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R2 R3
R4 R5

Chapter 1: TRANSFORMATIONS AND FUNCTIONS

1.1 – Horizontal and Vertical Translations

Transformation: A change on an original graph.
We deal with (1) Translations (2) reflections
(3) stretches / Compressions (4) Inverses.

Image points: Points on the original graph correspond to points on the transformed graph. The relationship between these sets of points can be called **mapping**. $(x, y) \rightarrow (x_1, y_1)$

A translation is one type of transformation. A translation can **shift** the graph of a function up, down, left, right. A translation occurs when the location of a graph changes but the shape remains the same.

Vertical Translation

- A **vertical translation** shifts the graph up or down.

- Starting with the original function, $y = f(x)$

$$y = f(x) + k$$

-If $k > 0$, the graph shifts up.

-If $k < 0$, the graph shifts down

- Each point (x, y) on the **original function** is mapped to $(x, y+k)$ on the **transformed function**.

$$(x, y) \longrightarrow (x, y+k)$$

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Example #1

The graph of $f(x) = x^2$ is shown on the coordinate grid below.

Perform the following **vertical translations** on the same grid.

Describe each transformation **in words** and state the **mapping notation**. Label each graph.

a) $y = f(x) + 4$

Vertical translation 4 units up

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

$y = x^2 + 4$

b) $y = f(x) - 7$

shift down 7

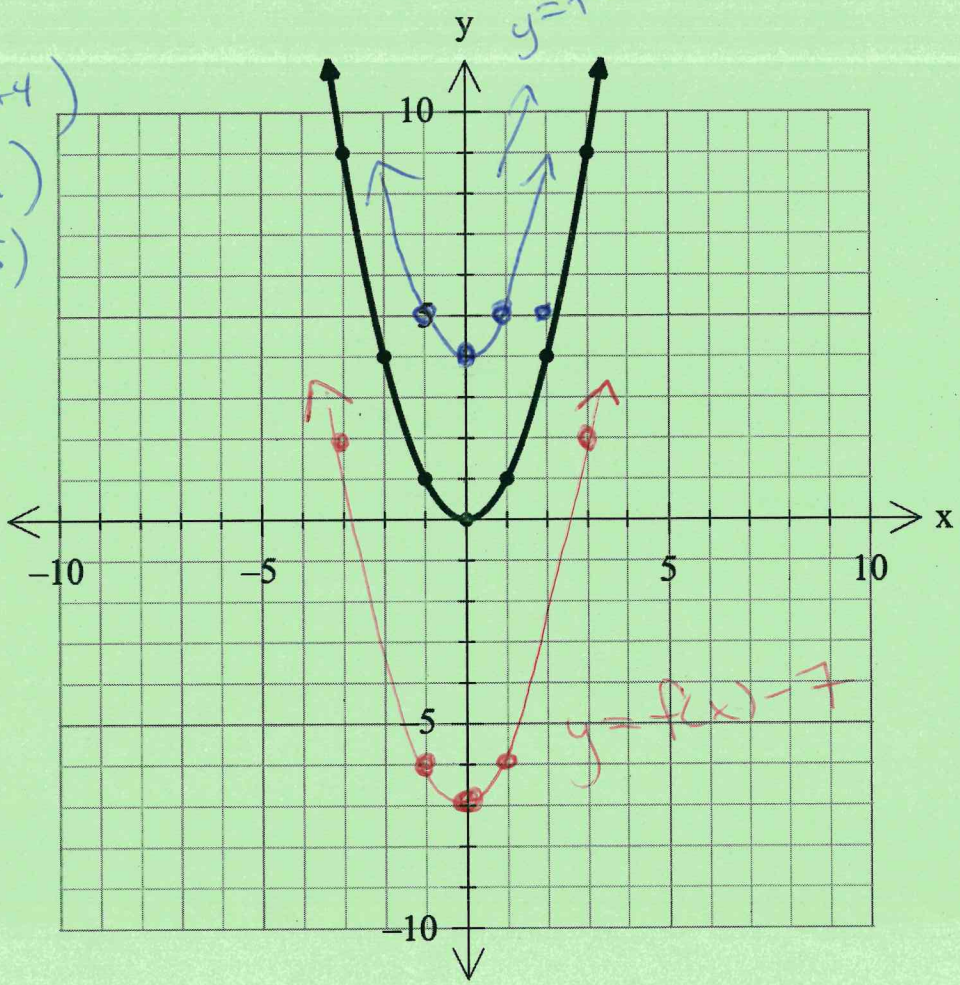
$(x, y) \rightarrow (x, y-7)$

$y = x^2 - 7$

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

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

$(1, 1) \rightarrow (1, 5)$



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Horizontal Translation

- A **horizontal translation** shifts the graph left or right

- Starting with the original function, $y = f(x)$

$$y = f(x-h)$$

-If $h > 0$, the graph shifts right $y = f(x-(+1))$ $y = f(x-1)$

-If $h < 0$, the graph shifts left

$y = f(x+4)$

- Each point (x, y) on the **original function** is mapped to $(x+h, y)$ on the **transformed function**.

$$(x, y) \rightarrow (x+h, y)$$

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Example #2

The graph of $f(x) = |x - 2|$ is shown on the graph below.

Perform the following **horizontal translations** on the same grid.

Describe each transformation **in words** and state the **mapping notation**. Label each graph.

