1 Review Exercises

1.1 In Exercises 1–6, plot the two points and find the slope of the line passing through the pair of points.

1. $(-3, 2), (8, 2)$
2. $(7, -1), (7, 12)$
3. $\left(\frac{3}{2}, 1\right), \left(5, \frac{5}{2}\right)$
4. $\left(-\frac{3}{4}, \frac{5}{6}\right), \left(\frac{1}{2}, -\frac{5}{2}\right)$
5. $(-4.5, 6), (2.1, 3)$
6. $(-2.7, -6.3), (-1, -1.2)$

In Exercises 7–16, use the point on the line and the slope of the line to find the general form of the equation of the line, and find three additional points through which the line passes. (There are many correct answers.)

	Point	*Slope*
7.	$(2, -1)$	$m = \frac{1}{4}$
8.	$(-3, 5)$	$m = -\frac{3}{2}$
9.	$(0, -5)$	$m = \frac{3}{2}$
10.	$(3, 0)$	$m = -\frac{2}{3}$
11.	$\left(\frac{1}{5}, -5\right)$	$m = -1$
12.	$\left(0, \frac{7}{8}\right)$	$m = -\frac{4}{5}$
13.	$(-2, 6)$	$m = 0$
14.	$(-8, 8)$	$m = 0$
15.	$(10, -6)$	m is undefined.
16.	$(5, 4)$	m is undefined.

In Exercises 17–20, find the slope-intercept form of the equation of the line that passes through the points. Use a graphing utility to graph the line.

17. $(2, -1), (4, -1)$
18. $(0, 0), (0, 10)$
19. $(-1, 0), (6, 2)$
20. $(1, 6), (4, 2)$

Rate of Change **In Exercises 21 and 22, you are given the dollar value of a product in 2005 *and* the rate at which the value of the item is expected to change during the 5 years following. Use this information to write a linear equation that gives the dollar value V of the product in terms of the year t. (Let $t = 5$ represent 2005.)**

	2005 Value	*Rate*
21.	\$12,500	\$850 increase per year
22.	\$72.95	\$5.15 decrease per year

23. ***Sales*** During the second and third quarters of the year, an e-commerce business had sales of \$160,000 and \$185,000, respectively. The growth of sales follows a linear pattern. Estimate sales during the fourth quarter.

24. ***Depreciation*** The dollar value of a VCR in 2004 is \$85, and the product will decrease in value at an expected rate of \$10.75 per year.
    (a) Write a linear equation that gives the dollar value V of the VCR in terms of the year t. (Let $t = 4$ represent 2004.)
    (b) Use a graphing utility to graph the equation found in part (a).
    (c) Use the *value* or *trace* feature of your graphing utility to estimate the dollar value of the VCR in 2008.

In Exercises 25–28, write the slope-intercept forms of the equations of the lines through the given point (a) parallel to the given line and (b) perpendicular to the given line. Verify your result with a graphing utility (use a square setting).

	Point	*Line*
25.	$(3, -2)$	$5x - 4y = 8$
26.	$(-8, 3)$	$2x + 3y = 5$
27.	$(-6, 2)$	$x = 4$
28.	$(3, -4)$	$y = 2$

1.2 In Exercises 29 and 30, which sets of ordered pairs represent functions from A to B? Explain.

29. $A = \{10, 20, 30, 40\}$ and $B = \{0, 2, 4, 6\}$
    (a) $\{(20, 4), (40, 0), (20, 6), (30, 2)\}$
    (b) $\{(10, 4), (20, 4), (30, 4), (40, 4)\}$
    (c) $\{(40, 0), (30, 2), (20, 4), (10, 6)\}$
    (d) $\{(20, 2), (10, 0), (40, 4)\}$

30. $A = \{u, v, w\}$ and $B = \{-2, -1, 0, 1, 2\}$
    (a) $\{(v, -1), (u, 2), (w, 0), (u, -2)\}$
    (b) $\{(u, -2), (v, 2), (w, 1)\}$
    (c) $\{(u, 2), (v, 2), (w, 1), (w, 1)\}$
    (d) $\{(w, -2), (v, 0), (w, 2)\}$

In Exercises 31–34, determine whether the equation represents y as a function of x.

