

# Algebra 1

Our Goal: To learn to graph quadratic functions of the form  $f(x) = a(x-h)^2 + k$

Warm Up: Quiz discussion, vertex of parabola review

## Today's Homework

8.4 Exercises, p.446-448: 6-66 (multiples of 6)

that's 6,12,18,24,30,36,42,48,54,60,66

## Previous Homework

None

Find the coordinates of the vertex.  $1x^2 + 0x + 2$

1.  $y = x^2$   $3. y = x^2 + 2$   $\frac{-b}{2a} = \frac{-0}{2(1)} = 0$

$(0, 2)$

3.  $y = \frac{2}{3}x^2$   $4. y = x^2 - 5x$

$\frac{-b}{2a} = \frac{-(-5)}{2(1)} = 2\frac{1}{2}$

$(2\frac{1}{2}, -6.25)$

5.  $y = -x^2$   $6. y = 3x^2 + x + 2$

$\frac{-b}{2a} = \frac{-1}{6}$

$3\left(\frac{-1}{6}\right)^2 + \left(\frac{-1}{6}\right) + 2$

$\frac{3}{36} - \frac{6}{36} + \frac{72}{36}$

$\frac{69 \div 3}{36 \div 3} \frac{23}{12}$

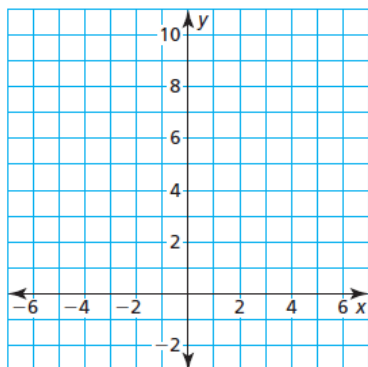
## Essential Question

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

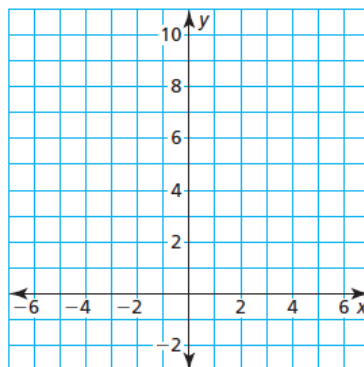
**Work with a partner.** Sketch the graphs of the functions in the same coordinate plane. How does the value of  $h$  affect the graph of

$y = a(x - h)^2$ ?

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



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

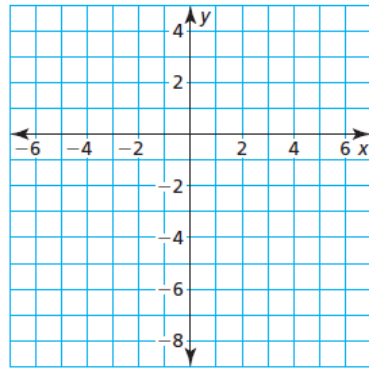
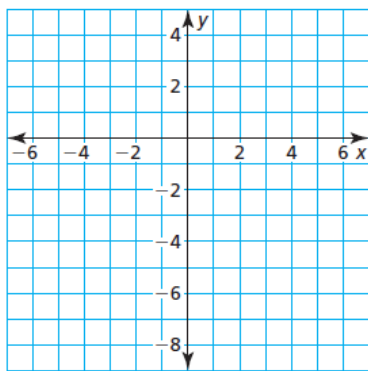


**Work with a partner.** Sketch the graphs of the functions in the same coordinate plane. How does the value of  $h$  affect the graph of

$$y = a(x - h)^2?$$

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

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



### Core Concept

#### 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.

A function is even if opposite inputs give the same outputs.

A function is odd if opposite inputs give opposite outputs.

Some functions are neither.

If a function is even it will fold on the  $y$ -axis

If the function is odd it

Determine whether each function is even, odd, or neither.

a.  $f(x) = 2x$

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

c.  $h(x) = 2x^2 + x - 2$

$$f(-x) = 2(-x)$$

$$= -2x$$

odd

$$g(-x) = (-x)^2 - 2$$

$$= x^2 - 2$$

even

$$h(-x) = 2(-x)^2 + (-x) - 2$$

$$= 2x^2 - x - 2$$

neither

Determine whether the function is even, odd, or neither.

