

☺ Chapter 4 Notes ☺

4.5 – Reflections and the Square Root Family

Objectives:

1. Define reflection.
2. Define the parent square root function, $y = \sqrt{x}$.
3. Define the square root symbol and function as the positive root.
4. Compare $f(x)$, $f(-x)$, $-f(x)$, and $-f(-x)$.
5. Apply the square root function in context.
6. Apply reflections to functions in general.
7. Symbolically solve the equation $a + \sqrt{x + b} = c$ for x .
8. Define and create piecewise functions.

Lets review function notation.

Let $f(x) = (x - 1)^2 - 3$. Find each of the following:

$$f(3) = (3-1)^2 - 3$$

$$= 2^2 - 3$$

$$= 4 - 3$$

$$f(3) = 1$$

$$-f(-3) = -[13] \text{ or } -[(3-1)^2 - 3]$$

$$= -13$$

$$f(-3) = f(-3) = (-3-1)^2 - 3$$

$$= (-4)^2 - 3$$

$$= 16 - 3$$

$$f(-3) = 13$$

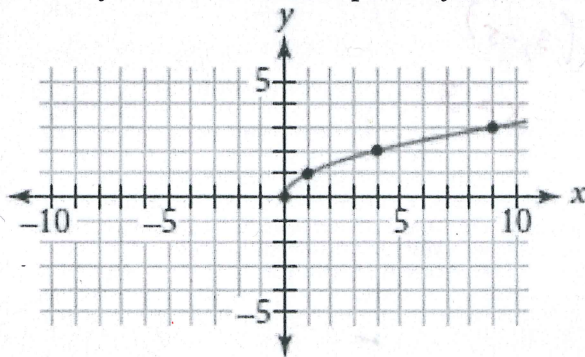
$$-f(3) = -[1] \text{ or } -[(3-1)^2 - 3]$$

$$= -1$$

Summarize what this notation tells us.

What is in parentheses is substituted for x . Anything outside the parentheses will be multiplied by the entire function.

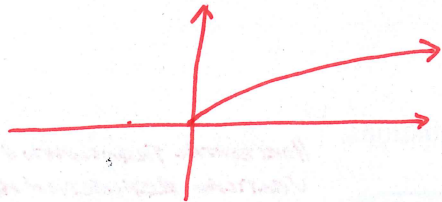
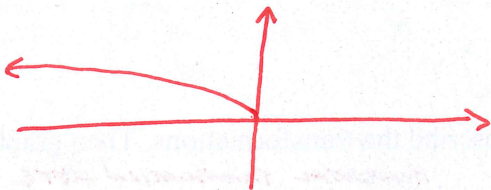
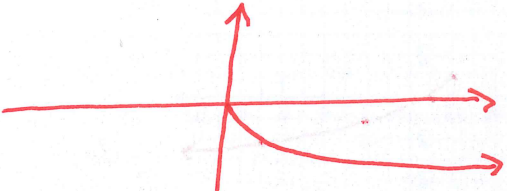
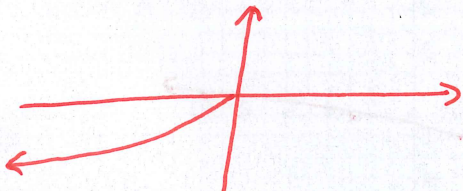
The graph of the square root function is another parent function that can be used to illustrate transformations.



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Investigation: Graph the following functions on your calculator. Sketch a graph of what you see, and then describe what happened to the parent function $y = \sqrt{x}$.

Summarize and compare each of the following reflections.

$f(x) = \sqrt{x}$	$f(x) = \sqrt{-x}$
	
	<i>$f(x)$ is reflected across y-axis (horizontal reflection)</i>
$f(x) = -\sqrt{x}$	$f(x) = -\sqrt{-x}$
	
<i>\sqrt{x} is reflected across x-axis (vertical reflection)</i>	<i>\sqrt{x} is reflected across y-axis and then the x-axis (horizontal reflection and vertical reflection)</i>

Reflection of a Function

A **reflection** is a transformation that flips a graph across a line, creating a mirror image.

Given the graph of $y = f(x)$,

the graph of $y = f(-x)$ is a horizontal reflection across the y -axis, and the graph of $-y = f(x)$, or $y = -f(x)$, is a vertical reflection across the x -axis.

When performing multiple transformations, follow order of operations.

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Example 1: Given the following equations, identify the transformations in order of their occurrence.

a. $y = -\sqrt{x+4}$

*HORIZONTAL TRANSLATION LEFT 4
VERTICAL REFLECTION ACROSS X*

b. $y = -\sqrt{x} + 10$

*VERTICAL REFLECTION ACROSS X
VERTICAL TRANSLATION UP 10*

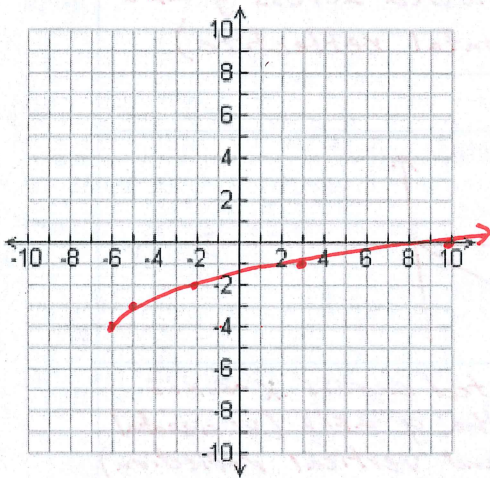
c. $y = -\sqrt{x-19} + 36$

*HORIZONTAL TRANSLATION RIGHT 19
VERTICAL REFLECTION ACROSS X
VERTICAL TRANSLATION UP 36*

Example 2: Describe the transformations. Then graph the following equations.

