

CHAPTER 2 Concept Review Questions

Fill in the blanks.

- A point in the plane can be represented uniquely by a/an _____ pair of numbers. The first number of the pair is called the _____, and the second number of the pair is called the _____.
- The point $P(a, 0)$ lies on the _____-axis, and the point $P(0, b)$ lies on the _____-axis.
 - If the point $P(a, b)$ lies in the fourth quadrant, then the point $P(-a, b)$ lies in the _____ quadrant.
- If $P_1(x_1, y_1)$ and $P_2(x_2, y_2)$ are any two distinct points on a nonvertical line L , then the slope of L is $m =$ _____.
 - The slope of a vertical line is _____.
 - The slope of a horizontal line is _____.
 - The slope of a line that slants upward from left to right is _____.
- If L_1 and L_2 are nonvertical lines with slopes m_1 and m_2 , respectively, then L_1 is parallel to L_2 if and only if _____ and L_1 is perpendicular to L_2 if and only if _____.
- An equation of the line passing through the point $P(x_1, y_1)$ and having slope m is _____. This form of the equation of a line is called the _____.
 - An equation of the line that has slope m and y -intercept b is _____. It is called the _____ form of an equation of a line.
- The general form of an equation of a line is _____.
 - If a line has equation $ax + by + c = 0$ ($b \neq 0$), then its slope is _____.
- If f is a function from the set A to the set B , then A is called the _____ of f , and the set of all values of $f(x)$ as x takes on all possible values in A is called the _____ of f . The range of f is contained in the set _____.
- The graph of a function is the set of all points (x, y) in the xy -plane such that x is in the _____ of f and $y =$ _____. The Vertical Line Test states that a curve in the xy -plane is the graph of a function $y = f(x)$ if and only if each _____ line intersects it in at most one _____.
- If f and g are functions with domains A and B , respectively, then (a) $(f \pm g)(x) =$ _____, (b) $(fg)(x) =$ _____, and (c) $\left(\frac{f}{g}\right)(x) =$ _____. The domain of $f + g$ is _____. The domain of $\frac{f}{g}$ is _____ with the additional condition that $g(x)$ is never _____.
- The composition of g and f is the function with rule $(g \circ f)(x) =$ _____. Its domain is the set of all x in the domain of _____ such that _____ lies in the domain of _____.
- A quadratic function has the form $f(x) =$ _____. Its graph is a/an _____ that opens _____ if $a > 0$ and _____ if $a < 0$. Its highest point or lowest point is called its _____. The x -coordinate of its vertex is _____, and an equation of its axis of symmetry is _____.
- A polynomial function of degree n is a function of the form _____.
 - A polynomial function of degree 1 is called a/an _____ function; one of degree 2 is called a/an _____ function.
 - A rational function is a/an _____ of two _____.
 - A power function has the form $f(x) =$ _____.

Review Exercises

In Exercises 1–6, find an equation of the line L that passes through the point $(-2, 4)$ and satisfies the given condition.

- L is a vertical line.
- L is a horizontal line.
- L passes through the point $(3, \frac{1}{2})$.
- The x -intercept of L is 3.
- L is parallel to the line $5x - 2y = 6$.
- L is perpendicular to the line $4x + 3y = 6$.
- Find an equation of the line with slope $-\frac{1}{2}$ and y -intercept -3 .
- Find the slope and y -intercept of the line with equation $3x - 5y = 6$.
- Find an equation of the line passing through the point $(2, 3)$ and parallel to the line with equation $3x + 4y - 8 = 0$.
- Find an equation of the line passing through the point $(-1, 3)$ and parallel to the line joining the points $(-3, 4)$ and $(2, 1)$.
- Find an equation of the line passing through the point $(-2, -4)$ that is perpendicular to the line with equation $2x - 3y - 24 = 0$.

In Exercises 12 and 13, sketch the graph of the equation.

