2.7

1. $(f+g)(2) = f(2) + g(2) = 3 + 5 = 8$
$(f-g)(2) = f(2) - g(2) = 3 - 5 = -2$
$(fg)(2) = f(2)g(2) = 3 \cdot 5 = 15$
$\left(\frac{f}{g}\right)(2) = \frac{f(2)}{g(2)} = \frac{3}{5}$

2. $f(g(x))$
$(f \circ g)(2) = f(5) = 12$

3. $f(x) = x+1$
$g(x) = 2x$
$(f \circ g)(x) = f(2x) = 2x+1$
$(g \circ f)(x) = g(x+1) = 2(x+1)$.

4. $f(x) = x+1$
$g(x) = 2x$
$(f \circ g)(x) = 2x+1$
$(g \circ f)(x) = 2(x+1)$.

5. a. f, g
b. f, g
c. f, g, 0

6. g, f.

8. $f(x) = x$
$g(x) = \sqrt{x}$

$(f+g)(x) = x + \sqrt{x}$ Domain: $[0, \infty)$
$(f-g)(x) = x - \sqrt{x}$ Domain: $[0, \infty)$
$(fg)(x) = x\sqrt{x} = x^{3/2}$ Domain: $[0, \infty)$
$\left(\frac{f}{g}\right)(x) = \frac{x}{\sqrt{x}} = \sqrt{x}$ Domain: $(0, \infty)$

10. $f(x) = 3 - x^2$
$g(x) = x^2 - 4$

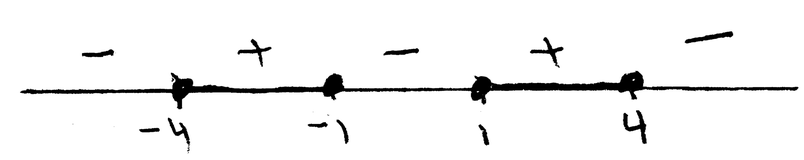
$(f+g)(x) = (3 - x^2) + (x^2 - 4) = -1$ Domain: $\mathbb{R}$.
$(f-g)(x) = (3 - x^2) - (x^2 - 4) = -2x^2 + 7$ Domain: $\mathbb{R}$
$(fg)(x) = (3 - x^2)(x^2 - 4) = -x^4 + 7x^2 - 12$ Domain: $\mathbb{R}$.
$\left(\frac{f}{g}\right)(x) = \frac{3 - x^2}{x^2 - 4}$ Domain: $\mathbb{R} - \{\pm 2\}$

12. $f(x) = x^2 + 2x$
$g(x) = 3x^2 - 1$

$(f+g)(x) = (x^2 + 2x) + (3x^2 - 1) = 4x^2 + 2x - 1$ Domain: $\mathbb{R}$.
$(f-g)(x) = (x^2 + 2x) - (3x^2 - 1) = -2x^2 + 2x + 1$ Domain: $\mathbb{R}$.
$(fg)(x) = (x^2 + 2x)(3x^2 - 1) = 3x^4 + 6x^3 - x^2 - 2x$ Domain: $\mathbb{R}$
$\left(\frac{f}{g}\right)(x) = \frac{x^2 + 2x}{3x^2 - 1}$ Domain: $\mathbb{R} - \{\pm \frac{1}{\sqrt{3}}\}$

14. $f(x) = \sqrt{16 - x^2}$ Domain: $[-4, 4]$
$g(x) = \sqrt{x^2 - 1}$ Domain: $(-\infty, -1] \cup [1, \infty)$

$(f+g)(x) = \sqrt{16 - x^2} + \sqrt{x^2 - 1}$ Domain: $[-4, -1] \cup [1, 4]$
$(f-g)(x) = \sqrt{16 - x^2} - \sqrt{x^2 - 1}$ Domain: $[-4, -1] \cup [1, 4]$
$(fg)(x) = (16 - x^2)^{\frac{1}{2}} (x^2 - 1)^{1/2}$
$= [(16 - x^2)(x^2 - 1)]^{1/2}$
$= [-(x-4)(x+4)(x-1)(x+1)]^{1/2}$
$= (-x^4 + 15x^2 - 16)^{1/2}$ Domain: $[-4, -1] \cup [1, 4]$



$\left(\frac{f}{g}\right)(x) = \left[\frac{16 - x^2}{x^2 - 1}\right]^{1/2}$ Domain: $[-4, -1) \cup (1, 4]$