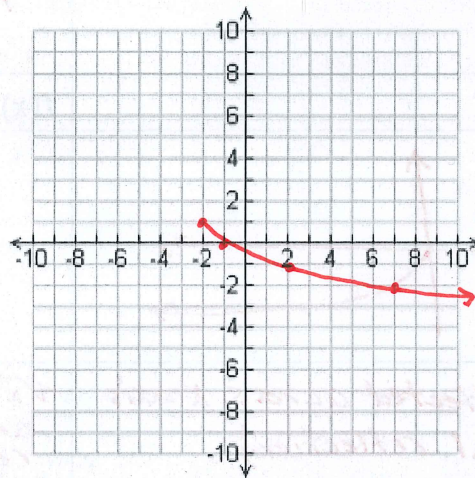
a. $y = \sqrt{x+6} - 4$

*HORIZONTAL TRANSLATION LEFT 6
VERTICAL TRANSLATION DOWN 4*

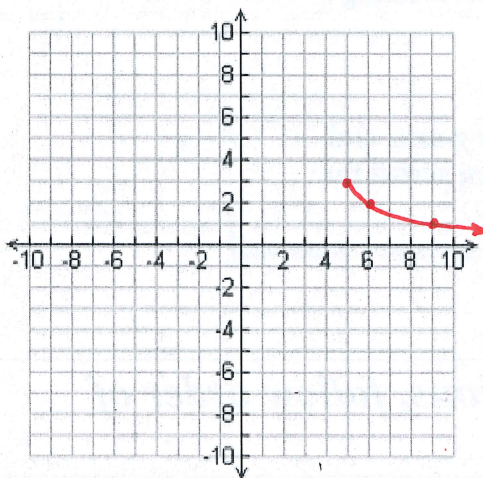


b. $y = -\sqrt{(x+2)} + 1$

*HORIZONTAL TRANSLATION LEFT 2
VERTICAL REFLECTION ACROSS X
VERTICAL TRANSLATION UP 1*

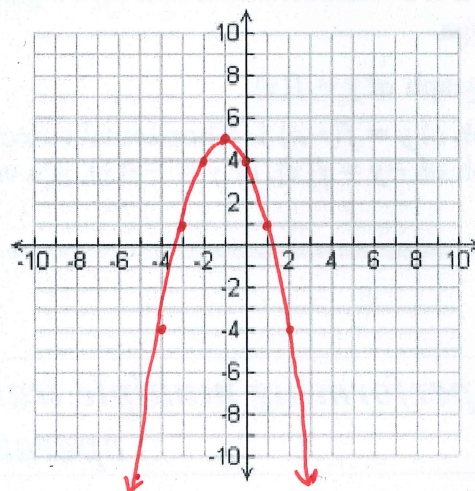


c. $y = -\sqrt{x-5} + 3$



*HORIZONTAL TRANSLATION RIGHT 5
VERTICAL REFLECTION ACROSS X
VERTICAL TRANSLATION UP 3*

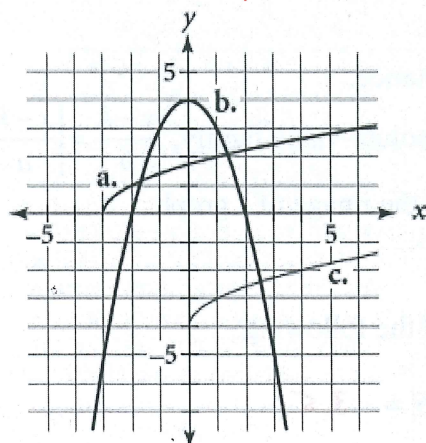
d. $y = -(x+1)^2 + 5$



*HORIZONTAL TRANSLATION LEFT 1
VERTICAL REFLECTION ACROSS X
VERTICAL TRANSLATION UP 5*

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Each graph below is a transformation of the graph of either the parent function $y = x^2$ or the parent function $y = \sqrt{x}$. Write an equation for each graph.



a.) Horizontal Translation Left 3 : $y = \sqrt{x+3}$

b.) VERTICAL REFLECTION, VERTICAL TRANSLATION UP 4 : $y = -x^2 + 4$

c.) VERTICAL TRANSLATION DOWN 4 : $y = \sqrt{x} - 4$

Describe what happens to the graph of $y = \sqrt{x}$ in each of the following situations.

a. x is replaced with $(x + 6)$.

HORIZONTAL TRANSLATION LEFT 6

$$y = \sqrt{x+6}$$

c. y is replaced with $(y + 1)$.

$$y+1 = \sqrt{x} \Rightarrow y = \sqrt{x} - 1$$

VERTICAL TRANSLATION UP 1

b. y is replaced with $(y - 5)$.

$$y-5 = \sqrt{x} \Rightarrow y = \sqrt{x} + 5$$

VERTICAL TRANSLATION UP 5

d. x is replaced with $(x - 8)$.

HORIZONTAL TRANSLATION RIGHT 8

$$y = \sqrt{x-8}$$

For the function $f(x)$ below, graph $f(-x)$ on graph A, $-f(x)$ on graph B and $-f(-x)$ on graph C.