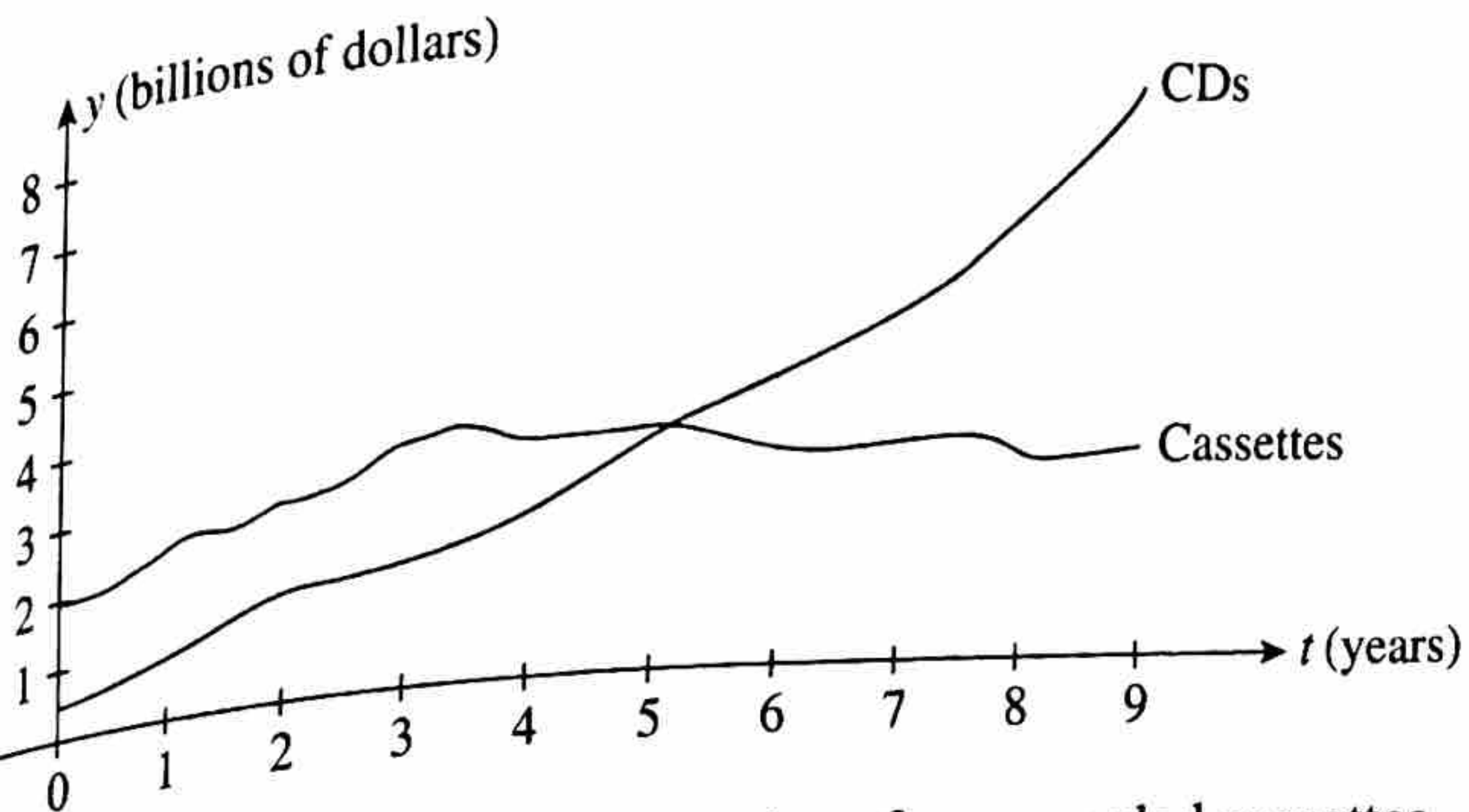
12. $3x - 4y = 24$ 13. $-2x + 5y = 15$

In Exercises 14 and 15, find the domain of the function.

