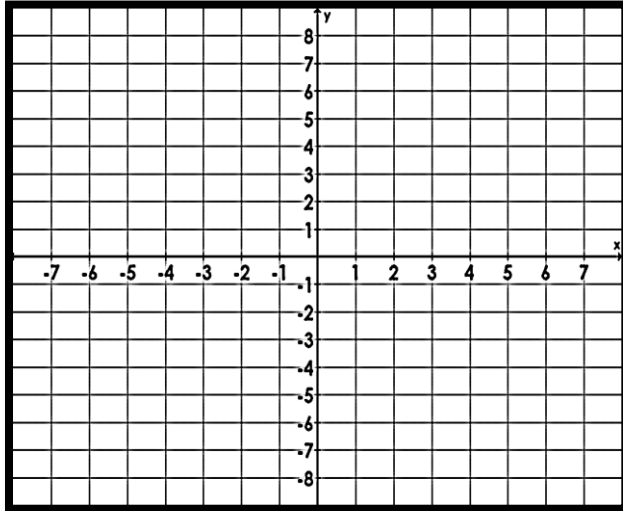# Day 1: Quadratic Transformations (H & K values)

The **parent function** of a function is the simplest form of a function. The parent function for a quadratic function is **y = x²** or **f(x) = x²**. Graph the parent function below.

x	x^2
-3	
-2	
-1	
0	
1	
2	
3	

As you can see, the graph of a quadratic function is very different than the graph of a linear function.

The U-shaped graph of a quadratic function is called a

_____.

The highest or lowest point on a parabola is called the

_____.

One other characteristic of a quadratic equation is that one of the terms is always _____.

There are several different forms a quadratic function can be written in, but the one we are going to work with for today is called **vertex form**. In the following explorations below, you are going to learn the effect of a, h, and k values have on the parent graph.

Vertex Form

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

Vertex: _____

Variable	Summary of the Effects of the Transformations			
a		Up:		Stretch:
		Down:		Shrink:
h			Left:	
			Right:	
k			Up:	
			Down:	

1

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

- _____ if _____

- _____ if _____

Practice: Identify the transformations and vertex from the equations below.
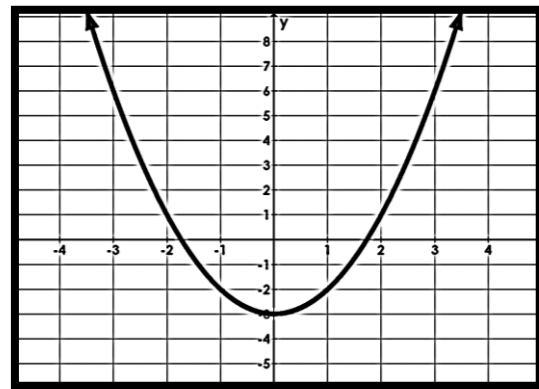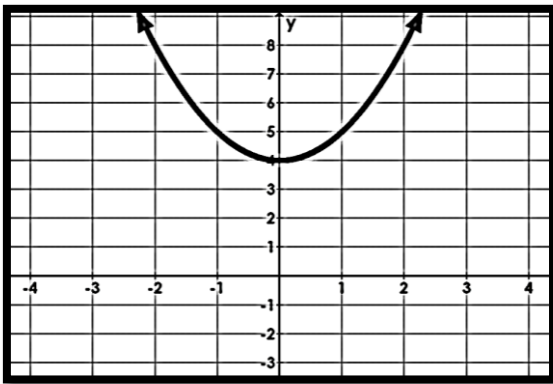
1. $y = x^2 + 5$ 2. $y = x^2 - 3$ 3. $y = x^2 + 7$ 4. $y = x^2 - 4$

Practice: Describe the transformations and name the vertex. Create an equation for the graphs listed below.

Practice: Given the transformations listed below, create an equation that would represent the transformations.

