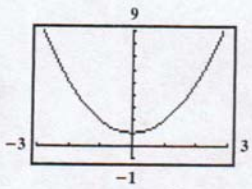
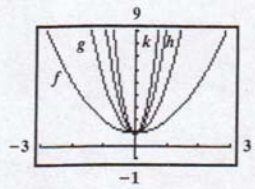
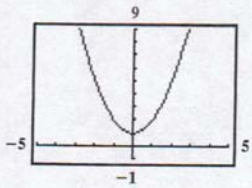
135. a.



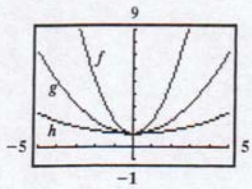
b.



136. a.



b.



137. makes sense **138.** makes sense
139. does not make sense **140.** does not make sense
141. false **142.** false **143.** false **144.** true
145. $g(x) = -(x+4)^2$ **146.** $g(x) = -|x-5| + 1$
147. $g(x) = -\sqrt{x-2} + 2$ **148.** $g(x) = -\frac{1}{4}\sqrt{16 - x^2} - 1$
149. $(-a, b)$ **150.** $(a, 2b)$ **151.** $(a+3, b)$ **152.** $(a, b-3)$

153. $2x^3 + x^2 - 5x + 2$ **154.** $9x^2 - 30x + 30$ **155.** $\frac{2x}{3-x}$

Section 2.6

Check Point Exercises

1. a. $(-\infty, \infty)$ **b.** $(-\infty, -7)\cup(-7, 7)\cup(7, \infty)$ **c.** $[3, \infty)$ **2. a.** $(f+g)(x) = x^2 + x - 6; (-\infty, \infty)$ **b.** $(f-g)(x) = -x^2 + x - 4; (-\infty, \infty)$ **c.** $(fg)(x) = x^3 - 5x^2 - x + 5; (-\infty, \infty)$ **d.** $\left(\frac{f}{g}\right)(x) = \frac{x-5}{x^2-1}; (-\infty, -1)\cup(-1, 1)\cup(1, \infty)$ **3. a.** $(f+g)(x) = \sqrt{x-3} + \sqrt{x+1}$ **b.** $[3, \infty)$

4. a. $(f \circ g)(x) = 10x^2 - 5x + 1$ **b.** $(g \circ f)(x) = 50x^2 + 115x + 65$ **c.** 16 **5. a.** $(f \circ g)(x) = \frac{4x}{1+2x}$ **b.** $\left(-\infty, -\frac{1}{2}\right)\cup\left(-\frac{1}{2}, 0\right)\cup(0, \infty)$
6. If $f(x) = \sqrt{x}$ and $g(x) = x^2 + 5$, then $h(x) = (f \circ g)(x)$.

