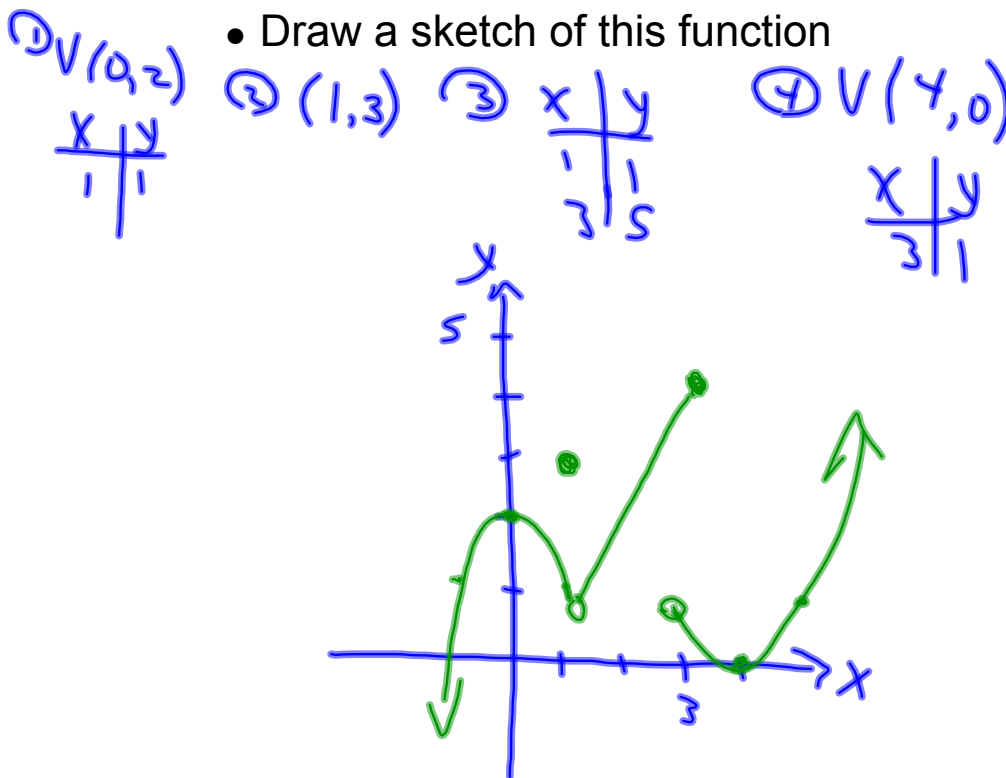


Warm-Up...

Given the function $f(x) = \begin{cases} 2-x^2 & \text{if } x < 1 \\ 3 & \text{if } x = 1 \\ 2x-1 & \text{if } 1 < x \leq 3 \\ (x-4)^2 & \text{if } x > 3 \end{cases}$

• Draw a sketch of this function

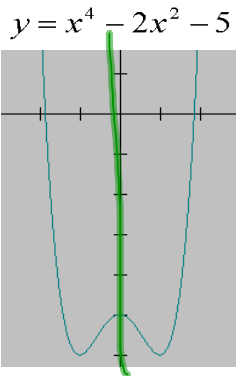
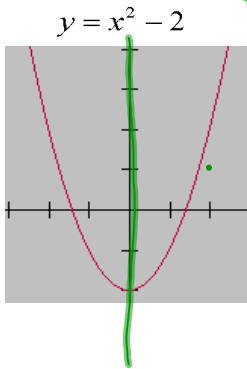


Symmetry

Even

$$f(-x) = f(x)$$

Even functions are symmetric about the y-axis

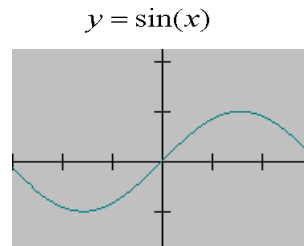
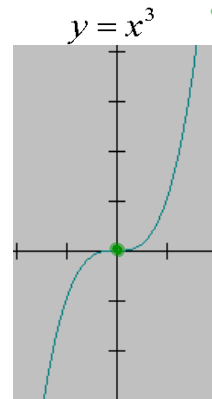


