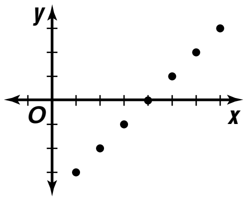
SELECTED ANSWERS

CHAPTER 1 LINEAR RELATIONS AND FUNCTIONS

Pages 9–12 Lesson 1-1

5. $y = x - 4$

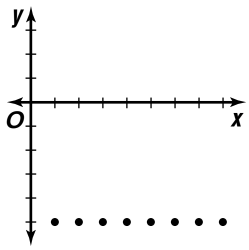


x	y
1	−3
2	−2
3	−1
4	0
5	1
6	2
7	3

7. {(−6, 1), (−4, 0), (−2, −4), (1, 3), (4, 3)}; D = {−6, −4, −2, 1, 4}; R = {−4, 0, 1, 3}

9.

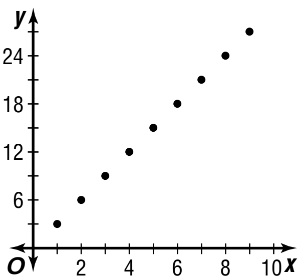
x	y
1	−5
2	−5
3	−5
4	−5
5	−5
6	−5
7	−5
8	−5



11. {−3, 3, 6};{−6, −2, 0, 4}; no; 6 is matched with two members of the range. **13.** −84

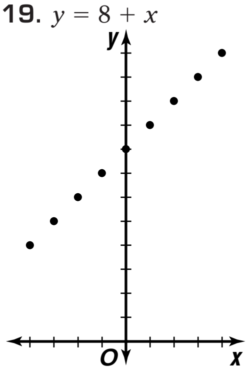
15. $x \geq -1$

17. $y = 3x$



x	y
1	3
2	6
3	9
4	12
5	15
6	18
7	21
8	24
9	27

19. $y = 8 + x$



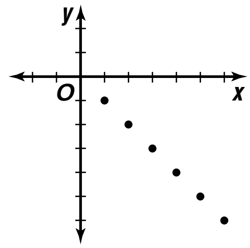
x	y
−4	4
−3	5
−2	6
−1	7
0	8
1	9
2	10
3	11
4	12

21. {(−10, 0), (−5, 0), (0, 0), (5, 0)}; D = {−10, −5, 0, 5}; R = {0} **23.** {(−3, −2), (−1, 1), (0, 0), (1, 1)}; D = {−3, −1, 0, 1}; R = {−2, 0, 1}

25. {(3, −4), (3, −2), (3, 0), (3, 1), (3, 3)}; D = {3}; R = {−4, −2, 0, 1, 3}

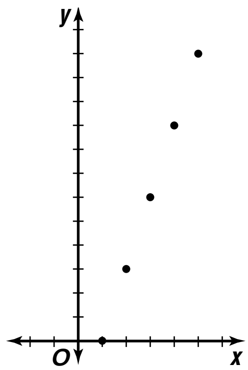
27.

x	y
1	−1
2	−2
3	−3
4	−4
5	−5
6	−6



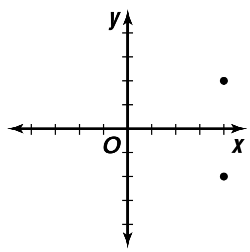
29.

x	y
1	0
2	3
3	6
4	9
5	12



31.

x	y
4	2
4	−2



33. {1}; {−6, −2, 0, 4}; no; The x-value 1 is paired with more than one y-value. **35.** {0, 2, 5}; {−8, −2, 0, 2, 8}; no; The x-values 2 and 5 are paired with more than one y-value. **37.** {−9, 2, 8, 9}; {−3, 0, 8}; yes; Each x-value is paired with exactly one y-value. **39.** domain: {−3, −2, −1, 1, 2, 3}; range: {−1, 1, 2, 3}; A function because each x-value is paired with exactly one y-value. **41.** 9 **43.** 2 **45.** $2n^2 - 5n + 12$ **47.** $|25m^2 - 13|$ **49.** $x \leq -3$ or $x \geq 3$ **51a.** $x \neq 1$ **51b.** $x \neq -5$ **51c.** $x \neq -2, 2$ **53.** $3x^3 + 4x - 7$ **55a.** 14,989,622.9 m; 59,958,491.6 m; 419,709,441.2 m; 1,768,775,502 m **55b.** 23,983,396.64 m **57.** B

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5. $3x^2 + 6x + 4$; $3x^2 + 2x - 14$; $6x^3 + 35x^2 + 26x - 45$; $\frac{3x^2 + 4x - 5}{2x + 9}$, $x \neq -\frac{9}{2}$ **7.** $2x^2 - 4x - 3$; $4x^2 - 16x + 15$ **9.** 5, 11, 23 **11.** $x^2 - x + 9$; $x^2 - 3x - 9$; $x^3 + 7x^2 - 18x$; $\frac{x^2 - 2x}{x + 9}$, $x \neq -9$
13. $\frac{x^3 - 2x^2 - 35x + 3}{x - 7}$, $x \neq 7$ – $\frac{x^3 - 2x^2 - 35x - 3}{x - 7}$, $x \neq 7$; $\frac{3x^2 + 15x}{x - 7}$, $x \neq 7$; $\frac{3}{x^3 - 2x^2 - 35x}$, $x \neq -5, 0,$ or 7
15. $x^2 + 8x + 7$; $x^2 - 5$ **17.** $3x^2 - 4$; $3x^2 - 24x + 48$ **19.** $2x^3 + 2x^2 + 2$; $8x^3 + 4x^2 + 1$
21. $\frac{x}{x - 1}$, $x \neq 1$; $\frac{1}{x}$, $x \neq 0$ **23.** $x \neq 7$ **25.** 7, 2, 7
27. 2, 2, 2 **29.** Yes; If $f(x)$ and $g(x)$ are both lines, they can be represented as $f(x) = m_1x + b_1$ and $g(x) = m_2x + b_2$. Then $[f \circ g](x) = m_1(m_2x + b_2) + b_1 = m_1m_2x + m_1b_2 + b_1$. Since m_1 and m_2 are constants, m_1m_2 is a constant. Similarly, m_1, b_2, and b_1 are constants, so $m_1b_2 + b_1$ is a constant. Thus, $[f \circ g](x)$ is a linear function if $f(x)$ and $g(x)$ are both linear. **31a.** $h[f(x)]$, because you must subtract before figuring the bonus.
31*b*. \$3750 **33a.** $v(p) = \frac{7p}{47}$ **33b.** $r(v) = 0.84v$
33c. $r(p) = \frac{147p}{1175}$ **33d.** \$52.94, \$28.23, \$99.72
35. $\{(-1, 8), (0, 4), (2, -6), (5, -9)\}$; $D = \{-1, 0, 2, 5\}$; $R = \{-9, -6, 4, 8\}$ **37.** $3\frac{11}{16}$ **39.** *C*

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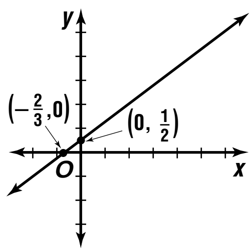
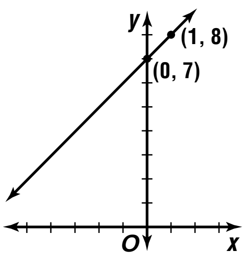
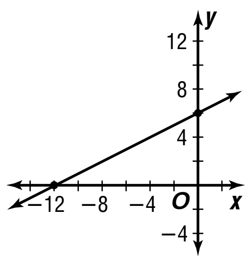
5.



7.

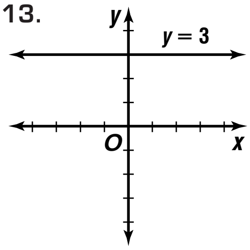


9. −12

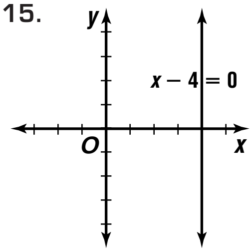


11a. (38.500, 173), (44.125, 188) **11b.** 2.667
11c. For each 1-centimeter increase in the length of a man's tibia, there is a 2.667-centimeter increase in the man's height.

13.



15.



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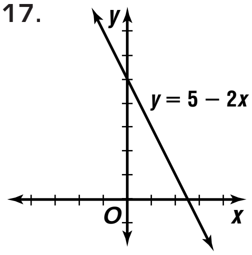
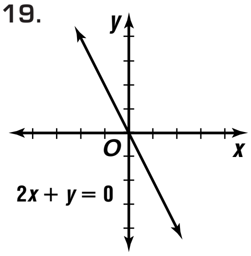


19.



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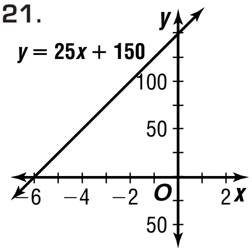

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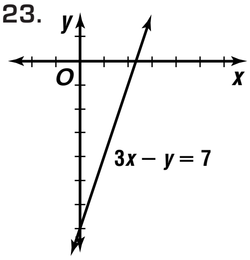
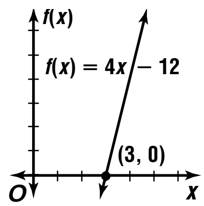
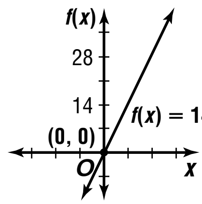


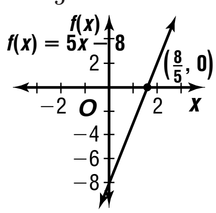
25. 3



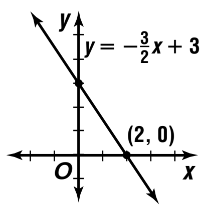
27. 0



29. $\frac{8}{5}$

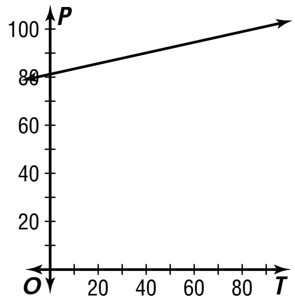


31. 2



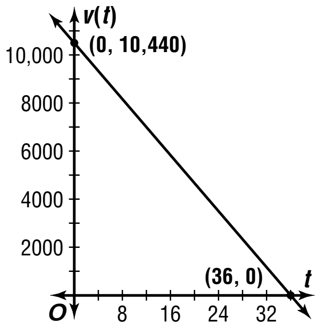
33a. 0.4 ohm **33b.** 2.4 volts **35a.** $\frac{1}{4}$ **35b.** For each 1-degree increase in the temperature, there is a $\frac{1}{4}$-pascal increase in the pressure.

35c.



37a. 36; The software has no monetary value after 36 months. **37b.** −290; For every 1-month change in the number of months, there is a \$290 decrease in the value of the software.

37c.