Exercise Set 2.6

1. $(-\infty, \infty)$ **2.** $(-\infty, \infty)$ **3.** $(-\infty, 4)\cup(4, \infty)$ **4.** $(-\infty, -5)\cup(-5, \infty)$ **5.** $(-\infty, \infty)$ **6.** $(-\infty, \infty)$ **7.** $(-\infty, -3)\cup(-3, 5)\cup(5, \infty)$
8. $(-\infty, -4)\cup(-4, 3)\cup(3, \infty)$ **9.** $(-\infty, -7)\cup(-7, 9)\cup(9, \infty)$ **10.** $(-\infty, -8)\cup(-8, 10)\cup(10, \infty)$ **11.** $(-\infty, -1)\cup(-1, 1)\cup(1, \infty)$
12. $(-\infty, -2)\cup(-2, 2)\cup(2, \infty)$ **13.** $(-\infty, 0)\cup(0, 3)\cup(3, \infty)$ **14.** $(-\infty, 0)\cup(0, 4)\cup(4, \infty)$ **15.** $(-\infty, 1)\cup(1, 3)\cup(3, \infty)$
16. $(-\infty, 2)\cup\left(2, \frac{10}{3}\right)\cup\left(\frac{10}{3}, \infty\right)$ **17.** $[3, \infty)$ **18.** $[-2, \infty)$ **19.** $(3, \infty)$ **20.** $(-2, \infty)$ **21.** $[-7, \infty)$ **22.** $[10, \infty)$ **23.** $(-\infty, 12]$
24. $(-\infty, 14]$ **25.** $[2, \infty)$ **26.** $[3, \infty)$ **27.** $[2, 5)\cup(5, \infty)$ **28.** $[3, 6)\cup(6, \infty)$ **29.** $(-\infty, -2)\cup(-2, 2)\cup(2, 5)\cup(5, \infty)$
30. $(-\infty, -3)\cup(-3, 2)\cup(2, 3)\cup(3, \infty)$ **31.** $(f+g)(x) = 3x + 2$; domain: $(-\infty, \infty)$; $(f-g)(x) = x + 4$; domain: $(-\infty, \infty)$; $(fg)(x) = 2x^2 + x - 3$; domain: $(-\infty, \infty)$; $\left(\frac{f}{g}\right)(x) = \frac{2x+3}{x-1}$; domain: $(-\infty, 1)\cup(1, \infty)$ **32.** $(f+g)(x) = 4x - 2$; domain: $(-\infty, \infty)$; $(f-g)(x) = 2x - 6$; domain: $(-\infty, \infty)$; $(fg)(x) = 3x^2 + 2x - 8$; domain: $(-\infty, \infty)$; $\left(\frac{f}{g}\right)(x) = \frac{3x-4}{x+2}$; domain: $(-\infty, -2)\cup(-2, \infty)$ **33.** $(f+g)(x) = 3x^2 + x - 5$; domain: $(-\infty, \infty)$; $(f-g)(x) = -3x^2 + x - 5$; domain: $(-\infty, \infty)$; $(fg)(x) = 3x^3 - 15x^2$; domain: $(-\infty, \infty)$; $\left(\frac{f}{g}\right)(x) = \frac{x-5}{3x^2}$; domain: $(-\infty, 0)\cup(0, \infty)$ **34.** $(f+g)(x) = 5x^2 + x - 6$; domain: $(-\infty, \infty)$; $(f-g)(x) = -5x^2 + x - 6$; domain: $(-\infty, \infty)$; $(fg)(x) = 5x^3 - 30x^2$; domain: $(-\infty, \infty)$; $\left(\frac{f}{g}\right)(x) = \frac{x-6}{5x^2}$; domain: $(-\infty, 0)\cup(0, \infty)$ **35.** $(f+g)(x) = 2x^2 - 2$; domain: $(-\infty, \infty)$; $(f-g)(x) = 2x^2 - 2x - 4$; domain: $(-\infty, \infty)$; $(fg)(x) = 2x^3 + x^2 - 4x - 3$; domain: $(-\infty, \infty)$; $\left(\frac{f}{g}\right)(x) = 2x - 3$; domain: $(-\infty, -1)\cup(-1, \infty)$ **36.** $(f+g)(x) = 6x^2 - 2$; domain: $(-\infty, \infty)$; $(f-g)(x) = 6x^2 - 2x$; domain: $(-\infty, \infty)$; $(fg)(x) = 6x^3 - 7x^2 + 1$; domain: $(-\infty, \infty)$; $\left(\frac{f}{g}\right)(x) = \frac{6x^2 - x - 1}{x-1}$; domain: $(-\infty, 1)\cup(1, \infty)$
37. $(f+g)(x) = 2x - 12$; domain: $(-\infty, \infty)$; $(f-g)(x) = -2x^2 - 2x + 18$; domain: $(-\infty, \infty)$; $(fg)(x) = -x^4 - 2x^3 + 18x^2 + 6x - 45$; domain: $(-\infty, \infty)$; $\left(\frac{f}{g}\right)(x) = \frac{3-x^2}{x^2+2x-15}$; domain: $(-\infty, -5)\cup(-5, 3)\cup(3, \infty)$ **38.** $(f+g)(x) = 4x - 7$; domain: $(-\infty, \infty)$; $(f-g)(x) = -2x^2 - 4x + 17$; domain: $(-\infty, \infty)$; $(fg)(x) = -x^4 - 4x^3 + 17x^2 + 20x - 60$; domain: $(-\infty, \infty)$; $\left(\frac{f}{g}\right)(x) = \frac{5-x^2}{x^2+4x-12}$; domain: $(-\infty, -6)\cup(-6, 2)\cup(2, \infty)$ **39.** $(f+g)(x) = \sqrt{x} + x - 4$; domain: $[0, \infty)$; $(f-g)(x) = \sqrt{x} - x + 4$; domain: $[0, \infty)$; $(fg)(x) = \sqrt{x}(x-4)$; domain: $[0, \infty)$; $\left(\frac{f}{g}\right)(x) = \frac{\sqrt{x}}{x-4}$; domain: $[0, 4)\cup(4, \infty)$
40. $(f+g)(x) = \sqrt{x} + x - 5$; domain: $[0, \infty)$; $(f-g)(x) = \sqrt{x} - x + 5$; domain: $[0, \infty)$; $(fg)(x) = \sqrt{x}(x-5)$; domain: $[0, \infty)$; $\left(\frac{f}{g}\right)(x) = \frac{\sqrt{x}}{x-5}$; domain: $[0, 5)\cup(5, \infty)$ **41.** $(f+g)(x) = \frac{2x+2}{x}$; domain: $(-\infty, 0)\cup(0, \infty)$; $(f-g)(x) = 2$; domain: $(-\infty, 0)\cup(0, \infty)$; $(fg)(x) = \frac{2x+1}{x^2}$; domain: $(-\infty, 0)\cup(0, \infty)$; $\left(\frac{f}{g}\right)(x) = 2x + 1$; domain: $(-\infty, 0)\cup(0, \infty)$

