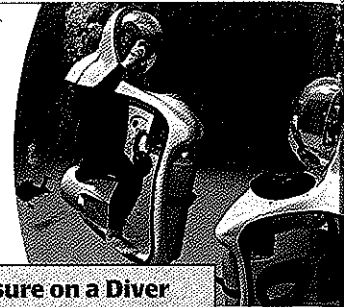


DOMAINS IN REAL LIFE In Example 5, the domain of each function is all real numbers because there is an output for every real number x . In real life, you may need to restrict the domain so that it is reasonable in the given situation.

EXAMPLE 6 Use a function in real life

DIVING A diver using a Diver Propulsion Vehicle (DPV) descends to a depth of 130 feet. The pressure P (in atmospheres) on the diver is given by $P(d) = 1 + 0.03d$ where d is the depth (in feet). Graph the function, and determine a reasonable domain and range. What is the pressure on the diver at a depth of 33 feet?

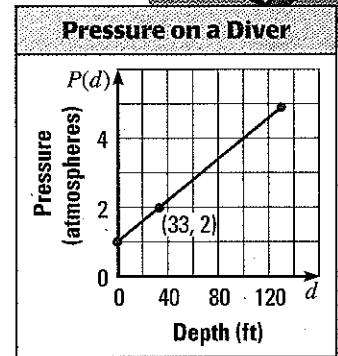


Solution

The graph of $P(d)$ is shown. Because the depth varies from 0 feet to 130 feet, a reasonable domain is $0 \leq d \leq 130$.

The minimum value of $P(d)$ is $P(0) = 1$, and the maximum value of $P(d)$ is $P(130) = 4.9$. So, a reasonable range is $1 \leq P(d) \leq 4.9$.

► At a depth of 33 feet, the pressure on the diver is $P(33) = 1 + 0.03(33) \approx 2$ atmospheres, which you can verify from the graph.



GUIDED PRACTICE for Example 6

7. **OCEAN EXPLORATION** In 1960, the deep-sea vessel *Trieste* descended to an estimated depth of 35,800 feet. Determine a reasonable domain and range of the function $P(d)$ in Example 6 for this trip.

2.1 EXERCISES

HOMEWORK KEY

- = WORKED-OUT SOLUTIONS on p. WS2 for Exs. 7, 17, and 45
- ★ = STANDARDIZED TEST PRACTICE Exs. 2, 9, 20, 24, 40, 46, and 49

SKILL PRACTICE

1. **VOCABULARY** Copy and complete: In the equation $y = x + 5$, x is the ? variable and y is the ? variable.
2. ★ **WRITING** Describe how to find the domain and range of a relation given by a set of ordered pairs.

EXAMPLE 1
on p. 72
for Exs. 3–9

REPRESENTING RELATIONS Identify the domain and range of the given relation. Then represent the relation using a graph and a mapping diagram.

3. $(-2, 3), (1, 2), (3, -1), (-4, -3)$
4. $(5, -2), (-3, -2), (3, 3), (-1, -1)$
5. $(6, -1), (-2, -3), (1, 8), (-2, 5)$
6. $(-7, 4), (2, -5), (1, -2), (-3, 6)$
7. $(5, 20), (10, 20), (15, 30), (20, 30)$
8. $(4, -2), (4, 2), (16, -4), (16, 4)$

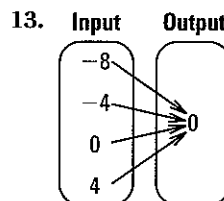
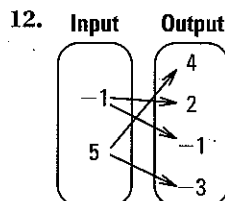
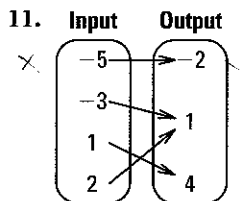
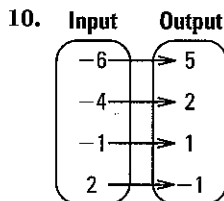
9. ★ **MULTIPLE CHOICE** What is the domain of the relation given by the ordered pairs $(-4, 2)$, $(-1, -3)$, $(1, 4)$, $(1, -3)$, and $(2, 1)$?