31. $16x - y^4 = 0$
32. $2x - y - 3 = 0$
33. $y = \sqrt{1 - x}$
34. $|y| = x + 2$

In Exercises 35–38, evaluate the function at each value of the independent variable and simplify.

35. $f(x) = x^2 + 1$
 (a) $f(2)$ (b) $f(-4)$
 (c) $f(t^2)$ (d) $-f(x)$

36. $g(x) = x^{4/3}$
 (a) $g(8)$ (b) $g(t + 1)$
 (c) $g(-27)$ (d) $g(-x)$

37. $h(x) = \begin{cases} 2x + 1, & x \le -1 \\ x^2 + 2, & x > -1 \end{cases}$
 (a) $h(-2)$ (b) $h(-1)$
 (c) $h(0)$ (d) $h(2)$

38. $f(x) = \dfrac{3}{2x - 5}$
 (a) $f(1)$ (b) $f(-2)$
 (c) $f(t)$ (d) $f(10)$

In Exercises 39–44, find the domain of the function.

39. $f(x) = (x - 1)(x + 2)$
40. $f(x) = x^2 - 4x - 32$
41. $f(x) = \sqrt{25 - x^2}$
42. $f(x) = \sqrt{x^2 + 8x}$
43. $g(s) = \dfrac{5}{3s - 9}$
44. $f(x) = \dfrac{2}{3x + 4}$

45. ***Cost*** A hand tool manufacturer produces a product for which the variable cost is \$5.35 per unit and the fixed costs are \$16,000. The company sells the product for \$8.20 and can sell all that it produces.
 (a) Write the total cost C as a function of x, the number of units produced.
 (b) Write the profit P as a function of x.

46. ***Consumerism*** The retail sales R (in billions of dollars) of lawn care products and services in the United States from 1994 to 2001 can be approximated by the model

$$R(t) = \begin{cases} -0.67t + 11.0, & 4 \le t \le 7 \\ 0.600t^2 - 10.06t + 50.7, & 8 \le t \le 11 \end{cases}$$

where t represents the year, with $t = 4$ corresponding to 1994. Use the *table* feature of a graphing utility to approximate the retail sales of lawn care products and services for each year from 1994 to 2001. (Source: The National Gardening Association)

In Exercises 47 and 48, find the difference quotient and simplify your answer.

47. $f(x) = 2x^2 + 3x - 1, \quad \dfrac{f(x + h) - f(x)}{h}, \quad h \ne 0$

48. $f(x) = x^3 - 5x^2 + x, \quad \dfrac{f(x + h) - f(x)}{h}, \quad h \ne 0$

1.3 In Exercises 49–52, use a graphing utility to graph the function and estimate its domain and range. Then find the domain and range algebraically.

49. $f(x) = 3 - 2x^2$
50. $f(x) = \sqrt{2x^2 - 1}$
51. $h(x) = \sqrt{36 - x^2}$
52. $g(x) = |x + 5|$

In Exercises 53–56, (a) use a graphing utility to graph the equation and (b) use the Vertical Line Test to determine whether y is a function of x.

53. $y = \dfrac{x^2 + 3x}{6}$
54. $y = -\dfrac{2}{3}|x + 5|$
55. $3x + y^2 = 2$
56. $x^2 + y^2 = 49$

In Exercises 57–60, (a) use a graphing utility to graph the function and (b) determine the open intervals on which the function is increasing, decreasing, or constant.

57. $f(x) = x^3 - 3x$
58. $f(x) = \sqrt{x^2 - 9}$
59. $f(x) = x\sqrt{x - 6}$
60. $f(x) = \dfrac{|x + 8|}{2}$

In Exercises 61–64, use a graphing utility to approximate (to two decimal places) any relative minimum or maximum values of the function.

