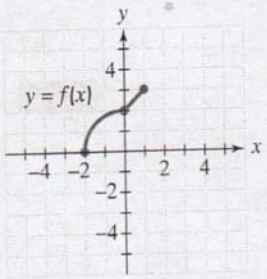
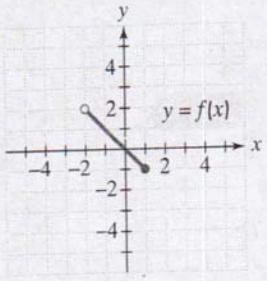
Check Point 8 Use the graph of each function to identify its domain and its range.

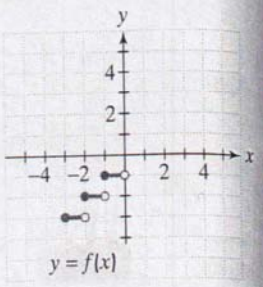
a.



b.



c.



9 Identify intercepts from a function's graph.

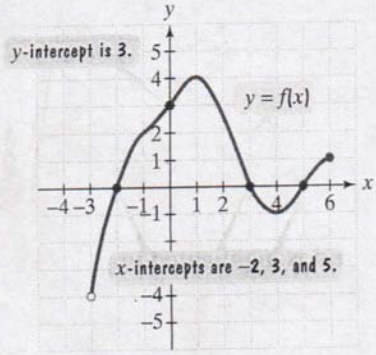


Figure 2.14 Identifying intercepts

Identifying Intercepts from a Function's Graph

Figure 2.14 illustrates how we can identify intercepts from a function's graph. To find the x-intercepts, look for the points at which the graph crosses the x-axis. There are three such points: $(-2, 0)$, $(3, 0)$, and $(5, 0)$. Thus, the x-intercepts are -2, 3, and 5. We express this in function notation by writing $f(-2) = 0$, $f(3) = 0$, and $f(5) = 0$. We say that -2, 3, and 5 are the *zeros of the function*. The **zeros of a function** f are the x-values for which $f(x) = 0$. Thus, the real zeros are the x-intercepts.

To find the y-intercept, look for the point at which the graph crosses the y-axis. This occurs at $(0, 3)$. Thus, the y-intercept is 3. We express this in function notation by writing $f(0) = 3$.

By the definition of a function, for each value of x we can have at most one value for y. What does this mean in terms of intercepts? **A function can have more than one x-intercept but at most one y-intercept.**

Exercise Set 2.1

Practice Exercises

In Exercises 1–10, determine whether each relation is a function. Give the domain and range for each relation.

1. $\{(1, 2), (3, 4), (5, 5)\}$
2. $\{(4, 5), (6, 7), (8, 8)\}$
3. $\{(3, 4), (3, 5), (4, 4), (4, 5)\}$
4. $\{(5, 6), (5, 7), (6, 6), (6, 7)\}$
5. $\{(3, -2), (5, -2), (7, 1), (4, 9)\}$
6. $\{(10, 4), (-2, 4), (-1, 1), (5, 6)\}$
7. $\{(-3, -3), (-2, -2), (-1, -1), (0, 0)\}$
8. $\{(-7, -7), (-5, -5), (-3, -3), (0, 0)\}$
9. $\{(1, 4), (1, 5), (1, 6)\}$
10. $\{(4, 1), (5, 1), (6, 1)\}$

In Exercises 11–26, determine whether each equation defines y as a function of x.

11. $x + y = 16$
12. $x + y = 25$
13. $x^2 + y = 16$
14. $x^2 + y = 25$
15. $x^2 + y^2 = 16$
16. $x^2 + y^2 = 25$
17. $x = y^2$
18. $4x = y^2$
19. $y = \sqrt{x + 4}$
20. $y = -\sqrt{x + 4}$
21. $x + y^3 = 8$
22. $x + y^3 = 27$
23. $xy + 2y = 1$
24. $xy - 5y = 1$
25. $|x| - y = 2$
26. $|x| - y = 5$

In Exercises 27–38, evaluate each function at the given values of the independent variable and simplify.

