- Grab the following:
  - Standards Tab and glue on a new page in your notebook
  - New Unit 3B Note Packet

  - Using your phones, if you can, download the app: **DESMOS**

Happy Valentine's Day

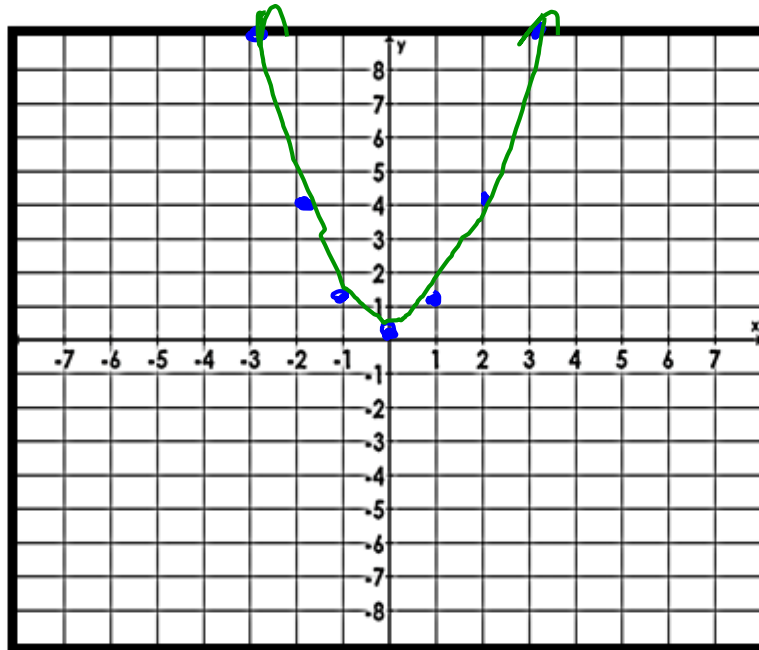# DAY 1: QUADRATIC TRANSFORMATIONS (H & K VALUES)

Unit 3B: Graphing Quadratic Functions

WHAT IS A QUADRATIC FUNCTION?

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

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 ___squared___.

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.
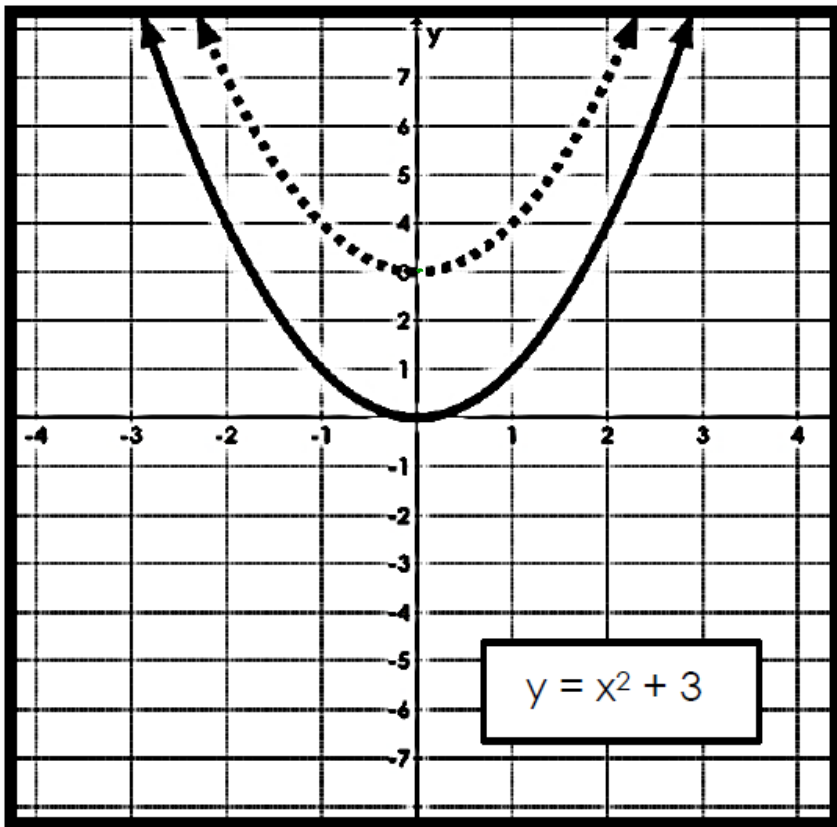
Vertex Form

