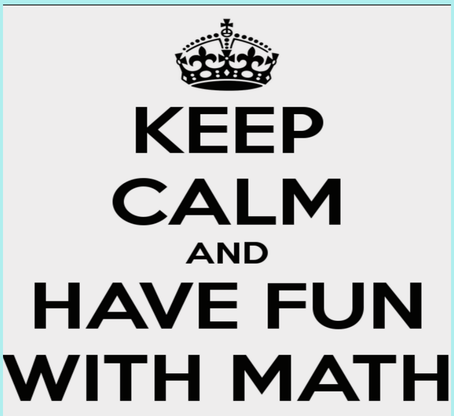
Radical Functions



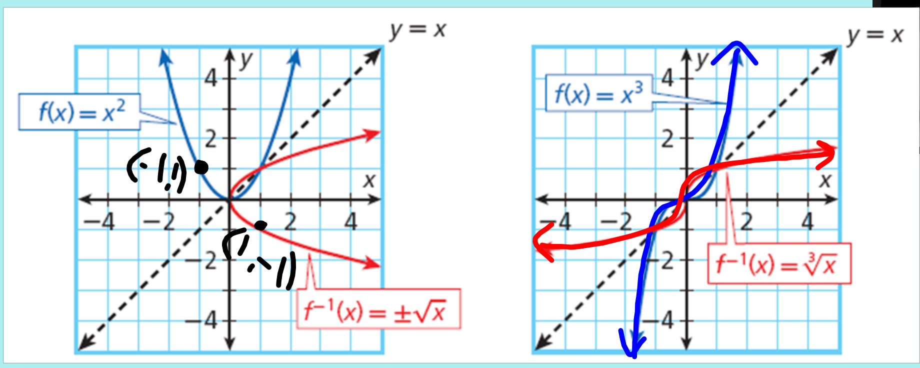
What are our objectives?

~Graph radical functions.

~Transform radical functions by changing parameters.

Back to the Future...

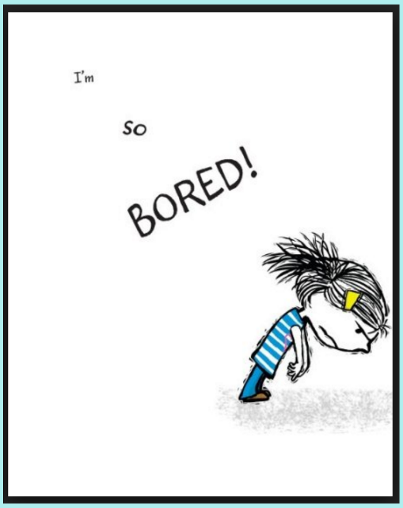
Let's look at these functions



The blue and red functions are *inverses* of each other. In other words, the coordinate of x and y have been switched.

We'll look at how to find and define inverses of each other next chapter.

Why do we care?



We're going to be looking at the inverse function of $f(x) = x^2, x \geq 0$

A **radical function** is a function whose rule is a radical expression.

A **square-root function** is a radical function involving $\sqrt{x}$. The square-root parent function is $f(x) = \sqrt{x}$. The cube-root parent function is $f(x) = \sqrt[3]{x}$.

Let's Jump Right In!

Graph each function and identify its domain and range.

