Worked-Out Solutions

This section of the book provides step-by-step solutions to exercises with circled exercise numbers. These solutions provide models that can help guide your work with the homework exercises.

The separate **Selected Answers** section follows this section. It provides numerous answers that you can use to check your own answers.

Chapter 1

Lesson 1.1 (pp. 6–9)

21. $7a + (4 + 5a)$

$= 7a + (5a + 4)$ Commutative property of addition

$= (7a + 5a) + 4$ Associative property of addition

$= (7 + 5)a + 4$ Distributive property

$= 12a + 4$ Simplify

31. $350 \text{ feet} \cdot \frac{1 \text{ yard}}{3 \text{ feet}} \approx 116.7 \text{ yards}$

59. a. Pluto, Neptune, Uranus, Saturn, Jupiter, Mars, Earth, Mercury, Venus

b. Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto

c. The greater the distance from the sun, the colder the surface temperature.

d. Venus

Lesson 1.2 (pp. 13–16)

21. When $m = 6$:

$8m + (2m - 9)^3 = 8(6) + (2(6) - 9)^3$

$= 8(6) + (3)^3$

$= 48 + 27 = 75$

29. $7(m - 3) + 4(m + 5) = 7m - 21 + 4m + 20$

$= (7m + 4m) + (-21 + 20) = 11m - 1$

59. $270 - 4.5(x)$. The expression makes sense for all positive integer values of x less than or equal to 60. When $x > 60$, the balance is negative.

Lesson 1.3 (pp. 21–24)

23. $5b - 4 = 2b + 8$ Check:

$3b - 4 = 8$ $5b - 4 = 2b + 8$

$3b = 12$ $5(4) - 4 \stackrel{?}{=} 2(4) + 8$

$b = 4$ $20 - 4 \stackrel{?}{=} 8 + 8$

$16 = 16$ ✓

43. $\frac{1}{2}t + \frac{1}{3}t = 10$ Check:

$6\left(\frac{1}{2}t + \frac{1}{3}\right)t = 6(10)$ $\frac{1}{2}t + \frac{1}{3}t = 10$

$3t + 2t = 60$ $\frac{1}{2}(12) + \frac{1}{3}(12) \stackrel{?}{=} 10$

$5t = 60$ $6 + 4 \stackrel{?}{=} 10$

$t = 12$ $10 = 10$ ✓

71. $7.75(25) + 6.25x = 250$

$193.75 + 6.25x = 250$

$x = 9$

You must work 9 hours/week at the second job.

Lesson 1.4 (pp. 30–32)

3. $A = \ell w \rightarrow \frac{A}{w} = \ell$

When $w = 50$ and $A = 250$: $\ell = \frac{A}{w} = \frac{250}{50} = 5$

The length of the rectangle is 5 millimeters.

9. $6x + 5y = 31 \rightarrow 5y = 31 - 6x \rightarrow y = \frac{31}{5} - \frac{6x}{5}$

When $x = -4$: $y = \frac{31}{5} - \frac{6(-4)}{5} = \frac{55}{5} = 11$

35. $F = \frac{9}{5}C + 32 \rightarrow F - 32 = \frac{9}{5}C \rightarrow \frac{5}{9}(F - 32) = C$

When $F = 50$: $\frac{5}{9}(50 - 32) = C$

$\frac{5}{9}(18) = C$

$10 = C$

The temperature of 10°C corresponds to 50°F.

Lesson 1.5 (pp. 37–40)

3. $d = rt \rightarrow 20 = 40t \rightarrow \frac{1}{2} = t$; $t = \frac{1}{2}$ hour

11. 11 15 19 23 (+4 +4 +4) An equation is $y = 11 + 4x$.

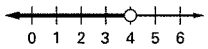
27. 15 16.5 18 19.5 21 (+1.5 +1.5 +1.5 +1.5)

An equation is $y = 15 + 1.5x$. It is not reasonable to assume the pattern in the table continues indefinitely. If it did, the plant would become indefinitely tall.

Lesson 1.6 (pp. 44–47)

13. $x < -2$ or $x > 4$

25. $15 - 3x > 3$



$x < 4$

55. a. Lowland: $0 \le e < 500$

b. Alpine: $2000 \le e < 2429$

Subalpine: $1400 \le e < 2000$

Alpine and subalpine: $1400 \le e < 2429$

c. Not in montane zone: $e < 500$ or $e \ge 1400$

Lesson 1.7 (pp. 55–58)

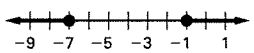
21. $|2d - 5| = 13$

$2d - 5 = -13$ or $2d - 5 = 13$

$2d = -8$ or $2d = 18$

$d = -4$ or $d = 9$

47. $|d + 4| \ge 3$



$d + 4 \le -3$ or $d + 4 \ge 3$

$d \le -7$ or $d \ge -1$

77. Accept: $|b - 21| \le 1$; Reject: $|b - 21| > 1$

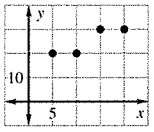
Chapter 2

Lesson 2.1 (pp. 76–79)

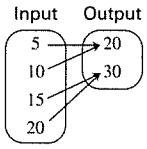
7. (5, 20), (10, 20), (15, 30), (20, 30)

Domain: 5, 10, 15, and 20; Range: 20 and 30

Graph



Mapping Diagram



17. The relation is not a function because the input −2 is mapped to both 0 and 5.

45. $V(r) = \frac{4}{3}\pi r^3$

$V(6) = \frac{4}{3}\pi(6)^3 = 288\pi \approx 905 \text{ units}^3$

$V(6)$ represents the volume of a sphere with a radius of 6 units.

Lesson 2.2 (pp. 86–88)

9. $m = \frac{3 - (-4)}{-1 - (-5)} = \frac{7}{4} > 0$; the line rises.

19. Line 1: through (1, 5) and (3, −2)

Line 2: through (−3, 2) and (4, 0)

$m_1 = \frac{-2 - 5}{3 - 1} = -\frac{7}{2}$

$m_2 = \frac{0 - 2}{4 - (-3)} = -\frac{2}{7}$

Because $m_1 \cdot m_2 = -\frac{7}{2} \cdot -\frac{2}{7} = 1 \ne -1$ and $m_1 \ne m_2$, the lines are neither perpendicular nor parallel.

45. A;

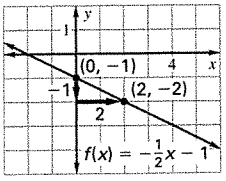
$$\text{Average rate of change} = \frac{\text{change in gallons}}{\text{change in days}}$$

$$= \frac{214 \text{ gallons} - 400 \text{ gallons}}{30 \text{ days} - 0 \text{ days}}$$

$$= \frac{-186 \text{ gallons}}{30 \text{ days}} = -6.2 \text{ gallons per day}$$

Lesson 2.3 (pp. 93–96)

15.

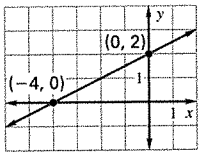


37. $-5x + 10y = 20$

x-intercept:

$-5x + 10(0) = 20$

$x = -4$

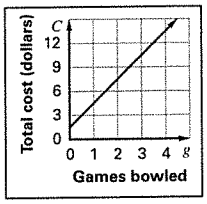


y-intercept:

$-5(0) + 10y = 20$

$y = 2$

61.



The y-intercept, 1.5, represents the cost to rent shoes, \$1.50. The slope, 3, represents the cost per game, \$3.

Lesson 2.4 (pp. 101–104)

15. Let $(x_1, y_1) = (7, -3)$ and $m = -\frac{4}{7}$.

$y - y_1 = m(x - x_1)$

$y - (-3) = -\frac{4}{7}(x - 7)$

$y = -\frac{4}{7}x + 1$

35. Let $(x_1, y_1) = (-5, -2)$ and $(x_2, y_2) = (-3, 8)$.

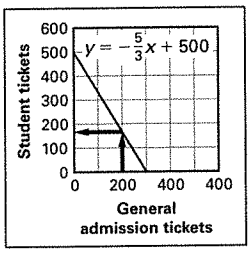
$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{8 - (-2)}{-3 - (-5)} = \frac{10}{2} = 5$

$y - y_1 = m(x - x_1)$

$y - (-2) = 5(x - (-5))$

$y = 5x + 23$

53. An equation is $15x + 9y = 4500$.



From the graph, you can see that if 200 general admissions tickets were sold, about 167 student tickets were sold.

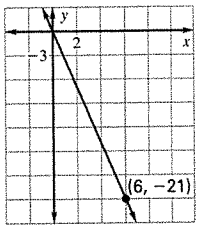
Lesson 2.5 (pp. 109–111)

5. $y = ax$

$-21 = a(6)$

$-\frac{7}{2} = a$

Substitute $-\frac{7}{2}$ for a in $y = ax$. $y = -\frac{7}{2}x$



15. $y = ax$

$-1.6 = a(-4.8)$

$\frac{1}{3} = a$

So, $y = \frac{1}{3}x$.

When $x = 12$:

$y = \frac{1}{3}(12) = 4$

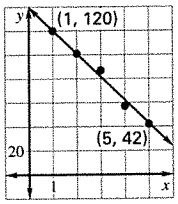
41. $\frac{23}{4.5} \approx 5.1$ $\frac{40}{7.8} \approx 5.1$ $\frac{82}{16} \approx 5.1$

Because the ratios are approximately equal, the data show direct variation. An equation relating s and t is $t = 5.1s$.

Lesson 2.6 (pp. 117–120)

9. The correlation coefficient is closest to -1 because the scatter plot shows a strong negative correlation.

11. a.



b. The line shown appears to pass through $(x_1, y_1) = (1, 120)$ and $(x_2, y_2) = (5, 42)$.

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{42 - 120}{5 - 1} = -\frac{78}{4} = -19.5$

$y - y_1 = m(x - x_1)$

$y - 120 = -19.5(x - 1)$

$y = -19.5x + 139.5$

c. When $x = 20$:

$y = -19.5(20) + 139.5 = -250.5$

WORKED-OUT SOLUTIONS

25. A scatter plot and possible line of best fit are shown. The line appears to pass through $(x_1, y_1) = (0, 2240)$ and $(x_2, y_2) = (6, 2850)$.

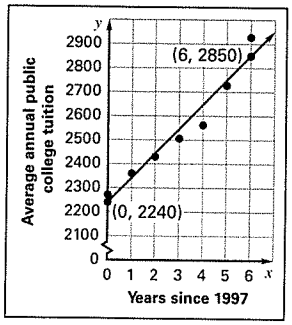
$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2850 - 2240}{6 - 0} = \frac{610}{6} \approx 101.7$$

$$y - y_1 = m(x - x_1)$$

$$y - 2240 = 101.7(x - 0)$$

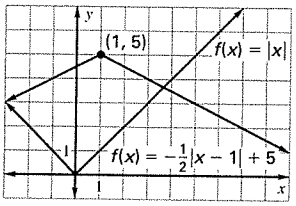
$$y = 101.7x + 2240$$

An approximation of the best-fitting line is $y = 101.7x + 2240$.



Lesson 2.7 (pp. 127–129)

13. The graph of $f(x) = -\frac{1}{2}|x - 1| + 5$ is the graph of $f(x) = |x|$ reflected in the x-axis, vertically shrunk by a factor of $\frac{1}{2}$, and translated right 1 unit and up 5 units.



19. Vertex is $(-2, -1)$; $y = a|x + 2| - 1$

Using point $(0, 0)$: $0 = a|0 + 2| - 1$

$$\frac{1}{2} = a$$

An equation is $y = \frac{1}{2}|x + 2| - 1$.

39. Vertex is $(69, 140)$; $y = a|x - 69| + 140$

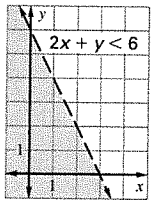
Using point $(0, 0)$: $0 = a|0 - 69| + 140$

$$-\frac{140}{69} = a$$

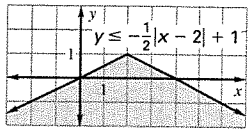
An equation is $y = -\frac{140}{69}|x - 69| + 140$.

Lesson 2.8 (pp. 135–138)

15.

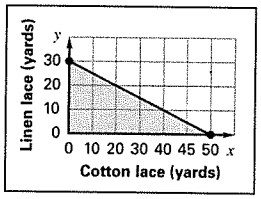


25.



45. x = yards of cotton lace; y = yards of linen lace

$1.5x + 2.5y \leq 75$



Let $x = 24$:

$1.5(24) + 2.5y \leq 75$

$y \leq 15.6$

You can buy 15.6 or less yards of linen lace.

Chapter 3

Lesson 3.1 (pp. 156–158)

9. $y = -3x - 2$

$4 \stackrel{?}{=} -3(-2) - 2$

$4 \stackrel{?}{=} 6 - 2$

$4 = 4$ ✓

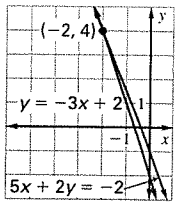
$5x + 2y = -2$

$5(-2) + 2(4) \stackrel{?}{=} -2$

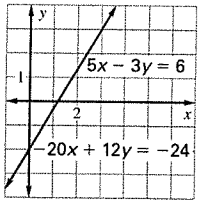
$-10 + 8 \stackrel{?}{=} -2$

$-2 = -2$ ✓

The solution is $(-2, 4)$.



21.



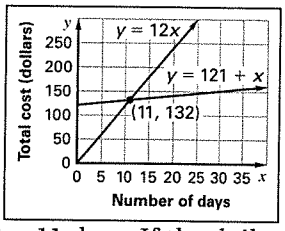
The graphs of the equations are the same line. The system has infinitely many solutions. The system is consistent and dependent.

37. Let y = total cost.

Let x = number of days.

Option A: $y = 121 + x$

Option B: $y = 12x$



The plans are equal after 11 days. If the daily cost of option B increases, the plans will be equal in fewer days.

Lesson 3.2 (pp. 164–167)

5. $6x - 2y = 5$

$-3x + y = 7 \rightarrow y = 3x + 7$

When $y = 3x + 7$:

$6x - 2(3x + 7) = 5$

$6x - 6x - 14 = 5$

$-14 \neq 5$ There is no solution.

29. $2x - 3y = 8 \xrightarrow{\times 2} 4x - 6y = 16$

$-4x + 5y = -10 \rightarrow -4x + 5y = -10$

$-y = 6$

When $y = -6$:

$2x - 3(-6) = 8$

$x = -5$ The solution is $(-5, -6)$.

59. x = double $x + y = 26 \rightarrow y = 26 - x$

y = singles $4x + 2y = 76$

$4x + 2(26 - x) = 76$ $y = 26 - x$

$4x + 52 - 2x = 76$ $y = 26 - 12$

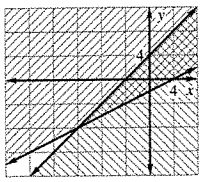
$x = 12$ $y = 14$

There were 12 doubles games and 14 singles games in progress.

Lesson 3.3 (pp. 171–173)

9. $4x - 4y \geq -16$

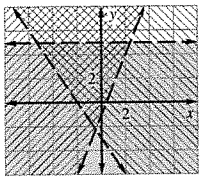
$-x + 2y \geq -4$



19. $3x + 2y > -6$

$-5 + 2y > -2$

$y < 5$



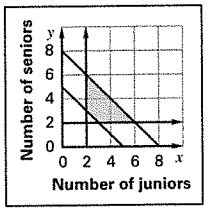
37. a. $x \geq 2$

$y \geq 2$

$x + y \leq 8$

$x + y \geq 5$

b.



c. *Sample answer:* 3 juniors, 4 seniors; 4 juniors, 4 seniors.

Lesson 3.4 (pp. 182–185)

11. $3x - y + 2z = 4$

$6x - 2y + 4z = -8$

$2x - y + 3z = 10$

$6x - 2y + 4z = -8$ Add −2 times Equation 1

$-6x + 2y - 4z = -8$ to Equation 2.

$0 = -8$

No solution

25. $x + 5y - 2z = -1$

$-x - 2y + z = 6$

$-2x - 7y + 3z = 7$

$x + 5y - 2z = -1$ Add Equation 2 to

$-y - 2y + z = 6$ Equation 1.

$3y - z = 5$ New Equation 1

$-2x - 7y + 3z = 7$ Add 2 times Equation

$2x + 10y - 4z = -2$ 1 to Equation 3.

$3y - z = 5$ New Equation 2

$3y - z = 5$ Add −1 times new Equation

$-3y + z = -5$ 1 to new Equation 2

$0 = 0$

Infinitely many solutions

45. a. f = 1st place; s = 2nd place; t = 3rd place

$f + s + t = 20$ Equation 1

$5f + 3s + t = 68$ Equation 2

$s = f + t$ Equation 3

$f + (f + t) + t = 20 \rightarrow 2f + 2t = 20$ New Eq. 1

$5f + 3(f + t) + t = 68 \rightarrow 8f + 4t = 68$ New Eq. 2

$-8f - 8t = -80$ Add −4 times new

$8f + 4t = 68$ Eq. 1 to new Eq. 2.

$-4t = -12$

$t = 3$

Substitute $t = 3$ into new Equation 1.

$2f + 2(3) = 20 \rightarrow f = 7$

Substitute $f = 7$ and $t = 3$ into Equation 3.

$s = f + t \rightarrow s = 7 + 3 = 10$

7 athletes placed first, 10 athletes placed second, and 3 athletes placed third.

WORKED-OUT SOLUTIONS

b. $f + s + t = 20$ Equation 1

$5f + 3s + t = 70$ Equation 2

$s = f + t$ Equation 3

$f + (f + t) + t = 20 \rightarrow 2f + 2t = 20$ New Eq. 1

$5f + 3(f + t) + t = 70 \rightarrow 8f + 4t = 70$ New Eq. 2

$-8f - 8t = -80$ Add -4 times new

$8f + 4t = 70$ Eq. 1 to new Eq. 2.

$-4t = -10$

$t = \frac{5}{2}$

t cannot be a fraction; you cannot have part of a person. This claim must be false.

Lesson 3.5 (pp. 191–193)

5. $\begin{bmatrix} 10 & -8 \\ 5 & -3 \end{bmatrix} - \begin{bmatrix} 12 & -3 \\ 3 & -4 \end{bmatrix}$

$= \begin{bmatrix} 10 - 12 & -8 - (-3) \\ 5 - 3 & -3 - (-4) \end{bmatrix} = \begin{bmatrix} -2 & -5 \\ 2 & 1 \end{bmatrix}$

21. $\begin{bmatrix} 1.8 & -1.5 & 10.6 \\ -8.8 & 3.4 & 0 \end{bmatrix} + 3\begin{bmatrix} 7.2 & 0 & -5.4 \\ 2.1 & -1.9 & 3.3 \end{bmatrix}$

$= \begin{bmatrix} 1.8 + 21.6 & -1.5 + 0 & 10.6 + (-16.2) \\ -8.8 + 6.3 & 3.4 + (-5.7) & 0 + 9.9 \end{bmatrix}$

$= \begin{bmatrix} 23.4 & -1.5 & -5.6 \\ -2.5 & -2.3 & 9.9 \end{bmatrix}$

33. a.

	May (M)			June (J)		
	A	B	C	A	B	C
Downtown	31	42	18	25	36	12
Mall	22	25	11	38	32	15

b. $M + J = \begin{bmatrix} 31 & 42 & 18 \\ 22 & 25 & 11 \end{bmatrix} + \begin{bmatrix} 25 & 36 & 12 \\ 38 & 32 & 15 \end{bmatrix}$

$= \begin{bmatrix} 31 + 25 & 42 + 36 & 18 + 12 \\ 22 + 38 & 25 + 32 & 11 + 15 \end{bmatrix} = \begin{bmatrix} 56 & 78 & 30 \\ 60 & 57 & 26 \end{bmatrix}$

The downtown store sold 56 of Model A, 78 of Model B, and 30 of Model C. The mall store sold 60 of Model A, 57 of Model B, and 26 of Model C.

c. $\frac{1}{2}(M + J) = \frac{1}{2}\begin{bmatrix} 56 & 78 & 30 \\ 60 & 57 & 26 \end{bmatrix}$

$= \begin{bmatrix} 28 & 39 & 15 \\ 30 & 28.5 & 13 \end{bmatrix}$

Lesson 3.6 (pp. 199–202)

13. $\begin{bmatrix} 9 & -3 \\ 0 & 2 \end{bmatrix}\begin{bmatrix} 0 & 1 \\ 4 & -2 \end{bmatrix}$

$= \begin{bmatrix} 9(0) + (-3)(4) & 9(1) + (-3)(-2) \\ 0(0) + 2(4) & 0(1) + 2(-2) \end{bmatrix}$

$= \begin{bmatrix} -12 & 15 \\ 8 & -4 \end{bmatrix}$

23. $-\frac{1}{2}AC = -\frac{1}{2}\begin{bmatrix} 5 & -3 \\ -2 & 4 \end{bmatrix}\begin{bmatrix} -6 & 3 \\ 4 & 1 \end{bmatrix}$

$= -\frac{1}{2}\begin{bmatrix} 5(-6) + (-3)(4) & 5(3) + (-3)(1) \\ (-2)(-6) + (4)(4) & (-2)(3) + (4)(1) \end{bmatrix}$

$= -\frac{1}{2}\begin{bmatrix} -42 & 12 \\ 28 & -2 \end{bmatrix} = \begin{bmatrix} 21 & -6 \\ -14 & 1 \end{bmatrix}$

41. SP: $(3 \times 2)(1 \times 3)$ (not equal) PS: $(1 \times 3)(3 \times 2)$ (equal)

So, matrix PS is defined.

$PS = [650 \quad 825 \quad 1050]\begin{bmatrix} 21 & 16 \\ 40 & 33 \\ 15 & 19 \end{bmatrix}$

$= [650(21) + 825(40) + 1050(15) \quad 650(16) + 825(33) + 1050(19)]$

$= [62{,}400 \quad 57{,}575]$

The profit for dealer A is \$62,400 and the profit for dealer B is \$57,575.

Lesson 3.7 (pp. 207–209)

11. $\begin{bmatrix} -1 & 12 & 4 \\ 0 & 2 & -5 \\ 3 & 0 & 1 \end{bmatrix}\begin{matrix} -1 & 12 \\ 0 & 2 \\ 3 & 0 \end{matrix}$

$= (-2 - 180 + 0) - (24 + 0 + 0) = -206$

23. Area $= \pm\frac{1}{2}\begin{bmatrix} 4 & 2 & 1 \\ 4 & 8 & 1 \\ 8 & 5 & 1 \end{bmatrix} = \pm\frac{1}{2}\begin{bmatrix} 4 & 2 & 1 & 4 & 2 \\ 4 & 8 & 1 & 4 & 8 \\ 8 & 5 & 1 & 8 & 5 \end{bmatrix}$

$= \pm\frac{1}{2}[(32 + 16 + 20) - (64 + 20 + 8)] = 12$

The area of the triangle is 12 square units.

43. a. x = single; y = double; z = triple

$x + y + z = 120$

$0.90x + 1.2y + 1.6z = 134$

$x = y + z \rightarrow x - y - z = 0$

$$\begin{vmatrix} 1 & 1 & 1 \\ 0.9 & 1.2 & 1.6 \\ 1 & -1 & -1 \end{vmatrix} \begin{matrix} 1 & 1 \\ 0.9 & 1.2 \\ 1 & -1 \end{matrix}$$

$= (-1.2 + 1.6 - 0.9) - (1.2 - 1.6 - 0.9) = 0.8$

$$x = \frac{\begin{vmatrix} 120 & 1 & 1 \\ 134 & 1.2 & 1.6 \\ 0 & -1 & -1 \end{vmatrix}}{0.8} = \frac{48}{0.8} = 60$$

$$y = \frac{\begin{vmatrix} 1 & 120 & 1 \\ 0.9 & 134 & 1.6 \\ 1 & 0 & -1 \end{vmatrix}}{0.8} = \frac{32}{0.8} = 40$$

$$z = \frac{\begin{vmatrix} 1 & 1 & 120 \\ 0.9 & 1.2 & 134 \\ 1 & -1 & 0 \end{vmatrix}}{0.8} = \frac{16}{0.8} = 20$$

There are 60 single-scoop, 40 double-scoop, and 20 triple-scoop cones sold.

b. New price = 1.1 × old price

1.1($.90) = $.99; 1.1($1.20) = $1.32; 1.1($1.60) = $1.76

New sales = 0.95 × old sales

0.95(60) = 57; 0.95(40) = 38; 0.95(20) = 19

New revenue = $.99(57) + $1.32(38) + $1.76(19) = $140.03

Lesson 3.8 (pp. 214–217)

3. $A = \begin{bmatrix} 1 & -5 \\ -1 & 4 \end{bmatrix}$

$$A^{-1} = \frac{1}{4-5}\begin{bmatrix} 4 & 5 \\ 1 & 1 \end{bmatrix} = -1\begin{bmatrix} 4 & 5 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} -4 & -5 \\ -1 & -1 \end{bmatrix}$$

25. $\begin{bmatrix} 4 & -1 \\ -7 & -2 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 10 \\ -25 \end{bmatrix}$

$$A^{-1} = \frac{1}{-8-7}\begin{bmatrix} -2 & 1 \\ 7 & 4 \end{bmatrix} = \begin{bmatrix} \frac{2}{15} & -\frac{1}{15} \\ -\frac{7}{15} & -\frac{4}{15} \end{bmatrix}$$

$$X = A^{-1}B = \begin{bmatrix} \frac{2}{15} & -\frac{1}{15} \\ -\frac{7}{15} & -\frac{4}{15} \end{bmatrix}\begin{bmatrix} 10 \\ -25 \end{bmatrix} = \begin{bmatrix} 3 \\ 2 \end{bmatrix} = \begin{bmatrix} x \\ y \end{bmatrix}$$

The solution of the system is (3, 2).

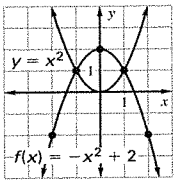
47. $\begin{bmatrix} 78 & 104 & 198 \\ 1 & 0 & 0.6 \\ 22 & 255 & 23.8 \end{bmatrix}\begin{bmatrix} b \\ t \\ w \end{bmatrix} = \begin{bmatrix} 500 \\ 3 \\ 100 \end{bmatrix}$

$$X = A^{-1}B = \begin{bmatrix} 2.3 \\ 0.8 \\ 1.2 \end{bmatrix}$$

2.3 oz Bran Crunchies; 0.8 oz Toasted Oats; and 1.2 oz Whole Wheat Flakes

Chapter 4

Lesson 4.1 (pp. 240–243)

15. 

Both graphs have the same axis of symmetry. The graph of $f(x) = -x^2 + 2$ opens down, and its vertex is 2 units higher than that of $y = x^2$.

37. $f(x) = \frac{3}{2}x^2 + 6x + 4$

$a > 0$; the function has a minimum value.

$$x = \frac{-b}{2a} = \frac{-(6)}{2\left(\frac{3}{2}\right)} = -2$$

Minimum: $f(-2) = \frac{3}{2}(-2)^2 + 6(-2) + 4 = -2$

57. $y = \frac{1}{9000}x^2 - \frac{7}{15}x + 500$

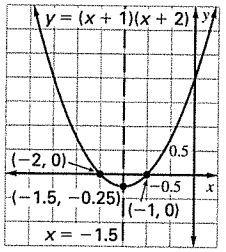
$$x = \frac{-b}{2a} = \frac{-\left(\frac{-7}{15}\right)}{2\left(\frac{1}{9000}\right)} = 2100$$

$y = \frac{1}{9000}(2100)^2 - \frac{7}{15}(2100) + 500 = 10$

The cable is 10 feet above the road.

WORKED-OUT SOLUTIONS

Lesson 4.2 (pp. 249–251)

19. 

$a = 1$, $p = -1$, and $q = -2$

x-int.: $x = -2$ and $x = -1$

Axis of sym.:

$$x = \frac{-2 + (-1)}{2} = -1.5$$

Vertex: $(-1.5, -0.25)$

29. $y = (x - 3)^2 + 6 = (x - 3)(x - 3) + 6$

$= (x^2 - 3x - 3x + 9) + 6 = x^2 - 6x + 15$

53. a. $y = -0.000234x(x - 160)$

$= -0.000234(x - 0)(x - 160)$

$p = 0$, $q = 160$; the field is 160 feet wide.

b. $x = \frac{p + q}{2} = \frac{0 + 160}{2} = 80$

$y = -0.000234(80)(80 - 160) \approx 1.5$

The maximum height is about 1.5 feet.

Lesson 4.3 (pp. 255–258)

33. $z^2 - 3z - 54 = 0 \rightarrow (z - 9)(z + 6) = 0$

$z - 9 = 0 \rightarrow z = 9$ or $z + 6 = 0 \rightarrow z = -6$

47. $y = x^2 + 7x - 30 = (x + 10)(x - 3)$

The zeros are -10 and 3.

67. a. $A = (30)(20) = 600 \text{ ft}^2$

b. New area (feet) = New length (feet) • New width (feet)

$1064 = (x + 30)(x + 20)$

c. $x^2 + 50x + 600 = 1064$

$(x - 58)(x - 8) = 0 \rightarrow x = -58$ or $x = 8$

Expand the length and width by 8 feet.

Lesson 4.4 (pp. 263–265)

27. $20x^2 + 124x + 24 = 4(5x^2 + 31x + 6)$

$= 4(5x + 1)(x + 6)$

39. $6r^2 - 7r - 5 = 0 \rightarrow (3r - 5)(2r + 1) = 0$

$r = \frac{5}{3} = 1\frac{2}{3}$ or $r = -\frac{1}{2}$

63. $96 = (2x + 8)(2x + 12) - 96$

$0 = 4x^2 + 40x - 96$

$0 = (4x - 8)(x + 12)$

$x = 2$ or $x = -12$

The border's width should be 2 feet.

Lesson 4.5 (pp. 269–271)

17. $\frac{\sqrt{2}}{4 + \sqrt{5}} = \frac{\sqrt{2}}{4 + \sqrt{5}} \cdot \frac{4 - \sqrt{5}}{4 - \sqrt{5}} = \frac{4\sqrt{2} - \sqrt{10}}{11}$

27. $-3w^2 = -213 \rightarrow w^2 = 71 \rightarrow w = \pm\sqrt{71}$

41. a. $\pi r^2 = 10^2 = 100$

b. $\pi r^2 = 100 \rightarrow r^2 = \frac{100}{\pi} \rightarrow r \approx 5.6$ feet

c. $\pi r^2 = s^2 \rightarrow r^2 = \frac{s^2}{\pi}$

$r = \sqrt{\frac{s^2}{\pi}} = \frac{s}{\sqrt{\pi}} \cdot \frac{\sqrt{\pi}}{\sqrt{\pi}} = \frac{s\sqrt{\pi}}{\pi}$

Lesson 4.6 (pp. 279–282)

11. $-5(n - 3)^2 = 10 \rightarrow (n - 3)^2 = -2$

$n - 3 = \pm\sqrt{-2} \rightarrow n = 3 \pm i\sqrt{2}$

29. $\frac{6i}{3 - i} = \frac{6i}{3 - i} \cdot \frac{3 + i}{3 + i} = \frac{18i + 6i^2}{9 + 3i - 3i - i^2}$

$= \frac{-6 + 18i}{10} = -\frac{6}{10} + \frac{18}{10}i = -\frac{3}{5} + \frac{9}{5}i$

67. Impedance: $12 + 8i - 6i - 10i = 12 - 8i$ ohms

Lesson 4.7 (pp. 288–291)

27. $x^2 - 2x = -25$

$x^2 - 2x + 1 = -25 + 1$

$(x - 1)^2 = -24$

$x - 1 = \pm\sqrt{-24} \rightarrow x = 1 \pm 2i\sqrt{6}$

45. $y = x^2 - 3x + 4$

$y + \frac{9}{4} = (x^2 - 3x + \frac{9}{4}) + 4$

$y = (x - \frac{3}{2})^2 + \frac{7}{4}$

The vertex is $(\frac{3}{2}, \frac{7}{4})$.

65.
$$y = (200 + 10x)(40 - x)$$
$$y = 8000 + 200x - 10x^2$$
$$y - 8000 = -10(x^2 - 20x)$$
$$y - 8000 + (-10)(100) = -10(x^2 - 20x + 100)$$
$$y - 9000 = -10(x - 10)^2$$
$$y = -10(x - 10)^2 + 9000$$

The revenue is maximized when the price is increased 10 times; $10(\$10) = \$100$.

Lesson 4.8 (pp. 296–299)

19. $4x^2 + 3 = x^2 - 7x \rightarrow 3x^2 + 7x + 3 = 0$

$$x = \frac{-7 \pm \sqrt{7^2 - 4(3)(3)}}{2(3)} = \frac{-7 \pm \sqrt{13}}{6}$$

39. $7r^2 - s = 2r + 9r^2 \rightarrow -2r^2 - 2r - 5 = 0$

$b^2 - 4ac = (-2)^2 - 4(-2)(-5) = -36 < 0$

Two imaginary: $\frac{-(-2) \pm \sqrt{-36}}{2(-2)} = -\frac{1}{2} \pm \frac{3}{2}i$

71. $S = -0.000013E^2 + 0.042E - 21$

$10 = -0.000013E^2 + 0.042E - 21$

$0 = -0.000013E^2 + 0.042E - 31$

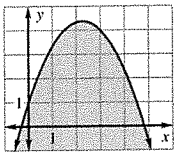
$$E = \frac{-0.042 \pm \sqrt{(0.042)^2 - 4(-0.000013)(-31)}}{2(-0.000013)}$$

$$E = \frac{-0.042 \pm \sqrt{0.000152}}{-0.000026}$$

$E \approx 1141$ meters or $E \approx 2090$ meters

Lesson 4.9 (pp. 304–307)

17. $y \leq -\frac{2}{3}x^2 + 3x + 1$

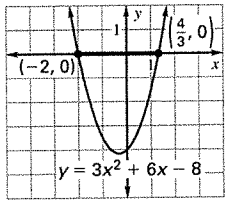


39. $3x^2 + 2x - 8 \leq 0$

$(3x - 4)(x + 2) = 0$

$x = \frac{4}{3}$ or $x = -2$

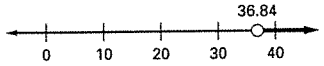
The solution is $-2 \leq x \leq \frac{4}{3}$.



73. $0.0017x^2 + 0.145x + 2.35 > 10$

$0.0017x^2 + 0.145x - 7.65 > 0$

$$x = \frac{-0.145 \pm \sqrt{0.073045}}{0.0034} \approx 36.84, -122.13$$



Test values $x = 0$ and $x = 37$ to determine that $x \geq 36.84$. The domain is $0 \leq x \leq 40$. So, the larvae's length tends to be greater than 10 mm between around 37 to 40 days.

Lesson 4.10 (pp. 312–315)

19. $y = a(x - p)(x - q) \rightarrow y = a(x + 3)(x - 3)$

$-4 = a(1 + 3)(1 - 3) \rightarrow \frac{1}{2} = a$

A quadratic function is $y = \frac{1}{2}(x + 3)(x - 3)$.

35. $y = ax^2 + bx + c$

$9 = a(-1)^2 + b(-1) + c \rightarrow a - b + c = 9$

$1 = a(1)^2 + b(1) + c \rightarrow a + b + c = 1$

$17 = a(3)^2 + b(3) + c \rightarrow 9a + 3b + c = 17$

Using substitution and $c = 9 - a + b$:

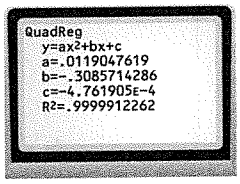
$a + b + (9 - a + b) = 1 \rightarrow b = -4$

$9a + 3(-4) + (9 - a - 4) = 17 \rightarrow a = 3$

$3 - (-4) + c = 9 \rightarrow c = 2$

A quadratic function is $y = 3x^2 - 4x + 2$.

49. a.



$y = 0.01190x^2 - 0.309x - 0.00048$

b. When $x = 10$, $y \approx -1.90$ seconds

Chapter 5

Lesson 5.1 (pp. 333–335)

17. $(6.3 \times 10^5)(8.9 \times 10^{-12}) = 56.07 \times 10^{-7}$

$= 5.607 \times 10^1 \times 10^{-7} = 5.607 \times 10^{-6}$

WORKED-OUT SOLUTIONS

31. $\frac{3c^3d}{9cd^{-1}} = \frac{3}{9}c^{3-1}d^{1-(-1)} = \frac{1}{3}c^2d^2$

Quotient of powers property

51. Bead: $d = 6$ mm, $r = 3$ mm

$v = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi(3)^3 = 36\pi$

Pearl: $d = 9$ mm, $r = \frac{9}{2}$ mm

$v = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi\left(\frac{9}{2}\right)^3 = \frac{243\pi}{2}$

$\frac{\text{Volume of pearl}}{\text{Volume of bead}} = \frac{\frac{243\pi}{2}}{36\pi} = \frac{243}{72} = 3.375$

About 3.4 times greater

Lesson 5.2 (pp. 341–344)

21.

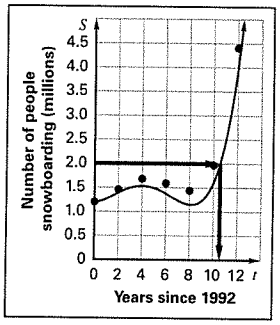
3	−7	11	4	0
		−21	−30	−78
	−7	−10	−26	−78

$f(3) = -78$

27. The degree is even and the leading coefficient is negative.

57.

t	0	2	4	6	8	10	12
s	1.2	1.46	1.68	1.59	1.44	1.97	4.41



The number of snowboarders was greater than 2 million in 2002 (when $t \approx 10$).

Lesson 5.3 (pp. 349–352)

11. $(5b - 6b^3 + 2b^4) - (9b^3 + 4b^4 - 7)$

$= 2b^4 - 4b^4 - 6b^3 - 9b^3 + 5b + 7$

$= -2b^4 - 15b^3 + 5b + 7$

21. $(2a - 3)(a^2 - 10a - 2)$

$= (2a - 3)(a^2) - (2a - 3)(10a) - (2a - 3)(2)$

$= 2a^3 - 23a^2 + 26a + 6$

61. $P = 0.00267sF = 0.00267s(0.0116s^2 + 0.789)$

$= 0.000030972s^3 + 0.00210663s$

When $s = 10$, $P(10) = 0.0520383$.

About 0.052 horsepower is needed.

Lesson 5.4 (pp. 356–359)

7. $3y^5 - 48y^3 = 3y^3(y^2 - 16) = 3y^3(y + 4)(y - 4)$

23. $4c^3 + 8c^2 - 9c - 18 = 4c^2(c + 2) - 9(c + 2)$

$= (c + 2)(2c + 3)(2c - 3)$

61. $\ell = x$; $h = x - 5$; $w = x - 5$

$v = \ell wh \rightarrow 250 = (x)(x - 5)(x - 5)$

$250 = x(x^2 - 10x + 25)$

$0 = x^3 - 10x^2 + 25x - 250$

$0 = x^2(x - 10) + 25(x - 10)$

$0 = (x^2 + 25)(x - 10) \rightarrow x = 10$

$\ell = 10$ in., $h = 5$ in., $w = 5$ in.

Lesson 5.5 (pp. 366–368)

17.

6	1	−5	−8	13	−12
		6	6	−12	6
	1	1	−2	1	−6

$x^3 + x^2 - 2x + 1 - \frac{6}{x - 6}$

25.

−9	1	2	−51	108	
		−9	63	−108	
	1	−7	12	0	

$f(x) = (x + 9)(x^2 - 7x + 12)$

$= (x + 9)(x - 4)(x - 3)$

43.

$$\begin{array}{r} -0.13x^2 + 11.2x - 560.9 \\ 14.8x + 725 \overline{)\ -1.95x^3 + 70.1x^2 - 188x + 2150} \\ \underline{-1.95x^3 - 95.5x^2} \\ 165.6x^2 - 188x \\ \underline{165.6x^2 + 8113.3x} \\ -8301.3x + 2150 \\ \underline{-8301.3x - 406{,}652.5} \\ 408{,}802.5 \end{array}$$

$f(x) = -0.13x^2 + 11.2x - 560.9 + \frac{408{,}802.5}{14.8x + 725}$

Lesson 5.6 (pp. 374–377)

7. $g(x) = 4x^5 + 3x^3 - 2x - 14$

Factors of the constant term: $\pm 1, \pm 2, \pm 7, \pm 14$

Factors of the leading coefficient: $\pm 1, \pm 2, \pm 4$

Possible rational zeros: $\pm\frac{1}{1}, \pm\frac{2}{1}, \pm\frac{7}{1}, \pm\frac{14}{1}, \pm\frac{1}{2}, \pm\frac{2}{2}, \pm\frac{7}{2}, \pm\frac{14}{2}, \pm\frac{1}{4}, \pm\frac{2}{4}, \pm\frac{7}{4}, \pm\frac{14}{4}$

$= \pm 1, \pm 2, \pm 7, \pm 14, \pm\frac{1}{2}, \pm\frac{7}{2}, \pm\frac{1}{4}, \pm\frac{7}{4}$

21. Possible rational zeros: $\pm 1, \pm 3, \pm 5, \pm 15, \pm\frac{1}{2}, \pm\frac{3}{2}, \pm\frac{5}{2}, \pm\frac{15}{2}, \pm\frac{1}{3}, \pm\frac{5}{3}, \pm\frac{1}{6}, \pm\frac{5}{6}$

Reasonable zeros: $x = -3, x = -\frac{5}{3}, x = \frac{1}{2}$

Test $x = -3$:

-3	6	25	16	-15
		-18	-21	15
	6	7	-5	0

$f(x) = (x + 3)(6x^2 + 7x - 5)$

$= (x + 3)(2x - 1)(3x + 5)$

Real zeros are $-3, \frac{1}{2}, -\frac{5}{3}$.

47. $V = x(x - 1)(x - 2) \rightarrow 24 = x(x^2 - 3x + 2)$

$0 = x^3 - 3x^2 + 2x - 24$

Possible rational zeros: $\pm 1, \pm 2, \pm 3, \pm 4, \pm 6, \pm 8, \pm 12, \pm 24$

Lesson 5.7 (pp. 383–386)

15. Possible rational zeros: $\pm 1, \pm 2, \pm 4, \pm 8$

$f(x) = x^4 + x^3 + 2x^2 + 4x - 8$

$= (x + 2)(x^3 - x^2 + 4x - 4)$

$= (x + 2)(x - 1)(x^2 + 4)$

$= (x + 2)(x - 1)(x - 2i)(x + 2i)$

The zeros are -2, 1, $2i$, and $-2i$.

37. $h(x) = x^5 - 2x^3 - x^2 + 6x + 5$

2 sign changes; 2 or 0 positive real zeros

$h(-x) = (-x)^5 - 2(-x)^3 - (-x)^2 + 6(-x) + 5$

$= -x^5 + 2x^3 - x^2 - 6x + 5$

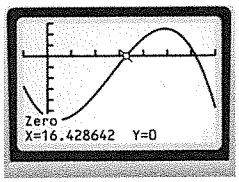
3 sign changes; 3 or 1 positive real zeros.

Possible numbers of zeros:

Positive	Negative	Imaginary	Total
2	3	0	5
0	3	2	5
2	1	2	5
0	1	4	5

61. $S = -0.015x^3 + 0.6x^2 - 2.4x + 19$

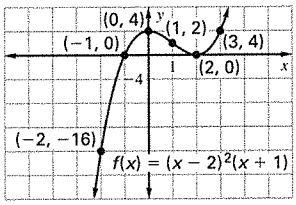
$0 = -0.015x^3 + 0.6x^2 - 2.4x - 56$



There are two positive zeros of this function, $x \approx 16.4$ and $x \approx 30.9$, but $x \approx 16.4$ is the most likely amount.

Lesson 5.8 (pp. 390–392)

3.

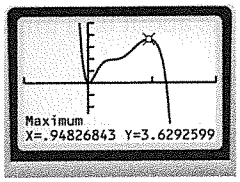


19. Turning pts: (−2.2, −38), local minimum; (−1.1, 0.8), local maximum; (0.3, −40), local minimum; (1.9, 8), local maximum; (2.75, −10.5), local minimum

Zeros: $x \approx -2.6, x \approx -1.4, x \approx -1, x \approx 1.5, x \approx 2.2, x \approx 3$

It must be at least a degree 6 function.

41.



At about 0.95 seconds into the stroke the swimmer is going the fastest.

Lesson 5.9 (pp. 397–399)

9. $f(x) = a(x + 5)(x)(x - 6)$

$-12 = a(1 + 5)(1)(1 - 6) \rightarrow \frac{2}{5} = a$

$f(x) = \frac{2}{5}x(x + 5)(x - 6)$

15. $f(1)$ $f(2)$ $f(3)$ $f(4)$ $f(5)$ $f(6)$

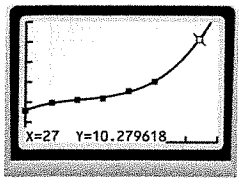
-3 0 11 30 57 92

3 11 19 27 35 First-order differences

8 8 8 8 Second-order differences

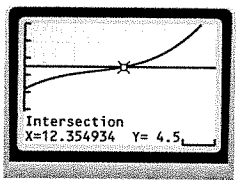
27. a. $m = 0.00081742t^3 - 0.02154t^2 + 0.249t + 3.17$

b.



About \$10.30

c.



In 1995 ($t \approx 12.4$)

Chapter 6

Lesson 6.1 (pp. 417–419)

9. $(\sqrt[n]{a})^m = a^{m/n} \rightarrow (\sqrt[3]{10})^7 = 10^{7/3}$

25. $27^{2/3} = (27^{1/3})^2 = (3)^2 = 9$

63. $p = ks^3 \rightarrow 1.2 = k(1700)^3 \rightarrow k = \dfrac{3}{12{,}282{,}500{,}000}$

$$p = \frac{3}{12{,}282{,}500{,}000}s^3 \rightarrow 1.5 = \frac{3}{12{,}282{,}500{,}000}s^3$$

$$\rightarrow 6{,}141{,}250{,}000 = s^3 \rightarrow s \approx 1831$$

About 1800 revolutions per minute

Lesson 6.2 (pp. 424–427)

5. $3^{1/4} \cdot 27^{1/4} = 3^{1/4} \cdot 3^{1/4} \cdot 3^{1/4} \cdot 3^{1/4}$

$$= 3^{(1/4 + 1/4 + 1/4 + 1/4)} = 3^1 = 3$$

27. $5\sqrt[4]{64} \cdot 2\sqrt[4]{8} = 10\sqrt[4]{512} = 40\sqrt[4]{2}$

85. $d = 1.9[(5.5 \times 10^{-4})\ell]^{1/2}$

$\ell = 10 \text{ cm} = 100 \text{ mm}$

$d = 1.9[(5.5 \times 10^{-4})(100)]^{1/2} \approx 0.4456$

The optimum diameter is about 0.45 mm.

Lesson 6.3 (pp. 432–434)

3. $f(x) + g(x) = -3x^{1/3} + 4x^{1/2} + 5x^{1/3} + 4x^{1/2}$

$$= 2x^{1/3} + 8x^{1/2}$$

Domain of f: all nonnegative reals

Domain of g: all nonnegative reals

Domain of $f + g$: all nonnegative reals

13. $g(x) \cdot f(x) = (5x^{1/2})(4x^{2/3}) = 20x^{7/6}$

Domain of f: all reals

Domain of g: all nonnegative reals

Domain of $g \cdot f$: all nonnegative reals

45. For \$15 discount: $f(x) = x - 15$

For 10% discount: $g(x) = x - 0.1x = 0.9x$

a. $g(f(x)) = g(x - 15) = 0.9(x - 15)$

$x = 85$: $0.9(85 - 15) = 0.9(70) = \$63.00$

b. $f(g(x)) = f(0.9x) = 0.9x - 15$

$x = 85$: $0.9(85) - 15 = 76.5 - 15 = \$61.50$

c. The 10% discount before the \$15 discount.

Lesson 6.4 (pp. 442–445)

7. $y = 12x + 7 \rightarrow x = 12y + 7 \rightarrow \dfrac{x}{12} - \dfrac{7}{12} = y$

15. $f(g(x)) = f(x - 4) = (x - 4) + 4 = x$ ✓

$g(f(x)) = g(x + 4) = (x + 4) - 4 = x$ ✓

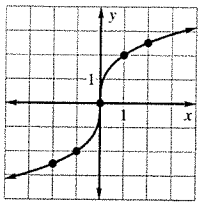
49. $v = 1.34\sqrt{\ell}$

$\left(\dfrac{v}{1.34}\right)^2 = \ell$

The waterlength should be $\ell = \left(\dfrac{7.5}{1.34}\right)^2 \approx 31.3$ feet.

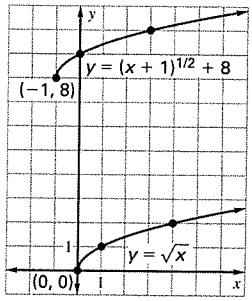
Lesson 6.5 (pp. 449–451)

11.



The domain and range are all real numbers.

17.



