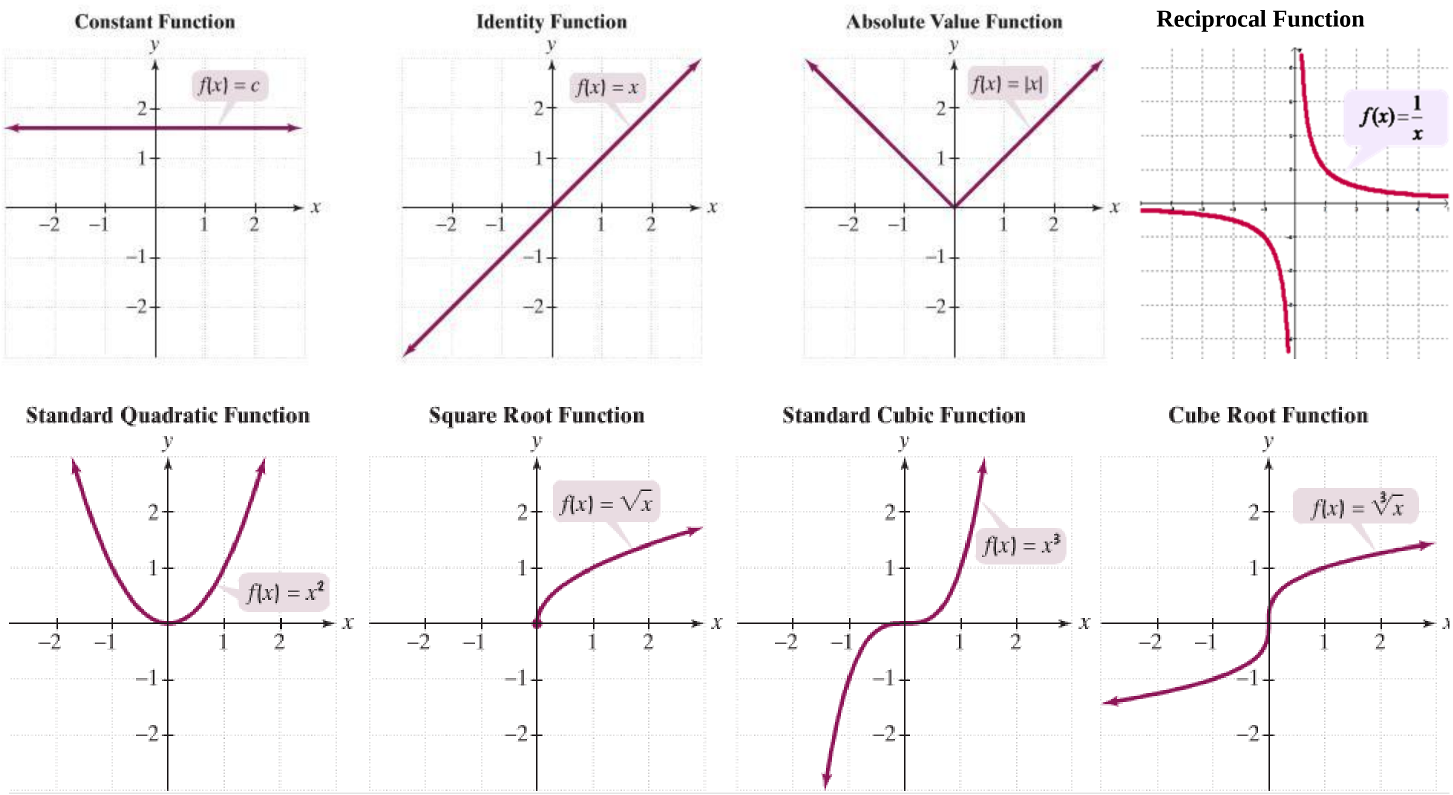
2.6 Transformations of Graphs

This section discusses certain "families" of functions. It can be very helpful to know the general shape of a graph when you see its equation. **Table 2-2 (p.229)** shows the various general equations for which you should know the graph….without having to graph them.



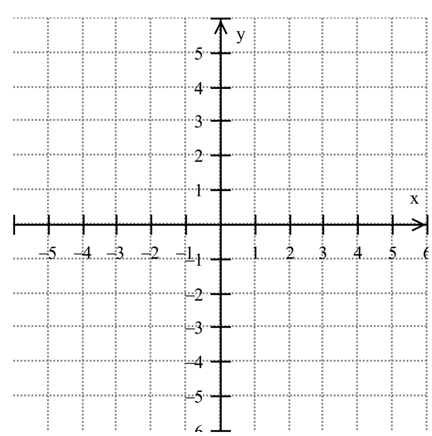
❖ **The Graph of** $y = f(x) + k$ & $y = f(x) - k$

Use a graphing calculator to graph and label each on the same grid:

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

b) $g(x) = x^2 + 2$

c) $h(x) = x^2 - 3$



What happens when constants are added or subtracted on the **"outside"** of the original function?

