Answers to Odd-Numbered Exercises and Tests

Chapter 1

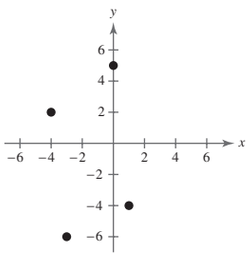
Section 1.1 *(page 9)*

Vocabulary Check *(page 9)*

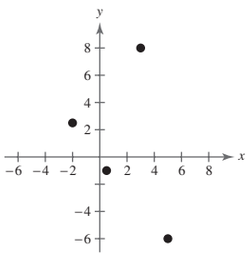
1. (a) v (b) vi (c) i (d) iv (e) iii (f) ii
2. Cartesian **3.** Distance Formula
4. Midpoint Formula

1. A: $(2, 6)$, B: $(-6, -2)$, C: $(4, -4)$, D: $(-3, 2)$

3.

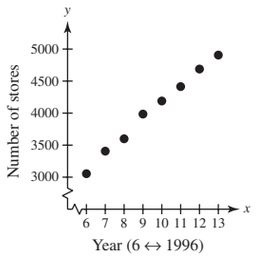


5.

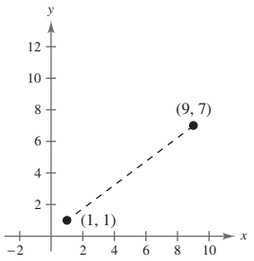


7. $(-3, 4)$ **9.** $(-5, -5)$ **11.** Quadrant IV
13. Quadrant II **15.** Quadrant III or IV
17. Quadrant III **19.** Quadrant I or III

21.

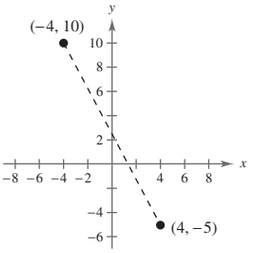


23. 8 **25.** 5
27. (a) 4, 3, 5 (b) $4^2 + 3^2 = 5^2$
29. (a) 10, 3, $\sqrt{109}$ (b) $10^2 + 3^2 = \left(\sqrt{109}\right)^2$
31. (a)



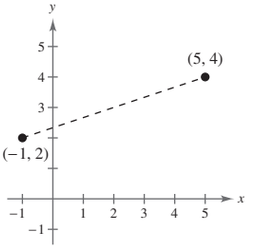
(b) 10
(c) (5, 4)

33. (a)



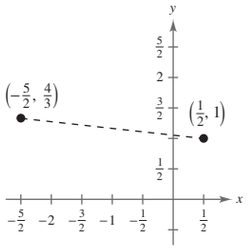
(b) 17
(c) $\left(0, \frac{5}{2}\right)$

35. (a)



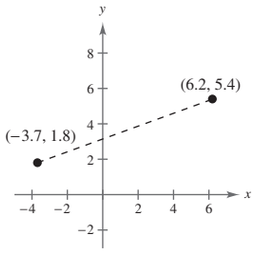
(b) $2\sqrt{10}$
(c) (2, 3)

37. (a)



(b) $\dfrac{\sqrt{82}}{3}$
(c) $\left(-1, \frac{7}{6}\right)$

39. (a)



(b) $\sqrt{110.97}$
(c) (1.25, 3.6)

41. $\left(\sqrt{5}\right)^2 + \left(\sqrt{45}\right)^2 = \left(\sqrt{50}\right)^2$
43. $(2x_m - x_1, 2y_m - y_1)$
45. $\left(\dfrac{3x_1 + x_2}{4}, \dfrac{3y_1 + y_2}{4}\right), \left(\dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2}\right),$
$\left(\dfrac{x_1 + 3x_2}{4}, \dfrac{y_1 + 3y_2}{4}\right)$
47. $2\sqrt{505} \approx 45$ yards **49.** \$3803.5 million
51. (0, 1), (4, 2), (1, 4) **53.** $(-3, 6)$, $(2, 10)$, $(2, 4)$, $(-3, 4)$
55. \$3.31 per pound; 2001 **57.** $\approx 250\%$

59. (a) The number of artists elected each year seems to be nearly steady except for the first few years. From six to eight artists will be elected in 2008.

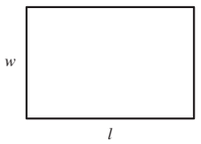
(b) The Rock and Roll Hall of Fame was opened in 1986.

61. 1998: \$19,384.5 million; 2000: \$20,223.0 million; 2002: \$21,061.5 million

63. $\sqrt[3]{\dfrac{4.47}{\pi}} \approx 1.12$ inches

65. Length of side = 43 centimeters; area = 800.64 square centimeters

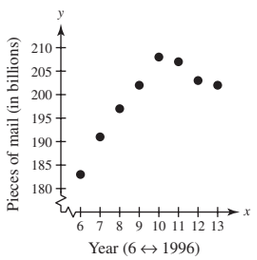
67. (a)



(b) $l = 1.5w$; $p = 5w$

(c) 7.5 meters × 5 meters

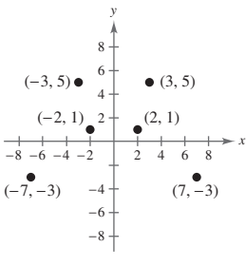
69. (a)



(b) 2002

(c) Answers will vary. Sample answer: Technology now enables us to transport information in many ways other than by mail. The Internet is one example.

71.



(a) The point is reflected through the y-axis.

(b) The point is reflected through the x-axis.

(c) The point is reflected through the origin.

73. False. The Midpoint Formula would be used 15 times.

75. No. It depends on the magnitudes of the quantities measured.

77. b **78.** c **79.** d **80.** a **81.** $x = 1$

83. $x = 2 \pm \sqrt{11}$ **85.** $x < \frac{3}{5}$ **87.** $14 < x < 22$

Section 1.2 *(page 22)*

Vocabulary Check *(page 22)*

1. solution or solution point **2.** graph

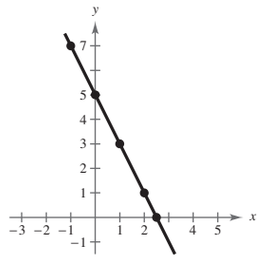
3. intercepts **4.** y-axis **5.** circle; (h, k); r

6. numerical

1. (a) Yes (b) Yes **3.** (a) No (b) Yes

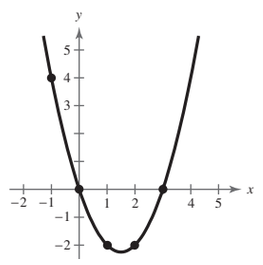
5.

x	-1	0	1	2	$\frac{5}{2}$
y	7	5	3	1	0
(x, y)	$(-1, 7)$	$(0, 5)$	$(1, 3)$	$(2, 1)$	$\left(\frac{5}{2}, 0\right)$



7.

x	-1	0	1	2	3
y	4	0	-2	-2	0
(x, y)	$(-1, 4)$	$(0, 0)$	$(1, -2)$	$(2, -2)$	$(3, 0)$



9. x-intercepts: $(\pm 2, 0)$
y-intercept: $(0, 16)$

11. x-intercept: $\left(\frac{6}{5}, 0\right)$
y-intercept: $(0, -6)$

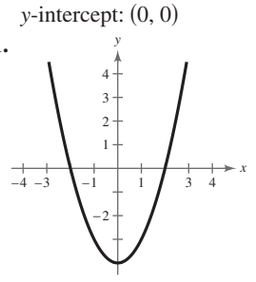
13. x-intercept: $(-4, 0)$
y-intercept: $(0, 2)$

15. x-intercept: $\left(\frac{7}{3}, 0\right)$
y-intercept: $(0, 7)$

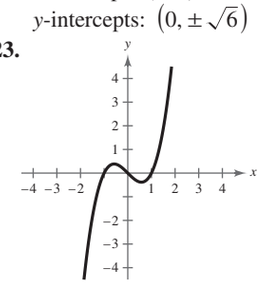
17. x-intercepts: $(0, 0), (2, 0)$
y-intercept: $(0, 0)$

19. x-intercept: $(6, 0)$
y-intercepts: $\left(0, \pm\sqrt{6}\right)$

21.



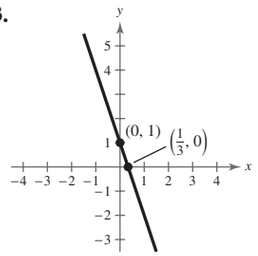
23.



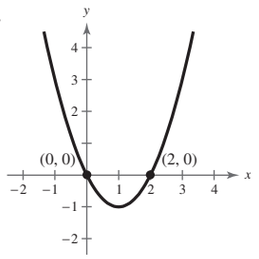
25. y-axis symmetry **27.** Origin symmetry

29. Origin symmetry **31.** x-axis symmetry

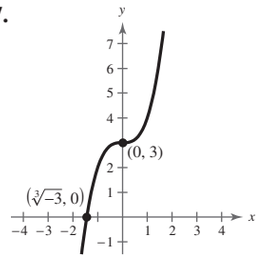
33.



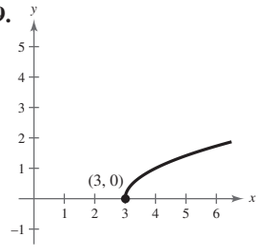
35.



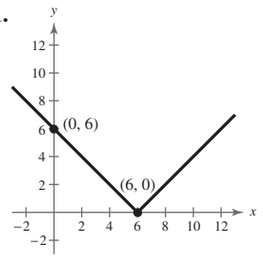
37.



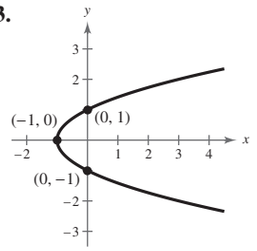
39.



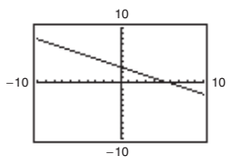
41.



43.

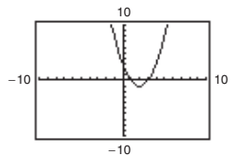


45.



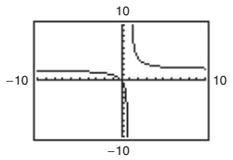
Intercepts: $(6, 0), (0, 3)$

47.



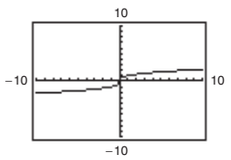
Intercepts: $(3, 0), (1, 0), (0, 3)$

49.



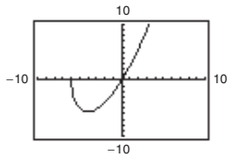
Intercept: $(0, 0)$

51.



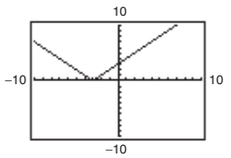
Intercept: $(0, 0)$

53.



Intercepts: $(0, 0), (-6, 0)$

55.



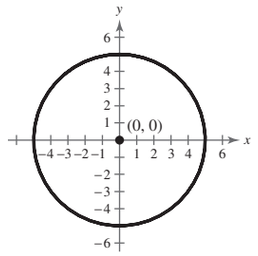
Intercepts: $(-3, 0), (0, 3)$

57. $x^2 + y^2 = 16$ **59.** $(x - 2)^2 + (y + 1)^2 = 16$

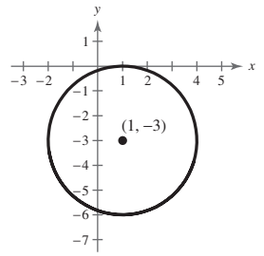
61. $(x + 1)^2 + (y - 2)^2 = 5$

63. $(x - 3)^2 + (y - 4)^2 = 25$

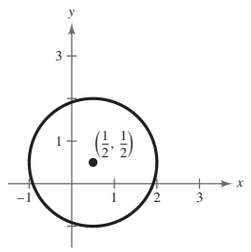
65. Center: $(0, 0)$; Radius: 5



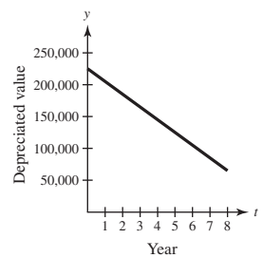
67. Center: $(1, -3)$; Radius: 3



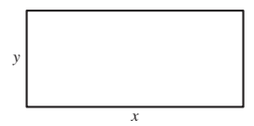
69. Center: $\left(\frac{1}{2}, \frac{1}{2}\right)$; Radius: $\frac{3}{2}$



71.

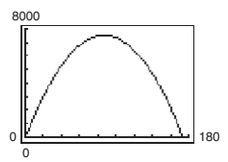


73. (a)



(b) Answers will vary.

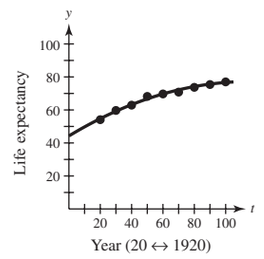
(c)



(d) $x = 86\frac{2}{3}$, $y = 86\frac{2}{3}$

(e) A regulation NFL playing field is 120 yards long and $53\frac{1}{3}$ yards wide. The actual area is 6400 square yards.

75. (a) and (b)



(c) 66.0 years (d) 2005: 77.0 years; 2010: 77.1 years

(e) Answers will vary.

77. False. A graph is symmetric with respect to the x-axis if, whenever (x, y) is on the graph $(x, -y)$ is also on the graph.

