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Lesson 1.06 Function Transformations

Students will be able to:

- Content Objective: Describe and graph the transformation made by a function from its parent function.

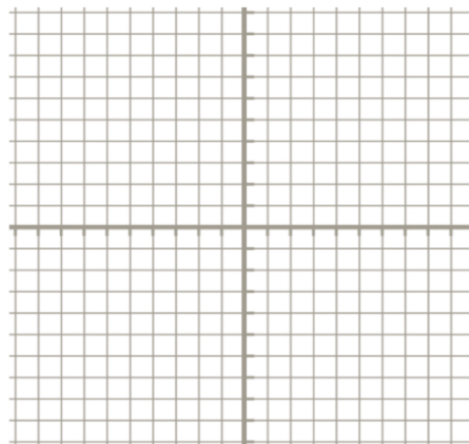- Language Objective: Explain how a transformation would change the vertex of a function.

Warm Up

Part I- Graph the following on the axes provided.
$$f(x) = x \qquad g(x) = x + 4 \qquad h(x) = x - 4$$
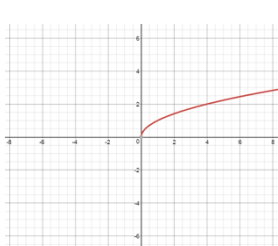What do you notice from the original graph of $f(x)$?
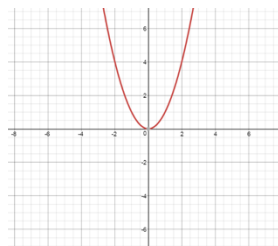
Vocabulary Review

Matching: Use the word bank to identify each function. Then, write the equation of the parent function.
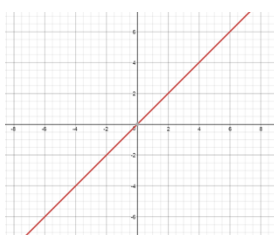
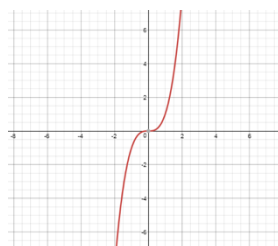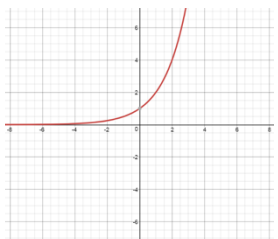| Word Bank |
|---|
| Linear |
| Quadratic |
| Exponential |
| Absolute Value |
| Cubic |
| Square Root |

_____ Function

_____ Equation

_____ Function

_____ Equation
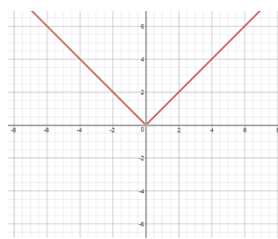
_____ Function

_____ Equation

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Skill 1: Vertical/Horizontal Translation

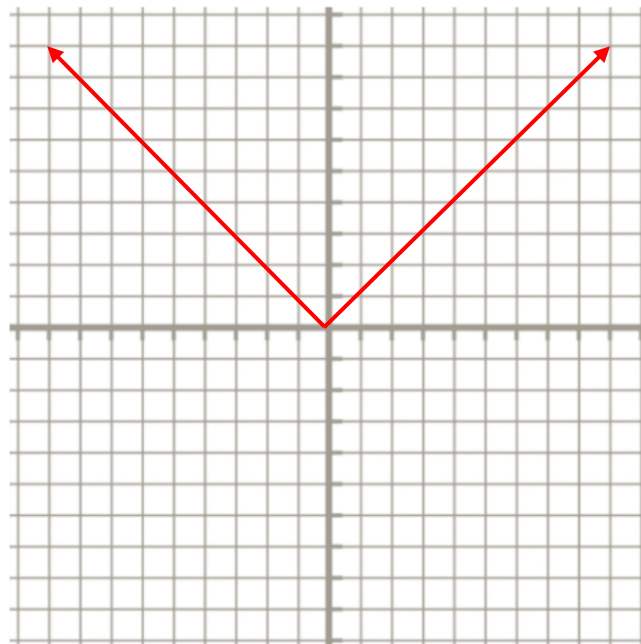Consider the following absolute value functions:

$$f(x) = |x| \qquad g(x) = |x - 2| + 1 \qquad h(x) = |x + 4| - 3$$

a. The parent function $f(x)$ is already graphed for you. Graph both $g(x)$ and $h(x)$ on the same axes and create a table of values below.

x	$g(x)$

| x	$h(x)$

a. Describe the transformation that occurred from the parent function to $g(x) = |x - 2| + 1$ and state the vertex.

b. Describe the transformation that occurred from the parent function to $h(x) = |x + 4| - 3$ and state the vertex.

c. What is the rule for a **vertical** shift?

d. What is the rule for **horizontal** shift?

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Skill 2: Reflections

Consider the following quadratic functions: $f(x) = (x+4)^2$ $g(x) = -(x+4)^2$ $h(x) = (-x+4)^2$

a. The function $f(x)$ is already graphed for you. Graph both $g(x)$ and $h(x)$ on the same axes.

b. What is the rule for a **reflection over the x-axis?**
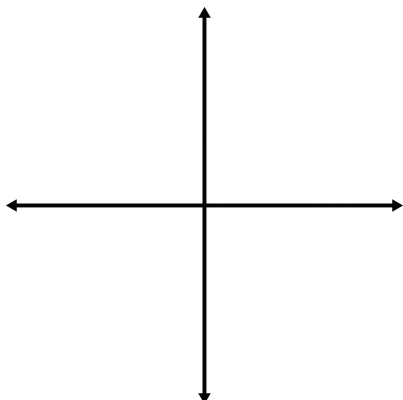
c. What is the rule for a **reflection over the y-axis?**
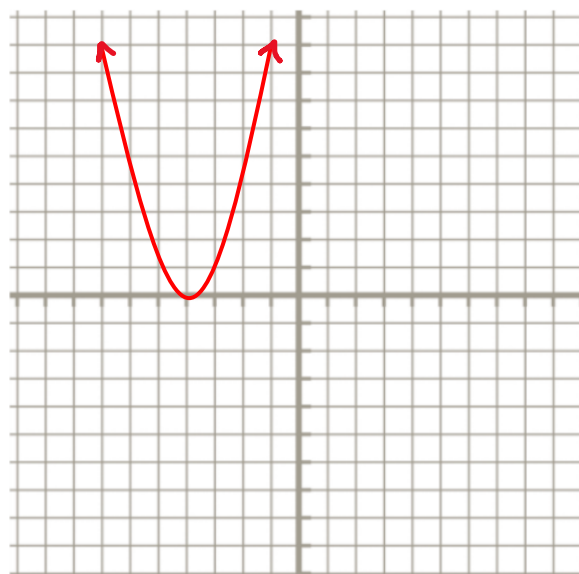
Skill 3: Dilations

1. Consider the exponential functions:

$v(x) = 2^x$ $w(x) = 3(2)^x$ $n(x) = \frac{1}{2}(2)^x$

a. Use your calculator to roughly sketch each function below.

