Lesson #39: Reflections &Transformations

By the end of the lesson, we will be able to:

~Graph transformations of

*Quadratic Functions x^2

*Cubic Functions x^3

*Square Root Functions $\sqrt{x}$

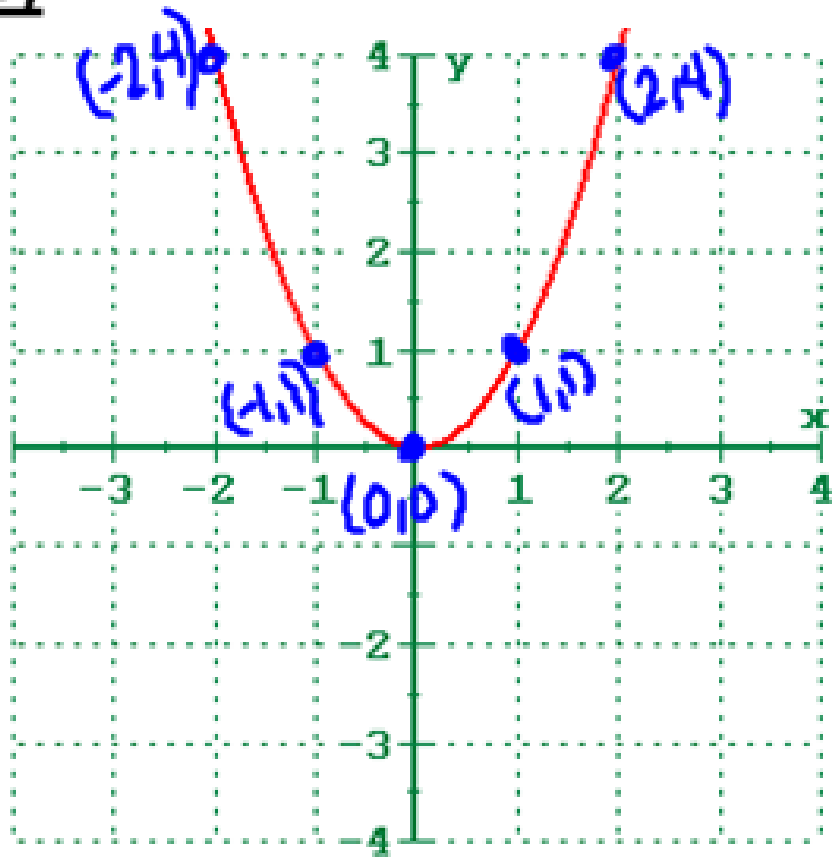
*Absolute Value Functions. $|x|$

~Write equations from graphs of the Quadratic, Cubic, Square Root, and Absolute Value functions.

Lesson 39: Transformations

Quadratic Functions (Parabolas)

$y = x^2$



Shape: "U"

5 Special Points:

(-2,4), (-1,1), (0,0)
(1,1), (2,4)

Transformations: $y = a(x - h)^2 + k$

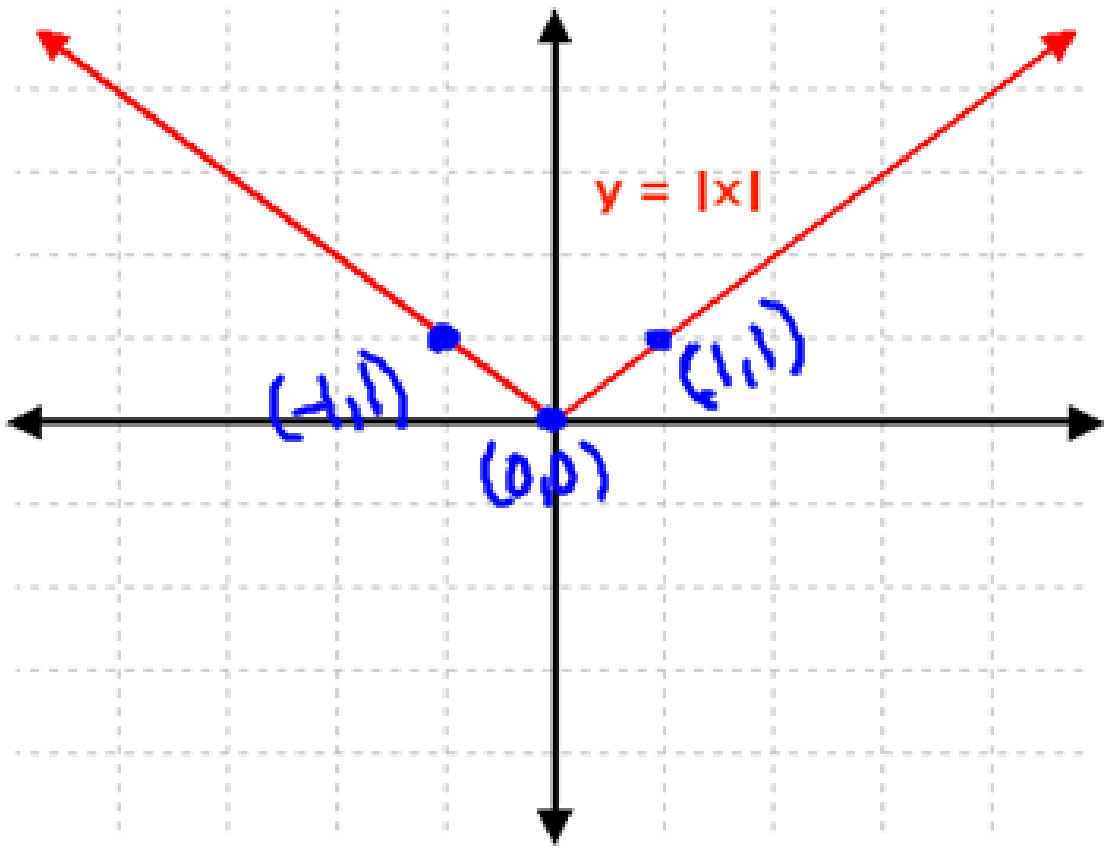
Domain: $\mathbb{R}$

Range: $y \geq 0$

Lesson 39: Transformations

Absolute Value Functions

$y = |x|$



Shape: "V"

