# Examples Transformations of Commonly Encountered Basic Functions

Based on power point presentations by Pearson Education, Inc. Revised by Ingrid Stewart, Ph.D.

#### Learning Objectives

- 1. Recognize vertical shifts of graphs of some basic functions.
- 2. Recognize horizontal shifts of graphs of some basic functions.
- 3. Recognize reflections of graphs across the *x* and across the *y* axis of some basic functions.
- 4. Recognize vertical stretches and vertical compressions of graphs of some basic functions.

## Example 1: Transformations of Some Basic Functions

Starting with the graph of the function  $f(x) = x^2$ , write the equation of the graph that results from the following:

- (1) a vertical shift up 3 units  $y = x^2 + 3$
- (2) a vertical shift down 3 units  $y = x^2 3$
- (3) a horizontal shift to the right 3 units  $y = (x 3)^2$
- (4) a horizontal shift to the left 3 units  $y = (x + 3)^2$

#### Example 2: Transformations of Some Basic Functions

Starting with the graph of the function  $k(x) = x^3$ , write the equation of the graph that results from the following:

- (1) a vertical shift up 1 unit and a horizontal shift to the right 2 units  $y = (x-2)^3 + 1$
- (2) a vertical shift up 3 units and a horizontal shift to the left 4 units  $y = (x + 4)^3 + 3$
- (3) a vertical shift down 5 units and a horizontal shift to the right 1 unit  $y = (x 1)^3 5$
- (4) a vertical shift down 2 units and a horizontal shift to the left 3 unit  $y = (x + 3)^3 2$

#### Example 3: Transformations of Some Basic Functions

Starting with the graph of the function f(x) = |x|, write the equation of the graph that results from the following:

- (1) a reflection across the x-axis y = -|x|
- (2) a reflection across the *y*-axis y = |-x|
- (3) a reflection across the x- and y-axis y = -|-x|

## Example 4: Transformations of Some Basic Functions

Given the transformation of a basic function  $g(x) = \sqrt{x-2} + 1$ , do the following:

a. Determine the basic function from which the function g can be obtained.

$$y = \sqrt{x}$$

b. Next, identify each transformation that can be applied to  $y = \sqrt{x}$  to obtain the function g.

vertical shift up one unit horizontal shift to the right 2 units

## Example 5: Transformations of Some Basic Functions

Given the transformation of a basic function  $k(x) = (x + 5)^3 - 9$ , do the following:

a. Determine the basic function from which the function *k* can be obtained.

$$y = x^3$$

b. Next, identify each transformation that can be applied to  $y = x^3$  to obtain the function k.

vertical shift down 9 units horizontal shift to the left 5 units

## Example 6: Transformations of Some Basic Functions

Given the transformation of a basic function  $f(x) = \sqrt[3]{x+2} + 10$  do the following:

a. Determine the basic function from which the function f can be obtained.

$$y = \sqrt[3]{x}$$

b. Next, identify each transformation that can be applied to  $y = \sqrt[3]{x}$  to obtain the function f.

vertical shift up 10 units horizontal shift to the left 2 units

## Example 7: Transformations of Some Basic Functions

Given the transformation of a basic function  $h(x) = (x - 7)^2 - 2$ , do the following:

a. Determine the basic function from which the function *h* can be obtained.

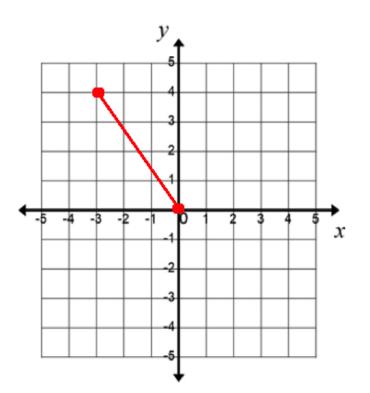
$$y = x^2$$

b. Next, identify each transformation that can be applied to  $y = x^2$  to obtain the function h.

vertical shift down 2 units horizontal shift to the right 7 units

#### Example 8: Transformations of Some Basic Functions (1 of 2)

The graph of the function f is shown below. Graph its transformation which is the function g(x) = f(x-2) - 1.



g(x) = f(x - 2) - 1 indicates a vertical shift of the graph of f of 1 unit down and a horizontal shift of 2 units to the right. We see that the graph of the function f contains the points (-3, 4) and (0, 0).

We know that a vertical shift affects y-coordinates, and a horizontal shift affects x-coordinates.

Subsequently, the graph of the function g contains the points (-3+2,4-1)=(-1,3) and (0+2,0-1)=(2,-1).

Please note during a <u>horizontal shift right</u> as it pertains to points, we ADD the appropriate number of units.

#### Example 8: Transformations of Some Basic Functions (2 of 2)

Below is the graph of the function f in red and the graph of its transformation g in blue.