42. $(f+g)(x) = 6$; domain: $(-\infty, 0)\cup(0, \infty)$; $(f-g)(x) = \dfrac{6x-2}{x}$; domain: $(-\infty, 0)\cup(0, \infty)$; $(fg)(x) = \dfrac{6x-1}{x^2}$; domain: $(-\infty, 0)\cup(0, \infty)$; $\left(\dfrac{f}{g}\right)(x) = 6x - 1$; domain: $(-\infty, 0)\cup(0, \infty)$ **43.** $(f+g)(x) = \dfrac{9x-1}{x^2-9}$; domain: $(-\infty, -3)\cup(-3, 3)\cup(3, \infty)$; $(f-g)(x) = \dfrac{x+3}{x^2-9} = \dfrac{1}{x-3}$; domain: $(-\infty, -3)\cup(-3, 3)\cup(3, \infty)$; $(fg)(x) = \dfrac{20x^2-6x-2}{(x^2-9)^2}$; domain: $(-\infty, -3)\cup(-3, 3)\cup(3, \infty)$; $\left(\dfrac{f}{g}\right)(x) = \dfrac{5x+1}{4x-2}$; domain: $\left(-\infty, -3\right)\cup\left(-3, \dfrac{1}{2}\right)\cup\left(\dfrac{1}{2}, 3\right)\cup(3, \infty)$

44. $(f+g)(x) = \dfrac{5x-3}{x^2-25}$; domain: $(-\infty, -5)\cup(-5, 5)\cup(5, \infty)$; $(f-g)(x) = \dfrac{x+5}{x^2-25} = \dfrac{1}{x-5}$; domain: $(-\infty, -5)\cup(-5, 5)\cup(5, \infty)$; $(fg)(x) = \dfrac{6x^2-10x-4}{(x^2-25)^2}$; domain: $(-\infty, -5)\cup(-5, 5)\cup(5, \infty)$; $\left(\dfrac{f}{g}\right)(x) = \dfrac{3x+1}{2x-4}$; domain: $(-\infty, -5)\cup(-5, 2)\cup(2, 5)\cup(5, \infty)$ **45.** $(f+g)(x) = \sqrt{x+4} + \sqrt{x-1}$; domain: $[1, \infty)$; $(f-g)(x) = \sqrt{x+4} - \sqrt{x-1}$; domain: $[1, \infty)$; $(fg)(x) = \sqrt{x^2+3x-4}$; domain: $[1, \infty)$; $\left(\dfrac{f}{g}\right)(x) = \dfrac{\sqrt{x+4}}{\sqrt{x-1}}$; domain: $(1, \infty)$ **46.** $(f+g)(x) = \sqrt{x+6} + \sqrt{x-3}$; domain: $[3, \infty)$; $(f-g)(x) = \sqrt{x+6} - \sqrt{x-3}$; domain: $[3, \infty)$; $(fg)(x) = \sqrt{x^2+3x-18}$; domain: $[3, \infty)$; $\left(\dfrac{f}{g}\right)(x) = \dfrac{\sqrt{x+6}}{\sqrt{x-3}}$; domain: $(3, \infty)$