61. $f(x) = (x^2 - 4)^2$
62. $f(x) = x^2 - x - 1$
63. $h(x) = 4x^3 - x^4$
64. $f(x) = x^3 - 4x^2 - 1$

In Exercises 65 and 66, sketch the graph of the piecewise-defined function by hand.

65. $f(x) = \begin{cases} 3x + 5, & x < 0 \\ x - 4, & x \ge 0 \end{cases}$

66. $f(x) = \begin{cases} x^2 + 7, & x < 1 \\ x^2 - 5x + 6, & x \ge 1 \end{cases}$

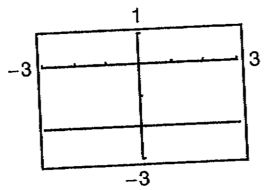
In Exercises 67 and 68, algebraically determine whether the function is even, odd, or neither. Verify your answer using a graphing utility.

67. $f(x) = (x^2 - 8)^2$

68. $f(x) = 2x^3 - x^2$

1.4 In Exercises 69–72, identify the common function and describe the transformation shown in the graph. Write an equation for the graphed function.

69.



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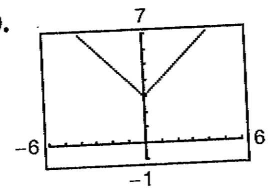

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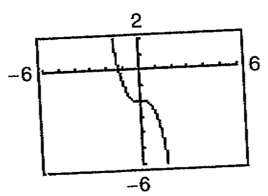

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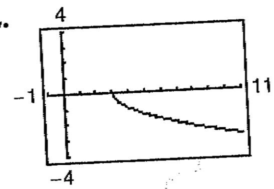


In Exercises 73–84, h is related to one of the six common functions on page 42. (a) Identify the common function f. (b) Describe the sequence of transformations from f to h. (c) Sketch the graph of h by hand. (d) Use function notation to write h in terms of the common function f.

73. $h(x) = x^2 - 6$

74. $h(x) = (x - 3)^2 - 2$

75. $h(x) = (x - 1)^3 + 7$

76. $h(x) = (x + 2)^3 + 5$

77. $h(x) = \sqrt{x} - 5$

78. $h(x) = |x + 8| - 1$

79. $h(x) = -x^2 - 3$

80. $h(x) = -(x - 2)^2 - 8$

81. $h(x) = -2x^2 + 3$

82. $h(x) = \frac{1}{2}(x - 3)^2 + 6$

83. $h(x) = -\frac{1}{2}|x| + 9$

84. $h(x) = \sqrt{3x} - 5$

1.5 In Exercises 85–94, let $f(x) = 3 - 2x$, $g(x) = \sqrt{x}$, and $h(x) = 3x^2 + 2$, and find the indicated values.

85. $(f - g)(4)$

86. $(f + h)(5)$

87. $(f + g)(25)$

88. $(g - h)(1)$

89. $(fh)(1)$

90. $\left(\frac{g}{h}\right)(1)$

91. $(h \circ g)(7)$

92. $(g \circ f)(-2)$

93. $(f \circ h)(-4)$

94. $(g \circ h)(6)$

Data Analysis **In Exercises 95 and 96, the numbers (in thousands) of students taking the SAT (y_1) and ACT (y_2) for the years 1996 through 2001 can be modeled by $y_1 = -2.75t^2 + 86.8t + 659$ and $y_2 = -1.88t^2 + 62.4t + 616$, where t represents the year, with $t = 6$ corresponding to 1996.** (Source: College Entrance Examination Board and ACT, Inc.)

95. Use a graphing utility to graph y_1, y_2, and $y_1 + y_2$ in the same viewing window.

96. Use the model $y_1 + y_2$ to estimate the total number of students taking the SAT and ACT in 2006.

1.6 In Exercises 97 and 98, find the inverse function of f informally. Verify that $f(f^{-1}(x)) = x$ and $f^{-1}(f(x)) = x$.