- (A) $-3, 1, 2$, and 4 (B) $-4, -1, 1$, and 2
 (C) $-4, -3, -1$, and 2 (D) $-4, -3, -1, 1, 2$, and 4

EXAMPLE 2

on p. 73
 for Exs. 10–20

IDENTIFYING FUNCTIONS Tell whether the relation is a function. *Explain.*



ERROR ANALYSIS Describe and correct the error in the student's work.

14. The relation given by the ordered pairs $(-4, 2)$, $(-1, 5)$, $(3, 6)$, and $(7, 2)$ is not a function because the inputs -4 and 7 are both mapped to the output 2 .

15.

x	0	1	2	1	0
y	5	6	7	8	9

The relation given by the table is a function because there is only one value of x for each value of y .

IDENTIFYING FUNCTIONS Tell whether the relation is a function. *Explain.*

16. $(3, -2)$, $(0, 1)$, $(1, 0)$, $(-2, -1)$, $(2, -1)$ (17) $(2, -5)$, $(-2, 5)$, $(-1, 4)$, $(-2, 0)$, $(3, -4)$
 (18) $(0, 1)$, $(1, 0)$, $(2, 3)$, $(3, 2)$, $(4, 4)$ 19. $(-1, -1)$, $(2, 5)$, $(4, 8)$, $(-5, -9)$, $(-1, -5)$

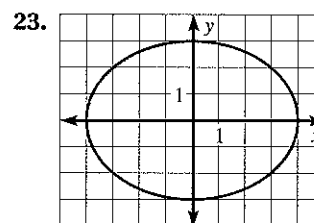
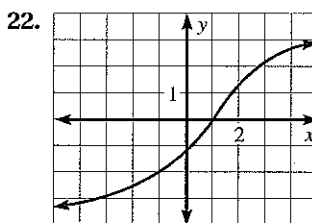
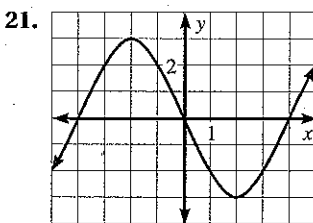
20. ★ **MULTIPLE CHOICE** The relation given by the ordered pairs $(-6, 3)$, $(-2, 4)$, $(1, 5)$, and $(4, 0)$ is a function. Which ordered pair can be included with this relation to form a new relation that is also a function?

- (A) $(1, -5)$ (B) $(6, 3)$ (C) $(-2, 19)$ (D) $(4, 4)$

EXAMPLE 3

on p. 74
 for Exs. 21–23

VERTICAL LINE TEST Use the vertical line test to tell whether the relation is a function.



24. ★ **SHORT RESPONSE** Explain why a relation is not a function if a vertical line intersects the graph of the relation more than once.

EXAMPLE 4

on p. 75
 for Exs. 25–33

GRAPHING EQUATIONS Graph the equation.

25. $y = x + 2$ 26. $y = -x + 5$ 27. $y = 3x + 1$
 28. $y = 5x - 3$ (29) $y = 2x - 7$ 30. $y = -3x + 2$
 31. $y = -2x$ 32. $y = \frac{1}{2}x + 2$ 33. $y = -\frac{3}{4}x - 1$

EXAMPLE 5
on p. 75
for Exs. 34–39

EVALUATING FUNCTIONS Tell whether the function is linear. Then evaluate the function for the given value of x .

34. $f(x) = x + 15; f(8)$

35. $f(x) = x^2 + 1; f(-3)$

36. $f(x) = |x| + 10; f(-4)$

37. $f(x) = 6; f(2)$

38. $g(x) = x^3 - 2x^2 + 5x - 8; g(-5)$

39. $h(x) = 7 - \frac{2}{3}x; h(15)$

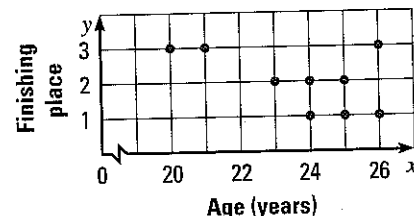
40. **★ SHORT RESPONSE** Which, if any, of the relations described by the equations $y = |x|$, $x = |y|$, and $|y| = |x|$ represent functions? *Explain.*

41. **CHALLENGE** Let f be a function such that $f(a + b) = f(a) + f(b)$ for all real numbers a and b . Show that $f(2a) = 2 \cdot f(a)$ and that $f(0) = 0$.

