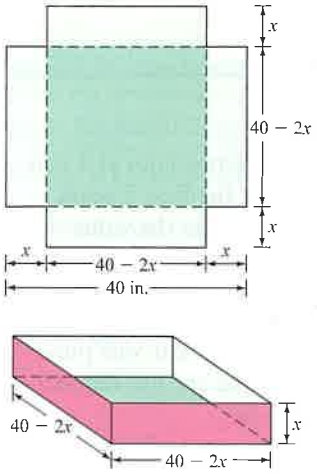

Figure 2.36

Solution

a. The length l of the box is $40 - 2x$. The width w is also $40 - 2x$. The height of the box is x. The volume V of a box is the product of its length, its width, and its height. Thus

$$V = (40 - 2x)^2 x$$

b. The squares that are cut from each corner require x to be larger than 0 inches but less than 20 inches. Thus the domain is $\{x \mid 0 < x < 20\}$.

Try Exercise 100, page 181

Answers to Exercises 47–62, and 93b are on pages AA3–AA4.

EXERCISE SET 2.2

Concept Check

In Exercises 1 to 4, write the domain and range for each relation. Then state whether the relation is a function.

1. $\{(2, 3), (5, 1), (-4, 3), (7, 11)\}$
   Yes. Domain: $\{-4, 2, 5, 7\}$; range: $\{1, 3, 11\}$
2. $\{(5, 10), (3, -2), (4, 7), (5, 8)\}$
   No. Domain: $\{3, 4, 5\}$; range: $\{-2, 7, 8, 10\}$
3. $\{(4, 4), (6, 1), (5, -3), (4, 5)\}$
   No. Domain: $\{4, 5, 6\}$; range: $\{-3, 1, 4, 5\}$
4. $\{(1, 0), (2, 0), (3, 0)\}$ Yes. Domain: $\{1, 2, 3\}$; range: $\{0\}$

In Exercises 5 to 10, determine whether the given value of x is in the domain of the function.

5. $f(x) = \dfrac{3x}{x + 4}, x = 0$
   Yes
6. $g(x) = 1 - x^2, x = -1$
   Yes
7. $F(x) = \dfrac{x - 1}{x + 1}, x = -1$
   No
8. $y(x) = \sqrt{2x - 8}, x = 2$
   No
9. $g(t) = \dfrac{5t - 1}{t^2 + 1}, t = -1$
   Yes
10. $F(t) = \dfrac{1}{t^3 + 8}, t = -2$
    No

In Exercises 11 to 18, determine whether the equation defines y as a function of x.

11. $2x + 3y = 7$ Yes
12. $5x + y = 8$ Yes
13. $-x + y^2 = 2$ No
14. $x^2 - 2y = 2$ Yes
15. $x^2 + y^2 = 9$ No
16. $y = \sqrt[3]{x}$ Yes
17. $y = |x| + 5$ Yes
18. $y = \sqrt{x^2 + 4}$ Yes

In Exercises 19 to 24, determine whether the given value of the variable is a zero of the function.

19. $f(x) = 3x + 6, x = -2$ Yes
20. $f(x) = 2x^3 - 4x^2 + 5x, x = 0$ Yes
21. $G(t) = 3t^2 + 2t - 1, t = -\dfrac{1}{3}$ No
22. $s(t) = \dfrac{2t + 6}{t + 1}, t = -1$ No
23. $y(s) = 5s^2 - 2s - 2, s = 1$ No
24. $g(x) = \dfrac{3x + 9}{x^2 - 4}, x = -3$ Yes

In Exercises 25 to 32, evaluate each function.

25. Given $f(x) = 3x - 1$, find
    a. $f(2)$ 5 b. $f(-1)$ −4 c. $f(0)$ −1
    d. $f\left(\dfrac{2}{3}\right)$ 1 e. $f(k)$ $3k - 1$ f. $f(k + 2)$ $3k + 5$
26. Given $g(x) = 2x^2 + 3$, find
    a. $g(3)$ 21 b. $g(-1)$ 5 c. $g(0)$ 3
    d. $g\left(\dfrac{1}{2}\right)$ $\dfrac{7}{2}$ e. $g(c)$ $2c^2 + 3$ f. $g(c + 5)$ $2c^2 + 20c + 53$
27. Given $A(w) = \sqrt{w^2 + 5}$, find
    a. $A(0)$ $\sqrt{5}$ b. $A(2)$ 3 c. $A(-2)$ 3
    d. $A(4)$ $\sqrt{21}$ e. $A(r + 1)$ $\sqrt{r^2 + 2r + 6}$ f. $A(-c)$ $\sqrt{c^2 + 5}$
28. Given $J(t) = 3t^2 - t$, find
    a. $J(-4)$ 52 b. $J(0)$ 0 c. $J\left(\dfrac{1}{3}\right)$ 0

Indicates Try It Exercises

d. $J(-c)$ $3c^2 + c$ e. $J(x + 1)$ $3x^2 + 5x + 2$ f. $J(x + h)$ $3x^2 + 6xh + 3h^2 - x - h$

29. Given $f(x) = \dfrac{1}{|x|}$, find

a. $f(2)$ $\frac{1}{2}$ b. $f(-2)$ $\frac{1}{2}$ c. $f\left(\dfrac{-3}{5}\right)$ $\frac{5}{3}$

d. $f(2) + f(-2)$ 1 e. $f(c^2 + 4)$ $\dfrac{1}{c^2 + 4}$ f. $f(2 + h)$ $\dfrac{1}{|2 + h|}$

