

Wednesday 9/18/19

1. QUIZ
2. Lunch
3. Composition of Functions Notes
4. HW/Practice

Topic: Composition of Functions

Name: _____ **Date:** _____

What am I learning today?

Warm-Up

Simplify the following if $f(x) = x^2 + 3$ and $g(x) = 2x - 1$

1. $(f - g)(x)$ 2. $(f + g)(x)$ 3. $(fg)(x)$

$$\begin{aligned} & (x^2 + 3) - (2x - 1) & (x^2 + 3) + (2x - 1) & (x^2 + 3)(2x - 1) \\ & x^2 + 3 - 2x + 1 & = x^2 + 3 + 2x - 1 & = 2x^3 - x^2 + 6x - 3 \\ & x^2 - 2x + 4 & = x^2 + 2x + 2 & \end{aligned}$$

Evaluate the following for the indicated value using the above functions:

4. $(g - f)(2)$ 5. $(fg)(-1)$ 6. $\left(\frac{g}{f}\right)(0)$

$$\begin{aligned} & (2x - 1) - (x^2 + 3) & (2x - 1)(2x - 1) & \frac{2x - 1}{x^2 + 3} \\ & (2(2) - 1) - (2^2 + 3) & = 2(-1)^2 - (-1)^2 + 6(-1) - 3 & = \frac{2(0) - 1}{(0)^2 + 3} = \frac{-1}{3} \\ & 3 - (7) & = -2 - 1 - 6 - 3 & \\ & = -4 & = -12 & \end{aligned}$$

Vocabulary
Composition of Functions

A **Composite function** is created when one **function** is **substituted** into another **function**.

- There are 2 ways a composition of functions can be shown.

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

This is read: "f of g of x"

- This means you **SUBSTITUTE** the second function listed into the first function.

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

- So, $g(x)$ is going to be substituted into $f(x)$DRAW THE ARROWS!!!

How it Looks

$$\begin{aligned} f(x) &= 5x - 2 \\ f(3) &= \\ 5(3) - 2 & \\ 15 - 2 &= 13 \end{aligned}$$

Examples

Composition w/Variables

If $f(x) = x - 1$ and $g(x) = 2x$ then find the following:

a. $(f \circ g)(x) = f(g(x))$ b. $(g \circ f)(x) = g(f(x))$ c. $(f \circ f)(x) = f(f(x))$

$$\begin{aligned} & \downarrow & \downarrow & \downarrow \\ & x - 1 & = 2x & = x - 1 \\ & = (2x) - 1 & = 2(x - 1) & = (x - 1) - 1 \\ & = 2x - 1 & = 2x - 2 & = x - 1 - 1 = x - 2 \end{aligned}$$

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You Try

1. If $f(x) = 2x + 3$ and $g(x) = x - 1$, find:

a. $(f \circ g)(x) = f(g(x))$
 $= 2x + 3$
 $= 2(x - 1) + 3$
 $= 2x - 2 + 3 = \boxed{2x + 1}$

b. $(g \circ f)(x) = g(f(x))$
 $= x - 1$
 $= (2x + 3) - 1 = \boxed{2x + 2}$

2. If $h(x) = x + 2$ and $g(x) = x^2 + 4$, find:

a. $(h \circ g)(x)$
 $= x + 2$
 $= (x^2 + 4) + 2$
 $= x^2 + 4 + 2 = \boxed{x^2 + 6}$

b. $(g \circ h)(x) = x^2 + 4$
 $= (x + 2)^2 + 4$
 $= (x + 2)(x + 2) + 4$
 $= x^2 + 2x + 2x + 4 + 4$
 $= x^2 + 4x + 8$

Compositions w/Values

Sometimes, instead of substituting a function into a function, specific values are used instead of variables.

Example: $(f \circ g)(3)$ or $(f(g(3)))$

***YOUR ANSWER WILL ALWAYS BE A **NUMBER**!!!

There are **2** ways of evaluating when a value is being substituted:

Option 1: Perform the composition, then substitute the value.

Option 2: Substitute the value into the 2nd function, then substitute that value into the 1st function.

Examples

Option 1

If $f(x) = x + 2$ and $g(x) = 4 - x^2$, find:

a. $f(g(-1)) \rightarrow f(g(x))$
 $= x + 2$
 $= (4 - x^2) + 2$
 $= (4 - (-1)^2) + 2$
 $= 4 - 1 + 2 = \boxed{5}$

b. $g(f(3)) = g(f(x))$
 $= 4 - x^2$
 $= 4 - (x + 2)^2$
 $= 4 - (3 + 2)^2 = 4 - 25 = \boxed{-21}$

Examples

Option 2

If $f(x) = x + 2$ and $g(x) = 4 - x^2$, find:

a. $f(g(-1))$
 ① $g(-1) = 4 - (-1)^2 = 4 - 1 = 3$
 ② $f(3) = 3 + 2 = \boxed{5}$

b. $g(f(3))$
 ① $f(3) = 3 + 2 = 5$
 ② $g(5) = 4 - (5)^2 = 4 - 25 = \boxed{-21}$

Summary

Summarize the lesson in your own words