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

Standard form: $x^2 + bx + c = 0$

SUMMARY OF TRANSFORMATIONS

Variable	Summary of the Effects of the Transformations			
a	Vertical stretch Vertical shrink	Up: $+a$ Down: $-a$	narrower Wider	Stretch: $a > 1$ Shrink: compress $0 < a < 1$
h	horizontal shift	Left: $+h$ Right: $-h$		
k	Vertical shift	Up: $+k$ Down: $-k$		

Vertex: (h, k)

GRAPH 1

The graph shows $y = x^2 + 3$ (solid) and the dotted parabola with arrows.

1. Describe how the dotted graph has been transformed from $y = x^2$.
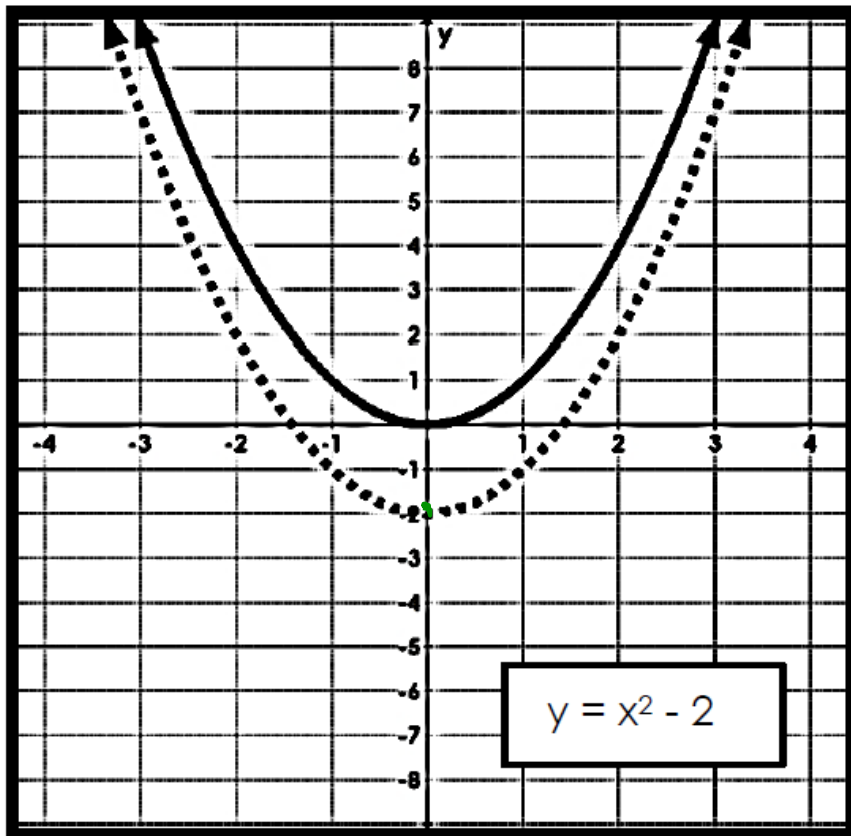
The graph is shifted 3 units up.

2. What is the vertex? $(0, 3)$

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

$+3$ moves the vertex up by 3 units.