1) $f(x)=\sqrt{x+3}$

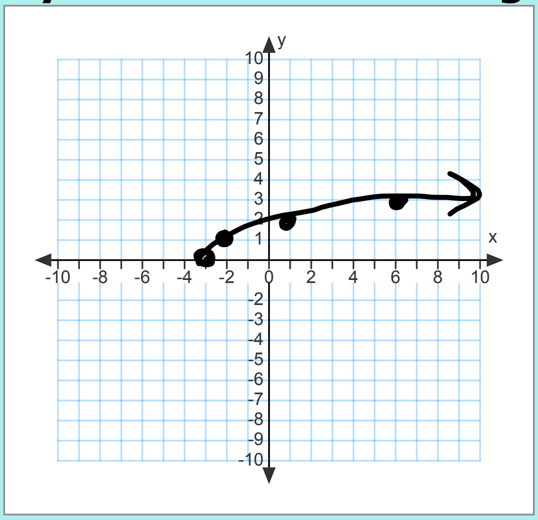
X	f(x)
-3	0
-2	1
1	2
6	3

$x+3=0$
$x=-3$

$x+3=1$
$x=-2$

$x+3=4$
$x=1$

$x+3=9$
$x=6$

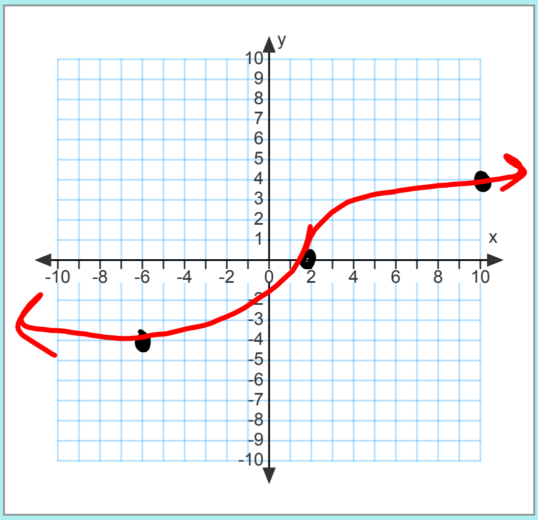


2) $f(x)=2\sqrt[3]{x-2}$

X	f(x)
2	0
-6	-4
10	4

$x-2=0$
$x=2$

$x-2=-8$
$x=-6$



Wait for it...

Wait for it...

Do Now:

Graph the following:

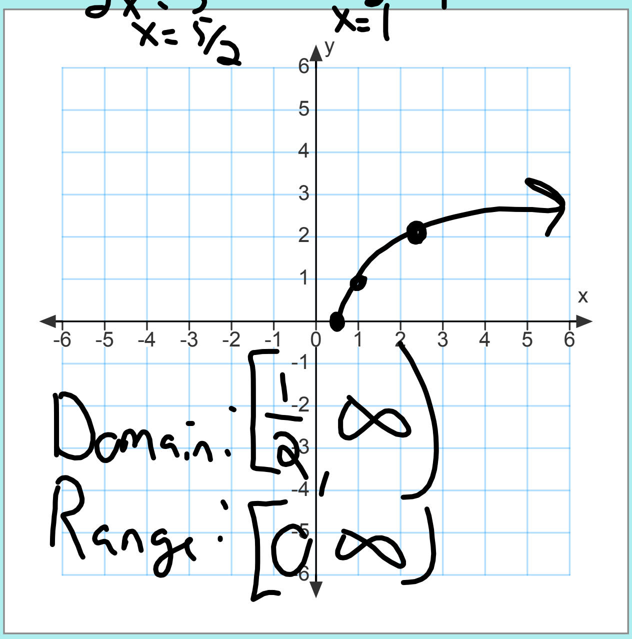
a) $f(x)=\sqrt{2x-1}$

$2x-1=0$
$+1 \quad +1$
$2x=1$
$x=\frac{1}{2}$

$2x-1=4$
$2x=5$
$x=\frac{5}{2}$

$2x-1=1$
$2x=2$
$x=1$

x	y
1/2	0
5/2	2
1	1



Domain: $[\frac{1}{2}, \infty)$
Range: $[0, \infty)$

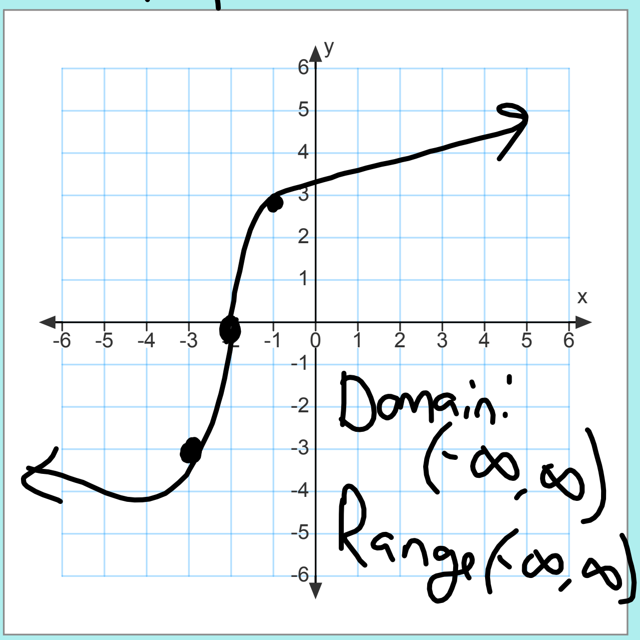
b) $f(x)=3\sqrt[3]{x+2}$

$x+2=0$
$x=-2$

$x+2=-1$
$x=-3$

$x+2=1$
$x=-1$

x	y
-2	0
-3	-3
-1	3



Domain: $(-\infty, \infty)$
Range: $(-\infty, \infty)$

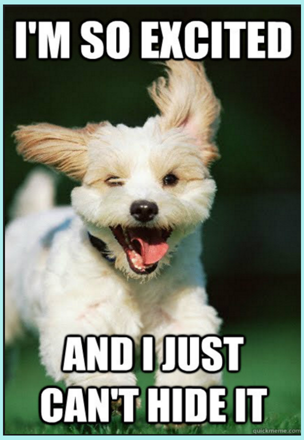
Rest of Chapter 5:

~Quiz next block (Wednesday) on graphing and simplifying

~ Friday = Section 5.8 (Solving)

~ Tuesday = Chapter 5 Part 2 Review

~ Thursday = Chapter 5 Part 2 Test



Transformations!

Transformations of the Square-Root Parent Function $f(x) = \sqrt{x}$

Transformation	$f(x)$ Notation	Examples
Vertical translation	$f(x) + k$	$y = \sqrt{x} + 3$ 3 units up $y = \sqrt{x} - 4$ 4 units down
Horizontal translation	$f(x - h)$	$y = \sqrt{x - 2}$ 2 units right $y = \sqrt{x + 1}$ 1 unit left
Vertical stretch/ compression	$af(x)$	$y = 6\sqrt{x}$ vertical stretch by 6 $y = \frac{1}{2}\sqrt{x}$ vertical compression by $\frac{1}{2}$
Horizontal stretch/ compression	$f\left(\frac{1}{b}x\right)$	$y = \sqrt{\frac{1}{5}x}$ horizontal stretch by 5 $y = \sqrt{3x}$ horizontal compression by $\frac{1}{3}$
Reflection	$-f(x)$ $f(-x)$	$y = -\sqrt{x}$ across x-axis $y = \sqrt{-x}$ across y-axis

Try Some

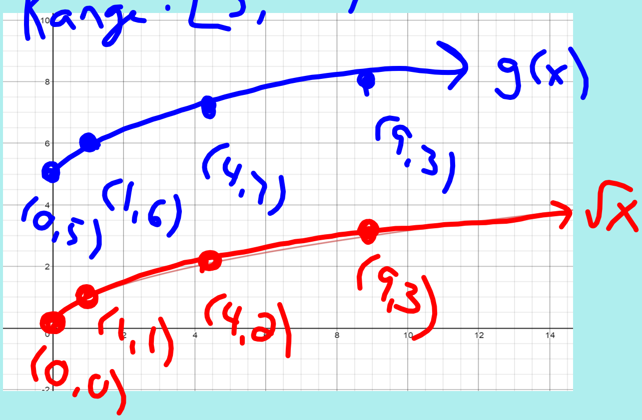
Using the graph of $f(x) = \sqrt{x}$ as a guide, describe the transformation and graph the function.