39a. 0.86 **39b.** \$1552.30 **39c.** 0.14 **39d.** \$252.70 **41a.** $d(p) = 0.88p$ **41b.** $r(d) = d - 100$ **41c.** $r(p) = 0.88p - 100$ **41d.** \$603.99, \$779.99, \$1219.99 **43.** −671 **45.** {(−3, 14), (−2, 13), (−1, 12), (0, 11)}, yes

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7. $y = 4x - 10$ **9.** $y = 2$ **11.** $y = 5x - 2$ **13.** $y = -\frac{3}{4}x$ **15.** $y = 6x - 19$ **17.** $y = -\frac{4}{9}x + \frac{49}{9}$ **19.** $y = 1$ **21.** $x = 0$ **23.** $x + 2y + 10 = 0$ **25a.** $t = 2 + \frac{x - 7000}{2000}$ **25b.** about 5.7 weeks **27a.** Sample answer: Using (20, 28) and (27, 37), $y = \frac{9}{7}x + \frac{16}{7}$ **27b.** Using sample answer from part a, 26.7 mpg **27c.** Sample answer: The estimate is close but not exact since only two points were used to write the equation. **29.** Yes; the slope of the line through (5, 9) and (−3, 3) is $\frac{3 - 9}{-3 - 5}$ or $\frac{3}{4}$. The slope of the line through (−3, 3), and (1, 6) is $\frac{6 - 3}{1 - (-3)}$ or $\frac{3}{4}$. Since these two lines would have the same slope and would share a point, their equations would be the same. Thus, they are the same line and all three points are collinear. **31a.** \$6111 billion **31b.** The rate is the slope. **33.** $x^5 - 3x^4 + 7x^3$, $\frac{x^3}{x^2 - 3x + 7}$ **35.** A

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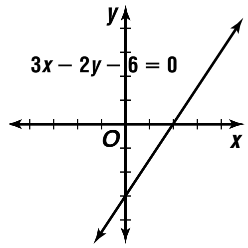
5. none of these **7.** parallel **9.** $5x - y - 16 = 0$ **11.** parallelogram **13.** parallel **15.** perpendicular **17.** perpendicular **19.** coinciding **21.** None of these; the slopes are neither the same nor opposite reciprocals. **23.** $4x - 9y - 183 = 0$ **25.** $x + 5y + 15 = 0$ **27.** $y + 13 = 0$ **29a.** 4 **29b.** $-\frac{49}{4}$ **31.** $x - 5y - 29 = 0$; $x = 7$; $x + 5y + 15 = 0$ **33a.** No; the lines that represent the situation do not coincide. **33b.** Yes; the lines that represent the situation coincide. **35.** $y = -2x + 7$

37.



39. Sample answer: {(2, 4), (2, −4), (1, 2), (1, −2), (0, 0)}; because the *x*-values 1 and 2 are paired with more than one *y*-value

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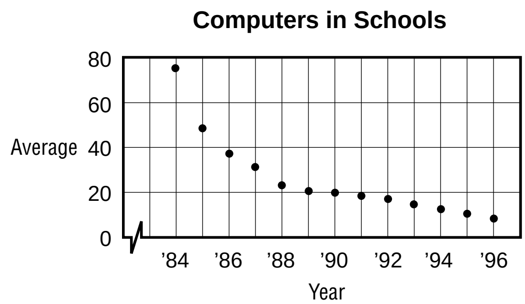
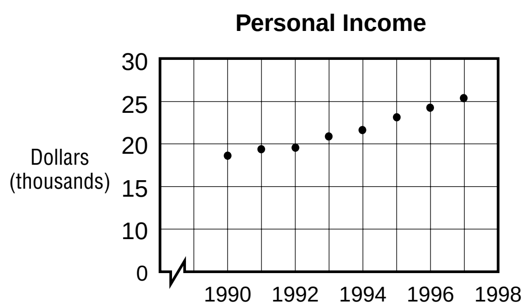
5a.



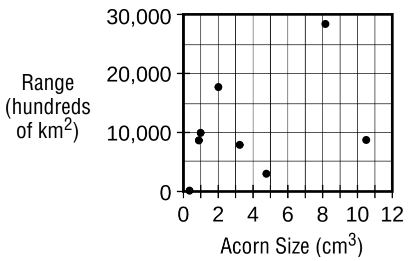
5b. Sample answer: Using (1987, 32) and (1996, 7.8), $y = -2.69x + 5377.03$ **5c.** $y = -6.28x + 12{,}530.14$; $r \approx -0.82$ **5d.** 1995; No; In 1995 there were 10 students per computer.

7a.



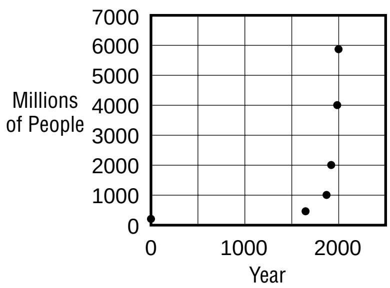
7b. Sample answer: Using (1991, 19,100) and (1995, 23,233), $y = 1058.25x - 2{,}087{,}875.75$
7c. $y = 1052.32x - 2{,}076{,}129.64$; $r \approx 0.99$
7d. \$33,771.96; Yes, *r* shows a strong relationship.

9a. **Acorn Size and Range**



9b. Sample answer: Using (0.3, 233) and (3.4, 7900), $y = 2473.23x - 508.97$ **9c.** $y = 885.82 + 6973.14$; $r \approx 0.38$ **9d.** The correlation value does not show a strong or moderate relationship.

11a. **World Population**



11b. Using (1, 200) and (1998, 5900), $y = 2.85x + 197.14$ **11c.** $y = 1.62x - 277.53$; $r \approx 0.56$
11d. 2979 million; No, the correlation value is not showing a very strong relationship. **13.** The rate of growth, which is the slope of the graphs of the regression equations, for the women is less than that of the men's rate of growth. If that trend continues, the men's median salary will always be more than the women's. **15.** $6x + y + 22 = 0$ **17.** $x^3 + 3x^2 + 3x + 1$; $x^3 + 1$ **19.** C

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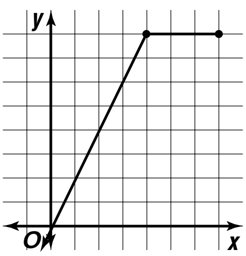
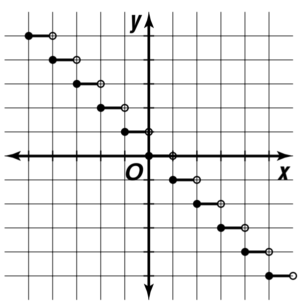
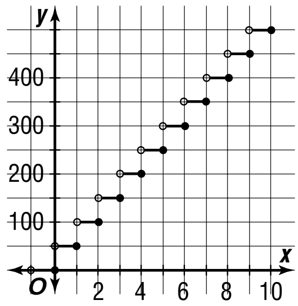
5.



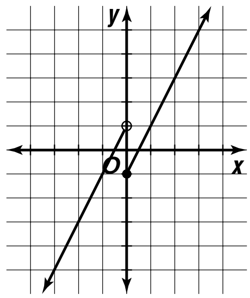
7.



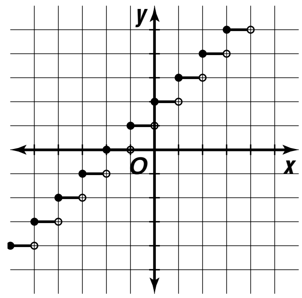
9. greatest integer function; h is hours, $c(h)$ is the cost, $c(h) = \begin{cases} 50h \text{ if } [\![h]\!] = h \\ 50[\![h + 1]\!] \text{ if } [\![h]\!] < h \end{cases}$



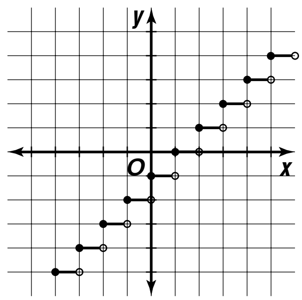
11.



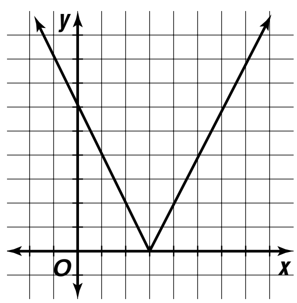
13.



15.



17.



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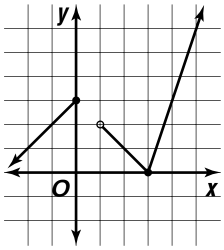
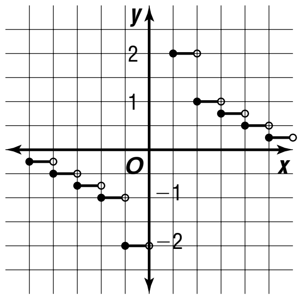
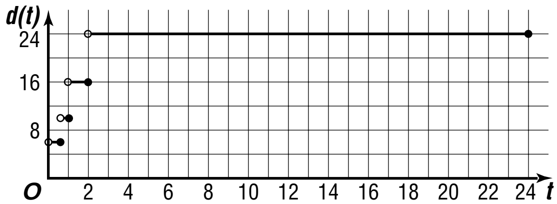
19.



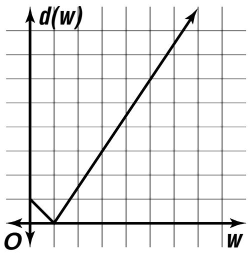
21.



23. step; t is the time in hours, $c(t)$ is the cost in dollars, $c(t) = \begin{cases} 6 \text{ if } t \leq \frac{1}{2} \\ 10 \text{ if } \frac{1}{2} < t \leq 1 \\ 16 \text{ if } 1 < t \leq 2 \\ 24 \text{ if } 2 < t \leq 24 \end{cases}$



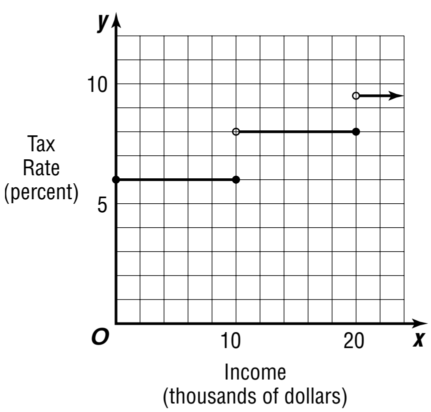
25. w is the weight in pounds, $d(w)$ is the discrepancy, $d(w) = |1 - w|$



27. If n is any integer, then all ordered pairs (x, y) where x and y are both in the interval $[n, n + 1)$ are solutions. **29a.** step

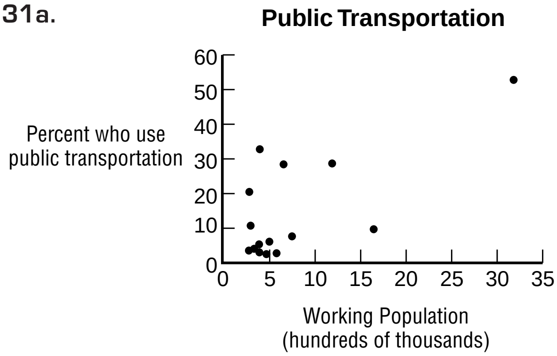
29b. $t(x) = \begin{cases} 6\% \text{ if } x \leq \$10{,}000 \\ 8\% \text{ if } \$10{,}000 < x \leq \$20{,}000 \\ 9.5\% \text{ if } x > \$20{,}000 \end{cases}$

29c.