3 Special Points:

(-1,1), (0,0) (1,1)

Transformations: $y = a|x - h| + k$

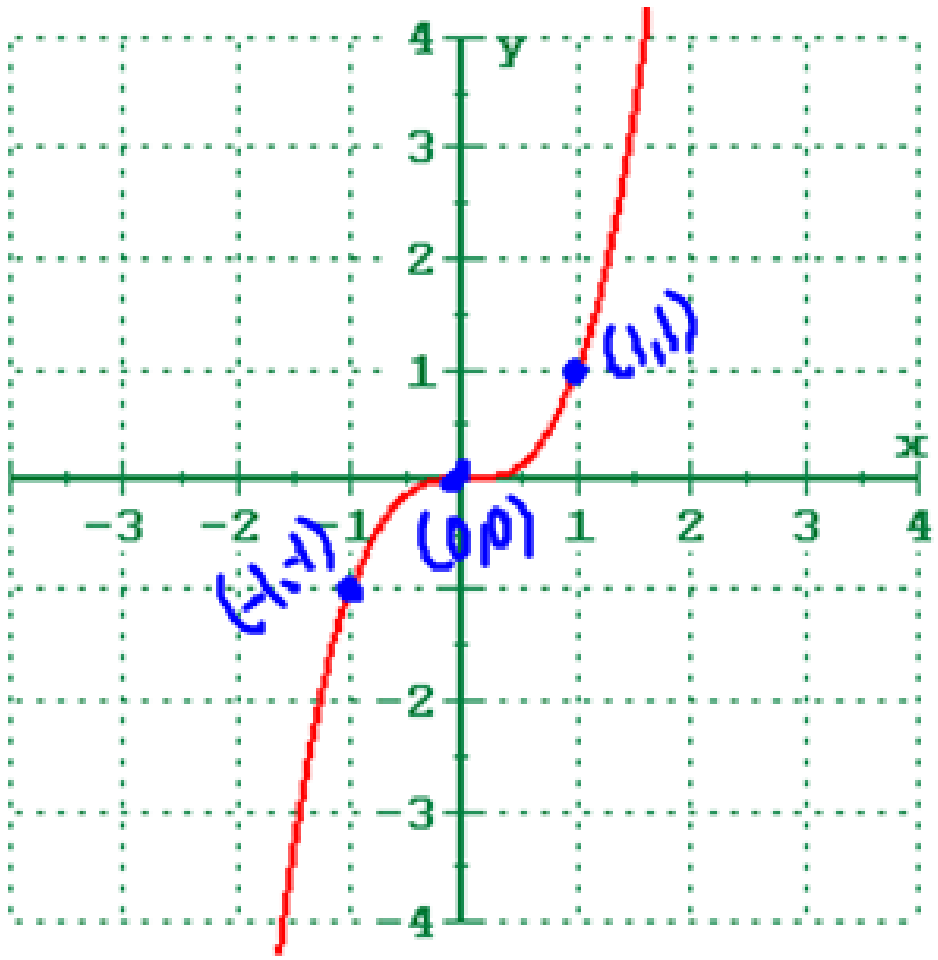
Domain: $\mathbb{R}$

Range: $y \geq 0$

Lesson 39: Transformations

Cubic Functions

$y = x^3$



Shape: chair

3

Special Points:

(-1,-1), (0,0) (1,1)

Transformations: $y = a(x - h)^3 + k$

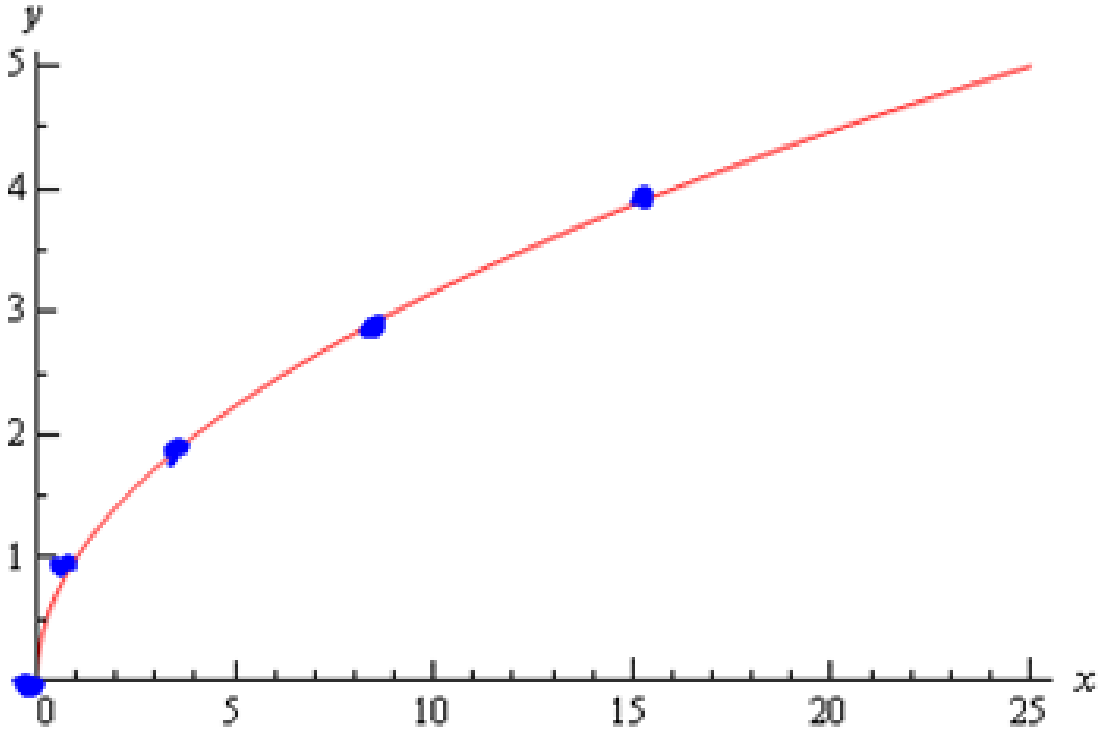
Domain: $\mathbb{R}$

Range: $\mathbb{R}$

Lesson 39: Transformations

Square Root Functions

$y = \sqrt{x}$



Shape:

3 Special Points:

(0,0), (1,1), (4,2)

Transformations: $y = a\sqrt{(x-h)} + k$

Domain: $x \geq 0$

Range: $y \geq 0$

Lesson 39: Transformations

Lets see the affect of each of the parameters on any function graph using GeoGebra!

"a" affects: flips upside down

-a flips down (upside down)

+a flips up (opens up)

"h" affects: moves left to right — *opposite*

-h - moves right

+h - moves left

"k" affects: moves up + down

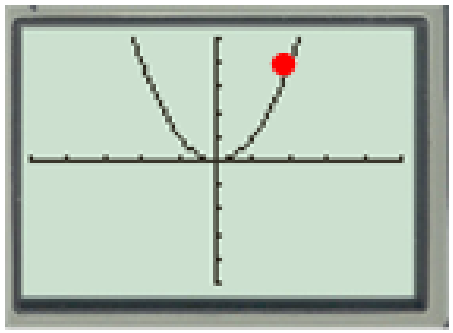
-k movesdown

+k moves up

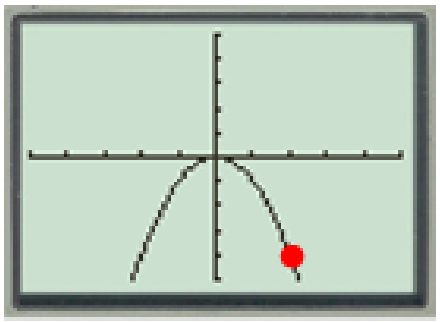
Lesson 39: Transformations

Reflections over x-axis and y-axis:

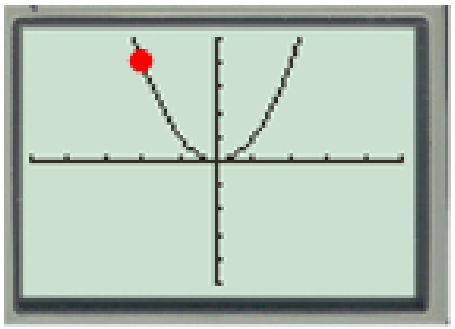
a.) $y = x^2$



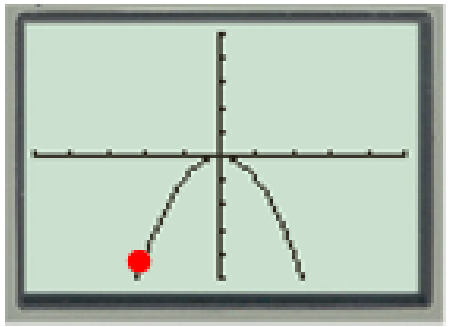
b.) $y = -x^2$ $a = -1$



c.) $y = (-x)^2$ flips over y-axis



d.) $y = -(-x)^2$



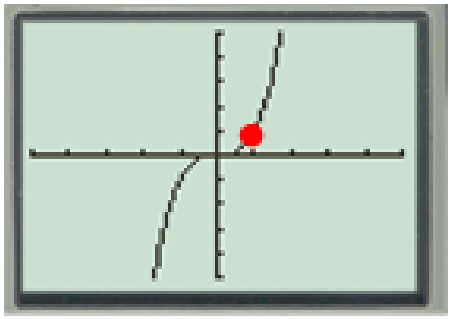
Lesson 39: Transformations

Reflections over x-axis and y-axis:

a=-1

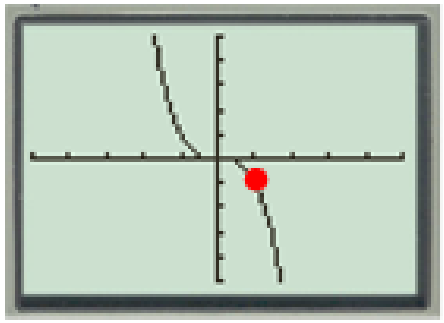
-a

a.) $y = x^3$



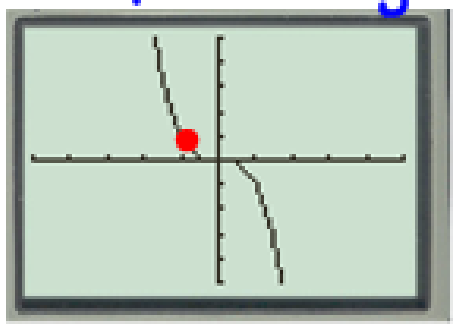
b.) $y = -(x)^3$

Flips over x-axis

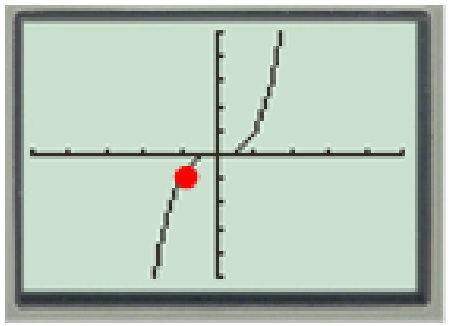


c.) $y = (-x)^3$

Flips over y-axis



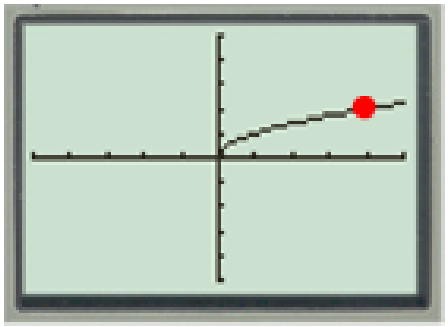
d.) $y = -(-x)^3$



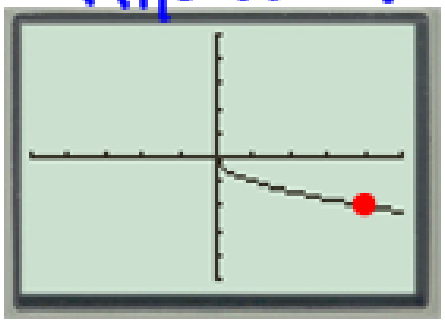
Lesson 39: Transformations

Reflections over x-axis and y-axis:

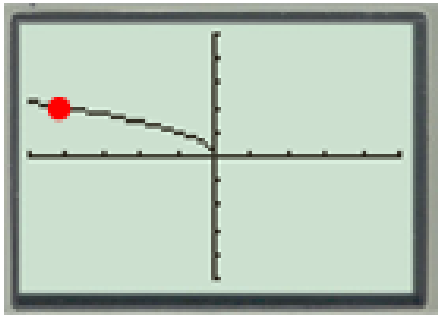
a.) $y = \sqrt{x}$



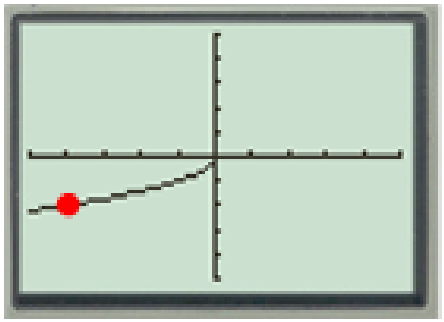
b.) $y = -\sqrt{x}$ $a = -1$ flips over x-axis



c.) $y = \sqrt{(-x)}$ flips over y-axis



d.) $y = -\sqrt{-x}$



Lesson 39: Transformations

What changes (transformations) are made to the parent graph given each of these functions?

Transformations from parent equations:

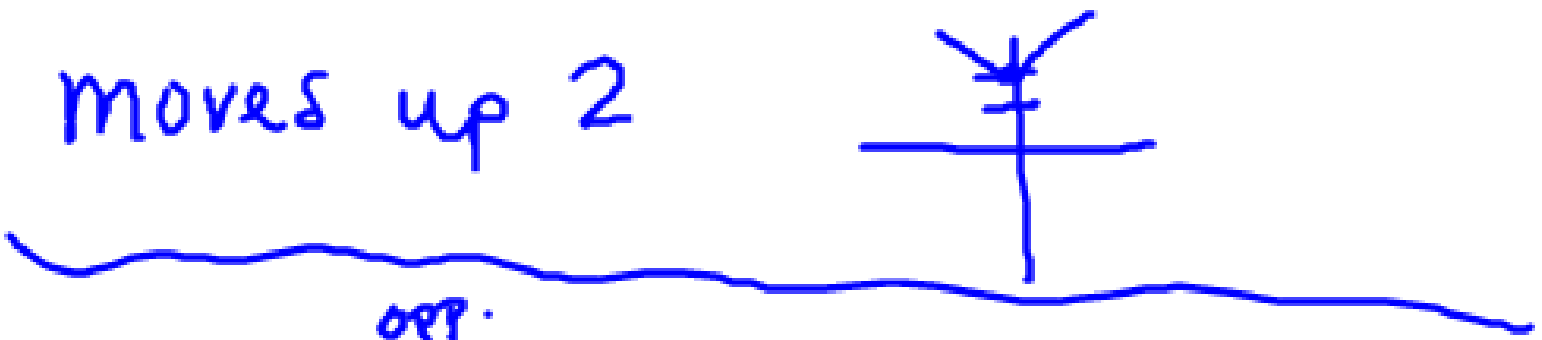
1. Do horizontal transformation "h". (Move left or right)
2. Do the "flip" or reflection.
   ($-a$ will flip upside down -- fold on x-axis)
   ($-x$ will flip left or right -- fold on y-axis)
3. Do vertical transformation "k". (Move up or down)

Lesson 39: Transformations

What changes (transformations) are made to the parent graph given each of these functions?

a.) $y = |x| + 2$ $a=1$ $h=0$ $k=2$

moves up 2



b.) $g(x) = (x - 3)^3$ opp. $a=1$ $h=3$ $k=0$

moves right 3

Lesson 39: Transformations

What changes (transformations) are made to the parent graph given each of these functions?

c.) $f(x) = -\sqrt{x-9}+2$ a=-1 h=9 k=2

Move right 9, flip over x-axis, up 2

flip upside down

d.) $f(x) = -|x+2|+3$ a=-1 h=-2 k=3

moves left 2, flip over x-axis, up 3

Lesson 39: Transformations

To graph equations:

1. Write down special points.
2. Add the "h" value to the X's in your special points.
3. If "a" is negative (outside parentheses), make the "y" value in the special points negative.
   If "x" is negative (inside parentheses), make the "x" value in the special points negative.
   ~~ **This is our reflection step.** ~~
4. Add the "k" value to the Y's in your special points.
5. Plot the points and connect the dots. (Remember arrows!)

Lesson 39: Transformations

$y = x^3$

Graph each equation using transformations. Label important points.