PROBLEM SOLVING

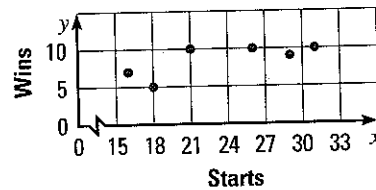
EXAMPLE 3
on p. 74
for Exs. 42–43

42. **BICYCLING** The graph shows the ages of the top three finishers in the Mt. Washington Auto Road Bicycle Hillclimb each year from 2002 through 2004. Do the ordered pairs (age, finishing place) represent a function? *Explain.*



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43. **BASEBALL** The graph shows the number of games started and the number of wins for each starting pitcher on a baseball team during a regular season. Do the ordered pairs (starts, wins) represent a function? *Explain.*



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44. **GEOMETRY** The volume V of a cube with edge length s is given by the function $V(s) = s^3$. Find $V(4)$. *Explain* what $V(4)$ represents.

45. **GEOMETRY** The volume V of a sphere with radius r is given by the function $V(r) = \frac{4}{3}\pi r^3$. Find $V(6)$. *Explain* what $V(6)$ represents.

EXAMPLE 6
on p. 76
for Exs. 46–48

46. **★ SHORT RESPONSE** For the period 1999–2004, the average number of acres w (in thousands), used to grow watermelons in the United States can be modeled by the function $w(t) = -6.26t + 172$ where t is the number of years since 1999. Determine a reasonable domain and range for $w(t)$. *Explain* the meaning of the range.

47. **MULTI-STEP PROBLEM** Anthropologists can estimate a person's height from the length of certain bones. The height h (in inches) of an adult human female can be modeled by the function $h(\ell) = 1.95\ell + 28.7$ where ℓ is the length (in inches) of the femur, or thigh bone. The function is valid for femur lengths between 15 inches and 24 inches, inclusive.

- Graph the function, and determine a reasonable domain and range.
- Suppose a female's femur is 15.5 inches long. About how tall was she?
- If an anthropologist estimates a female's height as 5 feet 11 inches, about how long is her femur?

○ = WORKED-OUT SOLUTIONS
on p. WS1

★ = STANDARDIZED
TEST PRACTICE

48. **MOUNTAIN CLIMBING** A climber on Mount Rainier in Washington hikes from an elevation of 5400 feet above sea level to Camp Muir, which has an elevation of 10,100 feet. The elevation h (in feet) as the climber ascends can be modeled by $h(t) = 1000t + 5400$ where t is the time (in hours). Graph the function, and determine a reasonable domain and range. What is the climber's elevation after hiking 3.5 hours?



49. **★ EXTENDED RESPONSE** The table shows the populations of several states and their electoral votes in the 2004 and 2008 U.S. presidential elections. The figures are based on U.S. census data for the year 2000.

State	Population (millions), p	Electoral votes, v
California	33.87	55
Florida	15.98	27
Illinois	12.42	21
New York	18.98	31
Ohio	11.35	20
Pennsylvania	12.28	21
Texas	20.85	34

- Identify the domain and range of the relation given by the ordered pairs (p, v) .
- Is the relation from part (a) a function? *Explain.*
- Is the relation given by the ordered pairs (v, p) a function? *Explain.*

50. **CHALLENGE** The table shows ground shipping charges for an online retail store.

Merchandise cost	Shipping cost
\$0.01–\$30.00	\$4.50
\$30.01–\$60.00	\$7.25
\$60.01–\$100.00	\$9.50
Over \$100.00	\$12.50

- Is the shipping cost a function of the merchandise cost? *Explain.*
- Is the merchandise cost a function of the shipping cost? *Explain.*

MIXED REVIEW

PREVIEW

Prepare for
Lesson 2.2
in Exs. 51–54.