GRAPH 2

$y = x^2 - 2$

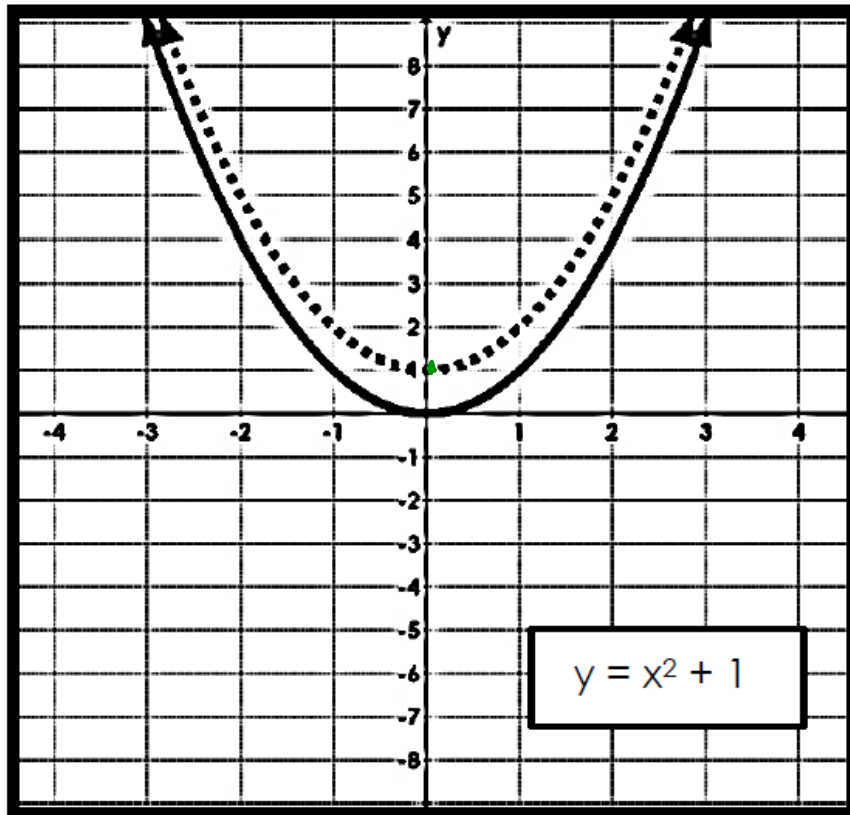1. Describe how the dotted graph has been transformed from $y = x^2$.

The graph is shifted down by 2 units.

2. What is the vertex? $(0, -2)$

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

-2 moves the vertex down by 2 units

GRAPH 3

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

The graph is shifted 1 unit up.

2. What is the vertex? $(0, 1)$

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

$+1$ moves the vertex up by 1 unit.

$y = x^2 + 1$

So how does the number at the end affect the graph?

$$ax^2 + bx + c = 0$$

THE K VALUE

The k Value

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

- Vertex moves up _____ if _K is positive_
- Vertex moves down _____ if _|k| is negative_

