3.9 Composition of Functions

<u>FunctionOperations</u>

- *Adding functions is expressed as $f(x) + g(x)$*
- *Subtracting functions is expressed as $f(x) - g(x)$*
- *Multiplying functions is expressed as $f(x)\,g(x$*

<u>AddingFunctions</u>

When you add two functions you combine like terms to form one singlefunction.

If $f(x) = 2x^2 +5x+3$ and $g(x) = -4x^2 -7x+6$

Then $f(x) + g(x)$ is

$$(2x^2+5x+3) + (-4x^2-7x+6)$$

$$-2x^2-2x+9$$

<u>Subtracting Functions</u>

When you subtract two functions you combine like terms to form one single function.

If $f(x) = 2x^2 +5x+3$ and $g(x) = -4x^2 -7x+6$

Note: Do not for get to change the signs of all of the terms in the second function. The subtraction sign affects all of those terms.

Then $f(x) - g(x)$

$$(2x^2+5x+3) - 1(-4x^2-7x+6)$$

$$(2x^2+5x+3) + (+4x^2+7x-6)$$

$$6x^2+12x-3$$

Multiplying Functions

If $f(x) = 3$ and $g(x) = 2x-7$

then $f(x) \times g(x)$

$$3(2x-7)$$

$$6x-21$$

If you wish to find $4\,g(x)$

$$4\cdot(2x-7)$$

$$8x-28$$

If $f(x) = 2x-3$ and $g(x) = 3x+4$

Then $f(x) \times g(x)$

$$(2x-3)(3x+4)$$

$$6x^2-x-12$$

Composition of Functions

Composition of functions is a way of combining operations on functions. Let's first review some notation and operations.

If $f(x) = 5x - 4$ then find $f(2)$ ***Remember this is read as "f" of 2.***

$f(2) = 5(2) - 4$

$f(2) = 6$

Point

$(2, 6)$

When we work with composition of functions we work with more complex operations for example

If $f(x) = 2x + 1$ and $g(x) = 2x^2 + 3x$
Determine $f(g(2))$ ***Note: This is read as "f" of "g" of 2.***

$f(g(2)) \leftarrow$ Work from the inside to the outside

$g(2) = 2(2)^2 + 3(2)$

$g(2) = 8 + 6$

$g(2) = 14$

$f(g(2))$

$f(14) = 2(14) + 1$

$f(14) = 29$

Now let's evaluate g(f(2))

If $f(x) = 2x + 1$ *and* $g(x) = 2x^2 + 3x$

$f(2) = 2(2) + 1$

$f(2) = 5$

$g(5) = 2(5)^2 + 3(5)$

$g(5) = 50 + 15$

$g(5) = 65$

$\cancel{2x^2 + 3x(5)}$

$\cancel{2(2^2) + 3(2)^{+5}}$

Try this one on your own

If $f(x) = 4x - 3$ *and* $g(x) = -3x^2 + 2x$ *determine* $f(g(3))$

Now let's express f(g(x))

If $f(x) = 2x + 1$ and $g(x) = 2x^2 + 3x$

F(g(x)) means every where there is an "x" in the function f(x) we replace it with the function g(x).

$f(g(x))$

$2x + 1$

$f(2x^2+3x) = 2(2x^2+3x) + 1$

$4x^2 + 6x + 1$

Now let's express g(f(x)) as functions of x.

$g(f(x))$

$g(2x+1) = 2x^2 + 3x$

$= 2\cdot(2x+1)^2 + 3\cdot(2x+1)$

$2\cdot(2x+1)(2x+1) + 3\cdot(2x+1)$

$2\cdot(4x^2+4x+1) + 6x+3$

$8x^2 + 14x + 5$

Try this one on your own

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

Find $f(g(x))$

$$f(x) = 3x - 4$$

$$f(4x^2 - 3x) = 3x - 4$$

$$= 3(4x^2 - 3x) - 4$$

$$= 12x^2 - 9x - 4$$

$f(x) = 2x + 1$

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

Assignment:* *Pg. 188 1-6 odds
Pg. 217 1-3, 5, 9, 10