# §2.7 Combining Functions (Function Compositions Only)

Recall how to input expressions into functions.

e.g. Let $f(x) = 2x^2 + 5x - 7$

Then $f(\quad) = 2(\quad)^2 + 5(\quad) - 7$

$f(3x-1) = 2(3x-1)^2 + 5(3x-1) - 7$

$= 2(9x^2 - 6x + 1) + 15x - 5 - 7$

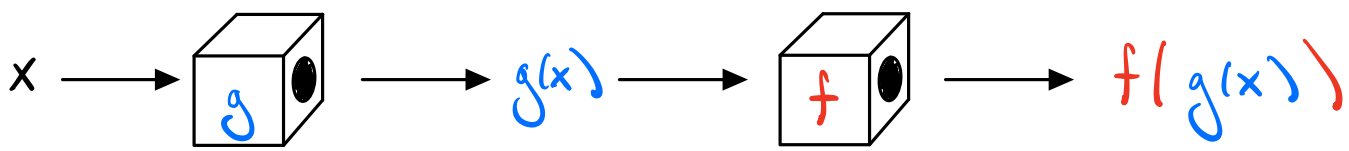
$= 18x^2 - 12x + 2 + 15x - 5 - 7$

$= 18x^2 + 3x - 10$

Now, suppose $g(x) = 3x - 1$. Then $f(g(x)) = f(3x-1) =$

This is called **function composition**,

"f of g of x", "f composed with g".




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

Idea: output of $g$ becomes input of $f$.

**ex.** If $f(-2) = 5$ and $g(4) = -2$, find $f(g(4))$.

**ex.** Let $f(x) = \dfrac{x+1}{x-1}$ & $g(x) = x^2 - 2$.

Find (a) $f \circ g(3)$ (b) $f \circ g(x)$ (c) $g \circ f(3)$ (d) $g \circ f(x)$ (e) $g \circ g(x)$ (f) $f \circ g(x)$ (hard!)

**ex.** Let $f(x) = \sqrt{x} + 1$ & $g(x) = 36x^2 - 100$

FIND (a) $f \circ g(x)$ & its domain

(b) $g \circ f(x)$ & its domain

(c) $f \circ f(x)$ & its domain

(d) $g \circ g(x)$ & its domain

## ADDITIONAL EXERCISES

**47–58 ■ Composition of Functions** Find the functions $f \circ g$, $g \circ f$, $f \circ f$, and $g \circ g$ and their domains.

**47.** $f(x) = 2x + 3, \quad g(x) = 4x - 1$

**48.** $f(x) = 6x - 5, \quad g(x) = \dfrac{x}{2}$

**49.** $f(x) = x^2, \quad g(x) = x + 1$

**50.** $f(x) = x^3 + 2, \quad g(x) = \sqrt[3]{x}$

**51.** $f(x) = \dfrac{1}{x}, \quad g(x) = 2x + 4$

**52.** $f(x) = x^2, \quad g(x) = \sqrt{x - 3}$

**53.** $f(x) = |x|, \quad g(x) = 2x + 3$

**54.** $f(x) = x - 4, \quad g(x) = |x + 4|$

**55.** $f(x) = \dfrac{x}{x + 1}, \quad g(x) = 2x - 1$

**56.** $f(x) = \dfrac{1}{\sqrt{x}}, \quad g(x) = x^2 - 4x$

**57.** $f(x) = \dfrac{x}{x + 1}, \quad g(x) = \dfrac{1}{x}$

**58.** $f(x) = \dfrac{2}{x}, \quad g(x) = \dfrac{x}{x + 2}$