____

In general, $f(x) + k$ **shifts the graph of *f* _______ *k* units.**

$f(x) - k$ **shifts the graph of *f* _______ *k* units.**

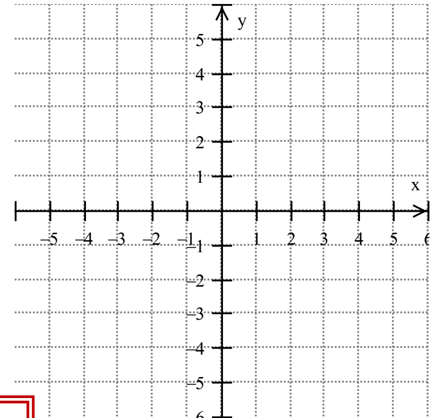
❖ The Graph of $y = f(x+h)$ & $y = f(x-h)$

Use a graphing calculator to graph and label each on the same grid:

a) $f(x) = |x|$

b) $g(x) = |x+2|$

c) $h(x) = |x-3|$



What happens when constants are added or subtracted on the **"inside"** of the original function?

____

In general, $f(x+h)$ shifts the graph of *f* to the ________ *h* units.

$f(x-h)$ shifts the graph of *f* to the ________ *h* units.

Ex. Given $f(x) = \sqrt{x+1} - 2$.

(a) List and graph the original function.

____

(b) List any shifts.

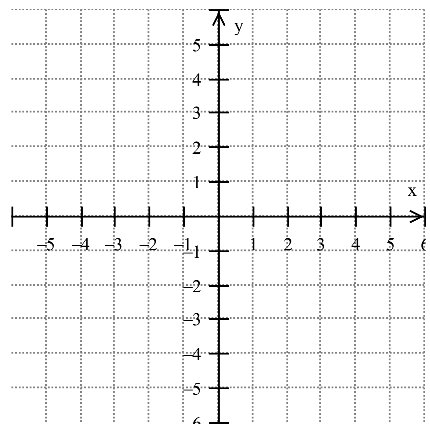
____

____

(c) Graph.

____

____

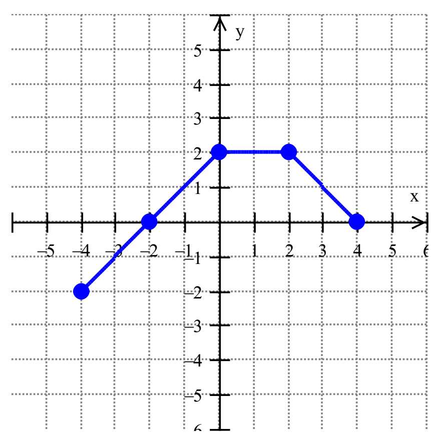


Ex. Use the graph of $f(x)$ given to graph $g(x) = f(x-1) + 3$.

To graph this transformation:

1.) Add 1 from each x

2.) Add 3 from each y



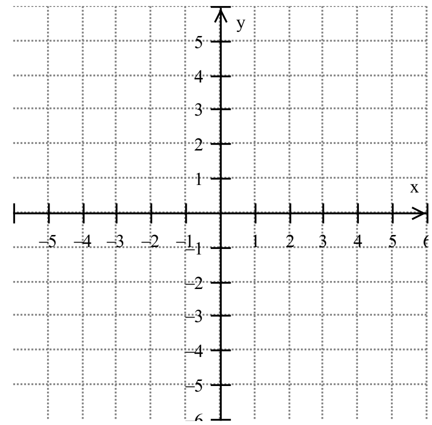
❖ The Graph of $y = -f(x)$ & $y = f(-x)$

Use a graphing calculator to graph and label each on the same grid:

a) $f(x) = \sqrt{x}$

b) $g(x) = -\sqrt{x}$

c) $h(x) = \sqrt{-x}$



What happens when **every "*y*"** is multiplied by **-1**?

____

What happens when **every "*x*"** is multiplied by **-1**?

____

In general, $-f(x)$ is a function that is reflected across the ____ *axis*.

