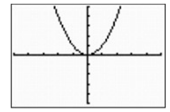
Math-3
Lesson 1-3

The Absolute Value Function
And
The Square Root Function

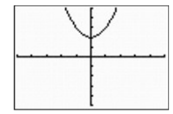
Describe how each function transforms the "parent" f(x).

$f(x) = x^2$



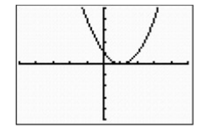
$g(x) = x^2 + 2$

f(x) up 2



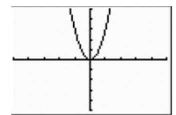
$h(x) = (x-1)^2$

f(x) right 1



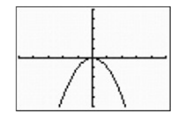
$j(x) = 3x^2$

f(x) VSF=3



$k(x) = -x^2$

f(x) reflected across the x-axis



Absolute Value Function

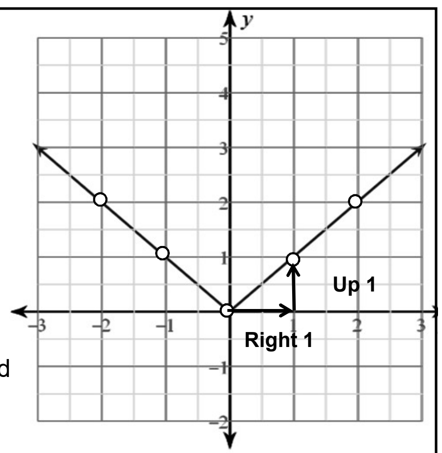
$f(x) = |x|$

Fill in the table, then graph the x-y pairs.

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

$y = |-2|$

$|-2|$ means "what is the distance between -2 and zero?



Just like the Quadratic Function, the point (0, 0) is the vertex and there is a point in the position "right 1, up 1" (from the vertex).

$f(x) = |x|$

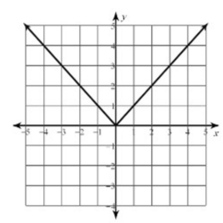
x	y
-2	2
-1	1
0	0
1	1
2	2

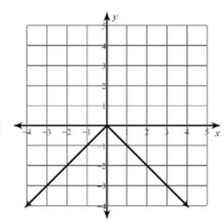
$g(x) = -|x|$

X-	y
-2	-2
-1	-1
0	0
1	-1
2	-2

Multiplying the parent function by -1 reflects it across the x-axis.

What is the vertex?





$f(x)=|x|$

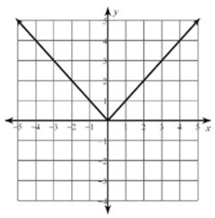
x	y
-2	2
-1	1
0	0
1	1
2	2

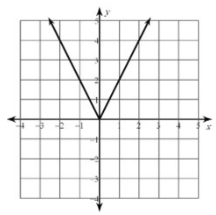
$g(x)=2|x|$

x	y
-2	4
-1	2
0	0
1	2
2	4

Multiplying the parent function by 2 makes each y-value of the parent 2 times as big; VSF = 2

What is the vertex?





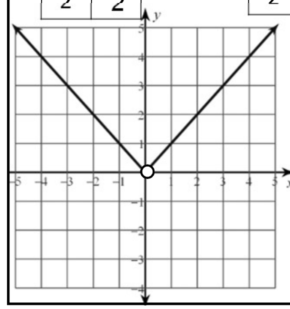
$f(x)=|x|$

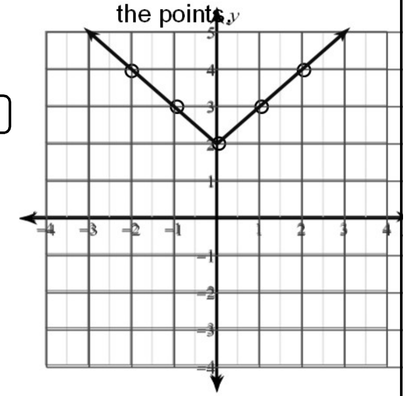
x	y
-2	2
-1	1
0	0
1	1
2	2

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

x	y
-2	4
-1	3
0	2
1	3
2	4

Fill in the table, graph the points.