29d. 9.5%

31a.



31b. Sample answer: Using (3,183,088, 53.4) and (362,777, 3.3), $y = 0.0000178x - 3.26$
31c. $y = 0.0000136x + 4.55$, $r \approx 0.68$ **31d.** 8.73%; No, the actual value is 22%. **33a.** (39, 29), (32, 15) **33b.** 2 **33c.** The average number of points scored each minute. **35.** $47.92 **37.** A

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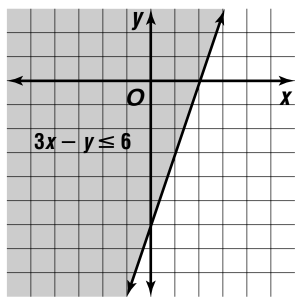
5.



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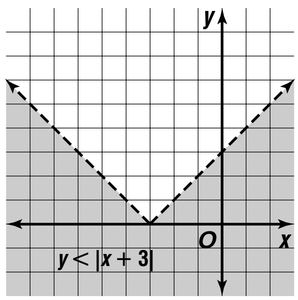
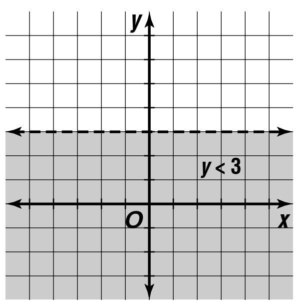


9.



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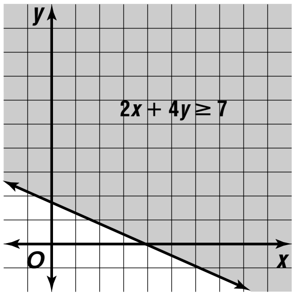

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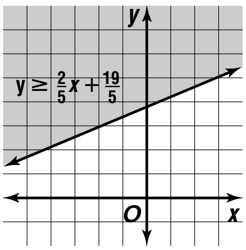

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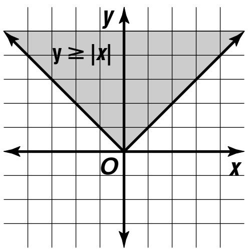

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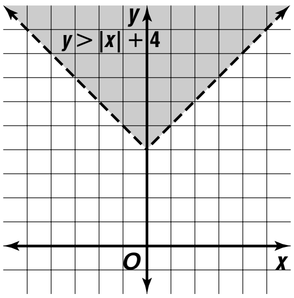

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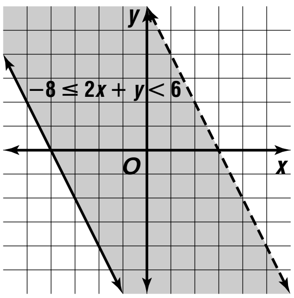

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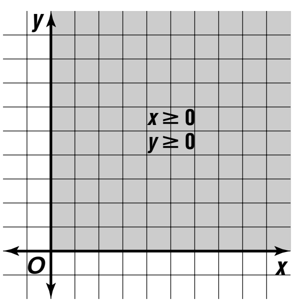
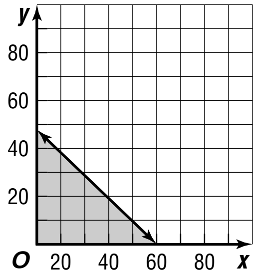


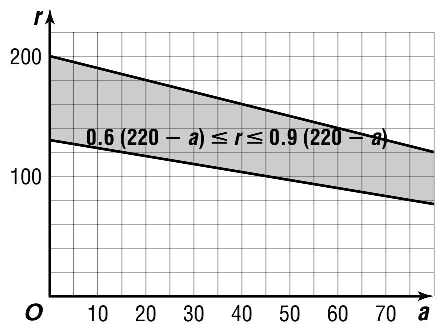
23a. $8x + 10y \leq 480$

23b.



23c. Sample answer: (0, 48), (60, 0), (45, 6)
23d. Sample answer: Using complex computer programs and systems of inequalities. **25a.** points in the first and third quadrants **25b.** If x and y satisfy the inequality, then either $x \geq 0$ and $y \geq 0$ or $x \leq 0$ and $y \leq 0$. If $x \geq 0$ and $y \geq 0$, then $|x| = x$ and $|y| = y$. Thus, $|x| + |y| = x + y$. Since $x + y$ is positive, $|x + y| = x + y$. If $x \leq 0$ and $y \leq 0$, then $|x| = -x$ and $|y| = -y$. Then $|x| + |y| = -x + (-y)$ or $-(x + y)$. Since both x and y are negative, $(x + y)$ is negative, and $|x + y| = -(x + y)$.
27a. $0.6(220 - a) \leq r \leq 0.9(220 - a)$

27b.



29a. $3x - y - 2 = 0$ **29b.** $x + 3y + 6 = 0$
31a. (0, 23), (16, 48); 1.5625 **31b.** the average change in the temperature per hour

Pages 57–61 Chapter 1 Study Guide and Assessment

1. c **3.** d **5.** i **7.** h **9.** e **11.** 10 **13.** 57
15. $\frac{6}{5}$ **17.** $|m^2 + 5m + 4|$ **19.** $x^2 + 5x - 2$; $x^2 + 3x + 2$; $x^3 + 2x^2 - 8x$; $\frac{x^2 + 4x}{x - 2}$, $x \neq 2$
21. $x^2 + 8x + 16$; $x^2 + 6x + 8$; $x^3 + 11x^2 + 40x + 48$; $x + 3$, $x \neq -4$ **23.** $\frac{x^3 - 8x^2 + 16x + 4}{x - 4}$, $x \neq 4$; $\frac{x^3 - 8x^2 + 16x - 4}{x - 4}$, $x \neq 4$; $4x$, $x \neq 4$; $\frac{x^3 - 8x^2 + 16x}{4}$, $x \neq 4$ **25.** $1.5x^2 + 5$; $0.75x^2 + 15x + 75$ **27.** $x^2 - x + 7$; $x^2 + 11x + 31$
29. $-2x^2 - 7$; $2x^2 - 12x + 28$

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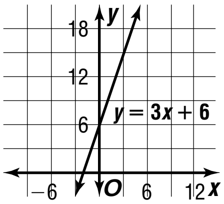
31.



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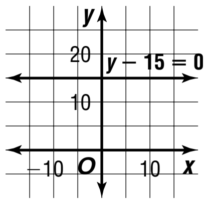

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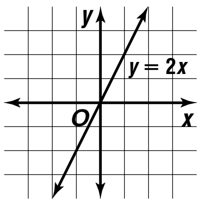
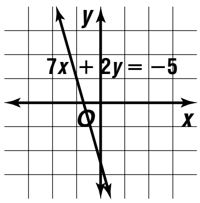
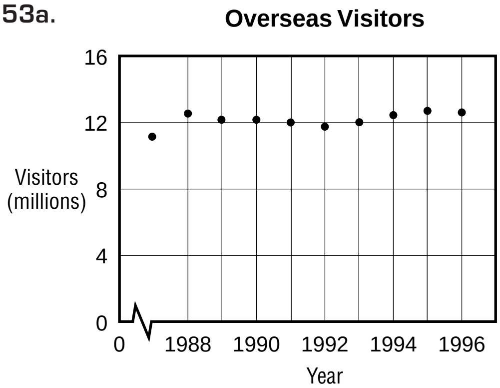


37.



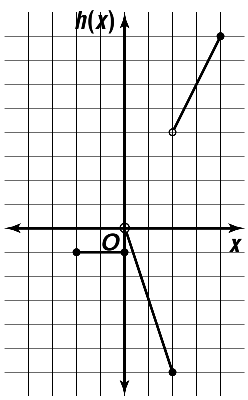
39. $y = 2x - 3$ **41.** $y = \frac{1}{2}x + \frac{9}{2}$ **43.** $y = 4x - 4$ **45.** $y = 0$ **47.** $x - y = 0$ **49.** $2x + y + 4 = 0$ **51.** $x + 2y - 9 = 0$

53a.



53b. Sample answer: Using (1987, 10,434) and (1996, 12,909), $y = 275x - 535{,}991$
53c. $y = 147.8x - 282{,}157.4$; $r \approx 0.61$
53d. 14,181,600 visitors; Sample answer: This is not a good prediction, because the r-value does not indicate a strong relationship.

55.



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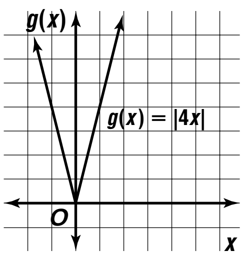
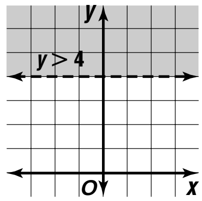
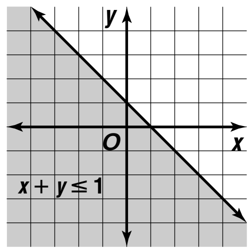


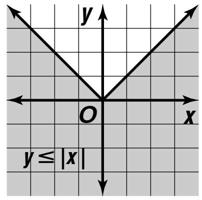
59.



61.



63.



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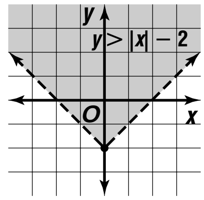
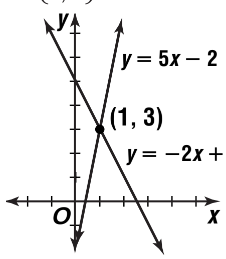


67a. 10 m, 40 m, 90 m, 160 m, 250 m **67b.** Yes, each element of the domain is paired with exactly one element of the range. **69.** $y = -0.284x + 12.964$; The correlation is moderately negative, so the regression line is somewhat representative of the data.

