$f(x) = x^2$, $g(x) = 2x - 3$, $h(x) = \sqrt{x+1}$

$g(f(x))$

$f(g(x))$ $f(x) = x^2$, $g(x) = 2x-3$ $(2x-3)^2$ $(2x-3)(2x-3)$ $\boxed{4x^2 - 12x + 9}$	$(g \circ f)(x)$ $g(x) = 2x-3$, $f(x) = x^2$ $2(x^2) - 3$ $\boxed{2x^2 - 3}$	$(f \circ h)(x)$ $f(x) = x^2$ $h(x) = \sqrt{x+1}$ $(\cancel{\sqrt{}}\,x+1)^{\cancel{2}}$ $\boxed{x+1}$
$h(g(x))$ $h(x) = \sqrt{x+1}$ $g(x) = 2x-3$ $\sqrt{(2x-3)+1}$ $\boxed{\sqrt{2x-2}}$	$g(h(x))$ $g(x) = 2x-3$ $h(x) = \sqrt{x+1}$ $2(\sqrt{x+1}) - 3$ $\boxed{2\sqrt{x+1} - 3}$	$(h \circ f)(x)$ $h(x) = \sqrt{x+1}$ $f(x) = x^2$ $\sqrt{x^2+1}$ $\boxed{\sqrt{x^2+1}}$

Operations with Functions

Notation for Function Operations	
Operation	Notation
Addition	$(f+g)(x) = f(x) + g(x)$
Subtraction distribute neg	$(f-g)(x) = f(x) - g(x)$
Multiplication Box or FOIL	$(fg)(x) = f(x) \cdot g(x)$
Division Factor & simply	$\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}$, where $g(x) \neq 0$

Example 1: Given $f(x) = 2x^2 + 4x - 6$ and $g(x) = 2x - 2$, find each value.

a. $(f+g)(2)$	b. $(f-g)(-4)$	c. $(fg)(-1)$
$f(2) + g(2)$ $f(2) = 2(2)^2 + 4(2) - 6$ $= 10$ $g(2) = 2(2) - 2$ $= 2$ $10 + 2 = \boxed{12}$	$f(-4) - g(-4)$ $10 - (-10)$ $\boxed{20}$	$f(-1) \cdot g(-1)$ $(-8) \cdot (-4)$ $\boxed{32}$

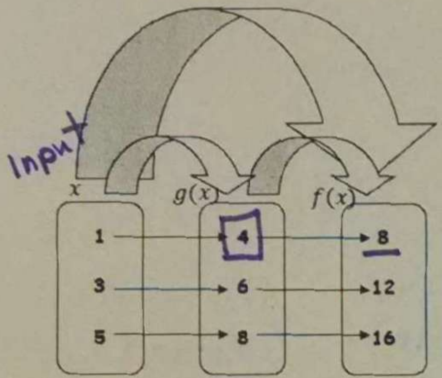
Example 2: Given $f(x) = 2x^2 + 4x - 6$ and $g(x) = 2x - 2$, find expression.

a. $(f+g)(x)$ $f(x) + g(x)$ $(2x^2 + 4x - 6) + (2x - 2)$ $2x^2 + 4x - 6 + 2x - 2$ $\boxed{2x^2 + 6x - 8}$	b. $(f-g)(x)$ $f(x) - g(x)$ $(2x^2 + 4x - 6) - (2x - 2)$ $2x^2 + 4x - 6 - 2x + 2$ $\boxed{2x^2 + 2x - 4}$
c. $(fg)(x)$ $g(x) \cdot f(x)$ $(2x - 2)(2x^2 + 4x - 6)$ $4x^3 + 8x^2 - 12x - 4x^2 - 8x + 12$ $\boxed{4x^3 + 4x^2 - 20x + 12}$	d. $\left(\frac{f}{g}\right)(x)$ $\frac{f(x)}{g(x)}$ $\frac{2x^2 + 4x - 6}{2x - 2}$ $\frac{2(x^2 + 2x - 3)}{2(x-1)}$ $\frac{\cancel{2}\cancel{(x-1)}(x+3)}{\cancel{2}\cancel{(x-1)}}$ $\boxed{x+3}$

	$2x^2$	$+4x$	-6
$2x$	$4x^3$	$8x$	$-12x$
-2	$-4x^2$	$-8x$	$+12$

$4x^3 + 4x^2 - 20x + 12$

Composition of Functions
The composition of functions $f(x)$ and $g(x)$ is notated $(f \circ g)(x) = f(g(x))$.



$f(g(1))$

To find $(f \circ g)(1)$, first find $g(1)$.

Then use 4 as the input into f:

So $(f \circ g)(1) =$ ______ $=$ 8

The order of function operations is the same as the order of operations for numbers and expressions (parentheses FIRST)

$f(g(3))$, evaluate $g(3)$ first and then substitute the result into f.

$g(f(3))$, evaluate $f(3)$ first and then substitute the result into g.

Example 3: Given $f(x) = 3x + 1$ and $g(x) = x^3$, find each value.

a. $f(g(2))$	b. $(g \circ f)(2)$	c. $f(g(-3))$
$g(2) = (2)^3$ $= 8$ $f(8) = 3(8)+1$ $f(g(2)) = \boxed{25}$	$g(\underbrace{f(2)})$ $f(2) = 3(2)+1$ $= 7$ $g(7) = (7)^3$ $g(f(2)) = \boxed{343}$	$g(-3) = (-3)^3$ $= -27$ $f(-27) = 3(-27)+1$ $f(g(-3)) = \boxed{-80}$

Example 4: Given $f(x) = 5x + 2$ and $g(x) = \frac{2}{x-1}$, write each composite function

a. $f(g(x))$	b. $(g \circ f)(x)$

Example 5: Use the tables to find each value.

$f(x)$

x	1	2	3	4	5
$f(x)$	1	0	1	4	9

$g(x)$

x	3	4	5	6	7
$g(x)$	0	2	4	6	8

a. $(f+g)(4)$	b. $\left(\frac{g}{f}\right)(5)$	c. $(g \circ f)(4)$
$f(4) + g(4)$ $4 + 2$ $\boxed{6}$	$\frac{g(5)}{f(5)}$ $\boxed{\frac{4}{9}}$	$g(\underbrace{f(4)})$ $f(4) = 4$ $g(4) = \boxed{2}$

d. $(g-f)(5)$	e. $(fg)(3)$	f. $(f \circ g)(4)$
$g(5) - f(5)$ $4 - 9$ $\boxed{-5}$	$f(3) \cdot g(3)$ $1 \cdot 3$ $\boxed{0}$	$f(\underbrace{g(4)})$ $\underbrace{f(2)}$ $\boxed{0}$