30. Given $T(x) = 5$, find

a. $T(-3)$ 5 b. $T(0)$ 5 c. $T\left(\frac{2}{7}\right)$ 5

d. $T(3) + T(1)$ 10 e. $T(x + h)$ 5 f. $T(3k + 5)$ 5

31. Given $s(x) = \dfrac{x}{|x|}$, find

a. $s(4)$ 1 b. $s(5)$ 1 c. $s(-2)$ -1

d. $s(-3)$ -1 e. $s(t), t > 0$ 1 f. $s(t), t < 0$ -1

32. Given $r(x) = \dfrac{x}{x + 4}$, find

a. $r(0)$ 0 b. $r(-1)$ $-\frac{1}{3}$ c. $r(-3)$ -3

d. $r\left(\frac{1}{2}\right)$ $\frac{1}{9}$ e. $r(0.1)$ $\frac{1}{41}$ f. $r(10{,}000)$ $\frac{2500}{2501}$

In Exercises 33 and 34, evaluate each piecewise-defined function for the indicated values.

33. $P(x) = \begin{cases} 3x + 1, & \text{if } x < 2 \\ -x^2 + 11, & \text{if } x \geq 2 \end{cases}$

a. $P(-4)$ -11 b. $P(\sqrt{5})$ 6

c. $P(c),\ c < 2$ $3c + 1$ d. $P(k + 1),\ k \geq 1$ $-k^2 - 2k + 10$

34. $Q(t) = \begin{cases} 4, & \text{if } 0 \leq t \leq 5 \\ -t + 9, & \text{if } 5 < t \leq 8 \\ \sqrt{t - 7}, & \text{if } 8 < t \leq 11 \end{cases}$

a. $Q(0)$ 4 b. $Q(e),\ 6 < e < 7$ $-e + 9$

c. $Q(n),\ 1 < n < 2$ 4 d. $Q(m^2 + 7),\ 1 < m \leq 2$ m

In Exercises 35 to 46, determine the domain of the function represented by the given equation.

35. $f(x) = 3x - 4$ All real numbers

36. $f(x) = -2x + 1$ All real numbers

37. $f(x) = x^2 + 2$ All real numbers

38. $f(x) = 3x^2 + 1$ All real numbers

39. $f(x) = \dfrac{4}{x + 2}$ $\{x | x \neq -2\}$

40. $f(x) = \dfrac{6}{x - 5}$ $\{x | x \neq 5\}$

41. $f(x) = \sqrt{7 + x}$ $\{x | x \geq -7\}$

42. $f(x) = \sqrt{4 - x}$ $\{x | x \leq 4\}$

43. $f(x) = \sqrt{4 - x^2}$ $\{x | -2 \leq x \leq 2\}$

44. $f(x) = \sqrt{12 - x^2}$ $\{x | -2\sqrt{3} \leq x \leq 2\sqrt{3}\}$

45. $f(x) = \dfrac{1}{\sqrt{x + 4}}$ $\{x | x > -4\}$

46. $f(x) = \dfrac{1}{\sqrt{5 - x}}$ $\{x | x < 5\}$

In Exercises 47 to 62, graph each function.

47. $f(x) = 3x - 4$

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

49. $g(x) = x^2 - 1$

50. $g(x) = 3 - x^2$

51. $f(x) = \sqrt{x + 4}$

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

53. $f(x) = |x - 2|$

54. $h(x) = 3 - |x|$

55. $L(x) = \left[\!\left[\frac{1}{3}x\right]\!\right]$ for $-6 \leq x \leq 6$

56. $M(x) = [\![x]\!] + 2$ for $0 \leq x \leq 4$

57. $N(x) = \text{int}(-x)$ for $-3 \leq x \leq 3$

58. $P(x) = \text{int}(x) + x$ for $0 \leq x \leq 4$

59. $f(x) = \begin{cases} 1 - x, & x < 2 \\ 2x, & x \geq 2 \end{cases}$

60. $g(x) = \begin{cases} 2x, & x \leq -1 \\ \dfrac{x}{2}, & x > -1 \end{cases}$

61. $r(x) = \begin{cases} -x^2 + 4, & x < -1 \\ -x + 2, & -1 \leq x \leq 1 \\ 3x - 2, & x > 1 \end{cases}$

62. $A(x) = \begin{cases} |x|, & x < 1 \\ x^2, & 1 \leq x < 3 \\ -x + 2, & x \geq 3 \end{cases}$

In Exercises 63 to 70, find the value or values of *a* in the domain of *f* for which *f*(*a*) equals the given number.

63. $f(x) = 3x - 2;\ f(a) = 10$ 4

64. $f(x) = 2 - 5x;\ f(a) = 7$ -1

65. $f(x) = x^2 + 2x - 2;\ f(a) = 1$ -3 and 1

66. $f(x) = x^2 - 5x - 16;\ f(a) = -2$ -2 and 7

67. $f(x) = |x|;\ f(a) = 4$ -4 and 4

68. $f(x) = |x + 2|;\ f(a) = 6$ -8 and 4

69. $f(x) = x^2 + 2,\ f(a) = 1$ No real values of a

70. $f(x) = |x| - 2;\ f(a) = -3$ No real values of a

In Exercises 71 to 78, find the zeros of *f*.

71. $f(x) = 3x - 6$ 2

72. $f(x) = 6 + 2x$ -3

73. $f(x) = 5x + 2$ $-\frac{2}{5}$

74. $f(x) = 8 - 6x$ $\frac{4}{3}$

75. $f(x) = x^2 - 4$ -2 and 2

76. $f(x) = x^2 + 4x - 21$ -7 and 3