Odd

$$f(-x) = -f(x)$$

Odd functions are symmetric about the origin

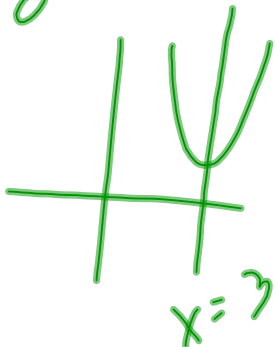
180°
Rotational



$$f(-x) = (-x)^2 - 2 = x^2 - 2$$

$$f(-x) = (-x)^3 = -x^3$$

$$y = x^2 - x + 2$$



$$f(x) = x^5 - x^3 + x$$

$$f(-x) = -x^5 + x^3 - x$$

odd about origin

$$f(x) = x^5 - x^3 + x + 3$$

$$f(-x) = -x^5 + x^3 - x + 3$$

New Functions from Old Functions...TRANSFORMATIONS



- Translations
- Stretches
- Reflections

Translation

- To *translate* or *shift* a graph is to move it up, down, left, or right without changing its shape.
- Translation is summarized by the following table and illustration:

Vertical and Horizontal Shifts Suppose $c > 0$. To obtain the graph of
 $y = f(x) + c$, shift the graph of $y = f(x)$ a distance c units upward
 $y = f(x) - c$, shift the graph of $y = f(x)$ a distance c units downward
 $y = f(x - c)$, shift the graph of $y = f(x)$ a distance c units to the right
 $y = f(x + c)$, shift the graph of $y = f(x)$ a distance c units to the left

$$f(x) = x^2$$

$$f(x) = x^2$$

$$f(x+c) = (x+c)^2$$

$$f(x) + c$$

$$f(x) = \frac{1}{x}$$

$$x^2 + c$$

$$f(x+c) = \frac{1}{x+c}$$

Translations illustrated...

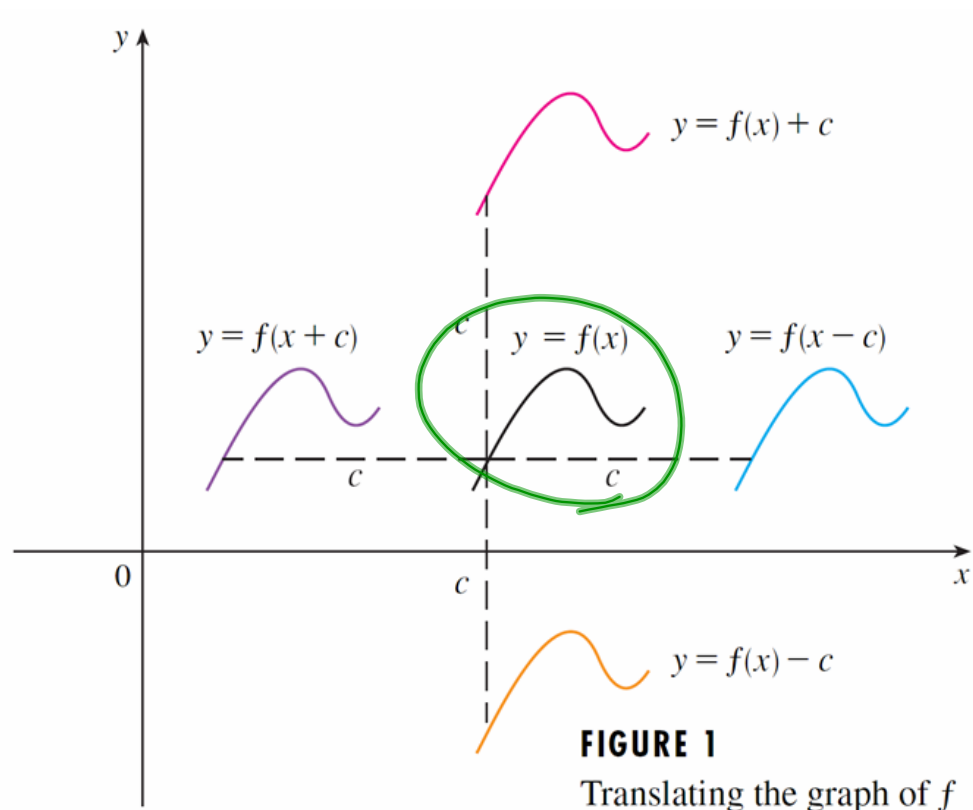


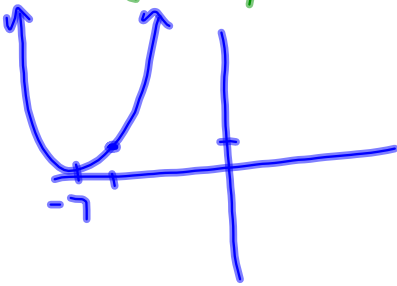
FIGURE 1
Translating the graph of f

Identify the translations for each of the following...