Adding 2 to the parent function causes the graph to translate ***up 2***

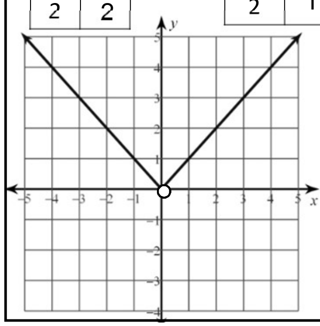
$f(x)=|x|$

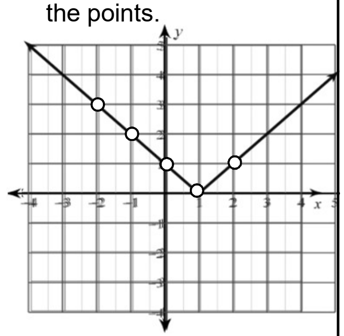
x	y
-2	2
-1	1
0	0
1	1
2	2

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

x	g(x)
-2	3
-1	2
0	1
1	0
2	1

Fill in the table, graph the points.

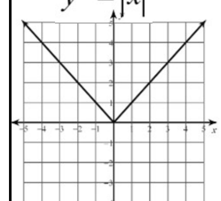




Replacing 'x' in the parent function with '(x – 1)' causes the graph to translate ***right '1'***

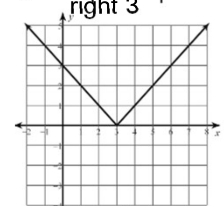
What is the transformation to the parent function?

$y=|x|$



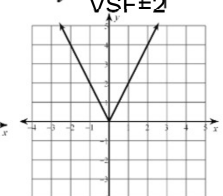
$y=|x-3|$

right 3



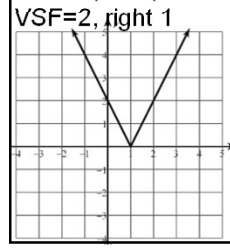
$y=2|x|$

VSF=2



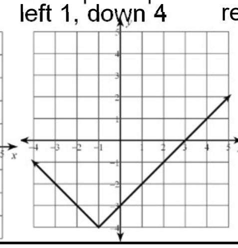
$y=2|x-1|$

VSF=2, right 1



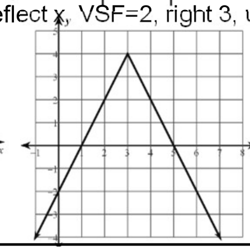
$y=|x+1|-4$

left 1, down 4



$y=-2|x-3|+4$

reflect x, VSF=2, right 3, up 4



$y = x^2$ $\qquad y = (-1)a(x-h)^2 + k$

Reflection across x-axis — **Vertical stretch factor** — **Shift left/right** — **shift up or down**

$y = |x|$ $\qquad y = (-1)a|x-h| + k$

$y = 3(x+5)^2 - 2$

VSF=3,
left 5, down 2

$f(x) = -5|x-2| + 3$

reflected (x-axis)
VSF=5, right 2, up 3

What does adding or subtraction "k" do to the parent function?

$f(x) = |x| + k$ Vertical shift (a distance of 'k' units)

What does adding or subtraction "h" do to the parent function?

$f(x) = |x - h|$ Horizontal shift

What does multiplying by 'a' do to the parent function?

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

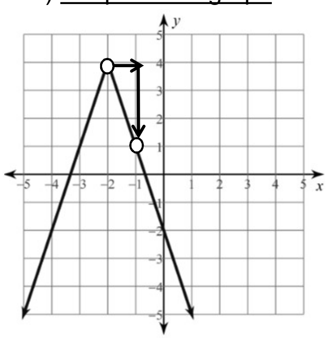
What does multiplying by (-1) do to the parent function?

$f(x) = -|x|$ Reflection (x-axis)

What equation has been graphed? $f(x) = |x|$

1) Vertex has moved left 2 and up 4.
$g(x) =$ _____ $|x+2| + 4$

2) Shape of the graph: *from the vertex* move right 1, down 3.



➔ Reflect x-axis, VSF=3.

$g(x) = -3|x+2| + 4$

Square Root Function

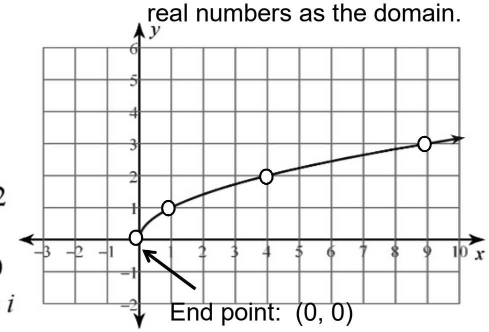
$f(x) = \sqrt{x}$

This is the first function, so far, that does NOT have all real numbers as the domain.