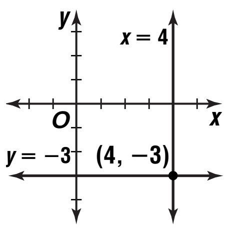
Page 65 Chapter 1 SAT and ACT Practice
1. D **3.** B **5.** A **7.** A **9.** C

Chapter 2 Systems of Equations and Inequalities

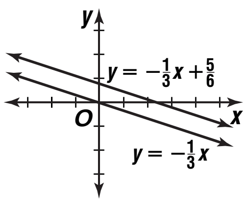
Pages 70–72 Lesson 2-1
5. (1, 3)



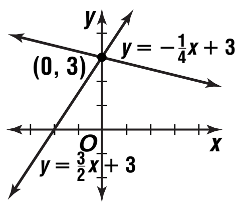
7. (2, −5) **9.** (6, 4) **11.** consistent and independent **13.** consistent and dependent
15. (4, −3)



17. no solution



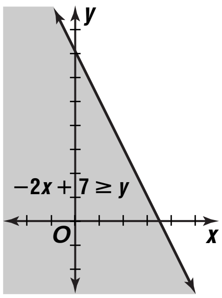
19. (0, 3)



21. (3, 21) **23.** (5.25, 0.75) **25.** (5, 2)
27. $\left(\frac{1}{3}, \frac{2}{3}\right)$ **29.** $\left(-\frac{6}{43}, -\frac{64}{43}\right)$

31. Sample answer: Elimination could be considered easiest since the first equation multiplied by 2 added to the second equation eliminates b; Substitution could also be considered easiest since the first equation can be written as $a = b$, making substitution very easy; $(-3, -3)$. **33a.** 6, 6, 8; 6, 6, 8 **33b.** isosceles **35a.** (7, 5.95) **35b.** If you drink 7 servings of soft drink, the price for each option is the same. If you drink fewer than 7 servings of soft drink during that week, the disposable cup price is better. If you drink more than 7 servings of soft drink, the refillable mug price is better. **35c.** Over a year's time, the refillable mug would be more economical. **37.** $1500

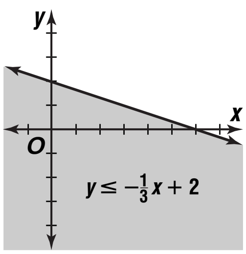
39.



41. $y = 2x + 6$ **43.** $3x + 1$ **45.** A

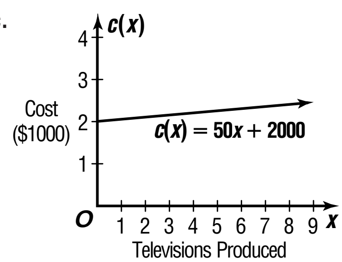
Pages 76–77 Lesson 2-2

5. $(7, -1, 1)$ **7.** acceleration: -32 ft/s^2, initial velocity: 56 ft/s, initial height: 35 ft **9.** $(-2, 2, 4)$ **11.** $(-6, -4, 7)$ **13.** no solution **15.** $(11, -17, 14)$ **17.** $(-4, 10, 7)$ **19.** International Fund = $1200; Fixed Assets Fund = $200; company stock = $600 **21.** $(-32, 138, 2)$ **23.** $(1, 1, 1), (-2, -2, -2)$ **25.**



27a. $C(x) = 50x + 2000$ **27b.** $2000, $50

27c.



Pages 82–86 Lesson 2-3

5. $(7, 2)$ **7.** $(4, 0)$ **9.** impossible **11.** $\begin{bmatrix} 16 & 4 \\ -8 & 24 \end{bmatrix}$

13. $[6 \quad -18]$ **15.** $(6, 11)$ **17.** $(5, 2.5)$ **19.** $(7, 9)$ **21.** $(-5, -15)$ **23.** $(-1, 1)$ **25.** $(5, 3, 2)$

27. $\begin{bmatrix} 8 & 12 \\ -7 & 9 \end{bmatrix}$ **29.** impossible **31.** $\begin{bmatrix} -2 & -2 \\ 5 & 7 \end{bmatrix}$

33. $\begin{bmatrix} 0 & 4 & 8 \\ -8 & 12 & 0 \\ 16 & 16 & -8 \end{bmatrix}$ **35.** $\begin{bmatrix} -14 & 3 & -2 \\ -2 & 3 & 5 \end{bmatrix}$

37. $\begin{bmatrix} 25 & 35 \\ -30 & 5 \end{bmatrix}$ **39.** impossible

41. $\begin{bmatrix} 16 & 4 & 12 \\ -22 & -14 & 16 \end{bmatrix}$ **43.** $\begin{bmatrix} 10 & -13 & -10 \\ -5 & 14 & -3 \end{bmatrix}$

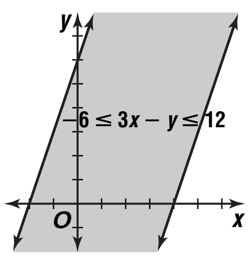
45. $\begin{bmatrix} -42 & 86 & -160 \\ -421 & 213 & -111 \end{bmatrix}$ **47.** $\begin{bmatrix} 78 & 30 & 12 \\ 12 & -120 & 168 \\ 72 & 90 & -72 \end{bmatrix}$

49. Sample answer:

	1996	2000	2006
18 to 24	8485	8526	8695
25 to 34	10,102	9316	9078
35 to 44	8766	9039	8433
45 to 54	6045	6921	7900
55 to 64	2444	2741	3521
65 and older	2381	2440	2572

51a. $a = 1, b = 0, c = 0, d = 1$ **51b.** a matrix equal to the original one **53.** The numbers in the first row are the triangular numbers. If you look at the diagonals in the matrix, the triangular numbers are the end numbers. To find the diagonal that contains 2001, find the smallest triangular number that is greater than or equal to 2001. The formula for the nth triangular number is $\frac{n(n+1)}{2}$. Solve $\frac{n(n+1)}{2} \geq 2001$. The solution is 63. So the 63rd entry in the first row is $\frac{63(63+1)}{2} = 2016$. Since $2016 - 2001 = 15$, we must count 15 places backward along the diagonal to locate 2001 in the matrix. This movement takes us from the position (row, column) = $(1, 63)$ to $(1 + 15, 63 - 15) = (16, 48)$. **55.** $\left(\frac{1}{2}, \frac{1}{3}, \frac{1}{4}\right)$

57.



59. Sample answer: $y = 0.36x + 61.4$ **61.** $\frac{3}{5}$ **63.** -2656

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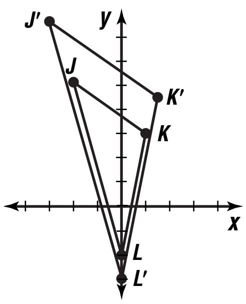
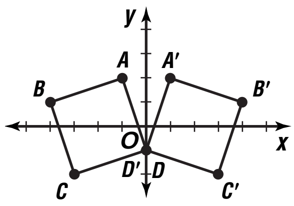
Pages 93–96 Lesson 2-4

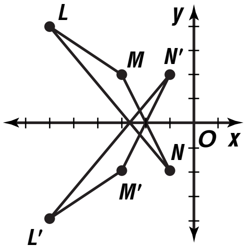
5. $J'(-3, 7.5)$, $K'(1.5, 4.5)$, $L'(0, -3)$



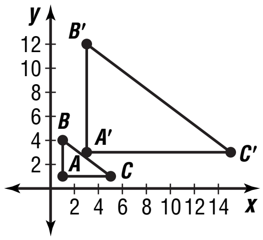
7. $A'(1, 2)$, $B'(4, 1)$, $C'(3, -2)$, $D'(0, -1)$



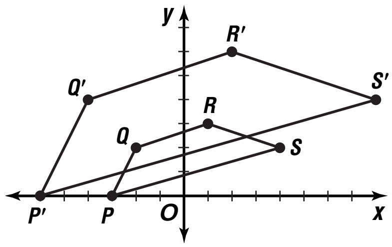
9. $L'(-6, -4)$, $M'(-3, -2)$, $N'(-1, 2)$



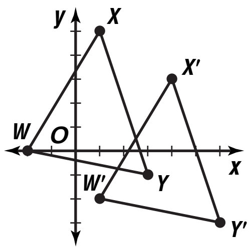
11. $A'(3, 3)$, $B'(3, 12)$, $C'(15, 3)$



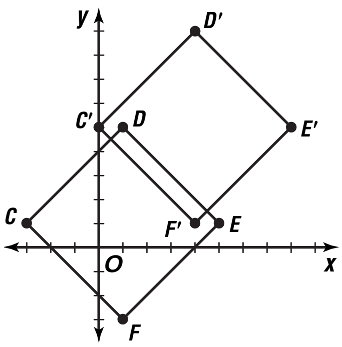
13. $P'(-6, 0)$, $Q'(-4, 4)$, $R'(2, 6)$, $S'(8, 4)$



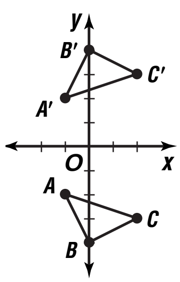
15. $W'(1, -2)$, $X'(4, 3)$, $Y'(6, -3)$



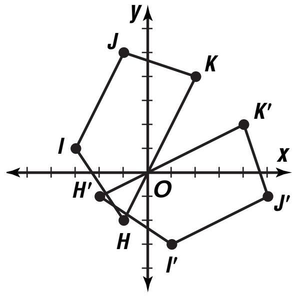
17. $C'(0, 5)$, $D'(4, 9)$, $E'(8, 5)$, $F'(4, 1)$



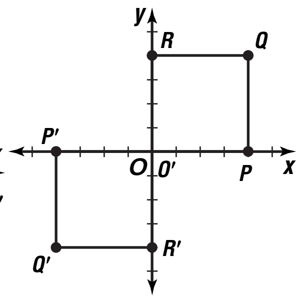
19. $A'(-1, 2)$, $B'(0, 4)$, $C'(2, 3)$



21. $H(-2, -1)$, $I'(1, -3)$, $J'(5, -1)$, $K'(4, 2)$



23. $O'(0, 0)$, $P'(-4, 0)$, $Q'(-4, -4)$, $R'(0, -4)$



25a. Let $\begin{bmatrix} a & b \\ c & d \end{bmatrix} = R_{x\text{-axis}}$.

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \cdot \begin{bmatrix} 1 & -2 & -1 \\ 3 & -1 & -3 \end{bmatrix} = \begin{bmatrix} 1 & -2 & -1 \\ -3 & 1 & 3 \end{bmatrix}$$

$$\begin{bmatrix} a + 3b & -2a - b & -a - 3b \\ c + 3d & -2c - d & -c - 3d \end{bmatrix} = \begin{bmatrix} 1 & -2 & -1 \\ -3 & 1 & 3 \end{bmatrix}$$

$a + 3b = 1$ $\quad -2a - b = -2$ $\quad -a - 3b = -1$

$c + 3d = -3$ $\quad -2c - d = 1$ $\quad -c - 3d = 3$

Thus, $a = 1$, $b = 0$, $c = 0$, and $d = -1$. By substitution, $R_{x\text{-axis}} = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$.

25b. Let $\begin{bmatrix} a & b \\ c & d \end{bmatrix} = R_{y\text{-axis}}$.

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \cdot \begin{bmatrix} 1 & -2 & -1 \\ 3 & -1 & -3 \end{bmatrix} = \begin{bmatrix} -1 & 2 & 1 \\ 3 & -1 & -3 \end{bmatrix}$$

$$\begin{bmatrix} a + 3b & -2a - b & -a - 3b \\ c + 3d & -2c - d & -c - 3d \end{bmatrix} = \begin{bmatrix} -1 & 2 & 1 \\ 3 & -1 & -3 \end{bmatrix}$$

$a + 3b = -1$ $\quad -2a - b = 2$ $\quad -a - 3b = 1$

$c + 3d = 3$ $\quad -2c - d = -1$ $\quad -c - 3d = -3$

Thus, $a = -1$, $b = 0$, $c = 0$, and $d = 1$. By substitution, $R_{y\text{-axis}} = \begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$.