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

1. $y = x^2 + 5$

Shift up by 5 units

$(0, 5)$

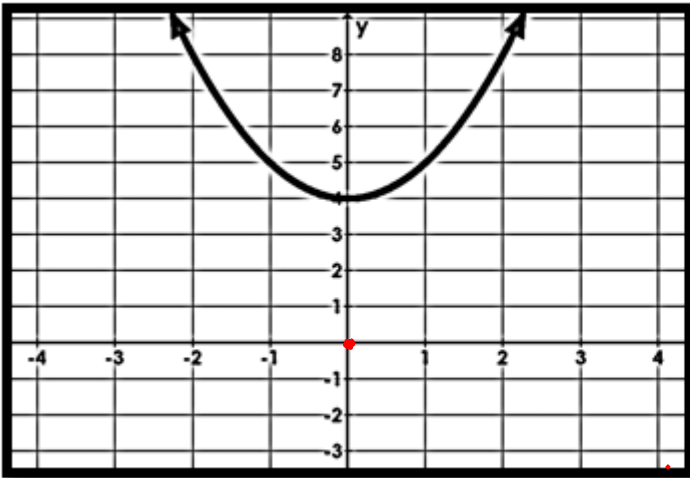2. $y = x^2 - 3$

down by 3 units

$(0, -3)$

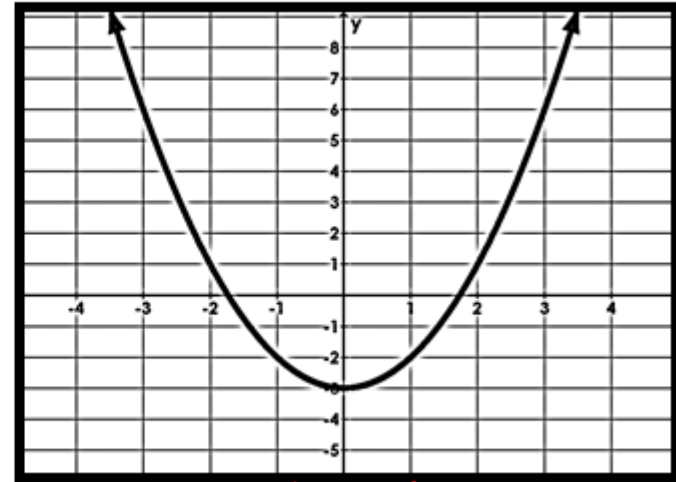3. $y = x^2 + 7$

Shift up by 7 units

$(0, 7)$

4. $y = x^2 - 4$

Shift down by 4 units

$(0, -4)$

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

Vertical shift up by 4 units

$(0, 4)$ $y = x^2 + 4$

Vertical shift down by 3 units. $(0, -3)$

$y = x^2 - 3$

Practice: Given the transformations listed below, create an equation that would represent the transformations.
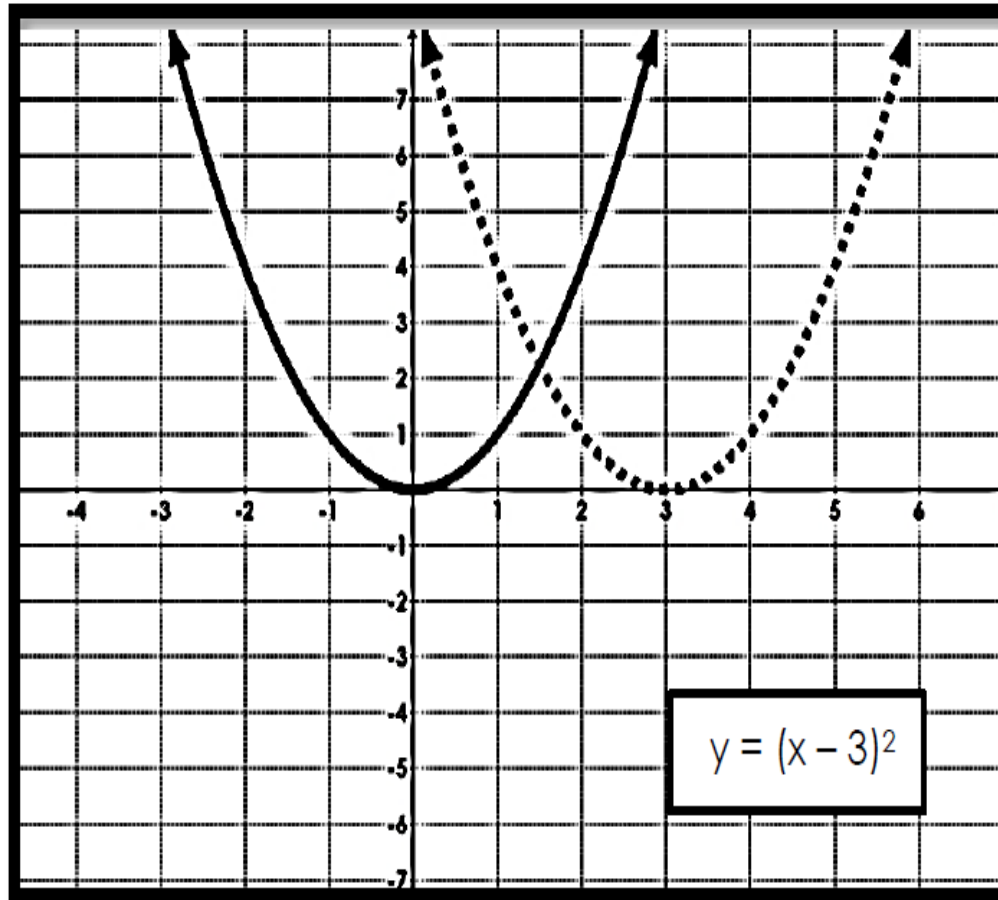
1. Shifted up 8 units