$f(-x)$ is a function that is reflected across the ____ *axis*.

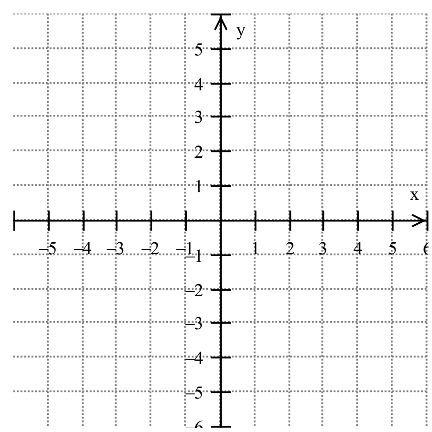
❖ The Graph of $y = a\,f(x)$

Use a graphing calculator to graph and label each on the same grid:

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

b) $g(x) = \frac{1}{2}x^2$

c) $h(x) = 2x^2$



The graph of $g(x) = \frac{1}{2}x^2$ is ________________

than the graph of $f(x) = x^2$.

- Notice the *y*-values are **decreased** by a factor of $\frac{1}{2}$ from the original.
- The graph is <u>pulled down</u> toward the *x*-axis.

The graph of $h(x) = 2x^2$ is ________________

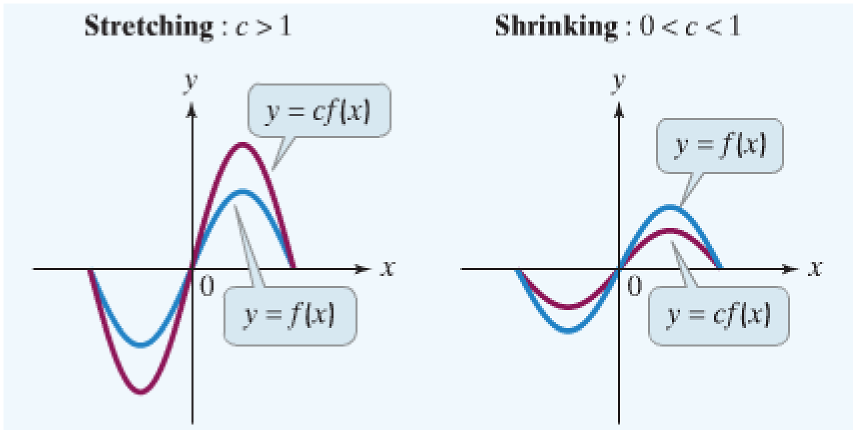
than the graph of $f(x) = x^2$.

- Notice the *y*-values are **increased** by a factor of **2** from the original.
- The graph is <u>"stretched" away</u> from the *x*-axis.

In general, $af(x)$ **is called a ____________________________ if** $0 < a < 1$**.**

$af(x)$ **is called a ____________________________ if** $a > 1$**.**

(Each of the original y-values will get **multiplied** by a.)



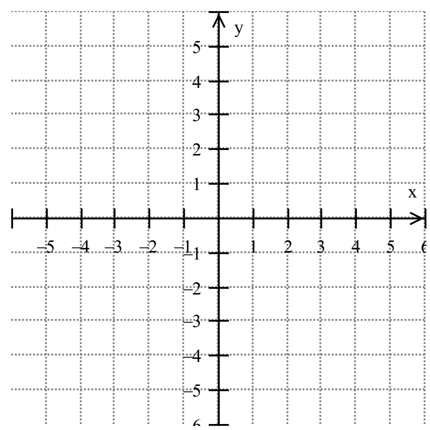
❖ The Graph of $y = f(ax)$

Use a graphing calculator to graph and label each on the same grid:

a) $f(x) = |x|$

b) $g(x) = \left|\frac{1}{2}x\right|$

c) $h(x) = |2x|$



The graph of $g(x) = \left|\frac{1}{2}x\right|$ is ________________

than the graph of $f(x) = |x|$.

- The graph is <u>"stretched" away</u> from the y-axis.