1. Shifted up 8 units   2. Shifted up 20 units   3. Shifted down 5 units

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

- _____ if _____

- _____ if _____

Practice: Identify the transformations and vertex from the equations below.
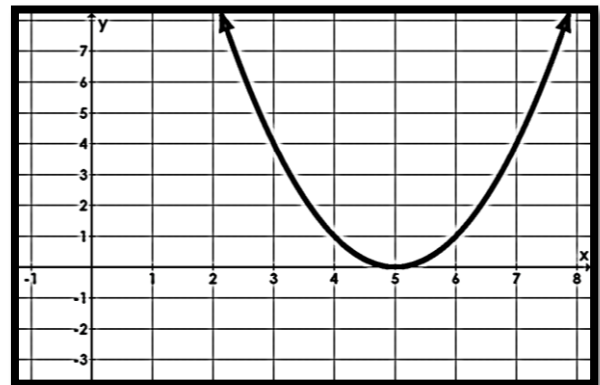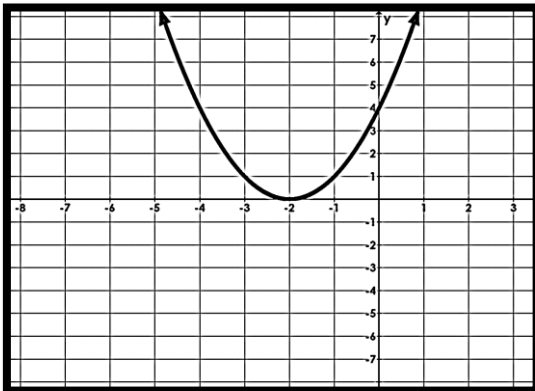
1. $y = (x - 4)^2$ 2. $y = (x + 6)^2$ 3. $y = (x - 7)^2$ 4. $y = (x + 3)^2$

Practice: Describe the transformations and name the vertex. Create an equation for the graphs listed below.

Practice: Given the transformations listed below, create an equation that would represent the transformations.

1. Shifted right 8 units   2. Shifted left 20 units   3. Shifted left 5 units

Putting It All Together

Practice: Identify the transformations and vertex from the equations below.
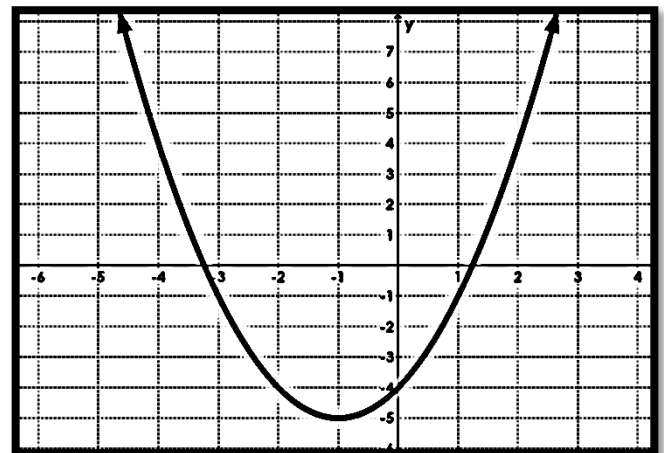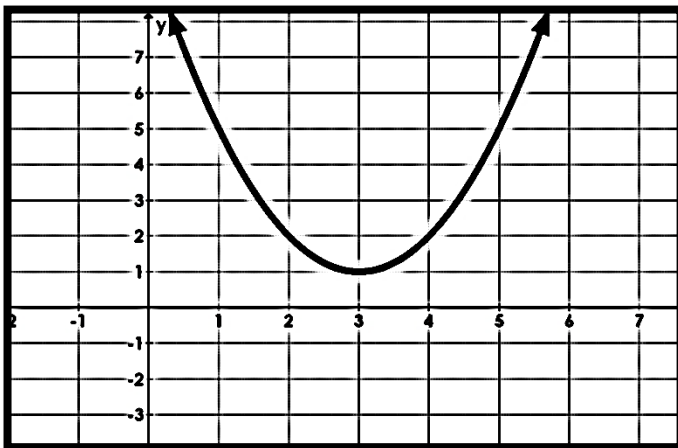
1. $y = (x - 2)^2 + 4$ 2. $y = (x + 3)^2 - 2$ 3. $y = (x - 9)^2 - 5$ 4. $y = (x + 5)^2 + 6$

Practice: Describe the transformations and name the vertex. Create an equation for the graphs listed below.