79. The viewing window is incorrect. Change the viewing window. Answers will vary.

81. $9x^5,\ 4x^3,\ -7$ **83.** $2\sqrt{2x}$

85. $\dfrac{10\sqrt{7x}}{x}$ **87.** $\sqrt[3]{|t|}$

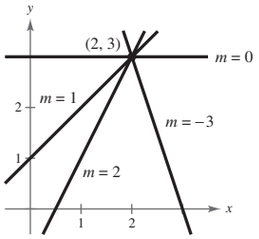
Section 1.3 *(page 34)*

Vocabulary Check *(page 34)*

1. linear **2.** slope **3.** parallel
4. perpendicular **5.** rate or rate of change
6. linear extrapolation
7. a. iii b. i c. v d. ii e. iv

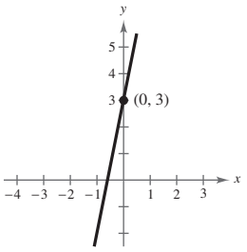
1. (a) L_2 (b) L_3 (c) L_1

3.

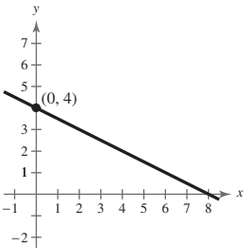


5. $\frac{3}{2}$ **7.** -4

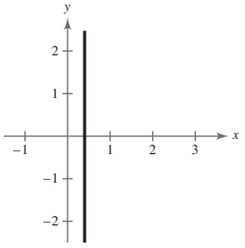
9. $m = 5$;
y-intercept: $(0, 3)$



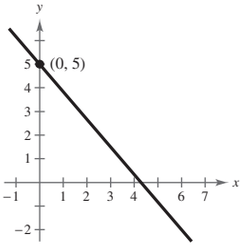
11. $m = -\frac{1}{2}$;
y-intercept: $(0, 4)$



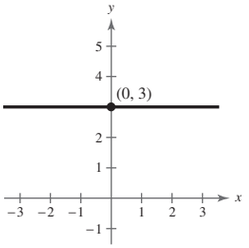
13. m is undefined.
There is no y-intercept.



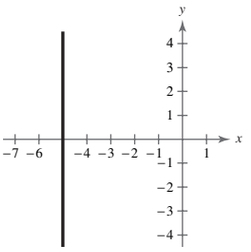
15. $m = -\frac{7}{6}$;
y-intercept: $(0, 5)$



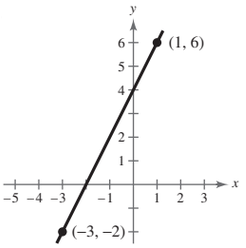
17. $m = 0$;
y-intercept: $(0, 3)$



19. m is undefined.
There is no y-intercept.

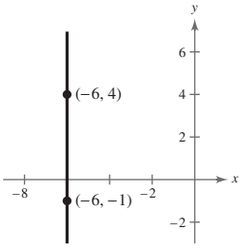


21.



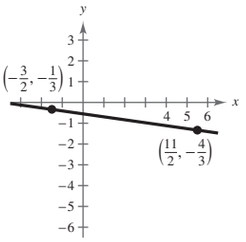
$m = 2$

23.



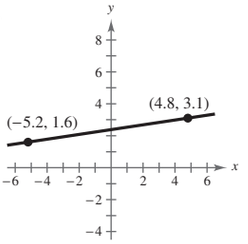
m is undefined.

25.



$m = -\frac{1}{7}$

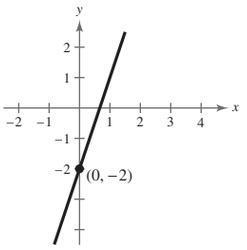
27.



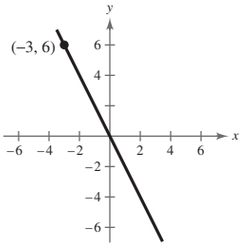
$m = 0.15$

29. $(0, 1), (3, 1), (-1, 1)$
31. $(6, -5), (7, -4), (8, -3)$
33. $(-8, 0), (-8, 2), (-8, 3)$
35. $(-4, 6), (-3, 8), (-2, 10)$
37. $(9, -1), (11, 0), (13, 1)$

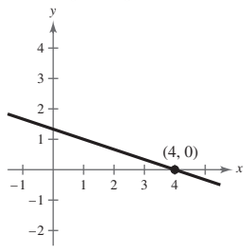
39. $y = 3x - 2$



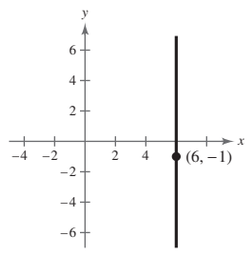
41. $y = -2x$



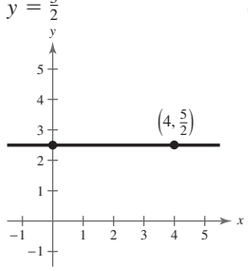
43. $y = -\frac{1}{3}x + \frac{4}{3}$



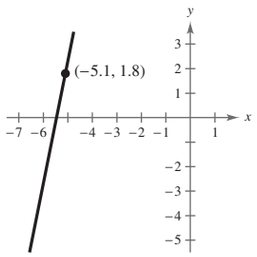
45. $x = 6$



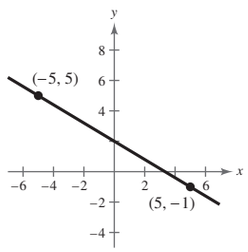
47. $y = \frac{5}{2}$



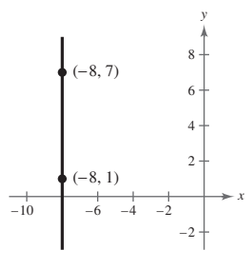
49. $y = 5x + 27.3$



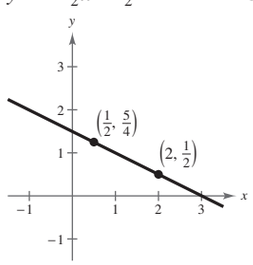
51. $y = -\frac{3}{5}x + 2$



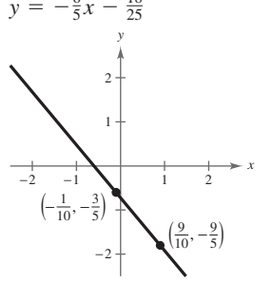
53. $x = -8$



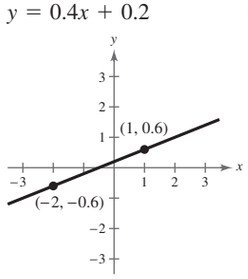
55. $y = -\frac{1}{2}x + \frac{3}{2}$



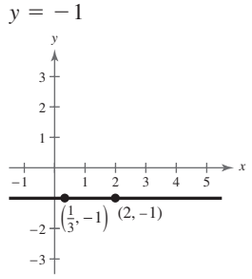
57. $y = -\frac{6}{5}x - \frac{18}{25}$



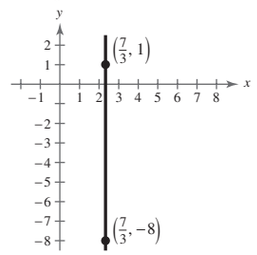
59. $y = 0.4x + 0.2$



61. $y = -1$



63. $x = \frac{7}{3}$



65. Perpendicular **67.** Parallel

69. (a) $y = 2x - 3$ (b) $y = -\frac{1}{2}x + 2$

71. (a) $y = -\frac{3}{4}x + \frac{3}{8}$ (b) $y = \frac{4}{3}x + \frac{127}{72}$

73. (a) $y = 0$ (b) $x = -1$

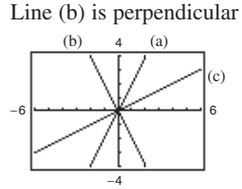
75. (a) $x = 2$ (b) $y = 5$

77. (a) $y = x + 4.3$ (b) $y = -x + 9.3$

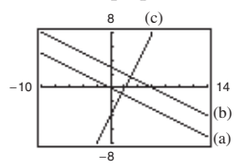
79. $3x + 2y - 6 = 0$ **81.** $12x + 3y + 2 = 0$

83. $x + y - 3 = 0$

85. Line (b) is perpendicular to line (c).



87. Line (a) is parallel to line (b).
Line (c) is perpendicular to line (a) and line (b).



89. $3x - 2y - 1 = 0$ **91.** $80x + 12y + 139 = 0$

93. (a) Sales increasing 135 units per year
(b) No change in sales
(c) Sales decreasing 40 units per year

95. (a) Salary increased greatest from 1990 to 1992; Least from 1992 to 1994
(b) Slope of line from 1990 to 2002 is about 2351.83
(c) Salary increased an average of \$2351.83 over the 12 years between 1990 and 2002

97. 12 feet **99.** $V(t) = 3165 - 125t$

101. b; The slope is -20, which represents the decrease in the amount of the loan each week. The y-intercept is $(0, 200)$ which represents the original amount of the loan.

102. c; The slope is 2, which represents the hourly wage per unit produced. The y-intercept is $(0, 8.50)$ which represents the initial hourly wage.

103. a; The slope is 0.32, which represents the increase in travel cost for each mile driven. The y-intercept is $(0, 30)$ which represents the amount per day for food.

104. d; The slope is -100, which represents the decrease in the value of the word processor each year. The y-intercept is $(0, 750)$ which represents the initial purchase price of the computer.

105. $y = 0.4825t - 2.2325$; $y(18) \approx \$6.45$; $y(20) \approx \$7.42$

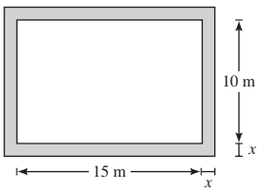
107. $V = -175t + 875$

109. (a) $y(t) = 179.5t + 40{,}571$
(b) $y(8) = 42{,}007$; $y(10) = 42{,}366$ (c) $m = 179.5$

111. $S = 0.85L$

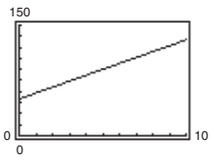
113. (a) $C = 16.75t + 36{,}500$ (b) $R = 27t$
(c) $P = 10.25t - 36{,}500$ (d) $t \approx 3561$ hours

115. (a)



(b) $y = 8x + 50$

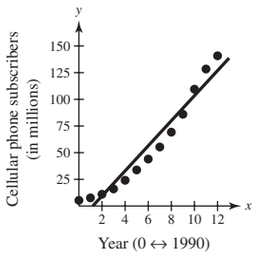
(c)



(d) $m = 8$, 8 meters

117. $C = 0.38x + 120$

119. (a) and (b)



(c) Answers will vary. Sample answer: $y = 11.72x - 14.1$

(d) Answers will vary. Sample answer: The y-intercept indicates that initially there were -14.1 million subscribers which doesn't make sense in the context of this problem. Each year, the number of cellular phone subscribers increases by 11.72 million.

(e) The model is accurate.

(f) Answers will vary. Sample answer: 196.9 million

121. False. The slope with the greatest magnitude corresponds to the steepest line.

123. Find the distance between each two points and use the Pythagorean Theorem.

125. No. The slope cannot be determined without knowing the scale on the y-axis. The slopes could be the same.

127. V-intercept: initial cost; Slope: annual depreciation

129. d **130.** c **131.** a **132.** b

133. -1 **135.** $\frac{7}{2}$, 7 **137.** No solution

139. Answers will vary.

Section 1.4 *(page 48)*

Vocabulary Check *(page 48)*

1. domain; range; function
2. verbally; numerically; graphically; algebraically
3. independent; dependent **4.** piecewise-defined
5. implied domain **6.** difference quotient

1. Yes **3.** No

5. Yes, each input value has exactly one output value.

7. No, the input values of 7 and 10 each have two different output values.

9. (a) Function
(b) Not a function, because the element 1 in A corresponds to two elements, -2 and 1, in B.
(c) Function
(d) Not a function, because not every element in A is matched with an element in B.

11. Each is a function. For each year there corresponds one and only one circulation.

13. Not a function **15.** Function **17.** Function
19. Not a function **21.** Function **23.** Not a function

25. (a) -1 (b) -9 (c) $2x - 5$

27. (a) 36π (b) $\frac{9}{2}\pi$ (c) $\frac{32}{3}\pi r^3$

29. (a) 1 (b) 2.5 (c) $3 - 2|x|$

31. (a) $-\dfrac{1}{9}$ (b) Undefined (c) $\dfrac{1}{y^2 + 6y}$

33. (a) 1 (b) -1 (c) $\dfrac{|x - 1|}{x - 1}$

35. (a) -1 (b) 2 (c) 6

37. (a) -7 (b) 4 (c) 9

39.

x	-2	-1	0	1	2
$f(x)$	1	-2	-3	-2	1

41.

t	-5	-4	-3	-2	-1
$h(t)$	1	$\frac{1}{2}$	0	$\frac{1}{2}$	1

43.

x	-2	-1	0	1	2
$f(x)$	5	$\frac{9}{2}$	4	1	0

45. 5 **47.** $\frac{4}{3}$ **49.** ± 3 **51.** $0, \pm 1$ **53.** $2, -1$

55. 3, 0 **57.** All real numbers

59. All real numbers t except $t = 0$

61. All real numbers y such that $y \geq 0$

63. All real numbers x such that $-1 \leq x \leq 1$

65. All real numbers x except $x = 0, -2$

67. All real numbers s such that $s \geq 1$ except $s = 4$

69. All real numbers x such that $x > 0$

71. $\{(-2, 4), (-1, 1), (0, 0), (1, 1), (2, 4)\}$

73. $\{(-2, 4), (-1, 3), (0, 2), (1, 3), (2, 4)\}$

75. $g(x) = cx^2; c = -2$ **76.** $f(x) = cx; c = \frac{1}{4}$

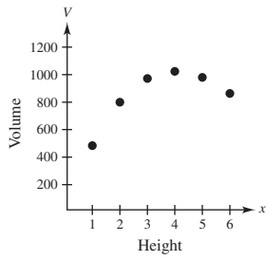
77. $r(x) = \dfrac{c}{x}; c = 32$ **78.** $h(x) = c\sqrt{|x|}; c = 3$

79. $3 + h, h \neq 0$ **81.** $3x^2 + 3xh + h^2 + 3, h \neq 0$

83. $-\dfrac{x+3}{9x^2}, x \neq 3$ **85.** $\dfrac{\sqrt{5x} - 5}{x - 5}$ **87.** $A = \dfrac{P^2}{16}$

89. (a) The maximum volume is 1024 cubic centimeters.