The graph of $h(x) = |2x|$ is ________________

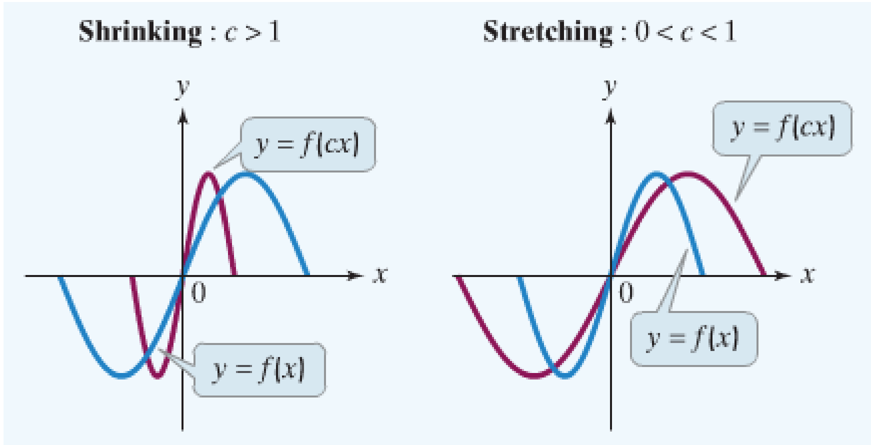
than the graph of $f(x) = |x|$.

- The graph is <u>pushed in</u> toward the y-axis.

In general, $f(ax)$ **is called a __________________ if** $0 < a < 1$**.**

$f(ax)$ **is called a __________________ if** $a > 1$**.**

(Each of the original x-values will get **divided** by a.)



❖ **Sequences of Transformations**

(p.236) **Summary of Transformations of Functions**

Ex. List the transformations.

(a) $T(x) = f(-x) - 5$

(b) $T(x) = -2f(x+1)$

A function involving more than one transformation can be graphed by performing transformations in the following order:

1.) Horizontal Shifting
2.) Stretching or Shrinking
3.) Reflecting
4.) Vertical Shifting

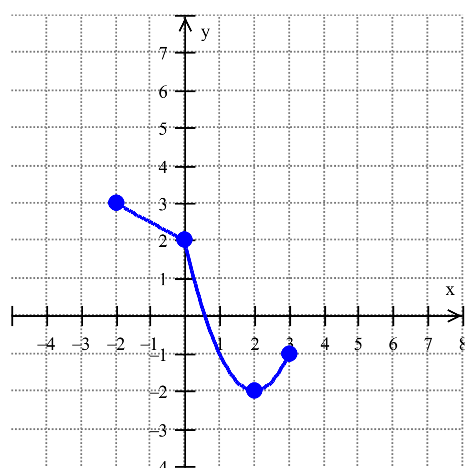
Ex. Use the graph of $f(x)$ shown to graph $T(x) = 2f(x-3)+1$.

Analyze the transformations in order:

1)

2)

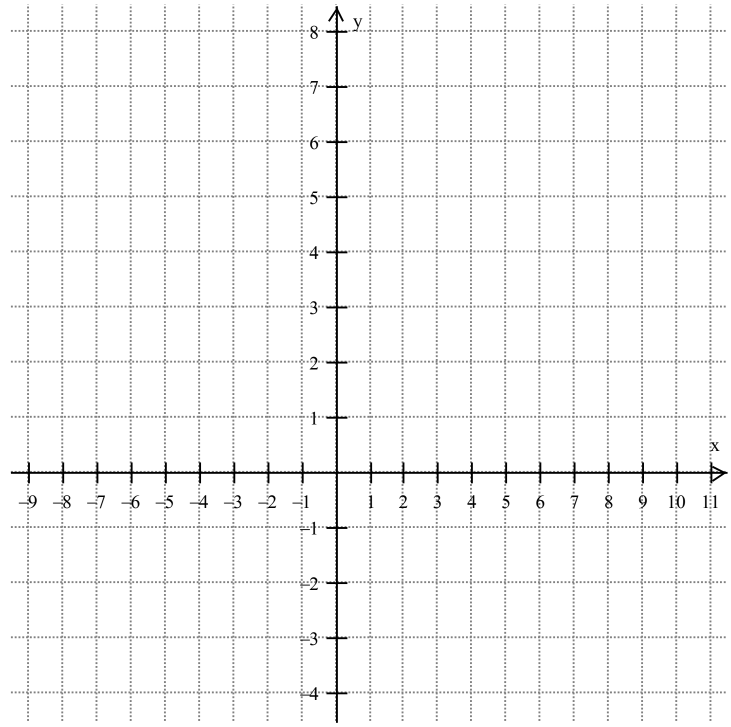
3)



Ex. Begin by graphing the cube root function, $f(x)=\sqrt[3]{x}$. Then graph $T(x)=-\sqrt[3]{x-2}+3$.

Original Cube Root Function

x	y
-8	
-1	
0	
1	
8	



NEW Cube Root Function

Analyze the transformations in order:

1)

2)

3)