

Topic: Functions: Operations
and
Compositions (1.7)

Question: Describe the numbers that must be excluded from $(f \circ g)(x)$.

Warm-Up

Write the slope-intercept form of the function that is perpendicular to the line $4x - y - 6 = 0$ and has the same y-intercept.

$$y = mx + b$$

$$y = -\frac{1}{4}x - 6$$

$$4x - y - 6 = 0$$

$$-4x \quad +6 \quad -4x + 6$$

$$-y = -4x + 6$$

$$y = 4x - 6$$

$$m_1 = 4$$

$$m_2 = -\frac{1}{4}$$

$$b = -6$$

Domain of Functions

$$f(x) = x^2 + 2x + 1 \quad D: \text{all } \mathbb{R} \\ -\infty, \infty$$

$$f(x) = \frac{1}{x} \quad D: \text{all } \mathbb{R}, x \neq 0$$

$$f(x) = \frac{1}{x-2} \quad D: \text{all } \mathbb{R} \ x \neq 2$$

$$f(x) = \frac{x^2 + 2x + 1}{(x-2)(x+3)} \quad D: \text{all } \mathbb{R} \ x \neq 2, x \neq -3$$

$$f(x) = 2x \quad x=0 \\ f(0) = 2(0) \\ f(0) = 0$$

$$f(x) = \sqrt{x} \quad D: \text{all } \mathbb{R} \geq 0 \\ [0, \infty)$$

$$f(x) = \sqrt{x-2} \quad \text{Domain} \\ x-2 \geq 0 \\ x \geq 2 \\ [2, \infty)$$

$$f(x) = \sqrt{3x-4} \quad 3x-4 \geq 0 \\ +4 \quad +4 \\ 3x \geq 4 \\ x \geq \frac{4}{3}$$

Combinations of Functions

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

2.) Difference $(f-g)(x) = f(x) - g(x)$

3.) Product $(f \cdot g)(x) = f(x) \cdot g(x)$

4.) Quotient $\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)} \quad g(x) \neq 0$

Example 1. Let $f(x) = x - 5$ and $g(x) = x^2 - 1$

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

$$\boxed{(f+g)(x) = x^2 + x - 6}$$

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

$$\boxed{(f-g)(x) = -x^2 + x - 4}$$

$$\begin{aligned} \text{c.) } (f \cdot g)(x) &= f(x) \cdot g(x) \\ &= (x - 5)(x^2 - 1) \\ &= x^3 - x - 5x^2 + 5 \end{aligned}$$

$$\boxed{(f \cdot g)(x) = x^3 - 5x^2 - x + 5}$$

$$\text{d.) } \left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}$$

$$\boxed{\left(\frac{f}{g}\right)(x) = \frac{x-5}{x^2-1}} \quad \text{all } \mathbb{R} \quad x \neq 1, x \neq -1$$

Compositions of functions

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

Example 2. $f(x) = 3x - 4$ and $g(x) = x^2 - 2x + 6$

$$\begin{aligned} \text{a) } (f \circ g)(x) &= f(g(x)) \\ &= f(x^2 - 2x + 6) \\ &= 3(x^2 - 2x + 6) - 4 \\ &= 3x^2 - 6x + 18 - 4 \end{aligned}$$

$$(f \circ g)(x) = 3x^2 - 6x + 14$$

$$\begin{aligned} \text{b) } (g \circ f)(x) &= g(f(x)) \\ &= g(3x - 4) \\ &= (3x - 4)^2 - 2(3x - 4) + 6 \\ &= (3x - 4)(3x - 4) - 2 \cdot 3x - 2 \cdot (-4) + 6 \\ &= 9x^2 - 12x - 12x + 16 - 6x + 8 + 6 \end{aligned}$$

$$(g \circ f)(x) = 9x^2 - 30x + 30$$

Assignment 1.7 Due Wednesday

① # 31-63 odd (page 220)

② - Bring Colored Pencils
• Read 1.6