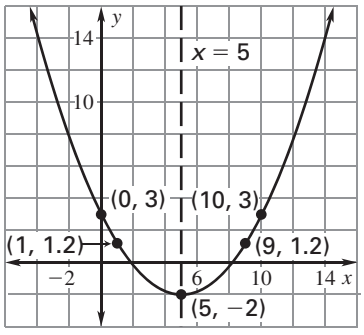
Graph $y = \frac{1}{5}x^2 - 2x + 3$.

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.