Domain: $x \geq -1$

Range: $y \geq 8$

37. a. $v = 331.5\sqrt{\dfrac{(273.15 + C)}{273.15}} = 331.5\sqrt{1 + \dfrac{C}{273.15}}$

b. Domain: $C \geq -273.15$; range: $v \geq 0$

Lesson 6.6 (pp. 456–459)

5. $\sqrt{9x} + 11 = 14$

$\sqrt{9x} = 3$

$9x = 9 \rightarrow x = 1$

Check: $\sqrt{9(1)} + 11 \stackrel{?}{=} 14$

$\sqrt{9} + 11 \stackrel{?}{=} 14$

$14 = 14$ ✓

13. $\sqrt[3]{x} - 10 = -3$

$\sqrt[3]{x} = 7$

$(\sqrt[3]{x})^3 = (7)^3 \rightarrow x = 343$

Check: $\sqrt[3]{343} - 10 \stackrel{?}{=} -3$

$7 - 10 \stackrel{?}{=} -3$

$-3 = -3$ ✓

WORKED-OUT SOLUTIONS

59. $h = 150$: $150 = 62.5\sqrt[3]{t} + 75.8$

$1.7 \approx t$

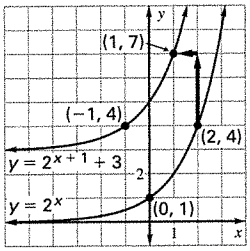
$h = 250$: $250 = 625\sqrt[3]{t} + 75.8$

$21.7 \approx t$

The elephant with a shoulder height of 250 cm is about 20 years older than the elephant with the shoulder height of 150 cm.

Chapter 7

Lesson 7.1 (pp. 482–485)

17. 

The domain is all real numbers and the range is $y > 3$.

29. $A = P\left(1 + \frac{r}{n}\right)^{nt} = 800\left(1 + \frac{0.02}{365}\right)^{365t}$

37. a. $P = 2200$; $r = 0.03$; $n = 4$; $t = 4$

$A = 2200\left(1 + \frac{0.03}{4}\right)^{4 \cdot 4} \approx 2479.38$

The balance is \$2479.38.

b. $P = 2200$; $r = 0.0225$; $n = 12$; $t = 4$

$A = 2200\left(1 + \frac{0.0225}{12}\right)^{12 \cdot 4} \approx 2406.98$

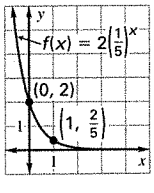
The balance is \$2406.98.

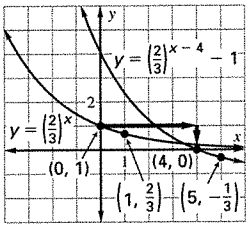
c. $P = 2200$; $r = 0.02$; $n = 365$; $t = 4$

$A = 2200\left(1 + \frac{0.02}{365}\right)^{365 \cdot 4} \approx 2383.23$

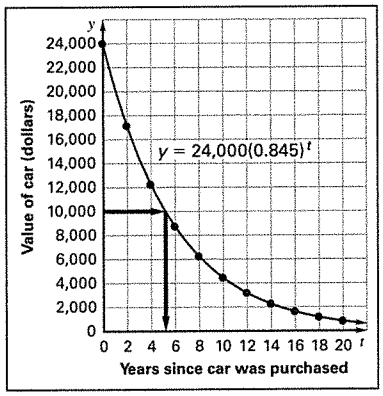
The balance is \$2383.23.

Lesson 7.2 (pp. 489–491)

9. 

19. 

Domain: all real numbers
Range: $y > -1$

33. a. 

About 5 years after it was purchased

b. $y = 24{,}000(0.845)^{50} \approx \$5.29$; too low

Lesson 7.3 (pp. 495–498)

5. $(2e^{3x})^3 = 2^3(e^{3x})^3 = 8e^{9x}$

35. $f(x) = \frac{1}{4}e^{-5x}$; exponential decay

57. $P = 2000$; $r = 0.04$; $t = 5$

$A = Pe^{rt} = 2000e^{(0.04)(5)} \approx \$2442.81$

Lesson 7.4 (pp. 503–505)

13. $\left(\frac{1}{2}\right)^{-3} = 8$, so $\log_{1/2} 8 = -3$.

33. $\log_3 81^x = \log_3 (3^4)^x = \log_3 3^{4x} = 4x$

61. a. $E = 2.5 \times 10^{24}$

$M = 0.29(\ln(2.5 \times 10^{24})) - 9.9 \approx 6.39$

b. $M = 0.29(\ln E) - 9.9$

$\frac{M + 9.9}{0.29} = \ln E \rightarrow e^{(M + 9.9)/0.29} = E$

This represents the amount of energy released as a function of the energy magnitude.

Lesson 7.5 (pp. 510–513)

11. $\log 144 = \log 12^2 = 2 \log 12 = 2.158$

17. $\log 3x^4 = \log 3 + \log x^4 = \log 3 + 4 \log x$

71. $L(10I) - L(I) = 10 \log \frac{10I}{I_0} - 10 \log \frac{I}{I_0}$

$= 10\left(\log \frac{10I}{I_0} - \log \frac{I}{I_0}\right)$

$= 10\left(\log 10 + \log \frac{I}{I_0} - \log \frac{I}{I_0}\right)$

$= 10 \log 10 = 10$ decibels

WORKED-OUT SOLUTIONS

Lesson 7.6 (pp. 519–522)

15. $11^{5x} = 33$

$\log_{11} 11^{5x} = \log_{11} 33$

$5x = \log_{11} 33 = \dfrac{\log 33}{\log 11} \rightarrow x \approx 0.2916$

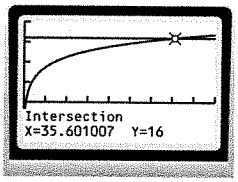
35. $5.2 \log_4 2x = 16$ Check:

$\log_4 2x \approx 3.0769$

$4^{(\log_4 2x)} \approx 4^{3.0769}$

$2x \approx 71.2020$

$x \approx 35.6010$



57. $R = 100e^{-0.00043t} \rightarrow 5 = 100e^{-0.00043t}$

$0.05 = e^{-0.00043t}$

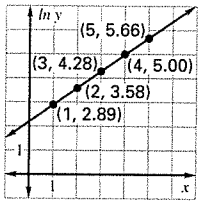
$\ln 0.05 = \ln e^{-0.00043t}$

$-2.9957 \approx -0.00043t$

$t \approx 6967$ years

Lesson 7.7 (pp. 533–536)

11. $m = \dfrac{5.66 - 2.89}{5 - 1} \approx 0.69$



$\ln y - 2.89 = 0.69(x - 1)$

$\ln y = 0.69x + 2.2$

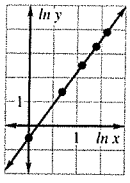
$y = e^{0.69x + 2.2}$

$y = e^{2.2}(e^{0.69})^x \approx 9(2)^x$

23.

ln x	0	0.693	1.099	1.386	1.609
ln y	−0.511	1.411	2.518	3.296	3.902

$m = \dfrac{3.902 - (-0.511)}{1.609 - 0} \approx 2.743$



$\ln y - (-0.511) = 2.743(\ln x - 0)$

$\ln y = \ln x^{2.743} - 0.511$

$y = e^{\ln x^{2.743} - 0.511}$

$y = e^{-0.511} \cdot e^{\ln x^{2.743}} \approx 0.6x^{2.743}$

33. a. A model is $y = 0.48(2.08)^x$.

b. Linear if a graph of (x, y) appears linear; exponential if a graph of $(x, \ln y)$ appears linear; power if a graph of $(\ln x, \ln y)$ appears linear. The graph of (x, y) appears linear, so a model is $y = 33.8x + 28$.

Chapter 8

Lesson 8.1 (pp. 554–557)

15. $y = \dfrac{a}{x} \rightarrow 2 = \dfrac{a}{7} \rightarrow 14 = a$

$y = \dfrac{14}{x} \rightarrow y = \dfrac{14}{3}$

21. $x \cdot y$: $12(132) = 1584$ $\quad y/x$: $132/12 = 11$

$18(198) = 3564 \quad 198/18 = 11$

$23(253) = 5819 \quad 253/23 = 11$

$29(319) = 9251 \quad 319/29 = 11$

$34(374) = 12{,}716 \quad 374/34 = 11$

x and y show direct variation because the ratios y/x are equal.

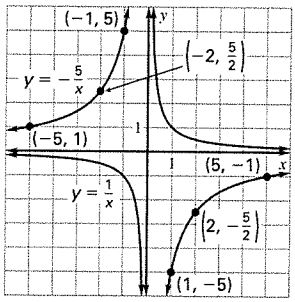
39. Snow shoes: $P = \dfrac{a}{A} \rightarrow 0.43 = \dfrac{a}{400} \rightarrow 172 = a$

An equation is $P = \dfrac{172}{A}$.

Boots: $P = \dfrac{172}{60} \rightarrow P \approx 2.87$ lb/in.^{2}

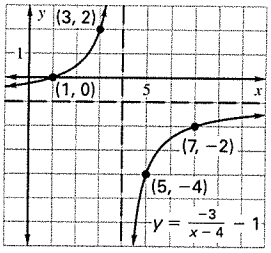
Lesson 8.2 (pp. 561–563)

5.



The graph of $y = \dfrac{-5}{x}$ lies farther from the axes than the graph of $y = \dfrac{1}{x}$, and it lies in Quadrants II and IV instead of Quadrants I and III.

21.

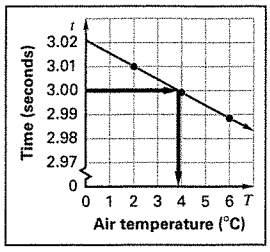


The domain is all real numbers except 4, and the range is all real numbers except −1.

39. a. $t = \dfrac{1000}{0.6T + 331} = \dfrac{1000}{0.6(25) + 331} \approx 2.89$

2.89 seconds to travel 1 kilometer; $2.89(5) = 14.45$ seconds to travel 5 kilometers

39. b.



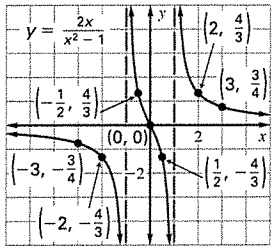
From the graph, you can estimate the temperature to be 3.9°C.

Lesson 8.3 (pp. 568–571)

7. $y = \frac{5}{x^2 - 1} \rightarrow y = \frac{5}{(x + 1)(x - 1)}$

No x-intercept; $x = -1$ and $x = 1$ are vertical asymptotes.

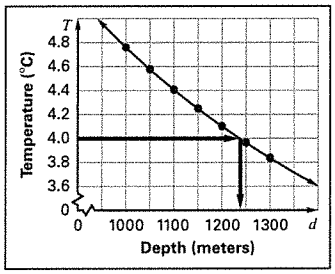
15.



33. a.

Depth	Temp.
1000	4.7634
1050	4.5796
1100	4.4094
1150	4.2515
1200	4.1044
1250	3.9672
1300	3.8389

b.



The mean temperature is 4°C at about 1238 meters.

Lesson 8.4 (pp. 577–580)

7. $\frac{(x - 5)(x + 4)}{(x + 5)(x - 3)}$ Cannot be simplified

25. $\frac{48x^7y^4}{6x^3y^6} = \frac{\cancel{6} \cdot 8 \cdot \cancel{x^3} \cdot x^4 \cdot \cancel{y^4}}{\cancel{6} \cdot \cancel{x^3} \cdot \cancel{y^4} \cdot y^2} = \frac{8x^4}{y^2}$

49.

$$S \div A = \frac{-6420t + 292{,}000}{6.02t^2 - 125t + 1000} \div \frac{-407t + 7220}{5.92t^2 - 131t + 1000}$$

$$= \frac{-6420t + 292{,}000}{6.02t^2 - 125t + 1000} \cdot \frac{5.92t^2 - 131t + 1000}{-407t + 7220}$$

For 1999, $t = 7$: $S \div A = \frac{247{,}060}{419.98} \cdot \frac{373.08}{4371} \approx \$50.21$

Lesson 8.5 (pp. 586–588)

5. $\frac{9}{x + 1} - \frac{2x}{x + 1} = \frac{9 - 2x}{x + 1}$

17. $\frac{8}{3x^2} - \frac{5}{4x} = \frac{32}{12x^2} - \frac{15x}{12x^2} = \frac{32 - 15x}{12x^2}$

43. a. $M = \frac{Pi}{1 - \left(\frac{1}{1 + i}\right)^{12t}} = \frac{Pi}{1 - \frac{1}{(1 + i)^{12t}}}$

$$= \frac{Pi}{\frac{(1 + i)^{12t} - 1}{(1 + i)^{12t}}} = \frac{Pi(1 + i)^{12t}}{(1 + i)^{12t} - 1}$$

b. $P = 15{,}500$; $i = 0.005$; $t = 4$

$$m = \frac{15{,}500(0.005)(1 + 0.005)^{48}}{(1 + 0.005)^{48} - 1} \approx \$364.02$$

Lesson 8.6 (pp. 593–595)

5. $\frac{9}{3x} = \frac{4}{x + 2}$ Check: $\frac{9}{3(6)} \stackrel{?}{=} \frac{4}{(6) + 2}$

$4(3x) = 9(x + 2)$ $\frac{9}{18} \stackrel{?}{=} \frac{4}{8}$

$x = 6$ $\frac{1}{2} = \frac{1}{2}$ ✓

15. $\frac{2}{3x} + \frac{1}{6} = \frac{4}{3x}$ Check: $\frac{2}{3(4)} + \frac{1}{6} \stackrel{?}{=} \frac{4}{3(4)}$

$6x\left(\frac{2}{3x} + \frac{1}{6}\right) = 6x\left(\frac{4}{3x}\right)$ $\frac{2}{12} + \frac{1}{6} \stackrel{?}{=} \frac{4}{12}$

$2(2) + 1(x) = 4(2) \rightarrow x = 4$ $\frac{4}{12} = \frac{4}{12}$ ✓

35.

$$n = \frac{635t^2 - 7350t + 27{,}200}{t^2 - 11.5t + 39.4}$$

$$720 = \frac{635t^2 - 7350t + 27{,}200}{t^2 - 11.5t + 39.4}$$

$$720t^2 - 8280t + 28{,}368 = 635t^2 - 7350t + 27{,}200$$

$$85t^2 - 930 + 1168 = 0$$

$$t = \frac{930 \pm \sqrt{(930)^2 - 4(1168)(85)}}{2(85)} \approx 1.45, 9.45$$

Because 9.45 is not in the domain ($0 \le t \le 9$), $t \approx 1.45 \rightarrow 1995$.

Chapter 9

Lesson 9.1 (pp. 617–619)

7. $d = \sqrt{(6 - 2)^2 + (-5 - (-1))^2} = 4\sqrt{2}$

Midpoint $= \left(\frac{2 + 6}{2}, \frac{-1 + (-5)}{2}\right) = (4, -3)$

WORKED-OUT SOLUTIONS

27. $A(-4, 1), B(-2, 6), C(0, -1)$

$AB = \sqrt{(-2 - (-4))^2 + (6 - 1)^2} = \sqrt{29}$

$BC = \sqrt{(0 - (-2))^2 + (-1 - 6)^2} = \sqrt{53}$

$AC = \sqrt{(0 - (-4))^2 + (-1 - 1)^2} = \sqrt{20} = 2\sqrt{5}$

$AB \neq BC \neq AC$, so $\triangle ABC$ is scalene.

53. a. $M = \left(\frac{-6 + 3}{2}, \frac{5 + 11}{2}\right) = \left(-\frac{3}{2}, 8\right)$

b. $VS = \sqrt{(-6 - 0)^2 + (5 - 0)^2} = \sqrt{61}$

$SM = \sqrt{\left(-\frac{3}{2} - (-6)\right)^2 + (8 - 5)^2} = \frac{\sqrt{117}}{2}$

$VS + SM = \sqrt{61} + \frac{\sqrt{117}}{2}$

$\approx 13.2 \text{ units} \cdot \frac{0.1 \text{ mi}}{1 \text{ unit}} = 1.32 \text{ mi}$

c. $MP = \frac{\sqrt{117}}{2}$

$PV = \sqrt{(0 - 3)^2 + (0 - 11)^2} = \sqrt{130}$

$MP + PV = \frac{\sqrt{117}}{2} + \sqrt{130}$

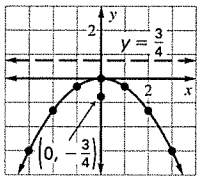
$\approx 16.8 \text{ units} \cdot \frac{0.1 \text{ mi}}{1 \text{ unit}} = 1.68 \text{ mi}$

Lesson 9.2 (pp. 623–625)

15. $5x^2 = -15y \rightarrow x^2 = -3y$

$4p = -3 \rightarrow p = -\frac{3}{4}$

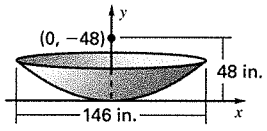
Focus: $\left(0, -\frac{3}{4}\right)$

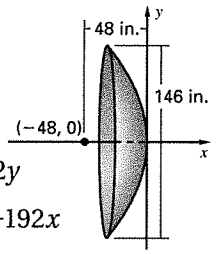


Directrix: $y = \frac{3}{4}$ Axis of symmetry: $x = 0$

27. Focus: $(-5, 0) \rightarrow p = -5 \rightarrow y^2 = -20x$

57. a.





b. $x^2 = 4(48)y \rightarrow x^2 = 192y$

$y^2 = 4(-48)x \rightarrow y^2 = -192x$

c. Using $x^2 = 192y$ and $x = 73$, $y \approx 27.8$

Using $y^2 = -192x$ and $y = 73$, $x \approx -27.8$.

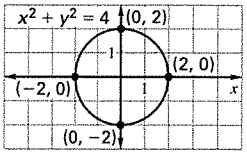
The dish is about 27.8 inches deep.

Lesson 9.3 (pp. 629–632)

17. $15x^2 + 15y^2 = 60$

$x^2 + y^2 = 4$

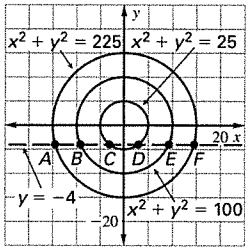
$r = \sqrt{4} = 2$



39. $r = \sqrt{(-8 - 0)^2 + (14 - 0)^2} = \sqrt{260}$

$x^2 + y^2 = (\sqrt{260})^2 \rightarrow x^2 + y^2 = 260$

65.



A: $x^2 + (-4)^2 = 225 \rightarrow x \approx \pm 14.5 \rightarrow (-14.5, -4)$

B: $x^2 + (-4)^2 = 100 \rightarrow x \approx \pm 9.2 \rightarrow (-9.2, -4)$

C: $x^2 + (-4)^2 = 25 \rightarrow x = \pm 3 \rightarrow (-3, -4)$

D: $x^2 + (-4)^2 = 25 \rightarrow x = \pm 3 \rightarrow (3, -4)$

E: $x^2 + (-4)^2 = 100 \rightarrow x \approx \pm 9.2 \rightarrow (9.2, -4)$

F: $x^2 + (-4)^2 = 225 \rightarrow x \approx \pm 14.5 \rightarrow (14.5, -4)$

a. $AF \approx |14.5 - (-14.5)| = 29$ mi

b. $BE \approx |9.2 - (-9.2)| = 18.4$ mi

c. $CD \approx |3 - (-3)| = 6$ mi

Lesson 9.4 (pp. 637–639)

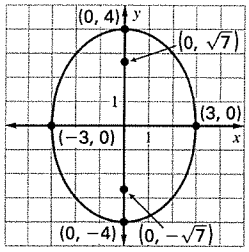
11. $16x^2 + 9y^2 = 144$

$\frac{x^2}{9} + \frac{y^2}{16} = 1$; $a = 4$, $b = 3$

Vertices: $(0, \pm 4)$;

Co-vertices: $(\pm 3, 0)$;

Foci: $(0, \pm\sqrt{7})$



29. $b = \sqrt{7}$; $c = 3$; $a^2 = b^2 + c^2 \rightarrow a = 4$

$\frac{x^2}{4^2} + \frac{y^2}{(\sqrt{7})^2} = 1$, or $\frac{x^2}{16} + \frac{y^2}{7} = 1$

49. Largest field:

$2a = 185 \rightarrow a = 92.5$; $2b = 155 \rightarrow b = 77.5$

$\frac{x^2}{77.5^2} + \frac{y^2}{92.5^2} = 1$, or $\frac{x^2}{6006.25} + \frac{y^2}{8556.25} = 1$

$A = \pi(92.5)(77.5) \approx 22{,}521$ square meters

Smallest field:

$2a = 135 \rightarrow a = 67.5$; $2b = 110 \rightarrow b = 55$

$\frac{x^2}{55^2} + \frac{y^2}{67.5^2} = 1$, or $\frac{x^2}{3025} + \frac{y^2}{4556.25} = 1$

$A = \pi(67.5)(55) \approx 11{,}663$ square meters

$11{,}663 \leq A \leq 22{,}521$

Lesson 9.5 (pp. 645–648)

13. $81x^2 - 16y^2 = 1296$

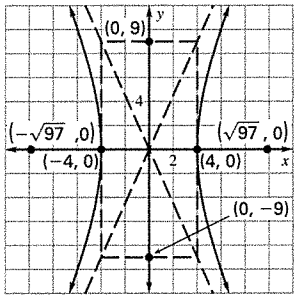
$\frac{x^2}{16} - \frac{y^2}{81} = 1$

$a = 4$; $b = 9$; $c = \sqrt{97}$

Vertices: $(\pm 4, 0)$

Foci: $(\pm\sqrt{97}, 0)$

Asymptotes: $y = \pm\frac{9}{4}x$



23. $c = 4\sqrt{5}$; $a = 4$; $b^2 = c^2 - a^2 - a \rightarrow b = 8$

$\frac{y^2}{4^2} - \frac{x^2}{8^2} = 1$, or $\frac{y^2}{16} - \frac{x^2}{64} = 1$

41. a. $A(30.5, 0)$; $B(85, -40)$

b. Vertices: $(\pm 30.5, 0)$; horizontal trans. axis

$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1 \rightarrow \frac{x^2}{30.5^2} - \frac{y^2}{b^2} = 1$

$\frac{85^2}{30.5^2} - \frac{(-40)^2}{b^2} = 1 \rightarrow b^2 \approx 236.5$

So, an equation is $\frac{x^2}{930.25} - \frac{y^2}{236.5} = 1$.

c. $x = 42$: $\frac{42^2}{930.25} - \frac{y^2}{236.5} = 1 \rightarrow y \approx 14.6$

$h = 40 + 14.6 = 54.6$ feet

Lesson 9.6 (pp. 655–657)

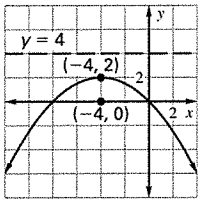
3. $(x + 4)^2 = -8(y - 2)$

Parabola; vertical axis;
vertex at $(h, k) = (-4, 2)$.

$4p = -8 \rightarrow p = -2$

Focus: $(h, k + p) = (-4, 0)$

Directrix: $y = k - p \rightarrow y = 4$



19. Vertices: (6, −3), (6, 1); Focus: (6, −6), (6, 4)

Vertical transverse axis; $\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$

Center: $(h, k) = \left(\frac{6+6}{2}, \frac{-3+1}{2}\right)$

Distance between vertex (6, −3) and (h, k):

$a = |-3 - k| = |-3 - (-1)| = 2$

Distance between focus (6, −6) and (h, k):

$c = |-6 - k| = |-6 - (-1)| = 5$

$b^2 = c^2 - a^2 = 25 - 4 = 21 \rightarrow b = \sqrt{21}$

An equation is $\frac{(y+1)^2}{4} - \frac{(x-6)^2}{21} = 1$.

49. $x^2 - 10x + 4y = 0$; $A = 1$, $B = 0$, $C = 0$

$B^2 - 4AC = 0 - 4(1)(0) = 0 \rightarrow$ Parabola

$x^2 - 10x + 4y = 0$

$(x^2 - 10x + 25) = -4y + 25$

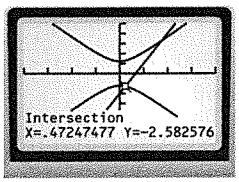
$(x - 5)^2 = -4\left(y - \frac{25}{4}\right)$

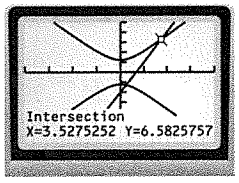
$(h, k) = \left(5, \frac{25}{4}\right)$; height $= \frac{25}{4} = 6.25$ feet

When $y = 0$, the x-intercepts are 0 and 10, so the distance of the jump is 10 feet.

Lesson 9.7 (pp. 661–664)

5.





The solutions are approximately (0.5, −2.6) and (3.5, 6.6).

15. $4x^2 - 5y^2 = -76$

$2x + y = -6 \rightarrow y = -2x - 6$

Substitute $-2x - 6$ for y in Equation 1.

$4x^2 - 5(-2x - 6)^2 = -76$

$4x^2 - 20x^2 - 120x - 180 = -76$

$-16x^2 - 120x - 104 = 0$

$2x^2 + 15x + 13 = 0$

$(2x + 2)\left(x + \frac{13}{2}\right) = 0 \rightarrow x = -1, x = -\frac{13}{2}$

When $x = -1$: $y = -2(-1) - 6 = -4$

When $x = -\frac{13}{2}$: $y = -2\left(-\frac{13}{2}\right) - 6 = 7$

The solutions are $(-1, -4)$ and $\left(-\frac{13}{2}, 7\right)$.

41. a. Oak Lane: $m = -\frac{1}{7}$, $(x_1, y_1) = (-2, 1)$

$$y - 1 = -\frac{1}{7}(x + 2) \rightarrow y = -\frac{1}{7}x + \frac{5}{7}$$

Circle: $x^2 + y^2 = 1$

b. $$x^2 + \left(-\frac{1}{7}x + \frac{5}{7}\right)^2 = 1$$

$$x^2 + \frac{1}{49}x^2 - \frac{10}{49}x + \frac{25}{49} = 1$$

$$49x^2 + x^2 - 10x + 25 = 49$$

$$50x^2 - 10x - 24 = 0$$

$$(5x - 4)(10x + 6) = 0 \rightarrow x = \frac{4}{5}, x = -\frac{3}{5}$$

$$y = -\frac{1}{7}\left(\frac{4}{5}\right) + \frac{5}{7} = \frac{3}{5}; y = -\frac{1}{7}\left(-\frac{3}{5}\right) + \frac{5}{7} = \frac{4}{5}$$

The solutions are $\left(\frac{4}{5}, \frac{3}{5}\right)$ and $\left(-\frac{3}{5}, \frac{4}{5}\right)$.

c. $d = \sqrt{\left(-\frac{3}{5} - \frac{4}{5}\right)^2 + \left(\frac{4}{5} - \frac{3}{5}\right)^2} = \sqrt{2} \approx 1.4$ mi

Chapter 10

Lesson 10.1 (pp. 686–689)

13. a. $26 \cdot 26 \cdot 26 \cdot 26 \cdot 10 \cdot 10 = 45{,}697{,}600$

b. $26 \cdot 25 \cdot 24 \cdot 23 \cdot 10 \cdot 9 = 32{,}292{,}000$

35. ${}_9P_2 = \frac{9!}{(9-2)!} = \frac{9!}{7!} = \frac{362{,}880}{5040} = 72$

65. Permutations of 9 objects taken 3 at a time:

${}_9P_3 = \frac{9!}{(9-3)!} = \frac{9!}{6!} = \frac{362{,}880}{720} = 504$ ways

Lesson 10.2 (pp. 694–697)

17. *Exactly one queen*: Choose 1 of the 4 queens and 4 of the 48 that are not queens.

${}_4C_1 \cdot {}_{48}C_4 = \frac{4!}{3!1!} \cdot \frac{48!}{44!4!} = 778{,}320$

No queen: Choose 5 cards from the 48 in a deck that are not queens.

${}_{48}C_5 = \frac{48!}{43!5!} = 1{,}712{,}304$

The total number of possible hands is $778{,}320 + 1{,}712{,}304 = 2{,}490{,}624$.

29. $(2s^4 + 5)^5 = {}_5C_0(2s^4)^5 5^0 + {}_5C_1(2s^4)^4 5^1 + {}_5C_2(2s^4)^3 5^2 + {}_5C_3(2s^4)^2 5^3 + {}_5C_4(2s^4)^1 5^4 + {}_5C_5(2s^4)^0 5^5 = 1(32s^{20}) + 5(16s^{16})(5) + 10(8s^{12})(25) + 10(4s^8)(125) + 5(2s^4)(625) + 1(1)(3125) = 32s^{20} + 400s^{16} + 2000s^{12} + 5000s^8 + 6250s^4 + 3125$

49. You can choose 3 of the 18 types of flowers.

${}_{18}C_3 = \frac{18!}{15!3!} = \frac{18 \cdot 17 \cdot 16 \cdot \cancel{15!}}{\cancel{15!} \cdot 3!} = 816$

Lesson 10.3 (pp. 702–704)

7. Factors of 150 from 1 to 50: 1, 2, 3, 5, 6, 10, 15, 25, 30, 50

$P = \frac{\text{Factors of 150}}{\text{Integers from 1 to 50}} = \frac{10}{50} = \frac{1}{5}$

17. There are ${}_{48}C_6$ different combinations of 6 numbers. Only 1 is the correct combination.

$P(\text{correct numbers}) = \frac{1}{{}_{48}C_6} = \frac{1}{12{,}271{,}512}$

39. $P = \frac{\text{Area of smallest circle}}{\text{Area of entire target}} = \frac{\pi \cdot 8^2}{\pi \cdot 40^2} = \frac{1}{25} = 0.04$

Lesson 10.4 (pp. 710–713)

11. $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

$$0.71 = 0.28 + 0.64 - P(A \text{ and } B)$$

$$-0.21 = -P(A \text{ and } B) \rightarrow P(A \text{ and } B) = 0.21$$

21. $P(\text{K or } \blacklozenge) = P(\text{K}) + P(\blacklozenge) - P(\text{K and } \blacklozenge)$

$$= \left(\frac{4}{52}\right) + \left(\frac{13}{52}\right) - \left(\frac{1}{52}\right) = \frac{4}{13}$$

45. The number of combinations of 6 food items is 10^6. The number of combinations of 6 different food items is $10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 \cdot 5$. So, the probability that at least 2 bring the same item is $P = 1 - P(\text{none are the same}) = 1 - \frac{10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 \cdot 5}{10^6} = 0.8488$.

Lesson 10.5 (pp. 721–723)

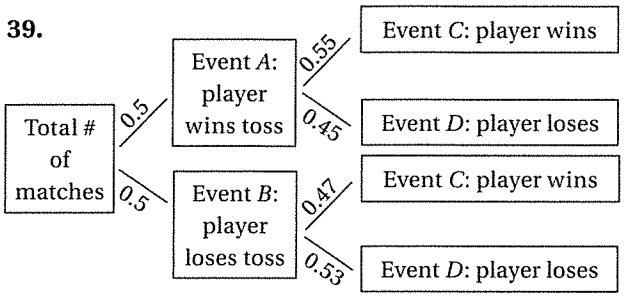
13. $P = P(\text{blue}) \cdot P(\text{green}) \cdot P(\text{red})$

$$= \left(\frac{3}{16}\right) \cdot \left(\frac{4}{16}\right) \cdot \left(\frac{5}{16}\right) = \frac{60}{4096} \approx 0.015$$

25. Primes from 1 to 20: 2, 3, 5, 7, 11, 13, 17, 19.

$$P(\text{odd}|\text{prime}) = \frac{P(\text{number of odd primes})}{P(\text{number of primes})} = \frac{7}{8}$$

39.

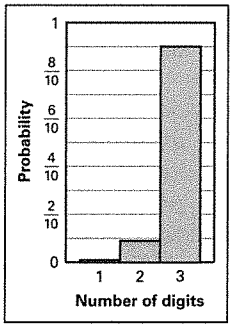


$$P(C) = P(A \text{ and } C) + P(B \text{ and } C)$$
$$= P(A) \cdot P(C|A) + P(B) \cdot P(C|B)$$
$$= (0.50) \cdot (0, 55) + (0, 50)(0.47) = 0.51$$

Lesson 10.6 (pp. 727–730)

5.

N	Outcomes	P(N)
1	10	$\frac{10}{100} = \frac{1}{100}$
2	90	$\frac{90}{1000} = \frac{9}{100}$
3	900	$\frac{900}{1000} = \frac{9}{10}$



21. Each question has 4 possible answers, so the probability of guessing a correct answer is $p = 0.25$. There are 30 questions, so $n = 30$. The probability of randomly guessing 11 correct answers is $P(k = 11) = {}_{30}C_{11}(0.25)^{11}(1 - 0.25)^{30 - 11} \approx 0.055$.

45. a. $p = 0.34$;

$P(k = 5) = {}_{10}C_5(0.34)^5(1 - 0.34)^{10 - 5} \approx 0.14$

b. $p = P(\text{Rh}^-) = P(\text{O}^-) + P(\text{A}^-) + P(\text{B}^-) + P(\text{AB}^-)$

$= 0.15$

$P(k = 2) = {}_{10}C_2(0.15)^2(1 - 0.15)^{10 - 2} \approx 0.28$

c. $p = P(\text{O}) = P(\text{O}^+) + P(\text{O}^-) = 0.43$

$P(k = 0) = {}_{10}C_0(0.43)^0(1 - 0.43)^{10 - 0} \approx 0.004$

$P(k = 1) = {}_{10}C_1(0.43)^1(1 - 0.43)^{10 - 1} \approx 0.027$

$P(k = 2) = {}_{10}C_2(0.43)^2(1 - 0.43)^{10 - 2} \approx 0.093$

$P(k \le 2) = P(k = 0) + P(k = 1) + P(k = 2)$

≈ 0.124

d. $p = P(\text{Rh}^+) = P(\text{O}^+) + P(\text{A}^+) + P(\text{B}^+) + P(\text{AB}^+) = 0.85$

$P(k = 5) = {}_{10}C_5(0.85)^5(1 - 0.85)^{10 - 5} \approx 0.008$

$P(k = 6) = {}_{10}C_6(0.85)^6(1 - 0.85)^{10 - 6} \approx 0.040$

$P(k = 7) = {}_{10}C_7(0.85)^7(1 - 0.85)^{10 - 7} \approx 0.130$

$P(k = 8) = {}_{10}C_8(0.85)^8(1 - 0.85)^{10 - 8} \approx 0.276$

$P(k = 9) = {}_{10}C_9(0.85)^9(1 - 0.85)^{10 - 9} \approx 0.347$

$P(k = 10) = {}_{10}C_{10}(0.85)^{10}(1 - 0.85)^{10 - 10} \approx 0.197$

$P(k \ge 5) = P(k = 5) + P(k = 6) + P(k = 7) + P(k = 8) + P(k = 9) + P(k = 10) \approx 0.998$

Chapter 11

Lesson 11.1 (pp. 747–749)

5. Mean:

$$\frac{69 + 70 + 75 + 84 + 73 + 78 + 74 + 73 + 78 + 71}{10}$$

$= 74.5$

Median: ~~69~~, ~~70~~, ~~71~~, ~~73~~, 73, 74, ~~75~~, ~~78~~, ~~78~~, ~~84~~

$$\frac{73 + 74}{2} = 73.5$$

Mode: 73 and 78

15. Range: $158 - 135 = 23$

$$\bar{x} = \frac{135 + 142 + 148 + 136 + 152 + 140 + 158 + 154}{8}$$

$= 145.625$

$$\sigma = \sqrt{\frac{(135 - 145.625)^2 + (142 - 145.625)^2 + \cdots + (154 - 145.625)^2}{8}}$$

$$= \sqrt{\frac{519.875}{8}} \approx 8.1$$

29. a. The outlier is 5.

b. *With outlier*:

Mean: $\bar{x} = \frac{20 + 23 + \cdots + 23}{10} = 20.2$

Median: 22 Mode: 23 Range: $25 - 5 = 20$

Std. Dev.:

$$\sigma = \frac{(20 - 20.2)^2 + (23 - 20.2)^2 + \cdots + (23 - 20.2)^2}{10}$$

≈ 5.4

Without outlier:

Mean: $\bar{x} = \frac{20 + 23 + \cdots + 23}{9} \approx 21.9$

Median: 23 Mode: 23 Range: $25 - 19 = 6$

Std. Dev.:

$$\sigma = \sqrt{\frac{(20 - 20.2)^2 + (23 - 20.2)^2 + \cdots + (23 - 20.2)^2}{9}} \approx 2.1$$

c. The outlier causes the mean and median to decrease, and the range and standard deviation to increase. The mode stays the same.

Lesson 11.2 (pp. 753–755)

5.

	Original data set	Adding 17 to data values
Mean	78	$78 + 17 = 95$
Median	77	$77 + 17 = 94$
Mode	77	$77 + 17 = 94$
Range	9	9
Standard deviation	2.8	2.8

11.

	Original data set	Multiplying data values by 4
Mean	61.9	$61.9(4) = 247.6$
Median	62	$62(4) = 248$
Mode	58	$58(4) = 232$
Range	9	$9(4) = 36$
Standard deviation	3.4	$3.4(4) = 13.6$

19.

	Heights without stilts	Heights with stilts
Mean	70.8	$70.8 + 28 = 98.8$
Median	72	$72 + 28 = 100$
Mode	72	$72 + 28 = 100$
Range	8	8
Standard deviation	2.4	2.4

Lesson 11.3 (pp. 760–762)

3. $P(x \leq \bar{x} - \sigma) = 0.0015 + 0.0235 + 0.135 = 0.16$

11. 29 and 37 are one standard deviation on either side of the mean, which accounts for 68% of the data. So, the probability is 0.68.

33. a. 19.4 ounces: $z = \frac{19.4 - 20}{0.25} = -2.4$

20.4 ounces: $z = \frac{20.4 - 20}{0.25} = 1.6$

b. The table shows that $P(x \leq -2.4) = 0.0082$. So, the probability is 0.0082.

c. $P(x \leq 20.4) = 0.9452$; $P(x \leq 19.4) = 0.0082$

$P(x \leq 20.4) - P(x \leq 19.4) = 0.937$

Lesson 11.4 (pp. 769–771)

7. Margin of error $= \pm\frac{1}{\sqrt{n}} = \pm\frac{1}{\sqrt{1000}} \approx \pm 0.032$

The margin of error is about $\pm 3.2\%$.

19. Margin of error $= \pm\frac{1}{\sqrt{n}}$

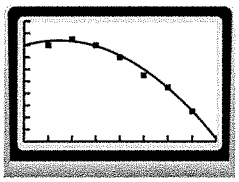
$\pm 0.056 = \pm\frac{1}{\sqrt{n}}$

$0.003136 = \frac{1}{n} \rightarrow n \approx 319$

29. *Sample answer*: It is not reasonable to assume that Kosta is going to win the election, because the margin of error is $\pm 5\%$. If the margin of error works in favor of Murdock, Kosta will have 49% (54% − 5%) and Murdock will have 51% (46% + 5%).

Lesson 11.5 (pp. 778–780)

3. Model: $y = -0.38x^2 + 1.1x + 16$



11. A model for the data is $y = 0.00211x^3 - 0.0766x^2 + 1.26x - 0.0664$.

Chapter 12

Lesson 12.1 (pp. 798–800)

19. $\frac{2}{3 \cdot 1}, \frac{2}{3 \cdot 2}, \frac{2}{3 \cdot 3}, \frac{2}{3 \cdot 4}, \ldots$

Next term: $\frac{2}{3 \cdot 5} = \frac{2}{15}$; A rule is $a_n = \frac{2}{3n}$.

47. $\sum_{n=0}^{4} n^3 = 0^3 + 1^3 + 2^3 + 3^3 + 4^3$

$= 0 + 1 + 8 + 27 + 64 = 100$

65.

n	1	2	3	4	5
a_n	1	3	7	15	31

A formula for the sequence is $a_n = 2^n - 1$.

$a_6 = 2^6 - 1 = 63$ moves for 6 rings

$a_7 = 2^7 - 1 = 127$ moves for 7 rings

$a_8 = 2^8 - 1 = 255$ moves for 8 rings

Lesson 12.2 (pp. 806–809)

15. Arithmetic sequence

$a_1 = -3; d = -1 - (-3) = 2$

A rule for the nth term is

$a_n = a_1 + (n - 1)d = -3 + (n - 1)2 = 2n - 5$

$a_{20} = 2(20) - 5 = 35$

41. $\sum_{i=1}^{8} (-3 - 2i)$

$a_1 = -3 - 2(1) = -5; a_8 = -3 - 2(8) = -19$

$s_8 = 8\left(\frac{-5 + (-19)}{2}\right) = -96$

65. a. $a_1 = 4; d = 8$

$a_n = a_1 + (n - 1)d = 4 + (n - 1)8 = -4 + 8n$

b. $a_{12} + a_{11} + \cdots + a_2 + a_1 = 576$ blocks

Lesson 12.3 (pp. 814–817)

19. Geometric sequence; $a_1 = 2; r = \frac{\frac{3}{2}}{2} = \frac{3}{4}$

$a_n = a_1 r^{n-1} = 2\left(\frac{3}{4}\right)^{n-1}$

$a_7 = 2\left(\frac{3}{4}\right)^{7-1} = \frac{1458}{4096} = \frac{729}{2048}$

49. $\sum_{i=1}^{8} 6(4)^{i-1}$

$a_1 = 6(4)^{1-1} = 6; r = 4$

$s_8 = a_1\left(\frac{1 - r^8}{1 - r}\right) = 6\left(\frac{1 - 4^8}{1 - 4}\right) = 131{,}070$

59. a. $a_1 = 1024 \div 2 = 512; r = \frac{1}{2}$

$a_n = a_1(r)^{n-1} = 512\left(\frac{1}{2}\right)^{n-1}$

b. $n = 10$; after 10 passes, the number of items remaining is $a_{10} = 512\left(\frac{1}{2}\right)^{10-1} = 1$.

Lesson 12.4 (pp. 823–825)

13. $\sum_{k=1}^{\infty} 7\left(-\frac{8}{9}\right)^{k-1}$

$a_1 = 7; r = -\frac{8}{9}; s = \frac{a_1}{1 - r} = \frac{7}{1 - \left(-\frac{8}{9}\right)} = \frac{63}{17}$

27. $625(0.001) + 625(0.001)^2 + 625(0.001)^3 + \cdots$

$= \frac{a_1}{1 - r} = \frac{625(0.001)}{1 - 0.001} = \frac{0.625}{0.999} = \frac{625}{999}$

39. D;

$n = 345 + 345(0.783) + 345(0.783)^2$

$+ 345(0.783)^3 + \cdots$

$= \frac{a_1}{1 - r} = \frac{345}{1 - 0.783} \approx 1.59$ billion

Lesson 12.5 (pp. 830–833)

15. Geometric sequence; $a_1 = 4; r = -3$

$a_n = r \cdot a_{n-1} = -3a_{n-1}$

A recursive rule is $a_1 = 4, a_n = -3a_{n-1}$.

27. $f(x) = \frac{1}{2}x - 3, x_0 = 2$

$x_1 = f(x_0)$	$x_2 = f(x_1)$	$x_3 = f(x_2)$
$= f(2)$	$= f(-2)$	$= f(-4)$
$= \frac{1}{2}(2) - 3$	$= \frac{1}{2}(-2) - 3$	$= \frac{1}{2}(-4) - 3$
$= -2$	$= -4$	$= -5$

45. Recursive rule:

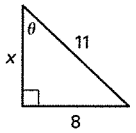
$a_1 = 2000, a_n = 1.014a_{n-1} - 100.$

Because $a_{24} = 62.14$, the balance at the beginning of the 24th month is \$62.14. So, she will be able to pay off the balance at the end of the 24th month.

Chapter 13

Lesson 13.1 (pp. 856–858)

5.



Using the Pythagorean theorem:

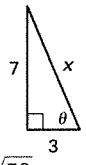
$x = \sqrt{11^2 - 8^2} = \sqrt{57}$

$\sin\theta = \frac{8}{11}$ $\cos\theta = \frac{\sqrt{57}}{11}$ $\tan\theta = \frac{8\sqrt{57}}{57}$

$\csc\theta = \frac{11}{8}$ $\sec\theta = \frac{11\sqrt{57}}{57}$ $\cot\theta = \frac{\sqrt{57}}{8}$

11. $\tan\theta = \frac{\text{opp}}{\text{adj}} = \frac{7}{3}$

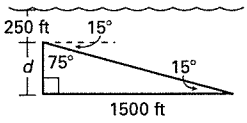
$x = \sqrt{7^2 + 3^2} = \sqrt{58}$



$\sin\theta = \frac{7\sqrt{58}}{58}$ $\cos\theta = \frac{3\sqrt{58}}{58}$ $\tan\theta = \frac{7}{3}$

$\csc\theta = \frac{\sqrt{58}}{7}$ $\sec\theta = \frac{\sqrt{58}}{3}$ $\cot\theta = \frac{3}{7}$

33.



$\tan 15° = \frac{d}{1500}$

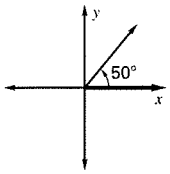
$d \approx 402$

The total depth is 402 + 250 = 652 feet.

As the angle of the dive increases, the depth increases.

Lesson 13.2 (pp. 862–865)

11. $\frac{5\pi}{18} = \frac{5\pi \text{ radians}}{18}\left(\frac{180°}{\pi \text{ radians}}\right) = 50°$



23. $40° = 40°\left(\frac{\pi \text{ radians}}{180°}\right) = \frac{2\pi}{9}$ radians

51. a. $\frac{15 \text{ rev}}{1 \text{ min}}\left(\frac{1 \text{ min}}{60 \text{ sec}}\right)\left(\frac{2\pi \text{ rad}}{1 \text{ rev}}\right) = \frac{\pi}{2}$ rad/sec

b. Arc length: $s = r\theta = 29\left(\frac{\pi}{2}\right) \approx 45.6$ feet

Lesson 13.3 (pp. 870–872)

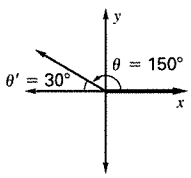
5. $r = \sqrt{x^2 + y^2} = \sqrt{(-7)^2 + (-24)^2} = \sqrt{625} = 25$

$\sin\theta = \frac{y}{r} = \frac{-24}{25}$ $\cos\theta = \frac{x}{f} = \frac{-7}{25}$

$\tan\theta = \frac{y}{x} = \frac{-24}{-7} = \frac{24}{7}$ $\csc\theta = \frac{r}{y} = \frac{-25}{24}$

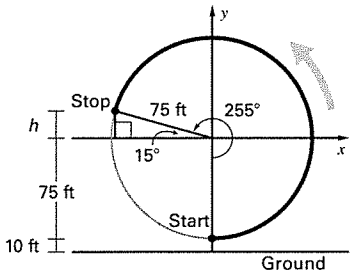
$\sec\theta = \frac{r}{x} = \frac{-25}{7}$ $\cot\theta = \frac{x}{y} = \frac{7}{24}$

17.



$\theta' = 180° - 150° = 30°$

37.



$\theta' = 270° - 255° = 15°$

$\sin 15° = \frac{h}{75}$

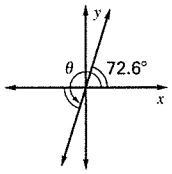
$19.4 \approx h$

When the ride stops, you are about 10 + 75 + 19.4 = 104.4 feet above the ground. If the radius is doubled, your height above the ground is doubled only if your starting height above the ground is also doubled.

Lesson 13.4 (pp. 878–880)

7. When $-\frac{\pi}{2} \le \theta \le \frac{\pi}{2}$, or $-90° \le \theta \le 90°$, the angle whose sine is $\frac{\sqrt{3}}{2}$ is $\theta = \sin^{-1}\frac{\sqrt{3}}{2} = \frac{\pi}{3}$, or $\theta = \sin^{-1}\frac{\sqrt{3}}{2} = 60°$.

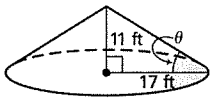
23.



$\tan\theta = 3.2$; $180° < \theta < 270°$

$\tan^{-1}(3.2) \approx 72.6°$, which is in Quadrant I. To find the angle in Quadrant III ($180° < \theta < 270°$): $\theta \approx 180 + 72.6 = 252.6°$

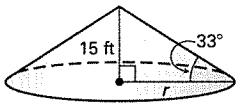
37.



$\tan\theta = \frac{11}{17}$

$\theta = \tan^{-1}\left(\frac{11}{17}\right) \approx 33°$

Because the angle of repose remains the same, you can use $\theta = 33°$ to find the radius of the 15 foot high pile:



$\tan 33° = \frac{15}{r} \rightarrow r = \frac{15}{\tan 33°}$

≈ 23

The diameter is about $d = 2r = 2(23) = 46$ ft.

Lesson 13.5 (pp. 886–888)

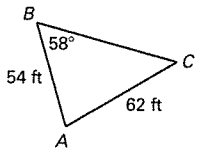
13. $\frac{\sin B}{16} = \frac{\sin 104°}{25}$

$\sin B = \frac{16 \sin 104°}{25} \approx 0.6210 \rightarrow B \approx 38.4°$

$A \approx 180° - 104° - 38.4° = 37.6°$

$\frac{a}{\sin 37.6°} = \frac{25}{\sin 104°} \rightarrow a = \frac{25 \sin 37.6°}{\sin 104°} \approx 15.7$

45. a.



b. $\frac{\sin C}{54} = \frac{\sin 58°}{62}$

$\sin C = \frac{54 \sin 58°}{62} \approx 0.7386 \rightarrow C \approx 47.6°$

$A \approx 180° - 58° - 47.6° = 74.4°$

$\frac{a}{\sin 74.4°} = \frac{62}{\sin 58°} \rightarrow a = \frac{62 \sin 74.4°}{\sin 58°} \approx 70.4$

c. Area $= \frac{1}{2} bc \sin A = \frac{1}{2}(62)(54)(\sin 74.4°)$

≈ 1612

$1612 \text{ ft}^2 \div 200 \text{ ft}^2/\text{bag} \approx 8.1 \text{ bags}$

You will need 9 bags of fertilizer.