27. $f(x) = 4x + 5$
    a. $f(6)$ b. $f(x + 1)$ c. $f(-x)$
28. $f(x) = 3x + 7$
    a. $f(4)$ b. $f(x + 1)$ c. $f(-x)$
29. $g(x) = x^2 + 2x + 3$
    a. $g(-1)$ b. $g(x + 5)$ c. $g(-x)$
30. $g(x) = x^2 - 10x - 3$
    a. $g(-1)$ b. $g(x + 2)$ c. $g(-x)$
31. $h(x) = x^4 - x^2 + 1$
    a. $h(2)$ b. $h(-1)$
    c. $h(-x)$ d. $h(3a)$
32. $h(x) = x^3 - x + 1$
    a. $h(3)$ b. $h(-2)$
    c. $h(-x)$ d. $h(3a)$
33. $f(r) = \sqrt{r + 6} + 3$
    a. $f(-6)$ b. $f(10)$ c. $f(x - 6)$

34. $f(r) = \sqrt{25 - r} - 6$

a. $f(16)$ **b.** $f(-24)$ **c.** $f(25 - 2x)$

35. $f(x) = \dfrac{4x^2 - 1}{x^2}$

a. $f(2)$ **b.** $f(-2)$ **c.** $f(-x)$

36. $f(x) = \dfrac{4x^3 + 1}{x^3}$

a. $f(2)$ **b.** $f(-2)$ **c.** $f(-x)$

37. $f(x) = \dfrac{x}{|x|}$

a. $f(6)$ **b.** $f(-6)$ **c.** $f(r^2)$

38. $f(x) = \dfrac{|x + 3|}{x + 3}$

a. $f(5)$ **b.** $f(-5)$ **c.** $f(-9 - x)$

In Exercises 39–50, graph the given functions, f and g, in the same rectangular coordinate system. Select integers for x, starting with −2 and ending with 2. Once you have obtained your graphs, describe how the graph of g is related to the graph of f.

39. $f(x) = x, g(x) = x + 3$

40. $f(x) = x, g(x) = x - 4$

41. $f(x) = -2x, g(x) = -2x - 1$

42. $f(x) = -2x, g(x) = -2x + 3$

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

44. $f(x) = x^2, g(x) = x^2 - 2$

45. $f(x) = |x|, g(x) = |x| - 2$

46. $f(x) = |x|, g(x) = |x| + 1$

47. $f(x) = x^3, g(x) = x^3 + 2$

48. $f(x) = x^3, g(x) = x^3 - 1$

49. $f(x) = 3, g(x) = 5$

50. $f(x) = -1, g(x) = 4$

In Exercises 51–54, graph the given square root functions, f and g, in the same rectangular coordinate system. Use the integer values of x given to the right of each function to obtain ordered pairs. Because only nonnegative numbers have square roots that are real numbers, be sure that each graph appears only for values of x that cause the expression under the radical sign to be greater than or equal to zero. Once you have obtained your graphs, describe how the graph of g is related to the graph of f.

51. $f(x) = \sqrt{x}$ $(x = 0, 1, 4, 9)$ and $g(x) = \sqrt{x} - 1$ $(x = 0, 1, 4, 9)$

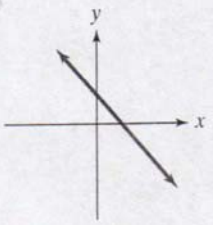
52. $f(x) = \sqrt{x}$ $(x = 0, 1, 4, 9)$ and $g(x) = \sqrt{x} + 2$ $(x = 0, 1, 4, 9)$

53. $f(x) = \sqrt{x}$ $(x = 0, 1, 4, 9)$ and $g(x) = \sqrt{x - 1}$ $(x = 1, 2, 5, 10)$

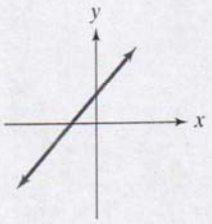
54. $f(x) = \sqrt{x}$ $(x = 0, 1, 4, 9)$ and $g(x) = \sqrt{x + 2}$ $(x = -2, -1, 2, 7)$

In Exercises 55–64, use the vertical line test to identify graphs in which y is a function of x.

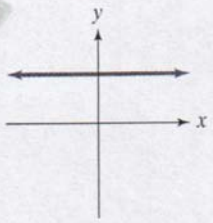
55.



