## 1.4: Composition of Functions

The term "composition of functions" (or "composite function") refers to the combining of functions in a manner where the output from one function becomes the input for the next function.

In math terms, the range (the $y$-value answers) of one function becomes the domain (the $x$-values) of the next function.

The notation used for composition is:

$$(f \circ g)(x) = f(g(x))$$

and is read "*f composed with g of x*" or "*f of g of x*".

Notice how the letters stay in the same order in each expression for the composition. $f(g(x))$ clearly tells you to start with function $g$ (innermost parentheses are done first).

$$(g \circ f)(x) = g(f(x))$$

## Examples:

**1.** Given the functions $f(x) = 5x$ and $g(x) = x^2 + 1$, find **a.)** $(f \circ g)(x)$ and **b.)** $(g \circ f)(x)$

Answer: **a.)** $(f \circ g)(x) = f(g(x)) = f(x^2 + 1) = 5(x^2 + 1) = 5x^2 + 5$

**b.)** $(g \circ f)(x) = g(f(x)) = g(5x) = (5x)^2 + 1 = 25x^2 + 1$

Notice that $(g \circ f)(x)$ and $(f \circ g)(x)$ do not necessarily yield the same answer.
Composition of functions is not commutative.

**2.** Given the functions $p(x) = x + 2$ and $h(x) = x^2$, find **a.)** $(h \circ p)(3)$ and **b.)** $(h \circ p)(x)$

Answer: **a.)**

**b.)**