Practice: Given the transformations listed below, create an equation that would represent the transformations.

1. Shifted up 4 units and left 3 units   2. Shifted right 5 units and down 2 units

3. Shifted left 8 units and down 1 unit   4. Shifted up 5 units and right 9 units

Quadratic Transformations (A values)

So far, we have discussed what the H and K values do when a quadratic function is in vertex form. How do you think the "a" coefficient will affect the graph? The "a" value affects the graph in two different ways which you will learned about in this lesson.
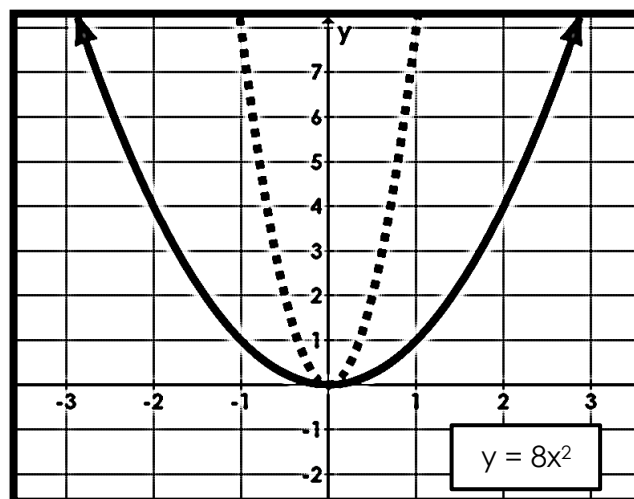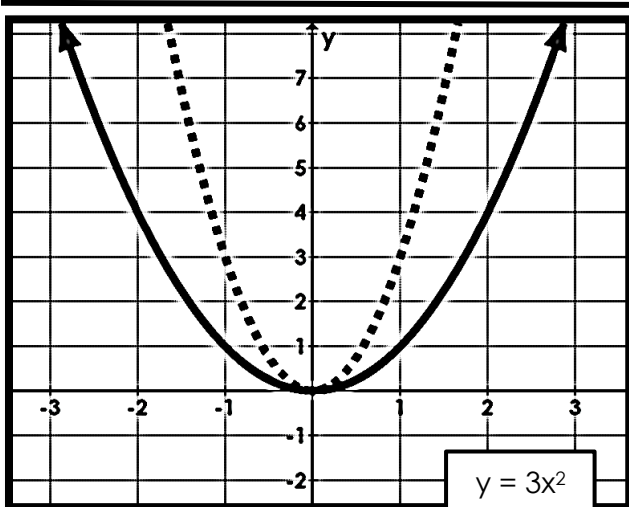
Vertex Form

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

h = _____

k = _____

Vertex: _____

The A Value, Part 1

$y = 3x^2$

$y = 8x^2$

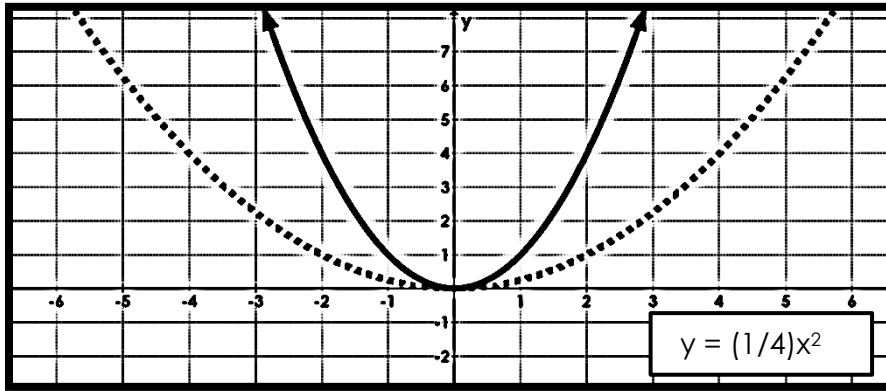1. Describe how the dotted graph has been transformed from $y = x^2$.
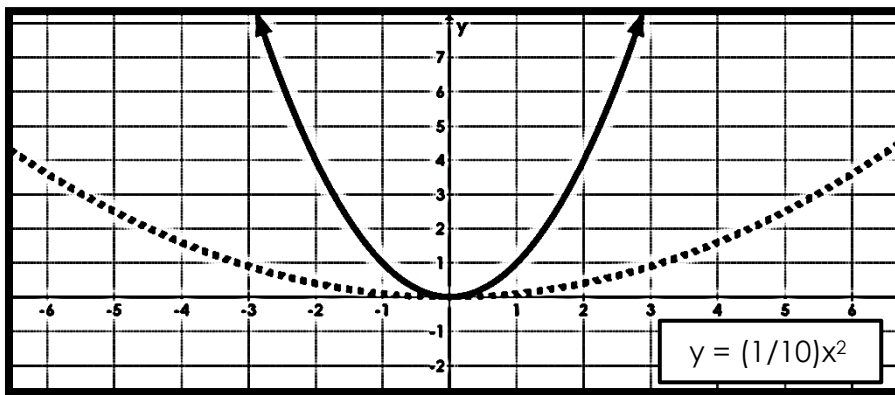
2. What is the vertex? _____