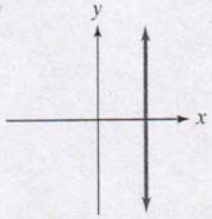
56.



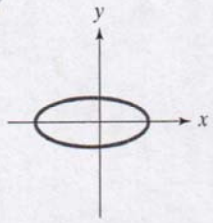
57.



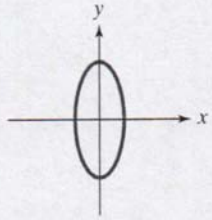
58.



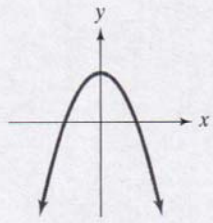
59.



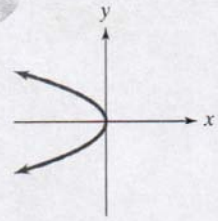
60.



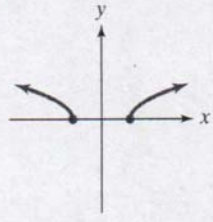
61.



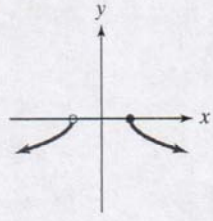
62.



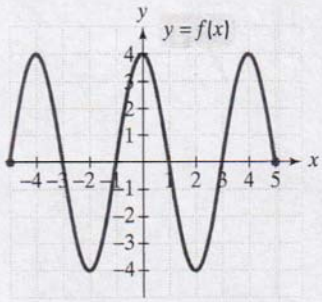
63.



64.



In Exercises 65–70, use the graph of f to find each indicated function value.



65. $f(-2)$

66. $f(2)$

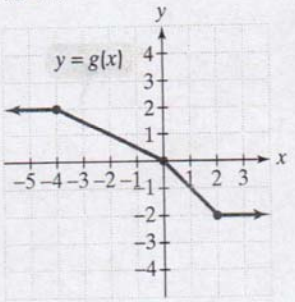
67. $f(4)$

68. $f(-4)$

69. $f(-3)$

70. $f(-1)$

Use the graph of g to solve Exercises 71–76.



71. Find $g(-4)$.

72. Find $g(2)$.

73. Find $g(-10)$.

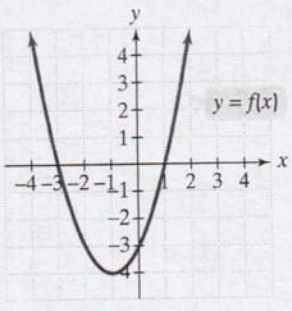
74. Find $g(10)$.

75. For what value of x is $g(x) = 1$?

76. For what value of x is $g(x) = -1$?

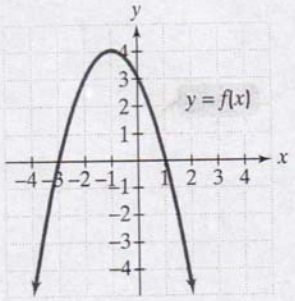
In Exercises 77–92, use the graph to determine **a.** *the function's domain;* **b.** *the function's range;* **c.** *the x-intercepts, if any;* **d.** *the y-intercept, if any; and* **e.** *the missing function values, indicated by question marks, below each graph.*

77.



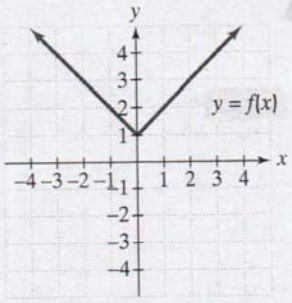
$f(-2) = ?$ $f(2) = ?$

78.



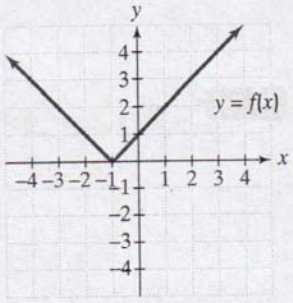
$f(-2) = ?$ $f(2) = ?$

79.



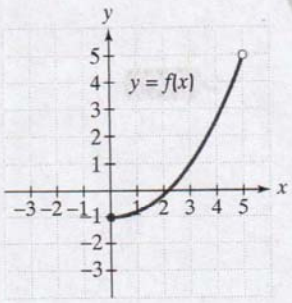
$f(-1) = ?$ $f(3) = ?$

80.