$y = (x)^3 - 3$

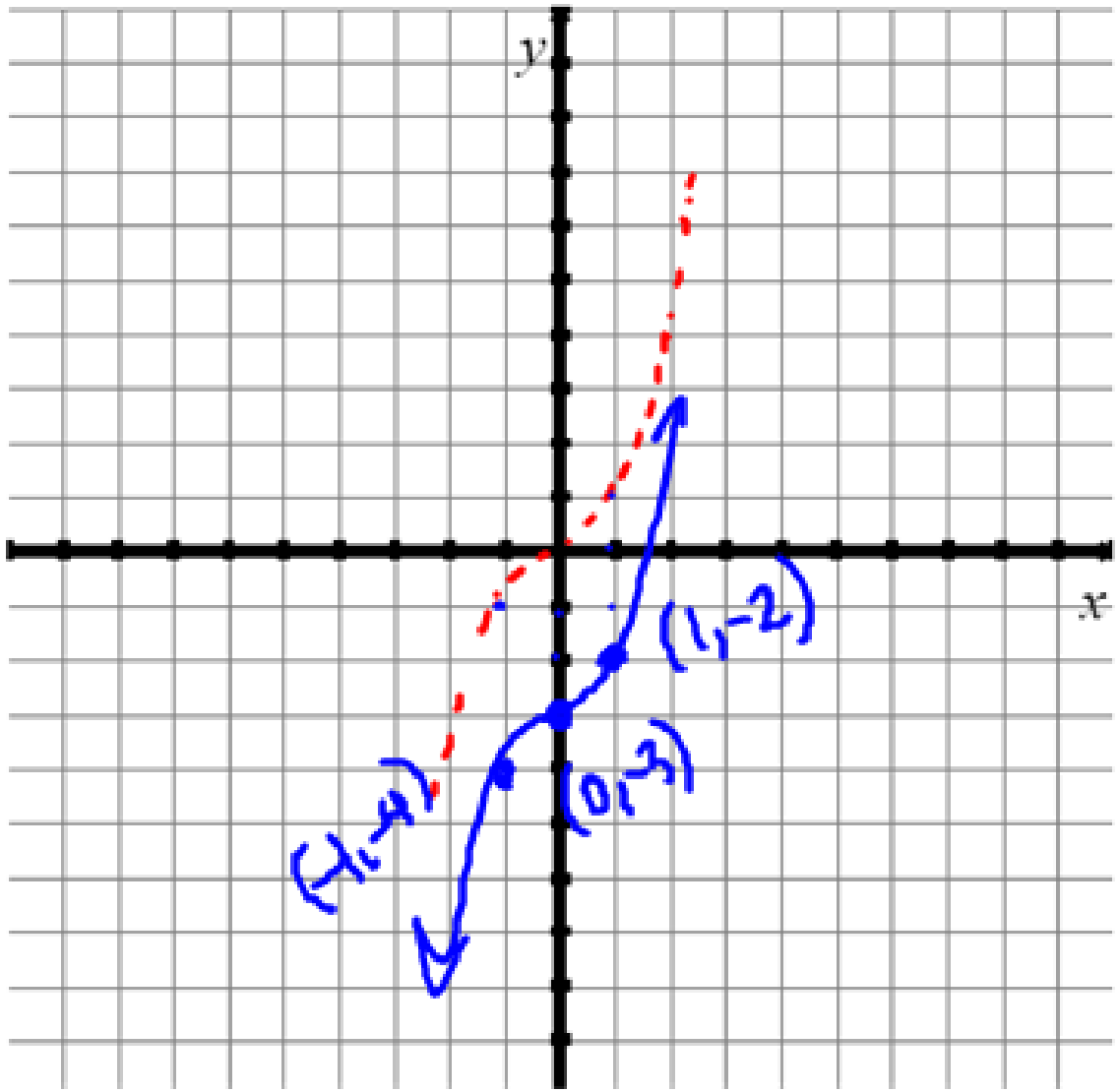
$a = 1 \quad h = 0 \quad k = -3$

$k = -3$ – add to y's

$(-1,-1) \rightarrow (-1,-4)$

$(0,0) \rightarrow (0,-3)$

$(1,1) \rightarrow (1,-2)$



Lesson 39: Transformations

Graph each equation using transformations. Label important points.