25c. Let $\begin{bmatrix} a & b \\ c & d \end{bmatrix} = R_{y = x}$.

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \cdot \begin{bmatrix} 1 & -2 & -1 \\ 3 & -1 & -3 \end{bmatrix} = \begin{bmatrix} 3 & -1 & -3 \\ 1 & -2 & -1 \end{bmatrix}$$

$$\begin{bmatrix} a + 3b & -2a - b & -a - 3b \\ c + 3d & -2c - d & -c - 3d \end{bmatrix} = \begin{bmatrix} 3 & -1 & -3 \\ 1 & -2 & -1 \end{bmatrix}$$

$a + 3b = 3$ $\quad -2a - b = -1$ $\quad -a - 3b = -3$

$c + 3d = 1$ $\quad -2c - d = -2$ $\quad -c - 3d = -1$

Thus, $a = 0$, $b = 1$, $c = 1$, and $d = 0$. By substitution, $R_{y = x} = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$.

25d. Let $\begin{bmatrix} a & b \\ c & d \end{bmatrix} = Rot_{90}$.

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \cdot \begin{bmatrix} 1 & -2 & -1 \\ 3 & -1 & -3 \end{bmatrix} = \begin{bmatrix} -3 & 1 & 3 \\ 1 & -2 & -1 \end{bmatrix}$$

$$\begin{bmatrix} a + 3b & -2a - b & -a - 3b \\ c + 3d & -2c - d & -c - 3d \end{bmatrix} = \begin{bmatrix} -3 & 1 & 3 \\ 1 & -2 & -1 \end{bmatrix}$$

$a + 3b = -3 \quad -2a - b = -1 \quad -a - 3b = 3$
$c + 3d = 1 \quad -2c - d = -2 \quad -c - 3d = -1$

Thus, $a = 0$, $b = -1$, $c = 1$, and $d = 0$. By substitution, $Rot_{90} = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$.

25e. Let $\begin{bmatrix} a & b \\ c & d \end{bmatrix} = Rot_{180}$.

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \cdot \begin{bmatrix} 1 & -2 & -1 \\ 3 & -1 & -3 \end{bmatrix} = \begin{bmatrix} -1 & 2 & 1 \\ -3 & 1 & 3 \end{bmatrix}$$

$$\begin{bmatrix} a + 3b & -2a - b & -a - 3b \\ c + 3d & -2c - d & -c - 3d \end{bmatrix} = \begin{bmatrix} -1 & 2 & 1 \\ -3 & 1 & 3 \end{bmatrix}$$

$a + 3b = -1 \quad -2a - b = 2 \quad -a - 3b = 1$
$c + 3d = -3 \quad -2c - d = 1 \quad -c - 3d = 3$

Thus, $a = -1$, $b = 0$, $c = 0$, and $d = -1$. By substitution, $Rot_{180} = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$.

25f. Let $\begin{bmatrix} a & b \\ c & d \end{bmatrix} = Rot_{270}$.

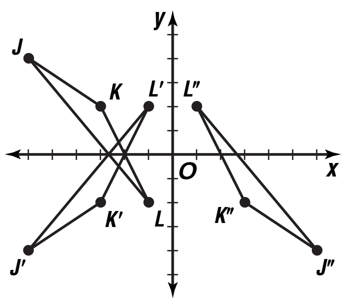
$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \cdot \begin{bmatrix} 1 & -2 & -1 \\ 3 & -1 & -3 \end{bmatrix} = \begin{bmatrix} 3 & -1 & -3 \\ -1 & 2 & 1 \end{bmatrix}$$

$$\begin{bmatrix} a + 3b & -2a - b & -a - 3b \\ c + 3d & -2c - d & -c - 3d \end{bmatrix} = \begin{bmatrix} 3 & -1 & -3 \\ -1 & 2 & 1 \end{bmatrix}$$

$a + 3b = 3 \quad -2a - b = -1 \quad -a - 3b = -3$
$c + 3d = -1 \quad -2c - d = 2 \quad -c - 3d = 1$

Thus, $a = 0$, $b = 1$, $c = -1$, and $d = 0$. By substitution, $Rot_{270} = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$.

27. $J''(6, -4)$, $K''(3, -2)$, $L''(1, 2)$



29a. The bishop moves along a diagonal until it encounters the edge of the board or another piece. The line along which it moves changes vertically and horizontally by 1 unit with each square moved, so the translation matrices are scalars. Sample matrices are $c\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$, $c\begin{bmatrix} 1 & 1 \\ -1 & -1 \end{bmatrix}$, $c\begin{bmatrix} -1 & -1 \\ 1 & 1 \end{bmatrix}$, and $c\begin{bmatrix} -1 & -1 \\ -1 & -1 \end{bmatrix}$, where c is the number of squares moved.

29b. The knight moves in combinations of 2 vertical-1 horizontal or 1 vertical-2 horizontal squares. These can be either up or down, left or right. Sample matrices are $\begin{bmatrix} 1 & 1 \\ 2 & 2 \end{bmatrix}$, $\begin{bmatrix} 1 & 1 \\ -2 & -2 \end{bmatrix}$, $\begin{bmatrix} -1 & -1 \\ 2 & 2 \end{bmatrix}$, $\begin{bmatrix} -1 & -1 \\ -2 & -2 \end{bmatrix}$, $\begin{bmatrix} 2 & 2 \\ 1 & 1 \end{bmatrix}$, $\begin{bmatrix} 2 & 2 \\ -1 & -1 \end{bmatrix}$, $\begin{bmatrix} -2 & -2 \\ 1 & 1 \end{bmatrix}$, and $\begin{bmatrix} -2 & -2 \\ -1 & -1 \end{bmatrix}$.

29c. The king can move 1 unit in any direction. The matrices describing this are $\begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}$, $\begin{bmatrix} -1 & -1 \\ 0 & 0 \end{bmatrix}$, $\begin{bmatrix} 0 & 0 \\ 1 & 1 \end{bmatrix}$, $\begin{bmatrix} 0 & 0 \\ -1 & -1 \end{bmatrix}$, $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$, $\begin{bmatrix} 1 & 1 \\ -1 & -1 \end{bmatrix}$, $\begin{bmatrix} -1 & -1 \\ 1 & 1 \end{bmatrix}$, and $\begin{bmatrix} -1 & -1 \\ -1 & -1 \end{bmatrix}$.

31. (0, −125); (125, 0), (0, 125), (−125, 0) **33.** The repeated dilations animate the growth of something from small to larger similar to a lens zooming into the origin. **35.** $\begin{bmatrix} 4 & 13 \\ -4 & 12 \end{bmatrix}$

37. hardbacks \$1, paperbacks \$0.25

39. $4x - y + 9 = 0$ **41.** $x^5 - 3x^4 + 7x^3$, $\frac{x^3}{x^2 - 3x + 7}$

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5. 10 **7.** −413 **9.** $-\frac{1}{29}\begin{bmatrix} 7 & -3 \\ -5 & -2 \end{bmatrix}$

11. $\left(-\frac{111}{13}, \frac{129}{13}\right)$ **13.** 8 kg of the metal with 55% aluminum and 12 kg of the metal with 80% aluminum

15. 4 **17.** 4 **19.** 48 **21.** −37 **23.** 1

25. 175.668 **27.** $-\frac{1}{10}\begin{bmatrix} -2 & 3 \\ 2 & 2 \end{bmatrix}$ **29.** $\frac{1}{6}\begin{bmatrix} 2 & -2 \\ -1 & 4 \end{bmatrix}$

31. does not exist **33.** $\begin{bmatrix} \frac{1}{2} & \frac{1}{8} \\ -5 & \frac{3}{4} \end{bmatrix}$ **35.** (0, −2)

37. $\left(\frac{7}{12}, \frac{7}{12}\right)$ **39.** $\left(\frac{1}{3}, -\frac{2}{3}\right)$ **41.** $\left(\frac{2}{9}, -\frac{4}{3}, -\frac{1}{3}\right)$

43. 30,143 **45.** (2, −1, 3)

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47. Let $A = \begin{bmatrix} a_1 & b_1 \\ a_2 & b_2 \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$.

$$A^{-1} = \begin{bmatrix} \dfrac{b_2}{a_1b_2 - a_2b_1} & \dfrac{-b_1}{a_1b_2 - a_2b_1} \\ \dfrac{-a_2}{a_1b_2 - a_2b_1} & \dfrac{a_1}{a_1b_2 - a_2b_1} \end{bmatrix}$$

$$AA^{-1} = \begin{bmatrix} \dfrac{a_1b_2 - a_2b_1}{a_1b_2 - a_2b_1} & \dfrac{-a_1b_1 + b_1a_1}{a_1b_2 - a_2b_1} \\ \dfrac{a_2b_2 - a_2b_2}{a_1b_2 - a_2b_1} & \dfrac{a_1b_2 - a_2b_1}{a_1b_2 - a_2b_1} \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I$$

Thus, $AA^{-1} = I$.

49. Yes

$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$. Does $(A^2)^{-1} = (A^{-1})^2$?

$$A^2 = \begin{bmatrix} a^2 + bc & ab + bd \\ ac + cd & bc + d^2 \end{bmatrix}$$

$$(A^2)^{-1} = \frac{1}{a^2d^2 - 2abcd + b^2d^2} \begin{bmatrix} bc + d^2 & -ab - bd \\ -ac - cd & a^2 + bc \end{bmatrix}$$

$$A^{-1} = \frac{1}{ad - bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix} = \begin{bmatrix} \dfrac{d}{ad - bc} & \dfrac{-b}{ad - bc} \\ \dfrac{-c}{ad - bc} & \dfrac{a}{ad - bc} \end{bmatrix}$$

$$(A^{-1})^2 = \frac{1}{a^2d^2 - 2abcd + b^2d^2} \begin{bmatrix} bc + d^2 & -ab - bd \\ -ac - cd & a^2 + bc \end{bmatrix}$$

Thus, $(A^2)^{-1} = (A^{-1})^2$.

