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

Extension 8.4

Key Idea

The **vertex form** of a quadratic function is $y = a(x - h)^2 + k$, where $a \neq 0$. The vertex of the parabola is (h, k).

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Graphing $y = (x - h)^2$

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

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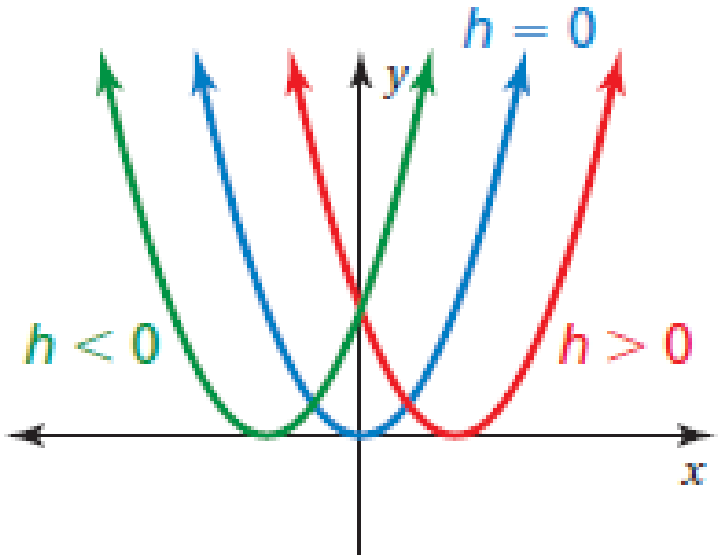
The **vertex form** of a quadratic function is $y = a(x - h)^2 + k$, where $a \neq 0$. The vertex of the parabola is (h, k).

Graphing $y = (x - h)^2$

- When $h > 0$, the graph of $y = (x - h)^2$ is a horizontal translation h units to the right of the graph of $y = x^2$.
- When $h < 0$, the graph of $y = (x - h)^2$ is a horizontal translation h units to the left of the graph of $y = x^2$.



EXAMPLE 1 Graphing $y = (x - h)^2$

Graph $y = (x - 4)^2$. Compare the graph to the graph of $y = x^2$.

STEP 1: Identify the vertex : (h, k)

$(4, 0)$ Really?

$y = a(x - h)^2$ *is the same as* $y = a\{x + (-h)\}^2$

Still hard to believe?

Let's write $y = (x - 4)^2$ as a simplified polynomial.

$$y = (x - 4)(x - 4)$$

$$y = x^2 - 4x - 4x + 16$$

$$y = x^2 - 8x + 16$$

$$-\frac{b}{2a}. = -\frac{(-8)}{2} = 4$$

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STEP 1: Identify the vertex : (h, k)

$(4, 0)$

STEP 2: Identify the Axis of Symmetry

$x = 4$

STEP 3: Find two other points and **reflect** them across the Axis of symmetry. Then connect the five points with a smooth curve.