14. $f(x) = \sqrt{9 - x}$
 15. $f(x) = \frac{x + 3}{2x^2 - x - 3}$

16. Let $f(x) = 3x^2 + 5x - 2$. Find:
 a. $f(-2)$
 b. $f(a + 2)$
 c. $f(2a)$
 d. $f(a + h)$

17. **SALES OF PRERECORDED MUSIC** The following graphs show the sales y of prerecorded music (in billions of dollars) by format as a function of time t (in years), with $t = 0$ corresponding to 1985.



- a. In what years were the sales of prerecorded cassettes greater than those of prerecorded CDs?
 b. In what years were the sales of prerecorded CDs greater than those of prerecorded cassettes?
 c. In what year were the sales of prerecorded cassettes the same as those of prerecorded CDs? Estimate the level of sales in each format at that time.
 Source: Recording Industry Association of America.

18. Let $y^2 = 2x + 1$.
 a. Sketch the graph of this equation.
 b. Is y a function of x ? Why?
 c. Is x a function of y ? Why?

19. Sketch the graph of the function defined by

$$f(x) = \begin{cases} x + 1 & \text{if } x < 1 \\ -x^2 + 4x - 1 & \text{if } x \geq 1 \end{cases}$$

20. Let $f(x) = \frac{1}{x}$ and $g(x) = 2x + 3$. Find:
 a. $f(x)g(x)$ b. $f(x)/g(x)$
 c. $f(g(x))$ d. $g(f(x))$

In Exercises 21 and 22, find the vertex and the x -intercepts of the parabola and sketch the parabola.

21. $y = 6x^2 - 11x - 10$ 22. $y = -4x^2 + 4x + 3$

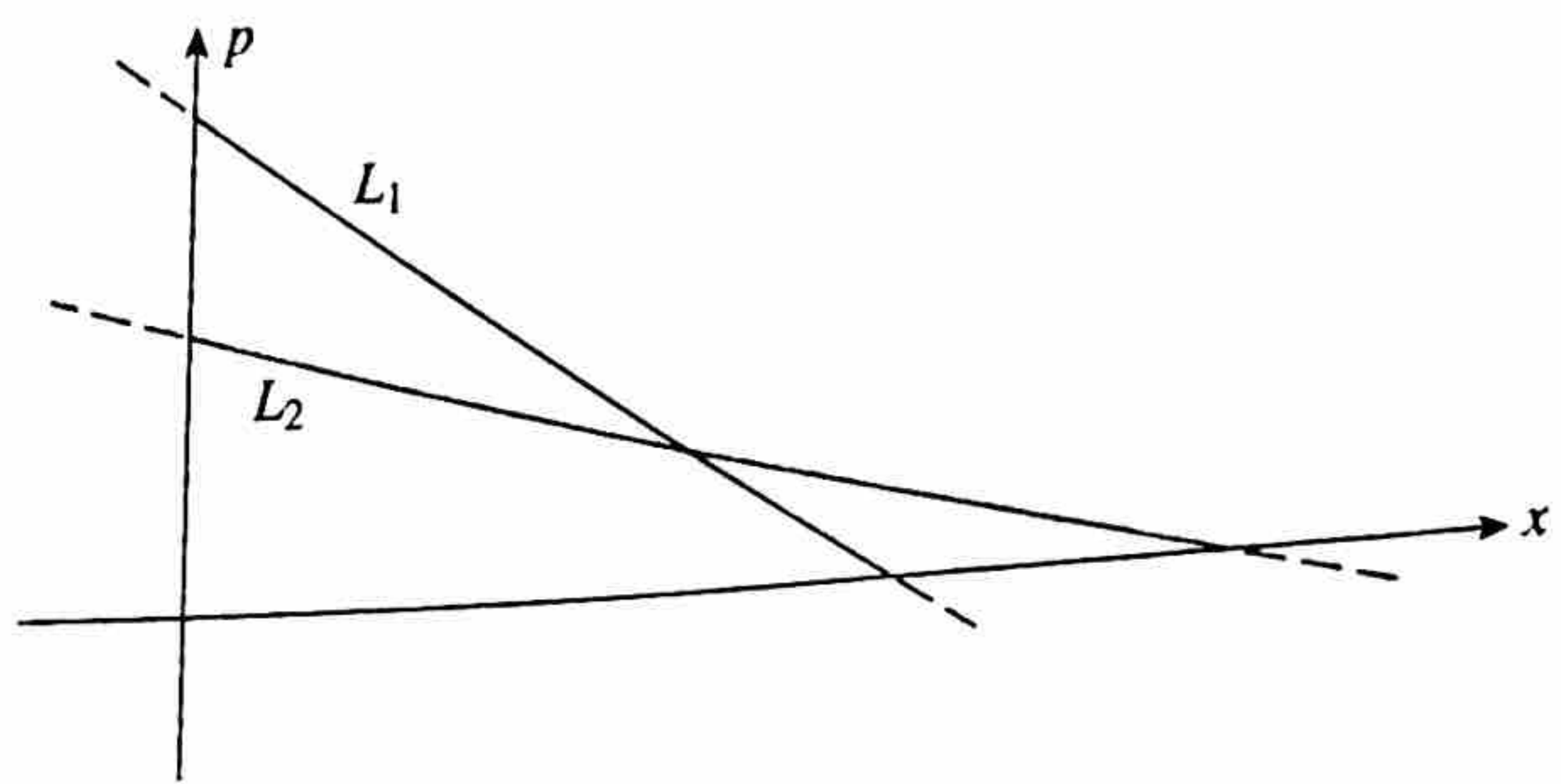
In Exercises 23 and 24, find the point of intersection of the lines with the given equations.