a) $y = f(x + 6)$

Shift left 6 units

$(x, y) \rightarrow (x - 6, y)$

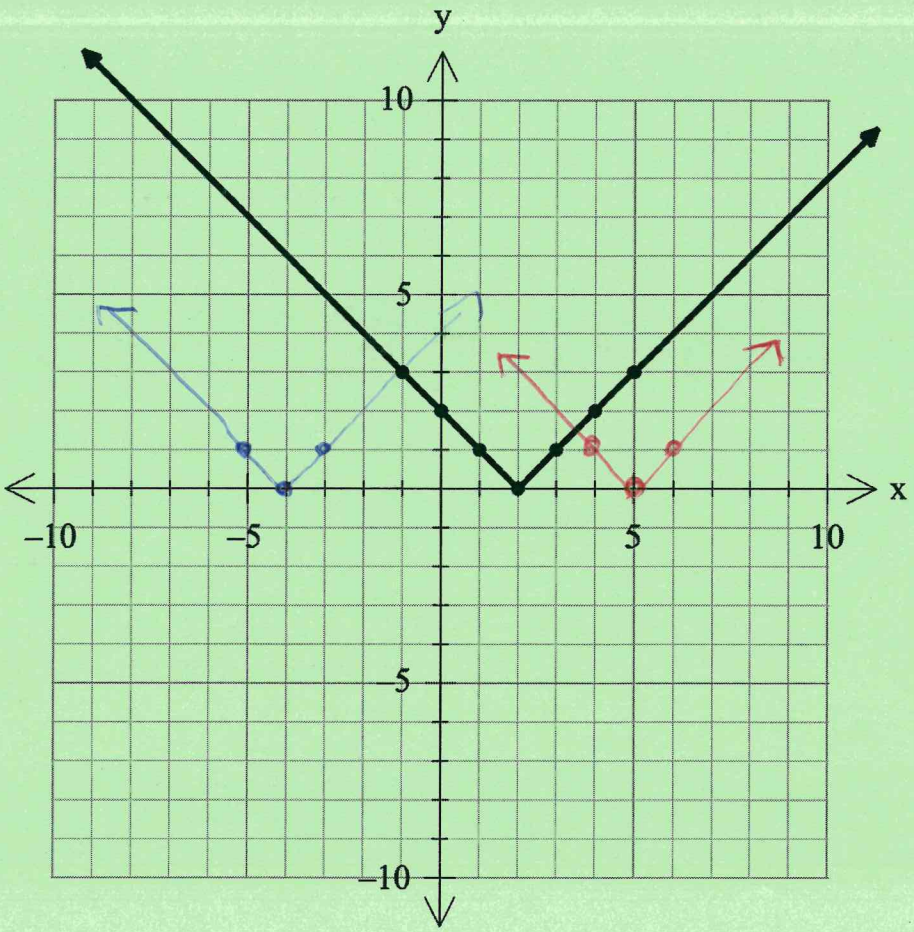
b) $y = f(x - 3)$

horizontal translation

3 units right

~~$(x + 3, y - 2)$~~

$(x, y) \rightarrow (x + 3, y)$



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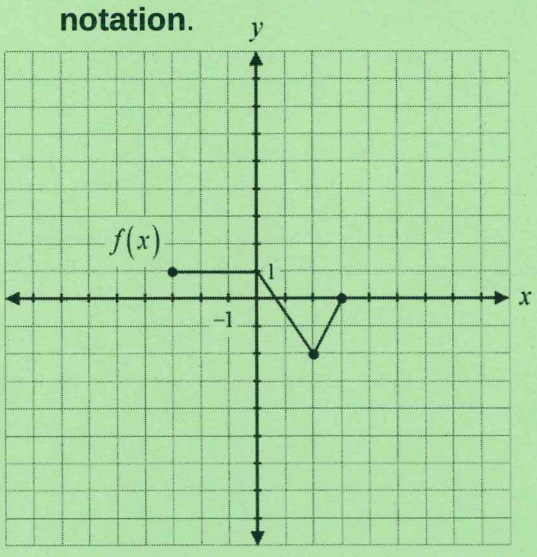
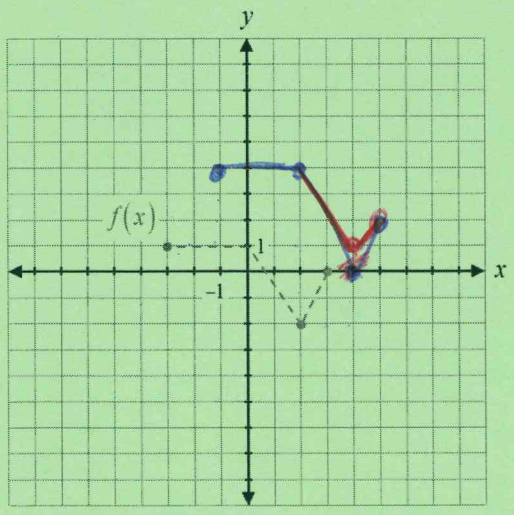
Example #3

Use the given graph of $f(x)$ to sketch the following functions on the graphs provided.

Describe **in words** how you transformed each function and provide the **mapping notation**.



