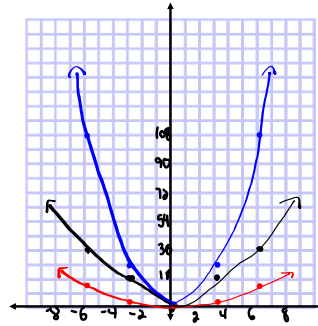


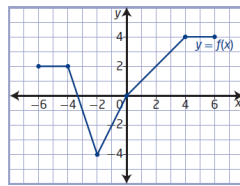
Questions from Homework

2. a) Copy and complete the table of values for the given functions.

| x | $f(x) = x^2$ | $g(x) = 3f(x)$ | $h(x) = \frac{1}{3}f(x)$ |
|----|--------------|----------------|--------------------------|
| -6 | 36 | 108 | 12 |
| -3 | 9 | 27 | 3 |
| 0 | 0 | 0 | 0 |
| 3 | 9 | 27 | 3 |
| 6 | 36 | 108 | 12 |

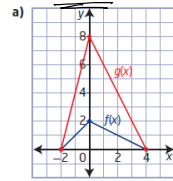


6. The graph of the function $y = f(x)$ is vertically stretched about the x-axis by a factor of 2. $a = 2$

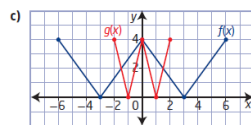


$(x, y) \rightarrow (x, 2y)$
 $f(x)$ $g(x)$
 D: $[-6, 6]$ D: $[-6, 6]$
 R: $[-4, 4]$ R: $[-8, 8]$

7. Describe the transformation that must be applied to the graph of $f(x)$ to obtain the graph of $g(x)$. Then, determine the equation of $g(x)$ in the form $y = af(bx)$.



$(x, y) \rightarrow (x, 4y)$ A vertical stretch by a factor of 4
 $f(x)$ $g(x)$
 $(-2, 0)$ $(-2, 0)$ $a = 4$
 $(0, 2)$ $(0, 8)$
 $(4, 0)$ $(4, 0)$ $y = 4f(x)$



$(x, y) \rightarrow (\frac{1}{3}x, y)$ A horizontal compression by a factor of 1/3
 $f(x)$ $g(x)$
 $(-6, 4)$ $(-2, 4)$
 $(-3, 0)$ $(-1, 0)$ $b = 3$
 $(0, 4)$ $(0, 4)$
 $(3, 0)$ $(1, 0)$ $y = f(3x)$
 $(6, 4)$ $(2, 4)$

5 a) $y = 4f(x)$

$a = 4 \rightarrow$ A vertical stretch about the x-axis by a factor of 4

$(x, y) \rightarrow (x, 4y)$

b) $y = f(3x)$

$b = 3 \rightarrow$ A horizontal compression about the y-axis by a factor 1/3

$(x, y) \rightarrow (\frac{1}{3}x, y)$

Warm-Up...

Given that $(-2, 5)$ is a point on the graph of $y = f(x)$, determine the coordinates of this point once the following transformations are applied...

(1) $y = \underline{3}f(x)$

$a = 3 \rightarrow$ vertical stretch by a factor of 3

$$(x, y) \rightarrow (x, 3y)$$

$$(-2, 5) \rightarrow \boxed{(-2, 15)}$$

(2) $y = f\left(\frac{1}{3}x\right)$

$b = \frac{1}{3} \rightarrow$ horizontal stretch by a factor of 3 & a horizontal reflection in the y-axis

$$(x, y) \rightarrow (-3x, y)$$

$$(-2, 5) \rightarrow \boxed{(6, 5)}$$

(3) $y = \underline{4}f\left[\frac{1}{2}(x+5)\right] - \underline{3}$

$a = 4$ vertical stretch by a factor of 4

$b = \frac{1}{2}$ horizontal stretch by a factor of 2

$h = -5$ translated 5 units left

$k = -3$ translated 3 units down

$$(x, y) \rightarrow (x-5, 4y-3)$$

$$(-2, 5) \rightarrow \boxed{(-9, 17)}$$

(4) $y - 5 = -2f(-2x + 6)$

$y = -2f(-2x + 6) + 5$

$y = -2f[-2(x-3)] + 5$

$a = -2$ vertical stretch by a factor of 2 and a vertical reflection in the x-axis

$b = -2$ horizontal stretch by a factor of $\frac{1}{2}$ and a horizontal reflection in the y-axis

$h = 3$ translated 3 units right

$k = 5$ translated 5 units up

$$(x, y) \rightarrow \left(-\frac{1}{2}x + 3, -2y + 5\right)$$

$$(-2, 5) \rightarrow \boxed{(4, -5)}$$

Transformations:

2. The function $y = f(x)$ is transformed to the function $g(x) = -3f(4x - 16) - 10$. Copy and complete the following statements by filling in the blanks.