3. How does the equation of the graph related to its vertex?

1. Describe how the dotted graph has been transformed from $y = x^2$.

2. What is the vertex? _____

3. How does the equation of the graph related to its vertex?

y = (1/4)x²

1. Describe how the dotted graph has been transformed from y = x².

2. What is the vertex? _____

3. How does the equation of the graph related to its vertex?

y = (1/10)x²

1. Describe how the dotted graph has been transformed from y = x².

2. What is the vertex? _____
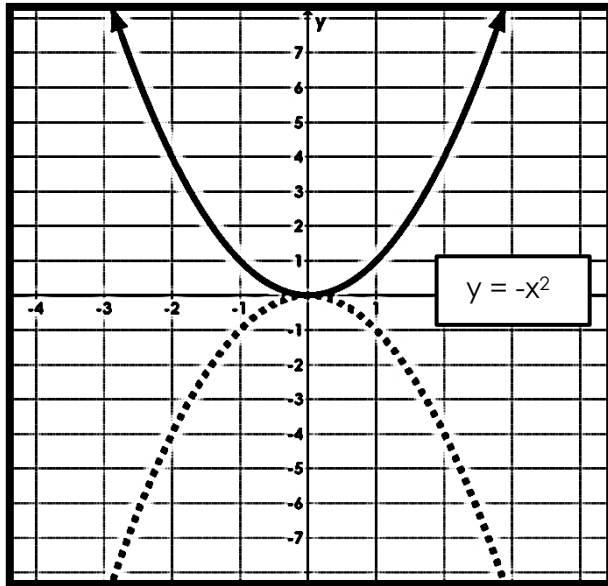
3. How does the equation of the graph related to its vertex?

How do you think the number in front affects the graph?

The a Value, Part 1

- _____ **if** _____

- _____ **if** _____

The A Value, Part 2

1. Describe how the dotted graph has been transformed from $y = x^2$.

2. What is the vertex? _____

3. How does the equation of the graph related to its vertex?

$y = -x^2$

The a Value, Part 2

- _____ **if** _____

- _____ **if** _____

Practice: Describe the transformations from the given function to the transformed function.

a. $f(x) = x^2 \rightarrow f(x) = 4x^2$

b. $y = x^2 \rightarrow y = \frac{1}{4}x^2$

c. $f(x) \rightarrow 6\,f(x)$

d. $f(x) = x^2 \rightarrow f(x) = -x^2$

f. $y = x^2 \rightarrow y = -\frac{1}{2}x^2$

g. $f(x) \rightarrow -4f(x)$

Putting It All Together

Practice: Given the equations below, name the vertex and describe the transformations:

a. $y = -(x - 4)^2 + 7$ b. $y = -2(x + 2)^2 + 5$ c. $y = \frac{1}{2}(x - 3)^2 - 8$

Practice: Create an equation to represents the following transformations:

a. Shifted down 4 units, right 1 unit, and reflected across the x-axis

b. Shifted up 6 units, reflected across the x-axis, and stretch by a factor of 3

c. Shifted up 2 units, left 4 units, reflected across the x-axis, and shrunk by a factor of ¾.