16. $f(x) = \frac{2}{x+1}$
$g(x) = \frac{x}{x+1}$

$(f+g)(x) = \frac{2}{x+1} + \frac{x}{x+1} = \frac{x+2}{x+1}$ Domain: $\mathbb{R} - \{-1\}$
$(f-g)(x) = \frac{2}{x+1} - \frac{x}{x+1} = -\frac{x-2}{x+1}$ Domain: $\mathbb{R} - \{-1\}$
$(fg)(x) = \left(\frac{2}{x+1}\right)\left(\frac{x}{x+1}\right) = \frac{2x}{(x+1)^2}$ Domain: $\mathbb{R} - \{-1\}$
$\left(\frac{f}{g}\right)(x) = \left(\frac{2}{x+1}\right)\left(\frac{x+1}{x}\right) = \frac{2}{x}$ Domain: $\mathbb{R} - \{-1, 0\}$

28. a. $f(2) = 2(2) - 3 = 1$
$f(1) = 2(1) - 3 = -1$
$f(f(2)) = -1$

b. $g(3) = 4 - 3^2 = -5$
$g(-5) = 4 - (-5)^2 = -21$
$g(g(3)) = -21$

30. a $f(-1) = 2(-1) - 3 = -5$
$f(-5) = 2(-5) - 3 = -13$
$f(f(-1)) = -13$.

b. $g(-1) = 4 - (-1)^2 = 3$
$g(3) = 4 - 3^2 = -5$
$g(g(-1)) = -5$.

32. a. $f(x) = 2x - 3$
$f(2x-3) = 2(2x-3) - 3$
$f(f(x)) = 4x - 9$

b. $g(x) = 4 - x^2$
$g(4-x^2) = 4 - (4-x^2)^2$
$g(g(x)) = x^4 + 8x^2 - 12$

34. $g(f(0)) = g(0) = 3$

36. $(f \circ g)(0) = f(g(0)) = f(3) = 0$

38. $(f \circ f)(4) = f(f(4)) = f(2) = -2$

40. $g(f(2)) = g(3) = 6$

42. $g(g(2)) = g(5) = 1$

44. $(g \circ f)(2) = g(f(2)) = g(3) = 6$

46. $(g \circ g)(2) = g(g(2)) = g(5) = 1$

48. $f(x) = 6x - 5$
$g(x) = \frac{x}{2}$

$(f \circ g)(x) = f\left(\frac{x}{2}\right) = 6\left(\frac{x}{2}\right) - 5 = 3x - 5$
Domain: $\mathbb{R}$.

$(g \circ f)(x) = g(6x-5) = \frac{6x-5}{2}$
Domain: $\mathbb{R}$.

$(f \circ f)(x) = f(6x-5) = 6(6x-5) - 5$
$= 36x - 35$
Domain: $\mathbb{R}$.

$(g \circ g)(x) = g\left(\frac{x}{2}\right) = \frac{1}{2}\left(\frac{x}{2}\right) = \frac{x}{4}$.
Domain: $\mathbb{R}$.

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

$(f \circ g)(x) = f(x^{1/3}) = (x^{\frac{1}{3}})^3 + 2 = x + 2$
Domain: $\mathbb{R}$.

$(g \circ f)(x) = g(x^3+2) = (x^3+2)^{1/3}$
Domain: $\mathbb{R}$.

$(f \circ f)(x) = f(x^3+2) = (x^3+2)^3 + 2$
$= x^9 + 3x^6(2) + 3x^3(4) + 8 + 2$
$= x^9 + 6x^6 + 12x^3 + 10$.
Domain: $\mathbb{R}$.

$(g \circ g)(x) = g(x^{1/3}) = (x^{1/3})^{1/3} = x^{1/9}$
Domain: $\mathbb{R}$

52. $f(x) = x^2$
$g(x) = (x-3)^{1/2}$ Domain: $[3, \infty)$

$(f \circ g)(x) = f[(x-3)^{1/2}] = [(x-3)^{1/2}]^2 = x - 3$.
Domain: $[3, \infty)$.

$(g \circ f)(x) = g(x^2) = (x^2 - 3)^{1/2} = [(x-\sqrt{3})(x+\sqrt{3})]^{1/2}$
Domain: $(-\infty, -\sqrt{3}] \cup [\sqrt{3}, \infty)$

$(f \circ f)(x) = f(x^2) = (x^2)^2 = x^4$
Domain: $\mathbb{R}$

$(g \circ g)(x) = g[(x-3)^{1/2}] = [(x-3)^{1/2} - 3]^{1/2}$
$(x-3)^{1/2} - 3 \geq 0$
$(x-3)^{1/2} \geq 3$
$x - 3 \geq 9$
$x \geq 12$
Domain. $[3, \infty) \cap [12, \infty) = [12, \infty)$.

54 $f(x) = x-4$
$g(x) = |x+4|$

$(f\circ g)(x) = f(|x+4|) = |x+4| - 4$
Domain: $\mathbb{R}$.

