Objective: Given functions students will be able to add
subtract, multiply, divide and compose
functions and find the new domain.

Study Problems
Page 116 # 3 - 21 (*3), 23, 35, 37,
45, 49, 51-53,57-63 odd, 71, 73, 84

Part 1 = p 116 # 3, 9 - 15 odd, 35 - 41 odd

Part 2   p 116 # 23, 25, 51-53, 57-63 odd

Warm-up

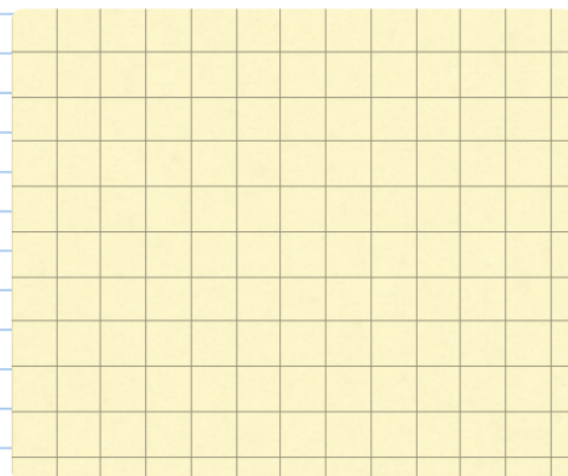Given $f(x) = x^2 + 2x$ and $g(x) = 2x + 1$, find:

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

b. $(f - g)(x)$

c. $(f \cdot g)(x)$

d. $\dfrac{f(x)}{g(x)}$

e. $(f \circ g)(x)$

Given $f(x) = x^2 + 2x$ and $g(x) = 2x + 1$, find:

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

b. $(g - f)(x)$

c. $(g \cdot f)(x)$

d. $\dfrac{g(x)}{f(x)}$

e. $(g \circ f)(x)$

Notation for arithmetic combinations

Addition	Multiplication
$(f + g)(x) = f(x) + g(x)$ $f + g$	$(f \cdot g)(x) = f(x) \cdot g(x)$ $f \cdot g$
Subtraction	Division
$(f - g)(x) = f(x) - g(x)$ $f - (g)$ * Distribute the negative	$\left(\dfrac{f}{g}\right)(x) = \dfrac{f(x)}{g(x)} = \dfrac{f}{g}$

Composition of functions

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

Change all x's in f for the function g

Example

Let $f(x) = 5x^2 - 4$ and $g(x) = 3x$

a) Find $g(f(2))$

b) Find $f(g(2))$

c) How $f(g(2))$ and $g(f(2))$ the same and different?

a) $f(2) = 5(2)^2 - 4$
   $f(2) = 16$

   $g(16) = 3(16) = \boxed{48}$

b) $g(2) = 3(2) = 6$

   $f(6) = 5\overset{36}{(6)}{}^2 - 4$
   $= \boxed{176}$

Example

Let $f(x) = \boxed{\sqrt{x^2 - 4}}$ and $g(x) = \dfrac{1}{3x}$

a) Find $g(f(x))$

b) Find $f(g(x))$

c) Find the domain of $f(g(x))$ and $g(f(x))$?

a) Domain : $\{X \in \mathbb{R} \mid x \geq 2, x \leq -2\}$

b) Domain : $\{X \in \mathbb{R} \mid x \neq 0, x \geq \frac{1}{6}, x \leq \frac{-1}{6}\}$

$\left[-\frac{1}{6}, 0\right) \cup \left(0, \frac{1}{6}\right]$

Domain

$x^2 - 4 \neq 0$
$x^2 \neq 4$
$x \neq \pm 2$

a) $g(f(x)) = \dfrac{1}{3(\sqrt{x^2-4})}$

b) $f(g(x)) = \sqrt{\left(\frac{1}{3x}\right)^2 - 4}$

$= \sqrt{\dfrac{1}{9x^2} - \dfrac{4}{1} \cdot \dfrac{9x^2}{9x^2}}$

$= \sqrt{\dfrac{1 - 36x^2}{9x^2}}$

$= \dfrac{\sqrt{1 - 36x^2}}{3x}$

$\to$ Domain

$3x \neq 0$

$1 - 36x^2 \geq 0$
$-36x^2 \geq -1$
$x^2 \leq \frac{1}{36}$