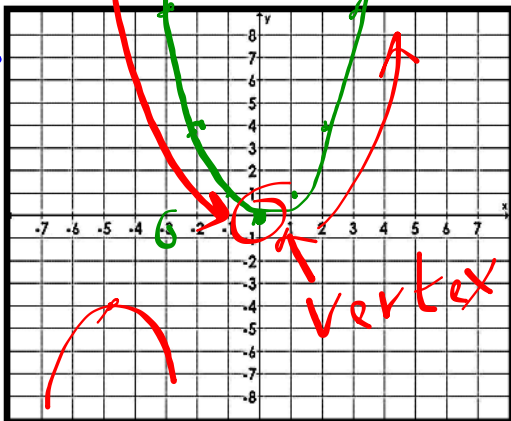


Day 1: Quadratic Transformations (H & K values)

The **parent function** of a function is the simplest form of a function. The parent function for a quadratic function is $y = x^2$ or $f(x) = x^2$. Graph the parent function below.

x	x^2
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9

x y



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 parabola.

The highest or lowest point on a parabola is called the vertex.

One other characteristic of a quadratic equation is that one of the terms is always x^2 .

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: (h, k)

$$y = Ax^2 + Bx + C$$

Go to: www.student.desmos.com
Enter the code: 2GR6FZ

Discovering Quadratic Transformations with Desmos

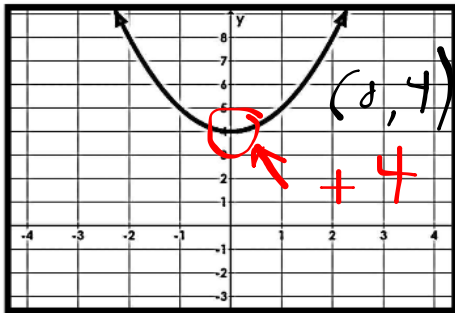
Slide 1 ~ The K Value ~ $y = x^2 + k$

- a. What does the k value do to the blue graph? \uparrow / \downarrow
- b. What does a positive k value do to the blue graph? \uparrow
- c. What does a negative k value do to the blue graph? \downarrow
- d. Which coordinate of the vertex changes when there is a k value present? y
- e. Name the transformations that would occur for the following equations (you may use the regular Desmos calculator for help). Then name the vertex.

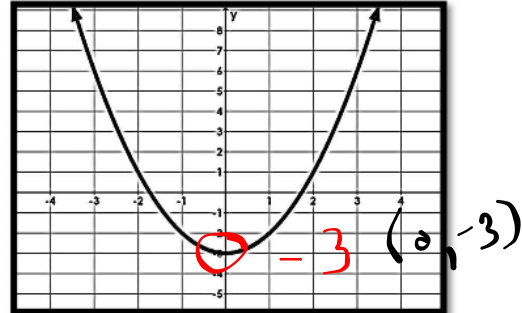
Equation	Transformations	Vertex
1. $y = x^2 + 5$	$\uparrow 5$	$(0, 5)$
2. $y = x^2 - 3$	$\downarrow 3$	$(0, -3)$
3. $y = x^2 + 7$	$\uparrow 7$	$(0, 7)$
4. $y = x^2 - 4$	$\downarrow 4$	$(0, -4)$

$y = x^2 + k$ $\updownarrow y\text{-axis}$

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



$y = x^2 + 4$



$y = x^2 - 3$

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

1. Shifted up 8 units

$k = +8$
 $y = x^2 + 8$

2. Shifted up 20 units

$y = x^2 + 20$

3. Shifted down 5 units

$y = x^2 - 5$

Algebra 1

Unit 6: Quadratic Functions

Notes

Slide 2 ~ The H Value ~ $y = (x - h)^2$

- a. What does the h value do to the blue graph? moves \leftrightarrow horizontal
- b. What does a positive h value do to the blue graph? $R \rightarrow$
- c. What does a negative h value do to the blue graph? $L \leftarrow$
- d. Which coordinate of the vertex changes when there is an h value present? x

Slide 3 ~ The Tricky Part about the H Value

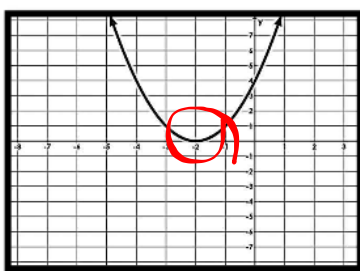
- e. Compare the blue graph to the black graph. How did the blue graph move? left
- f. What should be the h-value for the blue graph? -4
- g. However, when you look at the equation for the blue graph, what do you notice?
 $h = +4$
- h. Compare the green graph to the black graph. How did the green move? right
- i. What should be the h-value for the green graph? +
- j. However, when you look at the equation for the green graph, what do you notice? -

HMMM.....Now read Slide 4!

k. Name the transformations that would occur for the following equations (you may use the regular Desmos calculator for help). Then name the vertex.

