

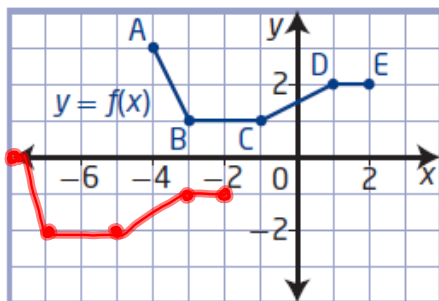
## Warm-Up

8. Copy and complete the table.

Translation	Transformed Function	Transformation of Points	
vertical	$y = f(x) + \underline{5}$	$(x, y) \rightarrow (x, y + 5)$	$k = 5$
horizontal	$y = f(x + \underline{7})$	$(x, y) \rightarrow (x - 7, y)$	$h = -7$
horizontal	$y = f(x - \underline{3})$	$(x, y) \rightarrow (x + 3, y)$	$h = 3$
vertical	$y = f(x) - \underline{6}$	$(x, y) \rightarrow (x, y - 6)$	$k = -6$
horizontal and vertical	$y + 9 = f(x + 4)$	$(x, y) \rightarrow (x - 4, y - 9)$	$y = f(x + 4) - 9$ $h = -4$ $k = -9$
horizontal and vertical	$y = f(x - \underline{4}) - \underline{6}$	$(x, y) \rightarrow (x + 4, y - 6)$	$h = 4$ $k = -6$
both	$y = f(x + \underline{2}) + \underline{3}$	$(x, y) \rightarrow (x - 2, y + 3)$	$h = -2$ $k = 3$
horizontal and vertical	$y = f(x - h) + k$	$(x, y) \rightarrow (x + h, y + k)$	

## Questions from Homework

4.



$$a) r(x) = f(x+4) - 3$$

$$h = -4 \quad k = -3$$

$$(x, y) \longrightarrow (x-4, y-3)$$

$$A(-4, 3)$$

$$A'(-8, 0)$$

$$B(-3, 1)$$

$$B'(-7, -2)$$

$$C(-1, 1)$$

$$C'(-5, -2)$$

$$D(1, 2)$$

$$D'(-3, -1)$$

$$E(2, 2)$$

$$E'(-2, -1)$$

# Transformations:

New Functions From Old Functions

✓Translations

Stretches

✓Reflections

# Reflections and Stretches

## Focus on...

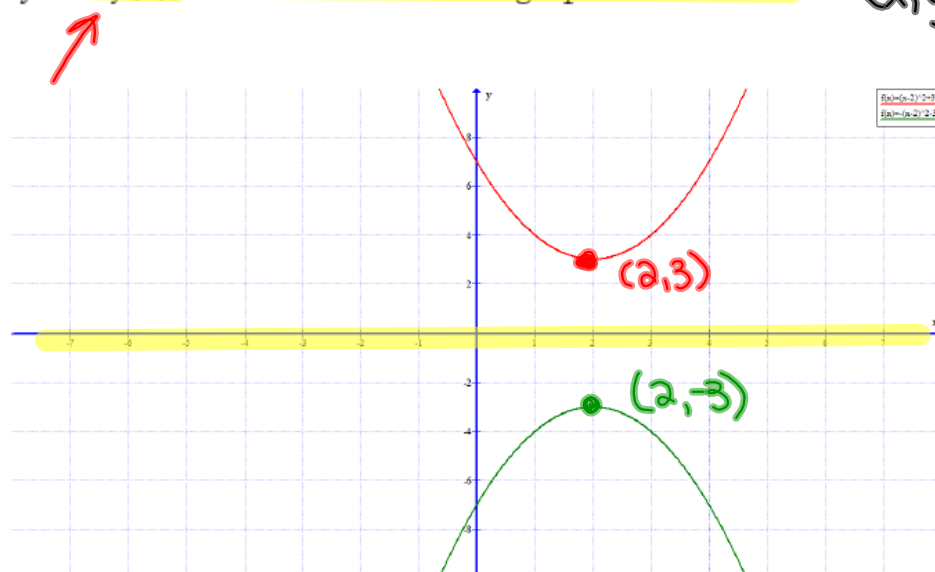
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- developing an understanding of the effects of reflections on the graphs of functions and their related equations
- developing an understanding of the effects of vertical and horizontal stretches on the graphs of functions and their related equations