97. $f(x) = 6x$

98. $f(x) = x + 5$

In Exercises 99 and 100, show that f and g are inverse functions (a) graphically and (b) numerically.

99. $f(x) = 3 - 4x, \quad g(x) = \frac{3 - x}{4}$

100. $f(x) = \sqrt{x + 1}, \quad g(x) = x^2 - 1, x \geq 0$

In Exercises 101–104, use a graphing utility to graph the function and use the Horizontal Line Test to determine whether the function is one-to-one and so has an inverse function.

101. $f(x) = \frac{1}{2}x - 3$

102. $f(x) = (x - 1)^2$

103. $h(t) = \frac{2}{t - 3}$

104. $g(x) = \sqrt{x + 6}$

In Exercises 105–108, find the inverse function of f algebraically.

105. $f(x) = \frac{x}{12}$

106. $f(x) = \frac{7x + 3}{8}$

107. $f(x) = 4x^3 - 3$

108. $f(x) = \sqrt{x + 10}$

1.7

109. ***Education*** The following ordered pairs give the entrance exam scores x and the grade-point averages y after 1 year of college for 10 students.

(75, 2.3), (82, 3.0), (90, 3.6), (65, 2.0), (70, 2.1), (88, 3.5), (93, 3.9), (69, 2.0), (80, 2.8), (85, 3.3)

(a) Create a scatter plot for the data.

(b) Does the relationship between x and y appear to be approximately linear? Explain.

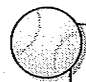
110. ***Stress Test*** A machine part was tested by bending it x centimeters 10 times per minute until it failed (y equals the time to failure in hours). The results are given as the following ordered pairs.

$(3, 61)$, $(6, 56)$, $(9, 53)$, $(12, 55)$, $(15, 48)$, $(18, 35)$, $(21, 36)$, $(24, 33)$, $(27, 44)$, $(30, 23)$

(a) Create a scatter plot for the data.

(b) Does the relationship between x and y appear to be approximately linear? If not, give some possible explanations.

111. ***Falling Object*** In an experiment, students measured the speed s (in meters per second) of a ball t seconds after it was released. The results are shown in the table.



Time, t	Speed, s
0	0
1	11.0
2	19.4
3	29.2
4	39.4

(a) Sketch a scatter plot of the data.

(b) Find the equation of the line that seems to best fit the data.

(c) Use the *regression* feature of a graphing utility to find a linear model for the data. Compare with the model in part (b).

(d) Use the model in part (c) to estimate the speed of the ball after 2.5 seconds.

112. ***Sales*** The table shows the sales S (in millions of dollars) for Timberland from 1995 to 2002. (Source: The Timberland Co.)

Year	Sales, S
1995	655.1
1996	690.0
1997	796.5
1998	862.2
1999	917.2
2000	1091.5
2001	1183.6
2002	1190.9

(a) Use the *regression* feature of a graphing utility to find a linear model for the data. Let t represent the year, with $t = 5$ corresponding to 1995.

(b) Use a graphing utility to plot the data and graph the model in the same viewing window.

(c) Interpret the slope of the model in the context of the problem.

(d) Use the model to find the year in which the sales will exceed \$1300 million.

(e) Create a table showing the actual values of S and the values of S given by the model. How closely does the model represent the data?