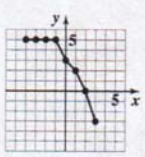
47. $(f+g)(x) = \sqrt{x-2} + \sqrt{2-x}$; domain: $\{2\}$; $(f-g)(x) = \sqrt{x-2} - \sqrt{2-x}$; domain: $\{2\}$; $(fg)(x) = \sqrt{x-2}\cdot\sqrt{2-x}$; domain: $\{2\}$; $\left(\dfrac{f}{g}\right)(x) = \dfrac{\sqrt{x-2}}{\sqrt{2-x}}$; domain: $\varnothing$ **48.** $(f+g)(x) = \sqrt{x-5} + \sqrt{5-x}$; domain: $\{5\}$; $(f-g)(x) = \sqrt{x-5} - \sqrt{5-x}$; domain: $\{5\}$; $(fg)(x) = \sqrt{x-5}\cdot\sqrt{5-x}$; $\{5\}$; $\left(\dfrac{f}{g}\right)(x) = \dfrac{\sqrt{x-5}}{\sqrt{5-x}}$; domain: $\varnothing$ **49. a.** $(f\circ g)(x) = 2x + 14$ **b.** $(g\circ f)(x) = 2x + 7$ **c.** $(f\circ g)(2) = 18$ **50. a.** $(f\circ g)(x) = 3x - 15$ **b.** $(g\circ f)(x) = 3x - 5$ **c.** $(f\circ g)(2) = -9$ **51. a.** $(f\circ g)(x) = 2x + 5$ **b.** $(g\circ f)(x) = 2x + 9$ **c.** $(f\circ g)(2) = 9$ **52. a.** $(f\circ g)(x) = 15x - 18$ **b.** $(g\circ f)(x) = 15x + 2$ **c.** $(f\circ g)(2) = 12$ **53. a.** $(f\circ g)(x) = 20x^2 - 11$ **b.** $(g\circ f)(x) = 80x^2 - 120x + 43$ **c.** $(f\circ g)(2) = 69$ **54. a.** $(f\circ g)(x) = 14x^2 - 62$ **b.** $(g\circ f)(x) = 98x^2 + 28x - 7$ **c.** $(f\circ g)(2) = -6$ **55. a.** $(f\circ g)(x) = x^4 - 4x^2 + 6$ **b.** $(g\circ f)(x) = x^4 + 4x^2 + 2$ **c.** $(f\circ g)(2) = 6$ **56. a.** $(f\circ g)(x) = x^4 - 6x^2 + 10$ **b.** $(g\circ f)(x) = x^4 + 2x^2 - 2$ **c.** $(f\circ g)(2) = 2$ **57. a.** $(f\circ g)(x) = -2x^2 - x - 1$ **b.** $(g\circ f)(x) = 2x^2 - 17x + 41$ **c.** -11 **58. a.** $(f\circ g)(x) = -5x^2 + 20x - 7$ **b.** $(g\circ f)(x) = -25x^2 + 40x - 13$ **c.** 13 **59. a.** $(f\circ g)(x) = \sqrt{x-1}$ **b.** $(g\circ f)(x) = \sqrt{x} - 1$ **c.** $(f\circ g)(2) = 1$ **60. a.** $(f\circ g)(x) = \sqrt{x+2}$ **b.** $(g\circ f)(x) = \sqrt{x} + 2$ **c.** $(f\circ g)(2) = 2$ **61. a.** $(f\circ g)(x) = x$ **b.** $(g\circ f)(x) = x$ **c.** $(f\circ g)(2) = 2$ **62. a.** $(f\circ g)(x) = x$ **b.** $(g\circ f)(x) = x$ **c.** $(f\circ g)(2) = 2$ **63. a.** $(f\circ g)(x) = x$ **b.** $(g\circ f)(x) = x$ **c.** 2 **64. a.** $(f\circ g)(x) = x$ **b.** $(g\circ f)(x) = x$ **c.** 2

65. a. $(f\circ g)(x) = \dfrac{2x}{1+3x}$ **b.** $\left(-\infty, -\dfrac{1}{3}\right)\cup\left(-\dfrac{1}{3}, 0\right)\cup(0, \infty)$ **66. a.** $(f\circ g)(x) = \dfrac{5x}{1+4x}$ **b.** $\left(-\infty, -\dfrac{1}{4}\right)\cup\left(-\dfrac{1}{4}, 0\right)\cup(0, \infty)$