23. $3x + 4y = -6$ and $2x + 5y = -11$
 24. $y = \frac{3}{4}x + 6$ and $3x - 2y + 3 = 0$

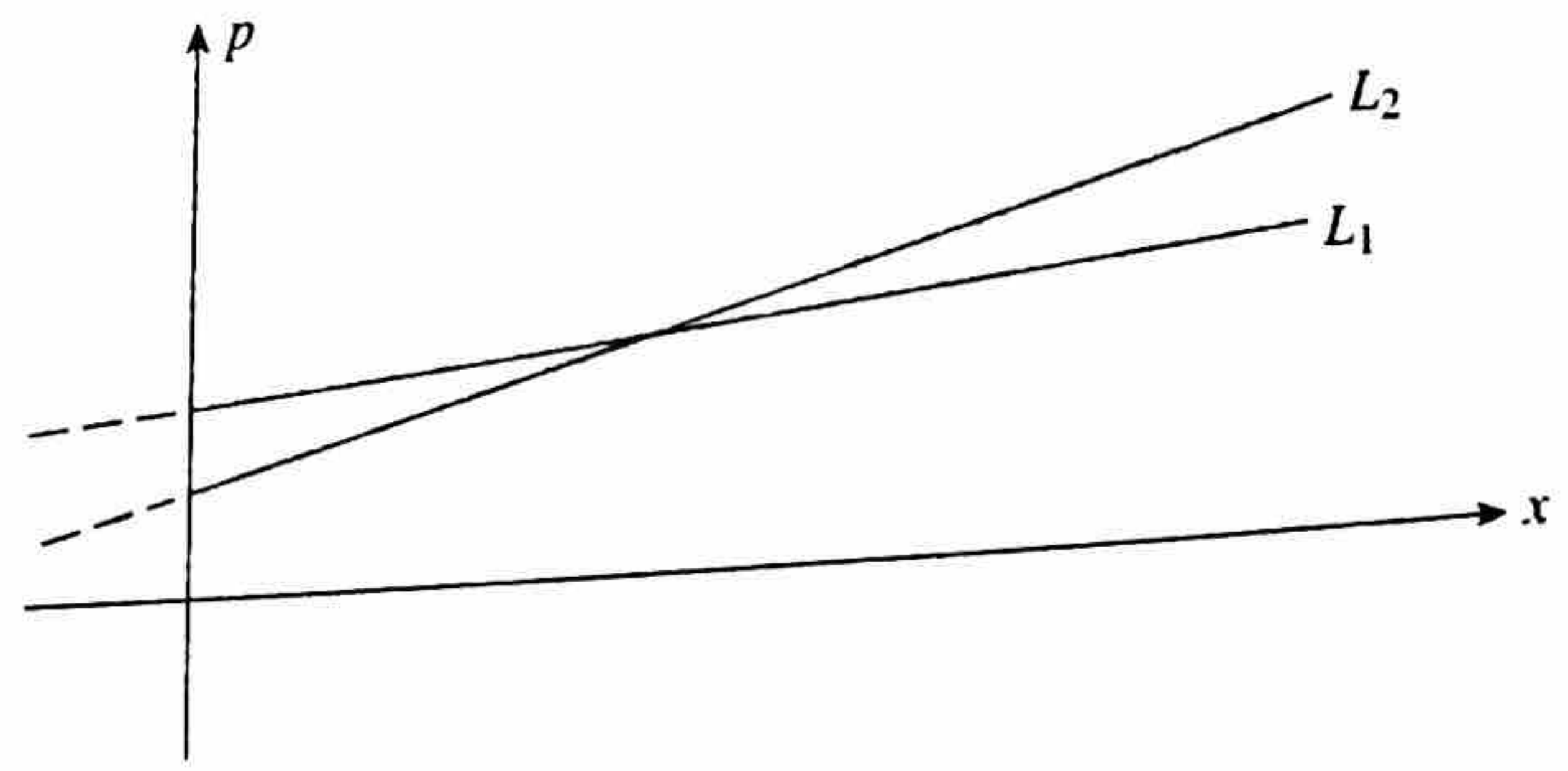
25. Find the point of intersection of the two straight lines having the equations $7x + 9y = -11$ and $3x = 6y - 8$.

26. The cost and revenue functions for a certain firm are given by $C(x) = 12x + 20,000$ and $R(x) = 20x$, respectively. Find the company's break-even point.

27. **DEMAND FOR CLOCK RADIOS** In the accompanying figure, L_1 is the demand curve for the model A clock radios manufactured by Ace Radio, and L_2 is the demand curve for their model B clock radios. Which line has the greater slope? Interpret your results.



28. **SUPPLY OF CLOCK RADIOS** In the accompanying figure, L_1 is the supply curve for the model A clock radios manufactured by Ace Radio, and L_2 is the supply curve for their model B clock radios. Which line has the greater slope? Interpret your results.



29. **CONSUMPTION FUNCTION** The consumption function in a certain economy is given by

$$C(y) = 0.75y + 6$$

where $C(y)$ is the personal consumption expenditure, y is the disposable personal income, and both $C(y)$ and y are measured in billions of dollars. Find $C(0)$, $C(50)$, and $C(100)$.

30. COMPANY SALES A company's total sales (in millions of dollars) are approximately linear as a function of time (in years). Sales in 2010 ($x = 0$) were \$2.4 million, whereas sales in 2015 amounted to \$7.4 million.

- Find an equation giving the company's sales as a function of time.
- What were the sales in 2013?

31. PROFIT FUNCTIONS A company has a fixed cost of \$30,000 and a production cost of \$6 for each CD it manufactures. Each CD sells for \$10.

- What is the cost function?
- What is the revenue function?
- What is the profit function?
- Compute the profit (loss) corresponding to production levels of 6000, 8000, and 12,000 units, respectively.

32. LINEAR DEPRECIATION An office building worth \$6 million when it was completed in 2008 is being depreciated linearly over 30 years.

- What is the rate of depreciation?
- What will be the book value of the building in 2018?