Lesson 13.6 (pp. 892–894)

17. $a^2 = b^2 + c^2 - 2bc \cos A$

$10^2 = 3^2 + 12^2 - 2(3)(12)\cos A$

$\frac{53}{72} = \cos A \rightarrow A \approx 43°$

$\frac{10}{\sin 43°} = \frac{3}{\sin B} \rightarrow \frac{3(\sin 43°)}{10} = \sin B$

$B \approx 12°$; $C \approx 180 - 43° - 12° = 125°$

In $\triangle ABC$, $A \approx 43°$, $B \approx 12°$, and $C \approx 125°$.

25. $s = \frac{1}{2}(a + b + c) = \frac{1}{2}(5 + 11 + 10) = 13$

Area $= \sqrt{s(s-a)(sb)(s-c)}$

$= \sqrt{13(13-5)(13-11)(13-10)} = \sqrt{624}$

≈ 25 square units

45. $\triangle ADB$: $s = \frac{1}{2}(743 + 1210 + 1480) = 1716.5$

Area $=$

$\sqrt{1716.5(1716.5-743)(1716.5-1210)(1716.5-1480)}$

$\approx 447{,}399$

$\triangle CDB$: $s = \frac{1}{2}(1000 + 858 + 1480) = 1669$

Area $=$

$\sqrt{1669(1669-1000)(1669-858)(1669-1480)}$

$\approx 413{,}697$

Area $= (447{,}399 + 413{,}697)\text{ft}^2 \left(\frac{1 \text{ acre}}{43{,}560 \text{ft}^2}\right)$

≈ 20 acres

If you first found the length of $\overline{AC}$, you could repeat the same process using $\triangle ABC$ and $\triangle ADC$.

Chapter 14

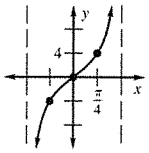
Lesson 14.1 (pp. 912–914)

5. Amplitude: 1; period: 2

17. $f(x) = 4 \tan x$

Period: π; intercept: (0, 0)

Asymptotes: $x = \pm\frac{\pi}{2}$



Halfway points: $\left(\frac{\pi}{4}, 4\right)\left(-\frac{\pi}{4}, -4\right)$

31. a. Equation has the form $y = a \cos bt$.

$a = \frac{1}{2}(3.5) = 1.75$

Period is 6, so $6 = \frac{2\pi}{b} \rightarrow b = \frac{\pi}{3}$.

Equation is $y = 1.75 \cos \frac{\pi}{3} t$.

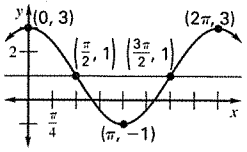
b. Choose $y = a \cos bt$ because at $t = 0$, the buoy is at its highest point.

Lesson 14.2 (pp. 919–922)

11. $y = 2 \cos x + 1$

Amplitude: $a = 2$

Period: $\frac{2\pi}{b} = 2\pi$

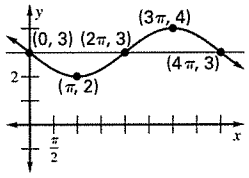


Horizontal shift: $h = 0$; Vertical shift: $k = 1$

23. $y = -\sin\frac{1}{2}x + 3$

Amplitude: $|a| = 1$

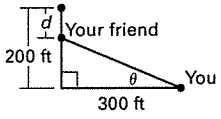
Period: $\frac{2\pi}{b} = \frac{2\pi}{\frac{1}{2}} = 4\pi$



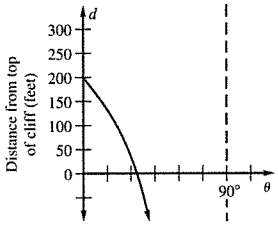
$h = 0$; $k = 3$; $a < 0$, so graph is reflected.

53. a. $\frac{200 - d}{300} = \tan\theta$

$d = -300\tan\theta + 200$



b.



c. $100 = -300\tan\theta + 200 \rightarrow \theta \approx 18.4°$

Lesson 14.3 (pp. 927–930)

5. $\cos\theta = \frac{5}{6}$, $3\pi < \theta < 2\pi$

$\sin^2\theta + \cos^2\theta = 1$

$\sin^2\theta + \left(\frac{5}{6}\right)^2 = 1$

$\sin\theta = -\frac{\sqrt{11}}{6}$ ← Negative because θ is in Quadrant III

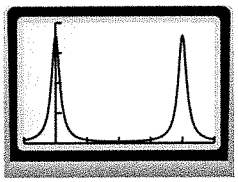
$\tan\theta = \frac{\sin\theta}{\cos\theta} = -\frac{\sqrt{11}}{5}$ $\quad \cot\theta = \frac{\cos\theta}{\sin\theta} = -\frac{5}{\sqrt{11}}$

$\csc\theta = \frac{1}{\sin\theta} = \frac{-6}{\sqrt{11}}$ $\quad \sec\theta = \frac{1}{\cos\theta} = \frac{6}{5}$

11. $\frac{\sin(-\theta)}{\cos(-\theta)} = \frac{-\sin\theta}{\cos\theta} = -\tan\theta$

41. a. $r = \frac{1.069}{1 - 0.97\sin\left(\frac{\pi}{2} - \theta\right)} = \frac{1.069}{1 - 0.97\cos\theta}$

b.



c.

θ	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π
r	35.6	3.4	1.1	0.6	0.5

θ	$\frac{5\pi}{4}$	$\frac{3\pi}{2}$	$\frac{7\pi}{4}$	2π
r	0.6	1.1	3.4	35.6

Closest distance:

$0.543 \text{ a.u.} \cdot \frac{93{,}000{,}000 \text{ mi}}{1 \text{ a.u.}} \approx 50.5 \text{ million mi}$

Farthest distance:

$35.6 \text{ a.u.} \cdot \frac{93{,}000{,}000 \text{ mi}}{1 \text{ a.u.}} \approx 3.31 \text{ billion mi}$

Lesson 14.4 (pp. 935–937)

5. $12\sin^2\left(\frac{\pi}{6}\right) - 3 \stackrel{?}{=} 0$

$12\left(\frac{1}{2}\right)^2 - 3 \stackrel{?}{=} 0 \rightarrow 3 - 3 = 0$ ✓

13. $4\cos^2 x - 3 = 0 \rightarrow \cos^2 x = \frac{3}{4} \rightarrow \cos x = \pm\frac{\sqrt{3}}{2}$

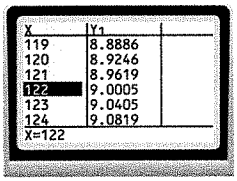
In $0 \le x < \pi$, $x = \frac{\pi}{6}$ and $x = \frac{5\pi}{6}$.

$x = \frac{\pi}{6} + n\pi$ or $x = \frac{5\pi}{6} + n\pi$

43. a. $S = 6(1.5)(0.75) + \frac{3}{2}(0.75)^2\left(\frac{\sqrt{3} - \cos\theta}{\sin\theta}\right)$

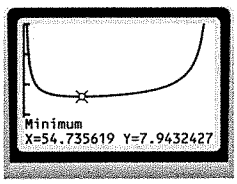
$= 6.75 + 0.84375\left(\frac{\sqrt{3} - \cos\theta}{\sin\theta}\right)$

b.



When $\theta \approx 122°$, $S = 9 \text{ in.}^2$

c.



A value of $\theta \approx 54.7°$ minimizes the surface area.

Lesson 14.5 (pp. 944–947)

5. $M = 6$, $m = 2$

Vertical shift: $k = \frac{M + m}{2} = \frac{6 + 2}{2} = 4$

The graph is a cosine curve with $h = 0$.

Period $= 4 = \frac{2\pi}{b} \rightarrow b = \frac{\pi}{2}$

$|a| = \frac{M - m}{2} = \frac{6 - 2}{2} = 2$

The graph is a reflection, so $a = -2$.

The function is $y = -2\cos\frac{\pi}{2}x + 4$.

9. $M = 6, m = -6$

Vertical shift: $k = \frac{M+m}{2} = \frac{6+(-6)}{2} = 0$

The graph is a sine curve with $h = 0$.

Period $= 2(3\pi - \pi) = 4\pi = \frac{2\pi}{b} \rightarrow b = \frac{1}{2}$

$|a| = \frac{M-m}{2} = \frac{6-(-6)}{2} = 6$

The graph is not a reflection, so $a = 6$.

The function is $y = 6 \sin \frac{1}{2}x$.

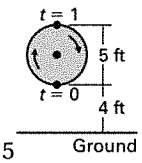
25. When $t = 0$, $m = 4$; when $t = 1$, $M = 9$.

$k = \frac{M+m}{2} = \frac{9+4}{2} = \frac{13}{2}$

The graph is a cosine curve with $h = 0$.

Period $= 2 = \frac{2\pi}{b} \rightarrow b = \pi$

$|a| = \frac{M-m}{2} = \frac{9-4}{2} = \frac{5}{2}$



The graph is a reflection, so $a = -\frac{5}{2}$.

A model is $y = -\frac{5}{2} \cos \pi x + \frac{13}{2}$.

Lesson 14.6 (pp. 952–954)

9. $\cos\left(-\frac{5\pi}{12}\right) = \cos\left(\frac{\pi}{3} - \frac{3\pi}{4}\right)$

$= \cos \frac{\pi}{3} \cos \frac{3\pi}{4} + \sin \frac{\pi}{3} \sin \frac{3\pi}{4}$

$= \frac{1}{2}\left(-\frac{\sqrt{2}}{2}\right) + \frac{\sqrt{3}}{2}\left(\frac{\sqrt{2}}{2}\right)$

$= \frac{\sqrt{6} - \sqrt{2}}{4}$

23. $\sin\left(x - \frac{3\pi}{2}\right) = \sin x \cos \frac{3\pi}{2} - \cos x \sin \frac{3\pi}{2}$

$= (\sin x)(0) - (\cos x)(-1) = \cos x$

43. a.

$\frac{WQ}{NA} = \frac{f \tan(\theta - t) + f \tan t}{h \tan \theta}$

$= \frac{f}{h}(\tan(\theta - t) + \tan t)\left(\frac{1}{\tan \theta}\right)$

$= \frac{f}{h}\left(\frac{\tan \theta - \tan t}{1 + \tan \theta \tan t} + \frac{\tan t(1 + \tan \theta \tan t)}{1 + \tan \theta \tan t)}\right)\left(\frac{1}{\tan \theta}\right)$

$= \frac{f}{h}\left(\frac{\tan \theta + \tan \theta \tan^2 t}{1 + \tan \theta \tan t}\right)\left(\frac{1}{\tan \theta}\right)$

$= \frac{f}{h}\left(\frac{\tan \theta(1 + \tan^2 t)}{1 + \tan \theta \tan t}\right)\left(\frac{1}{\tan \theta}\right)$

$= \frac{f}{h}\left(\frac{\sec^2 t}{1 + \tan \theta \tan t}\right)$

b. When $t = 0$:

$\frac{WQ}{NA} = \frac{f}{h}\left(\frac{\sec^2(0)}{1 + \tan \theta \tan(0)}\right) = \frac{f}{h}\left(\frac{1}{1+0}\right) = \frac{f}{h}$

Lesson 14.7 (pp. 959–962)

7. $\cos \frac{\pi}{8} = \cos \frac{1}{2}\left(\frac{\pi}{4}\right) = \sqrt{\frac{1 + \cos \frac{\pi}{4}}{2}}$

$= \sqrt{\frac{1 + \frac{\sqrt{2}}{2}}{2}} = \sqrt{\frac{2 + \sqrt{2}}{4}} = \frac{\sqrt{2 + \sqrt{2}}}{2}$

13. $\cos a = \frac{1}{3}, \frac{3\pi}{2} < a < 2\pi$

$\frac{3\pi}{4} < \frac{a}{2} < \pi \rightarrow \frac{a}{2}$ is in Quadrant II.

$\sin \frac{a}{2} = \sqrt{\frac{1 - \cos a}{2}} = \sqrt{\frac{1 - \frac{1}{3}}{2}} = \sqrt{\frac{1}{3}} = \frac{\sqrt{3}}{3}$

$\cos \frac{a}{2} = -\sqrt{\frac{1 + \cos a}{2}} = -\sqrt{\frac{1 + \frac{1}{3}}{2}} = -\sqrt{\frac{2}{3}} = -\frac{\sqrt{6}}{3}$

$\tan \frac{a}{2} = \frac{\sin \frac{a}{2}}{\cos \frac{a}{2}} = \frac{\frac{\sqrt{3}}{3}}{-\frac{\sqrt{6}}{3}} = \frac{\sqrt{3}}{3} \cdot \frac{-3}{\sqrt{6}} = \frac{-\sqrt{3}}{\sqrt{6}} = \frac{-\sqrt{2}}{2}$

53. When $M = 2.5$: $\sin \frac{\theta}{2} = \frac{1}{M} = \frac{1}{2.5}$

Using the Pythagorean Theorem:

$\cos \frac{\theta}{2} = \frac{\sqrt{5.25}}{2.5}$

$\sin \theta = 2 \sin \frac{\theta}{2} \cos \frac{\theta}{2} = 2\left(\frac{1}{2.5}\right)\left(\frac{\sqrt{5.25}}{2.5}\right) \approx 0.7332$

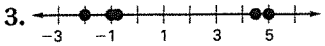
$\theta \approx 47°$

Selected Answers

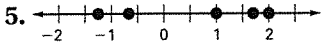
Chapter 1

1.1 Skill Practice (pp. 6–7) **1.** reciprocal

3.



5.



11. Associative property of addition **13.** Commutative property of multiplication **15.** Distributive property

17.
$6 \cdot (a \div 3) = 6 \cdot \left(a \cdot \frac{1}{3}\right)$ Definition of division
$= 6 \cdot \left(\frac{1}{3} \cdot a\right)$ Commutative property of multiplication
$= \left(6 \cdot \frac{1}{3}\right) \cdot a$ Associative property of multiplication
$= 2a$ Multiplication

19.
$(c - 3) + 3 = (c + (-3)) + 3$ Definition of subtraction
$= c + ((-3) + 3)$ Associative property of addition
$= c + 0$ Inverse property of addition
$= c$ Identity property of addition

21.
$7a + (4 + 5a) = 7a + (5a + 4)$ Commutative property of addition
$= (7a + 5a) + 4$ Associative property of addition
$= 12a + 4$ Combine like terms.

23. *Sample answer:* $a = -2$, $b = \frac{1}{4}$ **25.** \$8.50 per h

27. \$36.25 **29.** 195 mi **31.** $116\frac{2}{3}$ yd **33.** 2200 g

35. 1.75 gal **37.** 0.00175 ton **39.** The unit multiplier should be $\frac{0.82 \text{ euro}}{1 \text{ dollar}}$; 25 dollars $\cdot \frac{0.82 \text{ euro}}{1 \text{ dollar}} = 20.5$ euros.

41. 29.3 ft/sec **43.** 31.1 mi/h **45.** 0.04 oz/sec

47. 1800 mi/h **49.** Always; this represents the associative property of addition, which is true for all real numbers. **51.** Sometimes; it is true when $c = 0$.

53. Always; this represents the distributive property, which is true for all real numbers.

55.
$\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \cdot \frac{d}{c}$ Definition of division
$= \frac{ad}{bc}$ Definition of multiplication of fractions
$= \frac{ad}{cb}$ Commutative property of multiplication
$= \frac{a}{c} \cdot \frac{d}{b}$ Definition of multiplication of fractions
$= \frac{a}{c} \div \frac{b}{d}$ Definition of division

1.1 Problem Solving (pp. 8–9) **57. a.** Lance: 6, Darcy: 2, Javier: 3, Sandra: −2 **b.** Sandra, Darcy, Javier, Lance **59. a.** Pluto, Neptune, Uranus, Saturn, Jupiter, Mars, Earth, Mercury, Venus **b.** Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto **c.** *Sample answer:* The planets are in opposite orders in parts (a) and (b) with the exception of Mercury and Venus. **d.** Mercury or Venus **61. a.** cheetah: 102.67; three-toed sloth: 0.15; squirrel: 17.6; grizzly bear: 30 **b.** *Sample answer:* The cheetah is about 467 times faster than the three-toed sloth.

1.2 Skill Practice (pp. 13–15) **1.** base: 12, exponent: 7 **3.** The negative sign should be applied after evaluating the power, $-3^4 = -81$. **5.** 81 **7.** 49 **9.** −32 **11.** −10,000 **13.** −64 **15.** 64 **17.** −5 **19.** −100 **21.** 75 **23.** 6 **25.** $5x + 5$ **27.** $13z^2 - 2z + 10$ **29.** $11m - 1$ **31.** $-5p^2 + 21$ **35.** $10n + 24$; 44 **37.** 26 **39.** 49 **41.** $\frac{1}{9}$ **43.** $-7d + 11c$ **45.** $2m^2 + n^2 - 8m$ **47.** $13m^2 - 5$ **49.** $-8s + 8t$ **51.** *Sample answer:* $3k + 4k + (-8) - 2j$; $7k - 8 - 2j$ **53.** $(4 + 3) \cdot (5 - 2) = 21$ **55.** $(3 \cdot 4)^2 - (2^3 + 3)^2 = 23$

1.2 Problem Solving (pp. 15–16) **57.** 0, 10, 20, 30; \$1.89, \$3.20, \$4.51, \$5.82 **59.** $270 - 4.5x$; no; when $x > 60$ there will be a negative balance on the card, which means you will have spent more than what you had on the card. **63.** $-6.5x - 6y + 200$; \$88

1.3 Skill Practice (pp. 21–23) **1.** solution **3.** 3 **5.** 12 **7.** 6 **9.** $-\frac{2}{9}$ **11.** 4 **13.** −1 **15.** 18 **17.** −9 **21.** 1 **23.** 4 **25.** −7 **27.** $-1\frac{1}{3}$ **29.** 4 **31.** $-2\frac{2}{3}$ **33.** 4 **35.** −7 **37.** −2 **39.** 28 **41.** Both sides of the equations should be divided by $\frac{3}{7}$ instead of subtracting $\frac{3}{7}$ from each side; $\frac{3}{7}x = 15$, $x = 15 \div \frac{3}{7}$, $x = 35$. **43.** 12 **45.** 60 **47.** −23

49. $1\frac{2}{3}$ **51.** 6; 15, 8, 15, 8 **53.** 2; 6, 6, 3 **55.** 4 **57.** 2

59. 4 **61.** 2.9 **63.** no solution **65.** all real numbers

67. $x = \frac{d-b}{a-c}$; $a = c$ and $b \neq d$; $a = c$ and $b = d$

1.3 Problem Solving (pp. 23–24) **69.** 3 h **71.** 9 h

73. a. $3c + 2g = 8$ **b.** $2\frac{1}{4}$; $\frac{1}{2}$; $2\frac{5}{12}$; $\frac{1}{4}$ **75.** 18 min

1.4 Skill Practice (pp. 30–31) **1.** formula **3.** $\ell = \frac{A}{w}$; 5 mm **5.** $h = \frac{2A}{b_1 + b_2}$; 6 cm **7.** $y = 26 - 3x$; 5

9. $y = -\frac{6}{5}x + \frac{31}{5}$; 11 **11.** $y = \frac{3}{2}x - \frac{21}{2}$; -3

13. $y = \frac{7}{4}x - \frac{11}{4}$; 6 **17.** The variable y should only appear on one side of the equation, not both; $4y - xy = 9$, $y(4 - x) = 9$, $y = \frac{9}{4-x}$. **19.** $h = \frac{S}{\pi r} - k$; about 4.96 cm **21.** $y = \frac{40 + 3x}{x}$; 11 **23.** $y = \frac{16x + 28}{3x}$; $7\frac{2}{3}$ **25.** $y = \frac{15}{1 - 2x}$; 5 **27.** Method 1: $y = \frac{5}{3}x - 3$, $y = \frac{5}{3} \cdot 2 - 3$, $y = \frac{1}{3}$; Method 2: $15 \cdot 2 - 9y = 27$, $30 - 9y = 27$, $-9y = -3$, $y = \frac{1}{3}$; *Sample answer:* Method 1 is more efficient because it is already solved for y. **29.** $z = \frac{x + y}{xy - 1}$ **31.** $z = \frac{xy}{xy - y - x}$

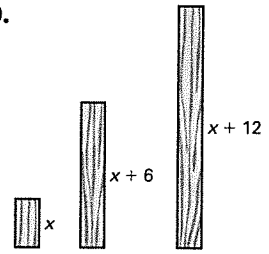
1.4 Problem Solving (pp. 31–32) **33.** $d = \frac{C}{\pi}$; about 36 in.

35. $C = \frac{5}{9}(F - 32)$; 10°C **37.** $R = 80c + 150d$; $d = \frac{R - 80c}{150}$; 80 designer tuxedos; 160 designer tuxedos; 240 designer tuxedos **39.** $V = \frac{\ell^2 w}{4\pi}$; $V = \frac{w^2 \ell}{4\pi}$

1.5 Skill Practice (pp. 37–38) **1.** verbal model **3.** 0.5 h **5.** 90 mi **7.** 54 ft **9.** 20 m **11.** $y = 4x + 11$ **13.** $y = 46 - 10x$ **17.** $4x + 9 = 12$, 0.75 ft **19.** The pattern shows the output is decreased by 10 each time; an equation that represents the table is $y = 75 - 10x$. **23.** $y = 7x - 16$

1.5 Problem Solving (pp. 38–39) **25.** 3.75 km/min **27.** $y = 1.5x + 15$; no; the bamboo shoot will eventually slow its growth rate and stop growing.

29.

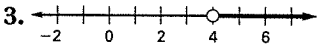


$3x + 18 = 72$, 18 in., 24 in., 30 in.

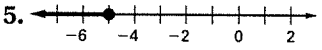
31. $40x + 7(20 - x) = 404$; 8 boxes of books, 12 boxes of clothes **33.** about 4.07 in.

1.6 Skill Practice (pp. 44–45) **1.** graph

3.

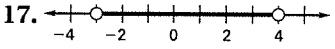


5.

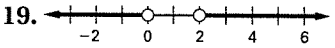


11. $-3 \leq x \leq 1$ **13.** $x < -2$ or $x > 4$

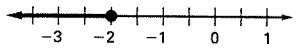
17.



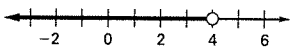
19.



23. $x \leq -2$

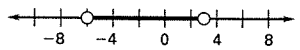


25. $x < 4$

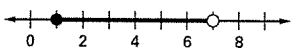


35. The inequality symbol should not be reversed when subtracting; $10 > 2x$, $5 > x$.

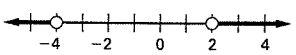
37. $-6 < x < 3$



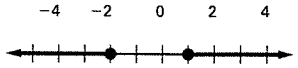
39. $1 \leq x < 7$



43. $x < -4$ or $x > 2$



45. $x \leq -\frac{1}{2}$ or $x \geq 1$



49. no solution **51.** no solution

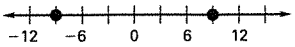
1.6 Problem Solving (pp. 46–47) **53.** $45x + 35 \leq 250$, $x \leq 4\frac{7}{9}$ days; 4 or fewer days **55. a.** $0 \leq e < 500$ **b.** $1400 \leq e < 2429$ **c.** $0 \leq e < 500$ or $1400 \leq e < 2429$ **57.** $50 \leq F \leq 95$; $10 \leq C \leq 35$ **59. a.** Amy: $0.65(84) + 0.15(80) + 0.2w \geq 85$, Brian: $0.65(80) + 0.15(100) + 0.2x \geq 85$, Clara: $0.65(75) + 0.15(95) + 0.2y \geq 85$, Dan: $0.65(80) + 0.15(90) + 0.2z \geq 85$ **b.** $w \geq 92$; $x \geq 90$; $y \geq 110$; $z \geq 97.5$ **c.** Amy, Brian, and Dan. *Sample answer:* It is impossible to score over 100 points on a test, so Clara will not be able to achieve a grade of 85 or better.

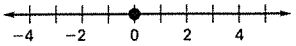
1.6 Problem Solving Workshop (p. 49)

1. $y = -35x + 200$; $x > 20$ **3.** $x \geq \$7000$

1.7 Skill Practice (pp. 55–56) **1.** An apparent solution that must be rejected because it does not satisfy the original equation. **3.** solution **5.** not a solution **7.** solution

SELECTED ANSWERS

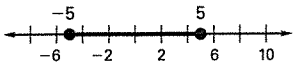
9. $-9, 9$ 

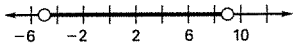
11. 0 

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

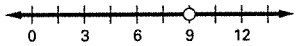
31. $-20, 4$ **33.** No; the equation has no solutions because an absolute value will never be negative.

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.

43. $-5 \le j \le 5$ 

45. $-5 < m < 9$ 

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

69. $x < 9$ or $x > 9$ 

71. $x \le \frac{-c-b}{a}$ or $x \ge \frac{c-b}{a}$ **73.** $x < \frac{c-b}{a}$ or $x > \frac{-c-b}{a}$

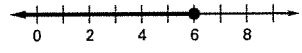
75. $|p - 6.5| \le 1$ **77.** $|b - 21| > 1$ **79.** $|x - 45| \le 15$

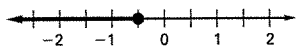
81. $|e - 6008| \le 5992$, $|m - 46{,}000| \le 45{,}000$

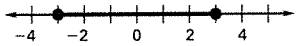
Chapter Review (pp. 61–64) **1.** exponent, base **3.** extraneous solution **5.** *Sample answer:* $3(x - 4)$ and $3x - 12$ **7.** Inverse property of multiplication **9.** Distributive property **11.** $3x - 6y$ **13.** $18b - 33$

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

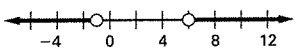
25. $y = -10x + 7$; -23 **27.** $y = \frac{-15}{x-6}$; 15 **29.** $y = \frac{5}{2}x - 5$; -20 **31.** $h = \frac{S - 2\pi r^2}{2\pi r}$; about 7.73 cm **33.** 602 mi

35. $x \le 6$ 

37. $x \le -\frac{1}{2}$ 

39. $-3 \le x \le 3$ 

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

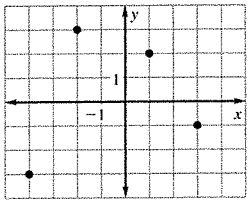
45. $y < -1$ or $y > 6$ 

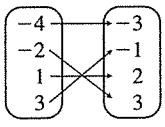
47. $|v - 26| \le 0.5$, 25.5 in. $\le v \le$ 26.5 in.

Chapter 2

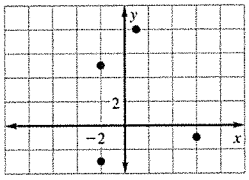
2.1 Skill Practice (pp. 76–78) **1.** independent, dependent

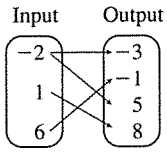
3. domain: $-4, -2, 1, 3$, range: $-3, -1, 2, 3$



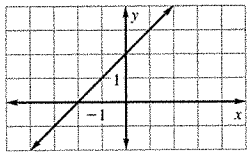


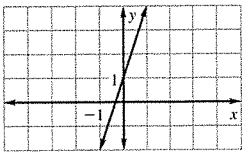
5. domain: $-2, 1, 6$, range: $-3, -1, 5, 8$





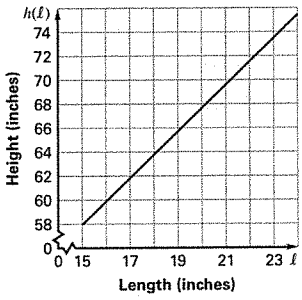
11. Yes; each input has exactly one output. **13.** Yes; each input has exactly one output. **15.** x is the input and y is the output, so there should be one value of y for each value of x; the relation given by the table is not a function because the inputs 1 and 0 each have more than one output. **17.** 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

25. 

27. 

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

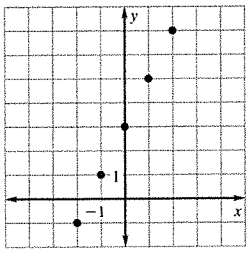
2.1 Problem Solving (pp. 78–79) **43.** Yes; each input has exactly one output. **45.** About 905; $V(6)$ represents the volume of a sphere with radius 6.

47. a. 

domain: $15 \le \ell \le 24$, range: $57.95 \le h(\ell) \le 75.5$

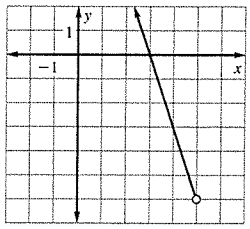
b. 59 in. or 4 ft 11 in. **c.** 21.7 in. **49. a.** domain: 11,350,000, 12,280,000, 12,420,000, 15,980,000, 18,980,000, 20,850,000, 33,870,000, range: 20, 21, 27, 31, 34, 55 **b.** Yes; each input p has exactly one output. **c.** No; the input 21 has more than one output.

Extension (p. 81)

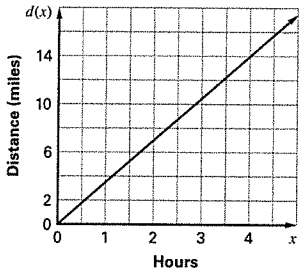
1. 

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

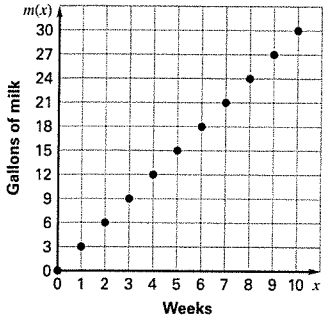
SELECTED ANSWERS

3. 

continuous; $y > -6$

5. $d(x) = 3.5x$ 

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

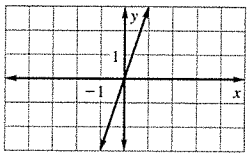
7. $m(x) = 3x$ 

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

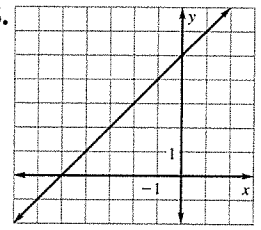
2.2 Skill Practice (pp. 86–87) **1.** slope **3.** $\frac{3}{2}$; rises **5.** $-\frac{5}{3}$; falls **7.** -4; falls **9.** $\frac{7}{4}$; rises **11.** undefined; is vertical **13.** 0; is horizontal **15.** The x and y coordinates were not subtracted in the correct order; $\frac{-1-(-3)}{2-(-4)} = \frac{1}{3}$. **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 $\overleftrightarrow{PQ} = \frac{2-1}{-3-(-1)} = -\frac{1}{2}$. The slope of $\overleftrightarrow{QR} = \frac{1-0}{-1-1} = -\frac{1}{2}$. The slope of $\overleftrightarrow{ST} = \frac{-1-(-2)}{3-5} = -\frac{1}{2}$.

2.2 Problem Solving (pp. 87–88) **41.** $\frac{7}{12}$ **43.** 6.5% **47. a.** $\frac{3}{8}$ **b.** yes **c.** $\frac{1}{8}$

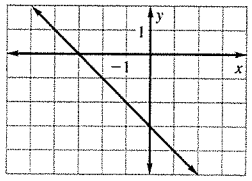
2.3 Skill Practice (pp. 93–94) **1.** slope-intercept

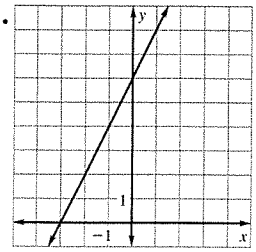
3. 

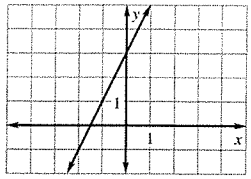
Both graphs have a y-intercept of 0, but the graph of $y = 3x$ has a slope of 3 instead of 1.

5. 

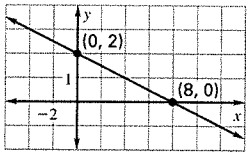
Both graphs have a slope of 1, but the graph of $y = x + 5$ has a y-intercept of 5 instead of 0.

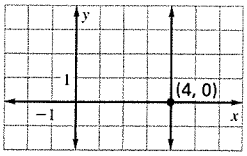
9. 

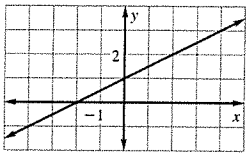
11. 

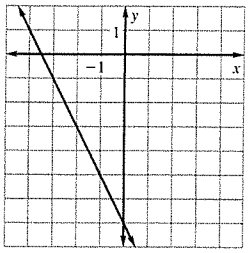
21. The slope and y-intercept were switched around. 

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

31. 

33. 

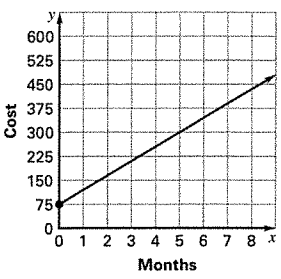
43. 

45. 

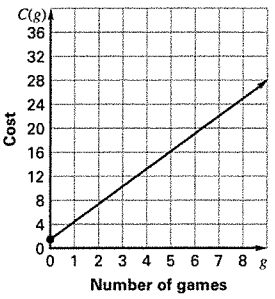
55. *Sample answer:* $x = 3$, $y = -2$ **57.** slope: $-\frac{A}{B}$, y-intercept: $\frac{C}{B}$

SELECTED ANSWERS

2.3 Problem Solving (pp. 94–96)

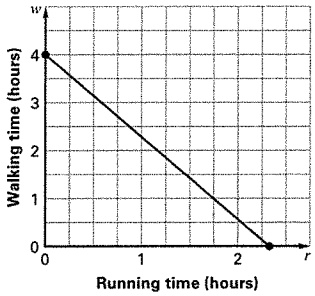
59. 

$480

61. 

$1.50; $3

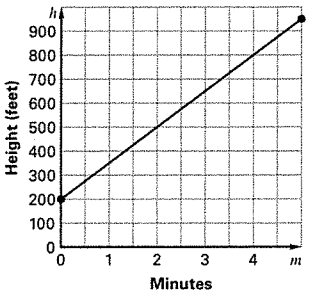
63. 30; fall; the value of the card will decrease after you buy each smoothie, so the line will fall from left to right.

65. 

Sample answer: $r = 0$ and $w = 4$, $r = 1.75$ and $w = 1$, $r = 0.875$ and $w = 2.5$

67. a.

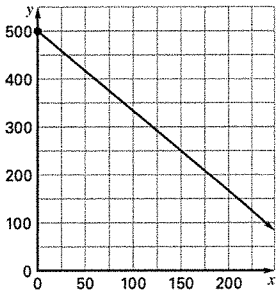
t (minutes)	h (feet)
0	200
1	350
2	500
3	650
4	800
5	950

b. 

c. $h(t) = 150t + 200$

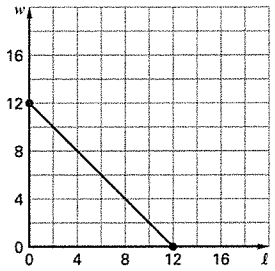
2.4 Skill Practice (pp. 101–103) **1.** standard **3.** $y = 2$ **5.** $y = 6x$ **7.** $y = -\frac{5}{4}x + 7$ **9.** $y = 4x - 2$ **11.** $y = 2x + 11$ **13.** $y = -9x + 85$ **15.** $y = -\frac{4}{7}x + 1$ **17.** $y = -\frac{1}{3}x - 2$ **19.** The x- and y-coordinates were transposed; $y - 1 = -2(x - 5)$, $y - 1 = -2x + 10$, $y = -2x + 11$. **21.** $y = -x + 8$ **23.** $y = -3x + 13$ **25.** $y = -\frac{1}{4}x - \frac{1}{4}$ **27.** $y = -2x + 6$ **29.** $y = -\frac{1}{4}x + \frac{19}{4}$ **31.** $y = -3x + 11$ **33.** $y = -\frac{2}{3}x + 7$ **35.** $y = 5x + 23$ **37.** $y = -3x + 17.5$ **41.** $-4x + y = -3$ **43.** $4x - 5y = -7$ **45.** $4x + 3y = 32$ **47.** *Sample answer:* $y = -\frac{1}{2}x + 8$

2.4 Problem Solving (pp. 103–104) **51.** $n = 15t + 50$ **53.** $15x + 9y = 4500$



Find the point on the line where x is 200 then the corresponding y-coordinate is how many student tickets were sold. **55.** $y = 1.66x + 21.62$; $48.18

57. a. $2\ell + 2w = 24$

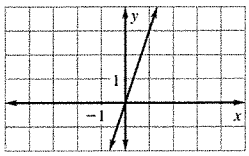
b. 

c. *Sample answer:*

ℓ	w
6	6
7	5
8	4
9	3
10	2

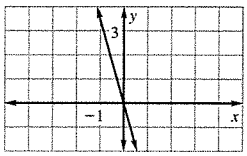
2.4 Problem Solving Workshop (p. 105) **1.** $y = 4x + 7$ **3.** $y = -\frac{1}{2}x + 16$ **5.** $y = 32.14x + 1764.36$

2.5 Skill Practice (pp. 109–110) **1.** *Sample answer:* If $y = ax$, then a is the constant of variation. a is a constant ratio of y to x for all ordered pairs (x, y).

3. $y = 3x$ 

SELECTED ANSWERS

5. $y = -3.5x$

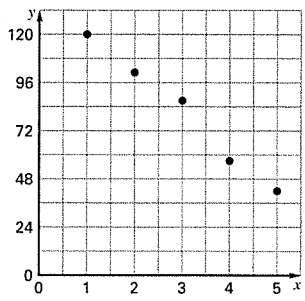


11. $y = 2x$; 24 **13.** $y = -0.2x$; -2.4 **15.** $y = \frac{1}{3}x$; 4
19. not direct variation **21.** direct variation; 2.5
23. direct variation; $\frac{1}{6}$ **25.** $y = -\frac{4}{3}x$; 3 **27.** $y = -7x$; $\frac{4}{7}$
29. $y = -7.2x$; $\frac{5}{9}$ **31.** direct variation; $y = -\frac{1}{3}x$
33. direct variation; $y = -4x$ **35.** The quotients need to be compared to each other, not the products; $\frac{24}{1} = 24$, $\frac{12}{2} = 6$, $\frac{8}{3} \approx 2.7$, $\frac{6}{4} = 1.5$, because the ratios are not equal, the data do not show direct variation.

2.5 Problem Solving (pp. 110–111) **39.** $w = 3600d$; 6300 lb **41.** direct variation; $t = 5.1s$ **43. a.** direct variation; $P = 4s$ **b.** Not a direct variation; the ratios of A to s are not equal. **c.** Not a direct variation; the ratios of A to P are not equal.

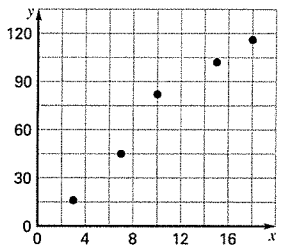
2.6 Skill Practice (pp. 117–118) **1.** best-fitting line **3.** negative correlation **5.** approximately no correlation **7.** 0 **9.** -1

11. a.



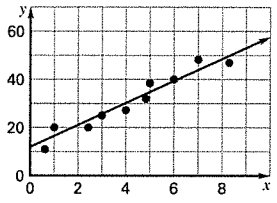
b. *Sample answer:* $y = -20x + 141$
c. about -259

13. a.

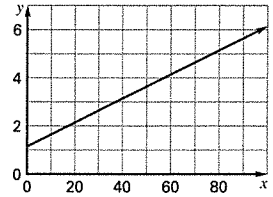


b. *Sample answer:* $y = 6.7x + 1$
c. about 135

17. The line should go through the middle of the data points. *Sample answer:*



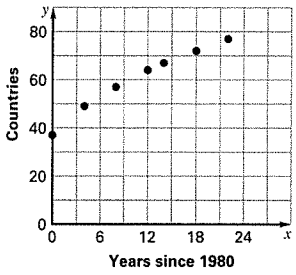
19. $y = 0.05x + 1.14$



21. a. *Sample answer:* Measuring the depth of water at different times while filling a swimming pool. The number of gallons of milk you buy and the total cost. **b.** *Sample answer:* The age of a car and its current value. The number of miles you have driven since you last put gas in the tank and the amount of gas left in the tank. **c.** *Sample answer:* The height of a person and the month they were born. The age of a person and the number of vehicles they own.

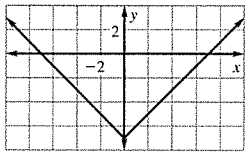
2.6 Problem Solving (pp. 119–120) **25.** *Sample answer:* $y = 101.3x + 2236.6$ **27. a.** (0, 37), (4, 49), (8, 57), (12, 64), (14, 67), (18, 72), (22, 77)

b.



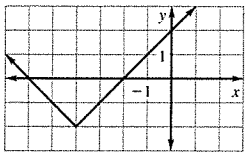
c. *Sample answer:* $y = 1.8x + 40.7$; 102 countries

2.7 Skill Practice (pp. 127–128) **1.** vertex
3.



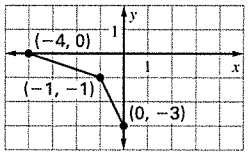
translated down 7 units

5.

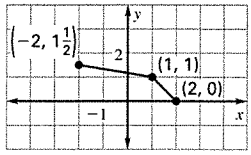


translated left 4 units and down 2 units

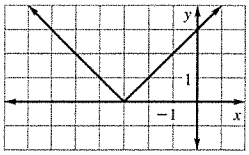
15. $y = -3|x|$ **17.** $y = \frac{1}{3}|x|$ **19.** $y = \frac{1}{2}|x + 2| - 1$
21.



23.



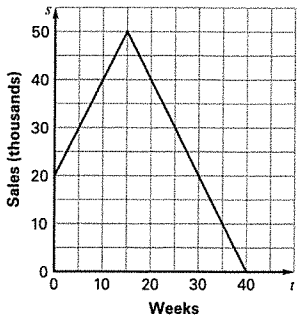
29. The graph should be translated left 3 units.



33. No. *Sample answer:* It does not pass the vertical line test.

SELECTED ANSWERS

2.7 Problem Solving (pp. 128–129)

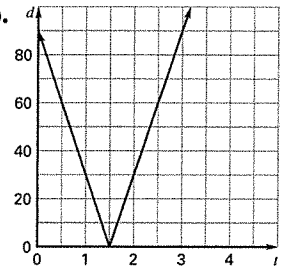
37. 

50,000 pairs of shoes

39. $y = -\frac{140}{69}|x - 69| + 140$

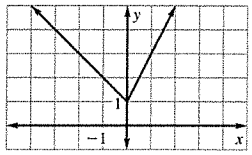
41. a.

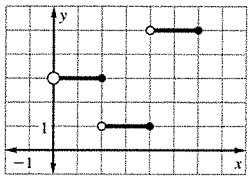
t	0	0.5	1	1.5	2	2.5	3
d	90	60	30	0	30	60	90

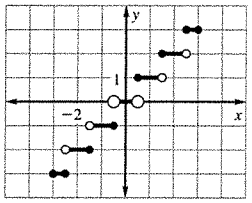
b. 

c. $d = 60|t - 1.5|$; $\frac{2}{3} \le t \le 2\frac{1}{3}$

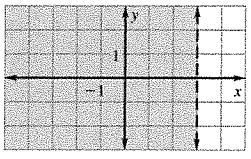
Extension (p. 131) **1.** -1 **3.** $\frac{5}{2}$

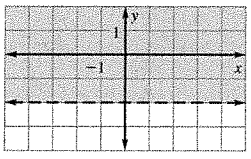
5. 

7. 

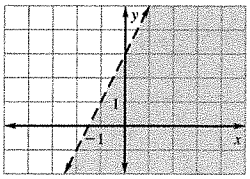
9. 

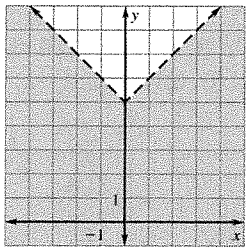
2.8 Skill Practice (pp. 135–136) **1.** half-plane **3.** solution, not a solution **5.** solution, solution

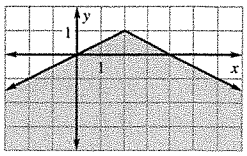
7. 

9. 

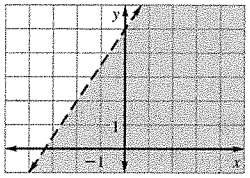
19. The boundary line should be a dashed line.

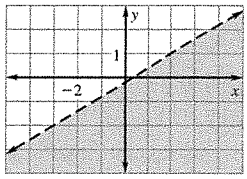


23. 

25. 

29. solution, not a solution **31.** solution, not a solution

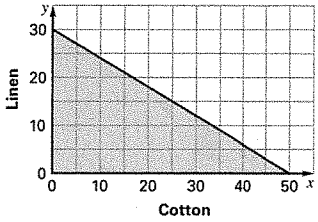
33. 

35. 

39. *Sample answer:* $y > x + 3$ **41.** $y > -\frac{3}{5}x + 3$; pick two points on the boundary line to find the slope and then use the point-slope form of an equation to find the equation. The boundary line is dotted, so the inequality dos not include points on the boundary. Then choose a point to determine which inequality sign to use. *Sample answer:* You and your sister want to spend at least \$15 on your little brother's birthday. You want to buy him some racecars that cost \$3 each and some building block sets that cost \$5 each.

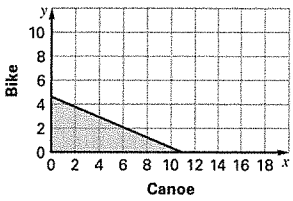
2.8 Problem Solving (pp. 137–138) **43.** $0.03x + 0.06y \le 20$

45. $1.5x + 2.5y \le 75$



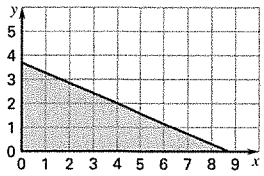
$y \le 15.6$ yd

47. a. $11x + 26y \le 120$



b. *Sample answer:* 2 days canoeing and 5 days biking, 3 days canoeing and 2 days biking, 2 days canoeing and 2 days biking

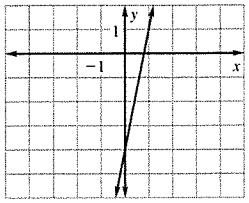
c. $11x + 26y \le 96$
Sample answer: 1 day canoeing and 3 days biking, 4 days canoeing and 2 days biking, 2 days canoeing and 2 days biking



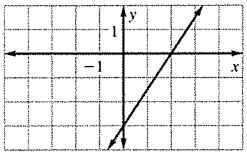
SELECTED ANSWERS

Chapter Review (pp. 141–144) **1.** standard **3.** direct variation **5.** domain: $-2, -1, 2, 3$, range: $-2, 0, 6, 8$; function **7.** linear function; 51 **9.** undefined **11.** 0

13.



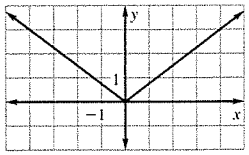
15.



17. $y = -\frac{3}{4}x + 2$ **19.** $y = -8x$; -24 **21.** $y = -0.8x$; -2.4

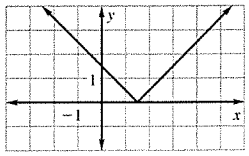
23. *Sample answer:* $y = -x + 2.3$

25.



shrunk vertically by a factor of $\frac{3}{4}$

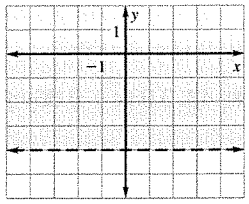
27.



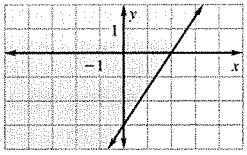
$1.75, $1.25

29. solution

31.



33.



Chapter 3

3.1 Skill Practice (pp. 156–157) **1.** independent **3.** $(1, -1)$ **5.** $(4, -1)$ **7.** $(5, 0)$ **9.** $(-2, 4)$ **11.** infinitely many solutions **13.** $(3, 3)$ **17.** $(2, -1)$; consistent and independent **19.** no solution; inconsistent **21.** infinitely many solutions; consistent and dependent **23.** $(2, 0)$; consistent and independent **25.** $(3, -1)$; consistent and independent **27.** infinitely many solutions; consistent and dependent **31.** no solution **33.** $(-4, 2)$ and $(-4, 2)$

3.1 Problem Solving (pp. 157–158) **35.** lifeguard: 6 h, cashier: 8 h **37.** 11 days; the number of days will decrease; the number of days will be divided by a larger number, which will decrease the quotient, which is the number of days. **39. a.** $m = -0.0958x + 50.8$ **b.** $w = -0.124x + 57.1$ **c.** in the year 2195 **d.** No. *Sample answer:* It is not likely that the same linear models will apply indefinitely.