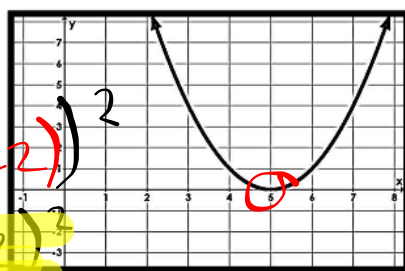
Equation	Transformations	Vertex
1. $y = (x - 4)^2$	$-4 \rightarrow$ right 4	$(4, 0)$
2. $y = (x + 6)^2$	$-6 \rightarrow$ left 6	$(-6, 0)$
3. $y = (x - 7)^2$	$+7 \rightarrow$ right 7	$(7, 0)$
4. $y = (x + 3)^2$	$-3 \rightarrow$ left 3	$(-3, 0)$

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



$(-2, 0)$

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



$(5, 0)$

$y = (x - 5)^2$

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

1. Shifted right 8 units

$h = +8$
 $y = (x - 8)^2$

2. Shifted left 20 units

$h = -20$
 $y = (x + 20)^2$

3. Shifted left 5 units

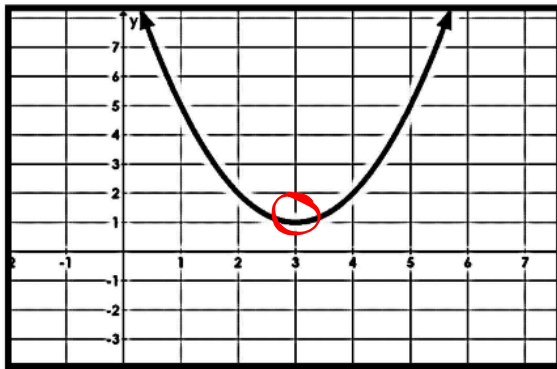
$h = -5$
 $y = (x + 5)^2$

Putting It All Together with H and K

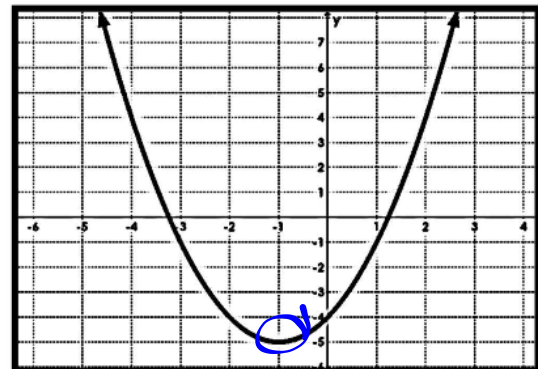
Practice: Identify the transformations and vertex from the equations below.

Equation	Transformations	Vertex
1. $y = (x - 2)^2 + 4$	+2: right 2 4 ↑ 4	(2, 4)
2. $y = (x + 3)^2 - 2$	-3: left 3 ↓ 2	(-3, -2)
3. $y = (x - 9)^2 - 5$	+9: right 9 ↓ 5	(9, -5)
4. $y = (x + 5)^2 + 6$	-5: left 5 ↑ 6	(-5, 6)

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



Transformations: → 3, ↑ 1
 Vertex: (3, 1)
 Equation: $y = (x - 3)^2 + 1$



Transformations: ← 1, ↓ 5
 Vertex: (-1, -5)
 Equation: $y = (x + 1)^2 - 5$

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

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

1. Shifted up 4 units and left 3 units

$k = +4$
 $h = -3$

$y = (x + 3)^2 + 4$

2. Shifted right 5 units and down 2 units

$h = 5$

3. Shifted left 8 units and down 1 unit

4. Shifted up 5 units and right 9 units