

## Section 1.7

### Vertical and Horizontal Shifts

Let  $c$  be a positive real number. Vertical and horizontal shifts in the graph of  $y = f(x)$  are represented as follows.

- a) Vertical shift  $c$  units upward:  $h(x) = f(x) + c$
- b) Vertical shift  $c$  units downward:  $h(x) = f(x) - c$
- c) Horizontal shift  $c$  units to the right:  $h(x) = f(x - c)$
- d) Horizontal shift  $c$  units to the left:  $h(x) = f(x + c)$

### Reflections in the Coordinate Axes

Reflections in the coordinate axes of the graph of  $y = f(x)$  are represented as follows.

- a) Reflection in the  $x$ -axis:  $h(x) = -f(x)$
- b) Reflection in the  $y$ -axis:  $h(x) = f(-x)$

### Nonrigid Transformation

Nonrigid transformations are those that cause a change in the shape of the original graph. Nonrigid transformation of the graph of  $y = f(x)$  are represented by the following.

- a)  $g(x) = cf(x)$  where the transformation is a vertical stretch if  $c > 1$  and a vertical shrink if  $0 < c < 1$ .
- b)  $h(x) = f(cx)$  where the transformation is a horizontal shrink if  $c > 1$  and a horizontal stretch if  $0 < c < 1$ .

**Problem 1.** Identify the parent function  $f$ , describe the sequences of transformations from  $f$  to  $g$ , and sketch the graph of  $g$ .

a)  $g(x) = x^2 - 2$

b)  $g(x) = 2x^2 + 2$

c)  $g(x) = -x^3 + 3$

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

e)  $g(x) = (x + 2)^3 - 2$

f)  $g(x) = \frac{1}{2}\sqrt{-x}$

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

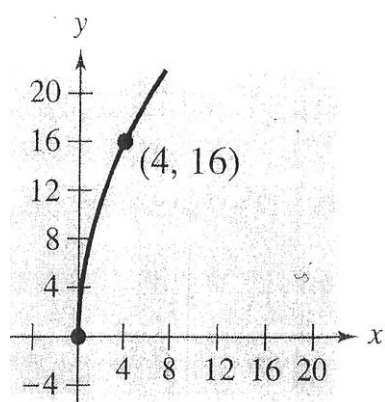
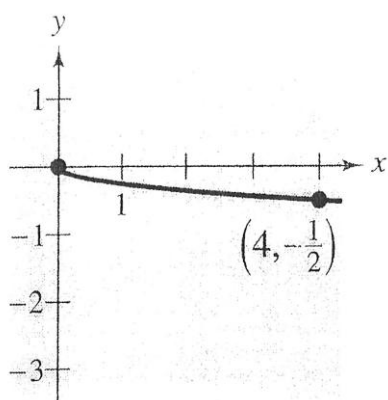
h)  $g(x) = 6 - |x + 5|$

i)  $g(x) = 2|x - 2| + 2$

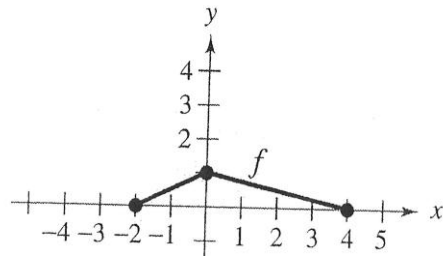
j)  $g(x) = \sqrt{3x} + 1$

k)  $g(x) = 2\lceil x + 5 \rceil$

**Problem 2.** Use the graph of  $f(x) = \sqrt{x}$  to write an equation for each function whose graph is shown.



**Problem 3.** Use the graph of  $f$  to sketch the graph of  $g$ .



a)  $g(x) = f(-x)$

b)  $g(x) = -2f(x) + 1$

c)  $g(x) = f(2x)$

d)  $g(x) = f\left(\frac{1}{2}x\right)$

Homework: Read section 1.7, do #9, 11, 13, 15, 20, 27, 39, 45, 53, 55 (the quiz for this section will be taken from these problems)