3.2 Skill Practice (pp. 164–165) **1.** substitution **3.** $(6, -1)$ **5.** no solution **7.** $\left(\frac{4}{3}, 2\right)$ **9.** $(0, 3)$ **11.** $(-3, 8)$ **13.** $(44, -17)$ **15.** $\left(7, \frac{1}{2}\right)$ **17.** $(-6, -2)$ **19.** $\left(-\frac{1}{2}, \frac{1}{6}\right)$ **21.** $(-8, 6)$ **23.** no solution **25.** $(7, 3)$

27. Failed to multiply the constant by -2.

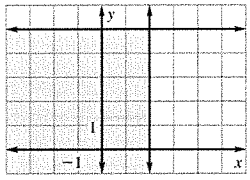
$$\begin{aligned} -6x - 4y &= -14 \\ 5x + 4y &= 15 \\ \hline -x &= 1 \\ x &= -1 \end{aligned}$$

29. $(-5, -6)$ **31.** infinitely many solutions **33.** $(-8, 0)$ **35.** $(7, -6)$ **37.** $\left(-\frac{3}{2}, 4\right)$ **39.** $\left(-\frac{3}{4}, \frac{1}{2}\right)$ **41.** $(2, 3)$ **43.** $(3, 2)$ **45.** about $(2.90, -2.16)$ **47.** $(-1, 2)$ **49.** $(7, 1)$ **51.** $\left(-\frac{1}{9}, 6\right)$ **53.** $(5, 4)$

3.2 Problem Solving (pp. 165–166) **55.** 5 acoustic, 4 electric **57.** The company can fill its orders by operating Factory A for 5 weeks and Factory B for 3 weeks. **59.** 12 doubles games, 14 singles games **61.** 80 pounds of peanuts, 20 pounds of cashews

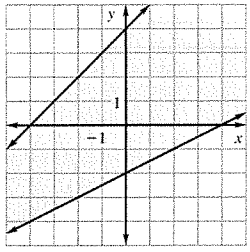
3.3 Skill Practice (pp. 171–172) **1.** The ordered pair must satisfy each inequality of the system.

5.

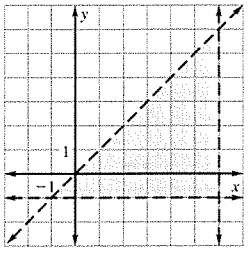


7. no solution

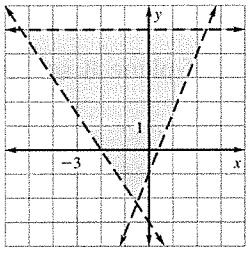
9.



17.

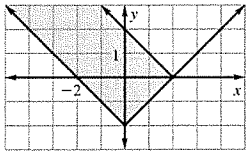


19.



27. *Sample answer:* $y < x - 1$, $y < -\frac{3}{4}x + 4$

29.

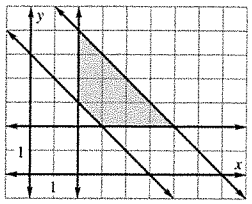


SELECTED ANSWERS

3.3 Problem Solving (pp. 172–173) **35.** $x \geq 20$, $x \leq 50$, $y \geq 0.3x$, $y \leq 0.7x$, where x represents the regular price and y represents the sale price; $6 \leq y \leq 14$

37. a. $x \geq 2$, $y \geq 2$, $x + y \leq 8$, $x + y \geq 5$

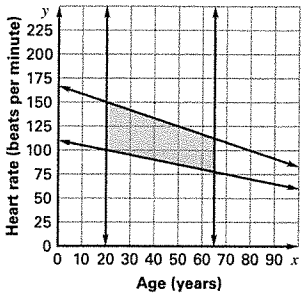
b.



c. *Sample answer:* 3 juniors, 4 seniors; 4 juniors, 4 seniors

39. a. $x \geq 20$, $x \leq 65$, $y \geq 0.5(220 - x)$, $y \leq 0.75(220 - x)$

b.



c. No; the person's heart rate is above the target zone. A 40-year old person's heart rate should be between 90 and 135 heartbeats per minute.

Extension (p. 176) **1.** 1; 14 **3.** 170; 580 **5.** 5; 55 **7.** 6 mini piñatas, 6 regular-sized piñatas **9.** 12 jars of tomato sauce, 4 jars of salsa

3.4 Skill Practice (pp. 182–183) **1.** *Sample answer:* $2x - 3y + z = 6$; a plane **3.** no **5.** yes **7.** no **9.** (1, 5, 6) **11.** no solution **13.** (0, 4, −2) **15.** (3, 2, 1) **17.** (−6, 4, −4) **19.** (0, 0, −2) **21.** In the 2nd equation, the coefficient of y was not multiplied by 2;

$$\begin{array}{r} 2x + \ y - 2z = 23 \\ 6x + 4y + 2z = 22 \\ \hline 8x + 5y \quad\ = 45 \end{array}$$

25. infinitely many solutions **27.** (−1, 4, 0) **29.** (−4, 5, −4) **31.** (0, −2, 6) **33.** (2, 6, −5) **35.** (2, 1, 0) **37.** $a = 12$, $b = -4$, $c = 10$; when you substitute −1 for x, 2 for y, and −3 for z into each of the equations, you get the results for a, b, and c.

3.4 Problem Solving (pp. 184–185) **43.** 1st delivery: 300 gal; 2nd delivery: 750 gal; 3rd delivery: 2050 gal **45. a.** $f + s + t = 20$, $5f + 3s + t = 68$, $s = f + t$, where f represents the number of first-place finishes, s represents the number of second-place finishes, and t represents the number of third-place finishes; 7 first-place finishes, 10 second-place finishes, 3 third-place finishes **b.** When you solve for f and t, you get a fractional answer and you cannot have fractions of a person. **47. a.** $2.5r + 4\ell + 2i = 32$, $r + \ell + i = 12$, $r = 2(\ell + i)$ where r represents the number of roses, ℓ represents the number of lilies, and i represents the number of irises **b.** 8 roses, 2 lilies, 2 irises **c.** yes; 8 roses, 2 lilies, 2 irises

3.5 Skill Practice (pp. 190–193) **1.** dimensions **3.** The corresponding entries were not added together to create a 2×1 matrix; $\begin{bmatrix} 13.1 \\ -1.2 \end{bmatrix}$ **5.** $\begin{bmatrix} -2 & -5 \\ 2 & 1 \end{bmatrix}$ **7.** $\begin{bmatrix} 3.6 & 4.7 \\ 6.2 & 7.5 \\ 14.3 & -1.2 \end{bmatrix}$ **9.** $\begin{bmatrix} -2 & -5 \\ 14 & -1 \\ -10 & 6 \end{bmatrix}$ **11.** $\begin{bmatrix} -6 & 0 & 15 \\ -12 & -21 & 9 \end{bmatrix}$ **13.** $\begin{bmatrix} -3 & 5.1 & 2.4 \\ 8.1 & 0 & -4.5 \end{bmatrix}$ **15.** $\begin{bmatrix} -13.2 & -6.82 & -9.9 \\ 2.2 & 0 & -5.5 \\ -12.1 & 3.96 & -14.08 \end{bmatrix}$ **17.** $\begin{bmatrix} 13 & -8 \\ -9 & 1 \end{bmatrix}$ **19.** $\begin{bmatrix} 12 & -8 \\ -4 & 0 \end{bmatrix}$ **21.** $\begin{bmatrix} 23.4 & -1.5 & -5.6 \\ -2.5 & -2.3 & 9.9 \end{bmatrix}$ **23.** $\begin{bmatrix} -6.3 & -0.75 & 10.7 \\ -6.5 & 3.6 & -3.3 \end{bmatrix}$ **25.** $x = \frac{19}{2}$, $y = 4$ **27.** $x = -2$, $y = -16$ **29.** *Sample answer:* $A = \begin{bmatrix} 5.5 & -3 \\ -8 & 7 \end{bmatrix}$, $B = \begin{bmatrix} 2 & -2 \\ -5 & 4 \end{bmatrix}$

3.5 Problem Solving (pp. 192–193) **31.** $\begin{bmatrix} 0 & 5 & 1 & -1 \\ -7 & -1 & -5 & -2 \\ 1 & -1 & 4 & 10 \end{bmatrix}$ **33. a.** $M = \begin{matrix} \text{Model A} \\ \text{Model B} \\ \text{Model C} \end{matrix} \begin{bmatrix} 31 & 22 \\ 42 & 25 \\ 18 & 11 \end{bmatrix}$, $J = \begin{matrix} \text{Model A} \\ \text{Model B} \\ \text{Model C} \end{matrix} \begin{bmatrix} 25 & 38 \\ 36 & 32 \\ 12 & 15 \end{bmatrix}$ **b.** $\begin{bmatrix} 56 & 60 \\ 78 & 57 \\ 30 & 26 \end{bmatrix}$; the sum represents the total sales for May and June. **c.** $\begin{bmatrix} 28 & 30 \\ 39 & 28.5 \\ 15 & 13 \end{bmatrix}$

3.6 Skill Practice (pp. 199–200) **1.** columns; rows **3.** defined; 2×2 **5.** not defined **7.** not defined **11.** $\begin{bmatrix} -2 & 1 \\ -8 & 4 \end{bmatrix}$ **13.** $\begin{bmatrix} -12 & 15 \\ 8 & -4 \end{bmatrix}$ **15.** $\begin{bmatrix} 11 & 35 \\ 8 & 0 \\ -9 & 7 \end{bmatrix}$ **17.** $\begin{bmatrix} 21 & -8 \\ 74 & -50 \end{bmatrix}$ **19.** The multiplication should be row 1 of left matrix by column 1 of the right matrix; $3(7) + (-1)(1) = 20$. **23.** $\begin{bmatrix} 21 & -6 \\ -14 & 1 \end{bmatrix}$ **25.** $\begin{bmatrix} -10 & 7 \\ -8 & 10 \end{bmatrix}$ **27.** $\begin{bmatrix} -2 & 4 & 0 \\ 5 & 15 & 8 \\ -16 & 17 & 36 \end{bmatrix}$ **29.** $\begin{bmatrix} -204 & 81 \\ 160 & -38 \end{bmatrix}$ **31.** $x = 3$, $y = 35$ **33.** $\begin{bmatrix} 18 & -5 \\ -10 & 3 \end{bmatrix}$, $\begin{bmatrix} -82 & 23 \\ 46 & -13 \end{bmatrix}$ **35.** *Sample answer:* $\begin{bmatrix} 3 & 7 \\ -2 & 5 \end{bmatrix}\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

3.6 Problem Solving (pp. 200–202)

37. $\begin{matrix}\text{Bats}\\ \text{Balls}\\ \text{Uniforms}\end{matrix}\begin{bmatrix}12\\45\\15\end{bmatrix}$, $\begin{matrix}\text{Bat} & \text{Ball} & \text{Uniform}\end{matrix}\begin{bmatrix}21 & 4 & 30\end{bmatrix}$; $\begin{matrix}\text{Cost}\\ \text{Item}\end{matrix}\begin{bmatrix}\\882\end{bmatrix}$

39. Friday: \$1150, Saturday: \$1675

41. *PS*; $[\,62{,}400 \quad 57{,}575\,]$, it shows the profit for all of the cars sold by each dealer. **43. a.** $\begin{bmatrix}0.8 & 0.05\\ 0.2 & 0.95\end{bmatrix}$

b. $M_1 = \begin{bmatrix}4400\\8600\end{bmatrix}$; the number of commuters after 1 year

c. $M_2 = \begin{bmatrix}3950\\9050\end{bmatrix}$, $M_3 = \begin{bmatrix}3612.5\\9387.5\end{bmatrix}$, $M_4 = \begin{bmatrix}3359.375\\9640.625\end{bmatrix}$; the number of commuters after 2, 3, and 4 years

3.7 Skill Practice (pp. 207–208) **1.** determinant **3.** -6 **5.** 25 **7.** 8 **9.** 39 **11.** -206 **13.** -34 **15.** 1160 **17.** -480 **19.** The sum of the products for the diagonals that go up should be subtracted from the sum of the products for the diagonals that go down; $10+0+(-8)-(3+24+0)=-25$ **23.** 12 **25.** 21 **27.** 25 **29.** $(-4, 3)$ **31.** $(-7, -5)$ **33.** $(6, -3, -7)$ **35.** $(0, 4, 1)$ **37.** $(8, 6, 7)$

3.7 Problem Solving (pp. 208–209) **41.** 12 ft^2 **43. a.** 60 single scoop, 40 double scoop, 20 triple scoop **b.** \$140.03 **45. a.** 4786 mi^2 **b.** 3201 mi^2 **c.** 7987 mi^2 **d.** Connect Vernal, UT, to Moab, UT.

3.8 Skill Practice (pp. 214–215)

1. matrix of variables $\begin{bmatrix}x\\y\end{bmatrix}$, matrix of constants $\begin{bmatrix}4\\-2\end{bmatrix}$

3. $\begin{bmatrix}-4 & -5\\ -1 & -1\end{bmatrix}$ **5.** $\begin{bmatrix}1 & -1\\ -\frac{5}{2} & 3\end{bmatrix}$ **7.** $\begin{bmatrix}-\frac{7}{4} & -\frac{3}{2}\\ 1 & 1\end{bmatrix}$

9. $\begin{bmatrix}-\frac{1}{12} & \frac{1}{6}\\ -\frac{1}{60} & \frac{1}{15}\end{bmatrix}$ **11.** The scalar should be $\frac{1}{\det}$; $\frac{1}{6}\begin{bmatrix}5 & -4\\ -1 & 2\end{bmatrix} = \begin{bmatrix}\frac{5}{6} & -\frac{2}{3}\\ -\frac{1}{6} & \frac{1}{3}\end{bmatrix}$. **13.** $\begin{bmatrix}11 & 9\\ -9 & -6\end{bmatrix}$

15. $\begin{bmatrix}-3 & 1\\ \frac{11}{2} & -\frac{1}{4}\end{bmatrix}$ **17.** $\begin{bmatrix}18 & 19 & 10\\ -3 & -4 & -2\end{bmatrix}$

19. $\begin{bmatrix}-\frac{3}{10} & -\frac{1}{5} & \frac{3}{10}\\ \frac{9}{10} & \frac{3}{5} & \frac{1}{10}\\ -\frac{1}{5} & \frac{1}{5} & \frac{1}{5}\end{bmatrix}$ **21.** $\begin{bmatrix}-\frac{1}{2} & 0 & \frac{1}{2}\\ -\frac{17}{16} & \frac{1}{8} & \frac{7}{16}\\ \frac{7}{32} & \frac{1}{16} & -\frac{1}{32}\end{bmatrix}$

23. $\begin{bmatrix}\frac{3}{20} & \frac{3}{10} & \frac{1}{20}\\ -\frac{11}{160} & \frac{9}{80} & \frac{3}{160}\\ -\frac{1}{40} & -\frac{1}{20} & -\frac{7}{40}\end{bmatrix}$ **25.** $(3, 2)$ **27.** $(-1, -4)$

29. $(10, -2)$ **31.** $(1, -8)$ **33.** $(-3, 5)$ **35.** $(-9, 19, -10)$ **37.** $(-1, -2, 3)$ **39.** $(-2, 10, 0)$

41. *Sample answer:* $\begin{bmatrix}2 & 3\\ 4 & 6\end{bmatrix}$

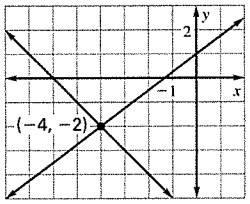
3.8 Problem Solving (pp. 215–217) **43.** single-engine: 150 h, twin-engine: 50 h **45. a.** $2x + y = 8$, $3x + y = 11$ where x represents rolls and y represents muffins

b. $\begin{bmatrix}2 & 1\\ 3 & 1\end{bmatrix}\begin{bmatrix}x\\y\end{bmatrix} = \begin{bmatrix}8\\11\end{bmatrix}$ **c.** 3 batches of rolls, 2 batches of muffins **47.** Bran Crunchies: 2.3 oz, Toasted Oats: 0.8 oz, Whole Wheat Flakes: 1.2 oz

49. a. $\begin{bmatrix}1 & 4 & 2\\ -1 & -3 & -5\end{bmatrix}$, $\begin{bmatrix}-1 & -3 & -5\\ -1 & -4 & -2\end{bmatrix}$; 90° clockwise rotation **b.** multiply AAT by A and then again by A

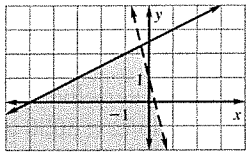
3.8 Problem Solving Workshop (p. 219) **1.** DVD: \$15, popcorn: \$1.75, movie pass: \$8 **3.** 11 lbs of sunflower seed, 9 lbs of thistle seed

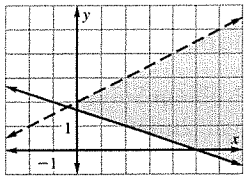
Chapter Review (pp. 222–226) **1.** consistent, inconsistent **3.** The number of columns in the left hand matrix is the same as the number of rows in the right hand matrix.

5. 

$(-4, -2)$

7. $(-3, 7)$ **9.** $(-6, 7)$

11. 

13. 

15. $(-3, -8, 4)$ **17.** 10 wind instruments, 3 string instruments, 2 percussion instruments

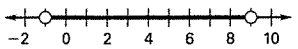
19. $\begin{bmatrix}6 & 4\\ 8 & -4\end{bmatrix}$ **21.** $\begin{bmatrix}2 & -4 & 0\\ 7 & 6 & 7\end{bmatrix}$ **23.** $\begin{bmatrix}64 & 32 & 40\\ -8 & 48 & -16\end{bmatrix}$

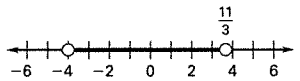
25. $\begin{bmatrix}28 & -76\\ -20 & 10\end{bmatrix}$ **27.** $\begin{bmatrix}-2 & 6 & -15\\ 6 & 0 & -3\end{bmatrix}$ **29.** -42 **31.** 18 **33.** $(7, 1)$ **35.** $(-1, -4)$

Cumulative Review (pp. 232–233) **1.** $-2x^2 + 7x$ **3.** $-4x^2 + 6x + 15$ **5.** $-\frac{5}{2}$ **7.** $-8, 2$ **9.** $-16, 25$

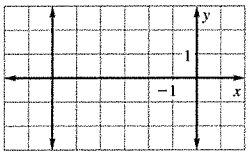
SELECTED ANSWERS

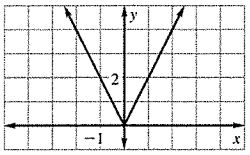
11. $5 \le x \le 10$ 

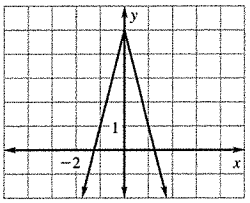
13. $-1 < x < 9$ 

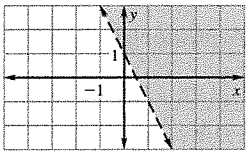
15. $-4 < x < \frac{11}{3}$ 

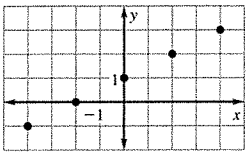
17. $-\frac{7}{12}$; falls **19.** 0; is horizontal

21. 

23. 

25. 

27. 

29. 

function

31. (5, −4) **33.** (−2, 4, 1) **35.** $\begin{bmatrix} 6 & 2 \\ 19 & 0 \end{bmatrix}$

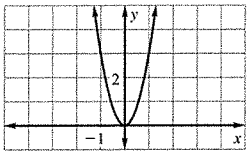
37. $\begin{bmatrix} -15 & 21 & -3 \\ -30 & 42 & -6 \end{bmatrix}$ **39.** $\begin{bmatrix} -\frac{4}{3} & -3 \\ 1 & 2 \end{bmatrix}$ **41.** $\begin{bmatrix} -\frac{1}{3} & -\frac{1}{3} \\ -\frac{1}{12} & -\frac{5}{24} \end{bmatrix}$

43. a. $W = \frac{TR^2}{R^2 + A^2}$ **b.** About 98 games; it's the same.

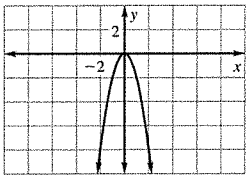
45. $c = \frac{1}{20}p$; \$6250 **47.** $s > 213$, $j < 263$, $s + j > 472.5$

Chapter 4

4.1 Skill Practice (pp. 240–241) **1.** parabola **3.** 16, 4, 0, 4, 16 **5.** 8, 2, 0, 2, 8

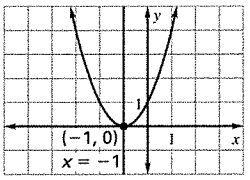
7. 

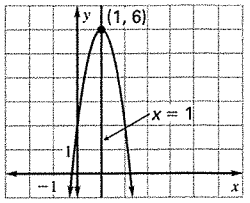
same axis of symmetry and vertex, opens up, and is narrower

9. 

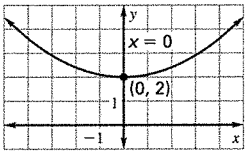
same axis of symmetry and vertex, opens down, and is narrower

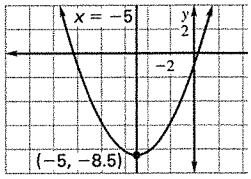
19. The formula for the x-coordinate of the vertex is $-\frac{b}{2a}$: $-\frac{24}{2(4)} = -3$.

21. 

23. 

33. maximum value; −1 **35.** minimum value; −1
37. minimum value; −2 **41.** $a = -0.02$, $b = 1$, $c = 6$
43. *Sample answer:* $y = -x^2 + 8x + 3$, $y = 2x^2 - 16x - 1$, $y = x^2 - 8x - 6$

47. 

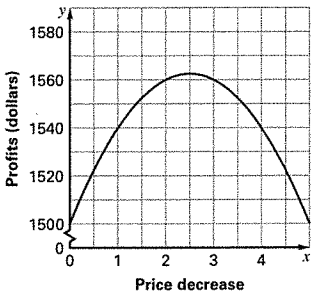
49. 

53. The axis of symmetry has to lie half way between the two x-coordinates; $x = -1$.

4.1 Problem Solving (pp. 242–243) **55.** Raise the price by \$0.75 to increase revenue to \$4900 per day.
57. about 10 ft **59. a.** profit = price • sales − expenses; $P(x) = (20 - x)(150 + 10x) - 1500$

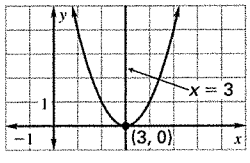
b.

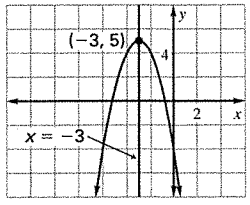
x	$P(x)$
0	1500
1	1540
2	1560
3	1560
4	1540
5	1500

c. 

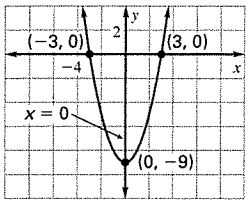
Reduce the price by \$2.50 to increase profits to \$1562.50 per week.

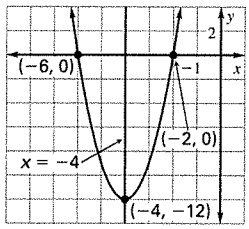
4.2 Skill Practice (pp. 249–250) **1.** vertex

3. 

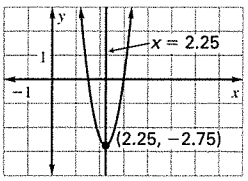
5. 

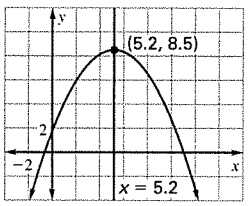
SELECTED ANSWERS

13. 

15. 

23. $p = 2$ and $q = -3$; the x-intercepts are 2 and -3. **25.** $y = x^2 - 2x - 15$ **27.** $y = -3x^2 + 18x - 24$ **29.** $y = x^2 - 6x + 15$ **31.** $y = 5x^2 + 30x + 41$ **33.** minimum: -4 **35.** minimum: 130 **37.** maximum: 729 **39.** minimum: -450 **41.** maximum: 211.25

43. 

45. 

49. *Sample answer:* $y = (x - 8)(x + 2)$, $y = (x - 4)(x - 2)$, $y = (x + 3)(x - 9)$

4.2 Problem Solving (pp. 250–251) **51.** 6 ft; about 28 ft **53. a.** 160 ft **b.** about 1.5 ft **55. a.** about 14%; about 55.5 cm^3 **b.** about 13.6%; about 44.1 cm^3 **c.** hot-air: domain: $5.52 < x < 22.6$, range: $0 < y < 55.5$; hot oil: domain: $5.35 < x < 21.8$, range: $0 < y < 44.1$; since moisture content and popping volume cannot be negative, the domain and range must each be positive numbers. A positive domain occurs between the x-intercepts and the greatest number in the range occurs at the maximum point, which is the vertex.

4.3 Skill Practice (pp. 255–257) **1.** an x value that makes the function equal to zero **3.** $(x + 1)(x + 5)$ **5.** $(a - 11)(a - 2)$ **7.** cannot be factored **9.** $(b + 8)(b - 5)$ **11.** $(x - 9)(x + 2)$ **13.** $(x + 12)(x - 3)$ **15.** $(x + 6)(x - 6)$ **17.** $(x - 12)^2$ **19.** $(x + 4)^2$ **21.** $(n + 7)^2$ **23.** $(z - 11)(z + 11)$ **25.** 5, 6 **27.** -7, 7 **29.** -4, -1 **31.** -5 **33.** -6, 9 **35.** 0, -9 **37.** 7 **39.** The equation was not factored correctly; $x^2 - x - 6 = 0$, $(x - 3)(x + 2) = 0$, $x = 3$ or $x = -2$. **43.** $3(10)(12) = (10 + x)(12 + x)$ **45.** 4 **47.** -10, 3 **49.** 0, 8 **51.** -5, 5 **53.** -12, -7 **55.** -1 **57.** $x^2 - 19x + 88 = 0$ **59.** 4 **61.** 3 **63.** *Sample answer:* $x^2 - 20x + 91 = 0$

4.3 Problem Solving (pp. 257–258) **65.** $3(50)(100) = (50 + x)(100 + x)$, -200, 50; 100 ft by 150 ft **67. a.** 600 ft^2 **b.** area of new patio = area of existing patio + area of expansion, $(30 + x)(20 + x) = 600 + 464$ **c.** -58, 8; 8 ft **69.** $3(18)(15) = (18 + x)(15 + x)$, -45, 12; 114 ft **71.** $2(100) = (10 + x)(10 + x)$; no; there are no real numbers a and b such that $ab = -100$ and $a + b = 20$.

4.4 Skill Practice (pp. 263–264) **1.** 4 **3.** $(2x + 3)(x + 1)$ **5.** $(4r + 1)(r + 1)$ **7.** $(11z - 9)(z + 1)$ **9.** cannot be factored **11.** $(9d + 5)(d - 2)$ **13.** $(3x + 1)(3x - 1)$ **15.** $(7n - 4)(7n + 4)$ **17.** $(7x + 5)^2$ **19.** $(3p - 2)^2$ **21.** $(6x - 7)^2$ **23.** $2(3z + 4)(3z + 2)$ **25.** $6u(u - 4)$ **27.** $4(5x + 1)(x + 6)$ **29.** $-3(6n - 5)(2n - 1)$ **31.** 4 should be factored out of each term in the binomial; $4x^2 - 36 = 4(x^2 - 9) = 4(x + 3)(x - 3)$. **33.** -2, 2 **35.** 0, $-\frac{2}{9}$ **37.** $-1\frac{1}{2}$ **39.** $-\frac{1}{2}$, $1\frac{2}{3}$ **41.** $-\frac{1}{4}$, 5 **43.** $-\frac{3}{5}$, 6 **45.** $-\frac{3}{11}$, 2 **47.** -1, $1\frac{1}{3}$ **49.** -1, $\frac{7}{12}$ **51.** 3 **53.** -1, $2\frac{2}{3}$ **55.** $-\frac{7}{9}$, 2 **57.** 0, 4

4.4 Problem Solving (pp. 264–265) **63.** 2 ft **65.** \$5.75; letting x represent the number of \$.25 decreases in the sandwich price, the revenue R is given by the function $R = (330 + 15x)(6 - 0.25x)$. The zeros of this function are -22 and 24, and their average is 1. So, to maximize the daily revenue, each sandwich should be sold for $6 - 0.25(1)$, or \$5.75. The maximum daily revenue is then $(330 + 15(1))(5.75) = (345)(5.75) = \$1983.75$. **67. a.** 72 in. **b.** $w = 32 - h$; $V = 36(36 - h)(h)$ **c.** 18 in., 18 in., 11,664 $in.^3$; find the roots of the equation in part (b) to be 0 and 36, so the line of symmetry is at $x = \frac{36 + 0}{2} = 18$. To find the maximum volume, substitute 18 for h into the equation from part (b).

4.5 Skill Practice (pp. 269–270) **1.** radicand **3.** $2\sqrt{7}$ **5.** $5\sqrt{6}$ **7.** 24 **9.** $\frac{\sqrt{5}}{4}$ **11.** $\frac{8\sqrt{3}}{3}$ **13.** $\frac{3\sqrt{22}}{11}$ **15.** $-\sqrt{3} - 1$ **17.** $\frac{4\sqrt{2} - \sqrt{10}}{11}$ **21.** The equation has two solutions; $x^2 = 81$, $x = \pm 9$. **23.** $\pm 5\sqrt{2}$ **25.** ± 5 **27.** $\pm\sqrt{71}$ **29.** ± 10 **31.** $1 \pm \sqrt{2}$ **33.** $-2 \pm \frac{\sqrt{26}}{2}$ **35.** Factor: $x^2 - 4 = 0$, $(x + 2)(x - 2) = 0$, $x = -2$ or $x = 2$; Solve the equation $x^2 - 4 = 0$, $x^2 = 4$, $x = \pm 2$.

4.5 Problem Solving (pp. 270–271) **39.** Earth: about 3.1 sec, Mars: 5 sec, Jupiter: about 2.0 sec, Saturn: about 3.2 sec, Pluto: about 12.2 sec **41. a.** $\pi r^2 = 100$ **b.** about 5.6 ft **c.** $\sqrt{\frac{s^2}{\pi}}$; $s^2 = \pi r^2$, $\frac{s^2}{\pi} = r^2$, $\sqrt{\frac{s^2}{\pi}} = r$

4.5 Problem Solving Workshop (p. 273) **1.** 1, 5 **3.** $1\frac{2}{3}$ **5.** about -4.4, about 1.4 **7.** about 108 mph **9.** 1.25 sec

4.6 Skill Practice (pp. 279–280) **1.** $a + bi$ **3.** $\pm 2i\sqrt{7}$ **5.** $\pm 2i$ **7.** $\pm i\sqrt{11}$ **9.** $\pm i$ **11.** $3 \pm i\sqrt{2}$ **13.** $17 - i$ **15.** $-8 + 6i$ **17.** $19 - 9i$ **19.** $21 + 9i$ **23.** $-8 - 4i$ **25.** $-18 - 13i$ **27.** 73 **29.** $-\frac{3}{5} + \frac{9}{5}i$ **31.** $\frac{3}{4} - \frac{1}{3}i$

SELECTED ANSWERS

33. $-\frac{59}{106}-\frac{21}{106}i$ **43.** $\sqrt{109}$ **45.** $\sqrt{37}$ **47.** 4 **49.** $7\sqrt{2}$

51. $-20+2i$ **53.** $-125+90i$ **55.** $-\frac{5}{26}-\frac{51}{26}i$

57. $i^2=-1$, so $-2i^2=2$; $4-i+8i-2i^2=6+7i$.

59. a. additive: $-2-i$, multiplicative: $\frac{2}{5}-\frac{1}{5}i$

b. additive: $-5+i$, multiplicative: $\frac{5}{26}+\frac{1}{26}i$

c. additive: $1-3i$, multiplicative: $-\frac{1}{10}-\frac{3}{10}i$

4.6 Problem Solving (pp. 281–282) **65.** $4-3i$ ohms

67. $12-8i$ ohms

69.

Powers of i	i	i^2	i^3	i^4	i^5	i^6	i^7	i^8
Simplified	i	-1	$-i$	1	i	-1	$-i$	1

The pattern repeats every four powers of i; $i^9=i$, $i^{10}=-1$, $i^{11}=-i$, $i^{12}=1$.

71. does not belong to the Mandelbrot set

73. belongs to the Mandelbrot set

75. a. $\frac{519}{125}+\frac{167}{125}i$ **b.** $\frac{2326}{265}+\frac{668}{265}i$ **c.** $\frac{98}{37}-\frac{4}{37}i$

4.7 Skill Practice (pp. 288–289) **1.** A binomial is the sum of two monomials and a trinomial is the sum of three monomials. **3.** $-5, 1$ **5.** $-14, -2$ **7.** $11\pm\sqrt{13}$

9. $-4\pm3\sqrt{5}$ **11.** $\frac{2\pm i\sqrt{3}}{3}$ **13.** 9; $(x+3)^2$ **15.** 144; $(x-12)^2$ **17.** 1; $(x-1)^2$ **19.** $\frac{49}{4}$; $\left(x+\frac{7}{2}\right)^2$ **21.** $\frac{1}{4}$; $\left(x-\frac{1}{2}\right)^2$

23. $-4\pm\sqrt{15}$ **25.** $-6\pm3\sqrt{2}$ **27.** $1\pm2i\sqrt{6}$

29. $-7\pm\sqrt{41}$ **31.** $-1\pm i\sqrt{2}$ **33.** $-\frac{1}{2}\pm\frac{i\sqrt{7}}{2}$

35. $-5+5\sqrt{3}$ **37.** $-2+2\sqrt{21}$ **39.** (2.8, 125.44); at 2.8 seconds the water will reach a maximum height of 125.44 feet. **41.** $y=(x-4)^2+3$; (4, 3)

43. $y=(x+6)^2+1$; $(-6, 1)$ **45.** $y=\left(x-\frac{3}{2}\right)^2+\frac{7}{4}$; $\left(\frac{3}{2}, \frac{7}{4}\right)$ **47.** $y=2(x+6)^2-47$; $(-6, -47)$

49. $y=2(x-7)^2+1$; (7, 1) **51.** 36 should be added to each side instead of 9; $4(x^2+6x+9)=11+36$; $4(x+3)^2=47$; $(x+3)^2=\frac{47}{4}$; $x+3=\pm\frac{\sqrt{47}}{2}$; $x=-3\pm\frac{\sqrt{47}}{2}$. **53.** $-\frac{3}{2}\pm i\frac{\sqrt{47}}{2}$ **55.** $\frac{1}{6}\pm i\frac{\sqrt{71}}{6}$

57. $-0.5\pm0.5i\sqrt{19}$

4.7 Problem Solving (pp. 290–291) **63.** 40 ft **65.** Selling systems for \$300 would maximize monthly revenue at \$9000. **67. a.** $1500=(120-2x)(x)$ **b.** about 17.75, about 42.25; 17.25 must be rejected because it gives a length for the garden that is greater than the length of the side of the school. **c.** about 42.25 ft by 35.5 ft

4.8 Skill Practice (pp. 296–297) **1.** discriminant **3.** $-1, 5$

5. $-4\pm i\sqrt{3}$ **7.** $\frac{1}{2}$ **9.** $\frac{2\pm\sqrt{3}}{2}$ **11.** $\frac{4\pm\sqrt{43}}{3}$ **13.** 2

15. $\frac{-3\pm i\sqrt{47}}{2}$ **17.** $-\frac{5\pm2\sqrt{10}}{5}$ **19.** $\frac{-7\pm\sqrt{13}}{6}$

21. $\frac{5\pm\sqrt{31}}{3}$ **23.** 2, 3 **25.** $-1, 3$ **27.** $-2, 4$ **29.** $-5, -3$

31. 0; one real solution **33.** -32; two imaginary solutions **35.** -20; two imaginary solutions **37.** -335; two imaginary solutions **39.** -36; two imaginary solutions **41.** $\frac{1\pm i\sqrt{67}}{2}$ **43.** $-2\frac{1}{2}, \frac{5}{14}$

45. $\frac{1\pm\sqrt{229}}{12}$ **47.** $0.875\pm0.752i$ **49.** $\sqrt{-144}=12i$; $x=\frac{-6\pm\sqrt{-144}}{6}$; $x=\frac{-6\pm12i}{6}$; $x=-1\pm2i$

51. $\frac{\frac{-b+\sqrt{b^2-4ac}}{2a}+\frac{-b-\sqrt{b^2-4ac}}{2a}}{2}=\frac{\frac{-2b}{2a}}{2}=\frac{-b}{2a}$, which is the formula for the axis of symmetry.

53. negative **57. a.** $c<16$ **b.** $c=16$ **c.** $c>16$

59. a. $c<48$ **b.** $c=48$ **c.** $c>48$ **61. a.** $c<0.25$

b. $c=0.25$ **c.** $c>0.25$ **63.** $-\frac{1}{3}x^2-\frac{1}{3}x+4=0$

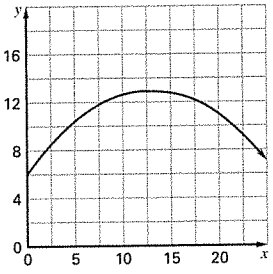
65. $2x^2+4x+4=0$

4.8 Problem Solving (pp. 298–299) **71.** 1141 m, 2090 m

73. a.

t	0	0.25	.05	0.75	1
(x, y)	(0, 6)	(5, 10.25)	(10, 12.5)	(15, 12.75)	(20, 11)

b.

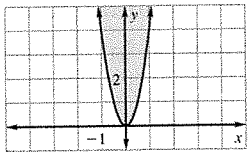


c. No; the height of the ball when $x=15$ is 12.75 feet, which is above the backboard, so the free throw would not be made.

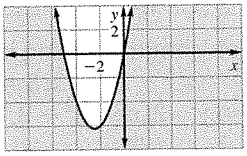
4.9 Skill Practice (pp. 304–305)

1. *Sample answer:* $3x^2-2x+5>0$, $y\geq x^2+4x-8$

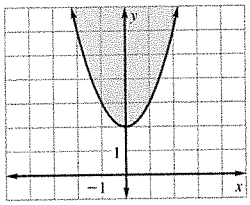
7.



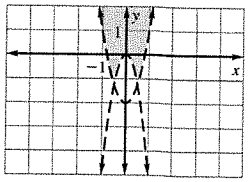
9.

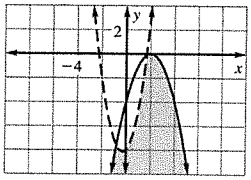


19.



The inside of the parabola should be shaded.

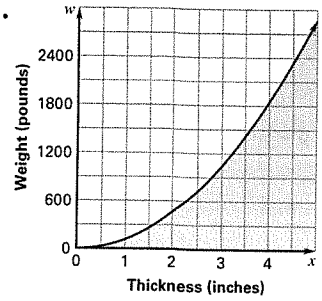
21. 

23. 

27. $x < -3$ or $x > 1$ **29.** $x \leq -2$ or $x \geq 4$ **31.** $2 < x < 8$ **33.** $-1 \leq x \leq 3$ **35.** $0 < x < 6$ **37.** $x < 0.59$ or $x > 3.4$ **39.** $-2 \leq x \leq 1.3$ **41.** $0.67 \leq x \leq 2.5$ **43.** $-1.2 < x < 3.7$ **47.** $-9 < x < -1$ **49.** $x < -\frac{2}{3}$ or $x > 5$ **51.** $x \leq -3.5$ or $x \geq 1.5$ **53.** $-0.27 \leq x \leq 1.5$ **55.** $-2.8 \leq x \leq -0.72$ **57.** $x < -0.46$ or $x > 1.8$ **59.** $-0.89 < x < 1.3$ **61.** no solution **63.** $x < 0.52$ or $x > 11.5$ **65.** $0 \leq x \leq 0.5$ **67.** no solution

4.9 Problem Solving (pp. 306–307)

71.



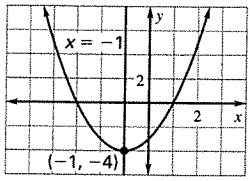
73. $37 \leq x \leq 40$; the domain restricts the number of days to less than or equal to 40. **75. a.** $-0.054x^2 + 1.43x - 8 < 0$; $x \leq 8.0$ or $x \geq 18.5$ **b.** No; the ball will go over the goal by 1.3 feet.

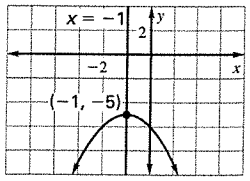
4.10 Skill Practice (pp. 312–313) **1.** best-fitting quadratic model **3.** $y = (x - 3)^2 + 2$ **5.** $y = \frac{1}{2}(x + 1)^2 - 3$ **7.** $y = -(x - 1)^2 + 6$ **9.** $y = -\frac{1}{4}(x + 3)^2 + 3$ **11.** $y = 2(x + 4)^2 - 2$ **13.** $y = \frac{1}{3}(x + 1)^2 - 4$ **17.** $y = -(x - 3)(x + 2)$ **19.** $y = \frac{1}{2}(x + 3)(x - 3)$ **21.** $y = x(x + 3)$ **23.** $y = 3(x - 3)(x - 7)$ **25.** $y = \frac{1}{2}(x + 6)(x - 3)$ **27.** The vertex form of the equation should be used instead of the intercept form; $y = a(x - 2)^2 + 3$; $5 = a(1 - 2)^2 + 3$; $5 = a + 3$; $a = 2$, so $y = 2(x - 2)^2 + 3$. **29.** $y = 2x^2 + 20x + 46$ **31.** $y = \frac{7}{4}x^2 + \frac{29}{4}x - 2$ **33.** $y = -\frac{11}{2}x^2 - \frac{21}{2}x + 5$ **35.** $y = 3x^2 - 4x + 2$ **37.** $y = -\frac{1}{2}x^2 + 4x - 3$ **39.** $y = -\frac{2}{3}x^2 + 2x + 10$ **41.** $y = 8x^2 + 64x - 264$ **43.** *Sample answer:* $y = \frac{3}{4}x^2$

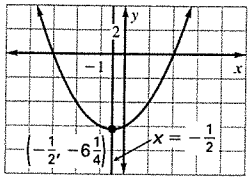
4.10 Problem Solving (pp. 314–315)

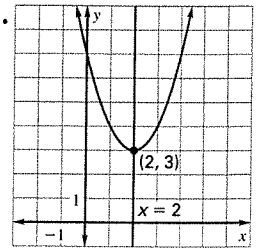
47. $y = -\frac{3}{80}(x - 20)^2 + 15$ **49. a.** $y = 0.012x^2 - 0.309x - 0.00048$ **b.** about -1.90 sec

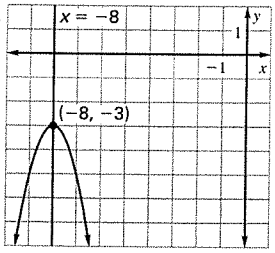
Chapter Review (pp. 318–322) **1.** If $a < 0$, the function has a maximum value and if $a > 0$, then the function has a minimum value. **3.** vertex form

5. 

7. 

9. 

11. 

13. 

15. $-5, 0$ **17.** $-3, 9$ **19.** -9 **21.** $(72 + x)(48 + x) = 2(72)(48)$; 24 ft **23.** $4 \pm 4\sqrt{2}$ **25.** ± 6 **27.** $-1 \pm 3\sqrt{3}$ **29.** $-9 - 18i$ **31.** 29 **33.** $-4 + 2i$ **35.** $3 \pm 2\sqrt{6}$ **37.** $\frac{-3 \pm \sqrt{13}}{2}$ **39.** $-\frac{1}{3}$ **41.** about 0.2 sec **43.** $-0.65 \leq x \leq 4.6$ **45.** $y = 2(x + 3)(x - 2)$ **47.** $y = -\frac{5}{4}(x - 2)^2 + 7$

Chapter 5

5.1 Skill Practice (pp. 333–334) **1. a.** Product of powers property **b.** Negative exponent property **c.** Power of a product property **3.** 243; product of powers property **5.** -3125; product of powers property **7.** $\frac{1}{125}$; quotient of powers property **9.** $\frac{343}{8}$; power of a quotient property, negative exponent property **11.** 729; quotient of powers property **13.** $\frac{1}{36}$; product of powers property, negative exponent property **15.** 6.3×10^9 **17.** 5.607×10^{-6} **19.** 9.261×10^{-12} **21.** 1.5×10^3 **23.** 2.25×10^{-2}

SELECTED ANSWERS

25. $1024y^{15}$; power of a product property, power of a power property **27.** $\frac{w^9}{x^3}$; product of powers property, negative exponent property **29.** $\frac{1}{27a^9b^{15}}$; power of a product property, power of a power property, negative exponent property **31.** $\frac{c^2d^2}{3}$; quotient of powers property **33.** $\frac{2}{3a^2b^2}$; quotient of powers property, negative exponent property **35.** $\frac{x^6}{3y^3}$; product of powers property, quotient of powers property, negative exponent property **37.** The exponents should be subtracted, not divided; x^8. **39.** The base should not change; $(-3)^6$. **41.** $\frac{\pi x^3}{2}$ **43.** $x^{11}y^5z^{-3}$ **45.** $a^{-4}b^9$

5.1 Problem Solving (pp. 334–335) **49.** Pacific: 6.2868×10^{17} m^3, Atlantic: 3.01824×10^{17} m^3, Indian: 2.71656×10^{17} m^3, Arctic: 1.7061×10^{16} m^3 **51.** *Sample answer:* The volume of the pearl is $\frac{27}{8}$ times as large as the volume of the bead. **53. a.** about 4.4225×10^{-7} m^3

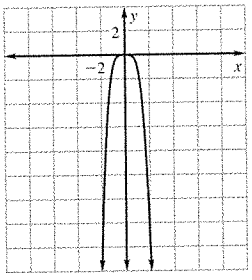
5.2 Skill Practice (pp. 341–343) **1.** degree: 4, type: quartic, leading coefficient: -5, constant term: 6 **3.** polynomial function; $f(x) = -x^2 + 8$, degree: 2, type: quadratic, leading coefficient: -1 **5.** polynomial function; $g(x) = \pi x^4 + \sqrt{6}$, degree: 4, type: quartic, leading coefficient: π **7.** polynomial function; $h(x) = -\frac{5}{2}x^3 + 3x - 10$, degree: 3, type: cubic, leading coefficient: $-\frac{5}{2}$ **9.** -32 **11.** 378 **13.** 182 **15.** 109 **17.** 149 **19.** -11 **21.** -78

23. The coefficient of x^3 was left out.

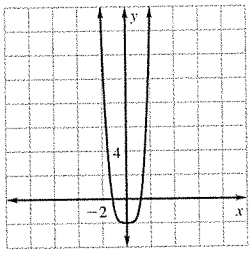
-2	-4	0	9	-21	7
		8	-16	14	14
	-4	8	-7	-7	21

25. degree: even, leading coefficient: positive **27.** degree: even, leading coefficient: negative **29.** $-\infty$, $-\infty$ **31.** $-\infty$, $+\infty$ **33.** $+\infty$, $-\infty$ **35.** $+\infty$, $+\infty$ **37.** *Sample answer:* $f(x) = -x^5 - 2x^4 + 1$

39.



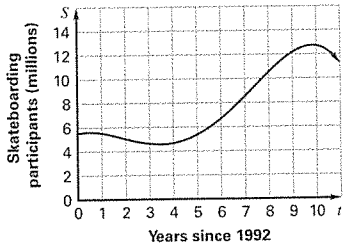
41.



51. $g(x) \to -\infty$ as $x \to -\infty$ and $g(x) \to +\infty$ as $x \to +\infty$

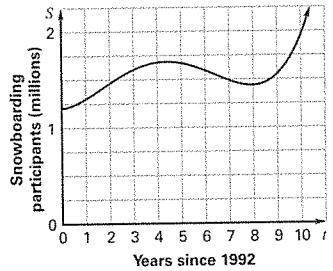
5.2 Problem Solving (pp. 343–344)

55.



1998

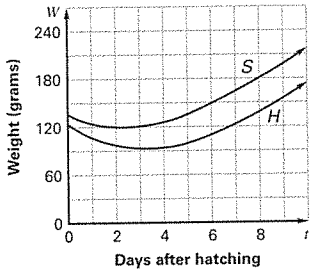
57.



2002

59. a. 35.625 g

b.



c. Sarus. *Sample answer:* Substituting 3 into each equation gives the Sarus chick weighing about 120 grams and the Hooded chick weighing about 92 grams. The weight of the Sarus is closer to 130 than the weight of the Hooded chick is.