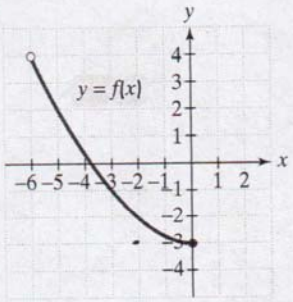
$f(-4) = ?$ $f(3) = ?$

81.



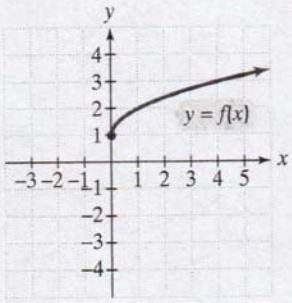
$f(3) = ?$

82.



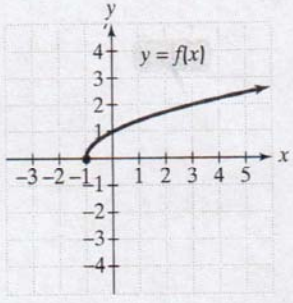
$f(-5) = ?$

83.



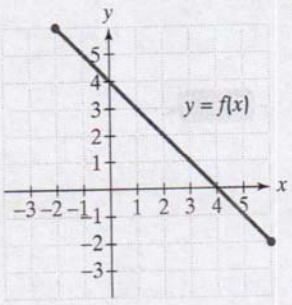
$f(4) = ?$

84.



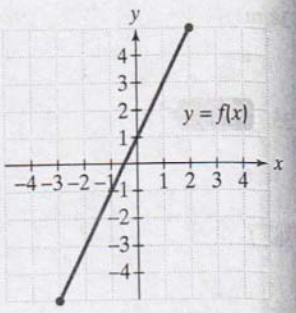
$f(3) = ?$

85.



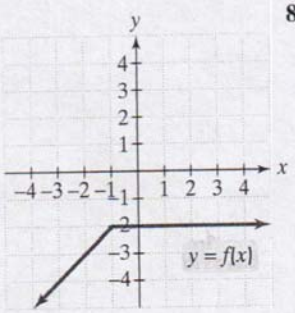
$f(-1) = ?$

86.



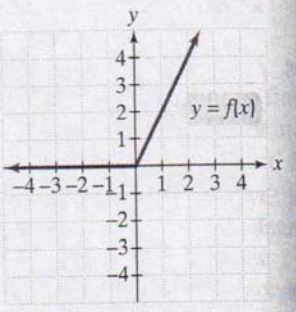
$f(-2) = ?$

87.



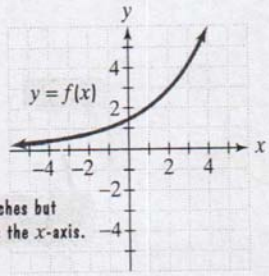
$f(-4) = ?$ $f(4) = ?$

88.



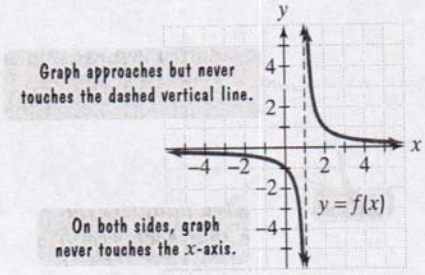
$f(-2) = ?$ $f(2) = ?$

89.



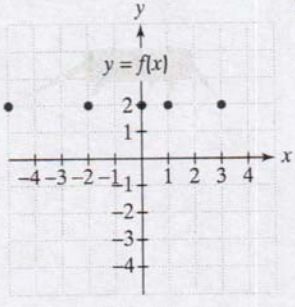
$f(4) = ?$

90.



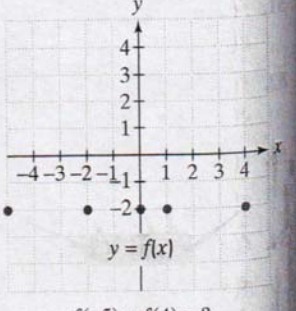
$f(2) = ?$

91.



$f(-5) + f(3) = ?$

92.



$f(-5) + f(4) = ?$