Height **In Exercises 113–116, the following ordered pairs (x, y) represent the percent y of women between the ages of 20 and 29 who are under a certain height x (in feet).** (Source: U.S. National Center for Health Statistics)

(4.67, 0.6)	**(5.17, 21.8)**	**(5.67, 92.4)**
(4.75, 0.7)	**(5.25, 34.3)**	**(5.75, 96.2)**
(4.83, 1.2)	**(5.33, 48.9)**	**(5.83, 98.6)**
(4.92, 3.1)	**(5.42, 62.7)**	**(5.92, 99.5)**
(5.00, 6.0)	**(5.50, 74.0)**	**(6.00, 100.0)**
(5.08, 11.5)	**(5.58, 84.7)**	

113. Use the *regression* feature of a graphing utility to find a linear model for the data.

114. Use a graphing utility to plot the data and graph the model in the same viewing window.

115. How closely does the model fit the data?

116. Can the model be used to estimate the percent of women who are under a height of greater than 6 feet?

Synthesis

True or False? **In Exercises 117–120, determine whether the statement is true or false. Justify your answer.**

117. If the graph of the common function $f(x) = x^2$ is moved six units to the right, moved three units upward, and reflected in the x-axis, then the point $(-1, 28)$ will lie on the graph of the transformation.

118. If $f(x) = x^n$ where n is odd, f^{-1} exists.

119. There exists no function f such that $f = f^{-1}$.

120. The sign of the slope of a regression line is always positive.

1 Chapter Test

Take this test as you would take a test in class. After you are finished, check your work against the answers given in the back of the book.

1. A line with slope $m = \frac{3}{2}$ passes through the point $(3, -1)$. List three additional points on the line. Then sketch the line.
2. Find an equation of the line that passes through the point $(0, 4)$ and is (a) parallel to and (b) perpendicular to the line $5x + 2y = 3$.
3. Does the graph at the right represent y as a function of x? Explain.

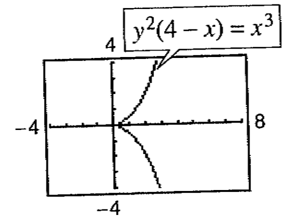


Figure for 3

4. Evaluate $f(x) = |x + 2| - 15$ at each value of the independent variable and simplify.

   (a) $f(-8)$ (b) $f(14)$ (c) $f(t - 6)$
5. Find the domain of $f(x) = 10 - \sqrt{3 - x}$.
6. An electronics company produces a car stereo for which the variable cost is \$5.60 and the fixed costs are \$24,000. The product sells for \$99.50. Write the total cost C as a function of x. Write the profit P as a function of x.

In Exercises 7 and 8, determine the open intervals on which the function is increasing, decreasing, or constant.

7. $h(x) = \frac{1}{4}x^4 - 2x^2$
8. $g(t) = |t + 2| - |t - 2|$

In Exercises 9 and 10, use a graphing utility to approximate (to two decimal places) any relative minimum or maximum values of the function.

9. $f(x) = -x^3 - 5x^2 + 12$
10. $f(x) = x^5 - x^3 + 2$

In Exercises 11–13, (a) identify the common function f, (b) describe the sequence of transformations from f to g, and (c) sketch the graph of g.

11. $g(x) = -2(x - 5)^3 + 3$
12. $g(x) = \sqrt{-x - 7}$
13. $g(x) = 4|-x| - 7$
14. Use the functions $f(x) = x^2$ and $g(x) = \sqrt{2 - x}$ to find the specified function and its domain.

    (a) $(f - g)(x)$ (b) $(f/g)(x)$ (c) $(f \circ g)(x)$ (d) $(g \circ f)(x)$

In Exercises 15–17, determine whether the function has an inverse function, and if so, find the inverse function.

15. $f(x) = x^3 + 8$
16. $f(x) = x^2 + 6$
17. $f(x) = \dfrac{3x\sqrt{x}}{8}$
18. The table shows the number of local telephone access lines L (in millions) in the United States from 1994 through 2000, where t represents the year, with $t = 4$ corresponding to 1994. Use the *regression* feature of a graphing utility to find a linear model for the data. Use the model to find the year in which the number of local telephone access lines will exceed 300 million. (Source: U.S. Federal Communications Commission)

Year, t	Lines, L
4	157
5	166
6	178
7	194
8	205
9	228
10	245

Table for 18