51. computer system: \$959, printer: \$239

53. $H'(5, 9)$, $I'(1, 5)$, $J'(-3, 9)$, $K'(1, 13)$

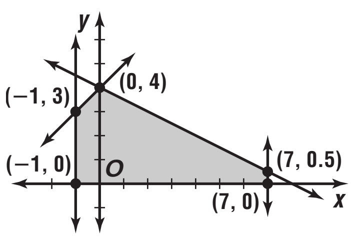
55. infinitely many solutions **57.** $x - 2y + 8 = 0$

59a. $\frac{1}{12}$ or approximately 0.0833 **59b.** 1.5 ft

61. No, more than one member of the range is paired with the same member of the domain.

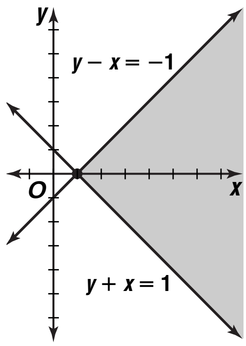
Pages 109–111 Lesson 2-6

5. $(-1, 0)$, $(-1, 3)$, $(0, 4)$, $(7, 0.5)$, $(7, 0)$

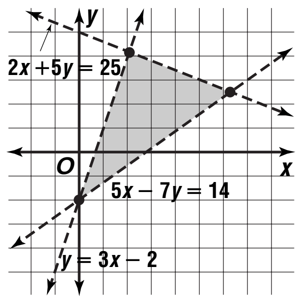


7. 3, −11

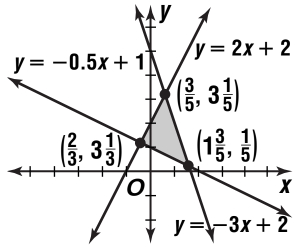
9.



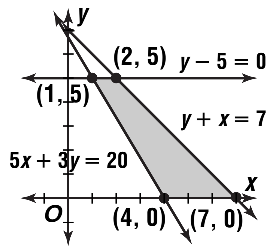
11.



13. $\left(\frac{3}{5}, 3\frac{1}{5}\right)$, $\left(-\frac{2}{5}, 1\frac{1}{5}\right)$, $\left(1\frac{3}{5}, \frac{1}{5}\right)$

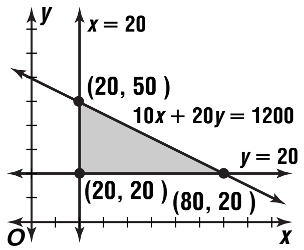


15. (2, 5), (7, 0), (4, 0), (1, 5)

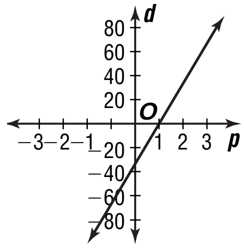


17. 19, 2 **19.** 16, 2 **21.** 9, −4 **23.** $x \le 4$, $x \ge -4$, $y \le 4$, $y \ge -4$ **25a.** vertices: $\left(5\frac{1}{2}, 0\right)$, $\left(6\frac{1}{2}, 0\right)$, $\left(9\frac{2}{3}, 6\frac{1}{3}\right)$, $\left(7\frac{1}{2}, 8\frac{1}{2}\right)$, $\left(2\frac{1}{2}, 8\frac{1}{2}\right)$, $\left(1\frac{1}{5}, 4\frac{3}{5}\right)$, $\left(2\frac{1}{2}, 2\right)$ **25b.** max at $\left(7\frac{1}{2}, 8\frac{1}{2}\right) = 88\frac{1}{2}$; min at $\left(2\frac{1}{2}, 2\right) = 24\frac{1}{2}$

27a.



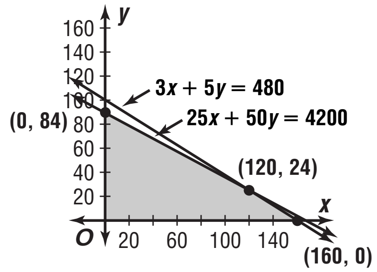
27b. $f(x, y) = 30x + 40y$ **27c.** 80 ft^2 at the Main St. site and 20 ft^2 at the High St. site **27d.** The maximum number of customers can be reached by renting 120 ft^2 at Main St. **29.** $\frac{1}{7}\begin{bmatrix} 2 & -1 \\ 3 & 2 \end{bmatrix}$

31. 

33. 60

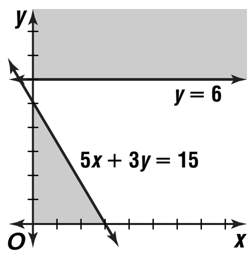
Pages 115–118 Lesson 2-7

5a. $25x + 50y \leq 4200$ **5b.** $3x + 5y \leq 480$

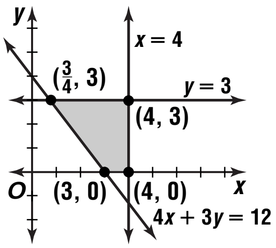
5c. 

5d. $P(x, y) = 5x + 8y$ **5e.** 160 small packages, 0 large packages **5f.** \$800 **5g.** No. If revenue is maximized, the company will not deliver any large packages, and customers with large packages to ship will probably choose another carrier for all of their business. **7.** 225 Explorers, 0 Grande Expeditions

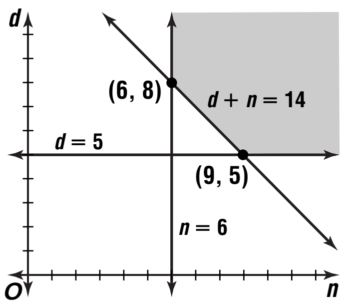
9. infeasible



11. alternate optimal solutions



13a. Let d = the number of day-shift workers and n = the number of night-shift workers. $d \geq 5$; $n \geq 6$; $d + n \geq 14$

13b. 

13c. $C(n, d) = 52d + 60n$ **13d.** 8 day-shift and 6 night-shift workers **13e.** \$776 **15.** 10 section-I questions, 2 section-II questions **17.** \$4000 in First Bank, \$7000 in City Bank **19.** 600 units of snack size, 1800 units of family-size

21. alternate optimal solutions **23a.** \$720 **23b.** Sample answer: Spend more than 30 hours per week on these services. **25.** (0, 6) **27.** Sample answer: $C = \$13.65 + \$0.15(n - 30)$; \$15.45

Pages 119–123 Chapter 2 Study Guide and Assessment

1. translation **3.** determinant **5.** scalar multiplication **7.** polygonal convex set

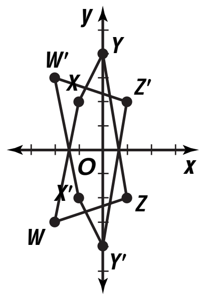
9. element **11.** $(2, -4)$ **13.** $\left(-\frac{5}{11}, -\frac{2}{11}\right)$

15. $(1, 2)$ **17.** $(-10, -6, 0)$ **19.** $(2, -1, 3)$

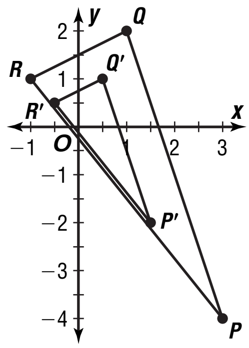
21. $\begin{bmatrix} -10 & -13 \\ 2 & 2 \end{bmatrix}$ **23.** $\begin{bmatrix} -8 \\ 20 \end{bmatrix}$ **25.** impossible

27. impossible

29. $W'(-2, 3)$, $X'(-1, -2)$, $Y'(0, -4)$, $Z'(1, 2)$



31. $P'(6, -8)$, $Q'(2, 4)$, $R'(-2, 2)$



33. $\begin{bmatrix} 1 & 1 & 1 \\ 3 & 3 & 3 \end{bmatrix}$ **35.** 0 **37.** 160 **39.** $\frac{1}{23}\begin{bmatrix} 5 & -8 \\ 1 & 3 \end{bmatrix}$

41. $\frac{1}{7}\begin{bmatrix} -4 & -5 \\ -1 & -3 \end{bmatrix}$ **43.** $\frac{1}{32}\begin{bmatrix} 1 & 5 \\ -6 & 2 \end{bmatrix}$ **45.** $(13, -5)$

47. $(-7, -4)$ **49.** 17, −4 **51.** 22 gallons in the truck and 6 gallons in the motorcycle **53.** 39 in., 31 in., 13 in.

Page 125 Chapter 2 SAT and ACT Practice

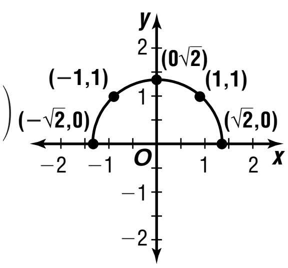
1. D **3.** D **5.** C **7.** D **9.** C

Chapter 3 The Nature of Graphs

Pages 134–136 Lesson 3-1

7. yes **9.** $y = x$ **11.** y-axis

13. x-intercept: (5, 0); other points: $\left(-6, \frac{3\sqrt{11}}{5}\right)$, $\left(6, -\frac{3\sqrt{11}}{5}\right)$, $\left(-6, -\frac{3\sqrt{11}}{5}\right)$



15. no

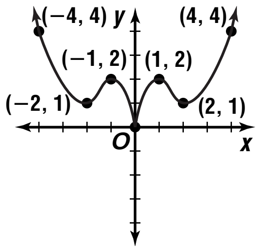
17. yes **19.** no

21. $y = x$ and $y = -x$

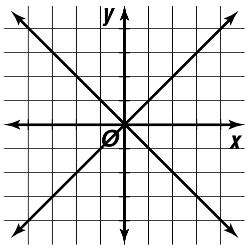
CONTENTS

23. none of these **25.** all **27.** x-axis and y-axis, $y = x$, and $y = -x$

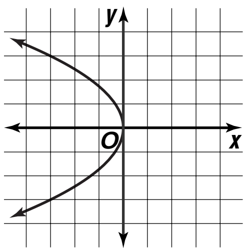
29.



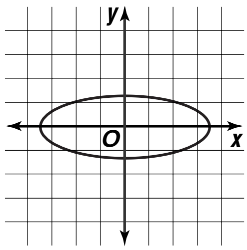
31. both



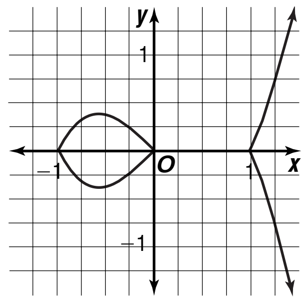
33. x-axis



35. both

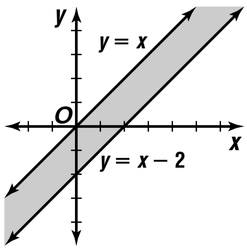


37. The equation $|y| = x^3 - x$ is symmetric about the x-axis.



39. Sample answer: $y = 0$
41. $(4\sqrt{2}, 6)$ or $(-4\sqrt{2}, 6)$
43. 50 bicycles, 75 tricycles
45. $(-2, -3, 7)$

47.

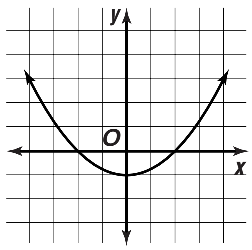


49. $-2x + 23$, $-2x + 5$

Pages 142–145 Lesson 3-2

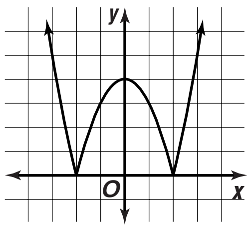
7. $g(x)$ is the graph of $f(x)$ compressed horizontally by a factor of $\frac{1}{3}$, reflected over the x-axis.
9a. translated up 3 units, portion of graph below x-axis reflected over the x-axis **9b.** reflected over the x-axis, compressed horizontally by a factor of $\frac{1}{2}$
9c. translated left 1 unit, compressed vertically by a factor of 0.75

11.