Fill in the table, then graph the x-y pairs

x	y	
9	3	$y = \sqrt{9} = 3$
4	2	$y = \sqrt{4} = 2$
1	1	$y = \sqrt{1} = 1$
0	0	$y = \sqrt{0} = 0$
-1	??	$y = \sqrt{-1} = i$

$y = \sqrt{x}$

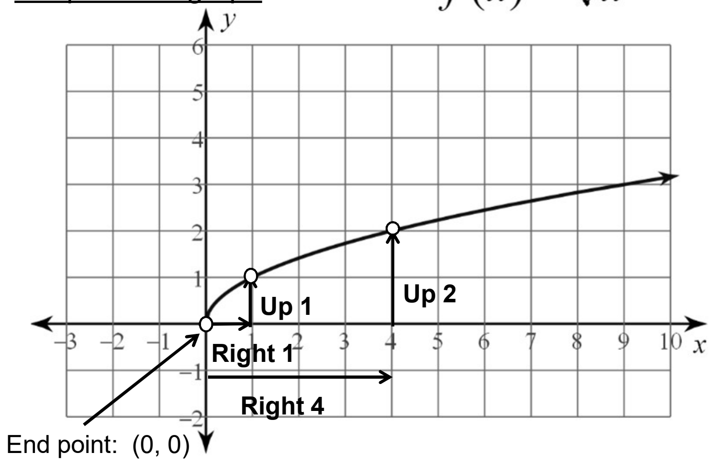


End point: (0, 0)

The square root of a negative number is an *imaginary number* and CANNOT be graphed on the REAL Plane.

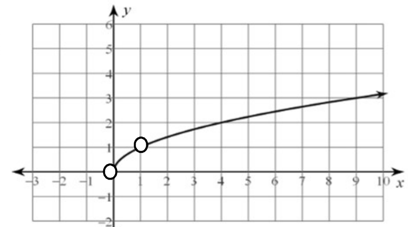
We say inputs that cause the *radicand* of the function to be negative, have *no corresponding output values.*

Shape of the graph $f(x)=\sqrt{x}$



Square Root Function (the top half of a sideways parabola)

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



Does the graph ever reach horizontal? *never*

Domain of the graph? $x=[0,\infty)$

Range of the graph? $y=[0,\infty)$

Where is the function increasing? $f(x)\uparrow on\colon\ y=[0,\infty)$

Where is the function decreasing? *never*

Where is the function positive? $f(x)>0\ on\colon\ y=[0,\infty)$

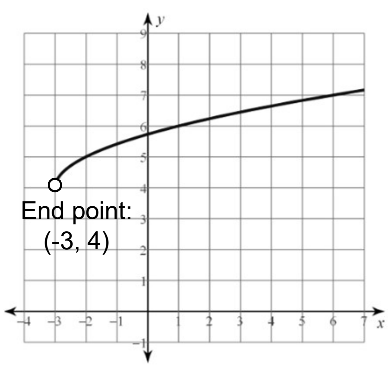
Where is the function negative? *never*

Describe the transformations to the parent function:

$y=4+\sqrt{x+3}$ $\quad y=\sqrt{x+3}+4$

Up 4, left 3

End point? $(-3,4)$



Domain and Range depend upon the endpoint and whether the graph has been reflected.

Domain?

$x=[-3,\infty)$

Range?

$y=[4,\infty)$

Describe the transformations to the parent function: $f(x)=\sqrt{x}$

Where is the endpoint of the graph?

$g(x)=\sqrt{x-2}+4$ right 2, up 4

End point: (2, 4)

$g(x)=4+\sqrt{x-2}$ Up 4, right 2

$k(x)=-3-2\sqrt{x+1}$ Left 1, down 3, reflected (x-axis), VSF-2

End point: (-1, -3)

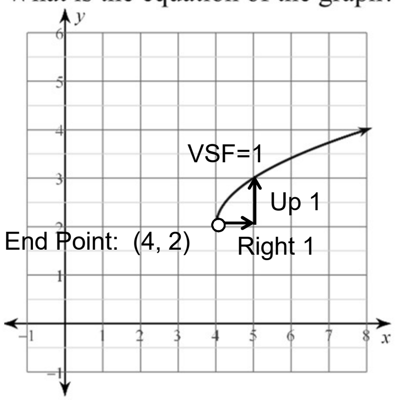
$h(x)=-5+2\sqrt{x}$ Down 5, VSF-2

End point: (0, -5)

$j(x)=1-4\sqrt{x+2}$ Left 2, up 1, reflected (x-axis), VSF-4

End point: (-2, 1)

What is the equation of the graph?



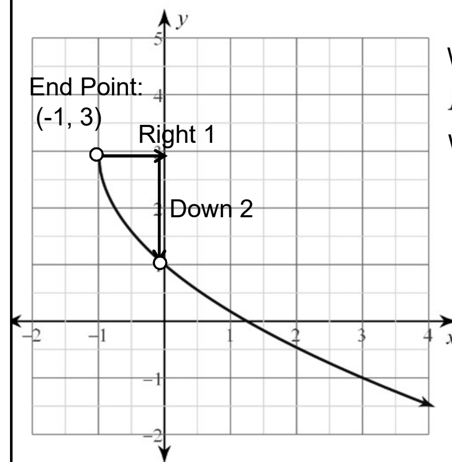
Transformation to the parent function?

right 4, up 2

$y = \sqrt{(x-4)} + 2$

$y = 2 + \sqrt{(x-4)}$

What is the equation of the graph?