$$f(x) = (x+7)^2$$

Base
 $y = x^2$

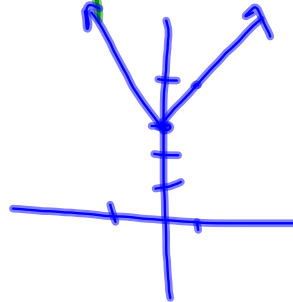
\Rightarrow Left 7



$$f(x) = |x| + 3$$

Base
 $y = |x|$

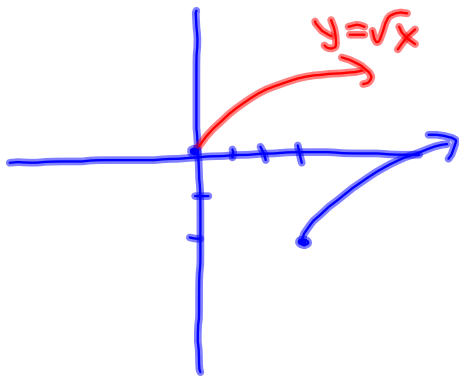
\Rightarrow Up 3



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

Base
 $y = \sqrt{x}$

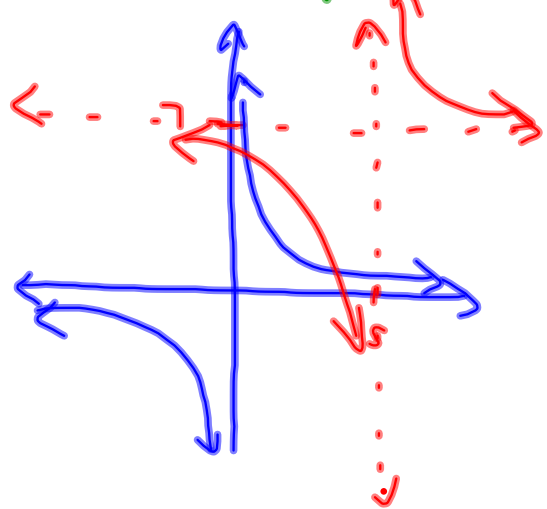
\Rightarrow Right 3
Down 2



$$f(x) = \frac{1}{x-5} + 7$$

Base
 $y = \frac{1}{x}$

\Rightarrow Rt. S & up 7



Using Mapping Notation to Describe Transformations:

*Think of this as a set of instructions to follow to TRANSFORM a graph

x	$y = x^2$
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9

x	$y = x^2 + 2$
-3	11
-2	6
-1	3
0	2
1	3
2	6
3	11

x	$y = (x - 5)^2$
2	9
3	4
4	1
5	0
6	1
7	4
8	9

(x, y) $(x, y) \rightarrow (x, y + 2)$ $(x, y) \rightarrow (x + 5, y)$

↑
" gets mapped to "