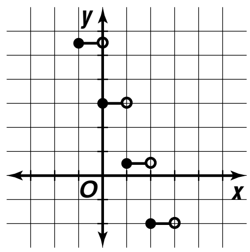


13. The graph of $g(x)$ is a translation of the graph of $f(x)$ up 6 units. **15.** The graph of $g(x)$ is the graph of $f(x)$ compressed horizontally by a factor of $\frac{1}{5}$. **17.** The graph of $g(x)$ is the graph of $f(x)$ expanded vertically by a factor of 3. **19.** $g(x)$ is the graph of $f(x)$ reflected over the x-axis, expanded horizontally by a factor of 2.5, translated up 3 units. **21a.** expanded horizontally by a factor of 5 **21b.** expanded vertically by a factor of 7, translated down 0.4 units **21c.** reflected across the x-axis, expanded vertically by a factor of 9, translated left 1 unit **23a.** compressed vertically by a factor of $\frac{1}{3}$, translated left 2 units **23b.** reflected over the y-axis, translated down 7 units **23c.** translated right 3 units and up 4 units, expanded vertically by a factor of 2 **25a.** compressed horizontally by a factor of $\frac{2}{5}$, translated down 3 units
25b. reflected over the y-axis, compressed vertically by a factor of 0.75 **25c.** The portion of the parent graph on left of the y-axis is replaced by a reflection of the portion on the right of the y-axis. The new image is then translated 4 units right.

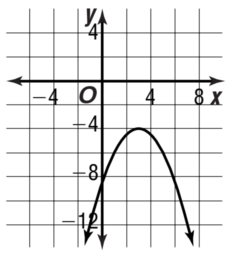
27. $y = \frac{0.25}{x - 4} + 3$ **29.**



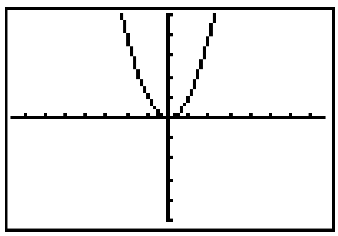
31.



33.



35a. 0



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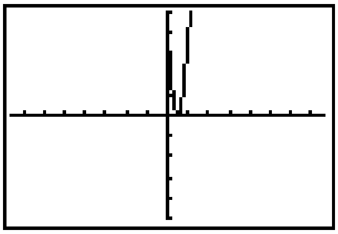
35b. 0.5



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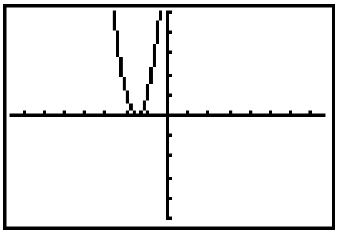
35c. −1.5



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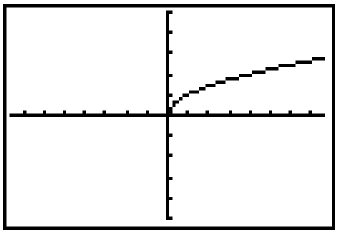
37a. 0



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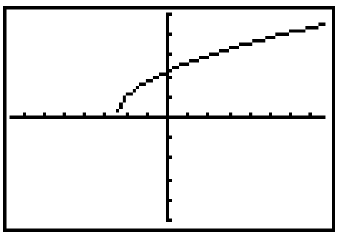
37b. −2.5



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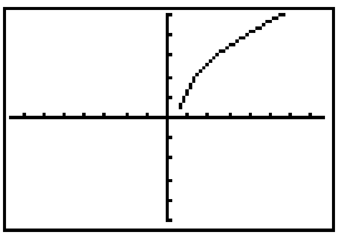
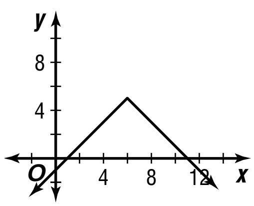
37c. 0.6



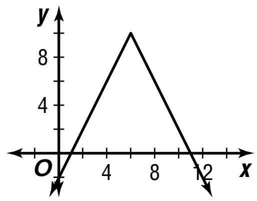
[−7.6, 7.6] scl:1 by [−5, 5] scl:1

39. The x-intercept will be $-\frac{b}{a}$.

41a. 25 units^2

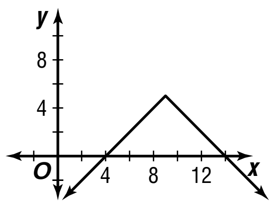


41b.



The area of the triangle is $\frac{1}{2}(10)(10)$ or 50 units^2. Its area is twice as large as that of the original triangle. The area of the triangle formed by $y = c \cdot f(x)$ would be $25c$ units^2.

41c.



The area of the triangle is $\frac{1}{2}(10)(5)$ or 25 units^2. Its area is the same as that of the original triangle. The area of the triangle formed by $y = f(x + c)$ would be 25 units^2.

43a. reflection over the x-axis, reflection over the y-axis, vertical translation, horizontal compression or expansion, and vertical expansion or compression **43b.** horizontal translation **45.** 30 preschoolers and 20 school-age **47.** $x = \pm 5$, $y = 9$, $z = 6$ **49.** The graph implies a negative linear relationship. **51.** −250 **53.** A

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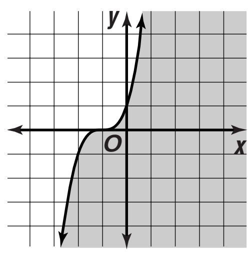
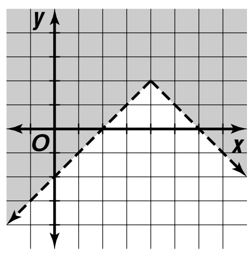
5. yes **7.**

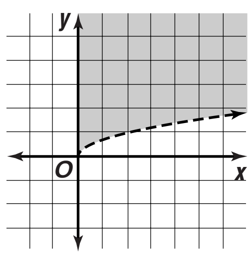


9.

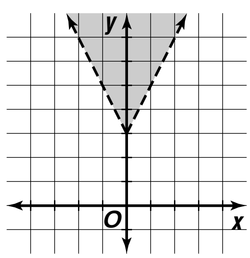


11. $\{x \mid 1 \leq x \leq 2\}$ **13.** no **15.** yes **17.** yes **19.** (0, 0), (1, 1), and (1, −1); if these points are in the shaded region and the other points are not, then the graph is correct.

21.



23.



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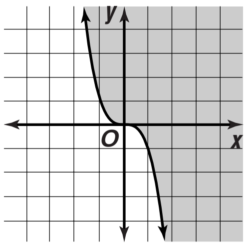
25.



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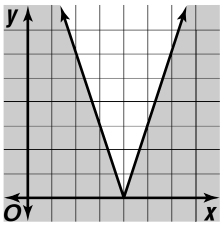

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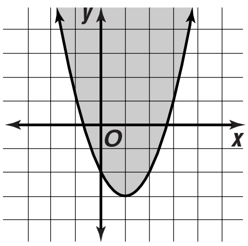

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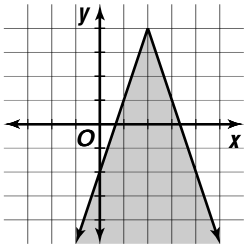
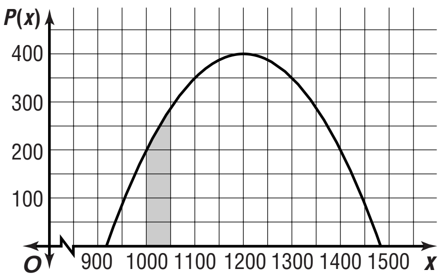


33. $\{x \mid x < -9 \text{ or } x > 1\}$ **35.** $\{x \mid -2 < x < 9\}$
37. no solution **39.** $\{x \mid -17 \leq x \leq 7\}$
41. $\{x \mid 5.5 < x < 10\}$ **43.** $x \geq 83\frac{2}{3}$

45a.



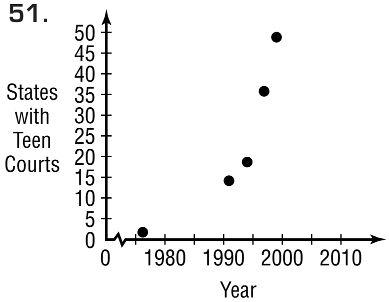
45b. The shaded region shows all points (x, y) where x represents the number of cookies sold and y represents the possible profit made for a given week.

47. y-axis

49. $\begin{bmatrix} 6 & \frac{-21}{4} \\ -3 & 0 \end{bmatrix}$

53. 10

51.



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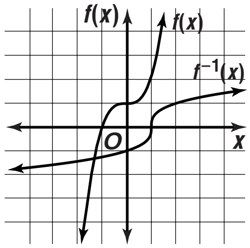
7.



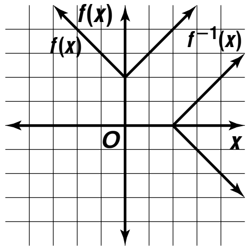
9. $f^{-1}(x) = -\frac{1}{3}x + \frac{2}{3}$; $f^{-1}(x)$ is a function. **11.** $f^{-1}(x) = -2 \pm \sqrt{x - 6}$; $f^{-1}(x)$ is not a function.

13. $f^{-1}(x) = 2x + 10$; $[f \circ f^{-1}](x) = f(2x + 10) = \frac{1}{2}(2x + 10) - 5 = x$

$[f^{-1} \circ f](x) = f^{-1}\left(\frac{1}{2}x - 5\right) = 2\left(\frac{1}{2}x - 5\right) + 10 = x$

Since $[f \circ f^{-1}](x) = [f^{-1} \circ f](x) = x$, f and f^{-1} are inverse functions.

15.



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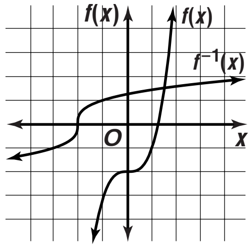

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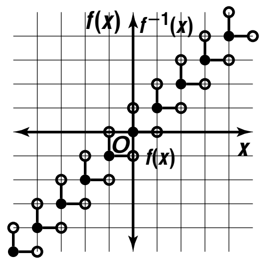

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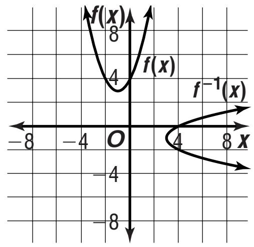
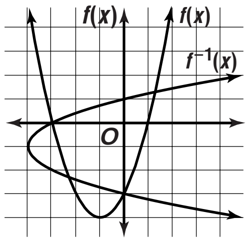


23.