a) $g(x) = f(x-2)+3$



Shift right 2 and up 3.

$(x, y) \rightarrow (x+2, y+3)$

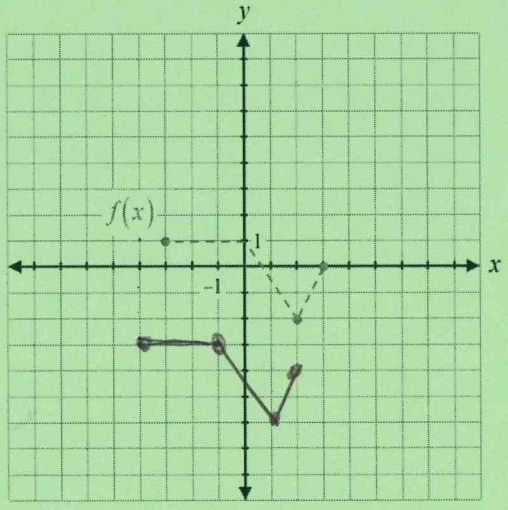
$(-3, 1) \rightarrow (-1, 4)$

$(0, 1) \rightarrow (2, 4)$

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

$(3, 0) \rightarrow (5, 3)$

b) $h(x) = f(x+1)-4$



left 1 and down 4

Shift ~~right~~

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

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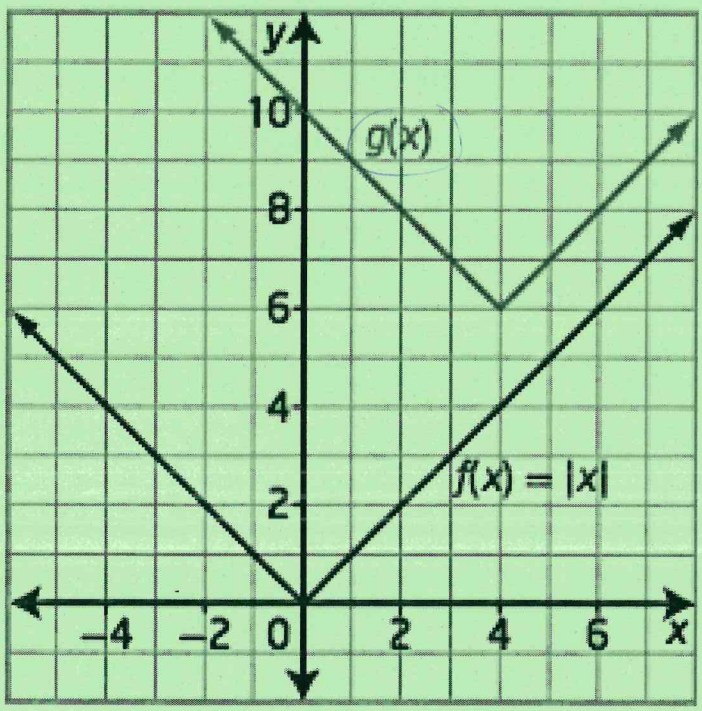
We must also be able to determine the **equation** of a function that has undergone a transformation.