a) $g(x) = \sqrt{x} + 5$

Vert. translation up 5

Domain: $[0, \infty)$

Range: $[5, \infty)$

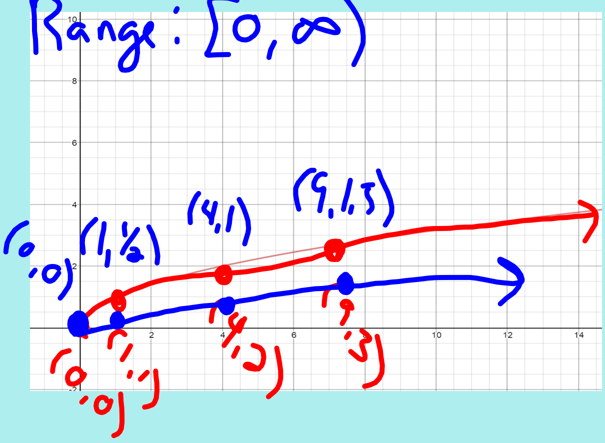


b) $g(x) = \frac{1}{2}\sqrt{x}$

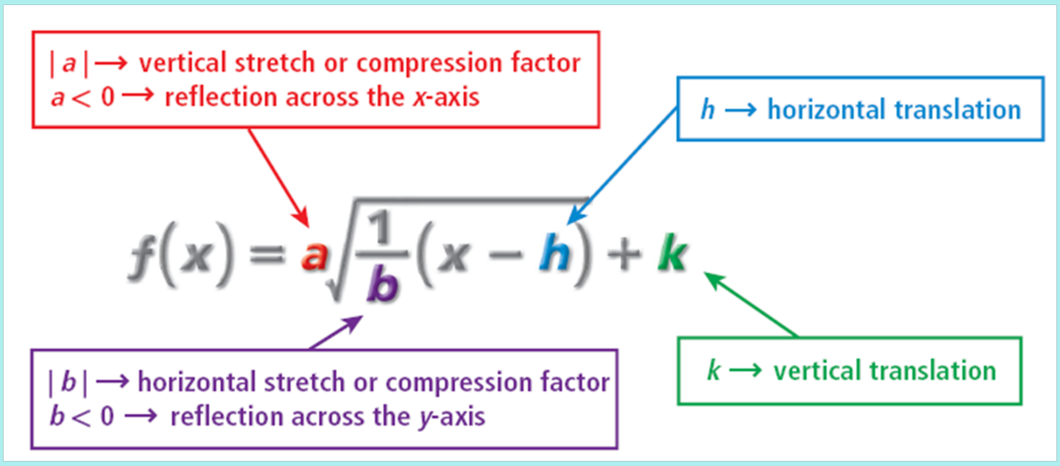
Vert. comp by ½

Domain: $[0, \infty)$

Range: $[0, \infty)$



Why Stop at One Transformation?

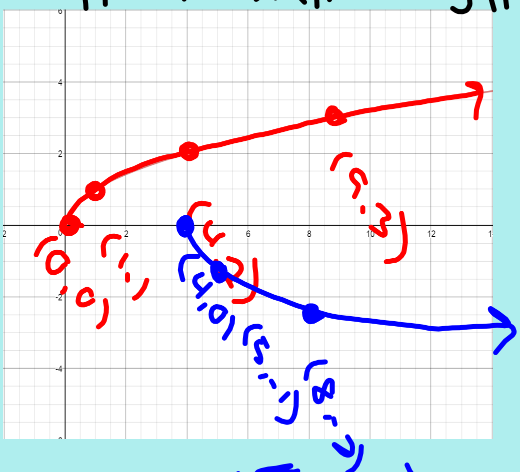


Using the graph of $f(x)=\sqrt{x}$ as a guide, describe the transformation and graph the function.

a) $g(x) = -\sqrt{x-4}$

Reflect x-axis (-y)

Hor. translation 4 right (x+4)



Domain: [4, ∞)

Range: (-∞, 0]

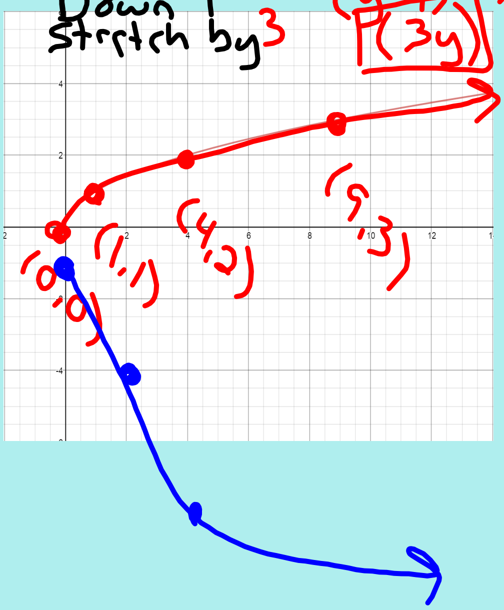
b) $g(x) = -3\sqrt{x} - 1$

Reflect over x (-y)