$y = x^2 + 8$

2. Shifted up 20 units

$y = x^2 + 20$

3. Shifted down 5 units
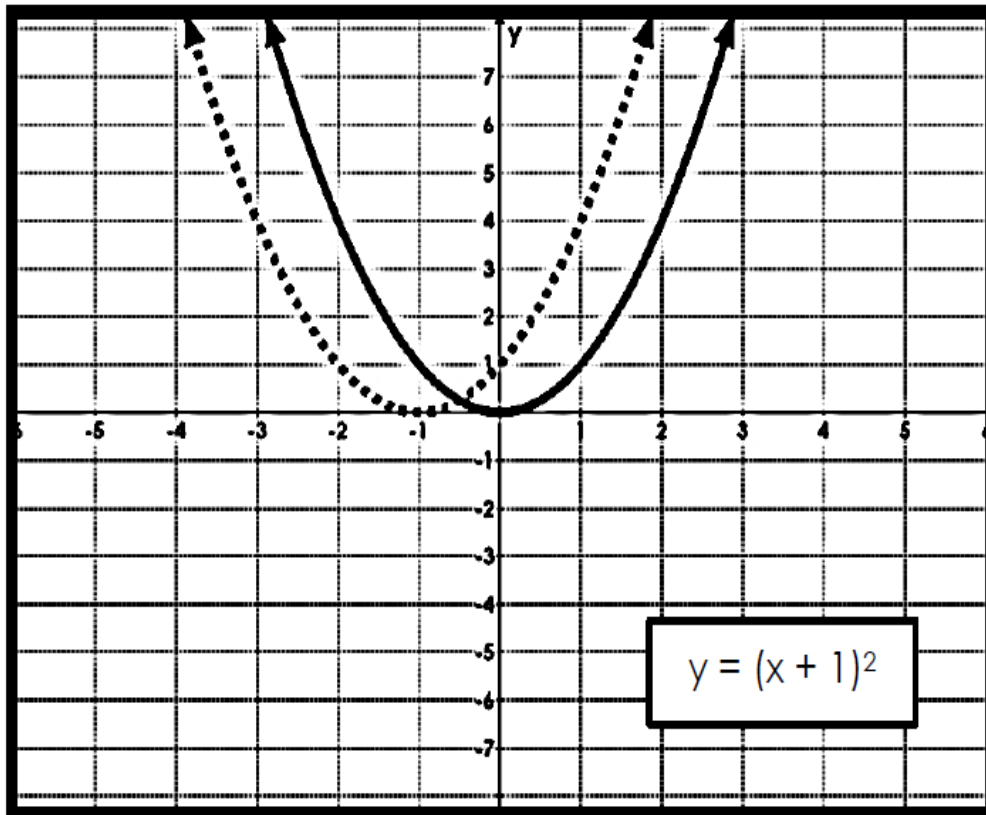
$y = x^2 - 5$

GRAPH 1

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

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

Horizontal Shift to the right by 3 units.

2. What is the vertex? $(3, 0)$

3. How is the equation of the graph related to its vertex? -3 shifts the vertex 3 units to the right
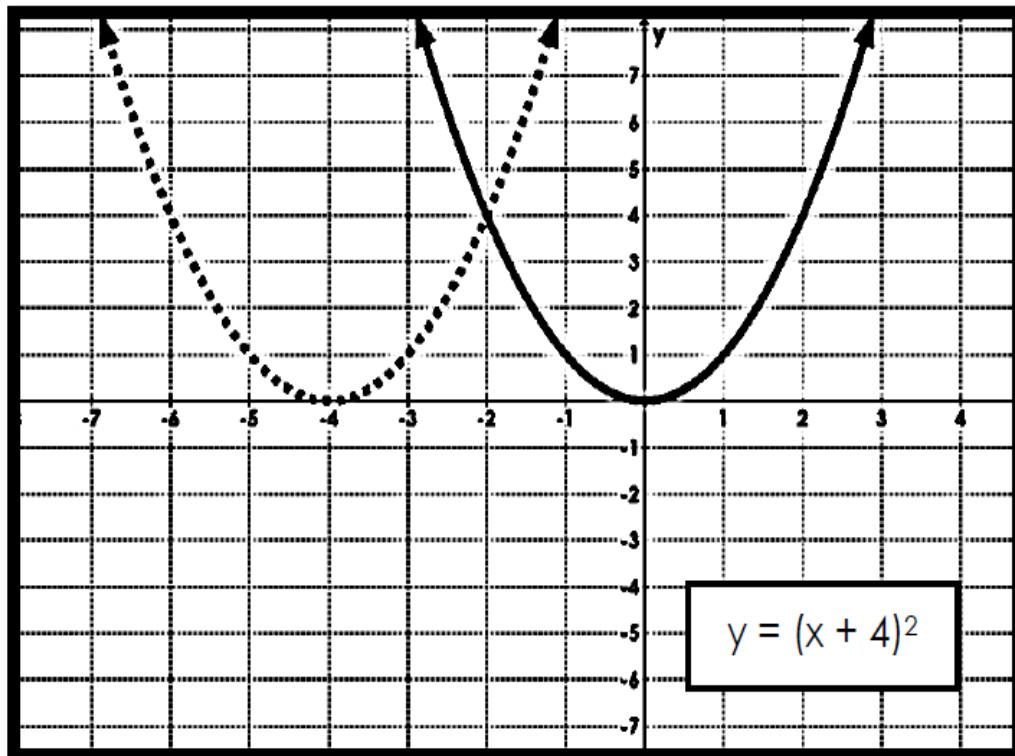
GRAPH 2

