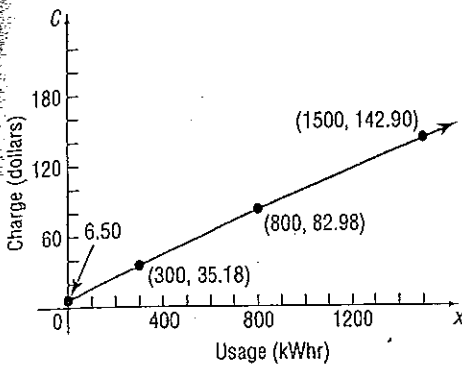**Figure 42**

The rule for computing C follows two equations:

$$C(x) = \begin{cases} 0.0956x + 6.50 & \text{if } 0 \le x \le 800 \\ 0.0856x + 14.50 & \text{if } x > 800 \end{cases} \quad \text{The Model}$$

See Figure 42 for the graph.

1.4 Assess Your Understanding

'Are You Prepared?' *Answers are given at the end of these exercises. If you get a wrong answer, read the pages listed in red.*

1. Sketch the graph of $y = \sqrt{x}$. (p. 15)

2. Sketch the graph of $y = \dfrac{1}{x}$. (pp. 15–16)

3. List the intercepts of the equation $y = x^3 - 8$. (p. 12)

Concepts and Vocabulary

4. The function $f(x) = x^2$ is decreasing on the interval _____

5. When functions are defined by more than one equation, they are called _____ functions.

6. *True or False* The cube function is odd and is increasing on the interval $(-\infty, \infty)$.

7. *True or False* The cube root function is odd and is decreasing on the interval $(-\infty, \infty)$.

8. *True or False* The domain and the range of the reciprocal function are the set of all real numbers.

Skill Building

In Problems 9–16, match each graph to its function.

A. *Constant function*   B. *Identity function*   C. *Square function*   D. *Cube function*
E. *Square root function*   F. *Reciprocal function*   G. *Absolute value function*   H. *Cube root function*

9.
10.
11.
12.
13.
14.
15.
16.
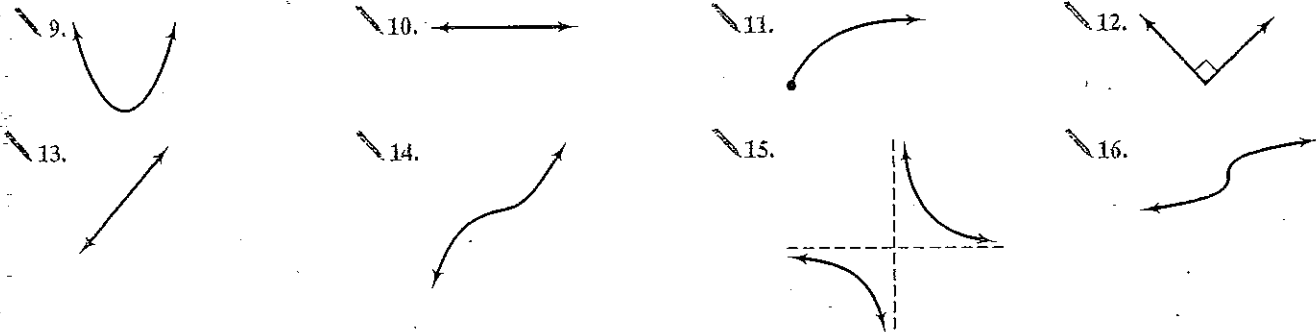
In Problems 17–24, sketch the graph of each function. Be sure to label three points on the graph.

17. $f(x) = x$

18. $f(x) = x^2$

19. $f(x) = x^3$

20. $f(x) = \sqrt{x}$

21. $f(x) = \dfrac{1}{x}$

22. $f(x) = |x|$

23. $f(x) = \sqrt[3]{x}$

24. $f(x) = 3$

25. If $f(x) = \begin{cases} x^2 & \text{if } x < 0 \\ 2 & \text{if } x = 0 \\ 2x + 1 & \text{if } x > 0 \end{cases}$

find: (a) $f(-2)$ (b) $f(0)$ (c) $f(2)$

26. If $f(x) = \begin{cases} -3x & \text{if } x < -1 \\ 0 & \text{if } x = -1 \\ 2x^2 + 1 & \text{if } x > -1 \end{cases}$

find: (a) $f(-2)$ (b) $f(-1)$ (c) $f(0)$

27. If $f(x) = \begin{cases} 2x - 4 & \text{if } -1 \le x \le 2 \\ x^3 - 2 & \text{if } 2 < x \le 3 \end{cases}$

find: (a) $f(0)$ (b) $f(1)$ (c) $f(2)$ (d) $f(3)$

28. If $f(x) = \begin{cases} x^3 & \text{if } -2 \le x < 1 \\ 3x + 2 & \text{if } 1 \le x \le 4 \end{cases}$

find: (a) $f(-1)$ (b) $f(0)$ (c) $f(1)$ (d) $f(3)$

In Problems 29–40:

(a) *Find the domain of each function.*   (b) *Locate any intercepts.*   (c) *Graph each function.*

(d) *Based on the graph, find the range.*   (e) *Is f continuous on its domain?*

29. $f(x) = \begin{cases} 2x & \text{if } x \neq 0 \\ 1 & \text{if } x = 0 \end{cases}$ **30.** $f(x) = \begin{cases} 3x & \text{if } x \neq 0 \\ 4 & \text{if } x = 0 \end{cases}$ **31.** $f(x) = \begin{cases} -2x + 3 & \text{if } x < 1 \\ 3x - 2 & \text{if } x \geq 1 \end{cases}$

32. $f(x) = \begin{cases} x + 3 & \text{if } x < -2 \\ -2x - 3 & \text{if } x \geq -2 \end{cases}$ **33.** $f(x) = \begin{cases} x + 3 & \text{if } -2 \leq x < 1 \\ 5 & \text{if } x = 1 \\ -x + 2 & \text{if } x > 1 \end{cases}$ **34.** $f(x) = \begin{cases} 2x + 5 & \text{if } -3 \leq x < 0 \\ -3 & \text{if } x = 0 \\ -5x & \text{if } x > 0 \end{cases}$

35. $f(x) = \begin{cases} 1 + x & \text{if } x < 0 \\ x^2 & \text{if } x \geq 0 \end{cases}$ **36.** $f(x) = \begin{cases} \dfrac{1}{x} & \text{if } x < 0 \\ \sqrt[3]{x} & \text{if } x \geq 0 \end{cases}$ **37.** $f(x) = \begin{cases} |x| & \text{if } -2 \leq x < 0 \\ x^3 & \text{if } x \geq 0 \end{cases}$
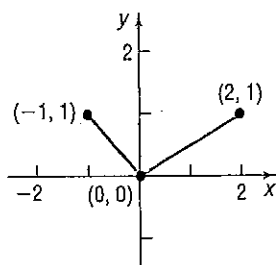
38. $f(x) = \begin{cases} 2 - x & \text{if } -3 \leq x < 1 \\ \sqrt{x} & \text{if } x \geq 1 \end{cases}$ **39.** $f(x) = 2 \operatorname{int}(x)$ **40.** $f(x) = \operatorname{int}(2x)$
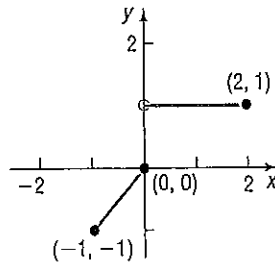
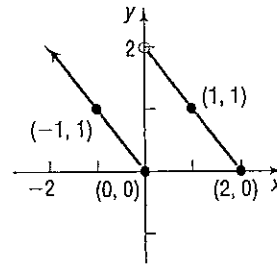*In Problems 41–44, the graph of a piecewise-defined function is given. Write a definition for each function.*
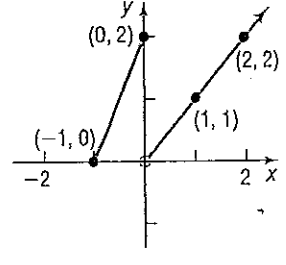
41.   **42.**   **43.**   **44.**

45. If $f(x) = \operatorname{int}(2x)$, find

(a) $f(1.2)$ (b) $f(1.6)$ (c) $f(-1.8)$

46. If $f(x) = \operatorname{int}\left(\dfrac{x}{2}\right)$, find

(a) $f(1.2)$ (b) $f(1.6)$ (c) $f(-1.8)$

Applications and Extensions

47. Cell Phone Service Sprint PCS offers a monthly cellular phone plan for $39.99. It includes 450 anytime minutes and charges $0.45 per minute for additional minutes. The following function is used to compute the monthly cost for a subscriber:

$$C(x) = \begin{cases} 39.99 & \text{if } 0 \leq x \leq 450 \\ 0.45x - 162.51 & \text{if } x > 450 \end{cases}$$

where x is the number of anytime minutes used. Compute the monthly cost of the cellular phone for use of the following numbers of anytime minutes:

(a) 200   (b) 465   (c) 451

Source: Sprint PCS

48. Parking at O'Hare International Airport The short-term (no more than 24 hours) parking fee F (in dollars) for parking x hours on a weekday at O'Hare International Airport's main parking garage can be modeled by the function

$$F(x) = \begin{cases} 2 & \text{if } 0 < x \leq 1 \\ 4 & \text{if } 1 < x \leq 3 \\ 10 & \text{if } 3 < x \leq 4 \\ 5 \operatorname{int}(x + 1) + 2 & \text{if } 4 < x < 9 \\ 51 & \text{if } 9 \leq x \leq 24 \end{cases}$$

Determine the fee for parking in the short-term parking garage for

(a) 2 hours   (b) 7 hours   (c) 15 hours

(d) 8 hours and 24 minutes

Source: O'Hare International Airport

49. Cost of Natural Gas In March 2013, Peoples Energy had the following rate schedule for natural gas usage in single-family residences:

Monthly service charge	$22.25
Per therm service charge	
First 50 therms	$0.25963/therm
Over 50 therms	$0.11806/therm
Gas charge	$0.3922/therm

(a) What is the charge for using 50 therms in a month?