33. DEMAND EQUATIONS There is no demand for a certain commodity when the unit price is \$200 or more, but for each \$10 decrease in price below \$200, the quantity demanded increases by 200 units. Find the demand equation and sketch its graph.

34. SUPPLY EQUATIONS Bicycle suppliers will make 200 bicycles available in the market per month when the unit price is \$50 and 2000 bicycles available per month when the unit price is \$100. Find the supply equation if it is known to be linear.

35. CLARK'S RULE Clark's Rule is a method for calculating pediatric drug dosages based on a child's weight. If a denotes the adult dosage (in milligrams) and w is the weight of the child (in pounds), then the child's dosage is given by

$$D(w) = \frac{aw}{150}$$

If the adult dose of a substance is 500 mg, how much should a child who weighs 35 lb receive?

36. REVENUE FUNCTIONS The monthly revenue R (in hundreds of dollars) realized in the sale of Royal electric shavers is related to the unit price p (in dollars) by the equation

$$R(p) = -\frac{1}{2}p^2 + 30p$$

Find the revenue when an electric shaver is priced at \$30.

37. GROWTH OF CRUISE INDUSTRY The number of North American cruise ship passengers has been increasing over the last several decades. The number of cruise ship passengers from 1995 through 2010 is approximated by the function

$$N(t) = 0.011t^2 + 0.521t + 4.6 \quad (0 \leq t \leq 15)$$

where $N(t)$ is the number of passengers (in millions) in year t , with $t = 0$ corresponding to 1995. What was the approximate number of passengers in 1995? In 2010?
Source: Cruise Lines International Association.

38. MALE LIFE EXPECTANCY Advances in medical science and healthier lifestyles have resulted in longer life expectancies. The life expectancy of a male whose current age is x years old is

$$f(x) = 0.0069502x^2 - 1.6357x + 93.76 \quad (60 \leq x \leq 75)$$

years. What is the life expectancy of a male whose current age is 65? A male whose current age is 75?

Source: Commissioners' Standard Ordinary Mortality Table.

39. FEMALE LIFE EXPECTANCY Advances in medical science and healthier lifestyles have resulted in longer life expectancies. The life expectancy of a female whose current age is x years old is

$$f(x) = 0.0053694x^2 - 1.4663x + 92.74 \quad (60 \leq x \leq 75)$$

years. What is the life expectancy of a female whose current age is 65? Whose current age is 75?

Source: Commissioners' Standard Ordinary Mortality Table.

40. HEALTH CLUB MEMBERSHIP The membership of the newly opened Venus Health Club is approximated by the function

$$N(x) = 200(4 + x)^{1/2} \quad (1 \leq x \leq 24)$$

where $N(x)$ denotes the number of members x months after the club's grand opening. Find $N(0)$ and $N(12)$, and interpret your results.

41. POPULATION GROWTH A study prepared for a Sunbelt town's Chamber of Commerce projected that the population of the town in the next 3 years will grow according to the rule

$$P(x) = 50,000 + 30x^{3/2} + 20x$$

where $P(x)$ denotes the population x months from now. By how much will the population increase during the next 9 months? During the next 16 months?

42. THURSTONE LEARNING CURVE Psychologist L. L. Thurstone discovered the following model for the relationship between the learning time T and the length of a list n :

$$T = f(n) = An\sqrt{n - b}$$

where A and b are constants that depend on the person and the task. Suppose that, for a certain person and a certain task, $A = 4$ and $b = 4$. Compute $f(4)$, $f(5)$, ..., $f(12)$, and use this information to sketch the graph of the function f . Interpret your results.

43. GLOBAL SUPPLY OF PLUTONIUM The global stockpile of plutonium for military applications between 1990 ($t = 0$) and 2003 ($t = 13$) stood at a constant 267 tons. On the other hand, the global stockpile of plutonium for civilian use was

$$2t^2 + 46t + 733$$

tons in year t over the same period.

