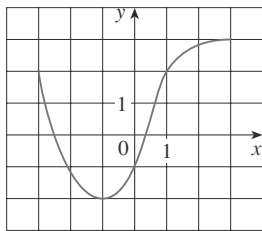
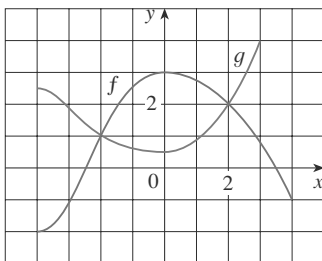


# 1.1 Exercises

- The graph of a function  $f$  is given.
  - State the value of  $f(-1)$ .
  - Estimate the value of  $f(2)$ .
  - For what values of  $x$  is  $f(x) = 2$ ?
  - Estimate the values of  $x$  such that  $f(x) = 0$ .
  - State the domain and range of  $f$ .
  - On what interval is  $f$  increasing?

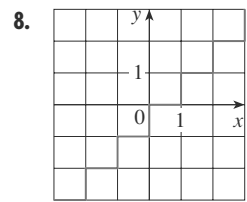
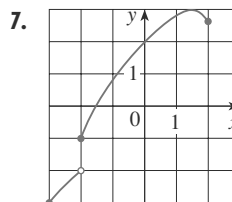
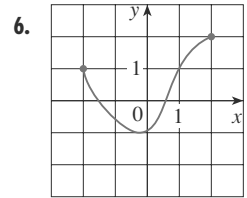
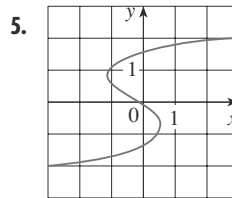


- The graphs of  $f$  and  $g$  are given.
  - State the values of  $f(-4)$  and  $g(3)$ .
  - For what values of  $x$  is  $f(x) = g(x)$ ?
  - Estimate the solution of the equation  $f(x) = -1$ .
  - On what interval is  $f$  decreasing?
  - State the domain and range of  $f$ .
  - State the domain and range of  $g$ .

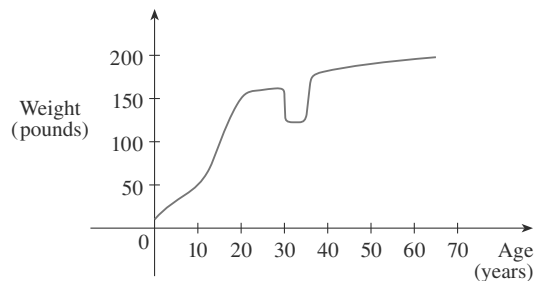


- Figures 1, 11, and 12 were recorded by an instrument operated by the California Department of Mines and Geology at the University Hospital of the University of Southern California in Los Angeles. Use them to estimate the ranges of the vertical, north-south, and east-west ground acceleration functions at USC during the Northridge earthquake.
- In this section we discussed examples of ordinary, everyday functions: Population is a function of time, postage cost is a function of weight, water temperature is a function of time. Give three other examples of functions from everyday life that are described verbally. What can you say about the domain and range of each of your functions? If possible, sketch a rough graph of each function.

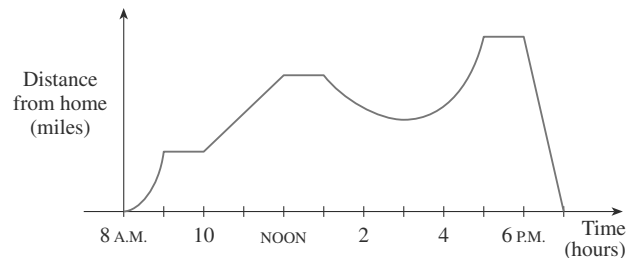
- Determine whether the curve is the graph of a function of  $x$ . If it is, state the domain and range of the function.



- The graph shown gives the weight of a certain person as a function of age. Describe in words how this person's weight varies over time. What do you think happened when this person was 30 years old?



- The graph shown gives a salesman's distance from his home as a function of time on a certain day. Describe in words what the graph indicates about his travels on this day.



- You put some ice cubes in a glass, fill the glass with cold water, and then let the glass sit on a table. Describe how the temperature of the water changes as time passes. Then sketch a rough graph of the temperature of the water as a function of the elapsed time.