5.3 Skill Practice (pp. 349–350) **1.** like terms **3.** $10x^2 - 8$ **5.** $14y - 8$ **7.** $7s^3 - 2s^2 + 8s + 10$ **9.** $2c^3 + 5c^2 + c + 9$ **11.** $-2b^4 - 15b^3 + 5b + 7$ **13.** $2x^4 - x^3$ **17.** $30x^3 + 10x^2$ **19.** $3z^2 - 8z - 3$ **21.** $2a^3 - 23a^2 + 26a + 6$ **23.** $-x^4 + 12x^3 - 34x^2 + 4x + 3$ **25.** $12y^4 - 9y^3 - 85y^2 - 19y + 5$ **27.** The cube of a binomial $(a - b)^3$ is found by $a^3 - 3a^2b + 3ab^2 - b^3$; $(2x - 7)^3 = (2x)^3 - 3(2x)^2(7) + 3(2x)(7)^2 - (7)^3 = 8x^3 - 84x^2 + 294x - 343$. **29.** $x^3 - 3x^2 - 25x - 21$ **31.** $2a^3 - 5a^2 - 37a - 30$ **33.** $-2b^3 + 7b^2 - 7b + 2$ **35.** $-12w^3 + 95w^2 - 143w + 30$ **37.** $-27q^3 + 132q^2 - 172q + 32$ **39.** $w^2 - 18w + 81$ **41.** $4c^2 + 20c + 25$ **43.** $25p^2 - 9$ **45.** $4a^2 - 81b^2$ **49.** $2\pi x^3 - 13\pi x^2 + 8\pi x + 48\pi$ **51.** $4x^3 - \frac{20}{3}x^2 - 7x + 12$ **53.** $(a + b)^2 = (a + b)(a + b) = a^2 + ab + ab + b^2 = a^2 + 2ab + b^2$ **55.** $(a - b)^3 = (a - b)(a - b)(a - b) = (a - b)(a^2 - 2ab + b^2) = a^3 - 2a^2b + ab^2 - a^2b + 2ab^2 - b^3 = a^3 - 3a^2b + 3ab^2 - b^3$

SELECTED ANSWERS

57. a. $(x-1)(x^4+x^3+x^2+x+1)$; $(x-1)(x^5+x^4+x^3+x^2+x+1)$
b. $(x-1)(x^{n-1}+x^{n-2}+x^{n-3}+\ldots+1)$

5.3 Problem Solving (pp. 351–352) **59.** $0.281t^3 - 16.8t^2 + 460t + 8600$ **61.** $F = 0.000031s^3 + 0.002107s$; about 0.05 horsepower **63.** $N = -1.51503t^4 - 25.53106t^3 + 215.9226t^2 + 127.75t + 9858.5$; calculate $L_m \cdot S_m + L_w \cdot S_w$.

5.4 Skill Practice (pp. 356–357) **1.** quadratic **3.** $7x(2x-3)$ **5.** $c(c+3)(c+6)$ **7.** $3y^3(y-4)(y+4)$ **11.** $(y-4)(y^2+4y+16)$ **13.** $(5n+6)(25n^2-30n+36)$ **15.** $(2c+7)(4c^2+14c+49)$ **17.** $-5(z-4)(z^2+4z+16)$ **19.** $(y-7)(y^2+4)$ **21.** $(3m-1)(m^2+3)$ **23.** $(c+2)(2c-3)(2c+3)$ **25.** $(a^2+1)(a^2+6)$ **27.** $2z(2z-1)(2z+1)(4z^2+1)$ **29.** $3x(x^2-6)(5x^2+6)$ **31.** The factor $3x$ should also be set equal to 0; $x = 0$ or $x = -4$ or $x = 4$. **33.** $0, -1\frac{2}{3}, 1\frac{2}{3}$ **35.** $2, -2, -6$ **37.** $0, -\sqrt{21}, \sqrt{21}$ **39.** $-\sqrt{3}, \sqrt{3}, 2, -2$ **43.** $(n^2-10)(n^2+6)$ **45.** $(12a-5)(3a^2+7)$ **47.** $(d+3)(d-3)(2d^2+5)$ **49.** $2y^2(y^2-5)(4y^2+1)$ **51.** 2 **53.** 5 **55.** $(c+d)(c-d)(7a+b)$

5.4 Problem Solving (pp. 358–359) **59.** 3 cm by 9 cm by 18 cm **61.** length: 10 in., width: 5 in., height: 5 in. **63.** The volume cannot be $\frac{7}{3}$ because the only x value that corresponds to that volume is about -1.37, which would yield a negative side length.

5.4 Problem Solving Workshop (p. 361) **1.** 4 **3.** 6 **5.** about 1.4, 4 **7.** 2.5 **9.** height: 12 in., width: 8 in., length: 18 in.

5.5 Skill Practice (pp. 366–367) **1.** If a polynomial $f(x)$ is divided by $x-k$, then the remainder is $r = f(k)$. **3.** $x+5+\frac{3}{x-4}$ **5.** $x^2+4x+7+\frac{9}{x-1}$ **7.** $3x+8+\frac{-4x+1}{x^2+x}$ **9.** $5x^2-12x+37+\frac{-122x+109}{x^2+2x-4}$ **11.** $2x+3+\frac{25}{x-5}$ **13.** $x+4+\frac{-15}{x+4}$ **15.** $x^2-x-4+\frac{-18}{x-4}$ **17.** $x^3+x^2-2x+1+\frac{-6}{x-6}$ **19.** The degree of the answer should be reduced by 1; $x^2+2x-1+\frac{1}{x-2}$. **21.** $(x-6)(x-5)(x+1)$ **23.** $(x-8)(x+2)(x+4)$ **25.** $(x-4)(x-3)(x+9)$ **27.** $(2x-7)(x-3)(x-1)$ **29.** $-1, 6$ **31.** $-0.4, 1.5$ **33.** $\frac{-4\pm\sqrt{14}}{2}$ **37.** $x+8$

5.5 Problem Solving (pp. 367–368) **41.** 1 million T-shirts **43.** $f(x) = -0.132x^2 + 11.2x - 560.9 + \frac{408{,}803}{14.8x+725}$ **45.** $-0.00233x^3 + 0.249x^2 - 21.0x + 1740 - \frac{445{,}000}{3.10x+256}$; divided the overnight stays function by the total visits function

5.6 Skill Practice (pp. 374–375) **1.** constant, leading coefficient **3.** $\pm1, \pm2, \pm4, \pm7, \pm14, \pm28$ **5.** $\pm1, \pm3, \pm9, \pm\frac{1}{2}, \pm\frac{3}{2}, \pm\frac{9}{2}$ **7.** $\pm1, \pm2, \pm7, \pm14, \pm\frac{1}{2}, \pm\frac{7}{2}, \pm\frac{1}{4}, \pm\frac{7}{4}$ **9.** $\pm1, \pm3, \pm5, \pm15, \pm\frac{1}{2}, \pm\frac{3}{2}, \pm\frac{5}{2}, \pm\frac{15}{2}, \pm\frac{1}{4}, \pm\frac{3}{4}, \pm\frac{5}{4}, \pm\frac{15}{4}, \pm\frac{1}{8}, \pm\frac{3}{8}, \pm\frac{5}{8}, \pm\frac{15}{8}$ **11.** 1, 3, 8 **13.** $-5, -1, 6$ **15.** $-2, -1$ **17.** $-4, -1, 1, 2$ **19.** $1, \frac{-1\pm\sqrt{17}}{2}$ **21.** $-3, -\frac{5}{3}, \frac{1}{2}$ **25.** $-1, \frac{3}{2}, 3$ **27.** $-4, -\frac{1}{3}, 3$ **29.** $-3.5, -1, 2$ **31.** $-2, 2$ **33.** $-2, 1, \frac{5}{2}, 3$ **35.** $-3, \frac{1}{2}, 1$ **37.** p should be factors of 5 and q should be factors of 6; possible zeros: $\pm1, \pm5, \pm\frac{1}{2}, \pm\frac{5}{2}, \pm\frac{1}{3}, \pm\frac{5}{3}, \pm\frac{1}{6}, \pm\frac{5}{6}$. **41.** $-1, 1, 2$; B **43.** -2; A

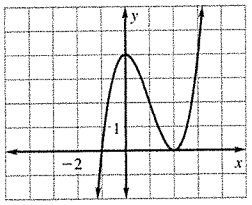
5.6 Problem Solving (pp. 376–377) **45.** length: 3 in., width: 3 in., height: 7 in. **47.** $x^3-3x^2+2x-24=0$; $\pm1, \pm2, \pm3, \pm4, \pm6, \pm8, \pm12, \pm24$ **49. a.** $-10t^3 + 140t^2 - 20t - 2150 = 0$ **b.** 1, 2, 5 **c.** 5; 1999

5.7 Skill Practice (pp. 383–385) **1.** repeated **3.** 4 **5.** 6 **7.** 7 **11.** $-5, -3, 1, 2$ **13.** $-5, -2, 2$ **15.** $-2, 1, 2i, -2i$ **17.** $i, -i, 1+\sqrt{3}, 1-\sqrt{3}$ **19.** $-4, -2, -\frac{3}{2}, 1$ **21.** $f(x) = x^3-2x^2-5x+6$ **23.** $f(x) = x^3-4x^2-15x+18$ **25.** $f(x) = x^4-4x^3+14x^2-36x+45$ **27.** $f(x) = x^4-18x^3+122x^2-370x+425$ **29.** $f(x) = x^4-x^3-18x^2+10x+8$ **31.** $f(x) = x^5-13x^4+60x^3-82x^2-144x+360$ **33.** *Sample answer:* $f(x) = x^5-4x^4+6x^3-6x^2+5x-2$ **35.** positive: 1, negative: 0, imaginary: 2 **37.** positive: 2 or 0, negative: 3 or 1, imaginary: 4, 2, or 0 **39.** positive: 3 or 1, negative: 2 or 0, imaginary: 4, 2, or 0 **41.** positive: 2 or 0, negative: 1, imaginary: 6 or 4 **43.** $x \approx -1.1, x \approx 1.3$ **45.** $x \approx -0.58, x \approx 1.9$ **47.** $x \approx -0.42, x \approx 2.0$ **49.** $x \approx -3.5, x \approx -1.1, x = -1, x \approx 2.1, x \approx 3.6$ **51.** There could be 3, 2, 1, or 0 positive zeros, 3, 2, 1, or 0 negative zeros, and 2 or 0 imaginary zeros. **53.** Positive real zeros: 1, negative real zeros: 2, imaginary zeros: 0; the graph crosses the positive x-axis once and the negative x-axis twice. **55.** Positive real zeros: 0, negative real zeros: 1, imaginary zeros: 4; the graph does not cross the positive x-axis and it crosses the negative x-axis once. Since the function has degree 5, the remaining 4 zeros must be imaginary.

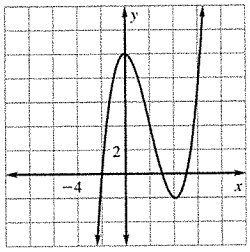
5.7 Problem Solving (pp. 385–386) **59.** year 3 and year 9 **61.** about 16.4 g per mL **63.** 0 in., about 59 in.; the bookshelf would have nearly 0 inches of deflection near each end because of the supports holding the bookshelf, so the answers make sense because they represent each end of a 60 inch bookshelf.

5.8 Skill Practice (pp. 390–391) **1.** turning

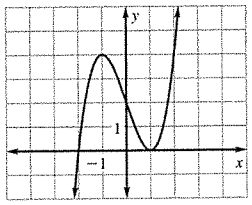
3.



5.

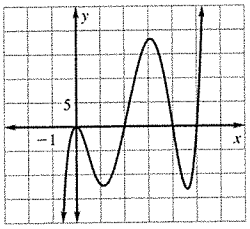


13. The x-intercepts should be at -2 and 1.



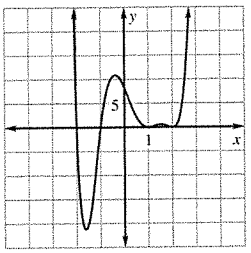
15–19. Sample answers are given. **15.** local maximum: $(-0.3, 0.3)$, local minimum: $(0.9, -1.3)$; zeros: -0.75, 0, 1.4, least degree: 3 **17.** local maximums: (1, 0), (3, 0), local minimum: $(2, -2)$; zeros: 1, 3, least degree: 4 **19.** local maximums: $(-1.1, 0.8)$, $(1.9, 8)$, local minimums: $(-2.2, -38)$, $(0.3, -41)$, $(2.8, -13)$; zeros: -2.6, -1.2, -1, 1.5, 2.2, 3, least degree: 6 **23.** x-intercept: -2.5; local maximum: $(-1.2, 4.0)$; local minimum: $(1.2, 0.96)$ **25.** x-intercepts: -2.2, 1, 1.7; local maximums: $(-1.6, 10.5)$, $(0.17, 2.0)$; local minimums: (0, 2), $(1.5, -1.7)$ **27.** x-intercepts: -0.77, 4.5; local maximum: $(0.47, -2.6)$; local minimums: $(-0.16, -3.1)$, $(3.4, -39.4)$ **29.** x-intercepts: -0.77, 0, 0.82; local maximum: $(0.47, 1.6)$; local minimum: $(-0.46, -1.5)$ **31.** *Sample answer:* Quadratic functions only have one turning point, therefore one maximum or minimum value. Cubic functions can have two turning points, therefore one maximum and one minimum, and the end behavior is to infinity, so there is no real maximum or minimum value. **33.** *Sample answer:* $y = x(x + 2)(x - 4)$, $y = x(x + 2)(x - 4)^2$, $y = x^3(x + 2)(x - 4)$

35.



domain: all real numbers, range: all real numbers

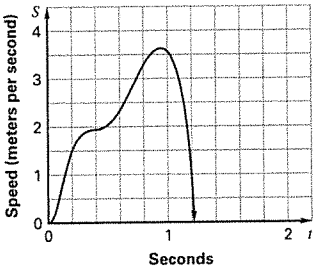
37.



domain: all real numbers, range: $y \geq -21.3$

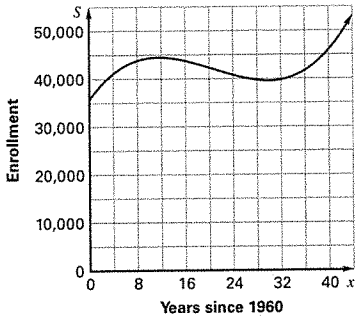
5.8 Problem Solving (pp. 391–392) **39.** maximum: about 5.8 in. by 13.8 in. by 2.1 in.; about 168 in.^{3}

41.



after about 0.95 sec

43. a.



b. Maximum: (11.7, 44,971), minimum: (29.8, 40,078). *Sample answer:* The maximum indicates that in 1972 the number of students enrolled was about 44,971,000. The minimum indicates that in 1990 there were about 40,078,000 students enrolled. **c.** $36{,}300 \leq y \leq 47{,}978$

5.9 Skill Practice (pp. 397–398) **1.** finite differences **3.** $y = 0.5x^3 - 2x^2 + 0.5x + 3$ **5.** $y = \frac{1}{6}x^3 - \frac{1}{3}x^2 - \frac{11}{6}x + 2$ **7.** $y = 2x^3 + 2x^2 - 8x - 8$ **9.** $y = \frac{2}{5}x^3 - \frac{2}{5}x^2 - 12x$ **11.** 1 should have been substituted for x and 3 for y; $3 = a(1 + 1)(1 - 2)(1 - 5)$, $3 = 8a$, $a = \frac{3}{8}$.

13.

$f(1)$	$f(2)$	$f(3)$	$f(4)$	$f(5)$	$f(6)$	$f(7)$
3	2	−3	−12	−25	−42	−63
	−1	−5	−9	−13	−17	−21
		−4	−4	−4	−4	−4

SELECTED ANSWERS

15.

$f(1)$	$f(2)$	$f(3)$	$f(4)$	$f(5)$	$f(6)$	$f(7)$
−3	0	11	30	57	92	135
3	11	19	27	35	43	
8	8	8	8	8		

19. $f(x) = -4x^2 + 15x$ **21.** $f(x) = -0.5x^3 + 5x^2 - 2.5x + 3$ **23.** 5; 6; there must be one more data point than the degree of the equation.

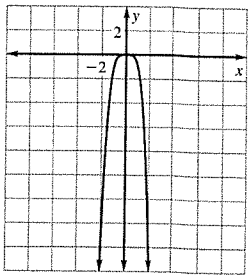
5.9 Problem Solving (pp. 398–399) **25.** $d = 0.5n^2 - 1.5n$ **27. a.** $m = 0.000817t^3 - 0.0215t^2 + 0.249t + 3.17$ **b.** about \$10.30 **c.** 1995

29.

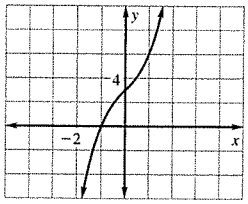
$f(1)$	$f(2)$	$f(3)$	$f(4)$	$f(5)$	$f(6)$	$f(7)$
2	4	8	16	30	52	84
2	4	8	14	22	32	
2	4	6	8	10		
2	2	2	2			

Chapter Review (pp. 402–406) **1.** local maximum, local minimum **3.** If it is in the form $c \times 10^n$ where $1 \le c < 10$ and n is an integer. **5.** 128; product of powers property **7.** $\frac{y^{10}}{x^4}$; power of a power property, negative exponent property **9.** $\frac{16}{9}$; quotient of powers property, negative exponent property **11.** $\frac{1}{x^8y^8}$; power of a quotient property, negative exponent property

13.



15.



17. $6x^3 - 9x^2 + 3x + 3$ **19.** $5x^3 - 29x^2 - 14x + 48$ **21.** $8(2x - 1)(4x^2 + 2x + 1)$ **23.** $(x - 2)(x + 2)(2x - 7)$ **25.** $x - 6 + \frac{18x - 16}{x^2 + 3x - 1}$ **27.** $2x^2 - x + 8 + \frac{-4}{x - 5}$ **29.** $(x + 2)(x - 3)(x - 4)$ **31.** $(x - 1)(3x - 2)(3x + 2)$ **33.** $-3, 2, 5$ **35.** $x^3 - 2x^2 - 19x + 20$ **37.** $x^4 - 15x^3 + 72x^2 - 120x + 56$ **39.** x-intercept: -1.7; local maximum: $(0, -1)$; local minimum: $(-1, -2)$ **41.** $y = x^3 - 8x^2 + 2x - 1$

Chapter 6

6.1 Skill Practice (pp. 417–418) **1.** index **7.** $12^{1/3}$ **9.** $10^{7/3}$ **11.** $\sqrt[4]{5}$ **13.** $(\sqrt[5]{14})^2$ **15.** ± 8 **17.** 0 **19.** no real roots **21.** 2 **23.** 64 **25.** 9 **27.** $\frac{1}{4}$ **29.** $\frac{1}{128}$ **31.** $\frac{1}{16}$ **35.** 2.89 **37.** 2.10 **39.** 12 **41.** 0.01 **43.** 0.02 **45.** -0.18 **47.** *Sample answer:* $27^{1/3}$, $81^{1/4}$ **49.** There are two real solutions; $x = \pm 3$. **51.** 6 **53.** 1, 9 **55.** ± 1.68 **57.** -7.66

6.1 Problem Solving (pp. 418–419) **61.** about 4.30 in. **63.** $\frac{3}{12{,}282{,}500{,}000}$; about 1800 RPM **65. a.** 4096 mm^3 **b.** tetrahedron: about 32.6 mm, octahedron: about 20.6 mm, dodecahedron: about 8.12 mm, icosahedron: about 12.3 mm **c.** No. *Sample answer:* The icosahedron has the greatest number of faces, 20, and an edge length of 12.3 millimeters which is greater than the edge length of the dodecahedron, which has 12 faces.

6.2 Skill Practice (pp. 424–425) **1.** No; they do not have the same index. **3.** 25 **5.** 3 **7.** $2 \cdot 5^{1/2}$ **9.** $\frac{\sqrt[5]{1331}}{11}$ **11.** $7^{3/4}$ **13.** $\frac{\sqrt[3]{50}}{16{,}000}$ **15.** 10 **17.** $2\sqrt{2}$ **19.** 2 **21.** 3 **25.** $2\sqrt[3]{2}$ **27.** $40\sqrt[4]{2}$ **29.** $\frac{\sqrt{3}}{2}$ **31.** $\sqrt[15]{3}$ **33.** $\frac{2}{5}\sqrt[3]{5}$ **35.** $\frac{1}{2}\sqrt[4]{7}$ **37.** $-2\sqrt[7]{2}$ **39.** $-6\sqrt[4]{2}$ **41.** The radicands are not the same, so they cannot be combined; $2\sqrt[3]{10} + 6\sqrt[3]{5}$. **43.** $x^{7/12}$ **45.** $3x$ **47.** $\frac{y^{4/3}}{x^{3/5}}$ **49.** $\frac{1}{x^4}$ **51.** *Sample answer:* $x^{5/4}$ and $x^{1/2}$ **53.** $yz^3\sqrt[4]{12x^2y^2}$ **55.** $x^2z^4\sqrt{xy}$ **57.** $\frac{x\sqrt[3]{y^2}}{y^2}$ **59.** $\sqrt[14]{x^{11}}$ **61.** $\frac{1}{2}y^{3/2}$ **63.** $2x^2y^{1/2}$ **65.** $(2xy + 3y)\sqrt[4]{2x^2}$ **67.** perimeter: $24x^{1/4}$, area: $35x^{1/2}$ **71.** $\frac{1}{y^{6.6}}$ **73.** $\frac{1}{x^{1.2}}$ **75.** $\frac{1}{y^{1.3}}$ **77.** $7z^{0.3}$ **79.** $x^{\sqrt{6}}$ **81.** $4x^2y^{\sqrt{2}}$

6.2 Problem Solving (pp. 426–427) **83. a.** about 580 cm^2 **b.** about 16,671 cm^2 **85.** about 0.45 mm **87. a.** about 2 times fainter **b.** about 1.6 times fainter **c.** about 3 times fainter **89. a.** $r = \sqrt[3]{\frac{3V}{4\pi}}$ **b.** $S = 4\pi\left(\sqrt[3]{\frac{3V}{4\pi}}\right)^2 = 4\pi\left(\frac{3V}{4\pi}\right)^{2/3} = \frac{4\pi(3V)^{2/3}}{(4\pi)^{2/3}} = (4\pi)^{1/3}(3V)^{2/3}$ **c.** The balloon with twice as much water will have $\sqrt[3]{4}$, or about 1.59, times the surface area of the balloon with less water.

6.3 Skill Practice (pp. 432–433) **1.** composition **3.** $2x^{1/3} + 8x^{1/2}$, all nonnegative real numbers **5.** $-6x^{1/3} + 8x^{1/2}$, all nonnegative real numbers

SELECTED ANSWERS

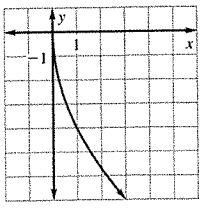
7. $-8x^{1/3}$, all nonnegative real numbers **9.** 0, all nonnegative real numbers **13.** $20x^{7/6}$, nonnegative real numbers **15.** $25x$, all nonnegative real numbers **17.** $\frac{5}{4x^{1/6}}$, positive real numbers **19.** 1, positive real numbers **21.** -64 **23.** $-\frac{36}{25}$ **25.** 71 **27.** -625 **29.** $\frac{6}{x} - 7$, all real numbers except $x = 0$ **31.** $\frac{2x - 13}{3}$, all real numbers **33.** x, all real numbers except $x = 0$ **35.** $4x - 21$, all real numbers **37.** 4 should be distributed to each term, not just the first term; $4x^2 - 12$. **39.** *Sample answer:* $f(x) = 3x$, $g(x) = 2x$

6.3 Problem Solving (pp. 433–434) **43.** $r(w) = 220w^{-0.266}$; about 134 breaths per minute, about 48.3 breaths per minute, about 11.3 breaths per minute **45. a.** \$63 **b.** \$61.50 **c.** Apply the 10% discount before the \$15 discount; you pay \$61.50 using this method and \$63 using the other method.

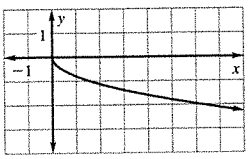
6.4 Skill Practice (pp. 442–443) **1.** An inverse relation interchanges the input and output values of the original relation. **3.** $y = \frac{x + 1}{4}$ **5.** $y = \frac{x + 6}{7}$ **7.** $y = \frac{x - 7}{12}$ **9.** $y = \frac{1}{5}x - \frac{1}{15}$ **11.** $y = \frac{7 - 5x}{3}$ **13.** Switching the roles of x and y does not include switching the sign of the variables; $x = -y + 3$, $x - 3 = -y$, $3 - x = y$. **15.** $f(g(x)) = x - 4 + 4 = x$, $g(f(x)) = x + 4 - 4 = x$ **17.** $f(g(x)) = \frac{1}{4}((4x)^{1/3})^3 = \frac{1}{4}(4x) = x$, $g(f(x)) = \left(4\left(\frac{1}{4}x^3\right)\right)^{1/3} = (x^3)^{1/3} = x$ **19.** $f(g(x)) = 4\left(\frac{1}{4}x - \frac{9}{4}\right) + 9 = x - 9 + 9 = x$, $g(f(x)) = \frac{1}{4}(4x + 9) - \frac{9}{4} = x + \frac{9}{4} - \frac{9}{4} = x$ **23.** $f^{-1}(x) = \sqrt[4]{\frac{x}{4}}$ **25.** $f^{-1}(x) = \frac{\sqrt[5]{x}}{2}$ **27.** $f^{-1}(x) = -\frac{5}{4}\sqrt{x}$ **29.** function **31.** not a function **33.** function **35.** not a function **37.** not a function **39.** $f^{-1}(x) = \sqrt[3]{x + 2}$ **41.** $f^{-1}(x) = -\sqrt[6]{\frac{40 - 5x}{2}}$ **43.** $f^{-1}(x) = \sqrt[4]{x + 9}$

6.4 Problem Solving (pp. 444–445) **47. a.** $w = 2\ell - 6$ **b.** 7 lb **49.** $\ell = \left(\frac{v}{1.34}\right)^2$; about 31.3 ft

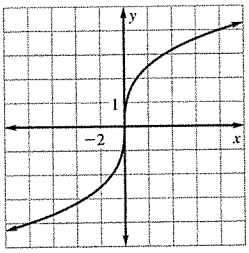
6.5 Skill Practice (pp. 449–450) **1.** radical

3. 

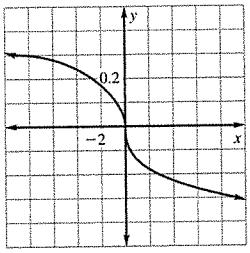
domain: $x \geq 0$, range: $y \leq 0$

5. 

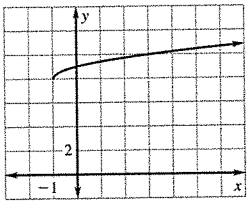
domain: $x \geq 0$, range: $y \leq 0$

11. 

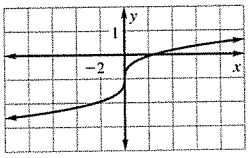
domain: all real numbers, range: all real numbers

13. 

domain: all real numbers, range: all real numbers

17. 

domain: $x \geq -1$, range: $y \geq 8$

19. 

domain: all real numbers, range: all real numbers

25. The domain is limited because the square root of a negative number is not a real number. Since the domain is restricted, the range is also affected. **29.** Domain: $x \geq 12$, range: $y \geq 0$; the expression under the radical sign must be greater than or equal to 0, so substitute the least value of x into the equation and find y. **31.** Domain: all real numbers, range: all real numbers; there are no restrictions on finding the cube root of a number and therefore no restrictions on the range. **33.** Domain: $x \geq 3$, range: $y \geq 6$; the expression under the radical sign must be greater than or equal to 0, so substitute the least value of x into the equation and find y.

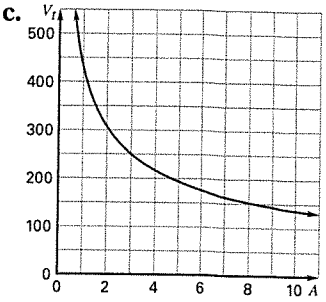
6.5 Problem Solving (pp. 450–451) **35.** about 43 ft above sea level **37. a.** $v = 331.5\sqrt{1 + \frac{C}{273.15}}$ **b.** domain: $C \geq -273.15$, range: $v \geq 0$ **39. a.** $v_t = 33.7\sqrt{\frac{165}{A}}$

SELECTED ANSWERS

b. *Sample answer:*

A	2	4	6	8	10
v_t	306.1	216.44	176.72	153.05	136.89

c.



6.6 Skill Practice (pp. 456–457) **1.** extraneous **3.** 7 **5.** 1 **7.** 6 **9.** 29 **11.** $-70\frac{1}{2}$ **13.** 343 **15.** 18 **17.** 8 **19.** 11 **21.** -37 **23.** 4 **25.** 32 **27.** 40 **29.** 108 **31.** 1 **33.** Both sides must be raised to the power; $((x+7)^{1/2})^2 = 5^2, x+7=25, x=18$. **35.** 25 **37.** 3, 8 **39.** $-2\frac{1}{10}$ **41.** $\frac{1}{2}$ **45.** 3 **47.** 4 **49.** $\frac{1}{4}$ **51.** $-2, 2$ **53.** (4, 25)

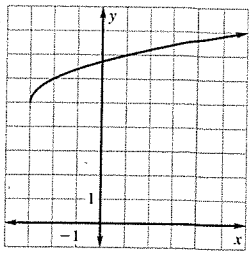
6.6 Problem Solving (pp. 457–459) **57.** about 391 min **59.** *Sample answer:* The elephant with a shoulder height of 250 centimeters is about 20 years older than the elephant with a shoulder height of 150 centimeters. **61. a.** about 0.162 mi/h **b.** about 80.4 mi/h **c.** $0.162 \le s \le 80.4$

6.6 Problem Solving Workshop (p. 461) **1.** -39 **3.** about 55.7 **5.** about 97 ft **7.** about 37.5 cm

6.6 Extension (p. 463) **1.** $x \ge 16$ **3.** $0 \le x \le 4$ **5.** $x \ge 1$ **7.** $0 \le x \le 6.25$ **9.** $0 \le x < 1.3$ **11.** $0 \le x < 4$ **13.** about 413 m^2

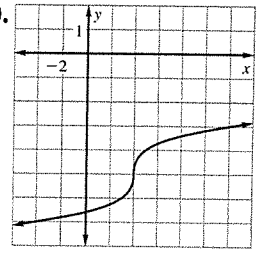
Chapter Review (pp. 466–468) **1.** 4 **3.** power **5.** If a horizontal line crosses the graph of the function more than once, the inverse is not a function. **7.** Take the square root of each side; raise each side to the $\frac{3}{2}$ power. **9.** 0 **11.** 5 **13.** $\frac{1}{9}$ **15.** -8 **17.** $\frac{1}{15}$ **19.** $\frac{3x^2y^2\sqrt{2z}}{7z^2}$ **21.** $3x - 14$ **23.** $4x + 26$ **25.** $y = \frac{\sqrt{x-9}}{2}$

27.



domain: $x \ge -3$, range: $y \ge 5$

29.

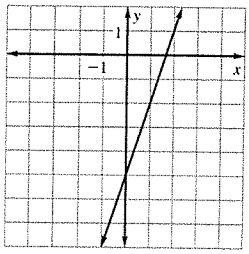


domain: all real numbers, range: all real numbers

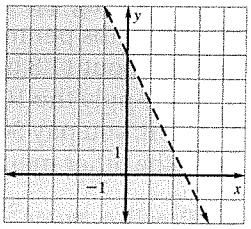
31. 16

Cumulative Review (pp. 474–475) **1.** $y = 4x - 11$ **3.** $y = -8x - 22$ **5.** $y = \frac{4}{5}x + 12$ **7.** -4 **9.** 2, 7 **11.** 2, 0, -5

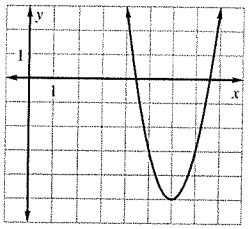
13.



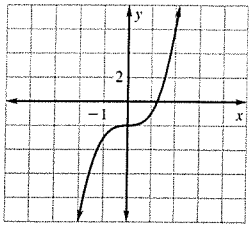
15.



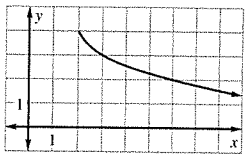
17.



19.



21.

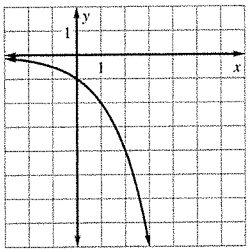


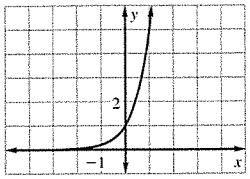
23. $(-1, 6)$ **25.** $9 - i$ **27.** $34 + 8i$ **29.** $y = -(x-6)^2 - 10$ **31.** $8x^9y^6$ **33.** x^7y **35.** $5x^2 + 6x - 16$ **37.** $2x^3 + 3x^2 - 34x + 35$ **39.** $(x^2 - 8)(x^2 + 5)$ **41.** $(x-6)(x-3)(x+3)$ **43.** $10x^2 - 28x - 6$, all real numbers **45.** $10x - 29$, all real numbers **47.** $f^{-1}(x) = \frac{7x-49}{3}$ **49.** $f^{-1}(x) = \sqrt[3]{6x+5}$ **51.** $f^{-1}(x) = \sqrt[5]{\frac{-9x+18}{8}}$ **53.** $y = 0.499x + 1.25$; about \$5,240,000 **55.** \$4642 **57.** $y = -\frac{1}{8}x^2 + 5x + 6$ **59.** $y = x^3 - 5x + 6$; \$690

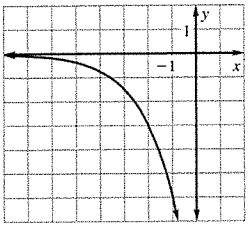
SELECTED ANSWERS

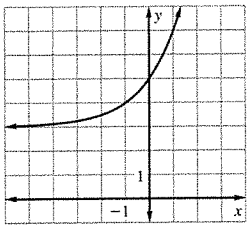
Chapter 7

7.1 Skill Practice (pp. 482–483) **1.** 2.4, 1.5, 50%

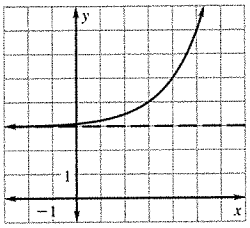
7. 

9. 

15.  domain: all real numbers, range: $y < 0$

17.  domain: all real numbers, range: $y > 3$

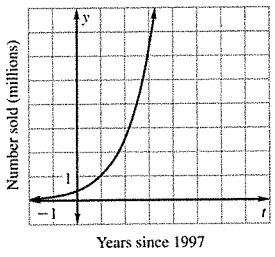
27. The power of $(x - 3)$ translates the parent graph 3 units to the right, not to the left.



29. $A = 800\left(1 + \frac{0.02}{365}\right)^{365t}$, where A represents the amount in the account after t years. **31. a.** \$1844.81 **b.** 18 yr **33. a.** The graph no longer has a vertical stretch of 2. **b.** The graph will increase slower. **c.** The graph will be translated 3 units to the right instead of 4 units to the left. **d.** The graph will be translated 1 unit down instead of 3 units up.

7.1 Problem Solving (pp. 484–485)

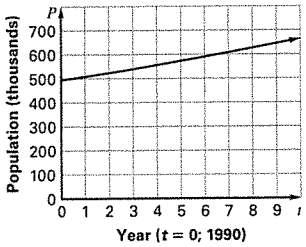
35. a. 0.42 million, 2.47, 147%

b. 

about 16 million DVD players

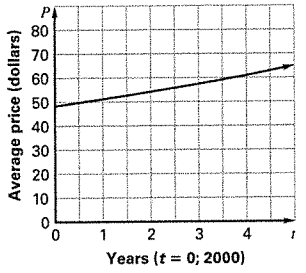
37. a. \$2479.38 **b.** \$2406.98 **c.** \$2383.23

39. a. $P = 494.29(1.03)^t$; 664,284 people

b. 

domain: $t \geq 0$, range: $P \geq 494.29$

c. 1996 **41. a.** $p = 48.28(1.06)^t$

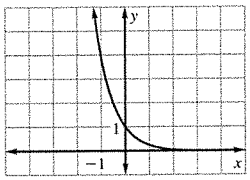
b. 

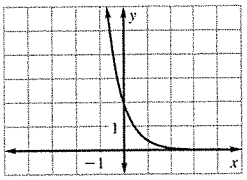
2003

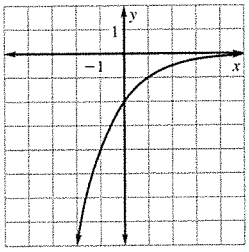
c. *Sample answer:* Since the function is only defined when t is between 0 and 4, you can look at the graph between these values to determine the minimum or maximum that gives meaningful results. **43.** No. *Sample answer:* The amounts are not equal except initially and one year after the investments are made.

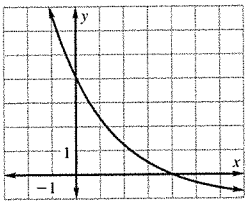
7.2 Skill Practice (pp. 489–490) **1.** 1250, 0.85, 15%

3. exponential decay **5.** exponential growth

7. 

9. 

17.  domain: all real numbers, range: $y < 0$

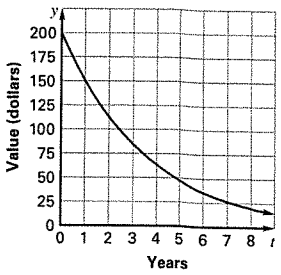
19.  domain: all real numbers, range: $y > -1$

25. a. The graph is a vertical stretch by a factor of $\frac{4}{3}$. **b.** The graph will be steeper because the decay factor is smaller. **c.** The graph moves 5 units to the right instead of 2 units to the right. **d.** The horizontal asymptote moves to $x = 3$.

SELECTED ANSWERS

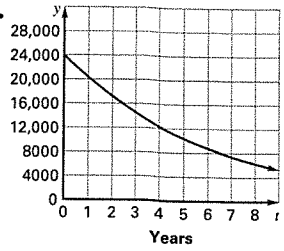
7.2 Problem Solving (pp. 490–491) **31. a.** $y = 200(0.75)^t$; about \$84.38

b.



c. after about 2.5 yr

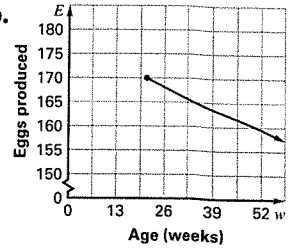
33. a.



after 5 yr **b.** \$5.29; no. *Sample answer:* A car does not normally last 50 years.

35. a. 0.89, 11%

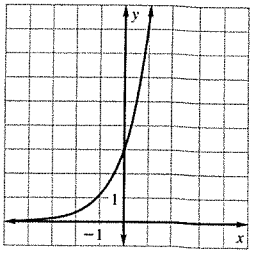
b.



c. about 134 eggs per yr **d.** Change the exponent to just w.

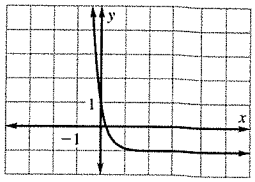
7.3 Skill Practice (pp. 495–496) **1.** e **3.** e^7 **5.** $8e^{9x}$ **7.** $\frac{1}{3e^{5x}}$ **9.** $3e^3$ **11.** $3e^{1-x}$ **13.** $2e^{3x}$ **17.** The 3 should be raised to the second power also; $(3e^{5x})^2 = 3^2e^{(5x)(2)} = 9e^{10x}$. **19.** about 20.086 **21.** about 9.025 **23.** about 0.670 **25.** about 1096.633 **27.** about 1.482 **29.** about −66.139 **31.** exponential decay **33.** exponential decay **35.** exponential decay **37.** exponential growth

43.



domain: all real numbers, range: $y > 0$

45.

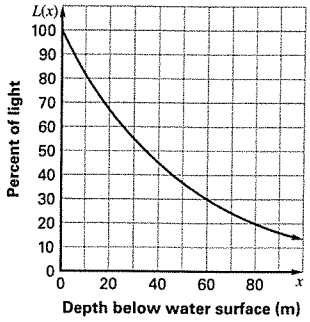


domain: all real numbers, range: $y > -1$

51. 10,000,000,000. *Sample answer:* Since small values of n were increasing the function very slowly, I checked larger intervals. I noticed that every power of 10 gave an answer one digit closer to the actual value of e. **53.** *Sample answer:* $f(x) = \frac{1}{2}e^{-3x}$, $g(x) = \frac{2}{3}e^{-5x}$

7.3 Problem Solving (pp. 497–498) **55.** about 895 million camera phones **57.** \$2442.81

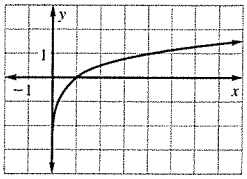
59. a. $L(x) = 100e^{-0.02x}$



b. about 45% **c.** about 35 m **61.** about 1.986 cm^2

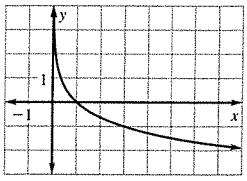
7.4 Skill Practice (pp. 503–504) **1.** common **3.** $4^2 = 16$ **5.** $6^{-2} = \frac{1}{36}$ **7.** *Sample answer:* The −3 and $\frac{1}{8}$ are switched around; $\log_2 \frac{1}{8} = -3$. **9.** 2 **11.** 6 **13.** −3 **15.** $-\frac{1}{2}$ **17.** 3 **19.** 2 **21.** about 1.792 **23.** about 0.793 **25.** about 1.683 **27.** about 4.700 **29.** x **31.** 8 **33.** $4x$ **35.** $5x$ **37.** $y = 8^x$ **39.** $y = \log_{0.4} x$ **41.** $y = \ln x - 2$ **43.** $y = e^x - 1$

45.



domain: $x > 0$, range: all real numbers

47.



domain: $x > 0$, range: all real numbers

7.4 Problem Solving (pp. 504–505) **59.** 2.3 **61. a.** about 6.4 **b.** $E = e^{(M+9.9)/0.29}$; the inverse represents the amount of energy released, in ergs, as a function of the energy magnitude.

7.5 Skill Practice (pp. 510–511) **1.** product **7.** 0.477 **9.** 1.204 **11.** 2.158 **13.** −0.602 **15.** $\log_3 4 + \log_3 x$ **17.** $\log 3 + 4\log x$ **19.** $\log_2 2 - \log_2 5$ **21.** $\log_4 x - \log_4 3 - \log_4 y$ **23.** $\log_7 5 + 3\log_7 x + \log_7 y + 2\log_7 z$ **25.** $2\ln x + \frac{1}{3}\ln y$ **27.** $\frac{1}{2}\log_2 x$ **29.** $\frac{3}{4}\ln x$ **31.** The two parts should be added, not multiplied; $\log_2 5 + \log_2 x$.

SELECTED ANSWERS

33. $\log_4 \frac{7}{10}$ **35.** $\log 11x^2$ **37.** $\log \frac{x^5}{y^4}$ **39.** $\ln 10x$ **41.** $\ln \frac{64}{y^4}$ **45.** about 1.404 **47.** about 2.465 **49.** about 1.631 **51.** about 1.581 **53.** about 1.513 **55.** 1.5 **57.** about 0.875 **59.** about −1.358 **61.** When using the change of base formula, the base goes in the denominator; $\frac{\log 7}{\log 3}$. **63.** 150 decibels

7.5 Problem Solving (pp. 512–513) **69.** about 76 decibels **71.** 10; $L(10I) - L(I) = 10 \log \frac{10I}{I_0} - 10 \log \frac{I}{I_0} =$ $10\left(\log \frac{10I}{I_0} - \log \frac{I}{I_0}\right) = 10\left(\log 10 + \log \frac{I}{I_0} - \log \frac{I}{I_0}\right) =$ $10 \log 10 = 10(1) = 10$ **73. a.** $s = 2 \log_2 f$

b.

f	1.414	2.000	2.828	4.000
s	about 1	2	about 3	4

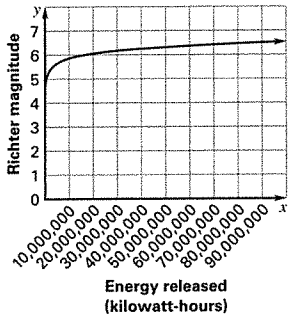
f	5.657	8.000	11.314	16.000
s	about 5	6	about 7	8

Sample answer: The amount of light increases by about 1 each time. **c.** About 22.627; if you set up the equation $9 = 2 \log_2 f$ and solve for f, the result is $2^{9/2}$.

7.6 Skill Practice (pp. 519–520) **1.** exponential **3.** 8 **5.** $\frac{7}{12}$ **7.** $-\frac{5}{7}$ **9.** $-\frac{5}{3}$ **11.** −2 **13.** about −1.609 **15.** about 0.292 **17.** about −0.723 **19.** about 0.650 **21.** about −0.378 **23.** about −0.203 **25.** 6 **27.** no solution **29.** $\frac{31}{15}$ **31.** $\frac{1}{3}$ **33.** e^7 or about 1096.633 **35.** about 35.601 **37.** 4 **39.** about 0.729 **41.** about 2.720 **43.** about 10.243 **45.** The logarithm was not simplified correctly, $x \log_3 6 \neq 2x$; $\log_3 6 \approx 1.631$, $x = 1.585$. **47.** *Sample answer:* $3^x = 81$, $\log_5 (x + 4) = 0$

7.6 Problem Solving (pp. 521–522) **55.** about 24°F **57.** about 6967 yr

59. a.



Japan: about 127,000,000 kilowatt-hours, Greece: about 11,500,000 kilowatt-hours, USA: about 23,500 kilowatt-hours

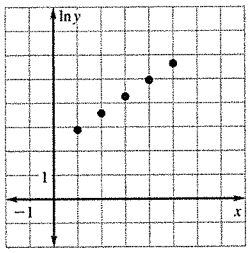
b. Japan: $6.6 = 0.67 \log (0.37E) + 1.46$, 126,893,702 kilowatt-hours; Greece: $5.9 = 0.67 \log (0.37E) + 1.46$, 11,446,269 kilowatt-hours; USA; $4.1 = 0.67 \log (0.37E) + 1.46$, 23,556 kilowatt-hours

7.6 Problem Solving Workshop (p. 525) **1.** about 0.799 **3.** about 2.10 **5.** 0.8 **7.** about 4.48 **9.** 2001 **11.** about 251.19 mm **13.** about 0.03225°C

Extension (p. 527) **1.** $x \leq 2.727$ **3.** $x \leq 1.51$ **5.** $x \leq 6.03$ **7.** $x \geq 27$ **9.** $0 < x \leq 36$ **11.** $0 < x < 32$ **13.** after 5.25 yr

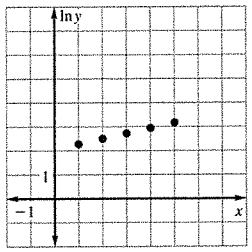
7.7 Skill Practice (pp. 533–534) **1.** exponential **3.** $y = \frac{3}{4} \cdot 4^x$ **5.** $y = \frac{1}{8} \cdot 2^x$ **7.** $y = \frac{2}{5} \cdot 5^x$ **9.** $y = 4.99 \cdot 0.499^x$

11.



$y = 9(2)^x$

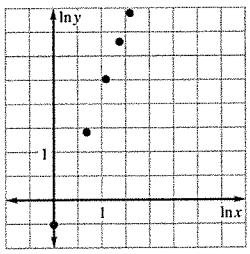
13.



$y = 7.83(1.25)^x$

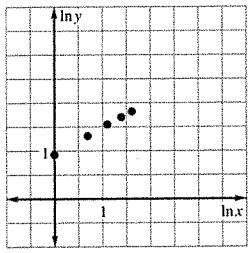
15. $y = 0.12x^{2.32}$ **17.** $y = 1.25x^{1.26}$ **19.** $y = 0.569x^{1.91}$ **21.** $y = 0.241x^{2.34}$

23.



$y = 0.606x^{2.74}$

25.

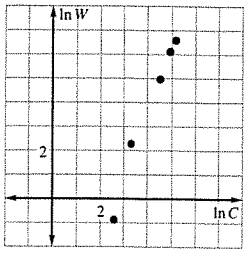


$y = 2.50x^{0.567}$

29. The x should be raised to the 3, not multiplied by it; $\ln y = \ln x^3 - 2$, $y = e^{\ln x^3 - 2}$, $y = e^{\ln x^3} \cdot e^{-2}$, $y = e^{\ln x^3} \cdot e^{-2}$, $y = 0.135x^3$

SELECTED ANSWERS

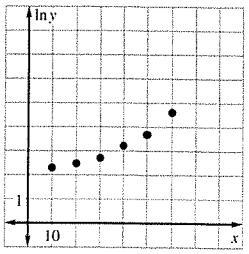
7.7 Problem Solving (pp. 534–536)

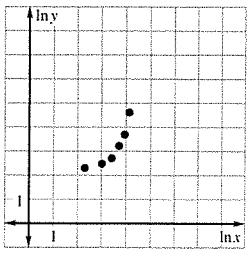
31. a. 

b. $y = 0.000466x^{2.80}$

c. about 64.8 kg

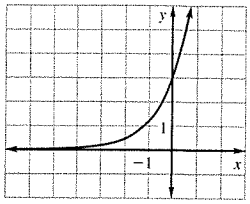
33. a. $y = 0.475(2.08)^x$ **b.** Graph the points (x, y); if they appear linear, then a line is the best fit. If not, graph the points $(x, \ln y)$; if these points appear linear, then an exponential model is the best fit for the data. If not, graph the points $(\ln x, \ln y)$; if these points appear linear, then a power model is the best fit for the data; $y = 33.8x + 2.8$.

35. a. 

b. 

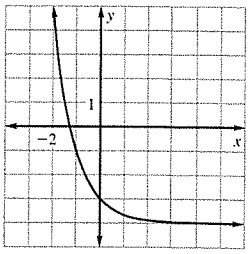
c. Exponential function; the points for $(x, \ln y)$ appear more linear than the points $(\ln x, \ln y)$, so an exponential model appears to be the best fit for the data. **d.** $y = 4.98(1.05)^x$; about 247 cm

Chapter Review (pp. 538–542) **1.** $y = 5$ **3.** *Sample answer:* $\log_b y = x$ if and only if $b^x = y$. **5.** Exponential function. *Sample answer:* The variable is in the exponent.

