

11.1 Evaluating and Composition of Functions

Objective: I can evaluate functions for a given value.

Objective: I can create new functions using composition.

Evaluate

$$f(x) = 3x - 7 \text{ for } x = 4$$

$$f(4) = 3(4) - 7$$

$$\underline{f(4)} = 12 - 7$$

$$\underline{f(4)} = 5$$

$$g(t) = 5 - t \text{ for } t = -2$$

$$g(-2) = 5 - (-2)$$

$$g(-2) = 5 + 2$$

$$\underline{g(-2)} = 7$$

$$h(x) = \frac{x}{2} + 3 \text{ for } x = 6$$

$$h(6) = \frac{6}{2} + 3$$

$$h(6) = 3 + 3$$

$$\underline{h(6)} = 6$$

What if you plug in an expression instead of a number?

Example: Evaluate $f(x) = 2x - 8$ for $t + 2$

$$f(t+2) = 2(t+2) - 8$$

$$f(t+2) = 2t + 4 - 8$$

$$f(t+2) = 2t - 4$$

COMPOSITION TASK

#	f then g	g then f
4	-14	-20
12	15	
11	0	
1	13	
37	41	
12	6	

$f(7) =$	$g(-2) = 2(-2) + 1 = 5$
$f(7) = 7 - 9 = -2$	$g(14) = -14 - 6 = -20$
$f(7) = 2(7) = 14$	$g(21) = -4 + 1 = 2$
$f(7) = 3(7) = 21$	$g(-5) = -3(-5) + 2 = 17$
$f(7) = -7 + 2 = -5$	$g(21) = 5(21) - 8 = 97$
$f(7) = 4(7) - 7 = 21$	$g(7) = 2(7) + 5 = 19$
$f(7) = \boxed{2(7) - 7} = 7$	$2(2(7) - 7) + 5$

Composition of Functions

When you plug a function into a second function, you are doing *composition of functions*.

$$\underline{f(g(x))} = (f \circ g)(x) \quad \text{Plug } g(x) \text{ into } f(x)$$

$$g(f(x)) = (g \circ f)(x) \quad \text{Plug } f(x) \text{ into } g(x)$$

ALWAYS work from the INSIDE to the OUTSIDE!

Example: Find $f(g(x))$ and $g(f(x))$.

$$f(x) = 4x - 1 \quad g(x) = 5 + 2x$$

$$f(g(x)) = 4(5+2x) - 1$$

$$(f \circ g)(x) = 20 + 8x - 1 = 19 + 8x$$

$$g(f(x)) = 5 + 2(4x - 1)$$

$$(g \circ f)(x) = 5 + 8x - 2 = 3 + 8x$$

Example: Find $(f \circ g)(x)$ and $(g \circ f)(x)$.

$$f(x) = \frac{x}{3} - 1 \quad g(x) = 3x + 6$$

$$(f \circ g)(x) = \frac{3x+6}{3} - 1 = \frac{3x+6-3}{3} = \frac{3x+3}{3} = x+1$$

$$(g \circ f)(x) = 3\left(\frac{x}{3} - 1\right) + 6 = \frac{3x}{3} - 3 + 6 = x + 3$$

Evaluate.

$$f(x) = x^2 - 1 \quad g(x) = 2x$$

$$f(g(2)) = (2x)^2 - 1 = (2 \cdot 2)^2 - 1 = 4^2 - 1 = 16 - 1 = 15$$

$$(f \circ g)(-1) = (2x)^2 - 1 = (2 \cdot -1)^2 - 1 = (-2)^2 - 1 = 4 - 1 = 3$$

$$g(f(-3)) = 2(x^2 - 1) = 2((-3)^2 - 1) = 2(9 - 1) = 2(8) = 16$$

$$(g \circ f)(0) = 2(x^2 - 1) = 2(0^2 - 1) = 2(0 - 1) = 2(-1) = -2$$

$(f \circ g)(2)$

$$3. f(x) = \frac{4}{x} - 6 \quad g(x) = x$$

$$4. f(x) = -3x \quad g(x) = \frac{x}{2}$$

$$5. f(x) = x^2 \quad g(x) = \sqrt{x}$$

$$(g \circ f)(2)$$

$$f(x) = \cancel{x-5}$$

$$g(x) = 3x = -9$$

$$3(x-5)$$

$$3x-15$$

$$3(2)-15$$

$$6-15$$

$$-9$$

$$f(x) = 5+x$$

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

$$-2(5+x)+3$$

$$-10-2x+3$$

$$-7-2x$$

$$-7-2(2)$$

$$-7-4$$

$$-11$$

$$f(x) = x^2$$

$$g(x) = \frac{3}{2}x-1$$

$$2^2 = 4$$

$$\frac{3}{2}(4)-1$$

$$\boxed{5}$$