The function $f(x)$ is transformed to the function $g(x)$ by a horizontal stretch about the **a** by a factor of **b**. It is vertically stretched about the **c** by a factor of **d**. It is reflected in the **e**, and then translated **f** units to the right and **g** units down.

$$g(x) = -3f(4x-16) - 10$$

factor ←

$$g(x) = \underline{-3}f[\underline{4}(x-\underline{4})] - \underline{10}$$

$a = -3$ $b = 4$ $h = 4$ $k = -10$

a) y-axis

b) 1/4

c) _____

d) _____

e) _____

f) _____

g) _____

Summary of Transformations...

| Transformations of the graphs of functions | |
|--|---|
| $f(x) + k$ | shift $f(x)$ up k units |
| $f(x) - k$ | shift $f(x)$ down k units |
| $f(x + h)$ | shift $f(x)$ left h units |
| $f(x - h)$ | shift $f(x)$ right h units |
| $f(-x)$ | reflect $f(x)$ about the y -axis |
| $-f(x)$ | reflect $f(x)$ about the x -axis |
| $af(x)$ | When $0 < a < 1$ – vertical shrinking of $f(x)$ |
| | When $a > 1$ – vertical stretching of $f(x)$ Multiply the y values by a |
| $f(bx)$ | When $0 < b < 1$ – horizontal stretching of $f(x)$ |
| | When $b > 1$ – horizontal shrinking of $f(x)$ Divide the x values by b |

Transformations:

$$y = f(x) \longrightarrow y = \underline{a}f(\underline{b}(x - \underline{h})) + \underline{k}$$

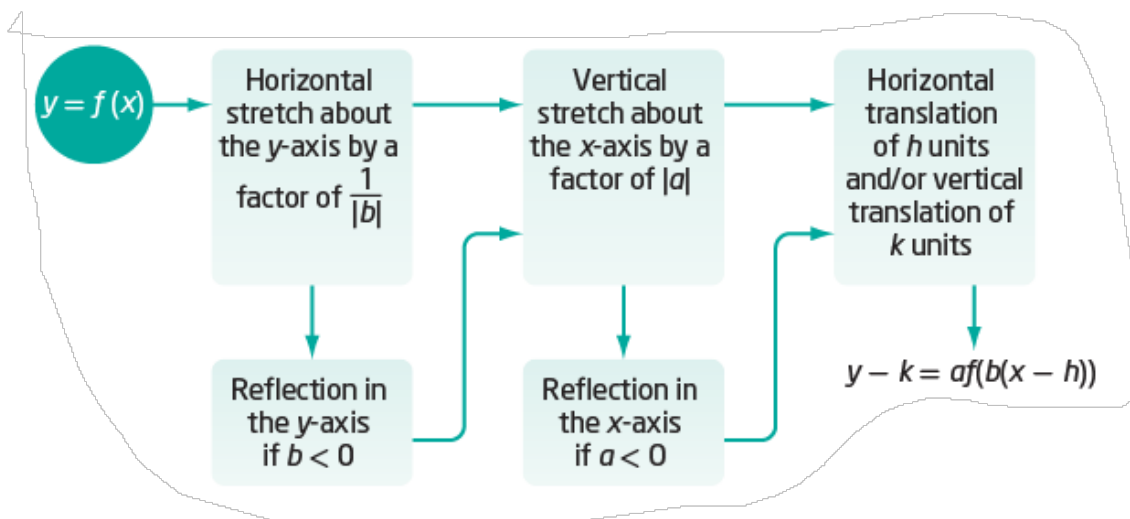
Mapping Rule: $(x, y) \rightarrow \left(\frac{1}{b}x + h, ay + k\right)$

Important note for sketching...

Transformations should be applied in following order:

1. Reflections
2. Stretches
3. Translations

Remember...RST

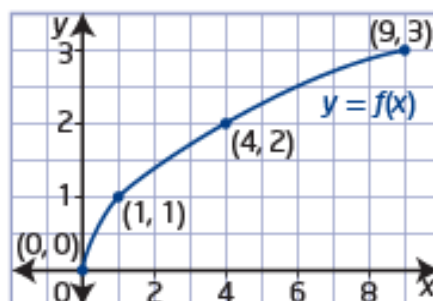


Example 1

Graph a Transformed Function

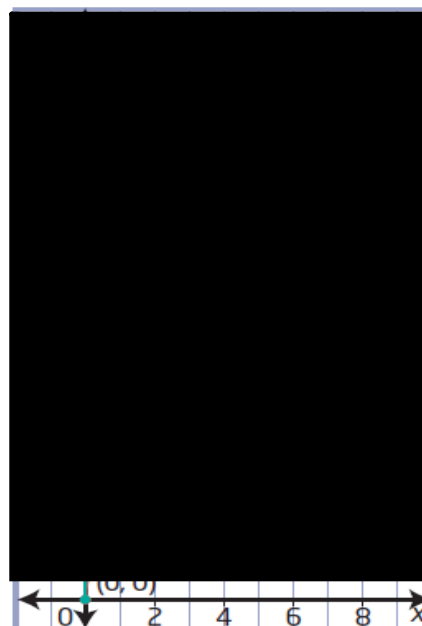
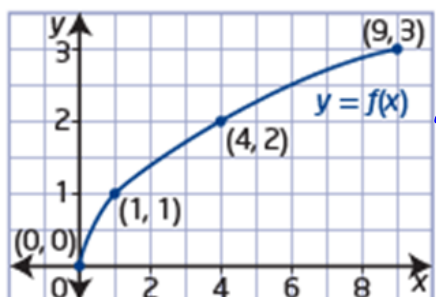
Describe the combination of transformations that must be applied to the function $y = f(x)$ to obtain the transformed function. Sketch the graph, showing each step of the transformation.

- a) $y = 3f(2x)$
- b) $y = f(3x + 6)$



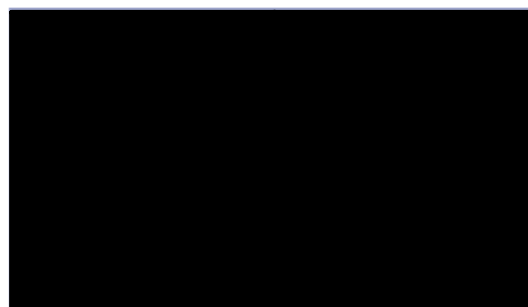
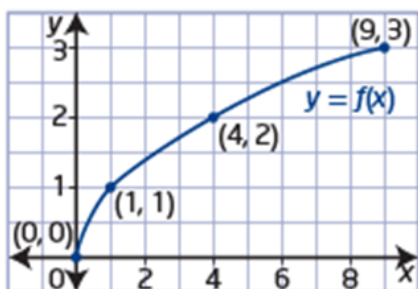
a) $y = 3f(2x)$

The graph of $y = f(x)$ is horizontally stretched about the y -axis by a factor of $\frac{1}{2}$ and then vertically stretched about the x -axis by a factor of 3.



b) $y = f(3x + 6)$

The graph of $y = f(x)$ is horizontally stretched about the y -axis by a factor of $\frac{1}{3}$ and then horizontally translated 2 units to the left.



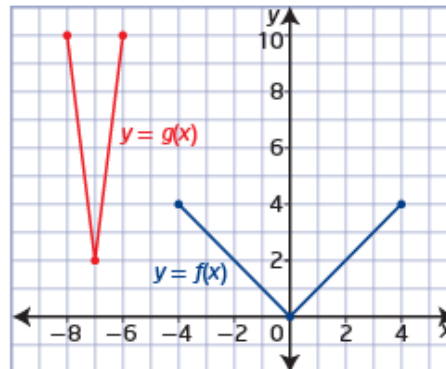
Homework

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Example 3

Write the Equation of a Transformed Function Graph

The graph of the function $y = g(x)$ represents a transformation of the graph of $y = f(x)$. Determine the equation of $g(x)$ in the form $y = af(b(x - h)) + k$. Explain your answer.



Solution

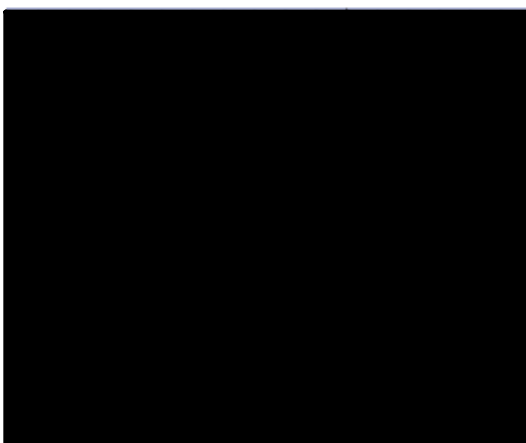
Locate key points on the graph of $f(x)$ and their image points on the graph of $g(x)$.

$$(-4, 4) \rightarrow (-8, 10)$$

$$(0, 0) \rightarrow (-7, 2)$$

$$(4, 4) \rightarrow (-6, 10)$$

The equation of the transformed function is XXXXXXXXXX



How could you use the mapping $(x, y) \rightarrow \left(\frac{1}{b}x + h, ay + k\right)$ to verify this equation?

17. The graph of the function $y = 2x^2 + x + 1$ is stretched vertically about the x -axis by a factor of 2, stretched horizontally about the y -axis by a factor of $\frac{1}{3}$, and translated 2 units to the right and 4 units down. Write the equation of the transformed function.

is stretched vertically about the x -axis by a factor of 2. stretched horizontally about the y -axis by a factor of $\frac{1}{3}$, and translated 2 units to the right and 4 units down. Write the equation of the transformed function.