(b)



Yes, V is a function of x.

(c) $V = x(24 - 2x)^2, 0 < x < 12$

91. $A = \dfrac{x^2}{2(x-2)}, x > 2$

93. Yes, the ball will be at a height of 6 feet.

95. 1990: \$27,300
1991: \$28,052
1992: \$29,168
1993: \$30,648
1994: \$32,492
1995: \$34,700
1996: \$37,272
1997: \$40,208
1998: \$41,300
1999: \$43,800
2000: \$46,300
2001: \$48,800
2002: \$51,300

97. (a) $C = 12.30x + 98{,}000$
(b) $R = 17.98x$
(c) $P = 5.68x - 98{,}000$

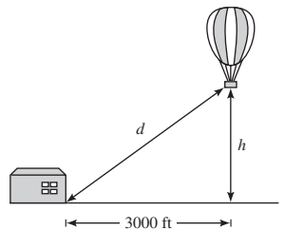
99. (a) $R = \dfrac{240n - n^2}{20}, n \geq 80$

(b)

n	90	100	110	120	130	140	150
$R(n)$	\$675	\$700	\$715	\$720	\$715	\$700	\$675

The revenue is maximum when 120 people take the trip.

101. (a)



(b) $h = \sqrt{d^2 - 3000^2}, d \geq 3000$

103. False. The range is $[-1, \infty)$.

105. The domain is the set of inputs of the function, and the range is the set of outputs.

107. (a) Yes. The amount you pay in sales tax will increase as the price of the item purchased increases.
(b) No. The length of time that you study will not necessarily determine how well you do on an exam.

109. $\frac{15}{8}$ **111.** $-\frac{1}{5}$ **113.** $2x - 3y - 11 = 0$

115. $10x + 9y + 15 = 0$

Section 1.5 *(page 61)*

Vocabulary Check *(page 61)*

1. ordered pairs **2.** Vertical Line Test
3. zeros **4.** decreasing
5. maximum **6.** average rate of change; secant
7. odd **8.** even

1. Domain: $(-\infty, -1], [1, \infty)$
Range: $[0, \infty)$

3. Domain: $[-4, 4]$
Range: $[0, 4]$

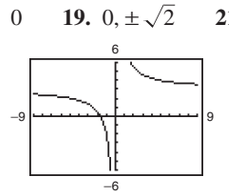
5. (a) 0 (b) -1 (c) 0 (d) -2

7. (a) -3 (b) 0 (c) 1 (d) -3 **9.** Function

11. Not a function **13.** Function **15.** $-\frac{5}{2}, 6$

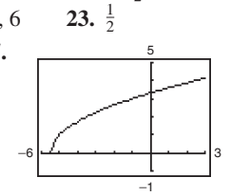
17. 0 **19.** $0, \pm\sqrt{2}$ **21.** $\pm\frac{1}{2}, 6$ **23.** $\frac{1}{2}$

25.



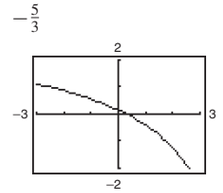
$-\frac{5}{3}$

27.



$-\frac{11}{2}$

29.



$\frac{1}{3}$

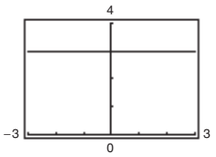
31. Increasing on $(-\infty, \infty)$

33. Increasing on $(-\infty, 0)$ and $(2, \infty)$
Decreasing on $(0, 2)$

35. Increasing on $(-\infty, 0)$ and $(2, \infty)$; Constant on $(0, 2)$

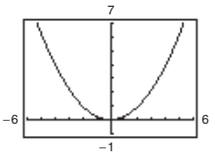
37. Increasing on $(1, \infty)$; Decreasing on $(-\infty, -1)$
Constant on $(-1, 1)$

39.



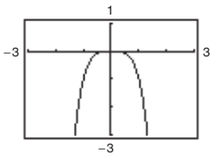
Constant on $(-\infty, \infty)$

41.



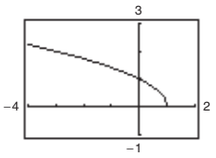
Decreasing on $(-\infty, 0)$
Increasing on $(0, \infty)$

43.



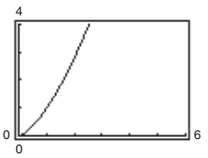
Increasing on $(-\infty, 0)$
Decreasing on $(0, \infty)$

45.



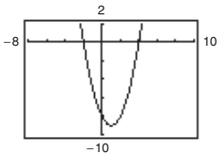
Decreasing on $(-\infty, 1)$

47.



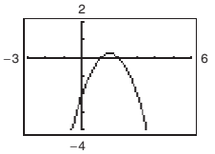
Increasing on $(0, \infty)$

49.



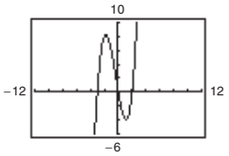
Relative minimum:
$(1, -9)$

51.



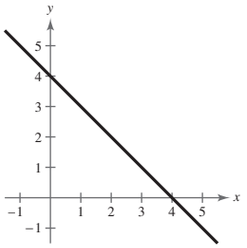
Relative maximum:
$(1.5, 0.25)$

53.



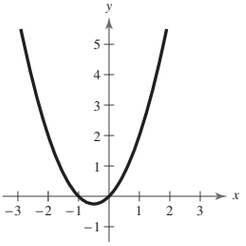
Relative maximum: $(-1.79, 8.21)$
Relative minimum: $(1.12, -4.06)$

55.



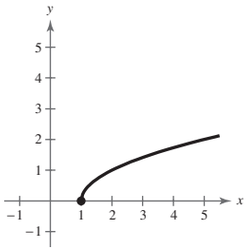
$(-\infty, 4]$

57.



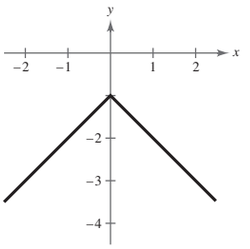
$(-\infty, -1], [0, \infty)$

59.



$[1, \infty)$

61.



$f(x) < 0$ for all x

63. The average rate of change from $x_1 = 0$ to $x_2 = 3$ is -2.

65. The average rate of change from $x_1 = 1$ to $x_2 = 5$ is 18.

67. The average rate of change from $x_1 = 1$ to $x_2 = 3$ is 0.

69. The average rate of change from $x_1 = 3$ to $x_2 = 11$ is $-\frac{1}{4}$.

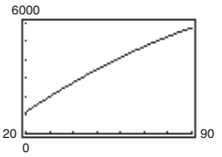
71. Even; y-axis symmetry **73.** Odd; origin symmetry

75. Neither even nor odd; no symmetry

77. $h = -x^2 + 4x - 3$ **79.** $h = 2x - x^2$

81. $L = \frac{1}{2}y^2$ **83.** $L = 4 - y^2$

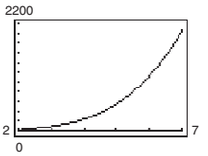
85. (a)



(b) 30 watts

87. (a) Ten thousands (b) Ten millions (c) Percents

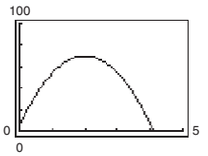
89. (a)



(b) The average rate of change from 2002 to 2007 is 408.56. The estimated revenue is increasing each year at a fast pace.

91. (a) $s = -16t^2 + 64t + 6$

(b)

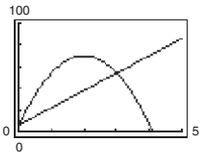


(c) Average rate of change $= 16$

(d) The slope of the secant line is positive.

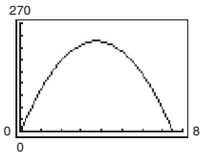
(e) Secant line: $16t + 6$

(f)



93. (a) $s = -16t^2 + 120t$

(b)

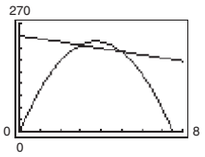


(c) Average rate of change $= -8$

(d) The slope of the secant line is negative.

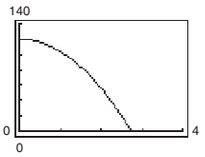
(e) Secant line: $-8t + 240$

(f)



95. (a) $s = -16t^2 + 120$

(b)

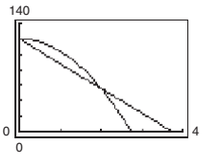


(c) Average rate of change $= -32$

(d) The slope of the secant line is negative.

(e) Secant line: $-32t + 120$

(f)



97. False. The function $f(x) = \sqrt{x^2 + 1}$ has a domain of all real numbers.

99. (a) Even. The graph is a reflection in the x-axis.

(b) Even. The graph is a reflection in the y-axis.

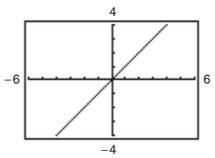
(c) Even. The graph is a vertical translation of f.

(d) Neither. The graph is a horizontal translation of f.

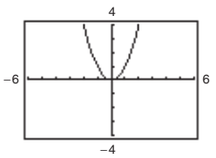
101. (a) $\left(\frac{3}{2}, 4\right)$ (b) $\left(\frac{3}{2}, -4\right)$

103. (a) $(-4, 9)$ (b) $(-4, -9)$

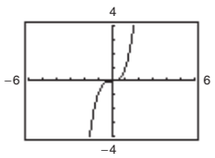
105. (a)



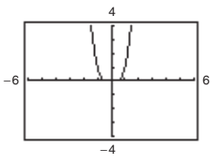
(b)



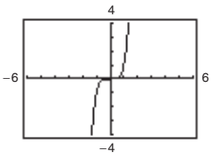
(c)



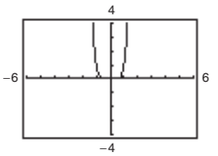
(d)



(e)



(f)



All the graphs pass through the origin. The graphs of the odd powers of x are symmetric with respect to the origin, and the graphs of the even powers are symmetric with respect to the y-axis. As the powers increase, the graphs become flatter in the interval $-1 < x < 1$.

107. 0, 10 **109.** $0, \pm 1$

111. (a) 37 (b) -28 (c) $5x - 43$

113. (a) -9 (b) $2\sqrt{7} - 9$

(c) The given value is not in the domain of the function.

115. $h + 4,\ h \neq 0$

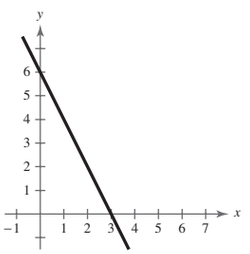
Section 1.6 *(page 71)*

Vocabulary Check *(page 71)*

1. g **2.** i **3.** h **4.** a **5.** b
6. e **7.** f **8.** c **9.** d

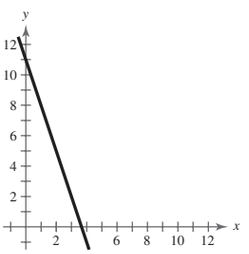
1. (a) $f(x) = -2x + 6$

(b)



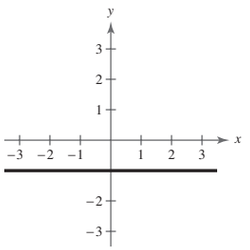
3. (a) $f(x) = -3x + 11$

(b)



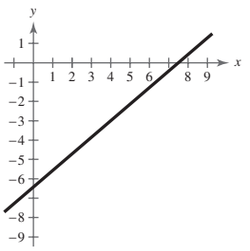
5. (a) $f(x) = -1$

(b)

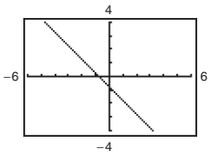


7. (a) $f(x) = \frac{6}{7}x - \frac{45}{7}$

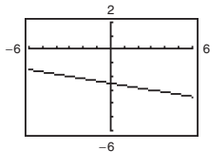
(b)



9.

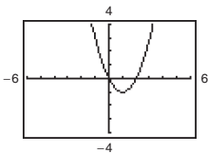


11.

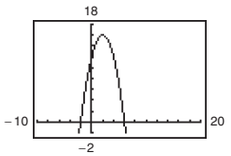


CHAPTER 1

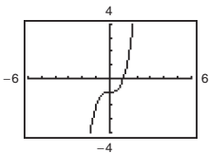
13.



