

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Period: \_\_\_\_\_

### 2.6 Transformations a, h, k

All of the different transformations of a function make <sup>up</sup> the rest of the family of functions. Take any parent function,  $f(x)$ , the transformations create new functions which have similar structure as the parent but may be flipped, moved, or dilated.

**General Function Notation:**  $f(x) \rightarrow af(x - h) + k$

a	h	k
Vertical reflection: (over the x-axis) <b>when a is negative</b>	Shift left: $(x+h)$	Shift up: $+k$
Vertical stretch: $ a  > 1$ greater than 1	Shift right: $(x-h)$	Shift down: $-k$
Vertical shrink: $ a  < 1$ less than 1		

Note:  $f(-x)$  is a horizontal reflection over the y-axis:

We can talk about transformations using function notation. Describe the transformations of the function,  $f(x)$ .

Example 1: $g(x) = 1f(x-1) - 3$ <b>right 1 unit</b> <b>down 3 units</b>	Example 2: $h(x) = -3f(x) + 2$ <b>reflects over x-axis</b> <b>vertical stretch of 3</b> <b>up 2 units</b>	Example 3: $p(x) = \frac{2}{3}f(x+6)$ <b>vertical shrink of <math>\frac{2}{3}</math></b> <b>left 6 units</b>
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We can talk about transformations when giving the equation of a function. State what the parent function for the equation and then describe the transformations of the parent function.

Example 4:  $y = 3\sqrt{x-7} + 1$

Parent function:  $y = \sqrt{x}$   
**Square Root**

Transformation(s):

**Vertical stretch of 3**  
**right 7 units**  
**up 1 unit**

Example 5:  $y = -\frac{1}{2}(x+3)^3$

Parent function:  $y = x^3$   
**Cubic**

Transformation(s):

**reflects/flips over x-axis**  
**left 3 units**  
**vertical shrink of  $\frac{1}{2}$**

Example 6:  $y = 3(2)^{x+1} - 5$

Parent Function:  $y = 2^x$   
**exponential**

Transformation(s):

**Vertical stretch of 3**  
**left 1 unit**  
**down 5 units**

We can talk about transformations when giving a graph of the function if we compare it to its parent function. Describe the transformations from  $f(x)$  to  $g(x)$ . Remember  $f(x)$  is the parent function. Attempt to write the equation based on the transformations.

- Graphs are approximately drawn to scale.
- There are no vertical shrinks or stretches from the parent function.
- Focus on the important point/features of each function based on its parent function.

<p>Example 7:</p> <p>The graph shows a coordinate plane with a grid. A parent function <math>f(x)</math> is a V-shape opening upwards with its vertex at the origin <math>(0,0)</math>. A transformed function <math>g(x)</math> is also a V-shape opening upwards, but its vertex is at <math>(0,3)</math>, indicating a vertical shift of 3 units up.</p>	<p>Example 8:</p> <p><math>(0,0)</math>  <math>(1,1)</math>  <math>(4,2)</math></p> <p>The graph shows a coordinate plane with a grid. A parent function <math>f(x)</math> is a curve starting at the origin <math>(0,0)</math> and passing through points <math>(1,1)</math> and <math>(4,2)</math>. A transformed function <math>g(x)</math> is a reflection of <math>f(x)</math> across the x-axis, starting at <math>(0,0)</math> and passing through <math>(1,-1)</math> and <math>(4,-2)</math>.</p>	<p>Example 9:</p> <p><math>(0,0)</math>  <math>(-1,-1)</math> <math>(1,1)</math>  <math>(-2,-8)</math> <math>(2,8)</math></p> <p>The graph shows a coordinate plane with a grid. A parent function <math>f(x)</math> is a cubic curve passing through the origin <math>(0,0)</math> and points <math>(-1,-1)</math>, <math>(1,1)</math>, <math>(-2,-8)</math>, and <math>(2,8)</math>. A transformed function <math>g(x)</math> is a reflection of <math>f(x)</math> across the y-axis and a vertical shift of 2 units down. It passes through <math>(0,-2)</math>, <math>(-1,-1)</math>, <math>(1,-1)</math>, <math>(-2,-8)</math>, and <math>(2,-8)</math>.</p>
<p>Transformation(s):  <b>UP 3 units</b></p> <p>Equation: _____</p>	<p>Transformation(s):  <b>flip over x-axis</b>  <b>left 4 units</b>  <b>down 3 units</b></p> <p>Equation: _____</p>	<p>Transformation(s):  <b>left 5 units</b>  <b>down 2 units</b></p> <p>Equation: _____</p>