$y = -2\sqrt{(x+1)} + 3$

What is the domain?

$Domain: \; x = [-1, \infty)$

What is the Range?

$range: \; x = (-\infty, 6]$

Let's generalize the transformations

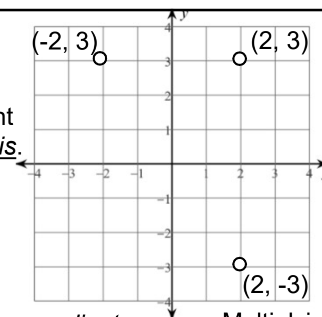
$f(x) = x^2 \qquad y = (-1)a(x-h)^2 + k$

Reflection across x-axis — **vertical stretch factor** — **Translates left/right** — **translating <u>up</u> or <u>down</u>**

$g(x) = |x| \qquad y = (-1)a|x-h| + k$

$h(x) = \sqrt{x} \qquad y = (-1)a\sqrt{x-h} + k$

Reflect this point across the *y-axis*. What are the *coordinates* the new point?



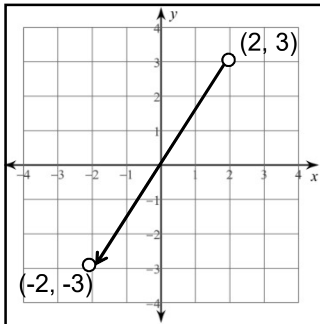
Reflect this point across the *x-axis*. What are the *coordinates* the new point?

Multiplying the *x-coordinate* of a point by (-1) causes the point to be reflected across the *y-axis*.

In general we say: *f(-x)* is a reflection of *f(x)* *across the y-axis.*

Multiplying the *y-coordinate* of a point by (-1) causes the point to be reflected across the *x-axis*.

In general we say: *-f(x)* is a reflection of *f(x) across the x-axis.*

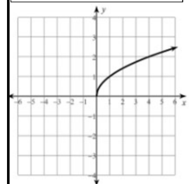


Reflect this point across the *origin*. What are the *coordinates* the new point?

Multiplying both the *x-coordinate* and *y-coordinate* of a point by (-1) causes the point to be reflected across the *origin*.

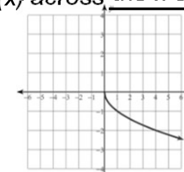
In general we say: *-f(-x)* is a reflection of *f(x) across the origin.*

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



What is the equation…

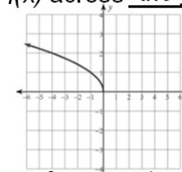
-f(x) is a reflection of *f(x)* across *the x-axis*



for an x-axis reflection?

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

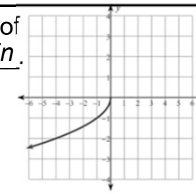
f(-x) is a reflection of *f(x)* across *the y-axis*.



for a y-axis reflection?

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

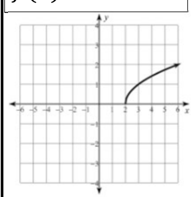
-f(-x) is a reflection of *f(x)* across *the origin*.



What the equation for a reflection across the origin?

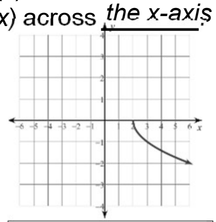
$g(x) = -\sqrt{-x}$

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



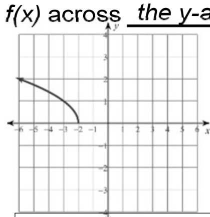
What does the square root equation look like…

-f(x) is a reflection of *f(x)* across *the x-axis*



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

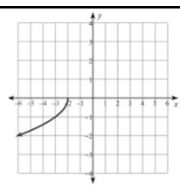
f(-x) is a reflection of *f(x)* across *the y-axis*.



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

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

-f(-x) is a reflection of *f(x)* across *the origin*.

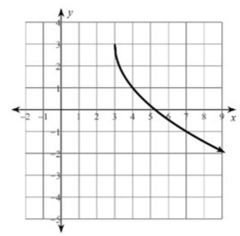


What does the square root equation look like…

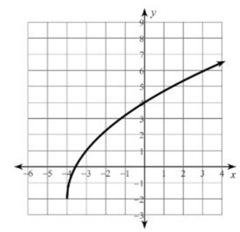
$g(x) = -\sqrt{-x-2}$

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

What is the equation?



$g(x) = 3 - 2\sqrt{x-3}$



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