

Warm-Up

Evaluate:

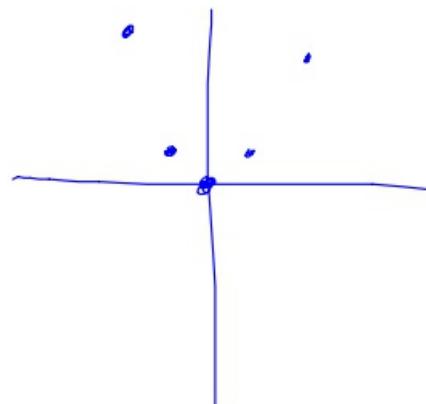
1. $g(a) = a^2 - 2$; Find $g(-4) = 14$

2. $w(n) = n^3 - 5n$; Find $w(-6) = -186$

Simplify:

3. $(10x - 7) - (-7x + 6)$

$$10x - 7 + 7x - 6 \\ \boxed{17x - 13}$$



Objective

Today we will:

- Perform Operations on Functions
- Write the equation of the composition of two functions

Agenda

- Notes/Modeled Examples
- Lesson Check
- Maze Worksheet Practice

Operations on Functions

Notation:

- Adding: $(f + g)(x)$ or $f(x) + g(x)$
- Subtracting: $(f - g)(x)$ or $f(x) - g(x)$
- Multiplying: $(f \cdot g)(x)$ or $f(x) \cdot g(x)$
- Dividing: $\left(\frac{f}{g}\right)(x)$ or $\frac{f(x)}{g(x)}$

Examples

$$f(x) = 3x + 2$$

$$g(x) = 5x^2 - 8x$$

$$h(x) = 12x - 7$$

Adding

1. $(f+g)(x)$

$$3x + 2 + 5x^2 - 8x$$

$$(f+g)(x) = 5x^2 - 5x + 2$$

2. $(h+g)(x)$

$$12x - 7 + 5x^2 - 8x$$

$$(h+g)(x) = 5x^2 + 4x - 7$$

Examples

$$f(x) = 3x + 2$$

$$g(x) = 5x^2 - 8x$$

$$h(x) = 12x - 7$$

Subtracting

$$1. \quad (f - g)(x) = (3x+2) - (5x^2 - 8x)$$

$$2. \quad (h - g)(x) = \overbrace{3x+2 - 5x^2 + 8x}^{(f-g)(x)} = -5x^2 + 11x + 2$$

$$(h-g)(x) = (12x-7) - (5x^2 - 8x)$$

$$12x-7 - 5x^2 + 8x$$

$$(h-g)(x) = -5x^2 + 20x - 7$$

Examples

$$f(x) = 3x + 2$$

$$g(x) = 5x^2 - 8x$$

$$h(x) = 12x - 7$$

Multiplying

$$\begin{aligned} 1. \quad (f \cdot g)(x) &= (3x+2)(5x^2-8x) = 15x^3 - 24x^2 + 10x^2 \\ &\quad - 16x \\ 2. \quad (h \cdot f)(x) &= f \cdot g(x) = 15x^3 - 14x^2 - 16x \\ (h \cdot f)x &= 36x^2 + 3x - 14 \end{aligned}$$

Examples

$$f(x) = x - 4$$

$$g(x) = x^2 - 2x - 8$$

$$h(x) = x + \sqrt{2}$$

Dividing: (Need to simplify!)

$$1. \left(\frac{g}{f} \right)(x) = \frac{x^2 - 2x - 8}{(x-4)} = \frac{(x+2)(x-4)}{(x-4)}$$

{-8
-4 2 | -2}

2.

$$\boxed{\left(\frac{g}{f} \right)(x) = x+2}$$

$$\left(\frac{f}{h} \right)(x) = \frac{x-4}{x+\sqrt{2}} \cdot \frac{(x-\sqrt{2})}{(x-\sqrt{2})} = \frac{x^2 - 4x - x\sqrt{2} + 4\sqrt{2}}{x^2 - x\sqrt{2} + x\sqrt{2} + \sqrt{4}}$$
$$\frac{x^2 - 4x - x\sqrt{2} + 4\sqrt{2}}{x^2 - 2}$$

Review of Substitution

$$3y + 7x = 18$$

$$y = 12x - 4$$

$$3(12x - 4) + 7x = 18$$

$$36x - 12 + 7x = 18$$

Composition of Functions

- Combining 2 separate functions into one new function
- Substitute the "Inner" Function into the "Outer" function

Notation

$$(h \circ g)(x) \quad \text{or} \quad h(g(x))$$

How to say it: "H of the g of x"

What to do: Substitute g into f

Ex. 1

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

Find $(h \circ g)(x)$

$$(h \circ g)(x) = 2(2x - 1) - 3$$

$$= 4x - 2 - 3$$

$$(h \circ g)(x) = 4x - 5$$

Ex. 2

$$f(x) = \cancel{x^2} - 3$$

$$g(x) = \cancel{x - 4}$$

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

$$\begin{aligned}(f \circ g)(x) &= (x-4)^2 - 3 \\ &= (x-4)(x-4) - 3 \\ (f \circ g)(x) &= x^2 - 8x + 13\end{aligned}$$

Ex. 3

$$h(n) = n - 3$$

$$g(n) = -3n - 5$$

Find $(g \circ h)(n)$

$$= -3(n-3) - 5$$

$$(g \circ h)(n) = -3n + 4$$

Ex. 4

$$h(a) = -4a - 5$$

Find $(h \circ h)(a)$

$$-4(-4a - 5) - 5$$

$$(h \circ h)(a) = 16a + 15$$

Ex. 5 $f(x) = 2x + 1$
 $g(x) = 2x - 2$
Find $(f \circ g)(6)$

$$2(2x-2) + 1$$
$$4x - 3 = \boxed{21}$$

Wrap-Up

What are our two types of notation for operations on functions?

What is important to remember for subtraction?

What does "composition of functions" mean?

What steps do we take to do this?