1.  $f(x) = 5x$

2.  $g(x) = 2^x$

3.  $h(x) = 2x^2 + 3$

$$f(-x) = -5x$$

ODD  
~~~~

$$g(-x) = 2^{-x}$$

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

neither  
~~~~

$$h(-x) = 2(-x)^2 + 3$$

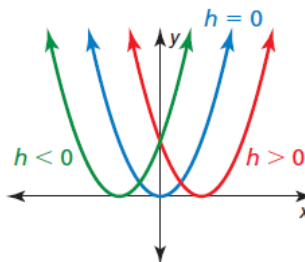
$$= 2x^2 + 3$$

## Core Concept

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

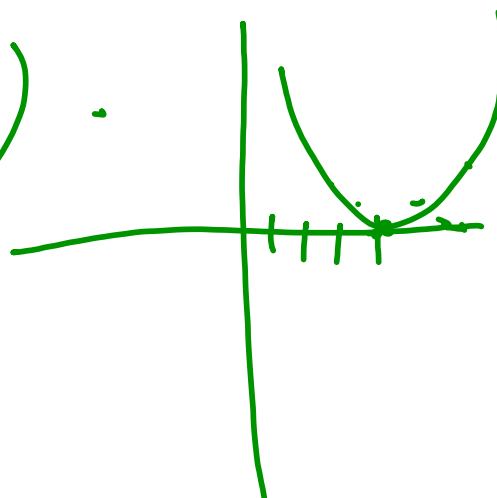
The vertex of the graph of  $f(x) = a(x - h)^2$  is  $(h, 0)$ , and the axis of symmetry is  $x = h$ .



Graph  $g(x) = \frac{1}{2}(x - 4)^2$ . Compare the graph to the graph of  $f(x) = x^2$ .

$$= \frac{1}{2}(x - 4)^2 + 0$$

$$V: (4, 0)$$



Graph the function. Compare the graph to the graph of  $f(x) = x^2$ .

4.  $g(x) = 2(x + 5)^2$

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

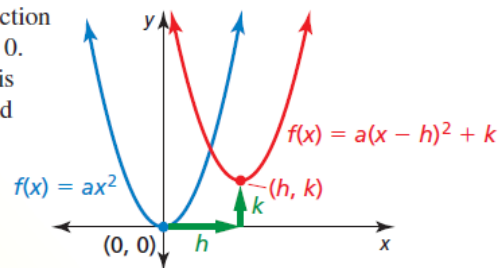
## Core Concept

### 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  $x = h$ .

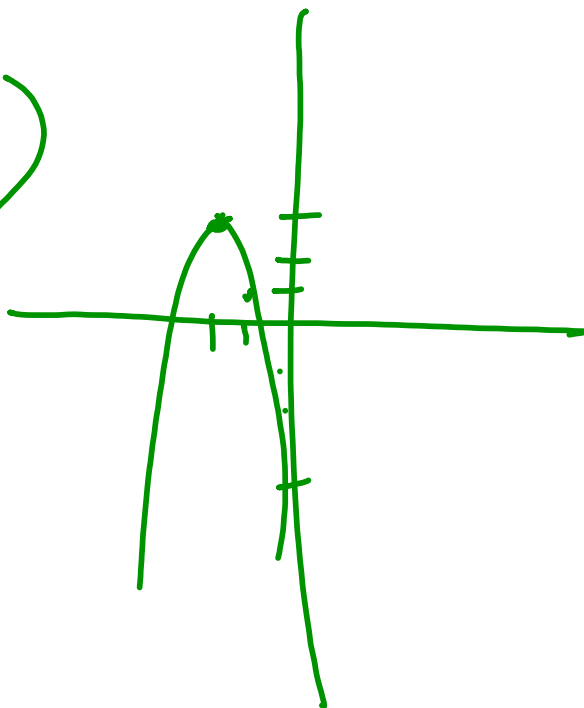


Graph  $g(x) = -2(x + 2)^2 + 3$ . Compare the graph to the graph of  $f(x) = x^2$ .

$$V: (-2, 3)$$

down

than  $x^2$



Consider function  $g$  in Example 3. Graph  $f(x) = g(x + 5)$ .

Graph the function. Compare the graph to the graph of  $f(x) = x^2$ .

6.  $g(x) = 3(x - 1)^2 + 6$

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

8. Consider function  $g$  in Example 3. Graph  $f(x) = g(x) - 3$ .

Water fountains are usually designed to give a specific visual effect. For example, the water fountain shown consists of streams of water that are shaped like parabolas. Notice how the streams are designed to land on the underwater spotlights. Write and graph a quadratic function that models the path of a stream of water with a maximum height of 5 feet, represented by a vertex of  $(3, 5)$ , landing on a spotlight 6 feet from the water jet, represented by  $(6, 0)$ .



<https://www.youtube.com/watch?v=INQpcDuE6e4>

<https://www.youtube.com/watch?v=OppJ458d4Gs>

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

$$y = a(x - 3)^2 + 5$$

$$0 = a(6 - 3)^2 + 5$$

$$0 = 9a + 5$$

$$-5 = 9a$$

$$a = \frac{-5}{9}$$

$$y = -\frac{5}{9}(x - 3)^2 + 5$$



9. **WHAT IF?** The vertex is (3, 6). Write and graph a quadratic function that models the path.

**Exit Ticket:** Given  $f(x) = \frac{1}{2}(x + 8)^2 + 4$ , tell what you know about the function and sketch its graph.