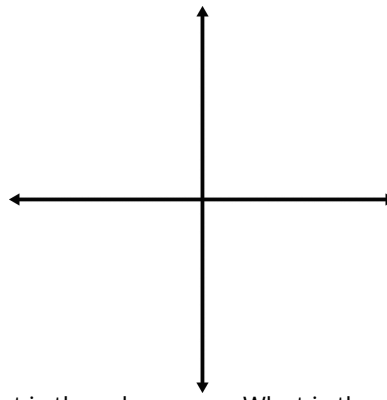b. What is the rule for a **vertical stretch?**

c. What is the rule for **vertical compression?**

2. Consider the exponential functions:

$v(x) = 2^x$ $w(x) = 2^{3x}$ $n(x) = 2^{.5x}$

a. Use your calculator to roughly sketch each function below.

b. What is the rule for a **horizontal stretch?**

c. What is the rule for **horizontal compression?**

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Graphic Organizer

Transformations of Functions: $f(x)$		
Vertical	Up	$f(x) + k$ shifts $f(x)$ up k units.
	Down	$f(x) - k$ shifts $f(x)$ down k units.
Horizontal	Right	$f(x - h)$ shifts $f(x)$ right h units.
	Left	$f(x + h)$ shifts $f(x)$ left h units.
Reflection	x-axis	$-f(x)$ reflects $f(x)$ over the x-axis.
	y-axis	$f(-x)$ reflects $f(x)$ over the y-axis.
Vertical	Stretch	$a \cdot f(x)$, where $a > 1$, stretches $f(x)$ vertically by a factor of a.
	Shrink	$a \cdot f(x)$, where $0 < a < 1$, shrinks $f(x)$ vertically by a factor of a.
Horizontal	Stretch	$f(bx)$, where $0 < b < 1$, stretches $f(x)$ horizontally , multiply y-values by b
	Shrink	$f(bx)$, where $b > 1$, shrinks $f(x)$ horizontally , divide x-values by b

Write It Out

Given the function $f(x) = |x|$ with the vertex at the origin (0,0), determine where the vertex of the function $h(x) = -|x - 1| + 4$ would lie? Explain your thinking.

Check Point

1. A function $f(x)$ has a domain of $-3 \leq x \leq 9$ and the range is $2 \leq y \leq 15$. What would the domain and range be after a transformation of $f(x - 2) - 8$?

2. **Multiple Choice**
   The point (5,8) lies on the parent function's graph $f(x)$. Which point would lie on the graph of the function after a transformation of $f(x + 4) + 2$

   a. $(9, 10)$

   b. $(1,2)$

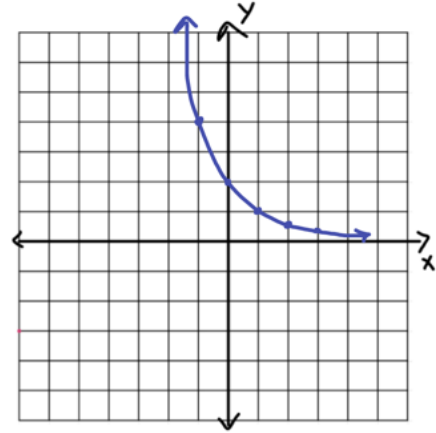   c. $(1, 10)$

   d. $(8, 5)$

1.06-Problem Set

Name:_____

1. Given the graph of $f(x)$ shown below, complete the following.

   a. Graph $f(x) - 5$. Label this $g(x)$.

   b. Graph $f(x + 4)$. Label this $h(x)$.

   c. Describe the transformation done to $f(x)$ represented by $2f(x)$ in words.

   d. Describe the transformation done to $f(x)$ represented by $f(\frac{1}{3}x)$ in words.

2. Given the function $y = 5^x$, write a function for y after each of the following transformations. The first one has been done for you.

a. Shift left 2 and up 4.	b. Shift right 1 and down 7.	c. Vertical Stretch by a factor of 3.	d. Vertical shrink by a factor of $\frac{2}{3}$.
$y = 5^{x+2} + 4$	_____	_____	_____

3. Given the function $f(x) = x^2$ describe the transformation that occurred to each function below.

   a. $f(x) = -(x + 2)^2 - 6$ b. $f(x) = (-x - 3)^2 + 4$

   c. $f(x) = 2(-x)^2 + 4$ d. $f(x) = \frac{1}{3}(x + 5)^2$