Intro: Key Features

Name _____

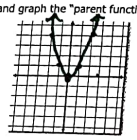
Math 2 – Transformations with Quadratic Functions

Directions: For this task, you should work in groups of 3-4. ALL group members should do all steps on the calculator, and then you should discuss what you are seeing together and agree on each conjecture. When you reach a conclusion, let your teacher know so he or she can sign off on your conclusion.

The parabola described by the equation $y = x^2$ is called the "parent function" for all quadratic functions. It is given this name because it is the most basic parabola: its vertex is at (0,0). It has not been stretched or shrunk (*dilated*). It has not been moved to the left, right, up, or down (*translated*). It has not been turned upside down (*reflected*).

Complete the table and graph the "parent function" of quadratics here:

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



A parabola that has been dilated, translated, or reflected is said to have undergone a transformation.

1. Graph the parabola $y = x^2$ in y1 on your graphing calculator. Then, graph each function given below in y2. Tell whether the function in y2 has been dilated (stretched or shrunk), translated (moved left or right), or reflected (turned upside down) with respect to the parent function in y1.

   a. $y = (x-3)^2$ Translate Right 3 (opposite sign)
   b. $y = (x-6)^2$ Right 6
   c. $y = (x+4)^2$ Left 4
   d. $y = (x+2)^2$ Left 2

   Make a conjecture about the type of transformation a parabola described by the equation $y = (x-h)^2$ has undergone. Be as specific as possible.

   Move "h" Units Right or Left
   (+) Left (-) Right

2. Again, graph the parabola $y = x^2$ under y1 on your graphing calculator. Then, graph the function given in y2. Tell whether the function in y2 has been dilated, translated, or reflected with respect to the parent function in y1.

   a. $y = x^2 + 2$ Moves Up 2
   b. $y = x^2 - 7$ Down 7
   c. $y = x^2 + 5$ Up 5
   d. $y = x^2 - 1$ Down 1

Translation

Quadratic Transformations

Make a conjecture about the type of transformation a parabola described by the equation $y = x^2 + k$ has undergone. Be as specific as possible.

Moving "k" Units Up or Down
(+) Up (-) Down

3. Once more, graph the parabola $y = x^2$ under y1 on your graphing calculator. Then, graph the function given in y2. Tell whether the function in y2 has been dilated, translated, or reflected with respect to the parent function in y1.

   a. $y = 2x^2$ dilated by 2 narrow
   b. $y = 3x^2$ smaller
   c. $y = \frac{2}{5}x^2$ dilated wider
   d. $y = .7x^2$ Widened
   e. $y = -2x^2$ Reflected over x-axis smaller
   f. $y = -.2x^2$ Reflected & Wider

Make a conjecture about the type of transformation a parabola described by the equation $y = ax^2$ has undergone. Be as specific as possible.

→ Dilation & Reflections
(-) Reflects over x-axis
$a > 1$ smaller "stretches"
$a < 1$ bigger "shrinks"

4. Let's combine the transformations. Try to list all the transformations that the graph of each quadratic function below has undergone with respect to the parent function, $y = x^2$. Check your lists using the graphing calculator.

   a. $y = (x-3)^2 + 4$ Translate Right 3, Up 4
   b. $y = 2x^2 - 3$ Dilated by factor 2, Translate Down 3
   c. $y = -\frac{1}{4}(x+2)^2 - 1$ Reflected over the x-axis Dilated by 1/4, Translate Left 2 Down 1

5. Last step: try to write the vertex form equation for a parabola that has undergone each of the following transformations with respect to the parent function, $y = x^2$:

   a. reflected over the x-axis, translated 2 units left and 1 unit up. $y = -(x+2)^2 + 1$
   b. shrunk by a factor of .62, translated 4 units up. $y = .62x^2 + 4$
   c. stretched by a factor of 4, reflected over the x-axis, translated 3 units down and 4 units right.

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

Vertex Form

$f(x) = (x \pm h)^2$

$f(x) = x^2 \pm k$

$f(x) = -x^2$

$f(x) = (-x)^2$

$f(x) = ax^2$

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

$f(x) = -(x+3)^2$

Standard form: $y = ax^2 + bx + c$

Vertex Form

Transformations

Horizontal Translation

(-) Right (+) Left

Vertical Translation

(+) VP (-) Down

Reflection over x axis

Modifies Horizontal Translation

Dilate by a factor of a

$a > 1$ stretches

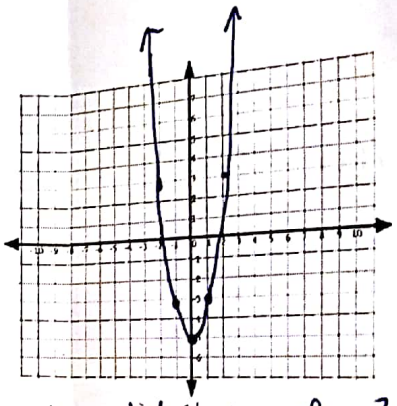
$a < 1$ shrink

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

↑ opposite h

vertex: $(-h, k)$

vertex: (0, -5)



How did it transform?

- Down 5
- Stretched by 2

Horizontal Translation

vertex (3, 5)

→ $y = (-x+3) - 5$

$-x + 3 = 0 \rightarrow x = 3$

$-x = -3$

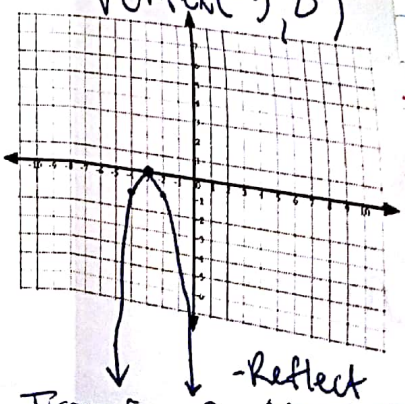
$y = (x+3) - 5$

vertex $(-3, -5)$

$x + 3 = 0$

$x = -3$

Vertex (-3, 0)



Transform?

- Reflect over x-axis
- Left 3