$$y = |x - 1| + 3$$

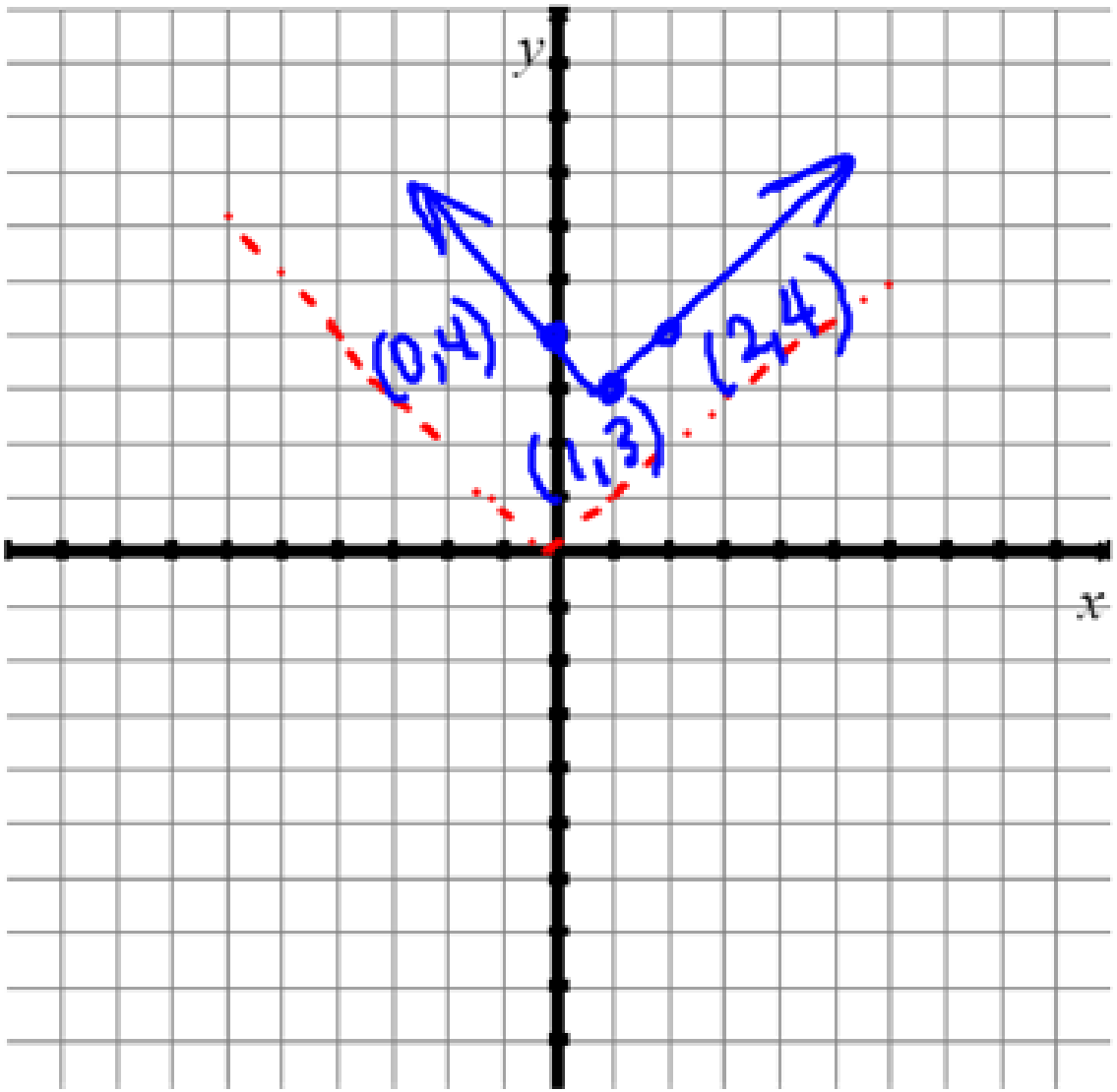
$a = 1 \quad h = 1 \quad k = 3$

$h = 1 \qquad k = 3$

$(-1,1) \rightarrow (0,1) \rightarrow (0,4)$

$(0,0) \rightarrow (1,0) \rightarrow (1,3)$

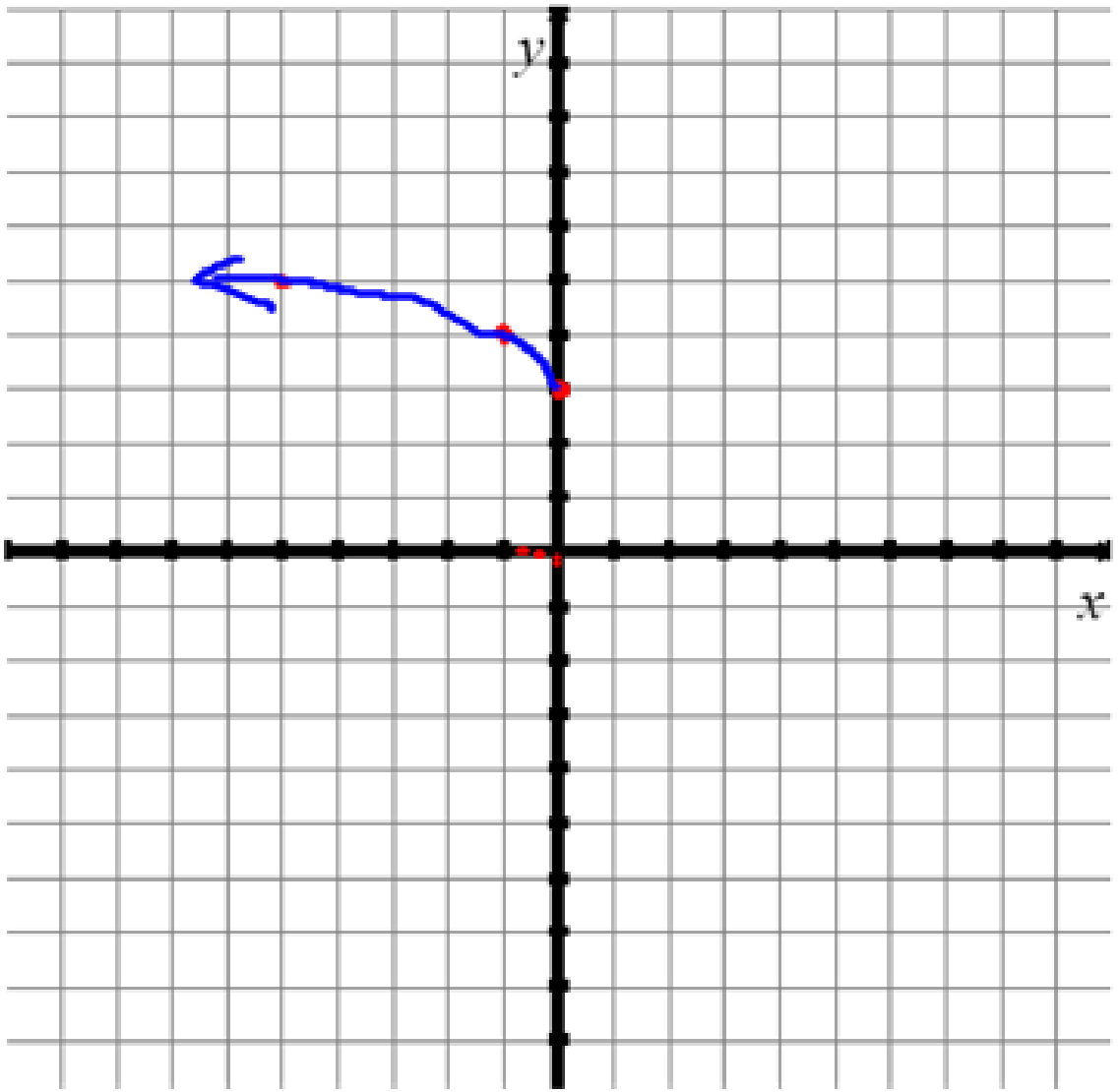
$(1,1) \rightarrow (2,1) \rightarrow (2,4)$



Lesson 39: Transformations

Graph each equation using transformations. Label important points.