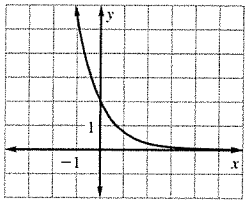
7. 

domain: all real numbers, range: $y > 0$

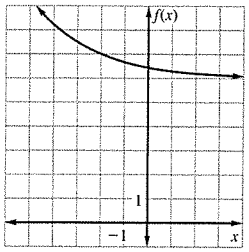
9. \$1725.39

11. 

domain: all real numbers, range: $y > -4$

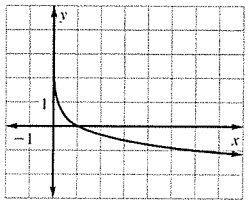
13. 

domain: all real numbers, range: $y > 0$

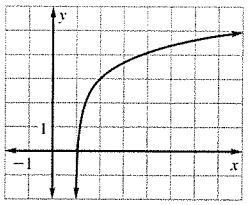
15. 

domain: all real numbers, range: $y > 6$

17. 5 **19.** -3

21. 

domain: $x > 0$, range: all real numbers

23. 

domain: $x > 0$, range: all real numbers

25. $\log_8 3 + \log_8 x + \log_8 y$ **27.** $\log 8 - 4 \log y$ **29.** $\log_7 384$ **31.** $\ln 36$ **33.** 7 **35.** $y = 64\left(\frac{1}{2}\right)^x$ **37.** $y = \frac{1}{4} \cdot 6x$

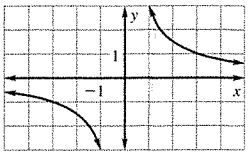
Chapter 8

8.1 Skill Practice (pp. 555–556) **1.** jointly **3.** inverse variation **5.** direct variation **7.** inverse variation **9.** direct variation **13.** $y = \frac{9}{x}$; 3 **15.** $y = \frac{14}{x}$; $\frac{14}{3}$ **17.** $y = \frac{5}{x}$; $\frac{5}{3}$ **19.** $y = \frac{-35}{3x}$; $-\frac{35}{9}$ **21.** direct variation **23.** inverse variation **25.** $z = \frac{1}{4}xy$; -5 **27.** $z = \frac{1}{14}xy$; $\frac{-10}{7}$ **29.** $z = -5xy$; 100 **31.** $x = \frac{ay}{z}$ **33.** $w = \frac{axz}{y}$ **35.** *Sample answer:* $f(x) = 2x$, $g(x) = \frac{2}{x}$

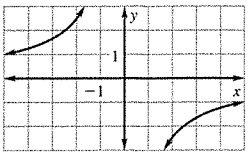
8.1 Problem Solving (pp. 556–557) **37.** $n = \frac{103.68}{s}$; 26 photos **39.** $P = \frac{172}{A}$; about 2.87 lb/in.^{2} **41. a.** $F = \frac{Gm_1m_2}{d^2}$ **b.** 6.7×10^{-11} **c.** It decreases; it increases.

SELECTED ANSWERS

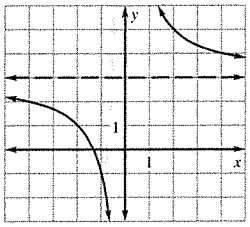
8.2 Skill Practice (pp. 561–562) **1.** range; domain

3. 

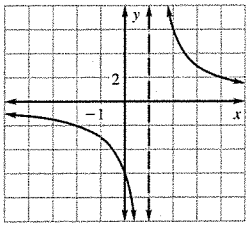
The graph lies farther from the axes than the graph of $y = \frac{1}{x}$. Both graphs lie in the 1st and 3rd quadrants and have the same asymptotes, domain, and range.

5. 

The graph lies farther from the axes than the graph of $y = \frac{1}{x}$ and is located in quadrants 2 and 4. Both graphs have the same asymptotes, domain, and range.

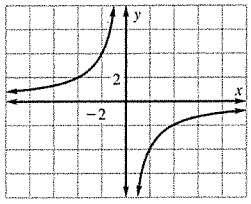
11. 

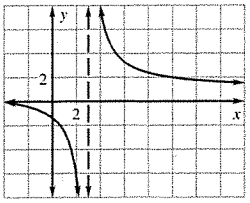
domain: all real numbers except 0, range: all real numbers except 3

13. 

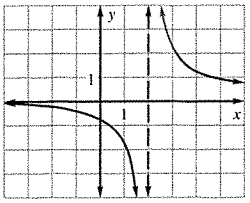
domain: all real numbers except 1, range: all real numbers except 0

25. The graph should be $y = \frac{-8}{x}$ not $y = \frac{8}{x}$.



27. 

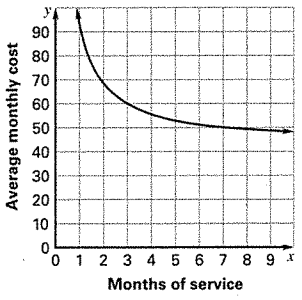
domain: all real numbers except 3, range: all real numbers except 1

29. 

domain: all real numbers except 2, range: all real numbers except $\frac{1}{4}$

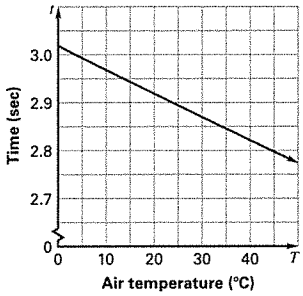
35. *Sample answer:* $y = \frac{3x + 1}{x + 8}$

8.2 Problem Solving (pp. 562–563)

37. $c = \frac{43m + 50}{m}$; 

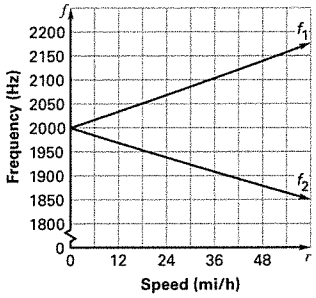
5 mo

39. a. About 14.5 sec. *Sample answer:* Substitute 25 for T to find $t \approx 2.89$. Since you are 5 kilometers away, multiply t by 5 to get $5(2.89) \approx 14.5$ seconds.

b. 

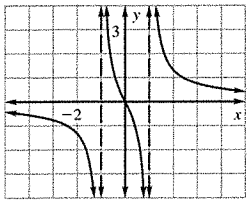
about 3.9°C

41. a. approaching: $f_1 = \frac{1{,}480{,}000}{740 - r}$, moving away: $f_1 = \frac{1{,}480{,}000}{740 + r}$

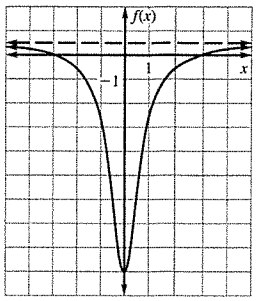
b. 

c. The frequency of a sound that is approaching is greater than that of a sound moving away.

8.3 Skill Practice (pp. 568–569) **1.** horizontal asymptote **3.** C **5.** B **7.** none; $x = 1$ and $x = -1$ **9.** none; $x = 5$ and $x = -3$ **11.** -3; $x = 0$ and $x = -\frac{1}{3}$ **13.** The vertical asymptote occurs at the zeros of the denominator not the numerator; the vertical asymptotes occur at the zeros of the denominator $x^2 - 8x + 7$. So, the vertical asymptotes are at $x = 7$ and $x = 1$.

15. 

SELECTED ANSWERS

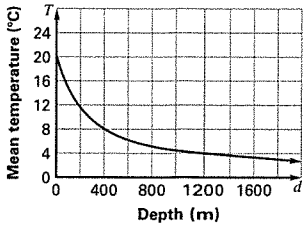
17. 

25. $0 < y \leq 7.5$ **27.** all real numbers except $-0.209 < y < -4.791$

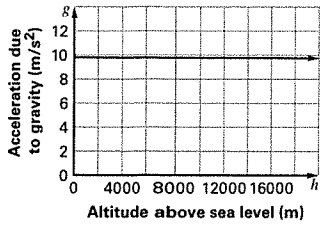
8.3 Problem Solving (pp. 569–571) **31. a.** $\ell = \frac{100}{\pi r^2}$ **b.** $S = 2\pi r^2 + \frac{200}{r}$ **c.** $r \approx 2.515$ ft, $\ell \approx 5.032$ ft

33. a.

Depth (m)	Mean Temperature (°C)
1000	4.763
1050	4.580
1100	4.409
1150	4.251
1200	4.104
1250	3.967
1300	3.839

b. 

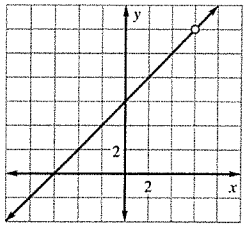
about 1238 m

35. a. 

b. about 9.78 m/sec^2 **c.** about 9.47 m/sec^2 **d.** *Sample answer:* g decreases, but at a very small rate.

8.4 Skill Practice (pp. 577–579) **1.** reciprocal **3.** B **5.** C **7.** simplified form **9.** $\frac{x-3}{x+5}$ **11.** $\frac{2(x-1)}{x-7}$ **13.** $\frac{x-6}{x+6}$ **15.** $\frac{4x-1}{3x+2}$ **17.** $\frac{x^2-3}{x-3}$ **19.** You can only divide out common factors. Since the factors that are divided out are not common factors of the entire numerator and denominator, you cannot divide them out; $\frac{x^2+16x+48}{x^2+8x+16} = \frac{(x+4)(x+12)}{(x+4)(x+4)} = \frac{x+12}{x+4}$ **21.** $\frac{2}{x}$ **23.** Exercise 21. *Sample answer:* The perimeter of Exercise 21 is smaller and the areas are the same.

25. $\frac{8x^4}{y^2}$ **27.** $\frac{2(x+1)}{x}$ **29.** $\frac{x+4}{2(x-5)}$ **31.** $(x+2)(x+7)$ **33.** $\frac{4(x+5)(x+4)}{x}$ **35.** $\frac{4x^4y}{5z}$ **37.** $\frac{16x(x-4)}{(x+4)}$ **39.** $\frac{x-5}{(x+5)^2}$ **41.** $\frac{5(x+1)}{x-1}$ **43.** $\frac{(x+8)(x-7)}{6x}$

45. 

8.4 Problem Solving (pp. 579–580) **49.** $\frac{S}{A} = \frac{(-6420t + 292{,}000)(5.92t^2 - 131t + 1000)}{(6.02t^2 - 125t + 1000)(-407t + 7220)}$; \$50.21 **51. a.** $V_{sphere} = \frac{4}{3}\pi r^3$, $V_{cylinder} = \pi r^2 h$, since the volumes are the same, set the equations equal to each other resulting in $h = \frac{4}{3}r$. **b.** $S_{sphere} = 4\pi r^2$, $S_{cylinder} = \frac{14}{3}\pi r^2$ **c.** $\frac{6}{7}$. *Sample answer:* The spherical tank uses less material.

8.5 Skill Practice (pp. 586–587) **1.** complex fraction **3.** $\frac{5}{x}$ **5.** $\frac{9-2x}{x+1}$ **7.** 5 **9.** $3x(x-2)$ **11.** $2x(x-5)$ **13.** $x(x-5)(x+5)$ **17.** $\frac{32-15x}{12x^2}$ **19.** $\frac{3(x+12)}{(x+8)(x-3)}$ **21.** $\frac{2x^2+3x+9}{(x+1)(x-3)}$ **23.** $\frac{-3(x+16)}{(x-4)^2}$ **25.** You must have a common denominator before you can add values in the numerator; $\frac{x(x-5)+4(x+2)}{(x+2)(x-5)} = \frac{x^2-x+8}{(x-5)(x+2)}$. **27.** $\frac{(2x+3)(x-1)}{(x-3)(x+3)^2}$ **29.** $\frac{8x^3-9x^2-28x+8}{x(x-4)(3x-1)}$ **31.** $\frac{x(x-18)}{6(5x+2)}$ **33.** $\frac{8x(x+1)}{(x-2)(5x+3)}$ **35.** $\frac{3x}{4(x-1)}$ **37.** *Sample answer:* $\frac{\frac{x^2-x-6}{x^2+4x}}{\frac{x+2}{x}}, \frac{\frac{x^2+3x-18}{4}}{\frac{x^2+10x+24}{4}}$

8.5 Problem Solving (pp. 587–588) **41.** $T = \frac{2da}{(a-j)(a+j)}$; about 10.2 h **43. a.** $M = \frac{Pi}{1-\left(\frac{1}{1+i}\right)^{12t}} = \frac{Pi}{1-\frac{1}{(1+i)^{12t}}} = \frac{Pi}{\frac{(1+i)^{12t}-1}{(1+i)^{12t}}} = \frac{Pi(1+i)^{12t}}{(1+i)^{12t}-1}$ **b.** \$364.02

SELECTED ANSWERS

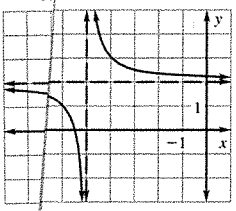
8.6 Skill Practice (pp. 592–593) **1.** cross multiplying **3.** Graph both sides of the equation. If the graphs intersect at a possible solution, then it is a solution. If the graphs do not intersect at a possible solution, then it is an extraneous solution. **5.** 6 **7.** 2 **9.** -1 **11.** no solution **15.** 4 **17.** $-\frac{7}{3}$ **19.** $\frac{-1 \pm \sqrt{79}}{3}$ **21.** 1 **23.** $-\frac{5}{2}$, 8 **25.** 0, 7 **27.** The student simply added numerators and denominators on the left side of the equation. Both sides of the equation should have been multiplied by the LCD, $6x$; $6x\left(\frac{5}{x} + \frac{23}{6}\right) = 6x\left(\frac{45}{x}\right)$, $30 + 23x = 270$. **29.** *Sample answer:* $\frac{6}{x+5} = \frac{2x}{x-1}$; $\frac{4}{x} + \frac{5}{3} = \frac{12}{x}$

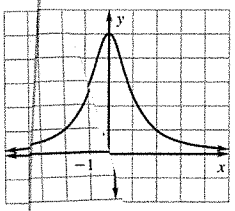
8.6 Problem Solving (pp. 594–595) **33.** 26 serves **35.** 1995 **37.** $\frac{1+\sqrt{5}}{2}$

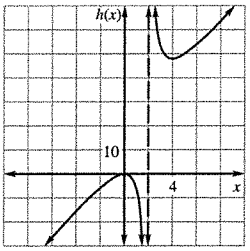
8.6 Problem Solving Workshop (p. 597) **1.** about ± 5.6 **3.** 9 **5.** about ± 3.2 **7. a.** 99 ft **b.** 33 ft

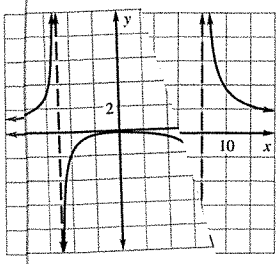
Extension (p. 600) **1.** $x < 2$ **3.** $x < 3$ **5.** $-1.5 < x < 4$ **7.** $x > -5$ **9.** $-1 \le x \le 1$ **11.** $0 < x < 1$ **13.** $x > -2$ **15.** $-4 < x < -3$ or $x > -2$ **17.** $-3 < x < -2$ or $x \ge 2$ **19.** 1999 to 2002 **21.** at least 13 mo

Chapter Review (pp. 603–606) **1.** inverse variation **3.** rational function **5.** cross multiplying **7.** $y = \frac{24}{x} - 8$ **9.** $y = \frac{-8}{x}$; $\frac{8}{3}$

11.  domain: all real numbers except $x = -5$, range: all real numbers except $y = 2$

13. 

15. 

17. 

19. $\frac{16x^3}{y^2}$ **21.** $\frac{3x(4x-1)}{(x-4)(x-3)}$ **23.** $\frac{3x^2+26x+36}{6x(x+3)}$ **25.** $\frac{-2(2x^2+3x+3)}{(x-3)(x+3)(x+1)}$ **27.** 5 **29.** -1 **31.** $-\frac{6}{11}$, 0 **33.** 0 **35.** no solution

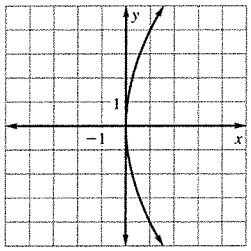
Chapter 9

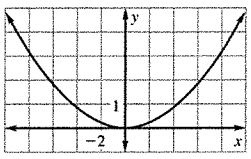
9.1 Skill Practice (pp. 617–618)

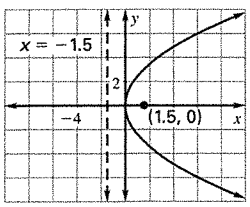
1. The distance d between (x_1, y_1) and (x_2, y_2) is $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$; the midpoint of the line segment joining $A(x_1, y_1)$ and $B(x_2, y_2)$ is $M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$. **3.** 17; $\left(4, \frac{15}{2}\right)$ **5.** $5\sqrt{5}$; $\left(\frac{5}{2}, 1\right)$ **7.** $4\sqrt{2}$; $(4, -3)$ **9.** $12\sqrt{2}$; $(2, 2)$ **11.** $\sqrt{145}$; $\left(\frac{1}{2}, 0\right)$ **13.** $\sqrt{449}$; $\left(5, \frac{9}{2}\right)$ **15.** $2\sqrt{194}$; $(1.2, 2)$ **17.** $\frac{\sqrt{3221}}{10}$ or about 5.68; $(0.35, -6)$ **21.** The difference of the squares should be added not subtracted; $d = \sqrt{(2 - (-4))^2 + (8 - 3)^2} = \sqrt{36 + 25} = \sqrt{61}$. **23.** isosceles **25.** scalene **27.** scalene **29.** scalene **31.** $y = -\frac{2}{3}x + \frac{43}{3}$ **33.** $y = -\frac{1}{4}x - \frac{5}{2}$ **35.** $y = -4x + \frac{17}{2}$ **37.** *Sample answer:* $(6, 4)$, $(2, 0)$ **39.** $y = -\frac{5}{4}x + \frac{55}{4}$ **41.** ± 6 **43.** -10, 2 **45.** $d(x) = \sqrt{5x^2 - 16x + 13}$; $\left(\frac{1}{5}, \frac{2}{5}\right)$, $(3, 6)$

9.1 Problem Solving (pp. 618–619) **47.** 17 m **49.** about 6.02 mi **51.** about 4.55 mi **53. a.** $(-1.5, 8)$ **b.** about 1.32 mi **c.** about 1.68 mi **55.** about 550 ft

9.2 Skill Practice (pp. 623–624) **1.** focus, directrix

3.  $(4, 0)$, $x = -4$, $y = 0$

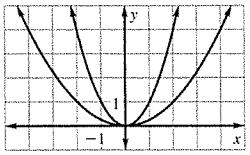
5.  $(0, 5)$, $y = -5$, $x = 0$

23. The parabola should open to the right rather than up; 

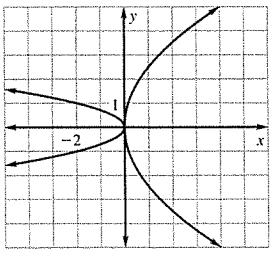
SELECTED ANSWERS

27. $y^2 = -20x$ **29.** $x^2 = -16y$ **31.** $x^2 = -40y$
33. $y^2 = -36x$ **35.** $x^2 = -\frac{3}{2}y$ **37.** $y^2 = -\frac{9}{4}x$
39. $y^2 = -12x$ **41.** $y^2 = 20x$ **43.** $x^2 = 16y$
45. $x^2 = -24y$ **47.** $y^2 = 6x$ **49.** $x^2 = \frac{22}{3}y$

51. a. The new focus will be located at (0, 1) rather than $\left(0, \frac{1}{4}\right)$. The new directrix will be $y = -1$ rather than $y = -\frac{1}{4}$. The parabola will be wider.

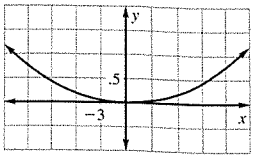


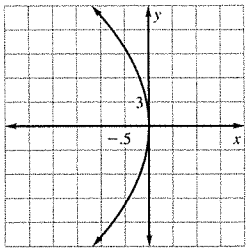
b. The new focus will be located at $\left(-\frac{1}{8}, 0\right)$ rather than $\left(\frac{3}{2}, 0\right)$. The new directrix will be at $x = \frac{1}{8}$ rather than $x = -\frac{3}{2}$. The parabola will open left rather than right and be narrower.



53. The graph gets wider. *Sample answer:* As the value of $|p|$ increases, then the focus and directrix (each of which lie $|p|$ units from the vertex) get further and further away from the vertex and from each other. Since each point on a parabola is equidistant from the focus and the directrix, this has the effect of making the parabola wider and wider as $|p|$ increases.

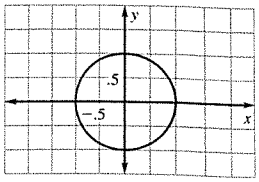
9.2 Problem Solving (pp. 624–625)
55. $x^2 = 24y$; about 3 ft
57. a.



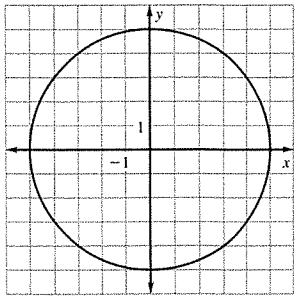


b. $x^2 = 192y$, $y^2 = -192x$ **c.** About 27.8 in.; no. *Sample answer:* Except for the direction they open, they are identical. **59. a.** about 20 in. **b.** *Sample answer:* $x^2 = 50y$; choose a value for p such that $4p > 10.5$; about 43.6 in. **c.** *Sample answer:* $x^2 = 8y$; choose a value for p such that $4p < 10.5$; about 17.4 in.

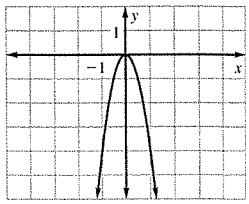
9.3 Skill Practice (pp. 629–630) **1.** center **3.** C **5.** A **7.** F
9.



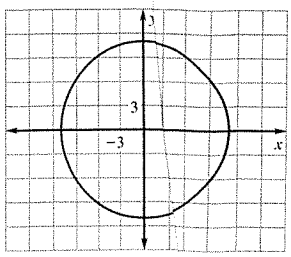
11.



5
23. $x^2 + y^2 = 64$ **25.** $x^2 + y^2 = 256$ **27.** $x^2 + y^2 = 15$
29. $x^2 + y^2 = 96$ **31.** $x^2 + y^2 = 36$ **33.** $x^2 + y^2 = 25$
35. $x^2 + y^2 = 100$ **37.** $x^2 + y^2 = 116$ **39.** $x^2 + y^2 = 260$
41. $x^2 + y^2 = 242$
45.



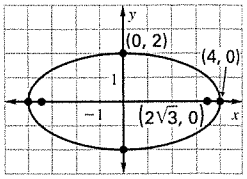
47.



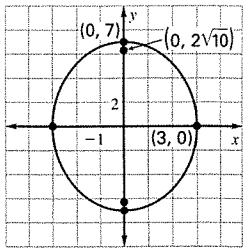
53. $y = -\frac{1}{4}x + \frac{17}{4}$ **55.** $y = \frac{5}{3}x + \frac{34}{3}$ **57.** $y = \frac{5}{9}x + \frac{106}{9}$
59. *Sample answer:* $x^2 + y^2 = 35$, $x^2 + y^2 = 36$, $x^2 + y^2 = 38$

9.3 Problem Solving (pp. 630–632) **63.** yes **65. a.** about 28.9 mi **b.** about 18.3 mi **c.** 6 mi **67.** about 794 ft

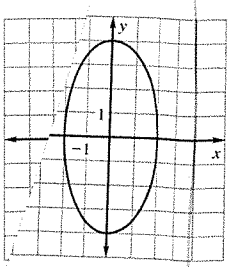
9.4 Skill Practice (pp. 637–638) **1.** foci
3.



$(\pm 4, 0)$, $(0, \pm 2)$, $(\pm 2\sqrt{3}, 0)$
5.

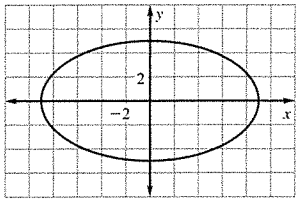


$(0, \pm 7)$, $(\pm 3, 0)$, $(0, \pm 2\sqrt{10})$
15. The major axis should be the y-axis, not the x-axis.

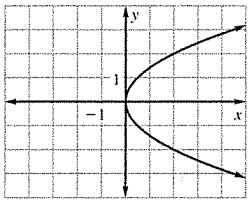


17. $\frac{x^2}{25}+\frac{y^2}{9}=1$ **19.** $\frac{x^2}{196}+\frac{y^2}{81}=1$ **21.** $\frac{x^2}{121}+\frac{y^2}{144}=1$
23. $\frac{x^2}{28}+\frac{y^2}{64}=1$ **25.** $\frac{x^2}{49}+\frac{y^2}{81}=1$ **27.** $\frac{x^2}{4}+\frac{y^2}{16}=1$
29. $\frac{x^2}{16}+\frac{y^2}{7}=1$ **31.** $\frac{x^2}{400}+\frac{y^2}{175}=1$ **33.** $\frac{x^2}{60}+\frac{y^2}{256}=1$

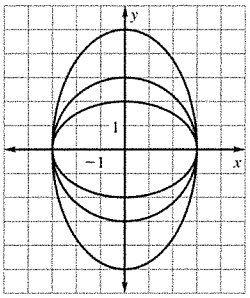
37.



39.



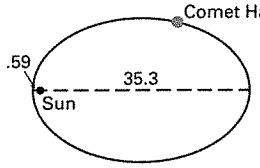
45. The conic changes from an ellipse elongated along the y-axis to a circle to an ellipse elongated along the x-axis.



9.4 Problem Solving (pp. 638–639)

49. $\frac{x^2}{(77.5)^2}+\frac{y^2}{(92.5)^2}=1, \frac{x^2}{(55)^2}+\frac{y^2}{(67.5)^2}=1$; about $11{,}700 \le A \le 22{,}500$

51.



Sample answer: $\frac{x^2}{21.1}+\frac{y^2}{320.4}$

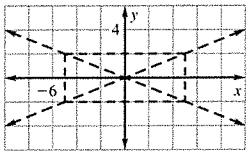
9.4 Problem Solving Workshop (p. 640) **1.** About 66,100 m^2; better. *Sample answer:* More rectangles means there is less area of the ellipse not included.

3. a. $\frac{x^2}{125^2}+\frac{y^2}{100^2}=1$ **b.** about 39,000 m^2

9.5 Skill Practice (pp. 645–646)

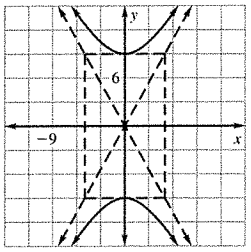
1. vertices, transverse axis

3.



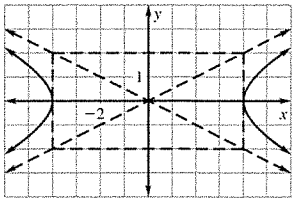
$(\pm 5, 0), (\pm\sqrt{29}, 0)$, $y = \pm\frac{2}{5}x$

5.



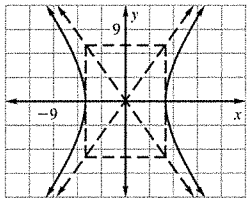
$(0, \pm 9), (0, \pm\sqrt{106})$, $y = \pm\frac{9}{5}x$

17. The equation of a hyperbola must equal one, so the hyperbola's vertices should be located at $(\pm 4, 0)$.

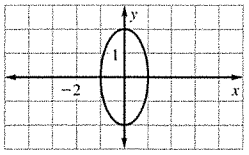


19. $\frac{x^2}{4}-\frac{y^2}{32}=1$ **21.** $\frac{y^2}{49}-\frac{x^2}{95}=1$ **23.** $\frac{y^2}{16}-\frac{x^2}{64}=1$
25. $\frac{x^2}{4}-\frac{y^2}{50}=1$

27.



29.



33. a. The hyperbola will be narrower, the vertices are the same, but the foci move to $(\pm\sqrt{13}, 0)$. **b.** The hyperbola will be wider, the vertices are the same, but the foci move to $(0, \pm\sqrt{41})$. **35.** *Sample answer:* $x^2-\frac{y^2}{4}=1, \frac{x^2}{4}-\frac{y^2}{16}=1, \frac{x^2}{9}-\frac{y^2}{36}=1$; as the value of a gets larger the hyperbola is stretched vertically.

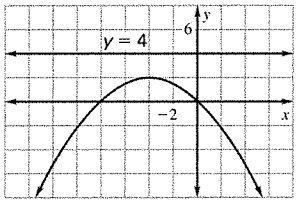
9.5 Problem Solving (pp. 646–647) **39.** $\frac{y^2}{\frac{1}{2}}-\frac{x^2}{\frac{1}{4}}=1$

41. a. (30.5, 0), (85, −40) **b.** $\frac{x^2}{930.25}-\frac{y^2}{236.45}=1$

c. about 54.6 ft **43. a.** $\frac{x^2}{16}-\frac{y^2}{20}=1$ **b.** *Sample answer:* Choose any point on the graph and observe that the difference of the distances from that point and the foci remain constant.

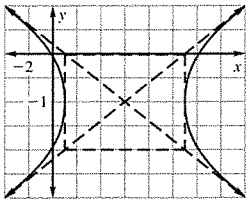
9.6 Skill Practice (pp. 655–656) **1.** The intersection of a plane and a double-napped cone form them.

3.



parabola with vertex $(-4, 2)$, focus $(-4, 0)$, and directrix $y = 4$

5.



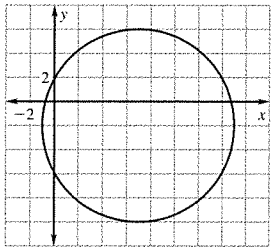
hyperbola with center $(6, -1)$, vertices $(11, -1)$ and $(1, -1)$, asymptotes $y = \frac{1}{5}x - \frac{11}{5}$ and $y = -\frac{1}{5}x + \frac{1}{5}$

13. $(x+5)^2+(y-1)^2=36$ **15.** $(y+3)^2=20(x+4)$
17. $\frac{(x-1)^2}{16}+\frac{(y-4)^2}{12}=1$ **19.** $\frac{(y+1)^2}{4}-\frac{(x-6)^2}{21}=1$

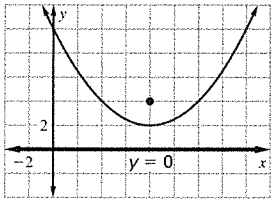
SELECTED ANSWERS

21. The center is at $(-2, 3)$, not $(2, -3)$; $\frac{(x+2)^2}{25} + \frac{(y-3)^2}{9} = 1$. **23.** $y = 4$ **25.** $x = 3, y = 5$ **27.** any line passing through the point $(-2, -1)$ **29.** circle **31.** ellipse **33.** parabola **35.** hyperbola

37. circle, $(x-7)^2 + (y+2)^2 = 64$



39. parabola, $(x-8)^2 = 8(y-2)$



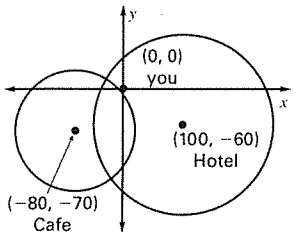
45. If the non-zero coefficients of x^2 and y^2 are the same it's a circle. If the non-zero coefficients of x^2 and y^2 are both positive and different it's an ellipse. If one of the non-zero coefficients of x^2 or y^2 is negative and the other one is positive it's a hyperbola. If one of the coefficients of x^2 or y^2 is zero it's a parabola.

9.6 Problem Solving (pp. 656–657)

49. $(x-5)^2 = -4\left(y - \frac{25}{4}\right)$; $6\frac{1}{4}$ ft, 10 ft

51. a. $(x-100)^2 + (y+60)^2 \le 150^2$, $(x+80)^2 + (y+70)^2 \le 100^2$

b.



One; the distance from your position to the hotel is less than the radius of the hotel's transmitter, but you are about 106 feet from the café's transmitter which is out of range.

c. *Sample answer:* Find the distance from the hotel to the cafe. If it's greater than 250 yards they do not overlap. It it's less than or equal to 250 yards they overlap.

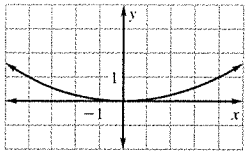
9.7 Skill Practice (pp. 661–662) **1.** quadratic **3.** $(-4, -4), (4, 4)$ **5.** $(0.472, -2.58), (3.53, 6.58)$ **7.** $(-2.18, -3.36), (1.38, 3.76)$ **9.** $(3, -3), (-2, 2)$ **11.** $\left(\frac{-64-2\sqrt{106}}{17}, \frac{8-4\sqrt{106}}{17}\right), \left(\frac{-64+2\sqrt{106}}{17}, \frac{4+2\sqrt{106}}{17}\right)$ **13.** $(0, 2), \left(\frac{4}{3}, \frac{2}{3}\right)$ **15.** $(-1, -4), \left(-\frac{13}{2}, 7\right)$ **17.** no solution **19.** $\left(\frac{7+3\sqrt{3}}{11}, \frac{-1+9\sqrt{3}}{11}\right), \left(\frac{7-3\sqrt{3}}{11}, \frac{-1-9\sqrt{3}}{11}\right)$ **23.** $(0, \pm\sqrt{5}), (-5, 0)$ **25.** $\left(\frac{1}{2}, \frac{1}{2}\right)$ **27.** no solution **29.** no solution **31.** $(4, 0)$ **33.** $(-1, -2), (2, 1)$ **35.** When $(1-y^2)^2$ was expanded, the last term should have been y^4; $1 - 2y^2 + y^4 + y^2 - 2 + 2y^2 - 2y = -1$, $y^4 + y^2 - 2y = 0$. **37.** about $(-2.32, -2.02)$, $(-0.296, -2.82)$

9.7 Problem Solving (pp. 662–664) **39.** $d = 0.8t$, $d = 2.5t^2$, 0.32 min **41. a.** $x^2 + y^2 = 1$, $y = -\frac{1}{7}x + \frac{5}{7}$ **b.** $\left(-\frac{3}{5}, \frac{4}{5}\right), \left(\frac{4}{5}, \frac{3}{5}\right)$ **c.** about 1.41 mi **43. a.** $(1, 1)$ **b.** about $(-8.94, -2.68)$

9.7 Extension (p. 666) **1.** 0 **3.** $\frac{\sqrt{15}}{8} \approx 0.484$ **5.** 1 **7.** $\frac{x^2}{36} + \frac{25(y-4)^2}{756} = 1$ **9.** $\frac{x^2}{49} + \frac{25(y-5)^2}{1176} = 1$ **11.** $\frac{(x-4)^2}{9} - \frac{25(y+4)^2}{504} = 1$ **13.** *Sample answer:* $\frac{x^2}{30.25} + \frac{y^2}{13.19} = 1$ **15.** In the ellipse $0 < c < a$, therefore $0 < \frac{c}{a} < 1$. In the hyperbola $0 < a < c$, therefore $\frac{c}{a} > 1$.

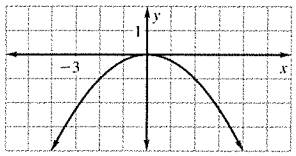
Chapter Review (pp. 669–672) **1.** parabola **3.** transverse axis **5.** $2\sqrt{17}$; $(-2, -4)$ **7.** $\sqrt{106}$; $\left(-\frac{1}{2}, \frac{1}{2}\right)$

9.



$(0, 4)$, $y = -4$, $x = 0$

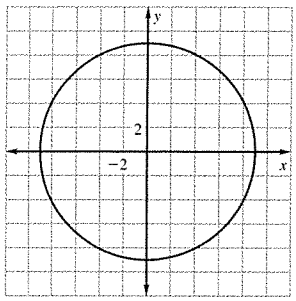
11.



$(0, -1)$, $y = 1$, $x = 0$

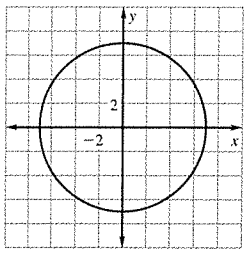
13. $x^2 = 12y$

15.



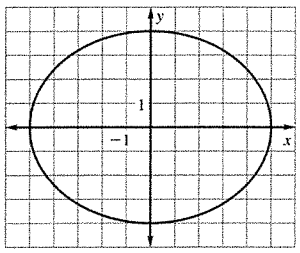
9

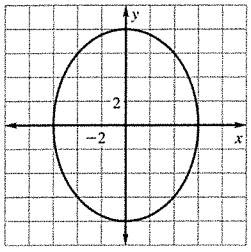
17.



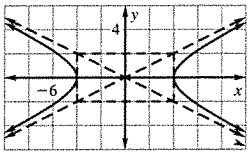
7

19. $x^2 + y^2 = 68$

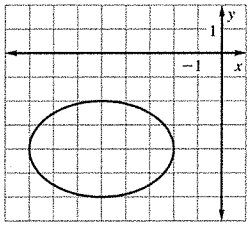
21.  $(\pm 5, 0), (0, \pm 4), (\pm 3, 0)$

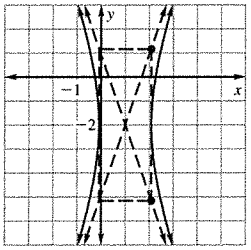
23.  $(0, \pm 8), (\pm 6, 0), \left(0, \pm 2\sqrt{7}\right)$

25. $\frac{y^2}{64} + \frac{x^2}{39} = 1$

27.  $(\pm 4, 0), \left(\pm 2\sqrt{5}, 0\right)$, $y = \pm\frac{1}{2}x$

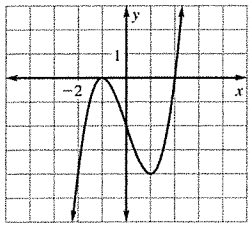
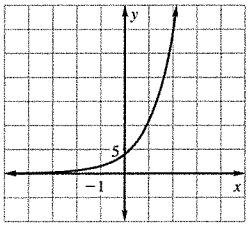
29. $\frac{y^2}{4} - \frac{x^2}{21} = 1$

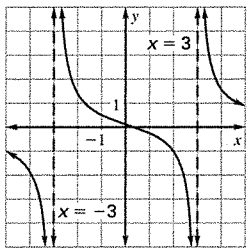
31. ellipse, $\frac{(x+5)^2}{9} + \frac{(y+4)^2}{4} = 1$ 

33. hyperbola, $\frac{(x-1)^2}{\frac{10}{9}} - \frac{(y+2)^2}{10} = 1$ 

35. (16, 8), (1, 2) **37.** (2, 0)

Cumulative Review (pp. 678–679) **1.** $-\frac{13}{7}$ **3.** 5, 7 **5.** −2, −5, 4 **7.** $\frac{3}{2}$ **9.** 7

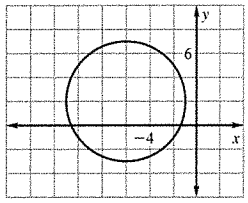
11.  **13.** 

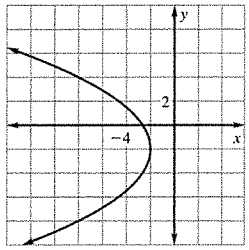
15. 

17. $(3x - 4)(2x + 5)$ **19.** $f^{-1}(x) = \frac{x+1}{6}$

21. $f^{-1}(x) = x^{1/5}$ **23.** decay **25.** $\ln\frac{x^3}{5}$ **27.** $\log\frac{x^5y}{z^3}$

29. $y = \frac{-75}{x}$ **31.** $\frac{3}{x+5}$ **33.** $\frac{x^2+2x+41}{x^2+3x-10}$ **35.** $\sqrt{29}; \left(\frac{11}{2}, 6\right)$

37. circle, $(x + 6)^2 + (y - 2)^2 = 25$; 

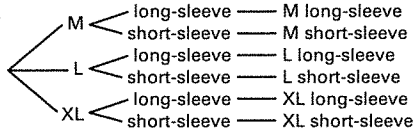
39. parabola, $(y + 2)^2 = -6(x + 2)$; 

41. 115 ft, 75 ft **43.** 400 adults, 250 students
45. about 7 mi^2 **47.** $0.85(t - 50)$, \$365.50
49. $s = 348(1.02)^t$

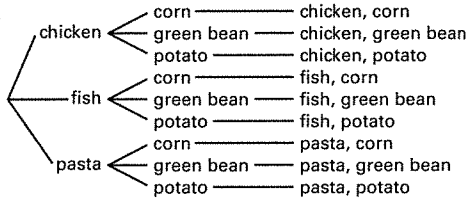
Chapter 10

10.1 Skill Practice (pp. 686–687) **1.** The number of ways n objects can be ordered.

3.



5.



7. 8 ways **9.** 60 ways **11.** a. 456,976,000 license plates **b.** 258,336,000 license plates
13. a. 45,697,600 license plates **b.** 32,292,000 license plates **15. a.** 118,813,760 license plates
b. 78,936,000 license plates **19.** 39,916,800 **21.** 40,320
23. 1 **25.** 720 **27.** 72 **29.** 630 **31.** 30 **33.** 40,320

SELECTED ANSWERS

35. 72 **37.** 5040 **39.** 3024 **41.** 1 **43.** 3 **45.** 60 **47.** 720 **49.** 3360 **51.** 40,320 **53.** 90,720 **59.** 10

10.1 Problem Solving (pp. 688–689)
63. 225,678,960 sets **65.** 504 ways **67. a.** 240 selections **b.** 252 selections **c.** 60,480 selections **69.** 70,560 displays

10.2 Skill Practice (pp. 694–695) **1.** nth row of Pascal's triangle **3.** 10 **5.** 84 **7.** 1 **9.** 21 **11.** The denominator should have been multiplied by 2!; $\frac{6!}{(6-2)! \cdot 2!} = \frac{720}{48} = 15$. **13.** 792 hands **15.** 778,320 hands **17.** 2,490,624 hands

19.

1 6 15 20 15 6 1
1 7 21 35 35 21 7 1
1 8 28 56 70 56 28 8 1
1 9 36 84 126 126 84 36 9 1
1 10 45 120 210 252 210 120 45 10 1

21. $y^{10} - 30y^9z + 405y^8z^2 - 3240y^7z^3 + 17{,}010y^6z^4 - 61{,}236y^5z^5 + 153{,}090y^4z^6 - 262{,}440y^3z^7 + 295{,}245y^2z^8 - 196{,}830yz^9 + 59{,}049z^{10}$ **23.** $128s^7 - 448s^6t^4 + 672s^5t^8 - 560s^4t^{12} + 280s^3t^{16} - 84s^2t^{20} + 14st^{24} - t^{28}$ **25.** $c^5 - 20c^4 + 160c^3 - 640c^2 + 1280c - 1024$ **27.** $4096p^6 - 6144p^5q + 3840p^4q^2 - 1280p^3q^3 + 240p^2q^4 - 24pq^5 + q^6$ **29.** $32s^{20} + 400s^{16} + 2000s^{12} + 5000s^8 + 6250s^4 + 3125$ **31.** $x^{12} - 4x^9y^2 + 6x^6y^4 - 4x^3y^6 + y^8$ **33.** 1080 **37.** The sum along each diagonal segment is equal to the sum of the two previous diagonal segment sums. **39.** combinations; 13,836,130,056 ways **41.** $1 = {}_nC_n = \frac{n!}{(n-n)! \cdot n!} = \frac{n!}{0! \cdot n!} = \frac{1}{0!}$, so 0! must equal 1.

10.2 Problem Solving (pp. 696–697)
49. 816 combinations **51. a.** 15,504 combinations **b.** 3,003 combinations **c.** 252 combinations; 10 combinations; 3 combinations **d.** 351,982,350,720 ways

10.3 Skill Practice (pp. 701–703) **1.** geometric **3.** $\frac{1}{2}$ **5.** $\frac{7}{50}$ **7.** $\frac{1}{5}$ **9.** $\frac{41}{50}$ **11.** $\frac{1}{52}$ **13.** $\frac{1}{4}$ **15.** $\frac{12}{13}$ **17.** $\frac{1}{12{,}271{,}512}$ **21.** $\frac{3}{11}$ **23.** $\frac{9}{5}$ **25.** The fraction should be outcomes not in the event, 4, to outcomes in the event, 2; $\frac{4}{2} = \frac{2}{1}$. **27.** $\frac{3}{7}$. *Sample answer:* Since the probability is 0.3, there are 3 out of 10 chances of the event occurring. The number of outcomes against event A is $10 - 3 = 7$. So the odds in favor of event A is the ratio of the number of favorable outcomes, 3, to the number of unfavorable outcomes, 7.

29. $\frac{13}{25}$; the experimental probability is slightly greater than the theoretical probability of $\frac{1}{2}$. **31.** $\frac{22}{25}$; the experimental probability is slightly greater than the theoretical probability of $\frac{5}{6}$. **33.** $\frac{11}{20}$

10.3 Problem Solving (pp. 703–704) **35.** $\frac{1}{2}$ **37.** $1 - \frac{\pi}{4}$ or about 0.215 **39.** $\frac{1}{25}$ **41. a.** $\frac{367}{1631}$ **b.** $\frac{110}{233}$ **c.** $\frac{53}{1631}$

10.4 Skill Practice (pp. 710–711) **1.** compound event **3.** 0.4 **5.** 0.65 **7.** $\frac{7}{12}$ **9.** 0.65 **11.** 0.21 **13.** $\frac{5}{7}$ **17.** 1 **19.** $\frac{3}{8}$ **21.** $\frac{4}{13}$ **23.** $\frac{2}{13}$ **25.** $\frac{3}{4}$ **27.** The probability of a club and 9 must be subtracted instead of added; $P(\text{club}) + P(9) - P(\text{club and } 9) = \frac{13}{52} + \frac{4}{52} - \frac{1}{52} = \frac{4}{13}$. **29.** 0.67; not disjoint **31.** $\frac{1}{5}$; not disjoint **33.** 24%; not disjoint **35.** $\frac{5}{36}$ **37.** $\frac{5}{6}$

10.4 Problem Solving (pp. 711–713) **43.** 0.7 **45.** about 0.8488 **47. a.** 58% **b.** 53% **c.** No; what percent of the tomatoes have bite marks. **49.** $\frac{17}{20}$

Extension (p. 716) **1.** {1, 2, 3, 4, 5, 7, 9, 11, 13, 16, 17} **3.** {1, 4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 19, 20} **5.** {1, 2, 3, 4, 5, 7, 8, 9, 11, 13, 14, 16, 17, 20} **7.** {3, 6, 7, 10, 12, 13, 15, 18, 19} **9.** no **11.** yes **13.** April, June, September, October, November, December **15.** January, February, March, April, May, June, July, August **17.** Yes; no; an irrational is a real number but is not an integer.

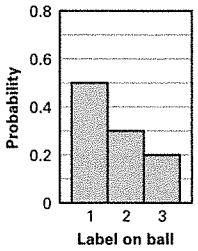
10.5 Skill Practice (pp. 721–722) **1.** conditional probability **3.** 0.24 **5.** 0.8 **7.** 0.75 **9.** about 0.047 **11.** about 0.059 **13.** about 0.015 **17.** 0.35 **19.** 0.75 **21.** 0.9 **23.** $\frac{1}{7}$ **25.** $\frac{7}{8}$ **27. a.** $\frac{1}{169}$ **b.** $\frac{4}{663}$ **29. a.** $\frac{1}{169}$ **b.** $\frac{4}{663}$ **31. a.** $\frac{1}{64}$ **b.** $\frac{13}{850}$ **33.** The probabilities should be multiplied instead of added; $P(A \text{ and } B) = 0.4 \cdot 0.5 = 0.2$. **35.** Since A and B are independent events, $P(A)$ has no affect on $P(B \mid A)$ so $P(B \mid A) = P(B)$.

10.5 Problem Solving (pp. 722–723) **37.** about 81% **39.** 51% **41. a.** 0%; about 2%; about 98% **b.** about 20%, about 30%, about 50% **c.** Yes; go for 2 points after the first touchdown. If the 2 points are scored, go for 1 point after the second touchdown. If the two points are not scored, go for 2 points after the second touchdown; win: about 45%, lose: about 30%.

10.6 Skill Practice (pp. 727–729) **1.** symmetric

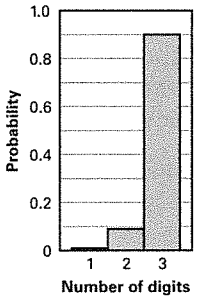
3.

x (value)	1	2	3
$P(x)$	$\frac{1}{2}$	$\frac{3}{10}$	$\frac{1}{5}$



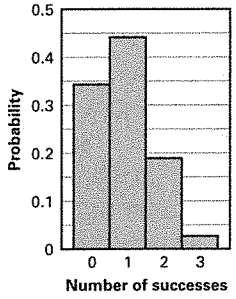
5.

x (value)	1	2	3
$P(x)$	$\frac{1}{100}$	$\frac{9}{100}$	$\frac{9}{10}$



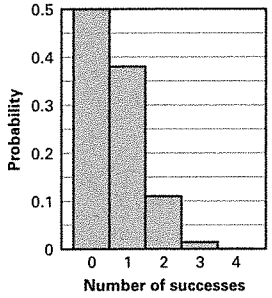
7. 3 **11.** about 0.00018 **13.** about 0.037 **15.** about 0.120 **17.** about 0.00018 **19.** about 0.0086 **21.** about 0.055 **23.** about 0.00000024 **25.** about 0.00000000000000000087 **27.** The ${}_5C_3$ was left out of the equation; ${}_5C_3\left(\frac{1}{6}\right)^3\left(\frac{5}{6}\right)^{5-3} \approx 0.03$. **29.** about 0.594 **31.** about 0.852

33.



skewed; 1 success

35.



skewed; 0 successes

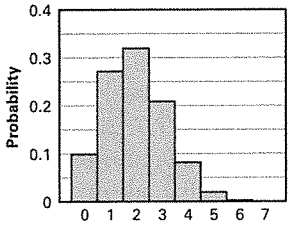
41. ${}_nC_k$; since order does not matter, find the combination of n things taken k at a time.