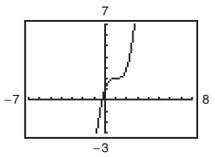
15.



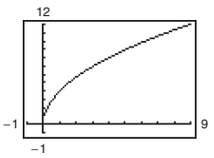
17.



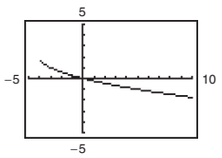
19.



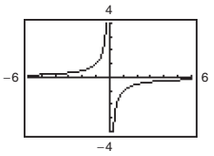
21.



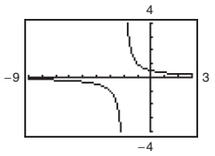
23.



25.



27.



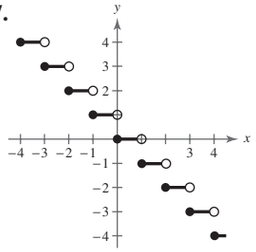
29. (a) 2 (b) 2 (c) -4 (d) 3

31. (a) 1 (b) 3 (c) 7 (d) -19

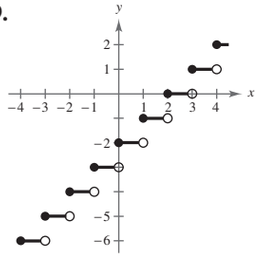
33. (a) 6 (b) -11 (c) 6 (d) -22

35. (a) -10 (b) -4 (c) -1 (d) 41

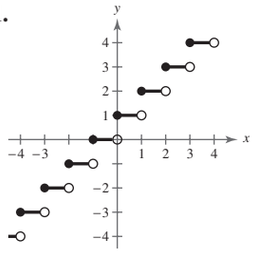
37.



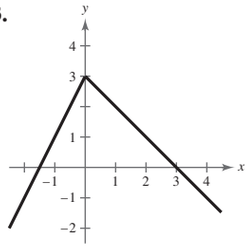
39.



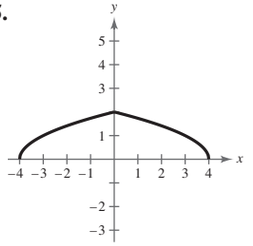
41.



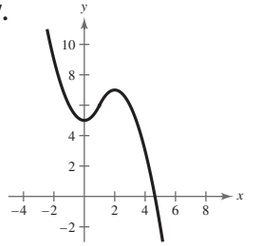
43.



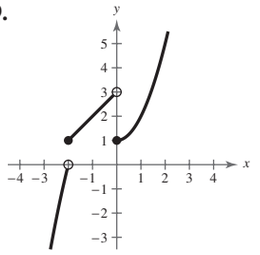
45.



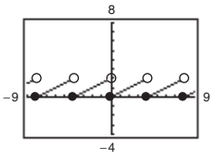
47.



49.



51. (a)



(b) Domain: $(-\infty, \infty)$;
Range: $[0, 2)$

(c) Sawtooth pattern

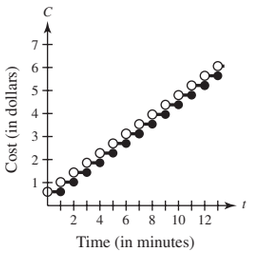
53. (a) $f(x) = |x|$ (b) $g(x) = |x + 2| - 1$

55. (a) $f(x) = x^3$ (b) $g(x) = (x - 1)^3 - 2$

57. (a) $f(x) = 2$ (b) $g(x) = 2$

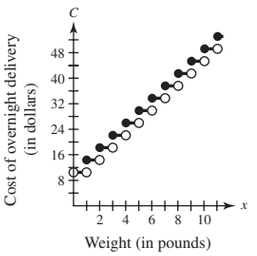
59. (a) $f(x) = x$ (b) $g(x) = x - 2$

61. (a)



(b) \$5.64

63. (a)



(b) \$50.25

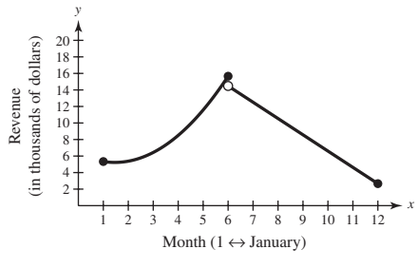
65. (a) $W(30) = 360$; $W(40) = 480$;
$W(45) = 570$; $W(50) = 660$

(b) $W(h) = \begin{cases} 12h, & 0 < h \le 45 \\ 18(h - 45) + 540, & h > 45 \end{cases}$

67. (a) $f(x) = \begin{cases} 0.505x^2 - 1.47x + 6.3, & 1 \le x \le 6 \\ -1.97x + 26.3, & 6 < x \le 12 \end{cases}$

Answers will vary. Sample answer: The domain is determined by inspection of a graph of the data with the two models.

(b)



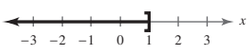
(c) $f(5) = 11.575, f(11) = 4.63$; These values represent the revenue for the months of May and November, respectively.

(d) These values are quite close to the actual data values.

69. False. A piecewise-defined function is a function that is defined by two or more equations over a specified domain. That domain may or may not include x- and y-intercepts.

71. $f(x) = \begin{cases} -\frac{4}{3}x + 6, & 0 \le x \le 3 \\ -\frac{2}{5}x + \frac{16}{5}, & 3 < x \le 8 \end{cases}$

73. $x \le 1$



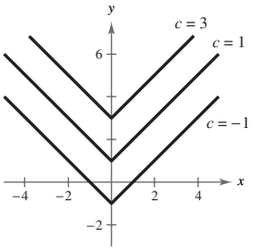
75. Neither

Section 1.7 *(page 79)*

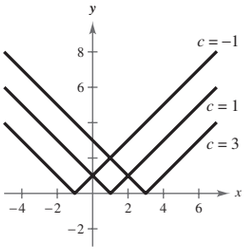
Vocabulary Check *(page 79)*

1. rigid **2.** $-f(x); f(-x)$ **3.** nonrigid
4. horizontal shrink; horizontal stretch
5. vertical stretch; vertical shrink
6. (a) iv (b) ii (c) iii (d) i

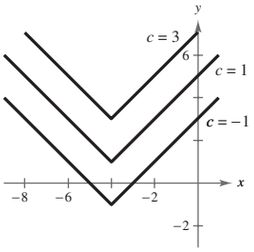
1. (a)



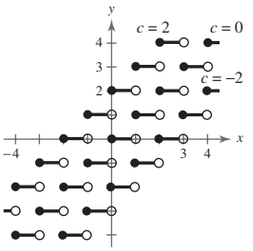
(b)



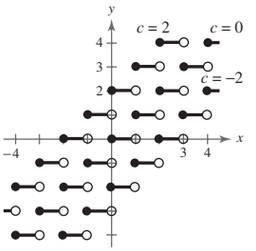
(c)



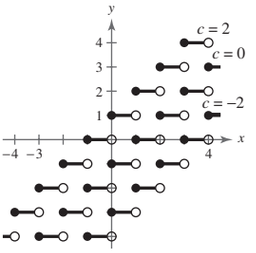
3. (a)



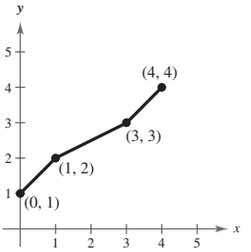
(b)



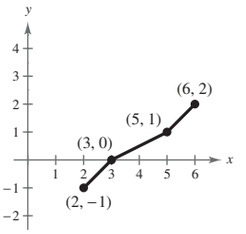
(c)



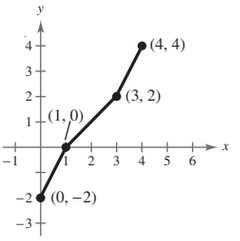
5. (a)



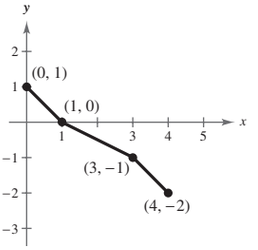
(b)



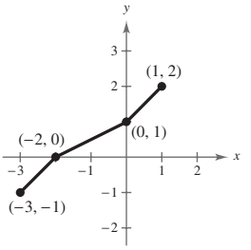
(c)



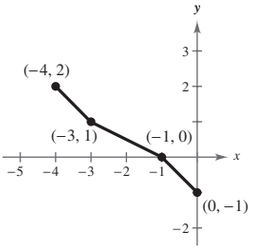
(d)



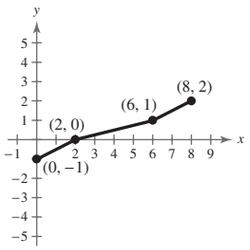
(e)



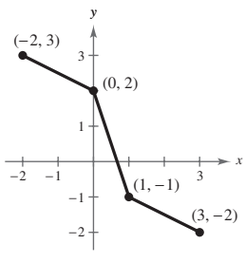
(f)



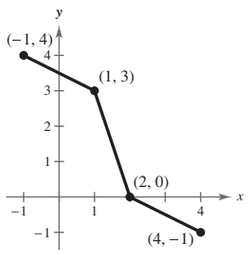
(g)



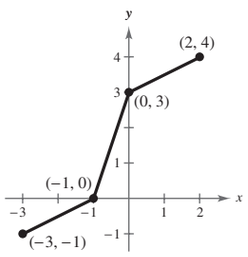
7. (a)



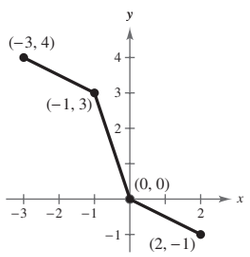
(b)



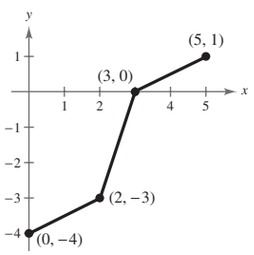
(c)



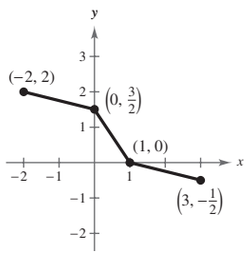
(d)



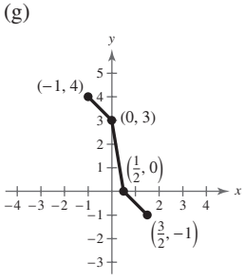
(e)



(f)



(g)



9. (a) $y = x^2 - 1$ (b) $y = 1 - (x + 1)^2$
(c) $y = -(x - 2)^2 + 6$ (d) $y = (x - 5)^2 - 3$

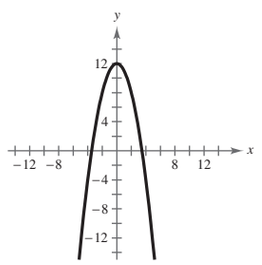
11. (a) $y = |x| + 5$ (b) $y = -|x + 3|$
(c) $y = |x - 2| - 4$ (d) $y = -|x - 6| - 1$

13. Horizontal shift of $y = x^3$; $y = (x - 2)^3$

15. Reflection in the x-axis of $y = x^2$; $y = -x^2$

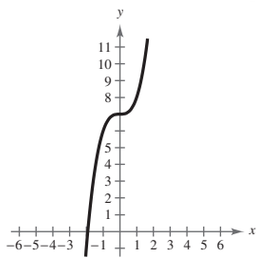
17. Reflection in the x-axis and vertical shift of $y = \sqrt{x}$; $y = 1 - \sqrt{x}$

19. (a) $f(x) = x^2$
(b) Reflection in the x-axis, and vertical shift 12 units upward, of $f(x) = x^2$
(c)



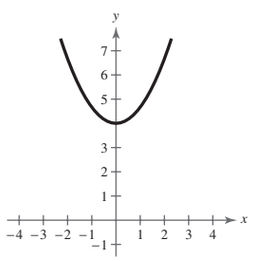
(d) $g(x) = 12 - f(x)$

21. (a) $f(x) = x^3$
(b) Vertical shift seven units upward, of $f(x) = x^3$
(c)



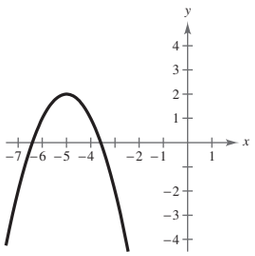
(d) $g(x) = f(x) + 7$

23. (a) $f(x) = x^2$
(b) Vertical shrink of two-thirds, and vertical shift four units upward, of $f(x) = x^2$
(c)



(d) $g(x) = \frac{2}{3}f(x) + 4$

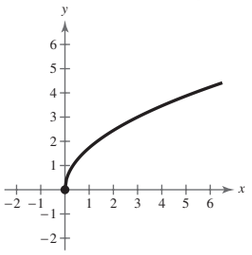
25. (a) $f(x) = x^2$
(b) Reflection in the x-axis, horizontal shift five units to the left, and vertical shift two units upward, of $f(x) = x^2$

(c) 

(d) $g(x) = 2 - f(x + 5)$

27. (a) $f(x) = \sqrt{x}$

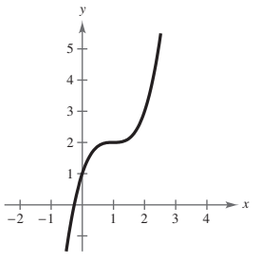
(b) Horizontal shrink of $\frac{1}{3}$, of $f(x) = \sqrt{x}$

(c) 