Evaluate the expression for the given values of x and y . (p. 10)

51. $\frac{y-3}{x-4}$ when $x = 6$ and $y = 2$

52. $\frac{y-8}{x-2}$ when $x = 3$ and $y = 4$

53. $\frac{y-(-5)}{x-1}$ when $x = -3$ and $y = -3$

54. $\frac{24-y}{15-x}$ when $x = -17$ and $y = 8$

Solve the equation. Check your solution. (p. 18)

55. $3x + 16 = 31$

56. $-4x - 7 = 17$

57. $5x + 12 = -3x - 4$

58. $5 - 8z = 25 + 4z$

59. $\frac{5}{2}(3v - 4) = 30$

60. $6(4w + 1) = 1.5(8w + 18)$

Solve the inequality. Then graph the solution. (p. 41)

61. $2x - 6 > 8$

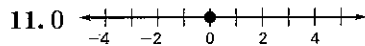
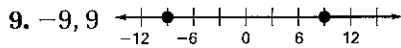
62. $\frac{1}{4}x + 7 > 0$

63. $15 - 2x \leq 7$

64. $4 - x < 3$

65. $-7 < 6x - 1 < 5$

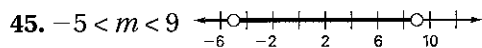
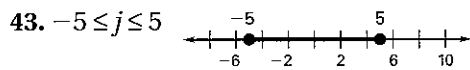
66. $x - 2 \leq 1$ or $4x + 3 \geq 19$



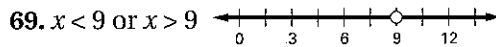
21. $-4, 9$ 23. $\frac{6}{7}, 2$ 25. $-7, 4$ 27. $-7, 2$ 29. $1\frac{4}{9}, 3$

31. $-20, 4$ 33. No; the equation has no solutions because an absolute value will never be negative.

35. -3 37. $-1\frac{1}{2}, -\frac{1}{2}$ 39. $-\frac{1}{6}, -3\frac{3}{4}$ 41. When writing the second equation, the right side of the equation should be $-x - 3$; $5x - 9 = -x - 3$, $6x - 9 = -3$, $6x = 6$, $x = 1$, the solutions are 3 and 1.



65. $c > 0$, $c = 0$, $c < 0$ 67. no solution



71. $x \leq \frac{-c-b}{a}$ or $x \geq \frac{c-b}{a}$ 73. $x < \frac{c-b}{a}$ or $x > \frac{-c-b}{a}$

75. $|p - 6.5| \leq 1$ 77. $|b - 21| > 1$ 79. $|x - 45| \leq 15$

81. $|e - 6008| \leq 5992$, $|m - 46,000| \leq 45,000$

Chapter Review (pp. 61–64) 1. exponent, base

3. extraneous solution 5. *Sample answer:* $3(x - 4)$

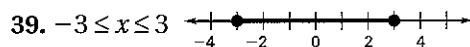
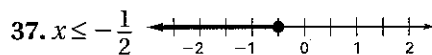
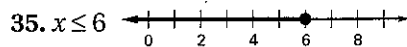
and $3x - 12$ 7. Inverse property of multiplication

9. Distributive property 11. $3x - 6y$ 13. $18b - 33$

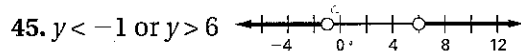
15. $-2t^4 + 5t^2$ 17. $-\frac{1}{6}$ 19. 9 21. -1 23. \$74.99

25. $y = -10x + 7$; -23 27. $y = \frac{-15}{x-6}$; 15 29. $y = \frac{5}{2}x - 5$;

-20 31. $\bar{h} = \frac{S - 2\pi r^2}{2\pi r}$; about 7.73 cm 33. 602 mi



41. $-3, 1\frac{2}{3}$ 43. no solution

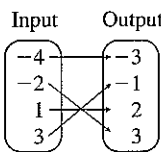
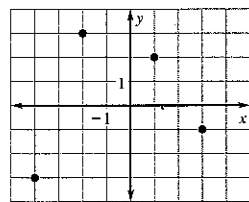