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

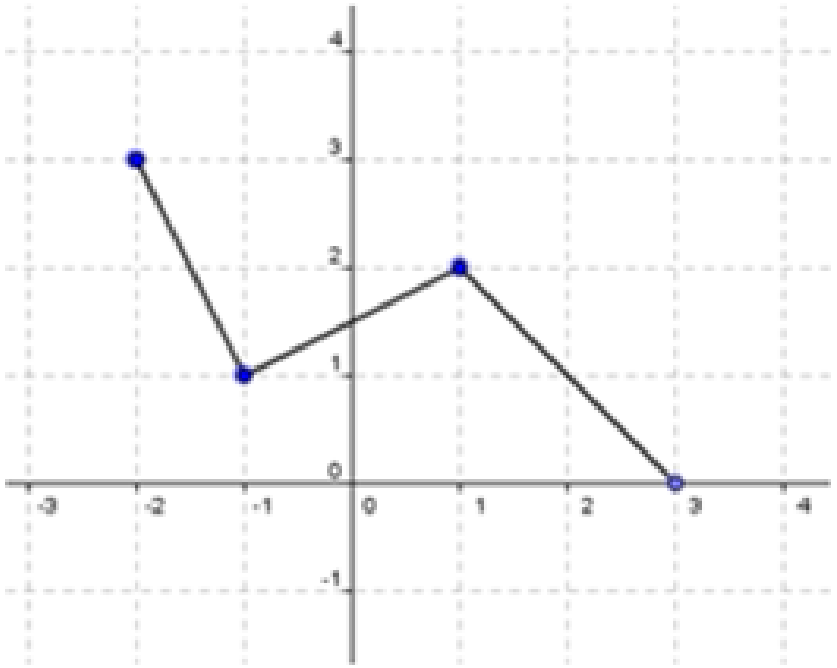


Lesson 39: Transformations

Given f(x), graph using transformations. Label important points.

$$f(x+1)-2$$

h = −1 k = −2



Add h to your x's.
Add k to your y's.

These will be your new points.

Look at the next example :)

Lesson 39: Transformations

Given f(x), graph using transformations. Label important points.

$$f(-x)+1$$

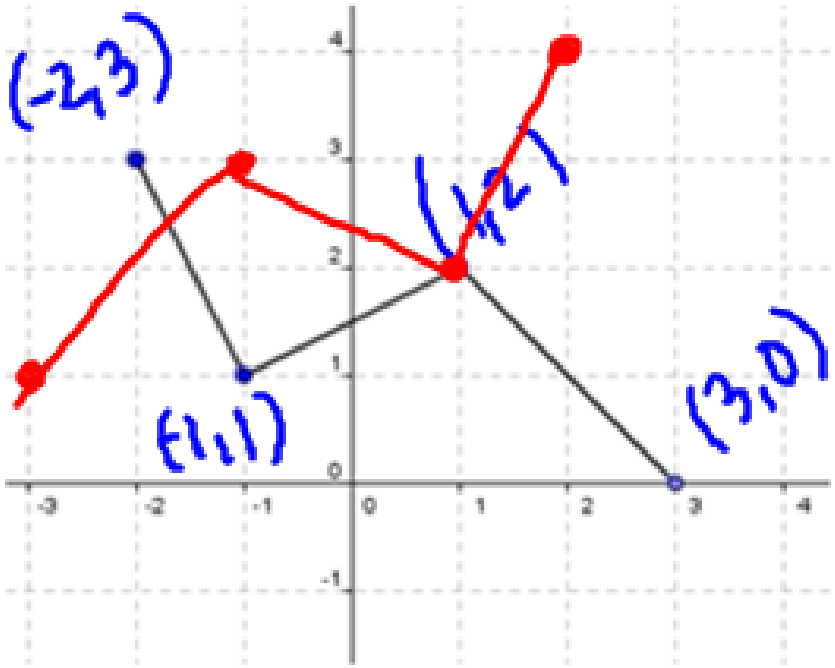
* x (-1) up 1 to y's

(-2,3) → (2,3) → (2,4)

(-1,1) → (1,1) → (1,2)

(1,2) → (-1,2) → (-1,3)

