

## Composing Functions – Intermediate Algebra

**Definition** – Evaluating one function at another function is the operation called composition. Given  $f(x)$  and  $g(x)$  we write  $(f \circ g)(x) = f(g(x))$ .

The most important thing to keep in mind here is to evaluate.

Examples: Let  $f(x) = -2x + 7$  and  $g(x) = x^2 + 1$ . Find the following.

$$\begin{aligned} 1. \quad f(1) &= -2(1) + 7 \\ &= -2 + 7 \\ &= \boxed{5} \end{aligned}$$

$$\begin{aligned} 2. \quad g(-4) &= (-4)^2 + 1 \\ &= 16 + 1 \\ &= \boxed{17} \end{aligned}$$

$$\begin{aligned} 3. \quad f(a) &= -2(a) + 7 \\ &= -2a + 7 \end{aligned}$$

$$4. \quad g(\text{hello}) = (\text{hello})^2 + 1$$

$$\begin{aligned} 5. \quad f(g(x)) &= f(x^2 + 1) \\ &= -2(x^2 + 1) + 7 \\ &= -2x^2 - 2 + 7 \end{aligned}$$

$$\boxed{f(g(x)) = -2x^2 + 5}$$

Black

Blue

Green

Examples: Let  $f(x) = 5x - 8$ ,  $g(x) = 2x + 6$ , and  $h(x) = 5x^2 + 2x - 7$ . Find the following compositions.

$$\begin{aligned}
 1. \quad f(g(x)) &= f(2x+6) \\
 &= 5(2x+6) - 8 \\
 &= 10x + 30 - 8 \\
 f(g(x)) &= 10x + 22
 \end{aligned}$$

$$\begin{aligned}
 2. \quad g(f(x)) &= g(5x-8) \\
 &= 2(5x-8) + 6 \\
 &= 10x - 16 + 6 \\
 g(f(x)) &= 10x - 10
 \end{aligned}$$

$$\begin{aligned}
 3. \quad f(h(x)) &= f(5x^2 + 2x - 7) \\
 &= 5(5x^2 + 2x - 7) - 8 \\
 &= 25x^2 + 10x - 35 - 8 \\
 &= 25x^2 + 10x - 43
 \end{aligned}$$

$$\begin{aligned}
 4. \quad h(\underbrace{f(1)}_{-3}) &= h(-3) = 5(-3)^2 + 2(-3) - 7 = 5(9) - 6 - 7 \\
 &= 45 - 13 \\
 &= 32 \\
 \underbrace{f(1)}_{-3} &= f(1) = 5(1) - 8 = 5 - 8 = -3
 \end{aligned}$$