(d) $g(x) = f(3x)$

29. (a) $f(x) = x^3$

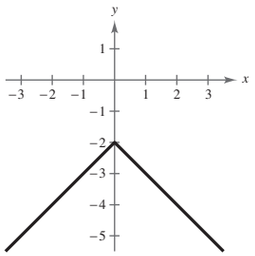
(b) Vertical shift two units upward, and horizontal shift one unit to the right, of $f(x) = x^3$

(c) 

(d) $g(x) = f(x - 1) + 2$

31. (a) $f(x) = |x|$

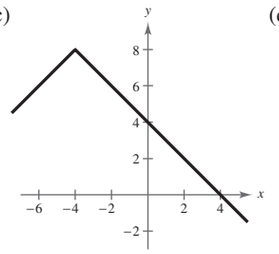
(b) Reflection in the x-axis, and vertical shift two units downward, of $f(x) = |x|$

(c) 

(d) $g(x) = -f(x) - 2$

33. (a) $f(x) = |x|$

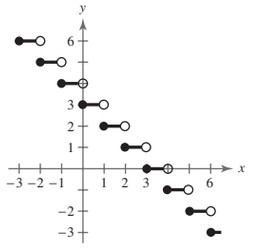
(b) Reflection in the x-axis, horizontal shift four units to the left, and vertical shift eight units upward, of $f(x) = |x|$

(c) 

(d) $g(x) = -f(x + 4) + 8$

35. (a) $f(x) = [\![x]\!]$

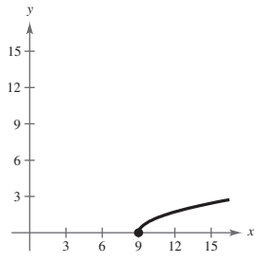
(b) Reflection in the x-axis, and vertical shift three units upward, of $f(x) = [\![x]\!]$

(c) 

(d) $g(x) = 3 - f(x)$

37. (a) $f(x) = \sqrt{x}$

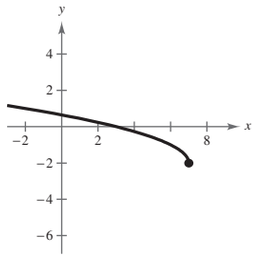
(b) Horizontal shift of nine units to the right, of $f(x) = \sqrt{x}$

(c) 

(d) $g(x) = f(x - 9)$

39. (a) $f(x) = \sqrt{x}$

(b) Reflection in the y-axis, horizontal shift of seven units to the right, and vertical shift two units downward, of $f(x) = \sqrt{x}$

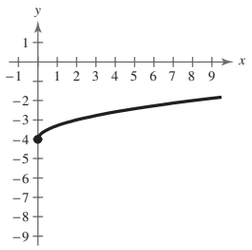
(c) 

(d) $g(x) = f(7 - x) - 2$

41. (a) $f(x) = \sqrt{x}$

(b) Horizontal stretch, and vertical shift four units downward, of $f(x) = \sqrt{x}$

(c)



(d) $g(x) = f\left(\frac{1}{2}x\right) - 4$

43. $f(x) = (x - 2)^2 - 8$ **45.** $f(x) = (x - 13)^3$

47. $f(x) = -|x| - 10$ **49.** $f(x) = -\sqrt{-x + 6}$

51. (a) $y = -3x^2$ (b) $y = 4x^2 + 3$

53. (a) $y = -\frac{1}{2}|x|$ (b) $y = 3|x| - 3$

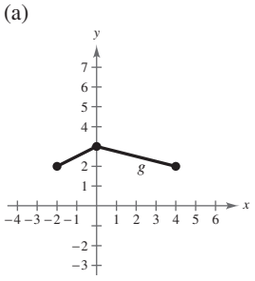
55. Vertical stretch of $y = x^3$; $y = 2x^3$

57. Reflection in the x-axis and vertical shrink of $y = x^2$; $y = -\frac{1}{2}x^2$

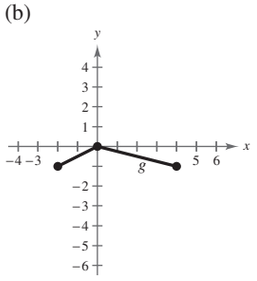
59. Reflection in the y-axis and vertical shrink of $y = \sqrt{x}$; $y = \frac{1}{2}\sqrt{-x}$

61. $y = -(x - 2)^3 + 2$ **63.** $y = -\sqrt{x} - 3$

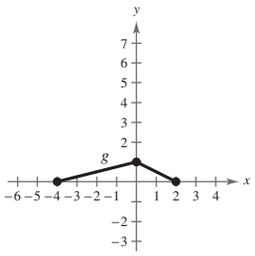
65. (a)



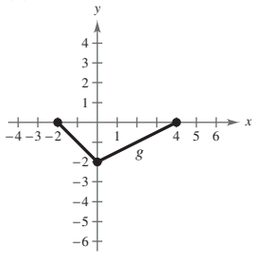
(b)



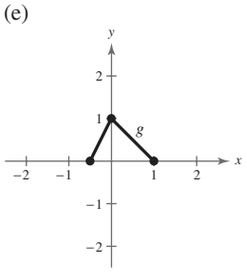
(c)



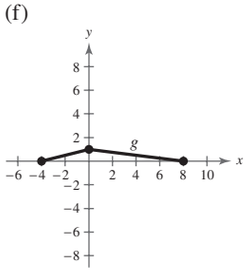
(d)



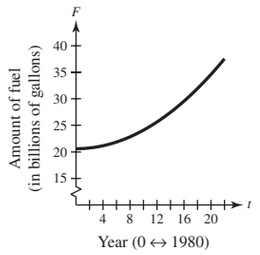
(e)



(f)



67. (a) Horizontal stretch of 0.035 and a vertical shift of 20.6 units upward.



(b) 0.77-billion-gallon increase in fuel usage by trucks each year

(c) $f(t) = 20.6 + 0.035(t + 10)^2$. The graph is shifted 10 units to the left.

(d) 52.1 billion gallons. Yes.

69. True. $|-x| = |x|$

71. (a) $g(t) = \frac{3}{4}f(t)$ (b) $g(t) = f(t) + 10{,}000$

(c) $g(t) = f(t - 2)$

73. $(-2, 0), (-1, 1), (0, 2)$ **75.** $\dfrac{4}{x(1 - x)}$

77. $\dfrac{3x - 2}{x(x - 1)}$ **79.** $\dfrac{(x - 4)\sqrt{x^2 - 4}}{x^2 - 4}$

81. $5(x - 3)$, $x \neq -3$

83. (a) 38 (b) $\frac{57}{4}$ (c) $x^2 - 12x + 38$

85. All real numbers x except $x = 1$

87. All real numbers x such that $-9 \leq x \leq 9$

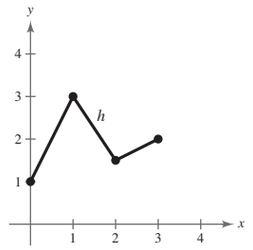
Section 1.8 *(page 89)*

Vocabulary Check *(page 89)*

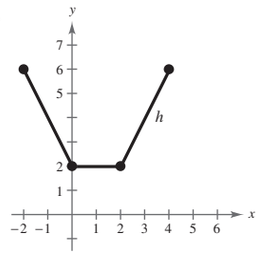
1. addition; subtraction; multiplication; division

2. composition **3.** $g(x)$ **4.** inner; outer

1.



3.



5. (a) $2x$ (b) 4 (c) $x^2 - 4$

(d) $\dfrac{x + 2}{x - 2}$; all real numbers x except $x = 2$

7. (a) $x^2 + 4x - 5$ (b) $x^2 - 4x + 5$ (c) $4x^3 - 5x^2$

(d) $\dfrac{x^2}{4x - 5}$; all real numbers x except $x = \dfrac{5}{4}$

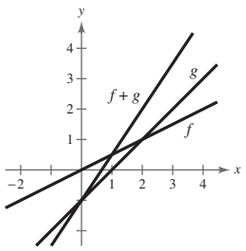
9. (a) $x^2 + 6 + \sqrt{1 - x}$ (b) $x^2 + 6 - \sqrt{1 - x}$
(c) $(x^2 + 6)\sqrt{1 - x}$
(d) $\dfrac{(x^2 + 6)\sqrt{1 - x}}{1 - x}$; all real numbers x such that $x < 1$

11. (a) $\dfrac{x + 1}{x^2}$ (b) $\dfrac{x - 1}{x^2}$ (c) $\dfrac{1}{x^3}$
(d) x; all real numbers x except $x = 0$

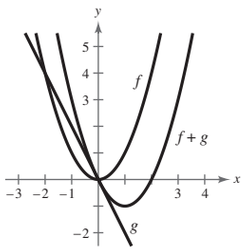
13. 3 **15.** 5 **17.** $9t^2 - 3t + 5$ **19.** 74

21. 26 **23.** $\frac{3}{5}$

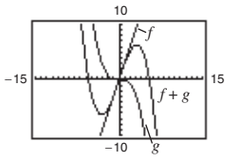
25.



27.



29.



$f(x)$, $g(x)$

31. (a) $(x - 1)^2$ (b) $x^2 - 1$ (c) x^4

33. (a) x (b) x (c) $\sqrt[3]{\sqrt[3]{x - 1} - 1}$

35. (a) $\sqrt{x^2 + 4}$ (b) $x + 4$
Domains of f and $g \circ f$: $x \geq -4$
Domains of g and $f \circ g$: all real numbers

37. (a) $x + 1$ (b) $\sqrt{x^2 + 1}$
Domains of f and $g \circ f$: all real numbers
Domains of g and $f \circ g$: all real numbers x such that $x \geq 0$

39. (a) $|x + 6|$ (b) $|x| + 6$
Domains of f, g, $f \circ g$, and $g \circ f$: all real numbers

41. (a) $\dfrac{1}{x + 3}$ (b) $\dfrac{1}{x} + 3$
Domains of f and $g \circ f$: all real numbers x except $x = 0$
Domains of g: all real numbers
Domains of $f \circ g$: all real numbers x except $x = -3$

43. (a) 3 (b) 0 **45.** (a) 0 (b) 4

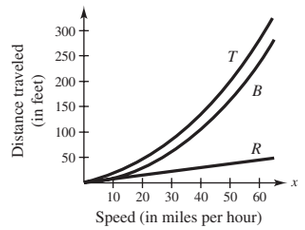
47. $f(x) = x^2$, $g(x) = 2x + 1$

49. $f(x) = \sqrt[3]{x}$, $g(x) = x^2 - 4$

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

53. $f(x) = \dfrac{x + 3}{4 + x}$, $g(x) = -x^2$

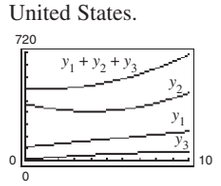
55. $T = \frac{3}{4}x + \frac{1}{15}x^2$



57. (a) $c(t) = \dfrac{p(t) + b(t) - d(t)}{p(t)} \times 100$
(b) $c(5)$ is the population change in the year 2005.

59. (a) $(A + N)(t) = 5.31t^2 - 102.0t + 1338$
$(A + N)(4) = 1014.96$
$(A + N)(8) = 861.84$
$(A + N)(12) = 878.64$
(b) $(A - N)(t) = 1.41t^2 - 17.6t + 132$
$(A - N)(4) = 84.16$
$(A - N)(8) = 81.44$
$(A - N)(12) = 123.84$

61. (a) $y_1 = 10.20t + 92.7$
$y_2 = 3.357t^2 - 26.46t + 379.5$
$y_3 = -0.465t^2 + 9.71t + 7.4$
(b) $y_1 + y_2 + y_3 = 2.892t^2 - 6.55t + 479.6$; this amount represents the amount spent on health care in the United States.
(c)



(d) In 2008, \$1298.708 billion is estimated to be spent on health services and supplies, and in 2010, \$1505.4 billion is estimated.

63. (a) $r(x) = \dfrac{x}{2}$ (b) $A(r) = \pi r^2$
(c) $(A \circ r)(x) = \pi\left(\dfrac{x}{2}\right)^2$; $(A \circ r)(x)$ represents the area of the circular base of the tank on the square foundation with side length x.

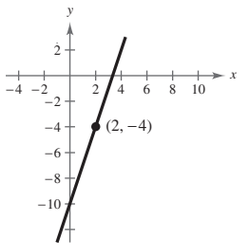
65. (a) $N(T(t)) = 30(3t^2 + 2t + 20)$ This represents the number of bacteria in the food as a function of time.
(b) $t = 2.846$ hours

67. $g(f(x))$ represents 3 percent of an amount over \$500,000.