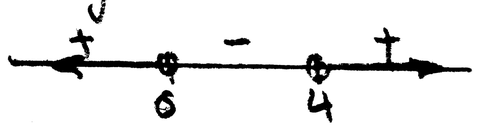
$(g\circ f)(x) = g(x-4) = |x-4+4| = |x|$
Domain: $\mathbb{R}$.

$(f\circ f)(x) = f(x-4) = (x-4)-4 = x-8$
Domain: $\mathbb{R}$.

$(g\circ g)(x) = g(|x+4|) = ||x+4|+4| = |x+4|+4$
Domain: $\mathbb{R}$.

56. $f(x) = \frac{1}{\sqrt{x}}$ Domain: $(0,\infty)$
$g(x) = x^2 - 4x = x(x-4)$.

$(f\circ g)(x) = f(x^2-4x) = \frac{1}{\sqrt{x(x-4)}}$



Domain: $(-\infty,0)\cup(4,\infty)$

$(g\circ f)(x) = g\left(\frac{1}{\sqrt{x}}\right) = \left(\frac{1}{\sqrt{x}}\right)^2 - 4\left(\frac{1}{\sqrt{x}}\right) = \frac{1}{x} - \frac{4}{\sqrt{x}}$
Domain: $(0,\infty)$

$(f\circ f)(x) = f\left(\frac{1}{\sqrt{x}}\right) = \frac{1}{\sqrt{\frac{1}{\sqrt{x}}}} = x^{\frac{1}{4}}$
Domain: $(0,\infty)$

$(g\circ g)(x) = g(x^2-4x) = (x^2-4x)^2 - 4(x^2-4x)$
$= x^4 - 8x^3 + 16x^2 - 4x^2 + 16x$
$= x^4 - 8x^3 + 12x^2 + 16x$

Domain: $\mathbb{R}$

56. $f(x) = \frac{2}{x}$ Domain: $\mathbb{R} - \{0\}$

$g(x) = \frac{x}{x+2}$ Domain: $\mathbb{R} - \{-2\}$

$(f \circ g)(x) = f\left(\frac{x}{x+2}\right) = \frac{2}{\frac{x}{x+2}} = \frac{2(x+2)}{x}$

Domain: $\mathbb{R} - \{-2, 0\}$.

$(g \circ f)(x) = g\left(\frac{2}{x}\right) = \frac{2/x}{2/x + 2} = \frac{1}{x+1}$

Domain: $\mathbb{R} - \{-1, 0\}$

$(f \circ f)(x) = f\left(\frac{2}{x}\right) = \frac{2}{\frac{2}{x}} = \frac{2x}{2} = x$

Domain: $\mathbb{R} - \{0\}$

$(g \circ g)(x) = g\left(\frac{x}{x+2}\right) = \frac{\frac{x}{x+2}}{\frac{x}{x+2} + 2} = \frac{x}{x + 2(x+2)} = \frac{x}{3x+4}$

Domain: $\mathbb{R} - \{-2, -\frac{4}{3}\}$

64. $F(x) = \sqrt{x} + 1$

$f(x) = x + 1$

$g(x) = \sqrt{x}$

66. $G(x) = \frac{1}{x+3}$

$f(x) = \frac{1}{x}$

$g(x) = x + 3$

68. $H(x) = \sqrt{1 + \sqrt{x}}$

$f(x) = \sqrt{x}$

$g(x) = 1 + \sqrt{x}$

75. $R(x) = x(0.15 - 0.000002x) = 0.15x - 0.000002x^2$

76. $P(x) = R(x) - C(x)$

$= (0.15x - 0.000002x^2) - (0.095x - 0.0000005x^2)$

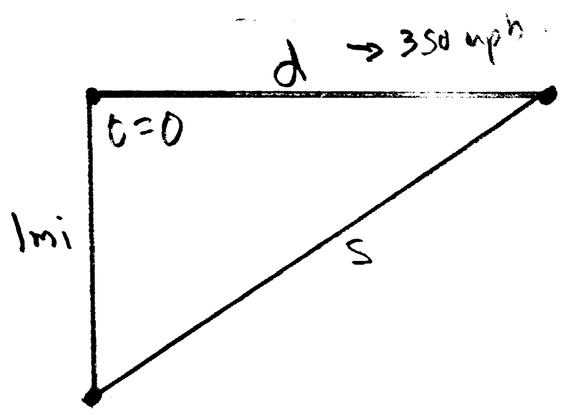
$P(x) = 0.055x - 0.0000015x^2$

78. a. $f(t) = t$ (cm)

b. $g(r) = \frac{4}{3}\pi r^3$

c. $V(t) = (g \circ f)(t) = \frac{4}{3}\pi t^3$

82.



a. $s(d) = (d^2 + 1)^{1/2}$

b. $d(t) = 350t$ (mi)

c. $s(t) = (s \circ d)(t) = s(350t) = [(350t)^2 + 1]^{1/2}$