

READ AND FOLLOW ALL DIRECTIONS. CIRCLE YOUR FINAL ANSWERS.
SHOW ALL WORK TO RECEIVE FULL CREDIT. NO CALCULATORS.

1. (2 points) A **relation** is a correspondence between two sets, or a collection of ordered pairs $\{(x, y) : x \in X, y \in Y\}$. Define the term **function** based on this definition of a relation.

A function is a relation in which no single x is related to two outputs y_1 and y_2 . That is, we don't have (x, y_1) and (x, y_2) both in the relation for $y_1 \neq y_2$.

2. (2 points) Does the relation $\{(1, 4), (2, 3), (3, 1), (1, 6)\}$ represent a function? Why or why not?

there are two y 's related to the input 1, so this is not a function

3. (2 points each) Write the function whose graph is the graph of $f(x) = x^2$, but is:
(a) Shifted up 4 units.

$$f(x) + 4 = x^2 + 4$$

- (b) Horizontally stretched by a factor of 4.

$$f\left(\frac{1}{4}x\right) = \left(\frac{1}{4}x\right)^2 = \frac{1}{16}x^2$$

- (c) Reflected over the x-axis.

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

Quiz #4

(d) Reflected over the y-axis.

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

4. (2 points each) Let $f(x) = 3x^2 + 5$ and $g(x) = 2x + 1$. The domains of f and g are all real numbers.

(a) What is $(f - g)(x)$?

$$\begin{aligned} (f-g)(x) &= f(x) - g(x) = (3x^2 + 5) - (2x + 1) \\ &= 3x^2 + 5 - 2x - 1 \\ &= 3x^2 - 2x + 4 \end{aligned}$$

(b) What is $(f/g)(x)$?

$$(f/g)(x) = \frac{f(x)}{g(x)} = \frac{3x^2 + 5}{2x + 1}$$

(c) What is the domain of $(f/g)(x)$?

$$\begin{aligned} \text{dom}(f/g) &= \text{dom } f \cap \text{dom } g \cap \{x \mid g(x) \neq 0\} \\ g(x) = 2x + 1 = 0 &\Rightarrow 2x = -1 \Rightarrow x = -\frac{1}{2} \\ \text{dom}(f/g) &= \{x \mid x \neq -\frac{1}{2}\} \end{aligned}$$

(d) Find $(f - g)(3)$ and $(f/g)(0)$.

$$(f-g)(3) = 3(3)^2 - 2 \cdot 3 + 4 = 3 \cdot 9 - 6 + 4 = 27 - 2 = 25$$

$$(f/g)(0) = \frac{3 \cdot 0^2 + 5}{2 \cdot 0 + 1} = \frac{5}{1} = 5$$

5. (1 point) EXTRA CREDIT. Suppose $f(x) = x^2 - 2$ and $g(x) = 5x$. Find $(f \circ g)(x)$

$$(f \circ g)(x) = f(g(x)) = f(5x) = (5x)^2 - 2 = 25x^2 - 2$$