Down 1 (y-1)

Stretch by 3 (3y)

-3y



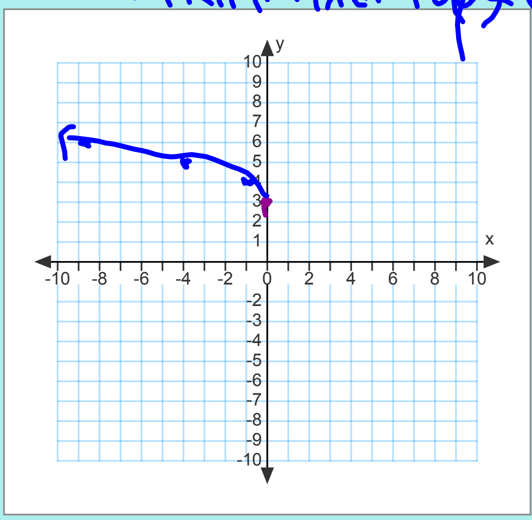
Try These

Transformation, Domain, Range

a) $g(x) = \sqrt{-x} + 3$

reflection across y (-x)

vertical translation up 3 (y+3)



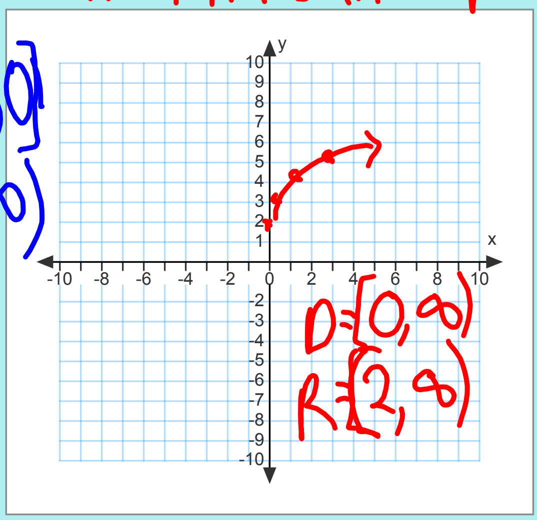
domain $(-\infty, 0]$

range $[3, \infty)$

b) $f(x) = \sqrt{3x} + 2$

horiz. compression 1/3

vertical translation up 2



D = $[0, \infty)$

R = $[2, \infty)$

Working Backwards

Use the description to write the square-root function *g*. The parent function $f(x)=\sqrt{x}$ is reflected across the *x*-axis, compressed vertically by a factor of $\frac{1}{5}$, and translated down 5 units.

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

reflect. across x-axis $-\sqrt{x}$

Comp. vert. by 1/5 $-\frac{1}{5}\sqrt{x}$

down 5 $g(x)=-\frac{1}{5}\sqrt{x}-5$

The parent function $f(x)=\sqrt{x}$ is reflected across the *x*-axis, stretched vertically by a factor of 2, and translated 1 unit up.

$\sqrt{x}$

reflect x-axis $=-\sqrt{x}$

vert. stretch by 2 $=-2\sqrt{x}$

trans. 1 up $=-2\sqrt{x}+1$

$g(x)=-2\sqrt{x}+1$

Word Problems... Yay!

A framing store uses the function $c(a) = 0.5\sqrt{a} + 0.2$ **to determine the cost *c* in dollars of glass for a picture with an area *a* in square inches. The store charges an addition $6.00 in labor to install the glass. Write the function *d* for the total cost of a piece of glass, including installation, and use it to estimate the total cost of glass for a picture with an area of 192 in^2.**

More Word Problems... Extra Yay!

Special airbags are used to protect scientific equipment when a rover lands on the surface of Mars. On Earth, the function *f*(*x*) = $\sqrt{64x}$ **approximates an object's downward velocity in feet per second as the object hits the ground after bouncing *x* ft in height.**

The downward velocity function for the Moon is a horizontal stretch of *f* by a factor of about $\frac{25}{4}$. Write the velocity function *h* for the Moon, and use it to estimate the downward velocity of a landing craft at the end of a bounce 50 ft in height.