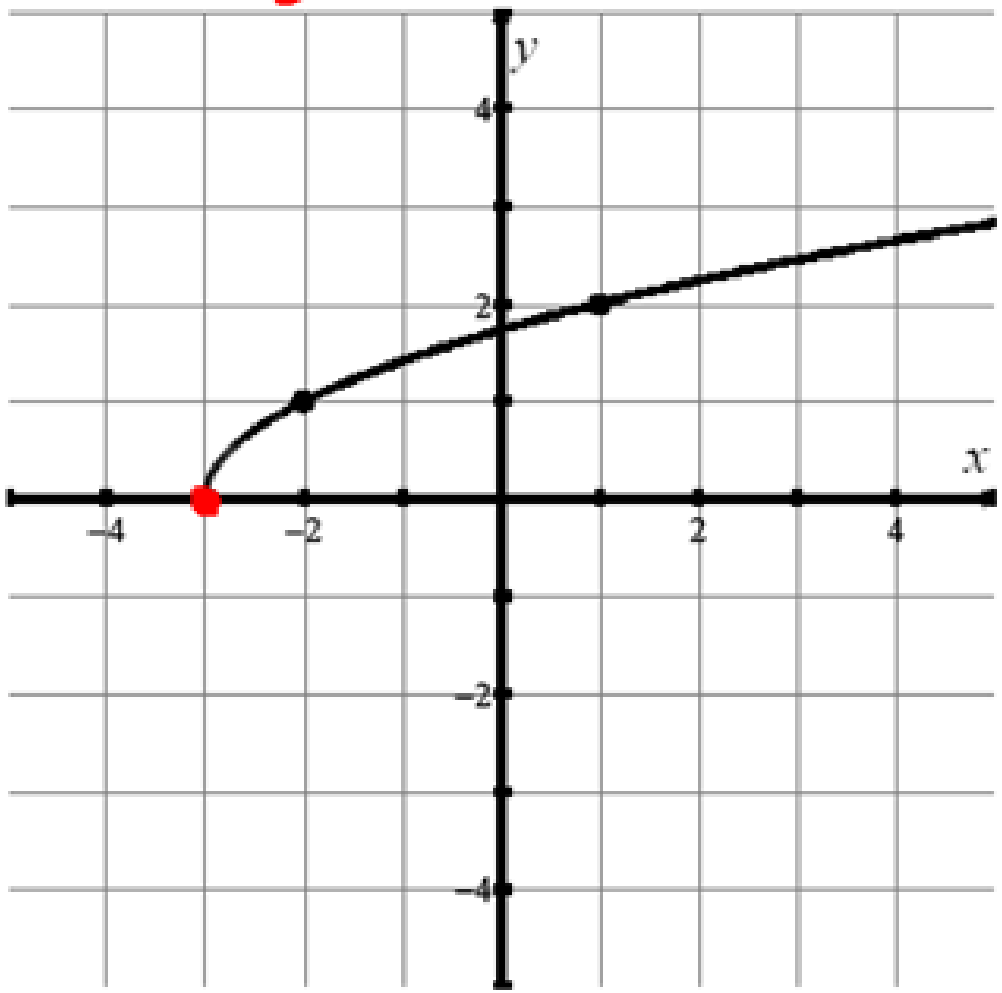
(3,0) → (-3,0) → (-3,1)



Lesson 39: Transformations

Write an equation for each graph. Then state the domain and range.

$y = \sqrt{x}$ shape



left 3

$h = -3$ $k = 0$

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

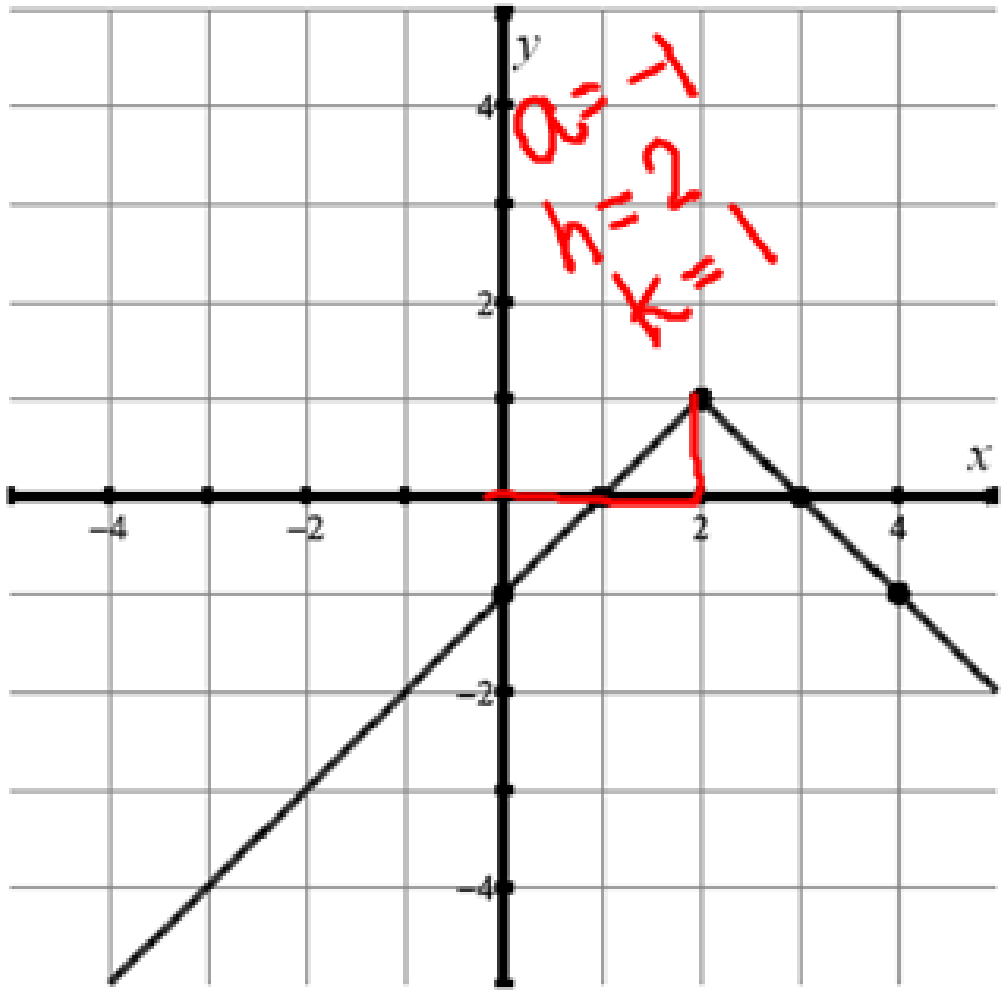
D: $x \geq -3$

R: $y \geq 0$

Lesson 39: Transformations

Write an equation for each graph. Then state the domain and range.

|x| shape



$y = -|x-2|+1$

D: $\mathbb{R}$

R: $y \leq 1$

Lesson #39: Reflections &Transformations

By the end of the lesson, we will be able to:

~Graph transformations of
- *Quadratic Functions
- *Cubic Functions
- *Square Root Functions
- *Absolute Value Functions.

~Write equations from graphs of the Quadratic, Cubic, Square Root, and Absolute Value functions.

Can you?

Homework:

Assignment 39