Algebra 1R – Mr. Bo
Unit 5 – Day 3 Notes

Name:_____
Date:_____

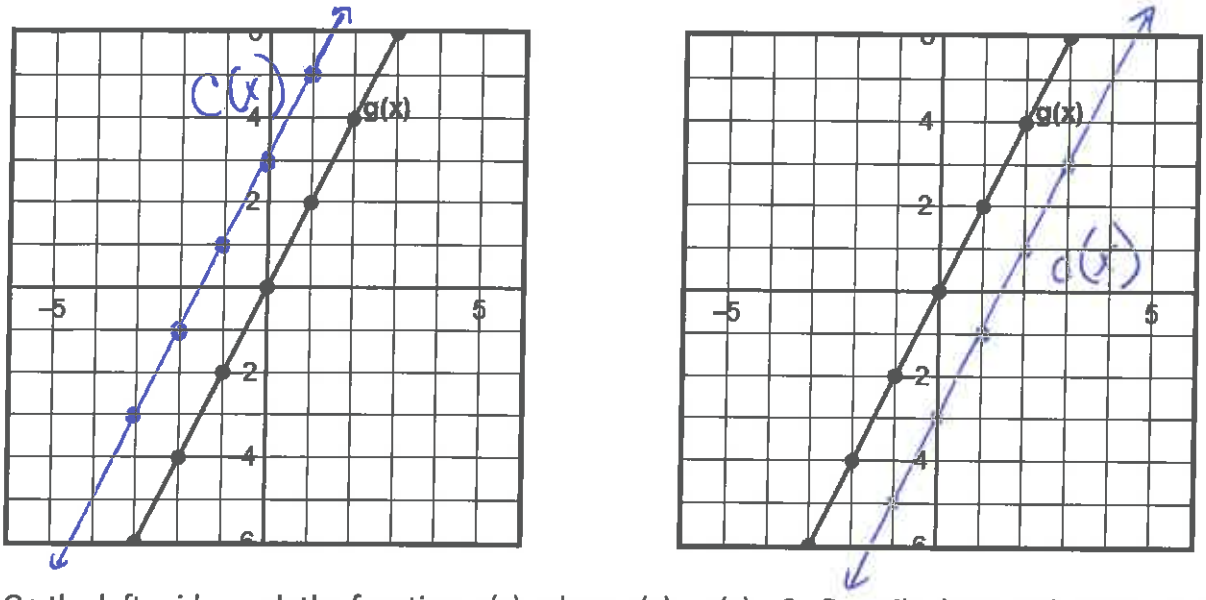
# Translations of Linear & Exponential Functions

## PROBLEM 1 Vertical Translations

**Transformation:** The mapping, or movement, of all points of a figure in a plane according to a common operation.

**Vertical Translation:** A type of *transformation* that shifts an entire graph up or down. It affects only the y-coordinate of each point on the graph.

1. Consider the graph of a function g(x) on the two grids below.




a. On the left grid, graph the function, c(x), where c(x) = g(x) + 3. Describe how each point on g(x) changed to produce the graph of c(x).

Added 3 to the y-coordinate, making the points move up.

b. On the right grid, graph the function, d(x), where d(x) = g(x) – 3. Describe how each point on g(x) changed to produce the graph of d(x).

Subtracted 3 from the y-coordinate, making the points move down.

c. If g(x) = 2x, the write the functions c(x) and d(x) in terms of x.

$c(x) = g(x) + 3$
$= 2x + 3$

$d(x) = g(x) - 3$
$= 2x - 3$

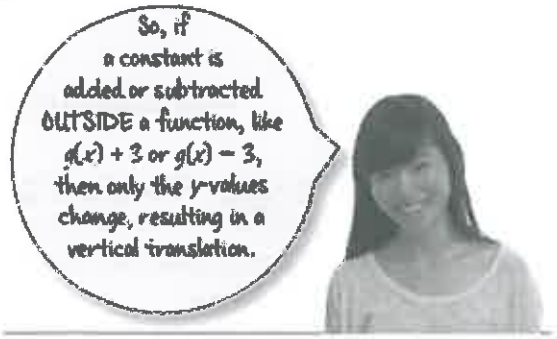
d. Describe how the formula for g(x) must be changed to produce a vertical translation of its graph.

Add to g(x) to move it up.
Subtract from g(x) to move it down.

2. For each function, describe the transformation to the function s(x).

a. $h(x) = s(x) + 8$ s(x) Shifted up 8 units.

b. $j(x) = s(x) - 5$ s(x) shifted down 5 units.




3. Write each function in terms of the function, f(x), where $f(x) = 2^x$.

a. $h(x) = 2^x + 7$

$= f(x) + 7$

b. $p(x) = 2^x - 4$

$= f(x) - 4$

c. n(x) is f(x) shifted down 5 units.