$$y = (x + 1)^2$$

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

Horizontal shift to left by 1 unit

2. What is the vertex? $(-1, 0)$

3. How is the equation of the graph related to its vertex? $+1$ Shifts the vertex 1 unit to the left

GRAPH 3

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

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

Horizontal shifts to the left by 4 units

2. What is the vertex? $(-4, 0)$

3. How is the equation of the graph related to its vertex? $+4$

Shifts the vertex 4 units to the left

So how does the number inside affect the graph?

The h Value

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

Graph

- moves right _____ if _h is negative_

- Vertex moves left _____ if _h is positive_

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

1. $y = (x - 4)^2$

Shift right by 4

$(4, 0)$

2. $y = (x + 6)^2$

Shift left by 6

$(-6, 0)$

3. $y = (x - 7)^2$
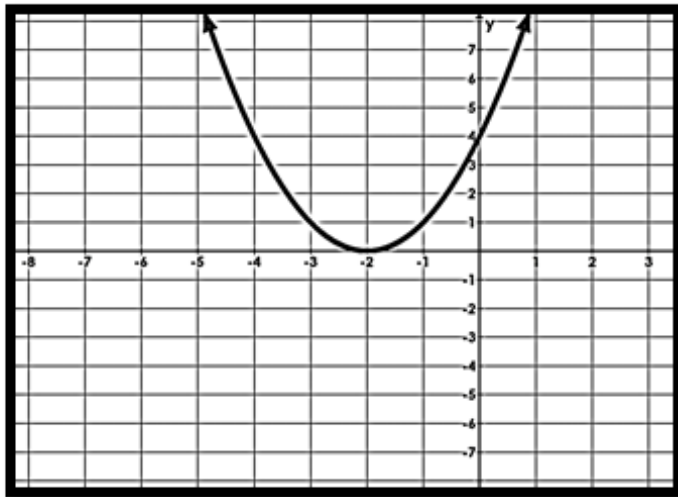
Shifts right by 7

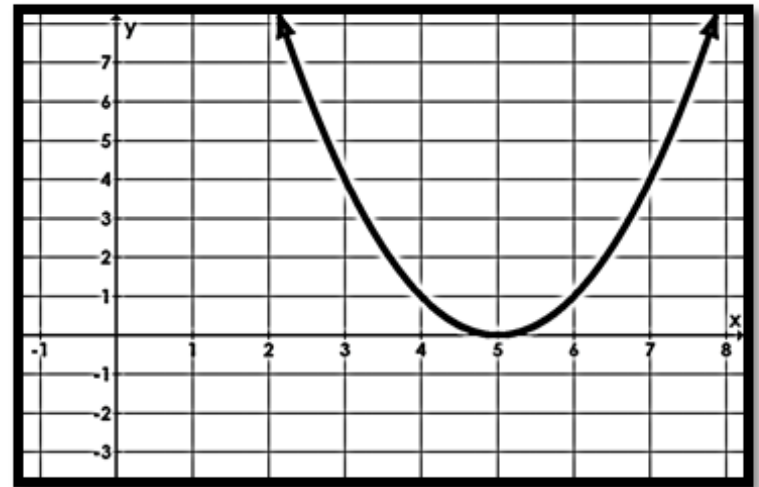$(7, 0)$

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

Shifts left by 3

$(-3, 0)$

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

Horizontal shift to left by 2 units. (−2,0) $y = (x+2)^2$

