Name _____ Date _____
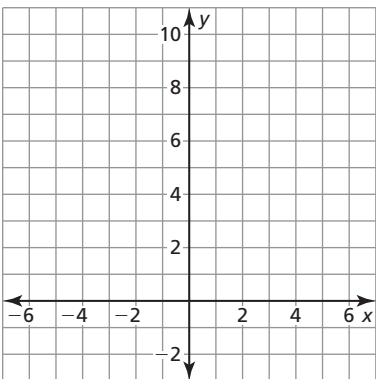
Essential Question How can you describe the graph of $f(x) = a(x - h)^2$?

1 **EXPLORATION:** Graphing $y = a(x - h)^2$ When $h > 0$

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Sketch the graphs of the functions in the same coordinate plane. How does the value of h affect the graph of $y = a(x - h)^2$?

a. $f(x) = x^2$ and $g(x) = (x - 2)^2$

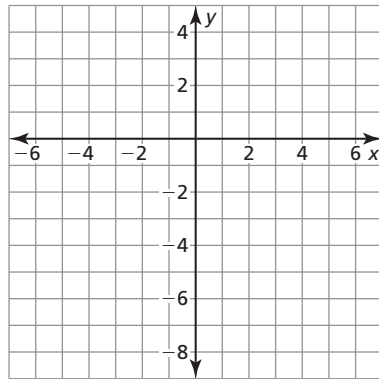b. $f(x) = 2x^2$ and $g(x) = 2(x - 2)^2$

Name_____ Date _____
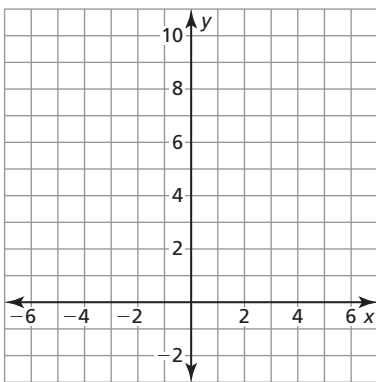
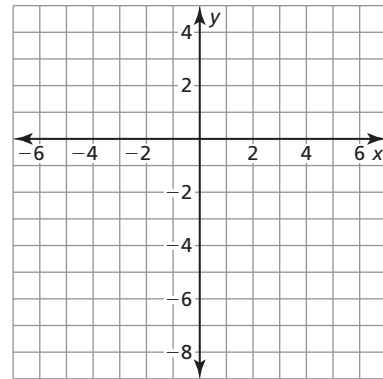**2** **EXPLORATION:** Graphing $y = a(x - h)^2$ When $h < 0$

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Sketch the graphs of the functions in the same coordinate plane. How does the value of h affect the graph of $y = a(x - h)^2$?

a. $f(x) = -x^2$ and $g(x) = -(x + 2)^2$ **b.** $f(x) = -2x^2$ and $g(x) = -2(x + 2)^2$

Communicate Your Answer

3. How can you describe the graph of $f(x) = a(x - h)^2$?

4. Without graphing, describe the graph of each function. Use a graphing calculator to check your answer.

a. $y = (x - 3)^2$

b. $y = (x + 3)^2$

c. $y = -(x - 3)^2$

8.4 Notetaking with Vocabulary
For use after Lesson 8.4

In your own words, write the meaning of each vocabulary term.

even function

odd function

vertex form (of a quadratic function)

Core Concepts

Even and Odd Functions

A function $y = f(x)$ is **even** when $f(-x) = f(x)$ for each x in the domain of f. The graph of an even function is symmetric about the y-axis.

A function $y = f(x)$ is **odd** when $f(-x) = -f(x)$ for each x in the domain of f. The graph of an odd function is symmetric about the origin. A graph is *symmetric about the origin* when it looks the same after reflections in the x-axis and then in the y-axis.

Notes:

Graphing $f(x) = a(x - h)^2$

- When $h > 0$, the graph of $f(x) = a(x - h)^2$ is a horizontal translation h units right of the graph $f(x) = ax^2$.

- When $h < 0$, the graph of $f(x) = a(x - h)^2$ is a horizontal translation $|h|$ units left of the graph of $f(x) = ax^2$.
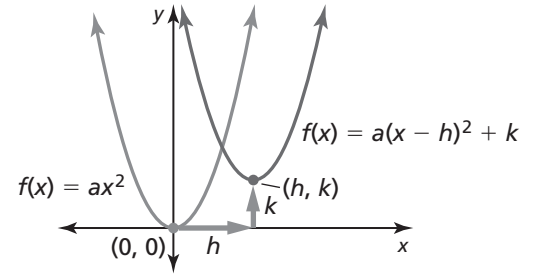
The vertex of the graph of $f(x) = a(x - h)^2$ is $(h, 0)$, and the axis of symmetry is $x = h$.

Notes:
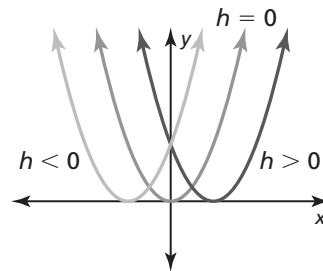
8.4   Notetaking with Vocabulary (continued)

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

The **vertex form** of a quadratic function is $f(x) = a(x - h)^2 + k$, where $a \neq 0$. The graph of $f(x) = a(x - h)^2 + k$ is a translation h units horizontally and k units vertically of the graph of $f(x) = ax^2$.

The vertex of the graph of $f(x) = a(x - h)^2 + k$ is (h, k), and the axis of symmetry is $x = h$.

Notes:

Extra Practice

In Exercises 1–4, determine whether the function is *even, odd,* or *neither.*

1. $f(x) = 5x$

2. $f(x) = -4x^2$

3. $h(x) = \dfrac{1}{2}x^2$

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

In Exercises 5–8, find the vertex and the axis of symmetry of the graph of the function.

5. $f(x) = 5(x - 2)^2$

6. $f(x) = -4(x + 8)^2$
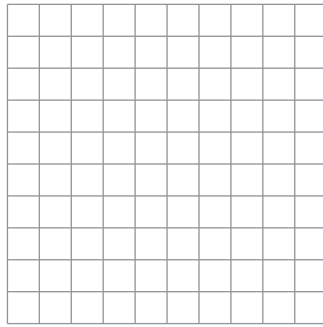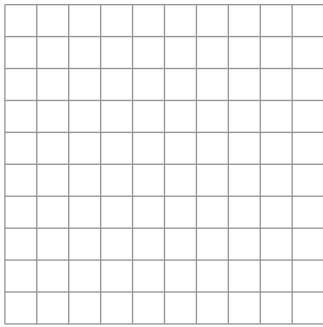
8.4 **Notetaking with Vocabulary** (continued)

7. $p(x) = -\dfrac{1}{2}(x - 1)^2 + 4$

8. $g(x) = -(x + 1)^2 - 5$

In Exercises 9 and 10, graph the function. Compare the graph to the graph of
$f(x) = x^2.$

9. $m(x) = 3(x + 2)^2$

10. $g(x) = -\dfrac{1}{4}(x - 6)^2 + 4$

In Exercises 11 and 12, graph _g_.

11. $f(x) = 3(x + 1)^2 - 1; g(x) = f(x + 2)$

12. $f(x) = \dfrac{1}{2}(x - 3)^2 - 5; g(x) = -f(x)$