Section 3.5

Graphing Techniques; Transformations

SHIFTS

Vertical Shifts: If a real number k is added to the right side of a function $y = f(x)$, the graph of the new function $y = f(x) + k$ is the graph of f **shifted vertically up** (if $k > 0$) or **down** (if $k < 0$).

Horizontal Shifts: If the argument x of a function f is replaced by $x - h$, the graph of the new function $y = f(x - h)$ is the graph of f **shifted horizontally left** (if $h < 0$) or **right** (if $h > 0$).

COMPRESSIONS AND STRETCHES

Vertical: When the right side of a function $y = f(x)$ is multiplied by a positive number a, the graph of the new function $y = af(x)$ is obtained by multiplying each y-coordinate of $y = f(x)$ by a. A **vertical compression** results if $0 < a < 1$ and a **vertical stretch** occurs if $a > 1$.

Horizontal: When the argument x of a function $y = f(x)$ is multiplied by a positive number a, the graph of the new function $y = f(ax)$ is obtained by multiplying each x-coordinate of $y = f(x)$ by $1/a$. A **horizontal compression** results if $a > 1$ and a **horizontal stretch** occurs if $0 < a < 1$.

REFLECTIONS

Reflection about the x-axis: When the right side of the function $y = f(x)$ is multiplied by -1, the graph of the new function $y = -f(x)$ is the **reflection about the x-axis** of the graph of the function $y = f(x)$. Another way to think about this is that all the y-coordinates are multiplied by -1.

Reflection about the y-axis: When the graph of the function $y = f(x)$ is known, the graph of the new function $y = f(-x)$ is the **reflection about the y-axis** of the graph of the function $y = f(x)$. Another way to think about this is that all the x-coordinates are multiplied by -1.