# Transformations of Functions: $(Part\ 1)$

## Horizontal Shifts:

If $g(x) = f(x+h)$ then the graph of $g$ can be obtained by shifting the graph of $f$ to the left by $h$ units. (subtract $h$ from every $x$-coordinate of the graph of $f$).

If $g(x) = f(x-h)$ then the graph of $g$ can be obtained by shifting the graph of $f$ to the right by $h$ units. (add $h$ from every $x$-coordinate of the graph of $f$).

Use a calculator to compare the graphs of
$f(x) = x^3$ , $g(x) = (x+3)^3$ , $h(x) = (x-3)^3$

Use a calculator to compare the graphs of
$f(x) = \frac{1}{x^2}$ , $g(x) = \frac{1}{(x+4)^2}$ , $h(x) = \frac{1}{(x-5)^2}$

## Vertical Shifts:

If $g(x) = f(x) + k$ then the graph of $g$ can be obtained by shifting the graph of $f$ up by $k$ units. (Add $k$ to every $y$-coordinate of the graph of $f$)

If $g(x) = f(x) - k$ then the graph of $g$ can be obtained by shifting the graph of $f$ down by $c$ units. (Subtract $k$ from every $y$-coordinate of the graph of $f$)

Use a calculator to compare the graphs of
$f(x) = x^2$ , $g(x) = x^2 + 4$ , $h(x) = x^2 - 3$

Let $f(x) = \sqrt{x}$ and let $g(x) = \sqrt{x-2} + 1$
Without graphing the functions, write a sentence that compares the graphs of $f$ and $g$.

## Reflections:

If $g(x) = -f(x)$ then the graph of $g$ can be obtained by reflecting the graph of $f$ across the $x$-axis. (Change the sign of every $y$-coordinate of the graph of $f$)

If $g(x) = f(-x)$ then the graph of $g$ can be obtained by reflecting the graph of $f$ across the $y$-axis. (Change the sign of every $x$-coordinate of the graph of $f$)

Use a calculator to compare the graphs of
$f(x) = x^2$ , $g(x) = x^2 + 4$ , $h(x) = x^2 - 3$

Let $f(x) = \sqrt{x}$ and let $g(x) = \sqrt{x-2} + 1$
Without graphing the functions, write a sentence that compares the graphs of $f$ and $g$.

**Stretching and Compressing:**

Let $a$ be a positive real number

If $g(x) = af(x)$ then the graph of $g$ can be obtained by *stretching* the graph of $f$ vertically if $a > 1$. (Multiply every $y$-coordinate of the graph of $f$ by $a$)

If $g(x) = af(x)$ then the graph of $g$ can be obtained by *compressing* the graph of $f$ vertically if $0 < a < 1$. (Multiply every $y$-coordinate of the graph of $f$ by $a$)

Use a calculator to compare the graphs of
$f(x) = \sqrt[3]{x}$, $g(x) = 2\sqrt[3]{x}$ , $h(x) = \frac{1}{3}\sqrt[3]{x}$

Let $f(x) = \sqrt{x}$ and let $g(x) = -2\sqrt{x+2} - 1$
Without graphing the functions, write a sentence that compares the graphs of $f$ and $g$.

Below is the graph of a function $f$. On the blank graph provided, graph the equation $y = -f(x-2)+3$