x	5	6	
y	1	4	

EXAMPLE 1 Graphing $y = (x - h)^2$

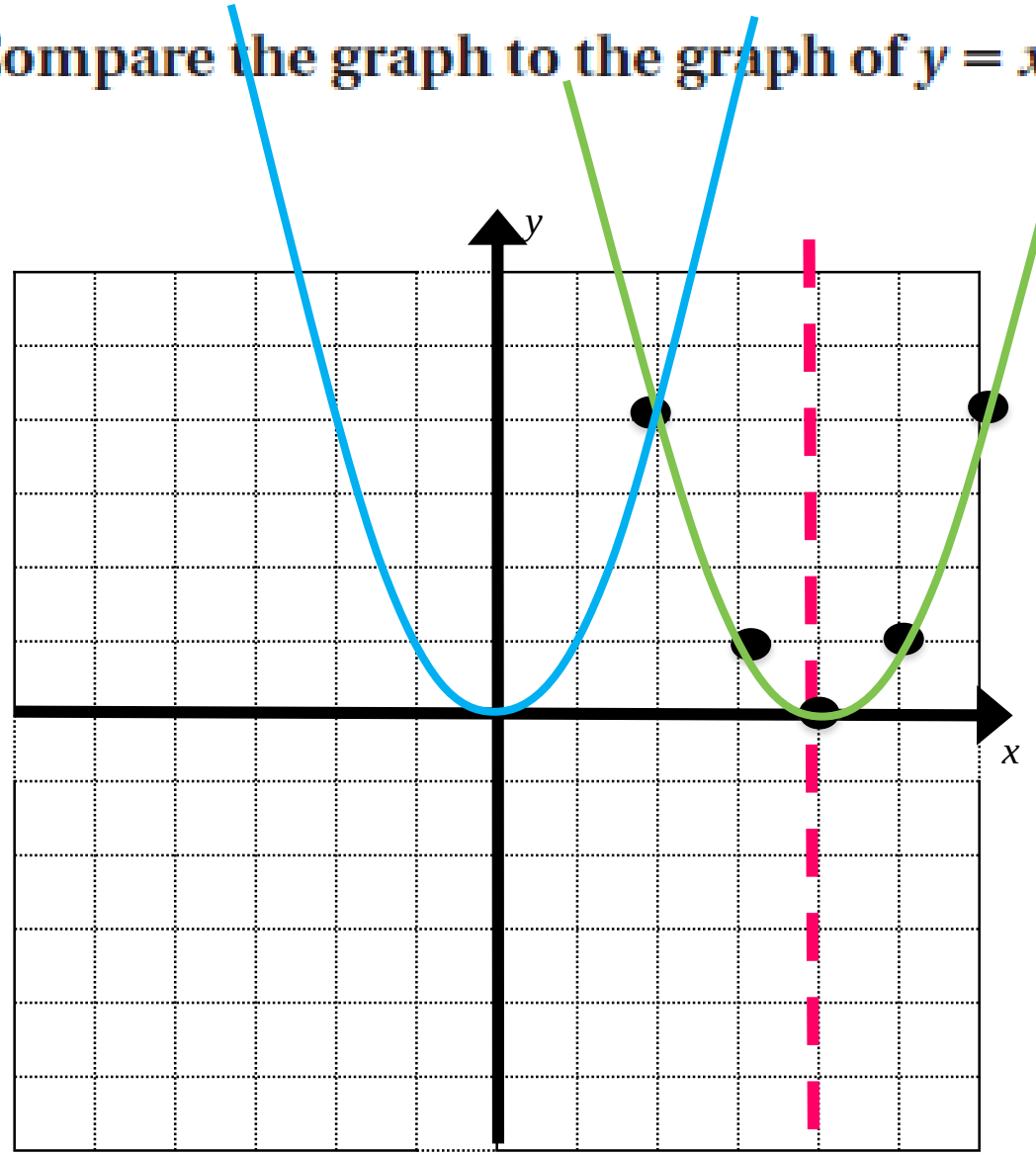
Graph $y = (x - 4)^2$. Compare the graph to the graph of $y = x^2$.

Vertex : (4,0)

Axis of Symmetry: $x = 4$

x	5	6
y	1	4

The graph of $y = (x - 4)^2$ is a translation 4 units to the right of the graph of $y = x^2$.



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

Graph $y = (x + 5)^2 - 1$. Compare the graph to the graph of $y = x^2$.

STEP 1: Identify the vertex : (h, k)

$(-5, -1)$

STEP 2: Identify the Axis of Symmetry

$x = -5$

STEP 3: Find two other points and **reflect** them across the Axis of symmetry.

x	-4	-3	
y	0	3	

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

Graph $y = (x + 5)^2 - 1$. Compare the graph to the graph of $y = x^2$.

Vertex : $(-5, -1)$

Axis of Symmetry: $x = -5$

x	-4	-3
y	0	3

The graph of $y = (x + 5)^2 - 1$ is a translation 5 units to the left and 1 unit down.