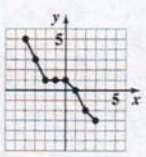
67. a. $(f\circ g)(x) = \dfrac{4}{4+x}$ **b.** $(-\infty, -4)\cup(-4, 0)\cup(0, \infty)$ **68. a.** $(f\circ g)(x) = \dfrac{6}{6+5x}$ **b.** $\left(-\infty, -\dfrac{6}{5}\right)\cup\left(-\dfrac{6}{5}, 0\right)\cup(0, \infty)$

69. a. $(f\circ g)(x) = \sqrt{x-2}$ **b.** $[2, \infty)$ **70. a.** $(f\circ g)(x) = \sqrt{x-3}$ **b.** $[3, \infty)$ **71. a.** $(f\circ g)(x) = 5 - x$ **b.** $(-\infty, 1]$ **72. a.** $(f\circ g)(x) = 3 - x$ **b.** $(-\infty, 2]$ **73.** $f(x) = x^4, g(x) = 3x - 1$ **74.** $f(x) = x^3, g(x) = 2x - 5$ **75.** $f(x) = \sqrt[3]{x}, g(x) = x^2 - 9$ **76.** $f(x) = \sqrt{x}, g(x) = 5x^2 + 3$ **77.** $f(x) = |x|, g(x) = 2x - 5$ **78.** $f(x) = |x|, g(x) = 3x - 4$ **79.** $f(x) = \dfrac{1}{x}, g(x) = 2x - 3$ **80.** $f(x) = \dfrac{1}{x}, g(x) = 4x + 5$ **81.** 5 **82.** -1 **83.** -1 **84.** 0 **85.** $[-4, 3]$ **86.** $(-4, 3)$

87.



88.



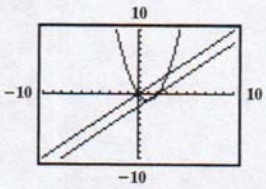
89. 1 **90.** 3 **91.** -6 **92.** -5 **93.** 1 and 2 **94.** $-\dfrac{4}{3}$ and 1

95. a. $(B-D)(x) = 10.9x^2 - 35x + 1641$ **b.** 1634.1 thousand **c.** overestimates by 0.1 thousand

96. a. $(B+D)(x) = 3.9x^2 + 5x + 6451$ **b.** 6573.5 thousand **c.** underestimates by 1.5 thousand

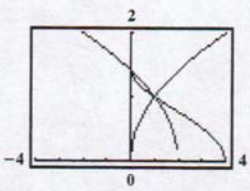
97. $(R-C)(20{,}000) = -200{,}000$; The company loses \$200,000 when 20,000 radios are sold.; $(R-C)(30{,}000) = 0$; The company breaks even when 30,000 radios are sold.; $(R-C)(40{,}000) = 200{,}000$; The company makes a profit of \$200,000 when 40,000 radios are sold. **98. a.** $m = -0.44$; Profit is decreasing. **b.** $m = 0.51$; Profit is increasing. **c.** $0.07x + 24.76$; $m = 0.07$; Profit is increasing. **99. a.** f gives the price of the computer after a \$400 discount. g gives the price of the computer after a 25% discount. **b.** $(f\circ g)(x) = 0.75x - 400$; This models the price of a computer after first a 25% discount and then a \$400 discount. **c.** $(g\circ f)(x) = 0.75(x - 400)$; This models the price of a computer after first a \$400 discount and then a 25% discount. **d.** $f\circ g$ because $0.75x - 400 < 0.75(x - 400)$ **100. a.** f gives the cost of a pair of jeans after a \$5 discount. g gives the cost of a pair of jeans that has been discounted 40%. **b.** $(f\circ g)(x) = 0.6x - 5$; The cost of a pair of jeans is 60% of the regular price minus \$5 rebate. **c.** $(g\circ f)(x) = 0.6(x - 5) = 0.6x - 3$; The cost of a pair of jeans is 60% of the price that has been reduced by \$5. **d.** $f\circ g$ because $0.6x - 5 < 0.6x - 3$

106.



At $x = 0$, there is no y-value since the function is not defined there.

107.



Domain: $[0, 4]$

108. makes sense **109.** makes sense **110.** does not make sense **111.** does not make sense **112.** false **113.** false **114.** false **115.** true

116. Assume f and g are even; then $f(-x) = f(x)$ and $g(-x) = g(x)$. $(fg)(-x) = f(-x)g(-x) = f(x)g(x) = (fg)(x)$, so fg is even.