12. Sketch a rough graph of the number of hours of daylight as a function of the time of year.
13. Sketch a rough graph of the outdoor temperature as a function of time during a typical spring day.
14. You place a frozen pie in an oven and bake it for an hour. Then you take it out and let it cool before eating it. Describe how the temperature of the pie changes as time passes. Then sketch a rough graph of the temperature of the pie as a function of time.
15. A homeowner mows the lawn every Wednesday afternoon. Sketch a rough graph of the height of the grass as a function of time over the course of a four-week period.
16. An airplane flies from an airport and lands an hour later at another airport, 400 miles away. If  $t$  represents the time in minutes since the plane has left the terminal building, let  $x(t)$  be the horizontal distance traveled and  $y(t)$  be the altitude of the plane.
- (a) Sketch a possible graph of  $x(t)$ .  
 (b) Sketch a possible graph of  $y(t)$ .  
 (c) Sketch a possible graph of the ground speed.  
 (d) Sketch a possible graph of the vertical velocity.
17. The number  $N$  (in thousands) of cellular phone subscribers in Malaysia is shown in the table. (Midyear estimates are given.)

$t$	1991	1993	1995	1997
$N$	132	304	873	2461

- (a) Use the data to sketch a rough graph of  $N$  as a function of  $t$ .  
 (b) Use your graph to estimate the number of cell-phone subscribers in Malaysia at midyear in 1994 and 1996.
18. Temperature readings  $T$  (in °F) were recorded every two hours from midnight to 2:00 P.M. in Dallas on June 2, 2001. The time  $t$  was measured in hours from midnight.

$t$	0	2	4	6	8	10	12	14
$T$	73	73	70	69	72	81	88	91

- (a) Use the readings to sketch a rough graph of  $T$  as a function of  $t$ .  
 (b) Use your graph to estimate the temperature at 11:00 A.M.
19. If  $f(x) = 3x^2 - x + 2$ , find  $f(2)$ ,  $f(-2)$ ,  $f(a)$ ,  $f(-a)$ ,  $f(a + 1)$ ,  $2f(a)$ ,  $f(2a)$ ,  $f(a^2)$ ,  $[f(a)]^2$ , and  $f(a + h)$ .
20. A spherical balloon with radius  $r$  inches has volume  $V(r) = \frac{4}{3}\pi r^3$ . Find a function that represents the amount of air required to inflate the balloon from a radius of  $r$  inches to a radius of  $r + 1$  inches.

21–22 ■ Find  $f(2 + h)$ ,  $f(x + h)$ , and  $\frac{f(x + h) - f(x)}{h}$ , where  $h \neq 0$ .

21.  $f(x) = x - x^2$

22.  $f(x) = \frac{x}{x + 1}$

23–27 ■ Find the domain of the function.

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

24.  $f(x) = \frac{5x + 4}{x^2 + 3x + 2}$

25.  $f(t) = \sqrt{t} + \sqrt[3]{t}$

26.  $g(u) = \sqrt{u} + \sqrt{4 - u}$

27.  $h(x) = \frac{1}{\sqrt[4]{x^2 - 5x}}$

28. Find the domain and range and sketch the graph of the function  $h(x) = \sqrt{4 - x^2}$ .

29–40 ■ Find the domain and sketch the graph of the function.

29.  $f(x) = 5$

30.  $F(x) = \frac{1}{2}(x + 3)$

31.  $f(t) = t^2 - 6t$

32.  $H(t) = \frac{4 - t^2}{2 - t}$

33.  $g(x) = \sqrt{x - 5}$

34.  $F(x) = |2x + 1|$

35.  $G(x) = \frac{3x + |x|}{x}$

36.  $g(x) = \frac{|x|}{x^2}$

37.  $f(x) = \begin{cases} x & \text{if } x \leq 0 \\ x + 1 & \text{if } x > 0 \end{cases}$

38.  $f(x) = \begin{cases} 2x + 3 & \text{if } x < -1 \\ 3 - x & \text{if } x \geq -1 \end{cases}$

39.  $f(x) = \begin{cases} x + 2 & \text{if } x \leq -1 \\ x^2 & \text{if } x > -1 \end{cases}$

40.  $f(x) = \begin{cases} -1 & \text{if } x \leq -1 \\ 3x + 2 & \text{if } |x| < 1 \\ 7 - 2x & \text{if } x \geq 1 \end{cases}$

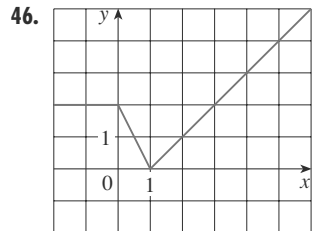
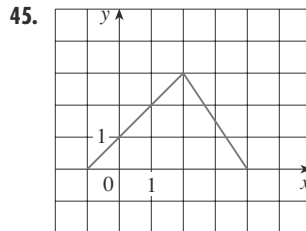
41–46 ■ Find an expression for the function whose graph is the given curve.