47. $|v - 26| \leq 0.5$, $25.5 \text{ in.} \leq v \leq 26.5 \text{ in.}$

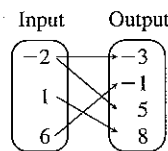
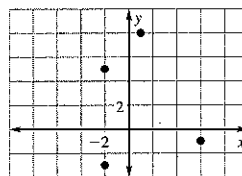
Chapter 2

2.1 Skill Practice (pp. 76–78) 1. independent, dependent

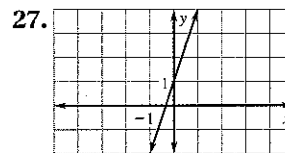
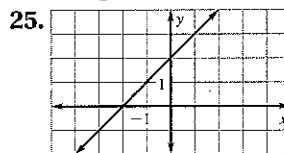
3. domain: $-4, -2, 1, 3$, range: $-3, -1, 2, 3$



5. domain: $-2, 1, 6$, range: $-3, -1, 5, 8$



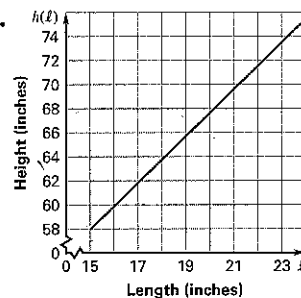
11. Yes; each input has exactly one output. 13. Yes; each input has exactly one output. 15. x is the input and y is the output, so there should be one value of y for each value of x ; the relation given by the table is not a function because the inputs 1 and 0 each have more than one output. 17. No; the input -2 has more than one output. 19. No; the input -1 has more than one output. 21. function 23. not a function



35. not linear; 10 37. linear; 6 39. linear; -3

2.1 Problem Solving (pp. 78–79) 43. Yes; each input has exactly one output. 45. About 905; $V(6)$ represents the volume of a sphere with radius 6.

47. a.

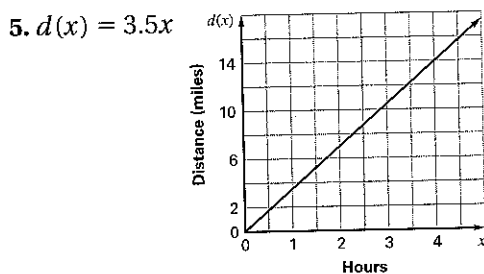
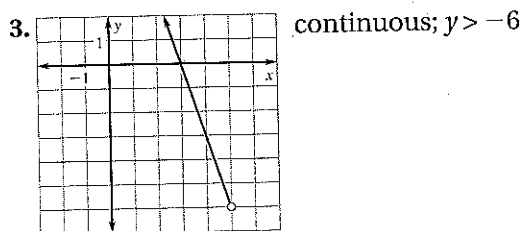


domain:
 $15 \leq l \leq 24$,
range:
 $57.95 \leq h(l) \leq 75.5$

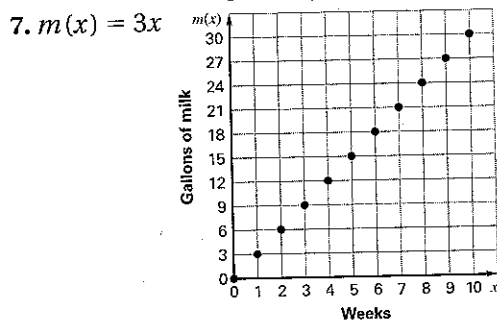
b. 59 in. or 4 ft 11 in. c. 21.7 in. 49. a. domain: 11,350,000, 12,280,000, 12,420,000, 15,980,000, 18,980,000, 20,850,000, 33,870,000, range: 20, 21, 27, 31, 34, 55 b. Yes; each input p has exactly one output. c. No; the input 21 has more than one output.