Example #4

The function $f(x)$ has been transformed into the function $g(x)$.

Determine the **equation of the translated function** in the form $y = f(x - h) + k$

a)



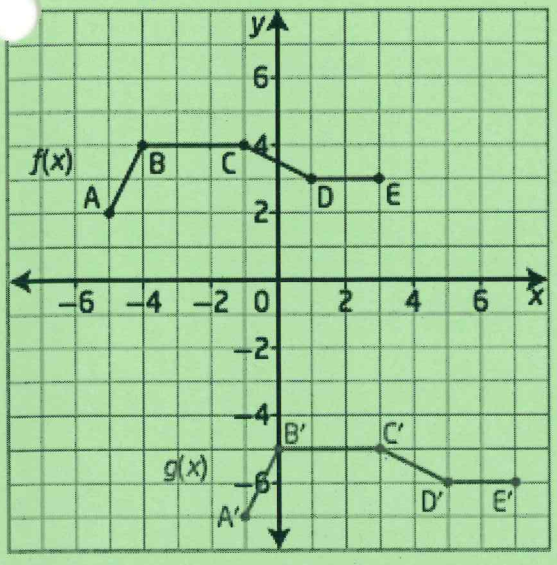
$f(x)$	→	$g(x)$
	→	
	→	
	→	
	→	
	→	

Answer: $g(x) = f(x-4) + 6$

Image Points: New points!

(4, 6), (5, 7) . . .

b)



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

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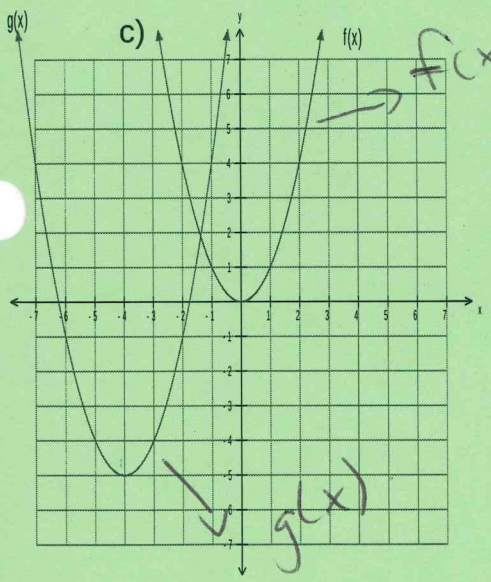
c)



Answer: $g(x) = f(x+4) - 5$

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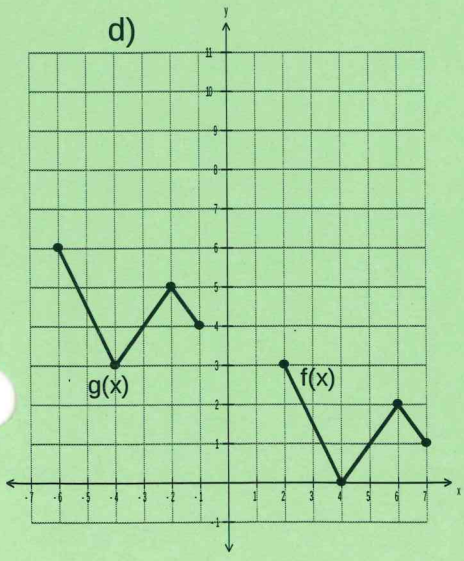
d)



Answer: $g(x) = f(x+8) + 3$

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