A **reflection** of a graph creates a mirror image in a line called the line of reflection. Reflections, like translations, do not change the shape of the graph. However, unlike translations, reflections may change the orientation of the graph.

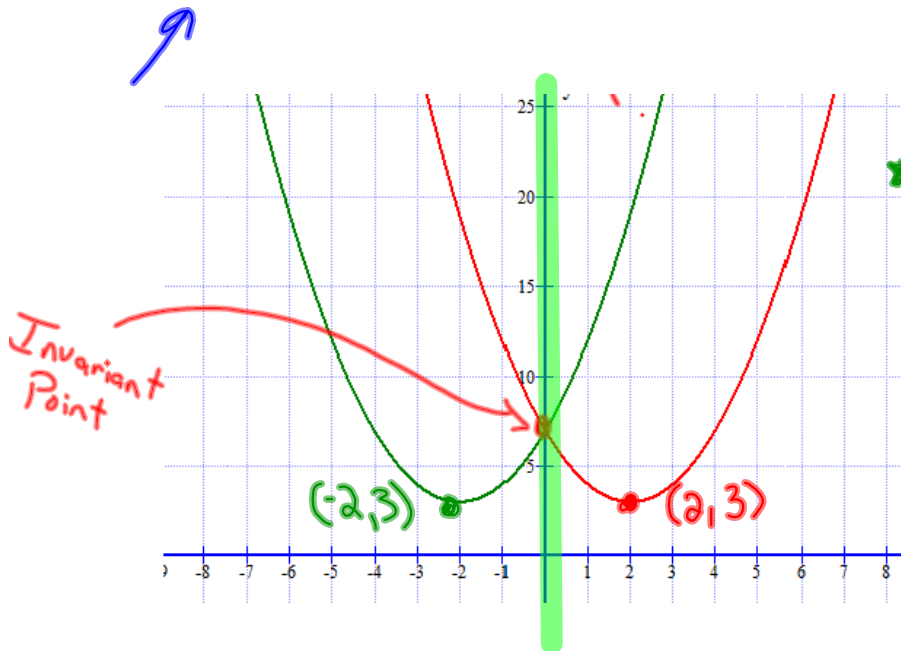
### Vertical Reflection

- When the output of a function  $y = f(x)$  is multiplied by  $-1$ , the result,  $y = -f(x)$ , is a reflection of the graph in the  $x$ -axis.  $(x, y) \rightarrow (x, -y)$



## Horizontal Reflection

- When the input of a function  $y = f(x)$  is multiplied by  $-1$ , the result,  $y = f(-x)$ , is a reflection of the graph in the  $y$ -axis.  $(x, y) \rightarrow (-x, y)$



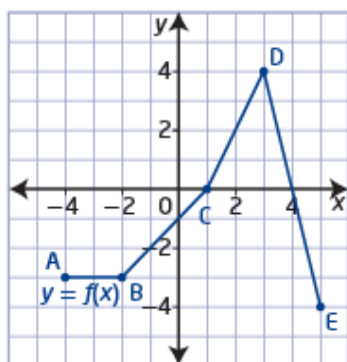
### invariant point

- a point on a graph that remains unchanged after a transformation is applied to it
- any point on a curve that lies on the line of reflection is an invariant point

**Example 1** Vertical Horizontal

**Compare the Graphs of  $y = f(x)$ ,  $y = -f(x)$ , and  $y = f(-x)$**

- a) Given the graph of  $y = f(x)$ , graph the functions  $y = -f(x)$  and  $y = f(-x)$ .
- b) How are the graphs of  $y = -f(x)$  and  $y = f(-x)$  related to the graph of  $y = f(x)$ ?