10.6 Problem Solving (pp. 729–730) **43.** about 0.196 **45. a.** about 0.143 **b.** about 0.276 **c.** about 0.124 **d.** about 0.999

47. a. $P(0)$ = about 0.099, $P(1)$ = about 0.271, $P(2)$ = about 0.319, $P(3)$ = 0.208, $P(4)$ = about 0.081, $P(5)$ = about 0.019, $P(6)$ = about 0.0025, $P(7)$ = about 0.00014

b.

x	$P(x)$
0	0.099
1	0.271
2	0.319
3	0.208
4	0.081
5	0.019
6	0.0025
7	0.00014



Chapter Review (pp. 734–736) **1.** combination **3.** No; there are more than two outcomes for each card selection. **5.** 479,001,600 ways; 11,880 ways **7.** 120 **9.** 90 **11.** $16a^4 + 32a^3b^2 + 24a^2b^4 + 8ab^6 + b^8$ **13.** $r^{15} - 20r^{12}s + 160r^9s^2 - 640r^6s^3 + 1280r^3s^4 - 1024s^5$ **15.** $\frac{1}{2}$ **17.** $\frac{11}{30}$ **19.** 0.868 **21.** 0.68 **23. a.** $\frac{5}{32}$ **b.** $\frac{1}{6}$ **25. a.** $\frac{1}{4}$ **b.** $\frac{7}{30}$ **27.** about 0.273 **29.** about 0.0039

Chapter 11

11.1 Skill Practice (pp. 747–748) **1.** central tendency; dispersion **3.** about 5.3; 5; 4, 5 and 6 **5.** 74.5, 73.5, 73 and 78 **9.** The numbers need to be written in increasing order prior to choosing the median; 9. **11.** 5, about 1.6 **13.** 4.7, about 1.7 **15.** 23, about 8.1 **17.** 68; about 10.7, 4, 4, 66, about 20.3; 3.5, 3.5, 4, 4, about 1.2 **19.** 0.7; 10, 11.6, 11.6, 12.1, about 4.2; about 11.9, 11.6, 11.6, 1.9, about 0.67 **21.** 152; 78.8, 71.5, 66, 92, about 25.1; about 70.7, 71, 66, 20, about 6.0 **23.** *Sample answer:* 8, 8, 8, 8, 11, 11, 12, 12, 12

11.1 Problem Solving (pp. 748–749) **27.** about 17.8, 20, 6 and 20 **29. a.** 5 **b.** 20.2, 22, 23, 20, about 5.4; about 21.9, 23, 23, 6, about 2.1 **c.** *Sample answer:* The mean and the median increase when the outlier is removed and the range and standard deviation decrease.

11.2 Skill Practice (p. 753) **1.** transformation **3.** 18, 17, 17, 9, about 3.0; 24, 23, 23, 9, about 3.0 **5.** 78, 77, 77, 9, about 2.8; 95, 94, 94, 9, about 2.8 **7.** 56, 53, 53, 21, about 7.0; 35, 32, 32, 21, about 7.0 **9.** The standard deviation does not change when adding a constant; 10. **11.** about 61.9, 62, 58, 9, about 3.36; about 248, 248, 232, 36, about 13.4 **13.** about 98.2, 100.5, 102, 19, about 6.62; about 245.5, about 251.3, 255, 47.5, about 16.6

15. about 229, 226.5, 222, 38, about 12.0; about 206.1, about 203.9, 199.8, 34.2, about 10.8

11.2 Problem Solving (pp. 753–755) **19. a.** about 70.8, 72, 72, 8, about 2.4 **b.** about 98.8, 100, 100, 8, about 2.4 **21. a.** about 6.84, 6.89, no mode, 1.16, about 0.324 **b.** about 22.4, about 22.6, no mode, about 3.80, about 1.06 **23. a.** 75.8, about 75.4, 74.5, 9.9, about 3.0 **b.** about 23.6, about 27.7, 22.5, 23.0, about 25.8, about 22.6, about 24.9, about 23.6, about 25.3, about 22.2, about 26.2, about 24.6 **c.** about 24.3, 24.1, 23.6, 5.5, about 1.6 **d.** The effect is a multiplication transformation with a factor of $\frac{5}{9}$, along with an addition transformation of about -17.8 for the mean, median, and mode.

11.3 Skill Practice (pp. 760–761) **1.** normal curve **3.** 0.16 **5.** 0.84 **7.** 0.68 **9.** 16% **11.** 0.68 **13.** 0.9735 **15.** 0.84 **19.** 0.7257 **21.** 0.0035 **23.** 0.5 **25.** 0.0548 **27.** 0.5363 **29.** The table was interpreted incorrectly; $P(z \geq -0.8) = 1 - 0.2119 = 0.7881$.

11.3 Problem Solving (pp. 761–762) **31.** 0.16 **33. a.** -2.4, 1.6 **b.** 0.0082 **c.** 0.937; $P(z \leq 1.6) - P(z \leq -2.4)$ **35. a.** 2.4 **b.** 1.2 **c.** Lisa; in a standard normal distribution Lisa's score is higher.

Extension (p. 765) **1.** 9.6, 2.4 **3.** 13.8, about 3.1 **5.** 25.2, about 2.7 **7.** 8.8, about 2.8 **9.** 105, about 5.1 **11.** about 0.93 **13.** about 0.0013 **15.** about 0.98 **17.** about 0.9987 **19.** Yes; $P(x \leq 56) \approx 0.01$, which is less than 0.05. **21.** Yes; $P(x \geq 12) \approx 1 - P(z \leq 2.5) \approx 1 - 0.9938 = 0.0062$, which is less than 0.05.

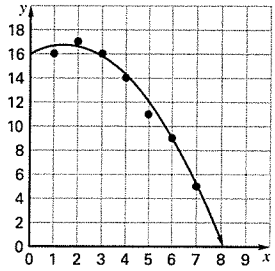
11.4 Skill Practice (pp. 769–770) **1.** random **3.** Systematic; unbiased; the sample is representative of the customers. **5.** Random; unbiased; each student has an equal change of being selected. **7.** $\pm 3.2\%$ **9.** $\pm 1.3\%$ **11.** $\pm 4.4\%$ **13.** $\pm 1.0\%$ **15.** 1111 people **17.** 100 people **19.** 319 people **21.** 237 people **25.** about 453 people

11.4 Problem Solving (pp. 770–771) **27. a.** about $\pm 4.8\%$ **b.** between 9.2% and 18.8% **29.** No. *Sample answer:* Since the margin of error is $\pm 5\%$, Kosta could have 49% of the votes and Murdock could have 51% of the votes. **31. a.** 47%, 53% **b.** about $\pm 4.5\%$ **c.** between 42.5% and 51.5%, between 48.5% and 57.5% **d.** no; 273 people

Extension (p. 773) **1.** *Sample answer:* This is a leading question. Respondents may think a "no" response means they are not supporters of city growth.

3. *Sample answer:* Many patients may answer untruthfully because their dentist is asking the question. The information should be collected anonymously. **5.** *Sample answer:* The question assumes that the respondent is familiar with the facts of the case. Any presentation of the facts (as interpreted by the pollster) may be biased as well. It might be best then to ask the question as given only to those who reply affirmatively to the question, "Are you familiar with the facts of the Carter case?" **7.** *Sample answer:* The flaw is that Algebra 2 students are the experimental group and Algebra 1 students are the control group; the experimental and control groups should both be Algebra 2 students.

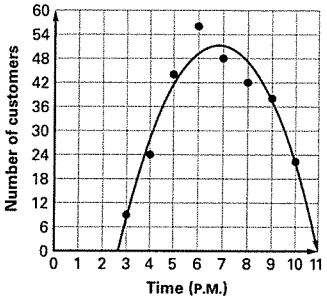
11.5 Skill Practice (p. 778) **1.** exponential **3.** $f(x) = -0.381x^2 + 1.12x + 15.7$;



7. The x and the value of b have been interchanged; $y = 9.71(1.55)^x$.

11.5 Problem Solving (p. 779) **11.** *Sample answer:* $y = 0.00211x^3 - 0.0766x^2 + 1.26x - 0.0664$ **13. a.** quadratic **b.** $y = -2.97x^2 + 40.4x - 85.9$

c.

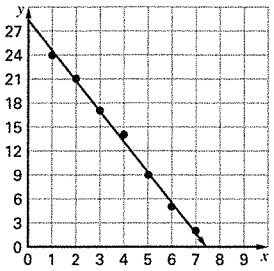


d. No; at 1:00 P.M., the function predicts a negative number of customers.

11.5 Problem Solving Workshop (p. 781) **1.** about 74°F; $y = 61.3(0.962)^x + 74$

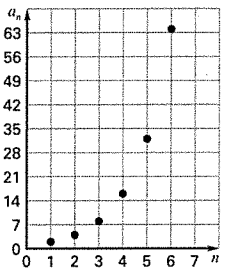
Chapter Review (pp. 784–786) **1.** Standard deviation **3.** z-score **5.** about 84.1, 86.5, 88, 17, about 6.2 **7.** about 130, 130, 140, 52, about 16.1 **9.** about 39.8, 38, 37, 14, about 4.6; about 32.8, 31, 30, 14, about 4.6 **11.** about 38.0, about 35.4, 59.8, 62.6, about 20.8; about 1.50, about 1.39, about 2.35, about 2.46, about 0.8 **13.** about 0.0548 **15.** about 0 **17.** about 0.0179 **19.** $\pm 2\%$ **21.** $\pm 1.4\%$

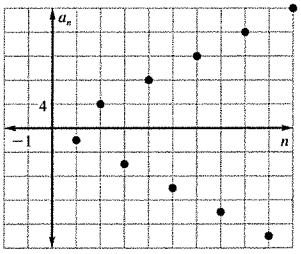
SELECTED ANSWERS

23. $y = -3.79x + 28.3$; 

Chapter 12

12.1 Skill Practice (pp. 798–799) **1.** sigma notation **3.** 3, 4, 5, 6, 7, 8 **5.** 1, 4, 9, 16, 25, 36 **7.** 1, 4, 16, 64, 256, 1024 **9.** $-4, -1, 4, 11, 20, 31$ **11.** $-4, -2, -\frac{4}{3}, -1, -\frac{4}{5}, -\frac{2}{3}$ **13.** $\frac{2}{3}, 1, \frac{6}{5}, \frac{4}{3}, \frac{10}{7}, \frac{3}{2}$ **15.** You can write the terms as $(5 \cdot 1 - 4), (5 \cdot 2 - 4), (5 \cdot 3 - 4), (5 \cdot 4 - 4)$, $a_5 = 21$, $a_n = 5n - 4$. **17.** You can write the terms as $(-1)^1(4 \cdot 1), (-1)^2(4 \cdot 2), (-1)^3(4 \cdot 3), (-1)^4(4 \cdot 4)$, $a_5 = -20$, $a_n = (-1)^n(4 \cdot n)$. **19.** You can write the terms as $\frac{2}{3(1)}, \frac{2}{3(2)}, \frac{2}{3(3)}, \frac{2}{3(4)}$, $a_5 = \frac{2}{15}$, $a_n = \frac{2}{3n}$. **21.** You can write the terms as $\frac{1}{4}, \frac{2}{4}, \frac{3}{4}, \frac{4}{4}, \frac{5}{4}$, $a_6 = \frac{6}{4}$, $a_n = \frac{n}{4}$. **23.** You can write the terms as $0.7(1) + 2.4, 0.7(2) + 2.4, 0.7(3) + 2.4, 0.7(4) + 2.4$, $a_5 = 5.9$, $a_n = 0.7n + 2.4$. **25.** You can write the terms as $1^2 + 0.2, 2^2 + 0.2, 3^2 + 0.2, 4^2 + 0.2$, $a_5 = 25.2$, $a_n = n^2 + 0.2$.

29. 

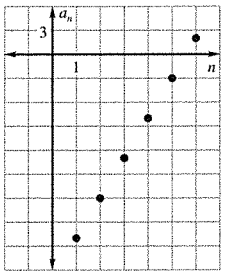
31. 

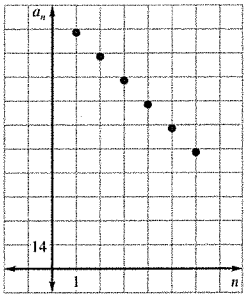
37. $\sum_{i=1}^{5} 3i + 4$ **39.** $\sum_{i=1}^{\infty} 2i - 3$ **41.** $\sum_{i=1}^{\infty} 7i - 4$

43. $\sum_{i=1}^{7} \frac{i}{3+i}$ **45.** 42 **47.** 100 **49.** 82 **51.** $\frac{761}{140}$ **53.** 35 **55.** 325 **57.** The lower limit is zero, so the first term should be 3; $3 + 5 + 7 + 9 + 11 + 13 = 48$.

12.1 Problem Solving (pp. 799–800) **63.** 60°, 90°, 108°, 120°, about 128.57°; $T_n = 180(n - 2)$; 1800° **65.** $a_n = 2^n - 1$; 63 moves, 127 moves, 255 moves **67. a.** 15 balls **b.** 35 balls **c.** Except for layer 1, there are always more balls in the same layer of the square pyramid. The difference in the number of balls is $\frac{n(n-1)}{2}$.

12.2 Skill Practice (pp. 806–807) **1.** common difference **3.** Arithmetic; there is a common difference of 3 between consecutive terms. **5.** Arithmetic; there is a common difference of 9 between consecutive terms. **7.** Arithmetic; there is a common difference of 0.5 between consecutive terms. **9.** Not arithmetic; there is not a common difference between consecutive terms. **11.** Arithmetic; there is a common difference of 1.5 between consecutive terms. **13.** $a_n = -1 + 6n$; 119 **15.** $a_n = -5 + 2n$; 35 **17.** $a_n = 36 - 11n$; -184 **19.** $a_n = \frac{7}{3} - \frac{1}{3}n$; $-\frac{13}{3}$ **21.** The equation for an arithmetic sequence is not correct; $a_n = a_1 + (n - 1)d$, $a_n = 37 + (n - 1)(-13)$, $a_n = 50 - 13n$.

23. $a_n = -28 + 5n$; 

25. $a_n = 152 - 14n$; 

31. $a_n = 9 + 5n$ **33.** $a_n = 22 - 4n$ **35.** $a_n = 13 + 2n$ **37.** $a_n = \frac{15}{4} + \frac{9}{4}n$ **41.** -96 **43.** 2585 **45.** 315 **47.** 132 **49.** $a_n = -3 + 5n$ **51.** $a_n = -1 - 2n$ **53.** False. *Sample answer:* Doubling the common difference alone does not double the sum. **55.** 12 **57.** 25 **59.** 15 **61.** 22,500

12.2 Problem Solving (pp. 808–809) **63. a.** $a_n = 6n$ **b.** 271 cells **65. a.** $a_n = -4 + 8n$ **b.** 576 blocks **67.** \$100

12.3 Skill Practice (pp. 814–815) **1.** common ratio **3.** Not geometric; there is no common ratio. **5.** Geometric; there is a common ratio of $\frac{1}{6}$. **7.** Not geometric; there is no common ratio. **9.** Geometric; there is a common ratio of $\frac{1}{2}$. **11.** Geometric; there is a common ratio of -3. **13.** Not geometric; there is no common ratio. **15.** $a_n = (-4)^{n-1}$; 4096

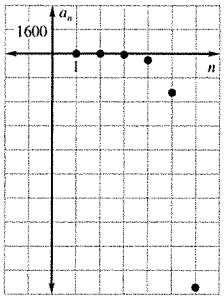
SELECTED ANSWERS

17. $a_n = 4(6)^{n-1}$; 186,624 **19.** $a_n = 2\left(\frac{3}{4}\right)^{n-1}$; $\frac{729}{2048}$

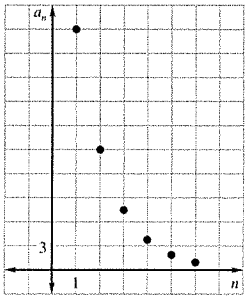
21. $a_n = 4\left(\frac{1}{2}\right)^{n-1}$; $\frac{1}{16}$ **23.** $a_n = -2(0.4)^{n-1}$; -0.008192

25. $a_n = 5(-2.8)^{n-1}$; 2409.45152

29. $a_n = -2(6)^{n-1}$;



31. $a_n = 30\left(\frac{1}{2}\right)^{n-1}$;



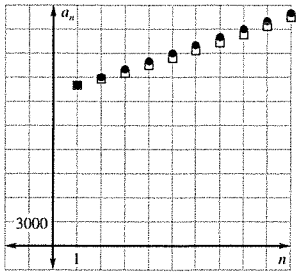
37. The exponent should be $n - 1$ instead of n; $a_n = 3(2)^{n-1}$. **39.** $a_n = 3(2)^{n-1}$ or $a_n = 3(-2)^{n-1}$

41. $a_n = \left(-\frac{1}{4}\right)(4)^{n-1}$ **43.** $a_n = -80\left(\frac{1}{2}\right)^{n-1}$ or $a_n = -80\left(-\frac{1}{2}\right)^{n-1}$ **45.** $a_n = 6(3)^{n-1}$ **47.** $a_n = \frac{32}{27}\left(\frac{3\sqrt[3]{12}}{4}\right)^{n-1}$

49. 131,070 **51.** $\frac{1365}{256}$ **53.** 838,861 **55.** *Sample answer:* $\frac{100}{31}, \frac{200}{31}, \frac{400}{31}, \frac{800}{31}, \frac{1600}{31}$

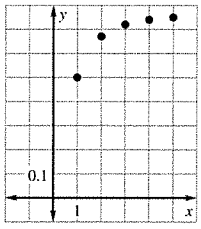
12.3 Problem Solving (pp. 815–817) **57. a.** $a_n = 5(2)^{n-1}$ **b.** 75 skydivers **59. a.** $a_n = 1024\left(\frac{1}{2}\right)^{n-1}$ **b.** 11. *Sample answer:* On the 11th pass, there is only 1 term to choose from so it must be the answer **61. a.** $a_n = 19{,}000 + 1000n$, arithmetic; $b_n = 20{,}000(1.04)^{n-1}$, geometric

b.

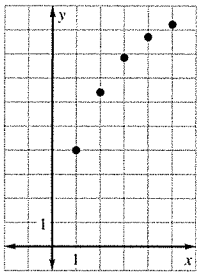


c. Company A: \$590,000; Company B: about \$595,562 **d.** 19 yr

12.4 Skill Practice (pp. 823–824) **1.** partial sum **3.** $S_1 = 0.5$, $S_2 \approx 0.67$, $S_3 \approx 0.72$, $S_4 \approx 0.74$, $S_5 \approx 0.75$; S_n appears to be approaching 0.75.



5. $S_1 = 4$, $S_2 = 6.4$, $S_3 = 7.84$, $S_4 \approx 8.71$, $S_5 \approx 9.22$; S_n appears to be approaching 10.



7. 10 **9.** no sum **11.** $\frac{12}{5}$ **13.** $\frac{63}{17}$ **15.** no sum **17.** $\frac{7}{10}$ **19.** Since $r > 1$, the infinite geometric series has no sum. **21.** $\frac{1}{2}$ **23.** 18 **25.** $\frac{4}{9}$ **27.** $\frac{625}{999}$ **29.** $\frac{130{,}000}{999}$ **31.** $\frac{5}{18}$ **33.** $\frac{0.9}{1 - 0.1} = \frac{0.9}{0.9} = 1$

12.4 Problem Solving (pp. 824–825) **37.** 70 ft **41. a.** 12 ft; 9 ft **b.** $\sum_{i=1}^{\infty} 12(0.75)^{i-1}$ **c.** 56 ft **d.** $\frac{2(0.75h)}{1 - 0.75} + h = 7h$

12.5 Skill Practice (pp. 830–831) **1.** iteration **3.** 1, 4, 7, 10, 13 **5.** $-1, -6, -11, -16, -21$ **7.** 2; 5; 26; 677; 458,330 **9.** 2, 8, 10, 18, 22 **11.** 2, 3, 6, 18, 108 **13.** $a_1 = 21$, $a_n = a_{n-1} - 7$ **15.** $a_1 = 4$, $a_n = -3\,a_{n-1}$ **17.** $a_1 = 44$, $a_n = \frac{1}{4}a_{n-1}$ **19.** $a_1 = 54$, $a_n = a_{n-1} - 11$ **21.** $a_1 = 16$, $a_2 = 9$, $a_n = a_{n-2} - a_{n-1}$ **23.** The rule does not work for all of the terms of the sequence; $a_1 = 5$, $a_2 = 2$, $a_n = a_{n-2} - a_{n-1}$. **25.** $-4, -14, -64$ **27.** $-2, -4, -5$ **29.** 5, 21, 437 **31.** 2, 4, 14 **35.** $a_1 = 1$, $a_2 = 2$, $a_n = 4(a_{n-2} + a_{n-1})$ **37.** $a_1 = 2$, $a_2 = 5$, $a_n = 3a_{n-2} + a_{n-1}$ **39.** $a_1 = -3$, $a_2 = -2$, $a_n = -1(a_{n-2} + a_{n-1})$ **41.** *Sample answer:* If the first two iterates are 2, the given rule must not be a function.

12.5 Problem Solving (pp. 832–833) **43. a.** $a_1 = 5000$, $a_n = 0.8a_{n-1} + 500$; 3524 fish **b.** The population of the lake approaches 2500 fish.

SELECTED ANSWERS

45. $a_1 = 2000$, $a_n = 1.014a_{n-1} - 100$; 24 mo. *Sample answer:* As long Gladys does not add anything to her credit card and continues her payments, her 24th payment will only be \$62.14.

47. a. $a_1 = 20$, $a_n = 0.7\,a_{n-1} + 20$ **b.** $66\frac{2}{3}$ mg

c. The maintenance level of the drug doubles as well; $a_1 = 20$, $a_n = 0.7\,(2a_{n-1}) + 2(20)$.

12.5 Problem Solving Workshop (p. 835)

1. The sequence approaches 400. **3.** The number of members approaches 15,000. **5.** *Sample answer:* 2% of the books are lost of discarded so 98% are retained; $a_n = 0.98a_{n-1} + 1150$.

Extension (p. 837)

1. Basis Step:

Check that the formula works for $n = 1$.

$2(1) - 1 = 1^2 \rightarrow 1 = 1$ ✓

Inductive Step:

Assume that $1 + 3 + 5 + \ldots + (2k - 1) = k^2$.

Show that $1 + 3 + 5 + \ldots + (2k - 1) + (2(k + 1) - 1) = (k + 1)^2$.

$1 + 3 + 5 + \ldots + (2k - 1) + (2(k + 1) - 1)$

$= k^2 + (2(k + 1) - 1)$

$= k^2 + 2k + 2 - 1$

$= k^2 + 2k + 1$

$= (k + 1)^2$ ✓

3. Basis Step:

Check that the formula works for $n = 1$.

$2^{1-1} = 2^1 - 1 \rightarrow 2^0 = 2 - 1 \rightarrow 1 = 1$ ✓

Inductive Step:

Assume that $1 + 2 + 2^2 + 2^3 + \ldots + 2^{k-1} = 2^k - 1$.

Show that $1 + 2 + 2^2 + 2^3 + \ldots + 2^{k-1} + 2^{(k-1)-1} = 2^{k+1} - 1$.

$1 + 2 + 2^2 + 2^3 + \ldots + 2^{k-1} + 2^{(k-1)-1}$

$= (2^k - 1) + 2^{(k+1)-1}$

$= 2^k - 1 + 2^k$

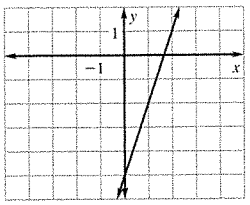
$= 2(2^k) - 1$

$= 2^{k+1} - 1$ ✓

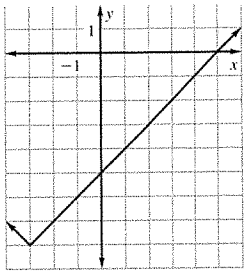
Chapter Review (pp. 840–842) **1.** terms **3.** explicit **5.** 133 **7.** 153 **9.** $a_n = 11 - 3n$ **11.** $a_n = 3 + 6n$ **13.** −403 **15.** 1200 **17.** $a_n = 256\left(\frac{1}{4}\right)^{n-1}$ **19.** $a_n = 144\left(\frac{1}{3}\right)^{n-1}$ or $a_n = 144\left(-\frac{1}{3}\right)^{n-1}$ **21.** 4088 **23.** $\frac{635}{8}$ **25.** 4 **27.** −0.4 **29.** $\frac{182}{333}$ **31.** $\frac{388}{495}$ **33.** 8, 40, 200, 1000, 5000 **35.** $a_1 = 6$, $a_n = 3a_{n-1}$ **37.** $a_1 = 7$, $a_n = a_{n-1} + 6$

Cumulative Review (pp. 848–849)

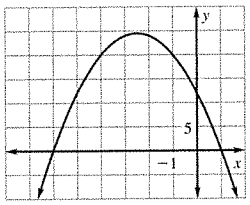
1.



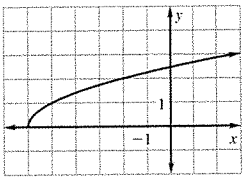
3.



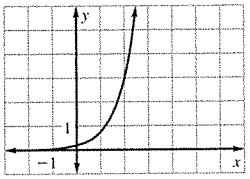
5.



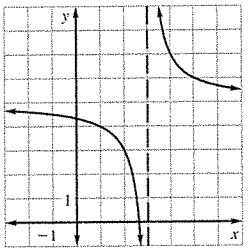
7.



9.

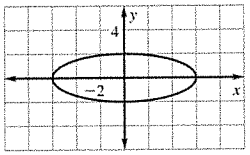


11.

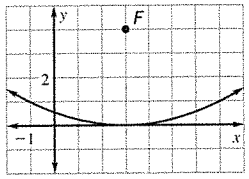


13. 13 **15.** 360 **17.** $y = \frac{18}{x}$; $-\frac{9}{4}$ **19.** $y = \frac{\frac{1}{2}}{x}$; $-\frac{1}{16}$

21.



23.



25. 524,160 **27.** 1 **29.** 0.15 **31.** about 12.857, 11, 11, 11, about 3.603 **33.** about 215.571, 216, 216, 25, about 8.086 **35.** about 88.857, 92, no mode, 28, about 8.967 **37.** 273 **39.** about 2.977 **41.** $a_n = -11 + 4n$, $a_1 = -7$, $a_n = a_{n-1} + 4$ **43.** $a_n = 3(4)^{n-1}$, $a_1 = 3$, $a_n = 4a_{n-1}$ **45.** 5 in. **47.** in 5 yr **49.** about 0.727 **51.** $a_n = 29{,}400 + 1600n$; \$43,800

Chapter 13

13.1 Skill Practice (pp. 856–857) **1.** The angle formed by the line of sight to an object and a line parallel to the ground. **3.** $\sin\theta = \frac{12}{13}$, $\cos\theta = \frac{5}{13}$, $\tan\theta = \frac{12}{5}$, $\csc\theta = \frac{13}{12}$, $\sec\theta = \frac{13}{5}$, $\cot\theta = \frac{5}{12}$

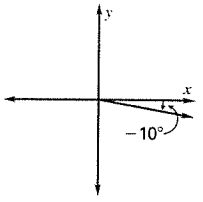
5. $\sin\theta = \frac{8}{11}$, $\cos\theta = \frac{\sqrt{57}}{11}$, $\tan\theta = \frac{8\sqrt{57}}{57}$, $\csc\theta = \frac{11}{8}$, $\sec\theta = \frac{11\sqrt{57}}{57}$, $\cot\theta = \frac{\sqrt{57}}{8}$

SELECTED ANSWERS

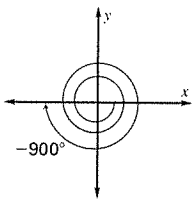
7. $\sin\theta = \frac{\sqrt{115}}{14}$, $\cos\theta = \frac{9}{14}$, $\tan\theta = \frac{\sqrt{115}}{9}$, $\csc\theta = \frac{14\sqrt{115}}{115}$, $\sec\theta = \frac{14}{9}$, $\cot\theta = \frac{9\sqrt{115}}{115}$ **9.** $\cos\theta = \frac{\sqrt{11}}{6}$, $\tan\theta = \frac{5\sqrt{11}}{11}$, $\csc\theta = \frac{6}{5}$, $\sec\theta = \frac{6\sqrt{11}}{11}$, $\cot\theta = \frac{\sqrt{11}}{5}$ **11.** $\sin\theta = \frac{7\sqrt{58}}{58}$, $\cos\theta = \frac{3\sqrt{58}}{58}$, $\csc\theta = \frac{\sqrt{58}}{7}$, $\sec\theta = \frac{\sqrt{58}}{3}$, $\cot\theta = \frac{3}{7}$ **13.** $\sin\theta = \frac{\sqrt{119}}{12}$, $\cos\theta = \frac{5}{12}$, $\tan\theta = \frac{\sqrt{119}}{5}$, $\csc\theta = \frac{12\sqrt{119}}{119}$, $\cot\theta = \frac{5\sqrt{119}}{119}$ **17.** $x = 8\sqrt{3}$, $y = 16$ **19.** $x = 4\sqrt{3}$, $y = 8\sqrt{3}$ **21.** $B = 55°$, $a \approx 9.18$, $b \approx 13.11$ **23.** $A = 72°$, $a \approx 22.83$, $b \approx 7.42$ **25.** $A = 15°$, $b \approx 55.98$, $c \approx 57.96$ **27.** $B = 26°$, $a \approx 65.61$, $c \approx 73.0$

13.1 Problem Solving (pp. 857–858) **31.** about 63.4 cm **33.** About 652 ft. *Sample answer:* The larger the angle the deeper the final depth. **35. a.** about 22,818 mi **b.** about 7263 mi

13.2 Skill Practice (pp. 862–863)
1. origin, initial side **3.** B **5.** A
7.



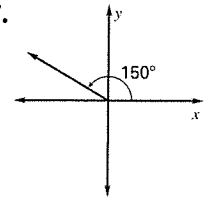
9.

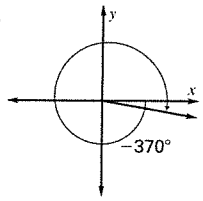


15–21. Sample answers are given. **15.** 430°, −290° **17.** 235°, −485° **19.** $\frac{\pi}{2}, -\frac{3\pi}{2}$ **21.** $\frac{10\pi}{9}, -\frac{8\pi}{9}$ **23.** $\frac{2\pi}{9}$ **25.** $-\frac{13\pi}{9}$ **27.** 20° **29.** 900° **33.** about 3.93 m, about 5.89 m^2 **35.** about 31.4 ft, about 188 ft^2 **37.** about 118 in., about 1470 $in.^2$ **39.** $\frac{1}{2}$ **41.** $\frac{\sqrt{3}}{3}$ **43.** about 2.41 **45.** about 0.975

13.2 Problem Solving (pp. 864–865) **49.** 72,000°, 400π **51. a.** $\frac{\pi}{2}$ **b.** about 45.6 ft **53. a.** about 16.5 in. **b.** 360°. *Sample answer:* Since each step has a central angle of $\frac{\pi}{8}$ and there are 16 steps, the staircase will cover $16\left(\frac{\pi}{8}\right)$ or 2π, which is equivalent to 360°. **c.** about 5195.4 $in.^2$

13.3 Skill Practice (pp. 870–871) **1.** quadrantal angle **3.** $\sin\theta = \frac{15}{17}$, $\cos\theta = \frac{8}{17}$, $\tan\theta = \frac{15}{8}$, $\csc\theta = \frac{17}{15}$, $\sec\theta = \frac{17}{8}$, $\cot\theta = \frac{8}{15}$ **5.** $\sin\theta = -\frac{24}{25}$, $\cos\theta = -\frac{7}{25}$, $\tan\theta = \frac{24}{7}$, $\csc\theta = -\frac{25}{24}$, $\sec\theta = -\frac{25}{7}$, $\cot\theta = \frac{7}{24}$ **7.** $\sin\theta = -\frac{\sqrt{2}}{2}$, $\cos\theta = \frac{\sqrt{2}}{2}$, $\tan\theta = -1$, $\csc\theta = -\sqrt{2}$, $\sec\theta = \sqrt{2}$, $\cot\theta = -1$ **9.** $\sin\theta = -\frac{5\sqrt{34}}{34}$, $\cos\theta = -\frac{3\sqrt{34}}{34}$, $\tan\theta = \frac{5}{3}$, $\csc\theta = -\frac{\sqrt{34}}{5}$, $\sec\theta = -\frac{\sqrt{34}}{3}$, $\cot\theta = \frac{3}{5}$ **13.** $\sin\theta = 1$, $\cos\theta = 0$, $\tan\theta$ = undefined, $\csc\theta = 1$, $\sec\theta$ = undefined, $\cot\theta = 0$ **15.** $\sin\theta = -1$, $\cos\theta = 0$, $\tan\theta$ = undefined, $\csc\theta = -1$, $\sec\theta$ = undefined, $\cot\theta = 0$
17. 30° **19.** 10°





25. $\sqrt{3}$ **27.** $-\frac{2\sqrt{3}}{3}$ **29.** $\frac{\sqrt{3}}{3}$ **31.** $\frac{2\sqrt{3}}{3}$ **33.** $\tan\theta = \frac{\sin\theta}{\cos\theta}$; $\sin 90° = 1$ and $\cos 90° = 0$ so $\tan 90°$ is undefined because you cannot divide by zero but $\cot\theta = \frac{0}{1} = 0$.

13.3 Problem Solving (pp. 871–872) **35.** about 10 ft **37.** About 104 ft; no. *Sample answer:* The initial height that the Ferris wheel is above the ground is not doubled so the entire height is not doubled.
39. a.

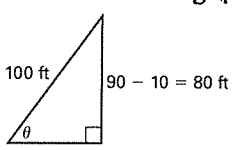
Angle of sprinkler, θ	25°	30°	35°	40°	45°
Horizontal distance water travels, d	15.0	16.9	18.4	19.2	19.5

Angle of sprinkler, θ	50°	55°	60°	65°
Horizontal distance water travels, d	19.2	18.4	16.9	15.0

b. 45°; since $\frac{v^2}{32}$ is constant, the maximum distance traveled will occur when $\sin 2\theta$ is as large as possible. The maximum value of $\sin 2\theta$ occurs when $2\theta = 90°$, that is, when $\theta = 45°$.
c. The distances are the same.

13.4 Skill Practice (p. 878) **1.** inverse **3.** $\frac{\pi}{2}$, 90° **5.** $\frac{\pi}{2}$, 90° **7.** $\frac{\pi}{3}$, 60° **9.** $-\frac{\pi}{6}$, −30° **13.** about 1.20, about 69.0° **15.** about 1.98, about 113.6° **17.** about −0.20, about −11.5° **19.** about 0.14, about 8.1° **21.** about 206.7° **23.** about 252.6° **25.** about 284.5° **27.** about 38.7° **29.** 120° **31.** *Sample answer:* 600°

13.4 Problem Solving (pp. 879–880)
35. about 53°



SELECTED ANSWERS

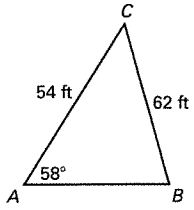
37. About 32.9°; about 46.4 ft. *Sample answer:* The pile is 15 feet high and the angle of repose is about 32.9°, the base of the right triangle formed is about 23.2 feet. Since this represents the radius of the pile, you need to multiply by 2 to get the diameter.

39. $\theta = \tan^{-1}\left(\frac{44t}{100}\right)$

13.5 Skill Practice (pp. 886–887) **1.** two angle measures and the length of a side, or the lengths of two sides and the measure of an angle opposite one of the two sides **3.** SSA; one triangle **5.** SSA; no triangle **7.** ASA; one triangle **9.** SSA; no triangle **11.** SSA; one triangle **13.** $A \approx 37.6°, B \approx 38.4°, a \approx 15.7$ **15.** $B = 65°, a \approx 23.8, b \approx 32.2$ **17.** $C = 95°, a \approx 17.6, b \approx 37.8$ **19.** $B = 119°, a \approx 6.5, c \approx 8.5$ **21.** $B \approx 54.1°, C \approx 87.9°, c \approx 30.8$, or $B \approx 125.9°, C \approx 16.1°, c \approx 8.6$ **23.** $B \approx 37.5°, C \approx 28.5°, c \approx 7.8$ **25.** $C = 99°, a \approx 62.7, c \approx 82.0$ **27.** The sides were not paired with their opposite angles; $\frac{\sin C}{5} = \frac{\sin 55°}{6}$, $\sin C = \frac{\sin 55°}{6} \approx 0.6826$, $C \approx 43.0°$. **29.** about 41.0 **31.** about 291.9 **33.** about 18.9 **35.** about 176.2 **37.** about 285.6 **39.** about 205.3

13.5 Problem Solving (pp. 887–888)
43. about 193.6 ft, about 212.9 ft

45. a.



b. third side: about 70.4 ft; other angles: about 47.6°, about 74.4° **c.** 9 bags **47. a.** about 152.9 m

13.6 Skill Practice (pp. 892–893) **1.** semiperimeter **3.** law of cosines **5.** law of sines **7.** law of sines **9.** $B \approx 30.7°, C \approx 35.3°, a \approx 41.1$ **11.** $A \approx 110.4°, C \approx 44.6°, b \approx 3.60$ **13.** $A \approx 30.3°, B \approx 128.4°, C \approx 21.3°$ **15.** $A \approx 55.7°, B \approx 76.3°, c \approx 15.3$ **17.** $A \approx 42.6°, B \approx 11.7°, C \approx 125.7°$ **19.** $A \approx 36.7°, B \approx 47.3°, c \approx 58.2$ **21.** about 104 **23.** about 1108.6 **25.** about 25 **27.** about 131.9 **29.** about 2259.7 **31.** about 994.3 **35.** Since you are looking for A the equation should be $a^2 = b^2 + c^2 - 2bc \cos A$; $18^2 = 15^2 + 10^2 - 2(15)(10) \cos A$, $A \approx \cos^{-1} 0.0033 \approx 89.8°$. **37.** $A = 45°, b \approx 25.2, c \approx 15.3$ **39.** $A \approx 68.2°, C \approx 21.8°, b \approx 16.2$ **41.** $A \approx 93.7°, B \approx 33.9°, C \approx 52.4°$

13.6 Problem Solving (pp. 893–894) **43.** about 119.6° **45.** About 19.8 acres. *Sample answer:* Find $\overline{AC}$ then find the area of $\triangle ACD$ and $\triangle ABC$ using Heron's formula. **47. a.** about 2.6 mi **b.** about 3 h 45 min **c.** About 1 h 46 min; 79.2° W of N. *Sample answer:* The angle at hiker 1 is 79.2° and you have parallel lines at each hiker pointing in the North direction. The angle at hiker 2 is then an alternate interior angle, and is congruent.

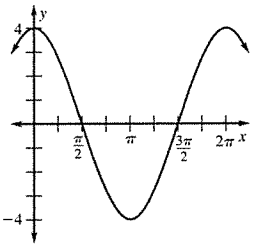
13.6 Problem Solving Workshop (p. 895)
1. about 81.9 **3.** about 4619.5 **5.** about 792.6 ft^2

Chapter Review (pp. 898–900) **1.** An angle in standard position has its vertex at the origin, and its initial side lies on the positive x-axis. **3.** unit circle **5.** *Sample answer:* The law of sines is a ratio relating the sine of an angle and its corresponding side to the other angles and corresponding sides. **7.** about 26.6 m **9.** $-\frac{4\pi}{9}$ **11.** 330° **13.** $-\sqrt{2}$ **15.** 2 **17.** about 19.5° **19.** $A \approx 31.7°, C \approx 44.3°, a \approx 13.5$ **21.** $A = 47°, a \approx 16.9, c \approx 22.1$ **23.** $A \approx 58.7°, C \approx 46.3°, b \approx 22.6$

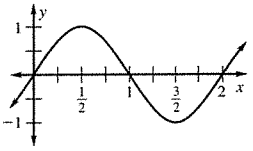
Chapter 14

14.1 Skill Practice (pp. 912–913)
1. period **3.** $1, \frac{\pi}{2}$ **5.** 1, 2

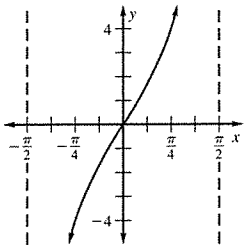
7.



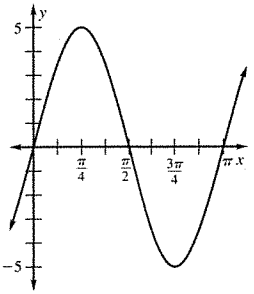
9.



17.

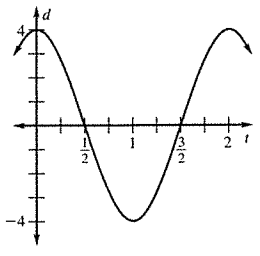


19.



25. *Sample answer:* The rise and fall of the tides versus time.

14.1 Problem Solving (pp. 913–914)
29.

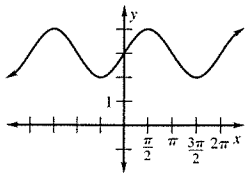


8 in.

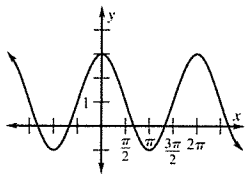
31. a. $y = 1.75 \cos \frac{\pi}{3} t$ **b.** Since the high point occurs at $t = 0$, the cosine function best represents situation.

14.2 Skill Practice (pp. 919–921) **1.** 3 **3.** E **5.** D **7.** A

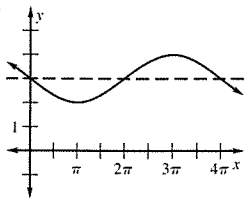
9.



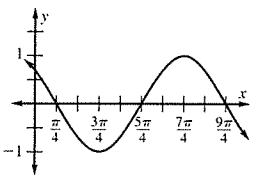
11.



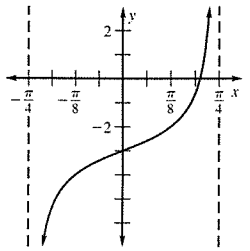
23.



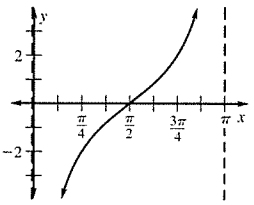
25.



37.



39.



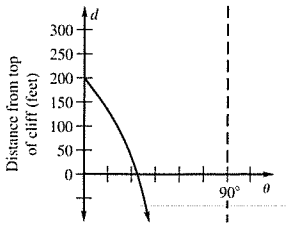
43. $y = 3 \sin (x - \pi) + 2$ **45.** $y = -\frac{1}{3} \cos \pi x - 1$

47. The graph of $y = \cos x$ can be obtained by translating the graph of $y = \sin x$ either to the left by $\frac{\pi}{2}$ or to the right $\frac{3\pi}{2}$.

14.2 Problem Solving (pp. 921–922)

51. $h = 3.75 \cos (200\pi t)$ **53. a.** $d = -300 \tan \theta + 200$

b.



c. about 18.4°

14.3 Skill Practice (pp. 927–928) **1.** A trigonometric equation that is true for all values of θ in its domain

3. $\cos \theta = \frac{2\sqrt{2}}{3}$, $\tan \theta = \frac{\sqrt{2}}{4}$, $\csc \theta = 3$, $\sec \theta = \frac{3\sqrt{2}}{4}$, $\cot \theta = 2\sqrt{2}$ **5.** $\sin \theta = -\frac{\sqrt{11}}{6}$, $\tan \theta = -\frac{\sqrt{11}}{5}$, $\csc \theta = -\frac{6\sqrt{11}}{11}$ $\sec \theta = \frac{6}{5}$, $\cot \theta = -\frac{5\sqrt{11}}{11}$

7. $\sin \theta = \frac{5\sqrt{29}}{29}$, $\cos \theta = -\frac{2\sqrt{29}}{29}$, $\tan \theta = -\frac{5}{2}$, $\csc \theta = \frac{\sqrt{29}}{5}$, $\sec \theta = -\frac{\sqrt{29}}{2}$ **11.** $-\tan \theta$

13. $\sec \theta$ **15.** $\sin^2 x$ **17.** 1 **19.** $\sin x$ **21.** -1

23. $\tan (-x) = -\tan (x)$, so Step 1 used an incorrect substitution; $-\frac{\sin x}{\cos x} \cdot \frac{1}{\sin x} = -\frac{1}{\cos x} = -\sec x$.

25. $\sin x \csc x = \sin x \left(\frac{1}{\sin x}\right) = 1$

27. $\frac{\cos\left(\frac{\pi}{2} - \theta\right) + 1}{1 - \sin (-\theta)} = \frac{\sin \theta + 1}{1 - \sin \theta} = 1$

29. $\frac{\csc^2 \theta - \cot^2 \theta}{1 - \sin^2 \theta} = \frac{1}{\cos^2 \theta} = \sec^2 \theta$

31. $\sin x + \cos x \cot x = \sin x + \cos x \left(\frac{\cos x}{\sin x}\right) =$

$\sin x + \frac{\cos^2 x}{\sin x} = \frac{\sin^2 x + \cos^2 x}{\sin x} = \frac{1}{\sin x} = \csc x$

33. $\frac{1 + \cos x}{\sin x} + \frac{\sin x}{1 + \cos x} = \frac{1 + 2\cos x + \cos^2 x + \sin^2 x}{(1 + \cos x)(\sin x)}$

$= \frac{1 + 2\cos x + 1}{(1 + \cos x)(\sin x)} = \frac{2 + 2\cos x}{(1 + \cos x)(\sin x)}$

$= \frac{2(1 + \cos x)}{(1 + \cos x)(\sin x)} = \frac{2}{\sin x} = 2 \csc x$

35. $\sin x$, $\csc x$, $\tan x$, $\cot x$; $\cos x$, $\sec x$

37. $\ln |\tan \theta| = \ln \left|\frac{\sin \theta}{\cos \theta}\right| = \ln |\sin \theta| - \ln |\cos \theta|$

14.3 Problem Solving (pp. 929–930)

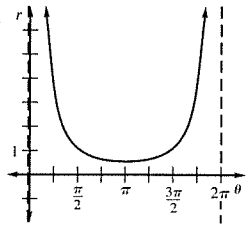
39. $\sec x \tan x - \sin x = \frac{1}{\cos x} \cdot \frac{\sin x}{\cos x} - \sin x =$

$\frac{\sin x}{\cos^2 x} - \frac{\sin x \cos^2 x}{\cos^2 x} = \frac{\sin x - \sin x \cos^2 x}{\cos^2 x} =$

$\frac{\sin x (1 - \cos^2 x)}{\cos^2 x} = \frac{\sin x (\sin^2 x)}{\cos^2 x} = \sin x \tan^2 x$

41. a. $r = \frac{1.069}{1 - 0.97 \cos \theta}$

b.



c.

θ	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π	$\frac{5\pi}{4}$	$\frac{3\pi}{2}$
r	35.6	3.40	1.07	0.634	0.543	0.634	1.07

about 50,500,000 mi, about 3,310,800,000 mi

43. The value of $\tan \theta$ increases as the value of $\sin \theta$ increases and the value of $\cos \theta$ decreases; $0 \le \theta \le \frac{\pi}{2}$, $2\pi \le \theta \le \frac{5\pi}{2}$, $4\pi \le \theta \le \frac{9\pi}{2}$, and so on.

14.4 Skill Practice (pp. 935–936) **1.** A trigonometric identity is true for all real values of x where a trigonometric equation is only true for some specific value(s) of x. **3.** $2 + 3 \cos (4\pi) - 5 = 2 + 3(1) - 5 = 0$

5. $12 \sin^2\left(\frac{\pi}{6}\right) - 3 = 12\left(\frac{1}{2}\right)^2 - 3 = 0$

7. $2 \cos^4\left(\frac{\pi}{2}\right) - \cos^2\left(\frac{\pi}{2}\right) = 2 (0)^4 - (0)^2 = 0$

9. $\frac{\pi}{6} + 2n\pi$ or $\frac{5\pi}{6} + 2n\pi$ **11.** $\frac{\pi}{6} + n\pi$

SELECTED ANSWERS

13. $\frac{\pi}{6} + n\pi$ or $\frac{5\pi}{6} + n\pi$ **17.** $\frac{\pi}{6}, \frac{7\pi}{6}$ **19.** $\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$

21. $\frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$ **23.** When two negative values are divided, the quotient is positive; $\cos x = \frac{1}{2}$, $x = \frac{\pi}{3}, \frac{5\pi}{3}$.