$n(x) = f(x) - 5$

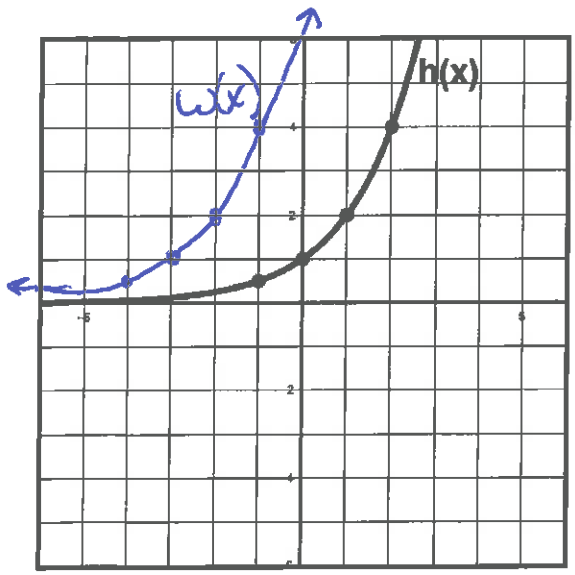
d. w(x) is f(x) shifted up 10 units.

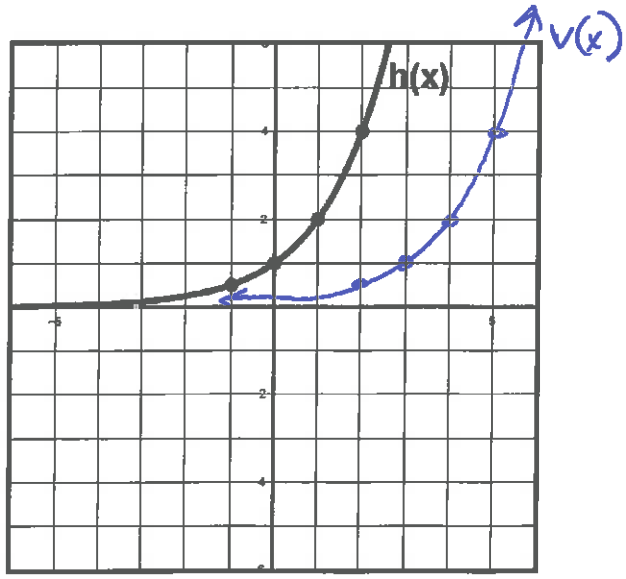
$w(x) = f(x) + 10$

## PROBLEM 2 Horizontal Translations

**Horizontal Translation:** A type of *transformation* that shifts an entire graph left or right. It affects only the x-coordinate of each point on the graph.

1. Consider the graph of a function h(x) on the two grids below.




a. On the left grid, graph the function, w(x), where w(x) = h(x+3). Describe how each point on h(x) changed to produce the graph of w(x).

Subtracted 3 from the x-coordinate making each pt move left

b. On the right grid, graph the function, v(x), where v(x) = h(x-3). Describe how each point on h(x) changed to produce the graph of v(x).

Add 3 to each x-coordinate making each pt move right.

c. If $h(x) = 2^x$, the write the functions w(x) and v(x) in terms of x.

$w(x) = h(x+3)$ $\quad v(x) = h(x-3)$

$= 2^{(x+3)}$ $\quad = 2^{(x-3)}$

d. Describe how the formula for h(x) must be changed to produce a horizontal translation of its graph.

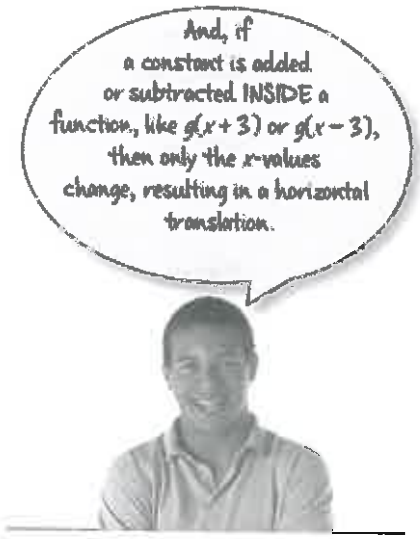
Subtract from x inside ( ) to move right

Add to x inside the ( ) to move left.

2. For each function, describe the transformation to the function s(x).

a. h(x) = s(x+8) s(x) shifted left 8 units

b. j(x) = s(x-5) s(x) shifted Right 5 units.




3. Write each function in terms of the function, f(x), where $f(x) = 2^x$.

a. $h(x) = 2^{x+7}$

$n(x) = f(x+7)$

b. $p(x) = 2^{x-4}$

$p(x) = f(x-4)$

c. n(x) is f(x) shifted right 5 units.

$n(x) = f(x-5)$

d. w(x) is f(x) shifted left 10 units.

$w(x) = f(x+10)$

## Check For Understanding:

Complete the table by describing the transformation of the graph of the basic function.

| Function | Description of Transformation of Graph |
|---|---|
| $f(x) = 5x + 4$ | the graph of $5x$ is shifted up 4 units. |
| $f(x) = 3(4^{x-6})$ | the graph of $3(4^x)$ is shifted Right 6 units. |
| $f(x)=8(x+2) - 9$ | the graph of $8x$ is shifted down 9 and left 2 units. |
| $f(x) + a$ where $a > 0$ | $f(x)$ is shifted up $a$ units |
| $f(x) - a$ where $a > 0$ | $f(x)$ is shifted down $a$ units |
| $f(x+a)$ where $a > 0$ | $f(x)$ is shifted left $a$ units |
| $f(x - a)$ where $a > 0$ | $f(x)$ is shifted Right $a$ units. |

Be prepared to share your answers.