- a. Find the function f giving the global stockpile of plutonium for military use from 1990 through 2003 and the function g giving the global stockpile of plutonium for civilian use over the same period.
- b. Find the function h giving the total global stockpile of plutonium between 1990 and 2003.
- c. What was the total global stockpile of plutonium in 2003?

Source: Institute for Science and International Security.

44. **MARKET EQUILIBRIUM** The monthly demand and supply functions for the Luminar desk lamp are given by

$$p = d(x) = -1.1x^2 + 1.5x + 40$$

$$p = s(x) = 0.1x^2 + 0.5x + 15$$

respectively, where p is measured in dollars and x in units of a thousand. Find the equilibrium quantity and price.

45. **INFLATING A BALLOON** A spherical balloon is being inflated at a rate of $\frac{9}{2}\pi$ ft³/min.

- a. Find a function f giving the radius r of the balloon in terms of its volume V .

$$\text{Hint: } V = \frac{4}{3}\pi r^3$$

- b. Find a function g giving the volume of the balloon in terms of time t .

- c. Find a function h giving the radius of the balloon in terms of time.

- d. What is the radius of the balloon after 8 min?

46. **HOTEL OCCUPANCY RATE** A forecast released by PricewaterhouseCoopers in June of 2004 predicted the occupancy rate of U.S. hotels between 2001 ($t = 0$) and 2005 ($t = 4$) to be

$$P(t) = \begin{cases} -0.9t + 59.8 & \text{if } 0 \leq t < 1 \\ 0.3t + 58.6 & \text{if } 1 \leq t < 2 \\ 56.79t^{0.06} & \text{if } 2 \leq t \leq 4 \end{cases}$$

percent.

- a. Compute $P(0)$, $P(1)$, $P(2)$, $P(3)$, and $P(4)$.

- b. Sketch the graph of P .

- c. What was the predicted occupancy rate of hotels for 2004?

Source: PricewaterhouseCoopers LLP Hospitality & Leisure Research.

47. **PACKAGING** By cutting away identical squares from each corner of a 20-in. \times 20-in. piece of cardboard and folding up the resulting flaps, an open box can be made. Denoting the length of a side of a cutaway by x , find a function of x giving the volume of the resulting box.

48. **CONSTRUCTION COSTS** The length of a rectangular box is to be twice its width, and its volume is to be 30 ft³. The material for the base costs 30¢/ft², the material for the sides costs 15¢/ft², and the material for the top costs 20¢/ft². Letting x denote the width of the box, find a function in the variable x giving the cost of constructing the box.

The problem-solving skills that you learn in each chapter are building blocks for the rest of the course. Therefore, it is a good idea to make sure that you have mastered these skills before moving on to the next chapter. The Before Moving On exercises that follow are designed for that purpose. After completing these exercises, you can identify the skills that you should review before starting the next chapter.

CHAPTER 2 Before Moving On...

1. Find an equation of the line that passes through $(-1, -2)$ and $(4, 5)$.

2. Find an equation of the line that has slope $-\frac{1}{3}$ and y-intercept $\frac{4}{3}$.

3. Let

$$f(x) = \begin{cases} -2x + 1 & \text{if } -1 \leq x < 0 \\ x^2 + 2 & \text{if } 0 \leq x \leq 2 \end{cases}$$

Find (a) $f(-1)$, (b) $f(0)$, and (c) $f(\frac{3}{2})$.

4. Let $f(x) = \frac{1}{x+1}$ and $g(x) = x^2 + 1$. Find the rules for

(a) $f + g$, (b) fg , (c) $f \circ g$, and (d) $g \circ f$.

5. **POSTAL REGULATIONS** Postal regulations specify that a parcel sent by parcel post may have a combined length and girth of no more than 108 in. Suppose a rectangular package that has a square cross section of x in. \times x in. is to have a combined length and girth of exactly 108 in. Find a function in terms of x giving the volume of the package.

Hint: The length plus the girth is $4x + h$ (see the accompanying figure).

