Name _____ Class _____ Date _____

2-6 Families of Functions

Horizontal and Vertical Translations

If h and k are positive numbers, then

$g(x) = f(x) + k$ shifts the graph of $f(x)$ **up** k units.

$g(x) = f(x) - k$ shifts the graph of $f(x)$ **down** k units.

$g(x) = f(x + h)$ shifts the graph of $f(x)$ **left** h units.

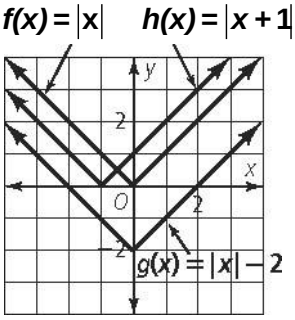
$g(x) = f(x - h)$ shifts the graph of $f(x)$ **right** h units.

Problem

How can you represent each translation of $y = |x|$ graphically?

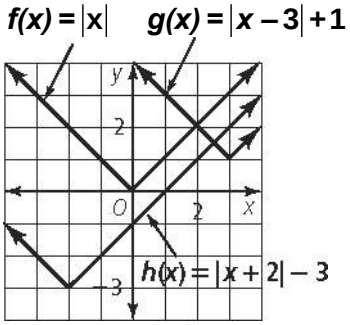
1. a. $g(x) = |x| - 2$ Shift the graph of $f(x) = |x|$ down 2 units.

b. $h(x) = |x + 1|$ Shift the graph of $f(x) = |x|$ left 1 unit.



2. a. $g(x) = |x - 3| + 1$ Shift the graph of $f(x) = |x|$ right 3 units and up 1 unit.

b. $h(x) = |x + 2| - 3$ Shift the graph of $f(x) = |x|$ left 2 units and down 3 units.



Exercises

Identify the type of translation of $f(x) = |x|$.

1. $g(x) = |x - 2|$

2. $g(x) = |x| + 1$

3. $g(x) = |x| - 3$

4. $g(x) = |x + 3|$

Graph each translation of $f(x) = |x|$.

5. $g(x) = |x - 1| - 5$

6. $g(x) = |x + 4| + 2$

Name _____ Class _____ Date _____

2-6 (continued)

Families of Functions

Reflection, Stretching, and Compression

If h and k are positive numbers, then

$g(x) = -f(x)$ reflects the graph of $f(x)$ in the ***x*-axis**.

$g(x) = f(-x)$ reflects the graph of $f(x)$ in the ***y*-axis**.

$g(x) = af(x)$, $a > 1$, is a vertical **stretch** of the graph of $f(x)$.

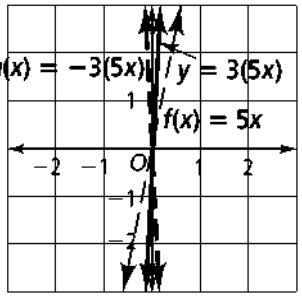
$g(x) = af(x)$, $0 < a < 1$, is a vertical **compression** the graph of $f(x)$.

Problem

What transformations change the graph of $f(x)$ to $g(x)$?

$f(x) = 5x$ $\quad$ $g(x) = -3(5x)$

There are two transformations.



First transformation: The graph of $y = 3(5x)$ is the graph of $f(x) = 5x$ stretched vertically by a factor of 3 because $a = 3$ and $a > 1$.

Second transformation: The graph of $g(x) = -3(5x)$ is the graph of $y = 3f(5x)$ reflected in the x-axis because the sign of $g(x)$ has changed.

So, the graph of $g(x)$ is the graph of $f(x)$ stretched vertically by a factor of 3 and reflected over the x-axis.

Exercises

Describe the transformations of $f(x)$ that produce $g(x)$.

7. $f(x) = -5x$

$g(x) = x$

8. $f(x) = x$

$g(x) = \frac{1}{4}x + 3$

Graph $f(x)$ and $g(x)$ on the same coordinate plane.

9. $f(x) = 2x$

$g(x) = -(2x - 2)$

10. $f(x) = x^2$

$g(x) = 2(x^2 - 3)$