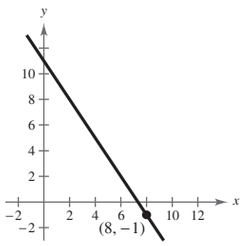
69. False. $(f \circ g)(x) = 6x + 1$ and $(g \circ f)(x) = 6x + 6$

71. Answers will vary. **73.** 3 **75.** $\dfrac{-4}{x(x + h)}$

77. $3x - y - 10 = 0$



79. $3x + 2y - 22 = 0$



Section 1.9 *(page 99)*

Vocabulary Check *(page 99)*

1. inverse; f-inverse **2.** range; domain
3. $y = x$ **4.** one-to-one **5.** horizontal

1. $f^{-1}(x) = \frac{1}{6}x$ **3.** $f^{-1}(x) = x - 9$

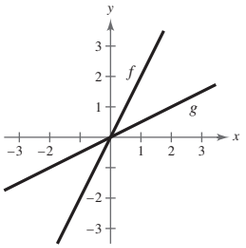
5. $f^{-1}(x) = \dfrac{x-1}{3}$ **7.** $f^{-1}(x) = x^3$

9. c **10.** b **11.** a **12.** d

13. (a) $f(g(x)) = f\left(\dfrac{x}{2}\right) = 2\left(\dfrac{x}{2}\right) = x$

$g(f(x)) = g(2x) = \dfrac{(2x)}{2} = x$

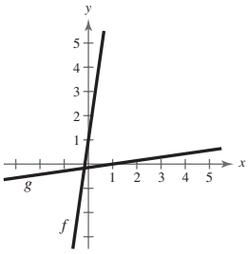
(b)



15. (a) $f(g(x)) = f\left(\dfrac{x-1}{7}\right) = 7\left(\dfrac{x-1}{7}\right) + 1 = x$

$g(f(x)) = g(7x + 1) = \dfrac{(7x+1) - 1}{7} = x$

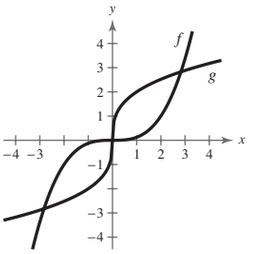
(b)



17. (a) $f(g(x)) = f\left(\sqrt[3]{8x}\right) = \dfrac{\left(\sqrt[3]{8x}\right)^3}{8} = x$

$g(f(x)) = g\left(\dfrac{x^3}{8}\right) = \sqrt[3]{8\left(\dfrac{x^3}{8}\right)} = x$

(b)



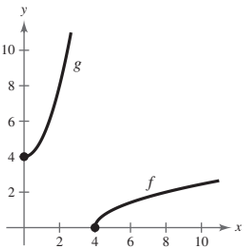
19. (a) $f(g(x)) = f(x^2 + 4),\ x \geq 0$

$= \sqrt{(x^2 + 4) - 4} = x$

$g(f(x)) = g\left(\sqrt{x - 4}\right)$

$= \left(\sqrt{x - 4}\right)^2 + 4 = x$

(b)



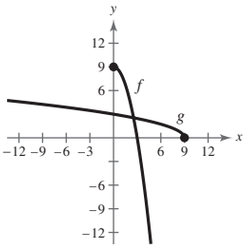
21. (a) $f(g(x)) = f\left(\sqrt{9 - x}\right),\ x \leq 9$

$= 9 - \left(\sqrt{9 - x}\right)^2 = x$

$g(f(x)) = g(9 - x^2),\ x \geq 0$

$= \sqrt{9 - (9 - x^2)} = x$

(b)



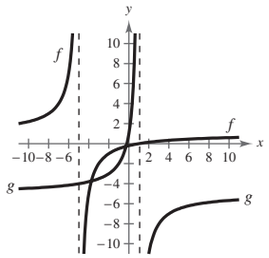
23. (a) $f(g(x)) = f\left(-\dfrac{5x+1}{x-1}\right) = \dfrac{-\left(\dfrac{5x+1}{x-1}\right) - 1}{-\left(\dfrac{5x+1}{x-1}\right) + 5}$

$= \dfrac{-5x - 1 - x + 1}{-5x - 1 + 5x - 5} = x$

$g(f(x)) = g\left(\dfrac{x-1}{x+5}\right) = \dfrac{-5\left(\dfrac{x-1}{x+5}\right) - 1}{\dfrac{x-1}{x+5} - 1}$

$= \dfrac{-5x + 5 - x - 5}{x - 1 - x - 5} = x$

(b)



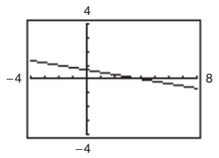
25. No

27.

x	-2	0	2	4	6	8
$f^{-1}(x)$	-2	-1	0	1	2	3

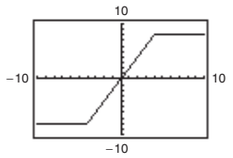
29. Yes **31.** No

33.



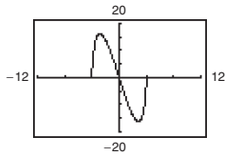
The function has an inverse.

35.



The function does not have an inverse.

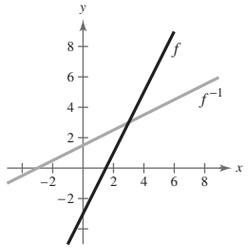
37.



The function does not have an inverse.

39. (a) $f^{-1}(x) = \dfrac{x+3}{2}$

(b)

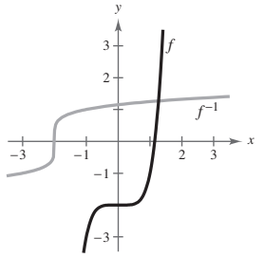


(c) The graph of f^{-1} is the reflection of the graph of f in the line $y = x$.

(d) The domains and ranges of f and f^{-1} are all real numbers.

41. (a) $f^{-1}(x) = \sqrt[5]{x+2}$

(b)

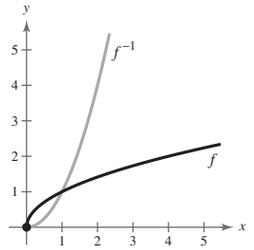


(c) The graph of f^{-1} is the reflection of the graph of f in the line $y = x$.

(d) The domains and ranges of f and f^{-1} are all real numbers.

43. (a) $f^{-1}(x) = x^2,\ x \geq 0$

(b)

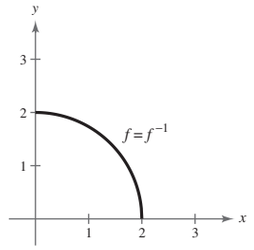


(c) The graph of f^{-1} is the reflection of the graph of f in the line $y = x$.

(d) The domains and ranges of f and f^{-1} are all real numbers x such that $x \geq 0$.

45. (a) $f^{-1}(x) = \sqrt{4 - x^2},\ 0 \leq x \leq 2$

(b)

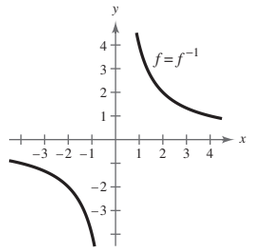


(c) The graph of f^{-1} is the same as the graph of f.

(d) The domains and ranges of f and f^{-1} are all real numbers x such that $0 \leq x \leq 2$.

47. (a) $f^{-1}(x) = \dfrac{4}{x}$

(b)

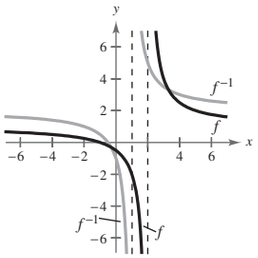


(c) The graph of f^{-1} is the same as the graph of f.

(d) The domains and ranges of f and f^{-1} are all real numbers x except $x = 0$.

49. (a) $f^{-1}(x) = \dfrac{2x+1}{x-1}$

(b)

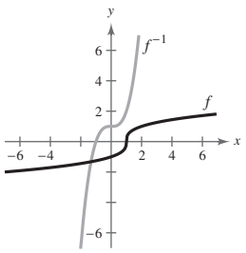


(c) The graph of f^{-1} is the reflection of the graph of f in the line $y = x$.

(d) The domain of f and the range of f^{-1} are all real numbers x except $x = 2$. The domain of f^{-1} and the range of f are all real numbers x except $x = 1$.

51. (a) $f^{-1}(x) = x^3 + 1$

(b)

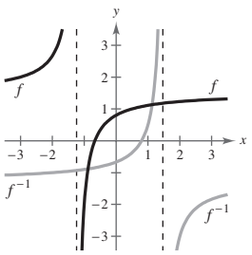


(c) The graph of f^{-1} is the reflection of the graph of f in the line $y = x$.

(d) The domains and ranges of f and f^{-1} are all real numbers.

53. (a) $f^{-1}(x) = \dfrac{5x - 4}{6 - 4x}$

(b)



(c) The graph of f^{-1} is the reflection of the graph of f in the line $y = x$.

(d) The domain of f and the range of f^{-1} are all real numbers x except $x = -\frac{5}{4}$. The domain of f^{-1} and the range of f are all real numbers x except $x = \frac{3}{2}$.

55. No inverse **57.** $g^{-1}(x) = 8x$ **59.** No inverse

61. $f^{-1}(x) = \sqrt{x} - 3$ **63.** No inverse

65. No inverse **67.** $f^{-1}(x) = \dfrac{x^2 - 3}{2}, \quad x \geq 0$

69. 32 **71.** 600 **73.** $2\sqrt[3]{x + 3}$

75. $\dfrac{x + 1}{2}$ **77.** $\dfrac{x + 1}{2}$

79. (a) $f^{-1}(108{,}209) = 11$

(b) f^{-1} represents the year for a given number of households in the United States.

(c) $y = 1578.68t + 90{,}183.63$

(d) $f^{-1} = \dfrac{t - 90{,}183.63}{1578.68}$ (e) $f^{-1}(117{,}022) = 17$

(f) $f^{-1}(108{,}209) = 11.418$; the results are similar.

81. (a) Yes

(b) f^{-1} yields the year for a given number of miles traveled by motor vehicles.

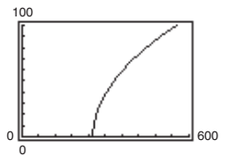
(c) $f^{-1}(2632) = 8$

(d) No. $f(t)$ would not pass the Horizontal Line Test.

83. (a) $y = \sqrt{\dfrac{x - 245.50}{0.03}}, \; 245.5 < x < 545.5$

x = degrees Fahrenheit; y = % load

(b)



(c) $0 < x < 92.11$

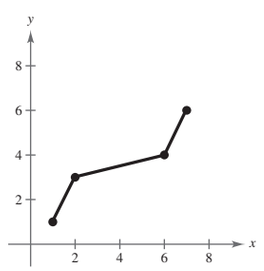
85. False. $f(x) = x^2$ has no inverse.

87. Answers will vary.

89.

x	1	3	4	6
y	1	2	6	7

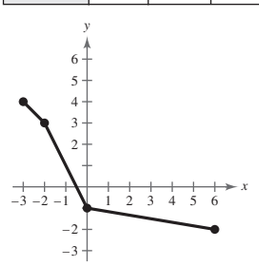
x	1	2	6	7
$f^{-1}(x)$	1	3	4	6



91.

x	-2	-1	3	4
y	6	0	-2	-3

x	-3	-2	0	6
$f^{-1}(x)$	4	3	-1	-2



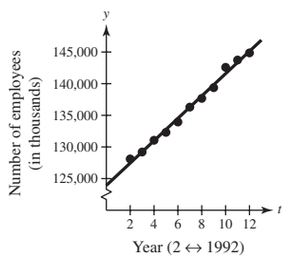
93. $k = \frac{1}{4}$ **95.** ± 8 **97.** $\frac{3}{2}$ **99.** $3 \pm \sqrt{5}$
101. $5, -\frac{10}{3}$ **103.** 16, 18

Section 1.10 *(page 109)*

Vocabulary Check *(page 109)*

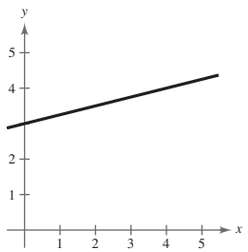
1. variation; regression **2.** sum of square differences
3. correlation coefficient **4.** directly proportional
5. constant of variation **6.** directly proportional
7. inverse **8.** combined **9.** jointly proportional

1.



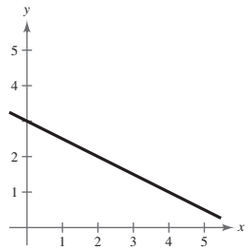
The model is a good fit for the actual data.

3.



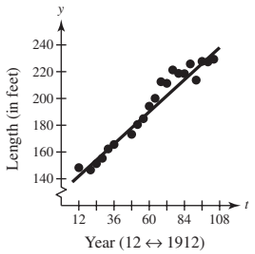
$y = \frac{1}{4}x + 3$

5.



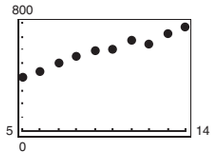
$y = -\frac{1}{2}x + 3$

7. (a) and (b)



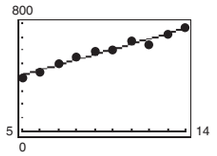
(c) $y = 1.03t + 130.27$ (d) The models are similar.
(e) Part (b): 238 feet; Part (c): 241.51 feet
(f) Answers will vary.

9. (a)



(b) $S = 38.4t + 224$

(c)

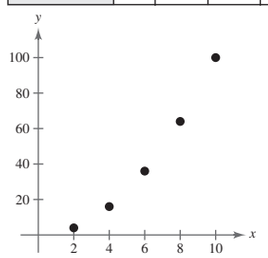


The model is a good fit.
(d) 2005: \$800 million; 2007: \$876.8 million
(e) Each year the annual gross ticket sales for Broadway shows in New York City increase by \$38.4 million.

