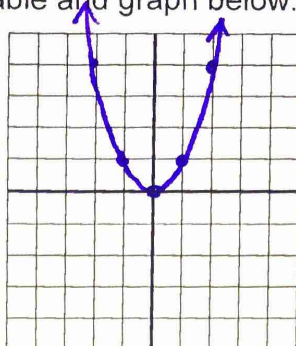


## Lesson 3.4 – Quadratic Functions

In Lesson 3.3 we learned how to translate a function. What other types of functions could we translate? Go to Desmos.com and click the start graphing button.

1. Graph  $f(x) = x^2$  and fill in the table and graph below.

x	y
-2	4
-1	1
0	0
1	1
2	4



Quadratic function  
→  $x^2$   
→ Parabola

2. Where is the lowest point of the graph located?

(0,0)

3. For what value of x does...

$f(x) = 16?$

-4 & 4

$f(x) = 9?$

-3 & 3

$f(x) = 25?$

-5 & 5

$f(x) = 0?$

0

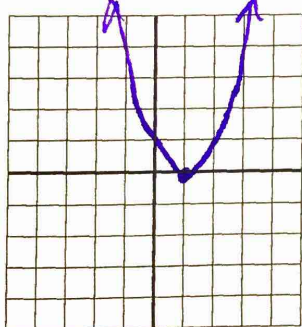
Axis of symmetry goes through vertex

What do you notice?

All the answers are  $\pm$  except for the last one.

4. Use your knowledge from previous lessons to graph each of the following functions **without Desmos**. When you are done, check your graphs in Desmos and describe how the graph has transformed from the parent function,  $f(x) = x^2$ ?

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

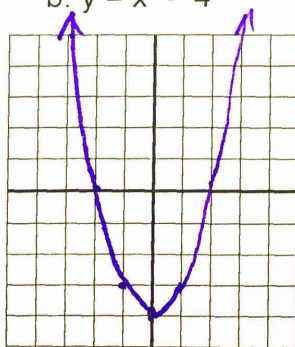


Vertex: (1,0)

Axis of Symmetry:  $x=1$

Transformation: Right 1

b.  $y = x^2 - 4$

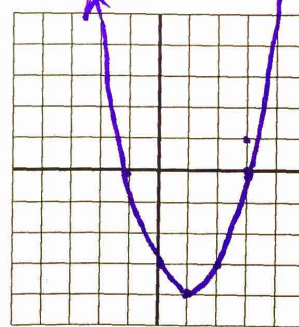


Vertex: (0,-4)

Axis of Symmetry:  $x=0$

Transformation: down 4

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



Vertex: (1,-4)

Axis of Symmetry:  $x=1$

Transformation: Right 1 down 4

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

vertex: (h, k)

axis of:  $x = h$   
Sym.

Vertex  
Symmetric: Both (x,y) & (-x,y) are on  $x^2$

## Lesson 3.4 – Translations and the Quadratic Family

<p>Important ideas:</p> <p>Quadratic Parent function:  <math>y = x^2</math>                  Vertex: <math>(0, 0)</math>                  Axis of sym: <math>x = 0</math></p>	<p>Translations of <math>y = x^2</math></p> <p><math>y = (x-h)^2 + k</math></p> <p style="text-align: center;"> <math>\nearrow</math> Right <math>h</math>      <math>\nearrow</math> up <math>k</math>                  Vertex: <math>(h, k)</math>                  Axis: <math>x = h</math> </p>	<p>Solving Quadratics:</p> <p>Undo <math>x^2</math> with <math>\sqrt{\quad}</math></p> <p>* Use SADMEP to get <math>x</math> alone.</p> <p>* Be careful of <math>\pm</math></p>
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### Check Your Understanding

1. Describe the translations of the graph of  $y = x^2$  needed to produce the graph of each equation.

a.  $y = x^2 - 6$

Down 6

b.  $y = (x + 5)^2$

Left 5

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

Right 3  
Down 9

2. Find the vertex of each parabola.

a.  $y = x^2 + 3$

$(x-0)^2 + 3$   
 $(0, 3)$

b.  $y = (x - 2)^2 + 0$

$(2, 0)$

c.  $y = -8 + (x + 5)^2$

$(-5, -8)$

3. Each parabola described is the graph of  $y = x^2$ . Write an equation for each parabola and sketch its graph.

a. The parabola is translated horizontally  $-3$  units.

$y = (x + 3)^2$

4. Describe what happens to the graph of  $y = x^2$  in the following situations.

a.  $y$  is replaced with  $(y + 1)$ .

$y + y = x^2$   
 $-1$                        $-1$

$y = x^2 - 1$

Down 1

b.  $x$  is replaced with  $(x - 5)$ .

$y = (x - 5)^2$

Right 5

5. Solve.

a.  $x^2 + 6 = 31$

$-6$        $-6$   
 $\sqrt{x^2} = \sqrt{25}$

$x = \pm 5$

b.  $x^2 - 12 = 52$

$+12$        $+12$

$x^2 = 64$

$x = \pm 8$

c.  $\sqrt{(x-3)^2} = \sqrt{100}$

$x - 3 = 10$

$x = 13$

$x - 3 = -10$

$x = -7$