41. The line segment joining the points  $(-2, 1)$  and  $(4, -6)$

42. The line segment joining the points  $(-3, -2)$  and  $(6, 3)$

43. The bottom half of the parabola  $x + (y - 1)^2 = 0$

44. The top half of the circle  $(x - 1)^2 + y^2 = 1$



47–51 ||| Find a formula for the described function and state its domain.

47. A rectangle has perimeter 20 m. Express the area of the rectangle as a function of the length of one of its sides.

48. A rectangle has area  $16 \text{ m}^2$ . Express the perimeter of the rectangle as a function of the length of one of its sides.

49. Express the area of an equilateral triangle as a function of the length of a side.

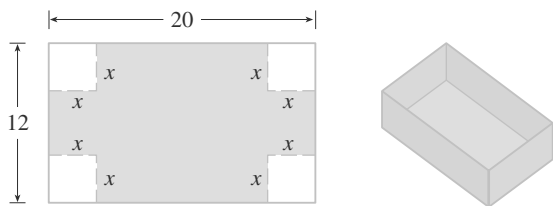
50. Express the surface area of a cube as a function of its volume.

51. An open rectangular box with volume  $2 \text{ m}^3$  has a square base. Express the surface area of the box as a function of the length of a side of the base.

52. A Norman window has the shape of a rectangle surmounted by a semicircle. If the perimeter of the window is 30 ft, express the area  $A$  of the window as a function of the width  $x$  of the window.



53. A box with an open top is to be constructed from a rectangular piece of cardboard with dimensions 12 in. by 20 in. by cutting out equal squares of side  $x$  at each corner and then folding up the sides as in the figure. Express the volume  $V$  of the box as a function of  $x$ .



54. A taxi company charges two dollars for the first mile (or part of a mile) and 20 cents for each succeeding tenth of a mile (or part). Express the cost  $C$  (in dollars) of a ride as a function of the distance  $x$  traveled (in miles) for  $0 < x < 2$ , and sketch the graph of this function.

55. In a certain country, income tax is assessed as follows. There is no tax on income up to \$10,000. Any income over \$10,000 is taxed at a rate of 10%, up to an income of \$20,000. Any income over \$20,000 is taxed at 15%.

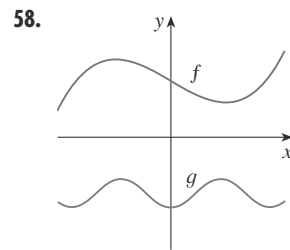
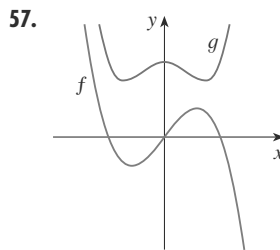
(a) Sketch the graph of the tax rate  $R$  as a function of the income  $I$ .

(b) How much tax is assessed on an income of \$14,000? On \$26,000?

(c) Sketch the graph of the total assessed tax  $T$  as a function of the income  $I$ .

56. The functions in Example 10 and Exercises 54 and 55(a) are called *step functions* because their graphs look like stairs. Give two other examples of step functions that arise in everyday life.

57–58 ||| Graphs of  $f$  and  $g$  are shown. Decide whether each function is even, odd, or neither. Explain your reasoning.



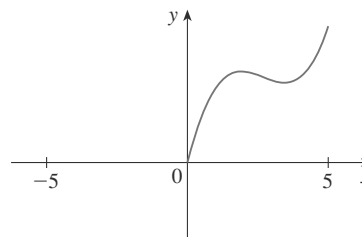
59. (a) If the point  $(5, 3)$  is on the graph of an even function, what other point must also be on the graph?

(b) If the point  $(5, 3)$  is on the graph of an odd function, what other point must also be on the graph?

60. A function  $f$  has domain  $[-5, 5]$  and a portion of its graph is shown.

(a) Complete the graph of  $f$  if it is known that  $f$  is even.

(b) Complete the graph of  $f$  if it is known that  $f$  is odd.



61–66 ||| Determine whether  $f$  is even, odd, or neither. If  $f$  is even or odd, use symmetry to sketch its graph.

61.  $f(x) = x^{-2}$

62.  $f(x) = x^{-3}$

63.  $f(x) = x^2 + x$

64.  $f(x) = x^4 - 4x^2$

65.  $f(x) = x^3 - x$

66.  $f(x) = 3x^3 + 2x^2 + 1$