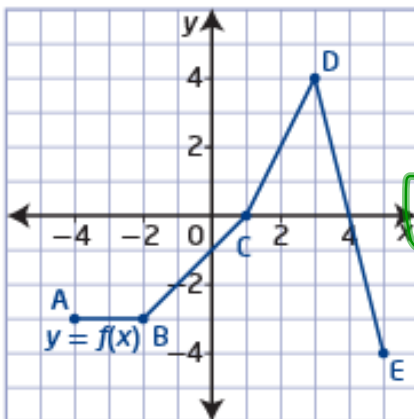
### Remember...

- When the output of a function  $y = f(x)$  is multiplied by  $-1$ , the result,  $y = -f(x)$ , is a reflection of the graph in the  $x$ -axis.

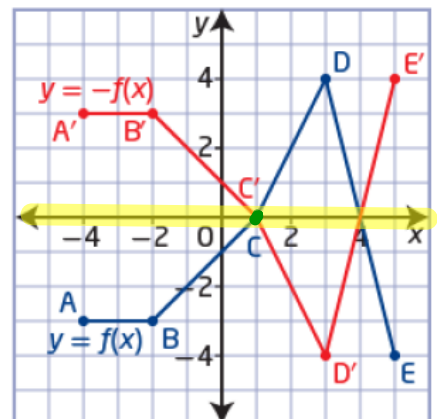
### Vertical Reflection

- Sketch  $y = -f(x)$  on the axis below

$$(x, y) \longrightarrow (x, -y)$$



$A(-4, -3)$	$A'(-4, 3)$
$B(-2, -3)$	$B'(-2, 3)$
$C(1, 0)$	$C'(1, 0)$
$D(3, 4)$	$D'(3, -4)$
$E(5, -4)$	$E'(5, 4)$



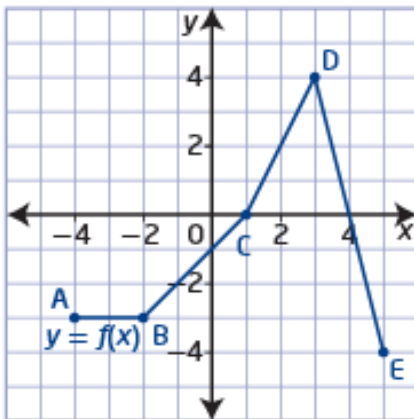


## Remember...

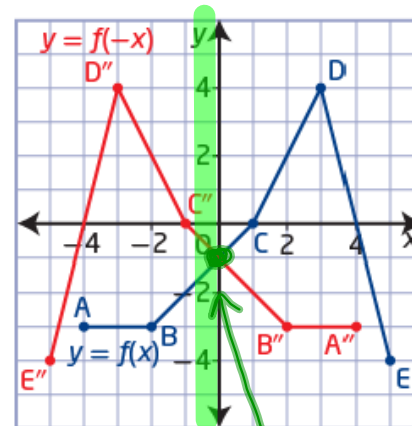
- When the input of a function  $y = f(x)$  is multiplied by  $-1$ , the result,  $y = f(-x)$ , is a reflection of the graph in the  $y$ -axis.

- Horizontal Reflection**
- Sketch  $y = f(-x)$  on the axis below

$$(x, y) \longrightarrow (-x, y)$$



$A(-4, -3)$	$A''(4, -3)$
$B(-2, -3)$	$B''(2, -3)$
$C(1, 0)$	$C''(-1, 0)$
$D(3, 4)$	$D''(-3, 4)$
$E(5, -4)$	$E''(-5, -4)$



invariant  
point  $(0, 0)$

## Homework

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