11. Inversely

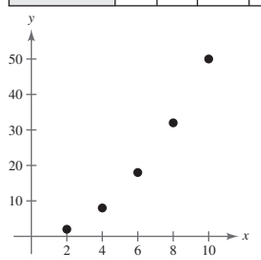
13.

x	2	4	6	8	10
$y = kx^2$	4	16	36	64	100



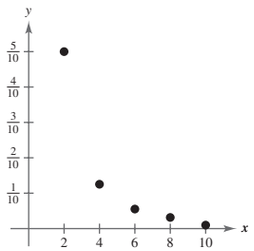
15.

x	2	4	6	8	10
$y = kx^2$	2	8	18	32	50



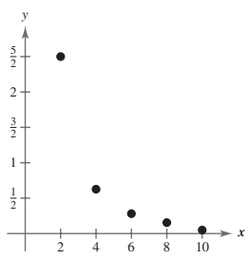
17.

x	2	4	6	8	10
$y = k/x^2$	$\frac{1}{2}$	$\frac{1}{8}$	$\frac{1}{18}$	$\frac{1}{32}$	$\frac{1}{50}$



19.

x	2	4	6	8	10
$y = k/x^2$	$\frac{5}{2}$	$\frac{5}{8}$	$\frac{5}{18}$	$\frac{5}{32}$	$\frac{1}{10}$



21. $y = \dfrac{5}{x}$ **23.** $y = -\dfrac{7}{10}x$ **25.** $y = \dfrac{12}{5}x$

27. $y = 205x$ **29.** $I = 0.035P$

31. Model: $y = \frac{33}{13}x$; 25.4 centimeters, 50.8 centimeters

33. $y = 0.0368x$; \$7360

35. (a) 0.05 meter (b) $176\frac{2}{3}$ newtons

37. 39.47 pounds **39.** $A = kr^2$ **41.** $y = \dfrac{k}{x^2}$

43. $F = \dfrac{kg}{r^2}$ **45.** $P = \dfrac{k}{V}$ **47.** $F = \dfrac{km_1m_2}{r^2}$

49. The area of a triangle is jointly proportional to its base and height.

51. The volume of a sphere varies directly as the cube of its radius.

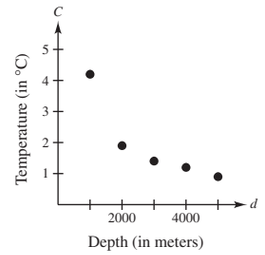
53. Average speed is directly proportional to the distance and inversely proportional to the time.

55. $A = \pi r^2$ **57.** $y = \dfrac{28}{x}$ **59.** $F = 14rs^3$

61. $z = \dfrac{2x^2}{3y}$ **63.** ≈ 0.61 mile per hour **65.** 506 feet

67. 1470 joules **69.** The velocity is increased by one-third.

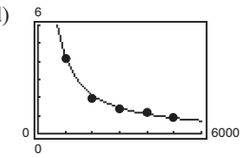
71. (a)



(b) Yes. $k_1 = 4200$, $k_2 = 3800$, $k_3 = 4200$, $k_4 = 4800$, $k_5 = 4500$

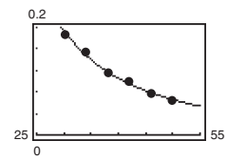
(c) $C = \dfrac{4300}{d}$

(d)



(e) ≈ 1433 meters

73. (a)



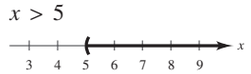
(b) 0.2857 microwatt per square centimeter

75. False. y will increase if k is positive and y will decrease if k is negative.

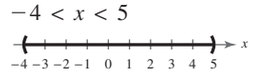
77. True. The closer the value of $|r|$ is to 1, the better the fit.

79. The accuracy is questionable when based on such limited data.

81. $x > 5$



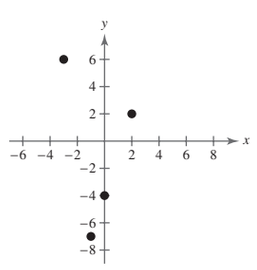
83. $-4 < x < 5$



85. (a) $-\frac{5}{3}$ (b) $-\frac{7}{3}$ (c) 21 **87.** Answers will vary.

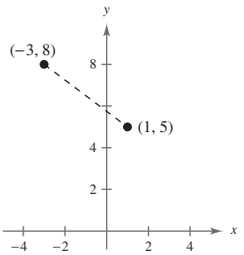
Review Exercises *(page 117)*

1.



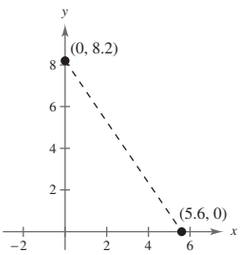
3. Quadrant IV

5. (a)



(b) 5
(c) $\left(-1, \frac{13}{2}\right)$

7. (a)



(b) 9.9
(c) (2.8, 4.1)

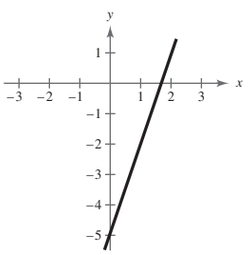
9. (2, 5), (4, 5), (2, 0), (4, 0)

11. \$656.45 million

13. Radius ≈ 22.5 centimeters

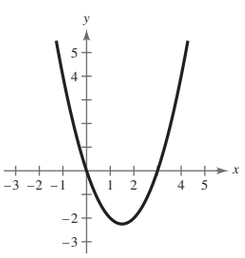
15.

x	-2	-1	0	1	2
y	-11	-8	-5	-2	1

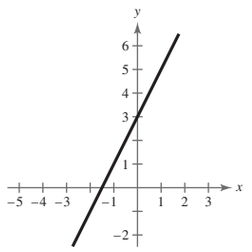


17.

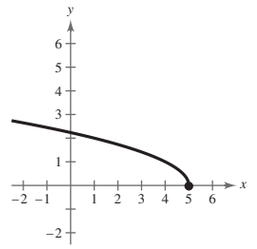
x	-1	0	1	2	3	4
y	4	0	-2	-2	0	4



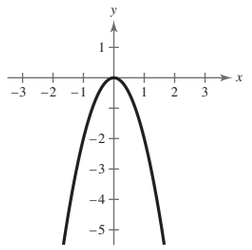
19.



21.



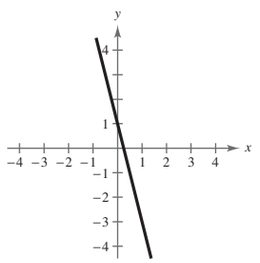
23.



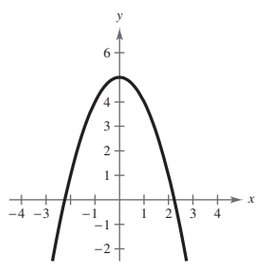
25. x-intercept: $\left(-\frac{7}{2}, 0\right)$
y-intercept: (0, 7)

27. x-intercepts: (1, 0), (5, 0)
y-intercept: (0, 5)

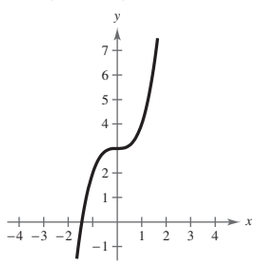
29. No symmetry



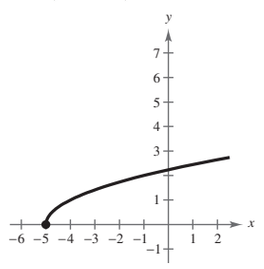
31. y-axis symmetry



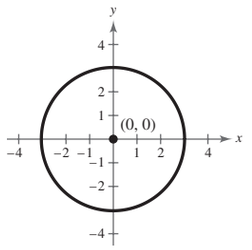
33. No symmetry



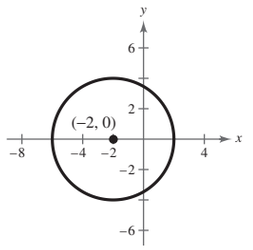
35. No symmetry



37. Center: (0, 0);
Radius: 3

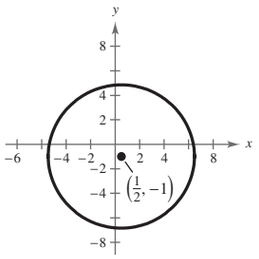


39. Center: $(-2, 0)$;
Radius: 4



CHAPTER 1

41. Center: $\left(\frac{1}{2}, -1\right)$; Radius: 6

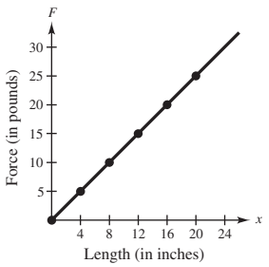


43. $(x - 2)^2 + (y + 3)^2 = 13$

45. (a)

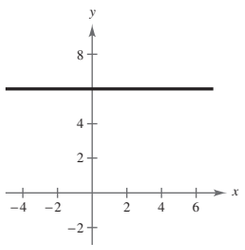
x	0	4	8	12	16	20
F	0	5	10	15	20	25

(b)

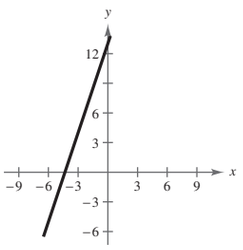


(c) 12.5 pounds

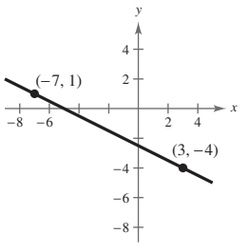
47. slope: 0
y-intercept: 6



49. slope: 3
y-intercept: 13

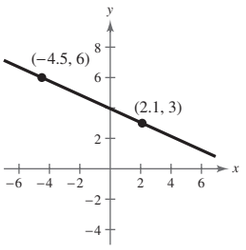


51.



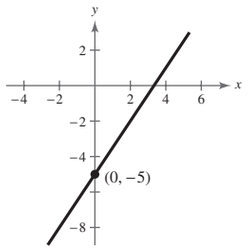
$m = -\frac{1}{2}$

53.

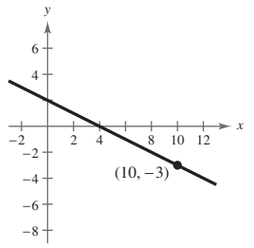


$m = -\frac{5}{11}$

55. $y = \frac{3}{2}x - 5$



57. $y = -\frac{1}{2}x + 2$



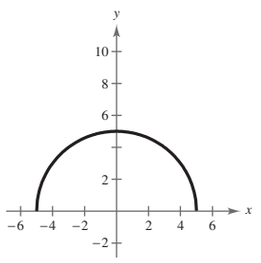
59. $x = 0$ **61.** $y = -\frac{4}{3}x + \frac{8}{3}$

63. (a) $y = \frac{5}{4}x - \frac{23}{4}$ (b) $y = -\frac{4}{5}x + \frac{2}{5}$

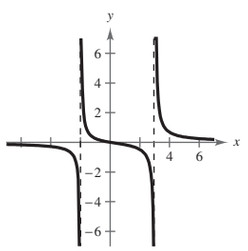
65. $V = 850t + 7400,\ 6 \le t \le 11$ **67.** No **69.** Yes

71. (a) 5 (b) 17 (c) $t^4 + 1$ (d) $t^2 + 2t + 2$

73. All real numbers x such that $-5 \le x \le 5$



75. All real numbers x except $x = 3, -2$



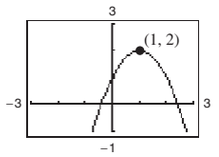
77. (a) 16 feet per second (b) 1.5 seconds
(c) -16 feet per second

79. $4x + 2h + 3,\quad h \neq 0$ **81.** Function

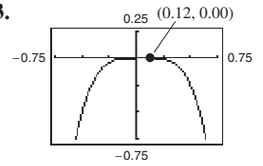
83. Not a function **85.** $\frac{7}{3}$, 3 **87.** $-\frac{3}{8}$

89. Increasing on $(0, \infty)$
Decreasing on $(-\infty, -1)$
Constant on $(-1, 0)$

91.



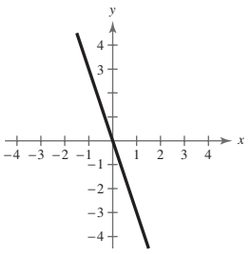
93.



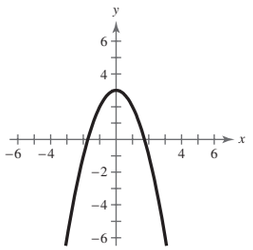
95. 4 **97.** $\dfrac{1-\sqrt{2}}{2}$ **99.** Neither even nor odd

101. Odd

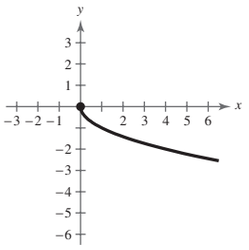
103. $f(x) = -3x$



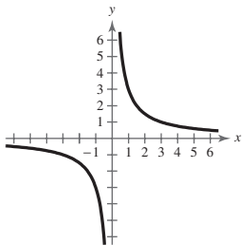
105.



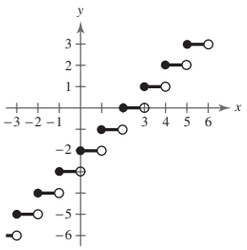
107.



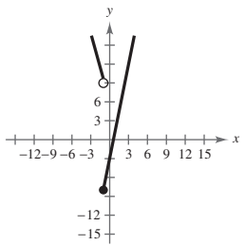
109.



111.



113.