25. $\frac{\pi}{6} + n\pi$ **27.** $\frac{\pi}{3} + n\pi$ or $\frac{2\pi}{3} + n\pi$ **29.** $\pi + 2n\pi$

31. $\frac{\pi}{3}, \frac{\pi}{2}$ **33.** about 0.572 **35.** $\frac{5\pi}{3}$ **37.** (0, 1)

39. $\left(\frac{\pi}{6}, \frac{\sqrt{3}}{3}\right), \left(\frac{2\pi}{3}, 3\sqrt{3}\right), \left(\frac{7\pi}{6}, \frac{\sqrt{3}}{3}\right), \left(\frac{5\pi}{3}, 3\sqrt{3}\right)$

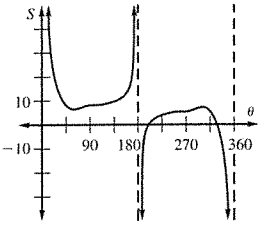
14.4 Problem Solving (pp. 936–937) **41.** July 26 and November 26 **43. a.** $S = \frac{27}{4} + \frac{27}{32}\left(\frac{\sqrt{3} - \cos\theta}{\sin\theta}\right)$

b. *Sample:*

θ	16	17	18	19
S	9.1095	8.9887	8.8825	8.7884

θ	120	121	122	123
S	8.9246	8.9619	9.0005	9.0405

about 17° and about 122°

c. 

about 54.7°

14.4 Problem Solving Workshop (p. 939) **1.** about 0.987, about 3.01 **3.** about 0.298, about 0.702 **5.** about 22.6, about 37.4 **7.** 1:32 AM, 10:52 AM, 1:56 PM, 11:16 PM **9.** about 0.17 sec and about 0.83 sec

14.5 Skill Practice (pp. 944–945) **1.** The graph of sine or cosine functions. **3.** *Sample answer:* $y = 3\sin 2x$

5. *Sample answer:* $y = -2\cos\frac{\pi}{2}x + 4$

7. To determine the amplitude, you must take half of the difference between the maximum and the minimum; $\frac{10 - (-6)}{2} = 8$.

9–17. Sample answers are given. **9.** $y = 6\sin\frac{1}{2}x$

11. $y = -\cos 3x + 4$ **13.** $y = 2\cos\frac{4}{5}\left(x - \frac{3\pi}{4}\right) + 7$

15. $y = 2\sin\frac{1}{4}(x + 2\pi) - 2$ **17.** $y = -6\cos\frac{3}{2}x - 6$

21. $y = 3\cos 4\left(x - \frac{\pi}{8}\right) + 2$;

$y = 3\cos\left(4x - \frac{\pi}{2}\right) + 2$ (Dist. property);

$y = 3\cos\left(\frac{\pi}{2} - 4x\right) + 2$ (Neg. angle identity);

$y = 3\sin 4x + 2$ (Cofunction identity)

14.5 Problem Solving (pp. 945–946)
23. $V = 100\sin 4\pi t$ **25.** $h = 2.5\sin\pi t + 6.5$
27. a. $N = 3.68\sin(0.776t - 0.703) + 20.4$
b. about 23,100 employees

14.6 Skill Practice (pp. 952–953) **1.** $\sin(a + b) = \sin a\cos b + \cos a\sin b$, $\sin(a - b) = \sin a\cos b - \cos a\sin b$, $\cos(a + b) = \cos a\cos b - \sin a\sin b$, $\cos(a - b) = \cos a\cos b + \sin a\sin b$, $\tan(a + b) = \frac{\tan a + \tan b}{1 - \tan a\tan b}$, $\tan(a - b) = \frac{\tan a - \tan b}{1 + \tan a\tan b}$

3. $\sqrt{3} - 2$ **5.** $2 - \sqrt{3}$ **7.** $\frac{\sqrt{2} - \sqrt{6}}{4}$ **9.** $\frac{\sqrt{6} - \sqrt{2}}{4}$

11. $\sin\left(\frac{\pi}{2} - 0\right) = \sin\frac{\pi}{2}\cos\theta - \cos\frac{\pi}{2}\sin\theta = 1(\cos\theta) - 0(\sin\theta) = \cos\theta$ **13.** $\frac{77}{85}$ **15.** $\frac{84}{85}$ **17.** $-\frac{84}{13}$ **19.** $\tan x$

21. $\cos x$ **23.** $\cos x$ **25.** $-\cos x$ **27.** $-\cot x$

29. $-\cot x$ **31.** The sign in the denominator should be negative when using the sum formula; $\frac{\tan x + \tan\frac{\pi}{4}}{1 - \tan x\tan\frac{\pi}{4}} = \frac{\tan x + 1}{1 - \tan x}$. **33.** $\frac{3\pi}{2}$ **35.** about 3.757, about 5.668 **37.** $0, \frac{\pi}{3}, \pi, \frac{5\pi}{3}$

14.6 Problem Solving (pp. 953–954) **41.** about 15 min 48 sec **43. a.** $\frac{f(1 + \tan^2 t)}{h(1 + \tan\theta\tan t)}$ **b.** $\frac{f(1 + \tan^2 0)}{h(1 + \tan\theta\tan 0)} = \frac{f}{h}$

14.7 Skill Practice (pp. 959–960) **1.** double angle

3. $\frac{\sqrt{2 + \sqrt{3}}}{2}$ **5.** $2 - \sqrt{3}$ **7.** $\frac{\sqrt{\sqrt{2} + 2}}{2}$ **9.** $\sqrt{2} + 1$

13. $\frac{\sqrt{3}}{3}, -\frac{\sqrt{6}}{3}, -\frac{\sqrt{2}}{2}$ **15.** $\frac{3\sqrt{10}}{10}, -\frac{\sqrt{10}}{10}, -3$

17. $\frac{4}{5}, -\frac{3}{5}, -\frac{4}{3}$ **19.** $\frac{4\sqrt{5}}{9}, \frac{1}{9}, 4\sqrt{5}$ **21.** 1 **23.** $\frac{2\tan\theta}{1 + \tan\theta}$

25. $\cos\theta - 1$ **29.** The correct half angle formula is $\pm\sqrt{\frac{1 - \cos a}{2}}$; $\sqrt{\frac{1 - \frac{\sqrt{2}}{2}}{2}} = \sqrt{\frac{\frac{2 - \sqrt{2}}{2}}{2}} = \sqrt{\frac{2 - \sqrt{2}}{4}} = \frac{\sqrt{2 - \sqrt{2}}}{2}$

31. $\sin 3\theta = \sin(2\theta + \theta) = \sin 2\theta\cos\theta + \cos 2\theta\sin\theta = 2\sin\theta\cos\theta\cos\theta + (2\cos^2\theta - 1)\sin\theta = 2\sin\theta\cos^2\theta + (2\cos^2\theta - 1)\sin\theta = \sin\theta(2\cos^2\theta + 2\cos^2\theta - 1) = \sin\theta(4\cos^2\theta - 1)$

33. $2\sin^2 x\tan\frac{x}{2} = 2\sin^2 x\left(\frac{1 - \cos x}{\sin x}\right) = 2\sin x(1 - \cos x) = 2\sin x - 2\sin x\cos x = 2\sin x - \sin 2x$ **35.** $\cos 4\theta = \cos(2\theta + 2\theta) = \cos 2\theta\cos 2\theta - \sin 2\theta\sin 2\theta = (\cos^2\theta - \sin^2\theta)^2 - (2\sin\theta\cos\theta)^2 = \cos^4\theta - 2\cos^2\theta\sin^2\theta + \sin^4\theta - 4\sin^2\theta\cos^2\theta = \cos^4\theta - 6\sin^2\theta\cos^2\theta + \sin^4\theta$

37. $\frac{4\pi}{3}$ **39.** $\frac{\pi}{4}, \frac{7\pi}{4}$ **41.** $\frac{\pi}{3}, \frac{\pi}{2}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{3\pi}{2}, \frac{5\pi}{3}$

43. The value of $\tan\theta$ increases as the value of $\sin\theta$ increases and the value of $\cos\theta$ decreases; $0 \le \theta \le \frac{\pi}{2}$, $2\pi\theta \le \frac{5\pi}{2}$, $4\pi\theta \le \frac{9\pi}{2}$, and so on.

SELECTED ANSWERS

14.7 Problem Solving (pp. 961–962)

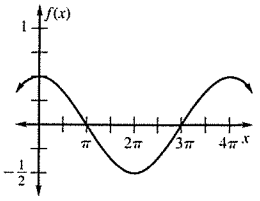
51. $24.3° \le \theta \le 65.7°$ **53.** about 47.2°

55. a. $y = -\frac{16}{(40)^2 \cos^2 \theta}(41.75)^2 + \tan\theta\,(41.75) + 6$

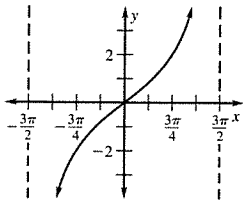
b. $y = -\frac{1743.0625}{100 \cos^2 \theta} + \tan\theta\,(41.75) + 6$; about 36.7° or about 58.8° **c.** *Sample answer:* The person aims toward the basket and the ball does not bounce off the rim.

Chapter Review (pp. 965–968) **1.** cycles **3.** period **5.** frequency

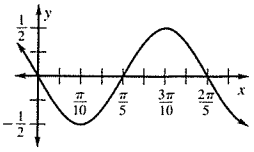
7.



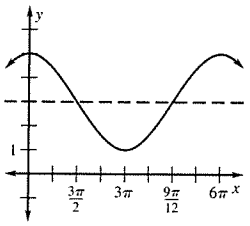
9.



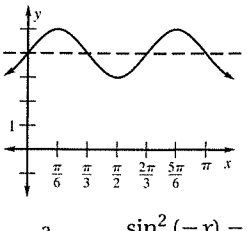
11.



13.



15.



17. $\sec^3 x$ **19.** $\frac{\sin^2(-x) - 1}{\cot^2 x} = \frac{-(1 - \sin^2 x)}{\frac{\cos^2 x}{\sin^2 x}} = \frac{-\cos^2 x}{\frac{\cos^2 x}{\sin^2 x}} = -\sin^2 x$ **21.** $\frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$ **23.** $\frac{\pi}{12}, \frac{\pi}{6}, \frac{\pi}{3}, \frac{5\pi}{12}, \frac{7\pi}{12}, \frac{2\pi}{3}, \frac{5\pi}{6}, \frac{11\pi}{12}, \frac{13\pi}{12}, \frac{7\pi}{6}, \frac{4\pi}{3}, \frac{17\pi}{12}, \frac{19\pi}{12}, \frac{5\pi}{3}, \frac{11\pi}{6}, \frac{23\pi}{12}$ **25.** *Sample answer:* $y = \cos \pi x - 2$ **27.** $2 + \sqrt{3}$ **29.** $-\frac{\sqrt{3}}{2}$ **31.** $\frac{\sqrt{2 + \sqrt{3}}}{2}$ **33.** $\frac{\sqrt{2 + \sqrt{3}}}{2}$ **35.** $\frac{\sqrt{3}}{2}, \frac{\sqrt{3}}{2}$

Skills Review Handbook

Operations with Positive and Negative Numbers (p. 975)

1. -6 **3.** -60 **5.** 2 **7.** 8 **9.** 44 **11.** -4 **13.** 12 **15.** -72 **17.** -2 **19.** -3 **21.** 9 **23.** 6 **25.** -15 **27.** -12 **29.** 5 **31.** 42 **33.** -17 **35.** 2

Fractions, Decimals, and Percents (p. 976) **1.** $\frac{13}{20}$ **3.** $\frac{3}{2}$ **5.** $\frac{7}{10}$ **7.** $\frac{13}{50}$ **9.** $\frac{19}{20}$ **11.** 0.25 **13.** 1.2 **15.** 0.375 **17.** 1.42 **19.** 0.3 **21.** 60% **23.** 130% **25.** 45% **27.** 80% **29.** 250%

Calculating with Percents (p. 977) **1.** 196 **3.** 38.4 **5.** 17 **7.** 1 **9.** 54% **11.** 10% **13.** 20% **15.** 2% **17.** 80 **19.** 60 **21.** 70 **23.** 8 **25.** 25% decrease **27.** 50% increase **29.** 96% increase **31.** 79% decrease

Factors and Multiples (p. 979) **1.** $2 \cdot 3 \cdot 7$ **3.** $3 \cdot 5^2$ **5.** $2 \cdot 5 \cdot 7$ **7.** $2^3 \cdot 3^2$ **9.** prime **11.** $2^3 \cdot 11$ **13.** prime **15.** 2^5 **17.** 8 **19.** 11 **21.** 4 **23.** 3 **25.** 10 **27.** 3 **29.** 1 **31.** 16 **33.** 30 **35.** 24 **37.** 6 **39.** 36 **41.** 30 **43.** 40 **45.** 891 **47.** $\frac{7}{16}$ **49.** $\frac{5}{6}$ **51.** $\frac{37}{40}$ **53.** $\frac{1}{3}$ **55.** $\frac{17}{30}$ **57.** $\frac{13}{20}$ **59.** $\frac{9}{20}$ **61.** $\frac{13}{16}$ **63.** $\frac{23}{30}$ **65.** $\frac{59}{80}$ **67.** $\frac{17}{20}$ **69.** $\frac{11}{18}$

Ratios and Proportions (p. 980) **1.** 1 to 3, 1:3, $\frac{1}{3}$ **3.** 5 to 4, 5:4, $\frac{5}{4}$ **5.** 5 to 6, 5:6, $\frac{5}{6}$ **7.** 1 to 1, 1:1, $\frac{1}{1}$ **9.** 4 to 9, 4:9, $\frac{4}{9}$ **11.** 7 to 1, 7:1, $\frac{7}{1}$ **13.** 7 **15.** 20 **17.** 2 **19.** 5 **21.** 40 **23.** 6.75 **25.** 99 **27.** 72

Converting Units of Measurement (p. 981) **1.** 6000 **3.** 5 **5.** 7.7 **7.** 16 **9.** 4000 **11.** 0.8 **13.** 6 **15.** 1.5 **17.** 3600 **19.** 3 **21.** $\frac{1}{8}$ **23.** 63,360 **25.** 2 **27.** 4000

Scientific Notation (p. 982) **1.** 6×10^{-1} **3.** 8×10^{-2} **5.** 4.08×10^{1} **7.** 3.85×10^{-4} **9.** 4.1236×10^{4} **11.** 4.86×10^{5} **13.** 1.002×10^{-2} **15.** 7.0505×10^{3} **17.** 9.85×10^{3} **19.** 8.05×10^{2} **21.** 5000 **23.** 0.82 **25.** 0.0032 **27.** 734,500 **29.** 1.814 **31.** 1,000,000 **33.** 0.000008 **35.** 1,870,000,000 **37.** 6,080,000 **39.** 34,010,000

Significant Digits (p. 983) **1.** 600 **3.** 81 **5.** 1.885 **7.** 4.9 **9.** 195 **11.** 0.036 **13.** 1009 **15.** 18 **17.** $17.40 **19.** 2.5 pints per student **21.** 2543 books per library **23.** $1250

Writing Algebraic Expressions (p. 984) **1.** $n + 8$ **3.** $2n$ **5.** $\frac{1}{5}n$ **7.** $5n$ **9.** $0.25n$ **11.** $n - 2$ **13.** $c - 4$ yr **15.** $x + 5$ dollars **17.** $45 - m$ min **19.** $10x$ dollars

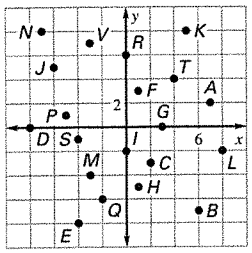
Binomial Products (p. 985) **1.** $a^2 + 8a + 15$ **3.** $t^2 + 15t + 56$ **5.** $y^2 + 6y + 8$ **7.** $y^2 - 4y + 4$ **9.** $z^2 - 8z + 16$ **11.** $y^2 - 4y - 21$ **13.** $25x^2 - 16$ **15.** $2c^2 + 3c - 35$ **17.** $-z^2 + 49$ **19.** $16a^2 + 24a + 9$ **21.** $-x^2 - 4x + 32$ **23.** $-a^2 + 18a - 81$ **25.** $10x^2 - 21x - 10$ **27.** $-24z^2 + 22z - 3$

LCDs of Rational Expressions (p. 986) **1.** $2a^2b$ **3.** z^3 **5.** $126m$ **7.** $3y^2$ **9.** $(n + 2)(n - 2)$ **11.** $5(n + 1)$ **13.** $6(m - 3)$ **15.** $(x - 4)^2$ **17.** $2n^3(5n + 4)$ **19.** $(k + 3)^4$ **21.** $70(n + 2)$ **23.** $(a + 2)^2$ **25.** $(k - 3)(k - 2)$ **27.** $(m - 7)(m - 4)(m^2 + 5m - 45)$

SELECTED ANSWERS

The Coordinate Plane (p. 987)

1–20.

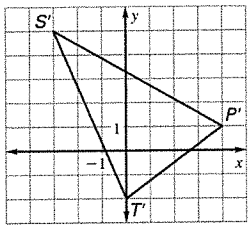


21. (2, 5) **23.** (5, −5)
25. (4, 0) **27.** (5, 4)
29. (4, −2) **31.** (−2, 0)
33. (−2, 2) **35.** (2, −4)
37. (2, −1) **39.** (−1, 5)
41. (−4, −3) **43.** (1, −3)

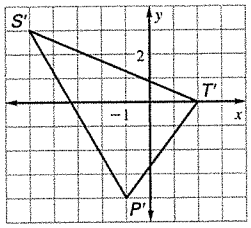
Transformations (p. 989)

1. (3, −8) **3.** (−3, 11) **5.** (8, 3) **7.** (−8, −3)

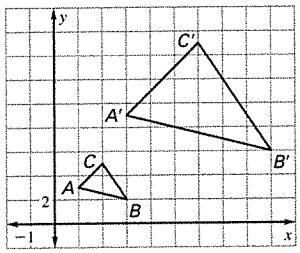
9.



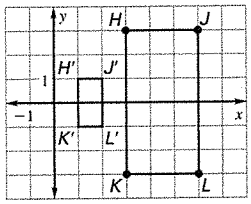
11.



19.



21.



Line Symmetry (p. 990) **1.** none **3.** 1 **5.** none **7.** 2 **9.** (−4, −1) **11.** (−2, 2)

Perimeter and Area (p. 991) **1.** 10 cm, 6 cm^2 **3.** 26 in., 24 $in.^2$ **5.** 48 yd, 84 yd^2 **7.** 14 m, 10.8 m^2

Circumference and Area of a Circle (p. 992)

1. $C = 10\pi$ in. or about 31 in., $A = 25\pi$ $in.^2$ or about 79 $in.^2$ **3.** $C = 8\pi$ in. or about 25 in., $A = 16\pi$ $in.^2$ or about 50 $in.^2$ **5.** $C = 24\pi$ ft or about 75 ft, $A = 144\pi$ ft^2 or about 452 ft^2 **7.** $C = 6\pi$ ft or about 19 ft, $A = 9\pi$ ft^2 or about 28 ft^2 **9.** $C = 2\pi$ cm or about 6 cm, $A = \pi$ cm^2 or about 3 cm^2 **11.** $C = 22\pi$ in. or about 69 in., $A = 121\pi$ $in.^2$ or about 380 $in.^2$

Surface Area and Volume (p. 993) **1.** 158 $in.^2$, 120 $in.^3$ **3.** 54 cm^2, 27 cm^3 **5.** 154π yd^2 or about 484 yd^2, 196π yd^3 or about 616 yd^3

Angle Relationships (p. 994) **1.** 39 **3.** 8 **5.** 16 **7.** 23 **9.** 29

Triangle Relationships (p. 995) **1.** 40 **3.** 60 **5.** 50 cm **7.** 12 ft **9.** 55°

Congruent and Similar Figures (p. 997) **1.** similar **3.** congruent **5.** congruent **7.** neither **9.** congruent **11.** 11.5 **13.** 14 **15.** 40 **17.** 7

More Problem Solving Strategies (p. 999) **1.** 4:15 P.M. **3.** 6 ways **5.** 40 parts **7.** 8 dimes, 5 nickels

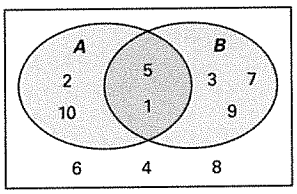
Logical Argument (p. 1001) **1.** valid; Chain Rule **3.** invalid **5.** valid; *And* Rule **7.** valid; *Or* Rule **9.** invalid **11.** true **13.** false **15.** true **17.** true **19.** false **21.** true

Conditional Statements and Counterexamples (p. 1003)

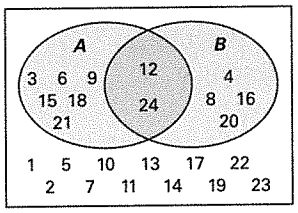
1. If you have the equation $y = mx + b$, then you have the graph of a line; if you have the graph of a line, then you have the equation $y = mx + b$, false. **3.** If Abby finishes her homework, then she can go swimming; if Abby goes swimming, then she finished her homework, false. **5.** If $4x + 8 = 28$, then $x = 5$; if $x = 5$, then $4x + 8 = 28$, true. **7.** True; if two lines are perpendicular, then they intersect to form a right angle and if two lines intersect to form a right angle, then they are perpendicular. **9.** False; not all orange vegetables are carrots. **11.** False; the converse is not true. **13.** False; zero is neither positive nor negative. **15.** False. *Sample answer:* An octagon could have exactly 5 congruent sides. **17.** False; *A* could be in between *B* and *C* and therefore would only be 2 inches from *C*. **19.** False. *Sample answer:* Charlie could have 10 dimes.

Venn Diagrams (p. 1004)

1.



3.



5. False. *Sample answer:* 10 is even, but it is not a multiple of 3 or 4. **7.** False; 1 is a positive odd integer and a factor of 10. **9.** True; 2 is the only even prime number.

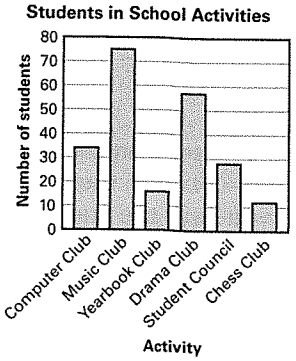
Mean, Median, Mode, and Range (p. 1005)

1. about $664, $675, $650, $300 **3.** 685 min, 713 min, none, 611 min **5.** 48 cookies, 48 cookies, 48 cookies, 24 cookies **7.** $9.20, $8.90, none, $5.85 **9.** 15 people, 14 people, 10 people and 18 people and 22 people, 25 people

SELECTED ANSWERS

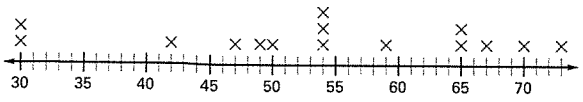
Graphing Statistical Data (p. 1006) **1.** 6 P.M. **3.** 5 diners; yes **5.** 14 diners **7.** winter and summer **9.** natural gas **11.** 50 homes

13.



Organizing Statistical Data (p. 1009)

1.

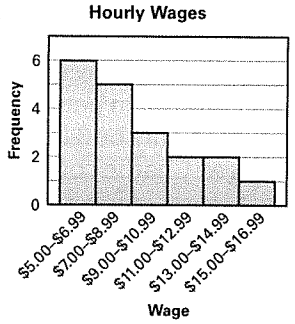


3.

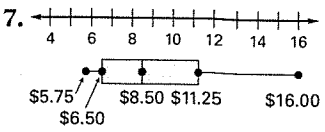
Stem	Leaves
3	0 0
4	2 7 9
5	0 4 4 4 9
6	5 5 7
7	0 3

Key: 3 | 0 = 30

5.



7.

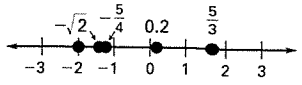


9. 5 **11.** 23 dogs **13.** 43 lb **15.** 25 children **17.** 12 songs **19.** 10 songs; 18 songs

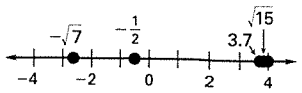
Extra Practice

Chapter 1 (p. 1010)

1.

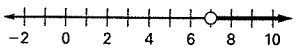


3.

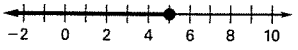


5. 1.25 lb **7.** 15 **9.** 52 **11.** $6r^2 - 5r + 12$ **13.** $8b - 20$ **15.** $-5m^2 + 9m - 12$ **17.** 5 **19.** −12 **21.** 2 **23.** 14 **25.** $y = \frac{1}{6}x + 3$; $\frac{10}{3}$ **27.** $y = \frac{9}{4}x - \frac{15}{2}$; 6 **29.** $y = \frac{5}{2 + 3x}$; $-\frac{5}{4}$ **31.** $y = -3x + 25$

33. $x > 7$

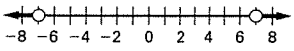


35. $x \leq 5$

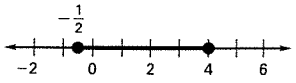


43. −1, 5 **45.** $-\frac{1}{9}$

47. $c < -7$ or $c > 7$

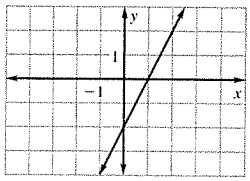


49. $-\frac{1}{2} \leq j \leq 4$

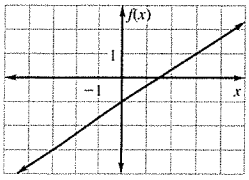


Chapter 2 (p. 1011) **1.** Function; for each input there is exactly one output. **3.** Not a function; there is more than one output for the input −2. **5.** $-\frac{1}{2}$; falls **7.** undefined; is vertical **9.** neither

11.



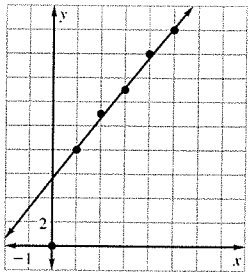
13.



19. $y = 7x - 3$ **21.** $y = -2$ **23.** $y = \frac{10}{3}x + \frac{1}{3}$

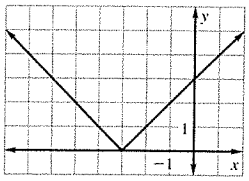
25. $y = 2x$; −4 **27.** $y = \frac{1}{4}x$; $-\frac{1}{2}$

29. a, b.



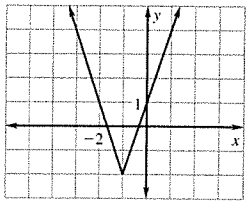
c. about 36

31.



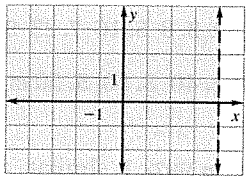
shifted left 3

33.

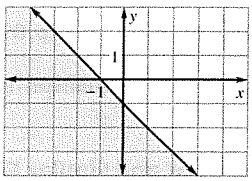


shifted down 2, left 1, and vertically stretched

35.

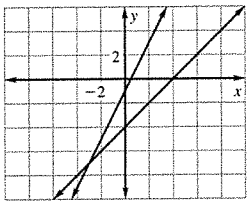


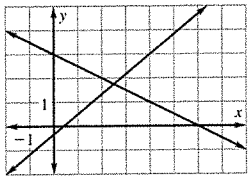
37.



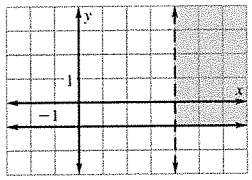
SELECTED ANSWERS

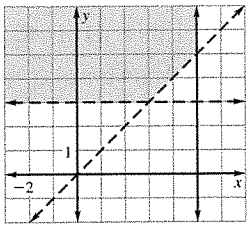
Chapter 3 (p. 1012)

1.  (−3, −7)

3.  (2.5, 1.75)

5. (1, −2) **7.** $\left(\frac{5}{2}, -5\right)$

9. 

11. 

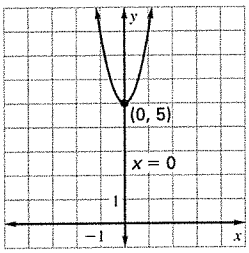
13. (2, −7, 5) **15.** $\left(\frac{3}{2}, -3, -3\right)$ **17.** $\begin{bmatrix} -12 & 9 \\ -8 & 4 \end{bmatrix}$

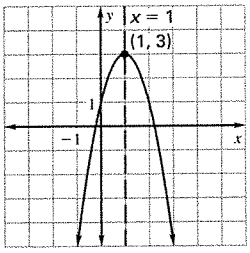
19. $\begin{bmatrix} 16 & 9 & -7 \\ -2 & 13 & 7 \end{bmatrix}$ **21.** not defined; the number of columns in the left matrix does not equal the number of rows in the right matrix. **23.** 66 **25.** −9 **27.** (3, −14)

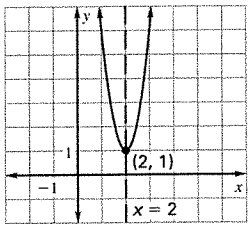
29. (3, −3, 1) **31.** $\begin{bmatrix} \frac{8}{3} & -\frac{7}{3} \\ -1 & 1 \end{bmatrix}$ **33.** $\begin{bmatrix} -8 & -5 \\ 3 & 2 \end{bmatrix}$

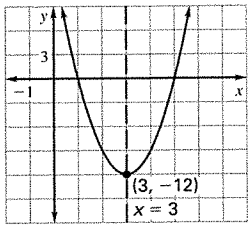
35. (14, −6) **37.** (−8, −3)

Chapter 4 (p. 1013)

1. 

3. 

5. 

7. 

9. $y = 7x^2 + 42x + 56$ **11.** $y = x^2 - 14x + 56$

13. $(x - 2)^2$ **15.** $(x + 9)(x + 12)$ **17.** −7, 2 **19.** −11, 5

21. $(2x - 5)(x + 3)$ **23.** not factorable **25.** $-\frac{4}{9}, \frac{4}{9}$

27. $-3, -\frac{3}{2}$ **29.** $2\sqrt{14}$ **31.** $\frac{2\sqrt{7}}{7}$ **33.** $\pm 2\sqrt{2}$ **35.** $5 \pm \sqrt{10}$

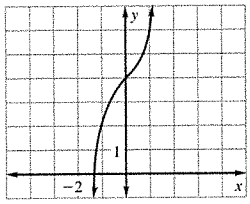
37. $11 - 3i$ **39.** $-\frac{13}{73} + \frac{14}{73}i$ **41.** $-3 \pm \sqrt{19}$ **43.** $3 \pm \sqrt{6}$

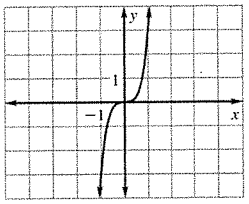
45. $-5 \pm \sqrt{35}$ **47.** $-\frac{3}{8} \pm \frac{\sqrt{201}}{8}$ **49.** $x \leq 0$ or $x \geq 10$

51. $-0.653 < x < 7.65$ **53.** $y = 3x^2 + 2x - 7$

55. $y = -2x^2 - 6x + 36$

Chapter 5 (p. 1014) **1.** 9.52×10^{11} **3.** 5×10^1 **5.** $\frac{b^6}{64a^{15}}$; power of a product property, negative exponent property **7.** $7x^2y^2$; product of powers property, quotient of powers property, negative exponent property

9. 

11. 

13. $-3x^2 + 3x - 8$ **15.** $3x^2(x + 3)^2$

17. $(x - 2)(x + 2)(2x + 1)$ **19.** $\pm\sqrt{7 \pm \sqrt{17}}$

21. $2x^2 + 10x + 25 + \frac{91}{x - 3}$ **23.** $-3, \frac{1}{2}, 1$

25. positive: 2 or 0, negative: 1, imaginary: 2 or 0

27. positive: 1, negative: 1, imaginary: 2 **29.** (−1.5, −4) local minimum, (0, 0) local maximum, (1.5, −4) local minimum; (−2, 0), (0, 0), (0, 0), (2, 0), degree 4

31. $y = 0.5x^3 + x^2 + 2x - 1$

Chapter 6 (p. 1015) **1.** ±3 **3.** −3 **5.** 32 **7.** 16 **9.** ±3

11. ±2.15 **13.** $\frac{1}{17^{1/7}}$ **15.** 3 **17.** $9\sqrt[3]{2}$ **19.** $48\sqrt[3]{2}$

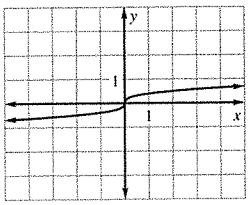
21. $y^2z^4\sqrt[5]{18x^3y^4}$ **23.** $2x^2y^2\sqrt[3]{12x^2y}$ **25.** $x^3 + x - 4$, all real numbers **27.** $\frac{-x + 4}{x^3}$, all real numbers except $x = 0$ **29.** $\frac{x^3}{64}$, all real numbers **31.** x, all real numbers

33. $f(g(x)) = 3\left(\left(\frac{x - 1}{3}\right)^{1/2}\right)^2 + 1 = x - 1 + 1 = x$,

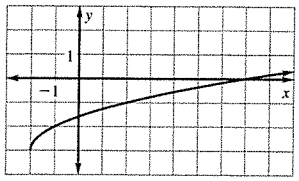
$g(f(x)) = \left(\frac{(3x^2 + 1) - 1}{3}\right)^{1/2} = \left(\frac{3x^2}{3}\right)^{1/2} = x$

35. $f^{-1}(x) = \frac{3}{4}x - \frac{3}{2}$ **37.** $f^{-1}(x) = -\sqrt[6]{-x + 2}$

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

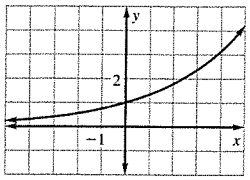
41.  domain: all real numbers, range: all real numbers

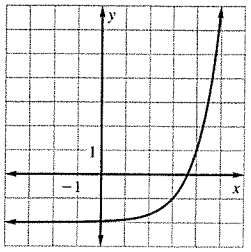
SELECTED ANSWERS

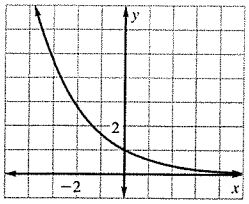
43.  domain: $x \geq -2$, range: $y \geq -3$

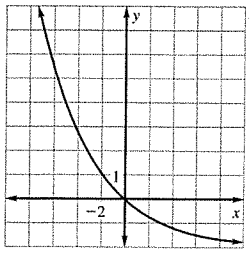
49. 3 **51.** -1 **53.** 3 **55.** 1, 3

Chapter 7 (p. 1016)

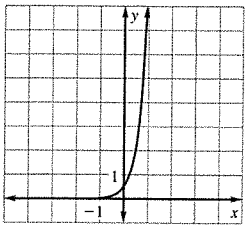
1.  domain: all real numbers, range: $y > 0$

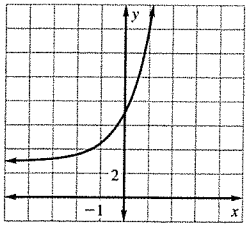
3.  domain: all real numbers, range: $y > -2$

5.  domain: all real numbers, range: $y > 0$

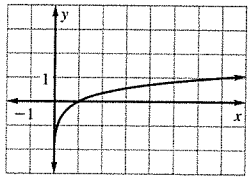
7.  domain: all real numbers, range: $y > -2$

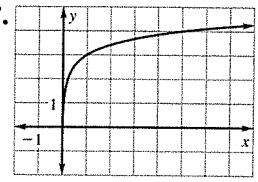
9. $\frac{1}{e^{11}}$ **11.** $9e^{4x}$

13.  domain: all real numbers, range: $y > 0$

15.  domain: all real numbers, range: $y > 3$

17. -2 **19.** 3 **21.** x **23.** $2x$

25.  domain: $x > 0$, range: all real numbers

27.  domain: $x > 0$, range: all real numbers

29. $\log_5 2 + \log_5 x - 1$ **31.** $\ln 20 + 3 \ln x + 2 \ln y$

33. $\log_4 20x^4$ **35.** $\ln \frac{10y^8}{x^2}$ **37.** about 3.161

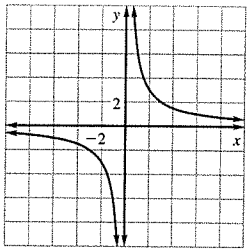
39. about 1.694 **41.** 1 **43.** no solution **45.** 3

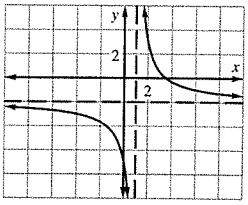
47. $y = \frac{3}{2} \cdot 2^x$ or $y = -\frac{3}{2} \cdot (-2)^x$ **49.** $y = 4 \cdot 1^x$

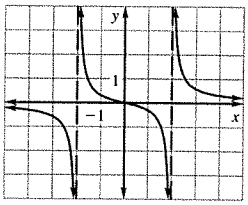
51. $y = \frac{1}{3} \cdot x^4$ **53.** $y = 0.538 \cdot x^{2.611}$

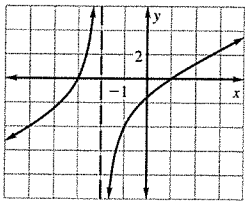
Chapter 8 (p. 1017) **1.** $y = \frac{-20}{x}$; 4 **3.** $y = \frac{15}{x}$; -3

5. inverse variation **7.** neither variation

9.  domain: all real numbers except $x = 0$, range: all real numbers except $y = 0$

11.  domain: all real numbers except $x = 1$, range: all real numbers except $y = -2$

13. 

15. 

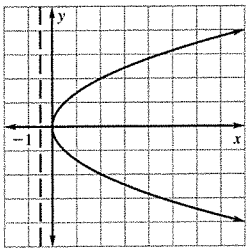
17. $\frac{x-2}{x+6}$ **19.** $\frac{x-12}{2(x-7)}$ **21.** $\frac{4}{3x^2}$ **23.** $\frac{3x(x+5)^2}{x-6}$

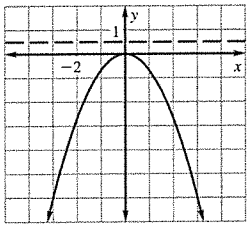
25. $\frac{(2x+1)(x-5)}{8x^3}$ **27.** $x - 1$ **29.** $\frac{5}{x-5}$

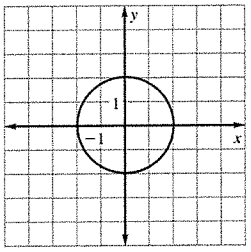
31. $\frac{x(x+6)}{3(1+3x)}$ **33.** 3 **35.** $-1, 2$

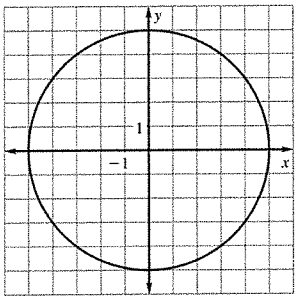
SELECTED ANSWERS

Chapter 9 (p. 1018) **1.** $2\sqrt{29}$; (0, 2) **3.** $2\sqrt{233}$; (1, 4)

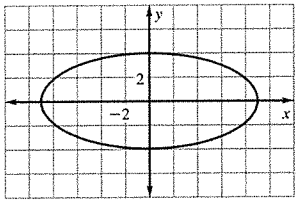
5.  $\left(\frac{1}{2}, 0\right), x = -\frac{1}{2}, y = 0$

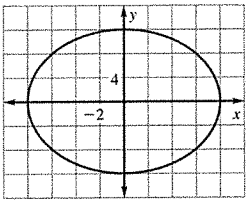
7.  $\left(0, -\frac{3}{8}\right), y = \frac{3}{8}, x = 0$

9.  2

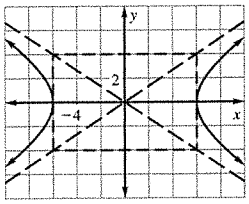
11.  5

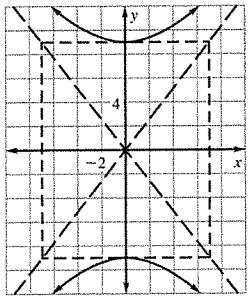
13. $x^2 + y^2 = 64$ **15.** $x^2 + y^2 = 50$

17.  (±9, 0), (0, ±4), $(\pm\sqrt{65}, 0)$

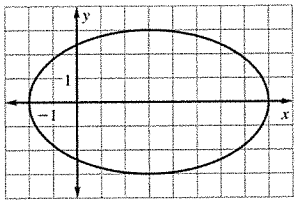
19.  (0, ±12), (±8, 0), $(0, \pm 4\sqrt{5})$

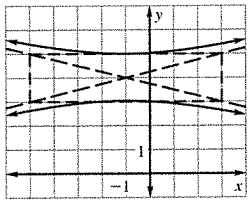
21. $\frac{x^2}{16} + \frac{y^2}{4} = 1$ **23.** $\frac{x^2}{81} + \frac{y^2}{72} = 1$

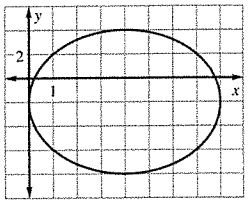
25.  (±6, 0), $(\pm 2\sqrt{13}, 0)$, $y = \pm\frac{2}{3}x$

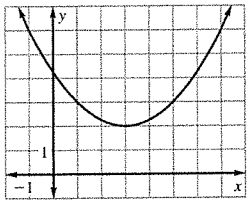
27.  (0, ±9), $(0, \pm\sqrt{130})$, $y = \pm\frac{9}{7}x$

29. $\frac{x^2}{1} - \frac{y^2}{3} = 1$

31.  center: (3, 0), vertices: (−2, 0) (8, 0), co-vertices: (3, 3) (3, −3), foci: (−1, 0) (7, 0)

33.  center: (−1, 4), vertices: (−1, 5) (−1, 3), foci: $(-1, 4 + \sqrt{17})$ $(-1, 4 - \sqrt{17})$, asymptotes: $y = \pm\frac{1}{4}x$

35. ellipse, $\frac{(x-4)^2}{16} + \frac{(y+2)^2}{36} = 1$ 

37. parabola, $(x-3)^2 = 4(y-2)$ 

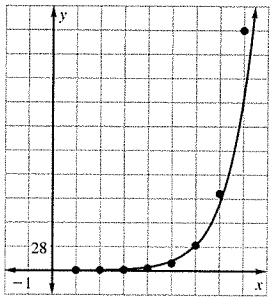
39. (0, −2) (7, 5)

Chapter 10 (p. 1019) **1. a.** 100,000,000 passwords **b.** 1,814,400 passwords **3. a.** 118,813,760 passwords **b.** 78,936,000 passwords **5.** 20 **7.** 362,880 **9.** 1260 **11.** 604,800 **13.** 35 **15.** 10 **17.** $x^3 - 9x^2 + 27x - 27$ **19.** $p^{10} + 20p^8 + 160p^6 + 640p^4 + 1280p^2 + 1024$ **21.** $\frac{13}{25}$ **23.** $\frac{1}{2}$ **25.** $1 - \frac{\pi}{4}$ **27.** 0.8 **29.** 0.6; not disjoint

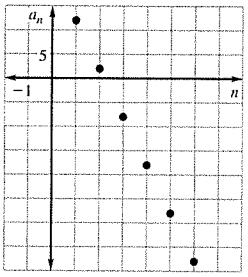
SELECTED ANSWERS

31. 0.17; not disjoint **33. a.** $\frac{1}{169}$ **b.** $\frac{4}{663}$ **35. a.** $\frac{1}{52}$ **b.** $\frac{1}{51}$ **37.** about 0.0417 **39.** about 0.0000305

Chapter 11 (p. 1020) **1.** 11, 11.5, 16, 11, 4.313 **3.** 1, 0, −3, 15, 4.991 **5.** 3.45, 4.4, 5.7, 9, 3.09 **7.** 41.5, 37.5, 36, 23, 8.221; 43.5, 39.5, 38, 23, 8.221 **9.** 2, 2.5, −2, 10, 3.5; 3, 3.75, −3, 15, 5.25 **11.** 0.34 **13.** 0.025 **15.** Self-selected; biased; only those parents who received the survey and feel strongly about the attendance policy are likely to respond. **17.** ± 4.1% **19.** ± 1.4% **21.** 2500 **23.** 260 **25.** $y = 0.108(2.56)^x$

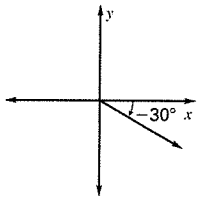


Chapter 12 (p. 1021) **1.** perfect squares listed in order starting at 3, 49, $a_n = (n + 2)^2$ **3.** each term is decreased by 5.5, −9.5, $a_n = 18 - 5.5n$ **5.** $\sum_{n=1}^{\infty} \frac{n}{5+n}$ **7.** 220 **9.** 1071 **11.** $a_n = -10n + 22$

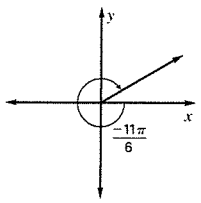


13. $a_n = 9n + 2$; 137 **15.** $a_n = -\frac{2}{3}n + \frac{11}{3}$; $-\frac{19}{3}$ **17.** $a_n = 2.5 + n$ **19.** $a_n = \frac{1}{27} \cdot 3^{n-1}$; 729 **21.** $a_n = 4 \cdot \left(\frac{4}{3}\right)^{n-1}$; about 53.3 **23.** 273.5 **25.** about 25.8 **27.** no sum **29.** $\frac{1}{3}$ **31.** $\frac{7}{33}$ **33.** $a_1 = 2.5$, $a_n = 2(a_{n-1})$ **35.** $a_1 = 1$ and $a_2 = 2$, $a_n = (a_{n-2})\,(a_{n-1})$ **37.** −10, −10, −10

Chapter 13 (p. 1022) **1.** $\cos\theta = \frac{4}{5}$, $\tan\theta = \frac{3}{4}$, $\csc\theta = \frac{5}{3}$, $\sec\theta = \frac{5}{4}$, $\cot\theta = \frac{4}{3}$ **3.** $\sin\theta = \frac{\sqrt{3}}{2}$, $\cos\theta = \frac{1}{2}$, $\tan\theta = \sqrt{3}$, $\csc\theta = \frac{2\sqrt{3}}{3}$, $\cot\theta = \frac{\sqrt{3}}{3}$ **5.** $B = 69°$, $a \approx 2.867$, $b \approx 7.469$ **7.** $A = 30°$, $a = 10$, $b = 10\sqrt{3}$ **9.** $B = 72°$, $a \approx 5.562$, $b \approx 17.119$ **11.** $\frac{5\pi}{9}$ **13.** 135° **15.** $\frac{5\pi}{2}$ ft, $\frac{25\pi}{4}$ ft^2 **17.** 12π cm, 72π cm^2 **19.**



30° **21.**

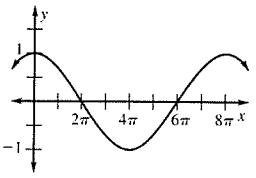


$\frac{\pi}{6}$

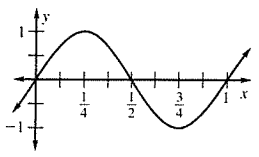
23. $-\frac{2\sqrt{3}}{3}$ **25.** $-\frac{\sqrt{2}}{2}$ **27.** $\frac{5\pi}{6}$, 150° **29.** $\frac{\pi}{4}$, 45° **31.** about 334.16° **33.** $B \approx 40.7°$, $C \approx 105.3°$, $c \approx 10.35$ or $B \approx 139.3°$, $C \approx 6.72°$, $c \approx 1.26$ **35.** $A \approx 36.4°$, $C \approx 57.6°$, $a \approx 7.73$ **37.** about 24.1 **39.** $A \approx 44.1°$, $B \approx 88.3°$, $C \approx 47.6°$ **41.** $B \approx 61.3°$, $C \approx 38.7°$, $a \approx 7.86$ **43.** about 189

Chapter 14 (p. 1023)

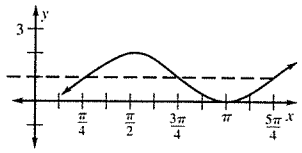
1.



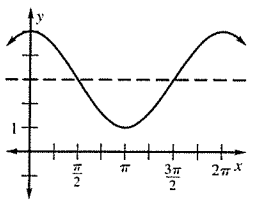
3.



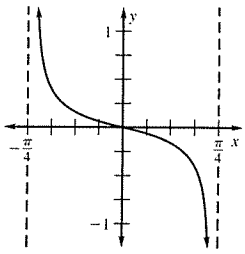
5.



7.



9.



11. 1 **13.** −1 **15.** $\frac{\cos^2 x + \sin^2 x}{\tan^2 x + 1} = \frac{1}{\sec^2 x} = \cos^2 x$ **17.** $\frac{\pi}{6} + n\pi$, $\frac{5\pi}{6} + n\pi$ **19.** $\frac{\pi}{4} + n\pi$ **21.** $\frac{7\pi}{6}$, $\frac{11\pi}{6}$ **23.** about 1.2995 **25.** $y = 3 + \frac{1}{2}\cos \pi x$ **27.** $\frac{-\sqrt{2} - \sqrt{6}}{4}$ **29.** $\frac{\sqrt{2} + \sqrt{6}}{4}$ **31.** $\frac{9\sqrt{19}}{50}$, $\frac{31}{50}$, $\frac{9\sqrt{19}}{31}$ **33.** $\frac{2\pi}{3} + 2n\pi$, $\frac{4\pi}{3} + 2n\pi$, $0 + 2n\pi$ **35.** $\frac{3\pi}{4} + 2n\pi$

SELECTED ANSWERS