Horizontal shift to right by 5 units. (5,0) $y = (x−5)^2$

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

$y = (x−8)^2$

$y = (x+20)^2$

$y = (x+5)^2$

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

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

Shift right by 2 units, shift up by 4 units

2. $y = (x + 3)^2 - 2$
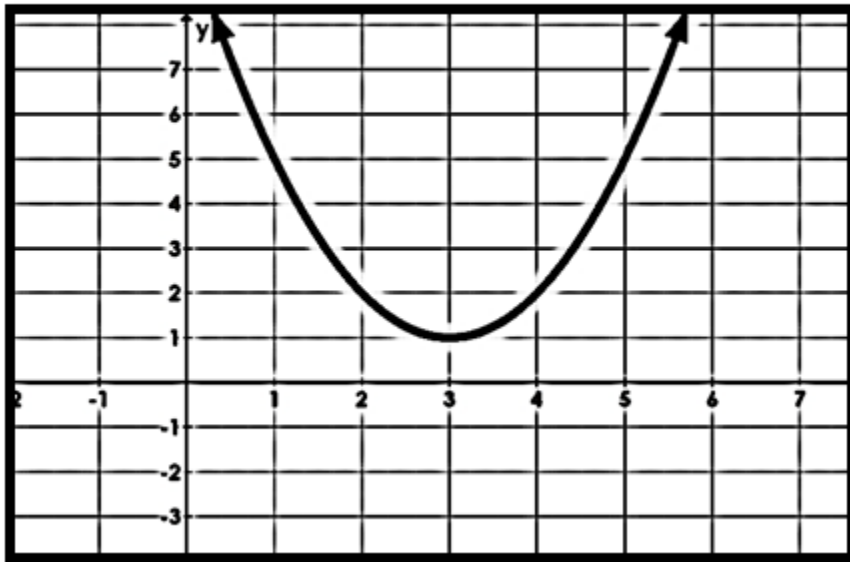
left by 3 units, down by 2 units

3. $y = (x - 9)^2 - 5$

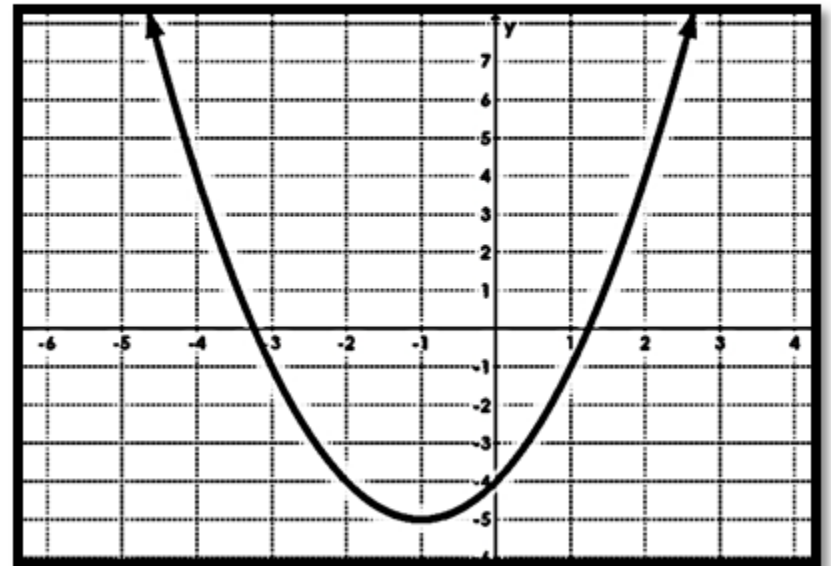Right by 9 units and down by 5 units

4. $y = (x + 5)^2 + 6$

Left by 5 units and up by 6 units.

PUTTING IT ALL TOGETHER

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

Horizontal shift to right by 3 units and Vertical shift up by 1 unit. (3,1)

$$y = (x-3)^2 + 1$$

Shift left by 1 unit, Shift down by 5 units
(-1,-5) $y = (x+1)^2 - 5$

PUTTING IT ALL TOGETHER

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

1. Shifted up 4 units and left 3 units

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

2. Shifted right 5 units and down 2 units

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

3. Shifted left 8 units and down 1 unit

$$y = (x+8)^2 - 1$$

4. Shifted up 5 units and right 9 units

$$y = (x-9)^2 + 5$$