Extension (p. 81)

1. discrete; $-1, 1, 3, 5, 7$



domain: $x \geq 0$, range: $d(x) \geq 0$; continuous



domain: whole numbers, range: multiples of 3; discrete

2.2 Skill Practice (pp. 86–87) 1. slope $3\frac{3}{2}$; rises

5. $-\frac{5}{3}$; falls 7. -4 ; falls 9. $\frac{7}{4}$; rises 11. undefined;

is vertical 13. 0; is horizontal 15. The x and y coordinates were not subtracted in the correct order; $\frac{-1 - (-3)}{2 - (-4)} = \frac{1}{3}$ 19. neither 21. perpendicular

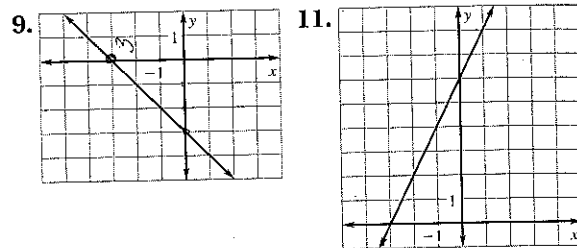
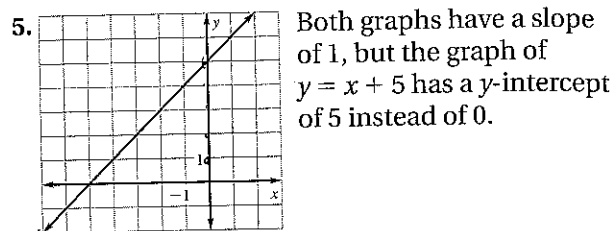
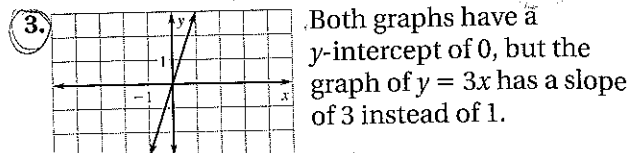
23. parallel 25. 13 mi/gal 27. 2 m/sec 29. 2 31. $\frac{1}{6}$

33. $-\frac{3}{2}$ 35. No; no. *Sample answer:* The slope of $\overrightarrow{PQ} = \frac{2-1}{-3-(-1)} = -\frac{1}{2}$. The slope of $\overrightarrow{QR} = \frac{1-0}{-1-1} = -\frac{1}{2}$. The slope of $\overrightarrow{ST} = \frac{-1-(-2)}{3-5} = -\frac{1}{2}$.

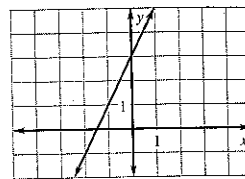
2.2 Problem Solving (pp. 87–88) 41. $\frac{7}{12}$ 43. 6.5%

47. a. $\frac{3}{8}$ b. yes c. $\frac{1}{8}$

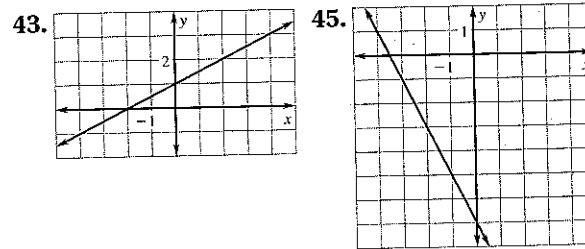
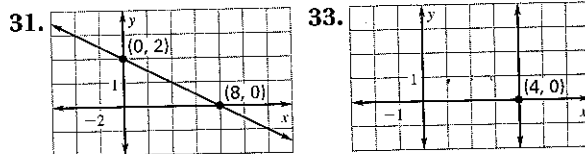
2.3 Skill Practice (pp. 93–94) 1. slope-intercept



21. The slope and y -intercept were switched around.



25. x -intercept: -15 , y -intercept: -3 27. x -intercept: 5, y -intercept: -10 29. x -intercept: 6, y -intercept: -4.5



55. *Sample answer:* $x = 3$, $y = -2$ 57. slope: $-\frac{A}{B}$, y -intercept: $\frac{C}{B}$