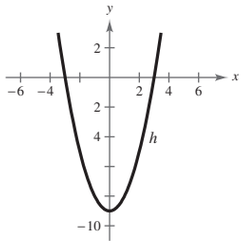


115. $y = x^3$

117. (a) $f(x) = x^2$

(b) Vertical shift of nine units downward

(c)

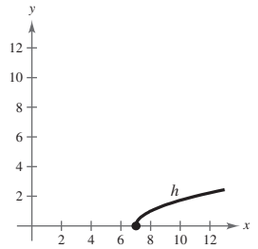


(d) $h(x) = f(x) - 9$

119. (a) $f(x) = \sqrt{x}$

(b) Horizontal shift of seven units to the right

(c)

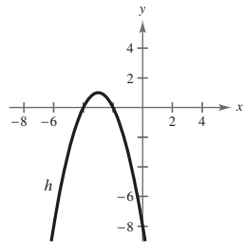


(d) $h(x) = f(x - 7)$

121. (a) $f(x) = x^2$

(b) Reflection in the x-axis, horizontal shift of three units to the left, and vertical shift of one unit upward

(c)

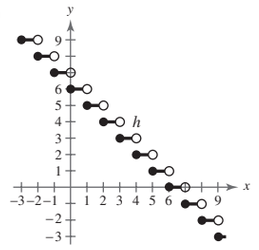


(d) $h(x) = -f(x + 3) + 1$

123. (a) $f(x) = [\![x]\!]$

(b) Reflection in the x-axis and vertical shift of six units upward

(c)

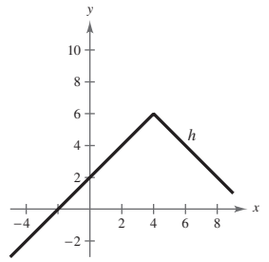


(d) $h(x) = -f(x) + 6$

125. (a) $f(x) = |x|$

(b) Reflections in the x-axis and the y-axis, horizontal shift of four units to the right, and vertical shift of six units upward

(c)

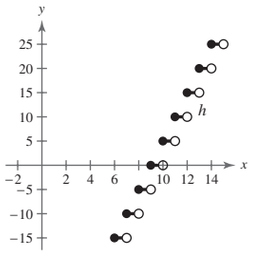


(d) $h(x) = -f(-x + 4) + 6$

127. (a) $f(x) = [\![x]\!]$

(b) Horizontal shift of nine units to the right and vertical stretch

(c)

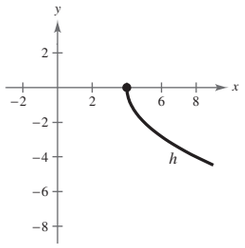


(d) $h(x) = 5f(x - 9)$

129. (a) $f(x) = \sqrt{x}$

(b) Reflection in the x-axis, vertical stretch, and horizontal shift of four units to the right

(c)



(d) $h(x) = -2f(x - 4)$

131. (a) $x^2 + 2x + 2$ (b) $x^2 - 2x + 4$

(c) $2x^3 - x^2 + 6x - 3$

(d) $\dfrac{x^2 + 3}{2x - 1}$; all real numbers x except $x = \dfrac{1}{2}$

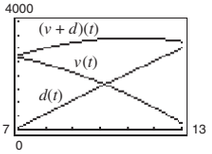
133. (a) $x - \frac{8}{3}$ (b) $x - 8$

Domains of f, g, $f \circ g$, and $g \circ f$: all real numbers

135. $f(x) = x^3$, $g(x) = 6x - 5$

137. (a) $(v + d)(t) = -36.04t^2 + 804.6t - 1112$

(b)

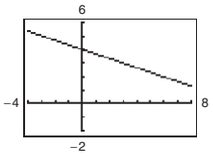


(c) $(v + d)(10) = 3330$

139. $f^{-1}(x) = x + 7$

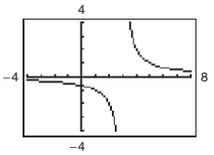
141. The function has an inverse.

143.



The function has an inverse.

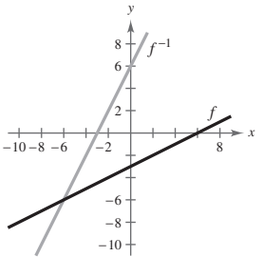
145.



The function has an inverse.

147. (a) $f^{-1}(x) = 2x + 6$

(b)

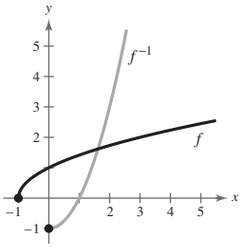


(c) The graph of f^{-1} is the reflection of the graph of f in the line $y = x$.

(d) Both f and f^{-1} have domains and ranges that are all real numbers.

149. (a) $f^{-1}(x) = x^2 - 1,\ x \geq 0$

(b)

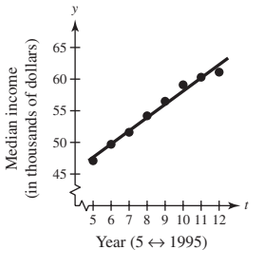


(c) The graph of f^{-1} is the reflection of the graph of f in the line $y = x$.

(d) f has a domain of $[-1, \infty)$ and a range of $[0, \infty)$; f^{-1} has a domain of $[0, \infty)$ and a range of $[-1, \infty)$.

151. $x \geq 4$; $f^{-1}(x) = \sqrt{\dfrac{x}{2}} + 4$

153. (a)



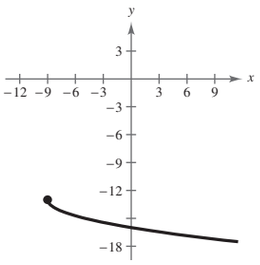
(b) The model is a good fit for the actual data.

155. Model: $m = \frac{8}{5}k$; 3.2 kilometers, 16 kilometers

157. A factor of 4

159. $\approx$ 2 hours, 26 minutes

161. False. The graph is reflected in the x-axis, shifted nine units to the left, and then shifted 13 units downward.

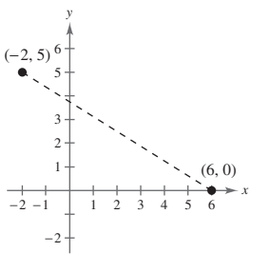


163. True. If y is directly proportional to x, then $y = kx$, so $x = (1/k)y$. Therefore, x is directly proportional to y.

165. A function from a set A to a set B is a relation that assigns to each element x in the set A exactly one element y in the set B.

Chapter Test *(page 123)*

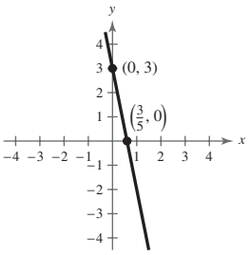
1.



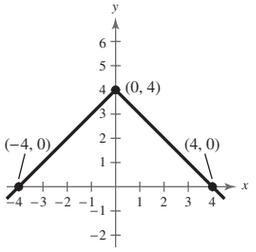
Midpoint: $\left(2, \frac{5}{2}\right)$; Distance: $\sqrt{89}$

2. ≈ 11.937 centimeters

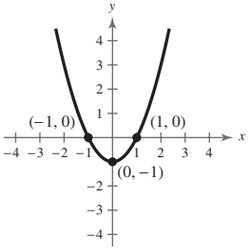
3. No symmetry



4. y-axis symmetry



5. y-axis symmetry



6. $(x - 1)^2 + (y - 3)^2 = 16$ **7.** $2x + y - 1 = 0$

8. $17x + 10y - 59 = 0$

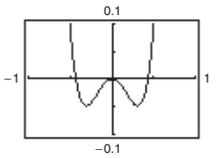
9. (a) $4x - 7y + 44 = 0$ (b) $7x + 4y - 53 = 0$

10. (a) $-\frac{1}{8}$ (b) $-\frac{1}{28}$ (c) $\frac{\sqrt{x}}{x^2 - 18x}$

11. $-10 \le x \le 10$

12. (a) $0, \pm 0.4314$

(b)

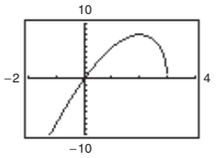


(c) Increasing on $(-0.31, 0), (0.31, \infty)$
Decreasing on $(-\infty, -0.31), (0, 0.31)$

(d) Even

13. (a) 0, 3

(b)

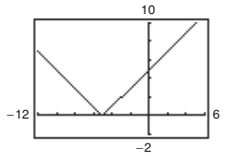


(c) Increasing on $(-\infty, 2)$
Decreasing on $(2, 3)$

(d) Neither even nor odd

14. (a) -5

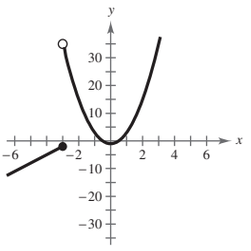
(b)



(c) Increasing on $(-5, \infty)$
Decreasing on $(-\infty, -5)$

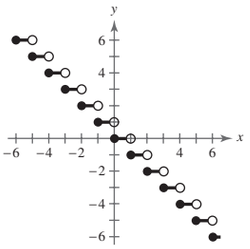
(d) Neither even nor odd

15.

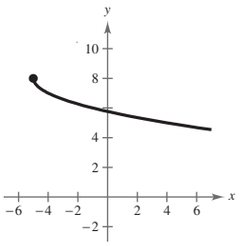


CHAPTER 1

16. Reflection in the x-axis of $y = [\![x]\!]$



17. Reflection in the x-axis, horizontal shift, and vertical shift of $y = \sqrt{x}$



18. (a) $2x^2 - 4x - 2$ (b) $4x^2 + 4x - 12$
(c) $-3x^4 - 12x^3 + 22x^2 + 28x - 35$
(d) $\dfrac{3x^2 - 7}{-x^2 - 4x + 5}, \quad x \neq -5, 1$
(e) $3x^4 + 24x^3 + 18x^2 - 120x + 68$
(f) $-9x^4 + 30x^2 - 16$

19. (a) $\dfrac{1 + 2x^{3/2}}{x}, \quad x > 0$ (b) $\dfrac{1 - 2x^{3/2}}{x}, \quad x > 0$
(c) $\dfrac{2\sqrt{x}}{x}, \quad x > 0$ (d) $\dfrac{1}{2x^{3/2}}, \quad x > 0$
(e) $\dfrac{\sqrt{x}}{2x}, \quad x > 0$ (f) $\dfrac{2\sqrt{x}}{x}, \quad x > 0$

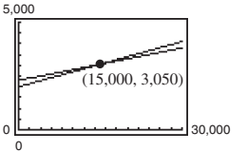
20. $f^{-1}(x) = \sqrt[3]{x - 8}$ **21.** No inverse

22. $f^{-1}(x) = \left(\frac{1}{3}x\right)^{2/3}, \ x \geq 0$ **23.** $v = 6\sqrt{s}$

24. $A = \dfrac{25}{6}xy$ **25.** $b = \dfrac{48}{a}$

Problem Solving *(page 125)*

1. (a) $W_1 = 2000 + 0.07S$ (b) $W_2 = 2300 + 0.05S$
(c)



Both jobs pay the same monthly salary if sales equal \$15,000.

(d) No. Job 1 would pay \$3400 and job 2 would pay \$3300.

3. (a) The function will be even.
(b) The function will be odd.
(c) The function will be neither even nor odd.

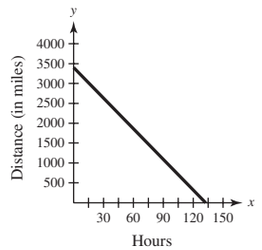
5. $f(x) = a_{2n}x^{2n} + a_{2n-2}x^{2n-2} + \cdots + a_2x^2 + a_0$
$f(-x) = a_{2n}(-x)^{2n} + a_{2n-2}(-x)^{2n-2} + \cdots + a_2(-x)^2 + a_0$
$= f(x)$

7. (a) $81\frac{2}{3}$ hours (b) $25\frac{5}{7}$ miles per hour
(c) $y = \dfrac{-180}{7}x + 3400$

Domain: $0 \leq x \leq \dfrac{1190}{9}$

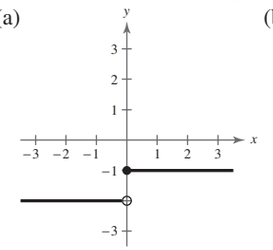
Range: $0 \leq y \leq 3400$

(d)

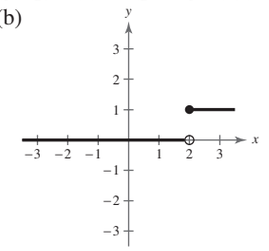


9. (a) $(f \circ g)(x) = 4x + 24$ (b) $(f \circ g)^{-1}(x) = \frac{1}{4}x - 6$
(c) $f^{-1}(x) = \frac{1}{4}x$; $g^{-1}(x) = x - 6$
(d) $(g^{-1} \circ f^{-1})(x) = \frac{1}{4}x - 6$
(e) $(f \circ g)(x) = 8x^3 + 1$; $(f \circ g)^{-1}(x) = \frac{1}{2}\sqrt[3]{x - 1}$;
$f^{-1}(x) = \sqrt[3]{x - 1}$; $g^{-1}(x) = \frac{1}{2}x$;
$(g^{-1} \circ f^{-1})(x) = \frac{1}{2}\sqrt[3]{x - 1}$
(f) Answers will vary. (g) $(f \circ g)^{-1}(x) = (g^{-1} \circ f^{-1})(x)$

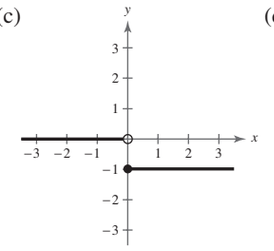
11. (a)



(b)



(c)



(d)