(b) What is the charge for using 500 therms in a month?

(c) Develop a function that models the monthly charge C for x therms of gas.

(d) Graph the function found in part (c).

Source: Peoples Energy, Chicago, Illinois, 2013

50. Cost of Natural Gas In February 2013, Laclede Gas had the following rate schedule for natural gas usage in single-family residences:

Monthly customer charge	$19.50
Distribution charge	
First 30 therms	$0.65403/therm
Over 30 therms	$0.04235/therm
Gas supply charge	$0.53668/therm

(a) What is the charge for using 20 therms in a month?
(b) What is the charge for using 150 therms in a month?
(c) Develop a model that gives the monthly charge C for x therms of gas.
(d) Graph the function found in part (c).
Source: Laclede Gas, 2013

51. Federal Income Tax Refer to the 2013 Tax Rate Schedules. If x equals taxable income and y equals the tax due, construct a function $y = f(x)$ for Schedule X.

52. Federal Income Tax Refer to the 2013 tax rate schedules. If x equals taxable income and y equals the tax due, construct a function $y = f(x)$ for Schedule Y-1.

2013 Tax Rate Schedules									
Schedule X-Single					Schedule Y-1 - Married Filing Jointly or Qualified Widow(er)				
If Taxable Income Is Over	But Not Over	The Tax Is This Amount	Plus This %	Of the Excess Over	If Taxable Income Is Over	But Not Over	The Tax Is This Amount	Plus This %	Of the Excess Over
$0	$8,925	$0 +	10%	$0	$0	$17,850	$0 +	10%	$0
8,925	36,250	892.50 +	15%	8,925	17,850	72,500	1,785 +	15%	17,850
36,250	87,850	4,991.25 +	25%	36,250	72,500	146,400	9,982.50 +	25%	72,500
87,850	183,250	17,891.25 +	28%	87,850	146,400	223,050	28,457.50 +	28%	146,400
183,250	398,350	44,603.25 +	33%	183,250	223,050	398,350	49,919.50 +	33%	223,050
398,350	400,000	115,586.25 +	35%	398,350	398,350	450,000	107,768.50 +	35%	398,350
400,000	–	116,163.75 +	39.6%	400,000	450,000	–	125,846 +	39.6%	450,000

Source: Internal Revenue Service

53. Cost of Transporting Goods A trucking company transports goods between Chicago and New York, a distance of 960 miles. The company's policy is to charge, for each pound, $0.50 per mile for the first 100 miles, $0.40 per mile for the next 300 miles, $0.25 per mile for the next 400 miles, and no charge for the remaining 160 miles.
(a) Graph the relationship between the cost of transportation in dollars and mileage over the entire 960-mile route.
(b) Find the cost as a function of mileage for hauls between 100 and 400 miles from Chicago.
(c) Find the cost as a function of mileage for hauls between 400 and 800 miles from Chicago.

54. Car Rental Costs An economy car rented in Florida from Enterprise® on a weekly basis costs $185 per week. Extra days cost $37 per day until the day rate exceeds the weekly rate, in which case the weekly rate applies. Also, any part of a day used counts as a full day. Find the cost C of renting an economy car as a function of the number x of days used, where $7 \le x \le 14$. Graph this function.
Source: enterprise.com

55. Mortgage Fees Fannie Mae charges a loan-level price adjustment (LLPA) on all mortgages, which represents a fee homebuyers seeking a loan must pay. The rate paid depends on the credit score of the borrower, the amount borrowed, and the loan-to-value (LTV) ratio. The LTV ratio is the ratio of amount borrowed to appraised value of the home. For example, a homebuyer who wishes to borrow $250,000 with a credit score of 730 and an LTV ratio of 80% will pay 0.5%

(0.005) of $250,000, or $1250. The table shows the LLPA for various credit scores and an LTV ratio of 80%.

Credit Score	Loan-Level Price Adjustment Rate
≤ 659	3.00%
660–679	2.50%
680–699	1.75%
700–719	1%
720–739	0.5%
≥ 740	0.25%

Source: Fannie Mae.

(a) Construct a function $C = C(s)$, where C is the loan-level price adjustment (LLPA) and s is the credit score of an individual who wishes to borrow $300,000 with an 80% LTV ratio.
(b) What is the LLPA on a $300,000 loan with an 80% LTV ratio for a borrower whose credit score is 725?
(c) What is the LLPA on a $300,000 loan with an 80% LTV ratio for a borrower whose credit score is 670?

56. Minimum Payments for Credit Cards Holders of credit cards issued by banks, department stores, oil companies, and so on receive bills each month that state minimum amounts that must be paid by a certain due date. The minimum due depends on the total amount owed. One such credit card