

# L2 - Reflections

December-14-15

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Re-cap:  $y = f(x-c) + d$   
 left/right by  $c$       up/down by  $d$

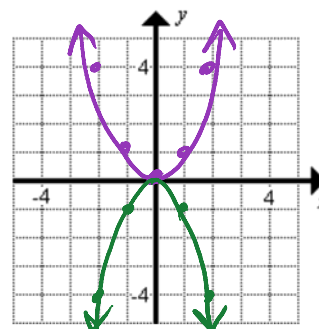
**Unit 6: Transformations**  
**Lesson 2 - Reflections of Functions**

A **reflection** can be identified with a “negative sign.” A reflection is a **mirror image** of a given function. Using a graphing calculator, let’s explore the effect of having a “negative sign” at different locations of a function.

Ex. 1: Graph  $y = x^2$  and  $y = -x^2$  on the same grid.

Change?

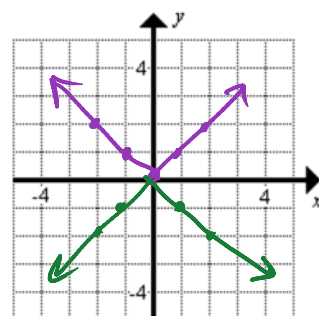
- Reflection in  $x$ -axis
- Vertical Reflection



Ex. 2: Graph  $y = |x|$  and  $y = -|x|$  on the same grid.

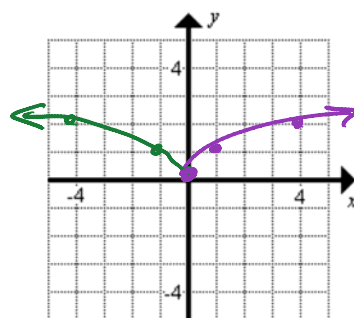
Change?

- Reflection in  $x$ -axis
- Vertical Reflection



Ex. 3: Graph  $y = \sqrt{x}$  and  $y = \sqrt{-x}$  on the same grid.

- Reflection in  $y$ -axis
- Horizontal Reflection



**Observations:**

$y = -f(x)$  → Vertical Reflection (VR) in  $x$ -axis      Mapping:  $(x, y) \rightarrow (x, -y)$

$y = f(-x)$  → Horizontal Reflection (HR) in  $y$ -axis      Mapping:  $(x, y) \rightarrow (-x, y)$

Ex. 4: Without using a graphing calculator,

a) graph  $f(x) = \sqrt{x+3} + 2$  with a solid line.

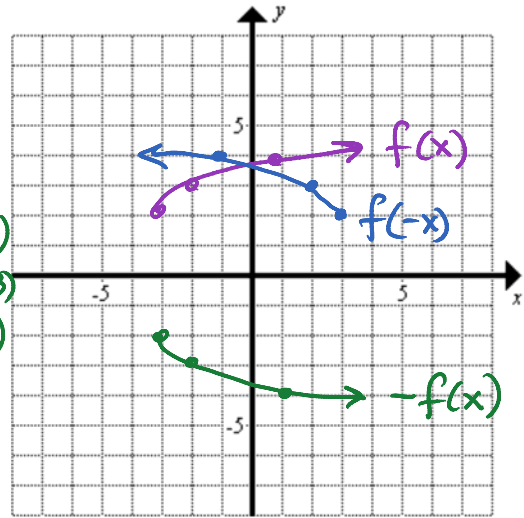
— HT: 3 left  
 Base:  $y = \sqrt{x}$  VT: 2 up

b) graph  $y = -f(x)$  with a dotted line.

VR ...  $(-3, 2) \rightarrow (-3, -2)$   
 $(x, y) \rightarrow (x, -y)$   $(-2, 3) \rightarrow (-2, -3)$   
 $(1, 4) \rightarrow (1, -4)$

c) graph  $y = f(-x)$  with a broken line.

HR ---  $(-3, 2) \rightarrow (3, 2)$   
 $(x, y) \rightarrow (-x, y)$   $(-2, 3) \rightarrow (2, 3)$   
 $(1, 4) \rightarrow (-1, 4)$



Ex. 5: Given  $f(x) = 4x^3 - 2x^2 + 1$ , write a new function after applying the following reflection:

a) over the x-axis

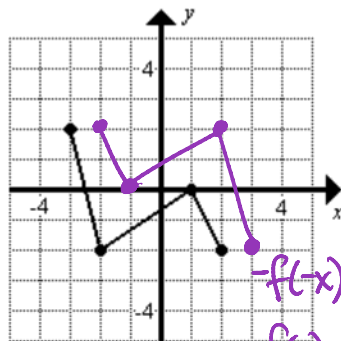
VR:  $y = -f(x)$   
 $y = -(4x^3 - 2x^2 + 1)$   
 $y = -4x^3 + 2x^2 - 1$

b) over the y-axis

HR:  $y = f(-x)$   
 $y = 4(-x)^3 - 2(-x)^2 + 1$   
 $y = -4x^3 - 2x^2 + 1$

Ex. 6: Given  $f(x)$ , graph the indicated relation. State the domain and range for each of them.

Determine if it is a function. Graph  $y = -f(-x)$  on the same grid.



VR HR :  $(x, y) \rightarrow (-x, -y)$   
 $(-3, 2) \rightarrow (3, -2)$   
 $(-2, -2) \rightarrow (2, 2)$   
 $(1, 0) \rightarrow (-1, 0)$   
 $(2, -2) \rightarrow (-2, 2)$   
 $f(x)$ : D:  $x \in [-3, 2]$   $-f(-x)$ : D:  $x \in [-2, 3]$   
 R:  $y \in [-2, 2]$  Reflect! R:  $y \in [-2, 2]$

Practice: Worksheet H2 - Reflections

Other Type of Reflection:

Inverses! Swap x and y

$f^{-1}(x)$  Reflect in  $y=x$