ex. $y = (x + 4)^2 - 6$

\Rightarrow left +4, down 6
 $(x, y) \rightarrow (x - 4, y - 6)$

\downarrow
 (x, y) from $y = x^2$

$y = \frac{1}{x + 7} + 10$

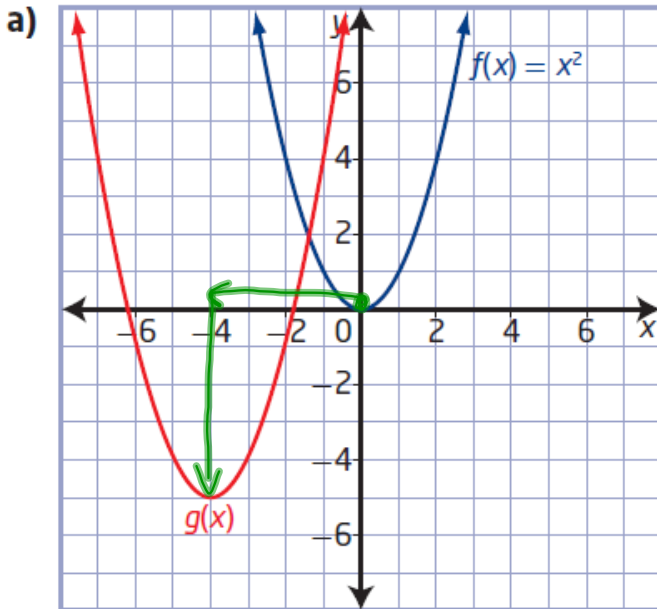
\Rightarrow left +7, up 10

$(x, y) \rightarrow (x - 7, y + 10)$

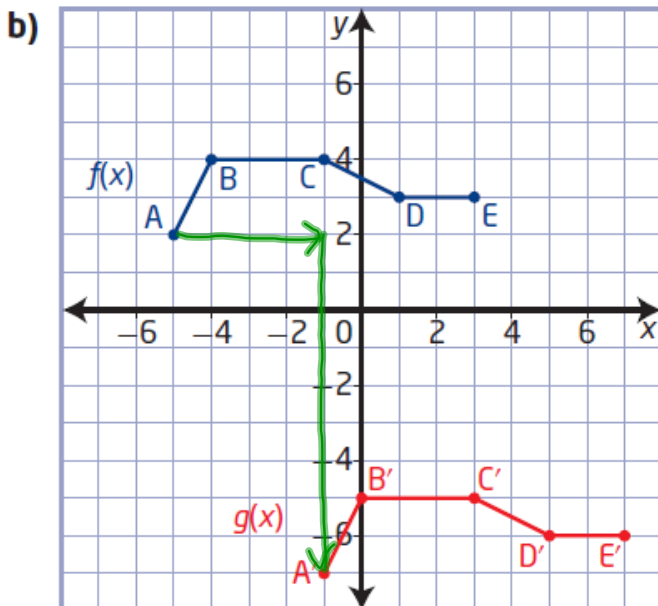
$(x, y) \Rightarrow y = \frac{1}{x}$

$\begin{array}{c|c} x & y \\ \hline 2 & \frac{1}{2} \end{array} \Rightarrow \begin{array}{c|c} x & y \\ \hline -5 & 10\frac{1}{2} \end{array}$

Determine the Equation of a Translated Function



$$f(x) = (x+4)^2 - 5$$

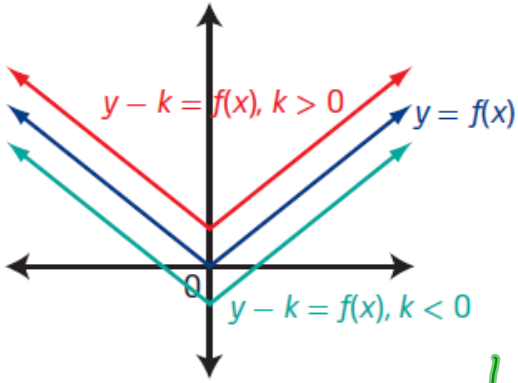
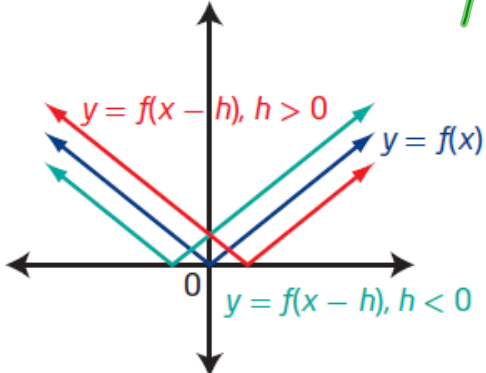


function
Notation

$$g(x) = f(x-4) - 9$$

$$(x, y) \rightarrow (x+4, y-9)$$

mapping
Notation

Transformation from $y = f(x)$	Mapping	Example
<p>A vertical translation</p> <p>If $k > 0$, the translation is up.</p> <p>If $k < 0$, the translation is down.</p>	$(x, y) \rightarrow (x, y + k)$	
<p>A horizontal translation</p> <p>If $h > 0$, the translation is to the right.</p> <p>If $h < 0$, the translation is to the left.</p>	$(x, y) \rightarrow (x + h, y)$	

Practice Problems...

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#3, 5, 6, 7, 10, 11, 18