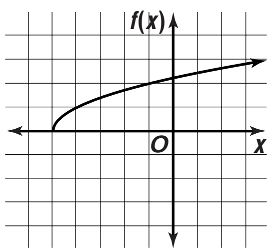


25. $f^{-1}(x) = \frac{x - 7}{2}$; $f^{-1}(x)$ is a function. **27.** $f^{-1}(x) = \frac{1}{x}$; $f^{-1}(x)$ is a function. **29.** $f^{-1}(x) = 3 \pm \sqrt{x - 7}$; $f^{-1}(x)$ is not a function.

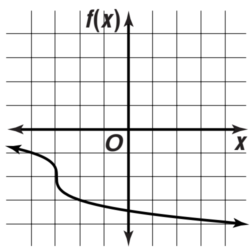
31. $f^{-1}(x) = \frac{1}{x} - 2$; $f^{-1}(x)$ is a function.

33. $f^{-1}(x) = 2 - \sqrt[3]{\frac{2}{x}}$; $f^{-1}(x)$ is a function.

35.



37.



SELECTED ANSWERS

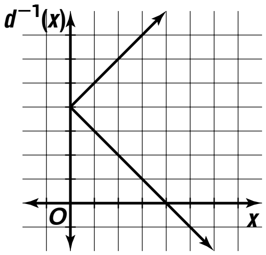
39. $f^{-1}(x) = -\frac{3}{2}x + \frac{1}{4}$

$$[f \circ f^{-1}](x) = f\left(-\frac{3}{2}x + \frac{1}{4}\right)$$
$$= -\frac{2}{3}\left(-\frac{3}{2}x + \frac{1}{4}\right) + \frac{1}{6}$$
$$= x - \frac{1}{6} + \frac{1}{6}$$
$$= x$$

$$[f^{-1} \circ f](x) = f^{-1}\left(-\frac{2}{3}x + \frac{1}{6}\right)$$
$$= -\frac{3}{2}\left(-\frac{2}{3}x + \frac{1}{6}\right) + \frac{1}{4}$$
$$= x - \frac{1}{4} + \frac{1}{4}$$
$$= x$$

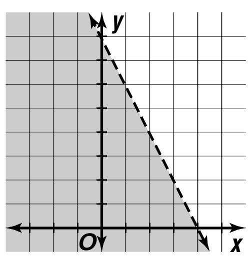
Since $[f \circ f^{-1}](x) = [f^{-1} \circ f](x) = x$, f and f^{-1} are inverse functions.

41a.



41b. No; the graph of $d(x)$ fails the horizontal line test. **41c.** $d^{-1}(x)$ gives the numbers that are 4 units from x on the number line. There are always two such numbers, so d^{-1} associates two values with each x-value. Hence, $d^{-1}(x)$ is not a function. **43a.** Sample answer: $y = -x$. **43b.** The graph of the function must be symmetric about the line $y = x$. **43c.** Yes, because the line $y = x$ is the axis of symmetry *and* the reflection line. **45.** It must be translated up 6 units and 5 units to the left; $y = (x - 6)^2 - 5$, $y = 6 \pm \sqrt{x + 5}$. **47a.** Yes. If the encoded message is not unique, it may not be decoded properly. **47b.** The inverse of the encoding function must be a function so that the encoded message may be decoded. **47c.** $(x + 2)^2 - 3$ **47d.** FUNCTIONS ARE FUN **49.** both **51.** $(-1, 7)$ **55.** $y = -x + 7$

53.



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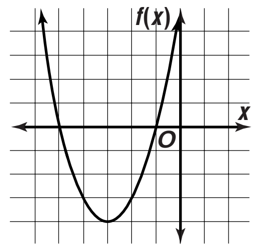
5. No. y is undefined when $x = -3$.
7. $y \to \infty$ as $x \to \infty$, $y \to -\infty$ as $x \to -\infty$

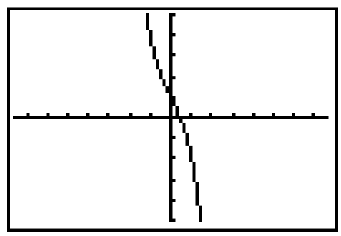
9.



Decreasing for $x < -3$. Increasing for $x > -3$.

11a. $t = 4$ **11b.** when $t = 4$ **11c.** 10 amps **13.** No. The function is undefined when $x = 2$. **15.** Yes. The function is defined when $x = 3$; the function approaches 1 (in fact is equal to 1) as x approaches 3 from both sides; and $y = 1$ when $x = 3$. **17.** Yes. The function is defined when $x = 1$; $f(x)$ approaches 3 as x approaches 1 from both sides; and $f(1) = 3$. **19.** Sample answer: $x = 0$. $g(x)$ is undefined when $x = 0$. **21.** $y \to -\infty$ as $x \to \infty$, $y \to -\infty$ as $x \to -\infty$ **23.** $y \to \infty$ as $x \to \infty$, $y \to \infty$ as $x \to -\infty$ **25.** $f(x) \to 2$ as $x \to \infty$, $f(x) \to 2$ as $x \to -\infty$

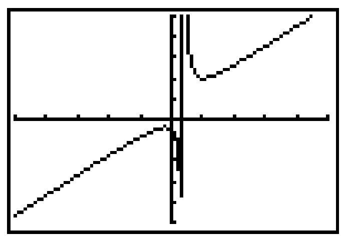
27.



[−7.6, 7.6] scl:1 by [−5, 5] scl:1

decreasing for all x

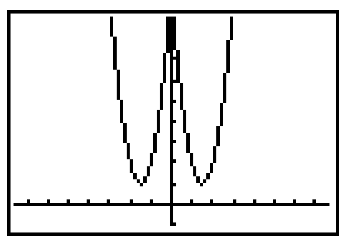
29.



[−25, 25] scl:5 by [−25, 25] scl:5

increasing for $x < -1$ and $x > 5$; decreasing for $-1 < x < 2$ and $2 < x < 5$

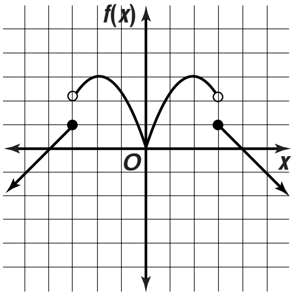
31.



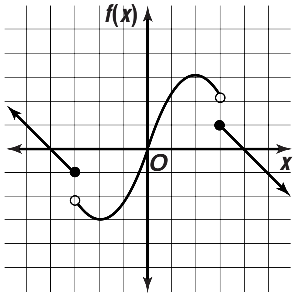
[−7.6, 7.6] scl:1 by [−1, 9] scl:1

decreasing for $x < -\frac{3}{2}$ and $0 < x < \frac{3}{2}$; increasing for $-\frac{3}{2} < x < 0$ and $x > \frac{3}{2}$

33a. f is decreasing for $-2 < x < 0$ and increasing for $x < -2$. f has jump discontinuity when $x = -3$ and $f(x) \to -\infty$ as $x \to -\infty$.



33b. f is increasing for $-2 < x < 0$ and decreasing for $x < -2$. f has a jump discontinuity when $x = -3$ and $f(x) \to \infty$ as $x \to -\infty$.



35a. 1954–1956, 1958–1959, 1960–1961, 1962–1963, 1966–1968, 1973–1974, 1975–1976, 1977–1978, 1989–1991 **35b.** 1956–1958, 1959–1960, 1961–1962, 1963–1966, 1968–1973, 1974–1975, 1976–1977, 1978–1989, 1991–1996 **37a.** The function must be monotonic. **37b.** The inverse must be monotonic. **39.** $a = 4$, $b = 2$ **41.** The graph of $g(x)$ is the graph of $f(x)$ translated left 2 units and down 4 units. **43.** 42 **45.** 20

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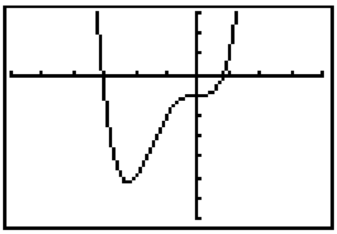
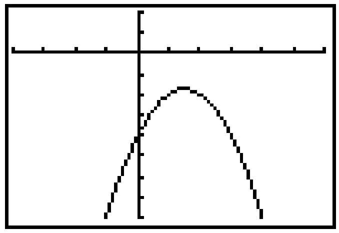
5. rel. min.: $(-1, -3)$; rel. max.: $(3, 3)$
7. rel. min.: $(-2.25, -10.54)$



[−6, 4] scl:1 by [−14, 6] scl:2

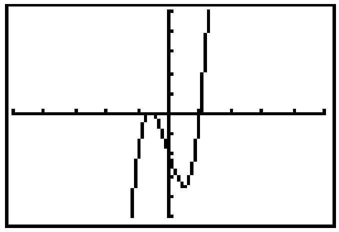
9. min. **11.** min. **13.** abs. max.: $(-4, 1)$
15. rel. max.: $(-2, 7)$; abs. min.: $(3, -3)$
17. abs. min.: $(3, -8)$; rel. max.: $(5, -2)$; rel. min.: $(8, -5)$

19. abs. max.: $(1.5, -1.75)$



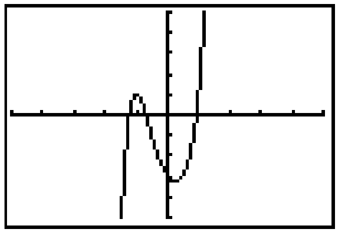
[−5, 5] scl:1 by [−8, 2] scl:1

21. rel. max.: $(-0.59, 0.07)$, rel. min.: $(0.47, -3.51)$



[−5, 5] scl:1 by [−5, 5] scl:1

23. rel. max.: $(-1, 1)$; rel. min.: $(0.25, -3.25)$



[−5, 5] scl:1 by [−5, 5] scl:1

25. abs. min.: $(-3.18, -15.47)$; rel. min.: $(0.34, -0.80)$; rel. max.: $(-0.91, 3.04)$ **27.** max. **29.** max. **31.** pt. of inflection **33.** min. **35a.** $V(x) = 2x(12.5 - 2x)(17 - 2x)$ **35b.** 2.37 cm by 2.37 cm **37a.** $f(x) = 5000\sqrt{x^2 + 4} + 3500(10 - x)$ **37b.** 1.96 km from point B **39.** The particle is at rest when $t \approx 0.14$ and when $t \approx 3.52$. Its position at these times are $s(0.14) \approx -8.79$ and $s(3.52) \approx -47.51$. **41.** No; the function is undefined when $x = 5$. **43.** 120 units of notebook and 80 units of newsprint **45.** -1, yes **47.** 5 free throws, 9 2-point field goals, 3 3-point field goals **49.** perpendicular **51.** D

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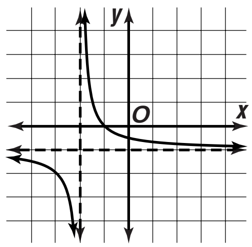
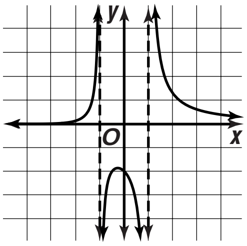
5. $x = 5$, $y = 1$ **7.** $f(x) = \frac{1}{x + 1} - 2$

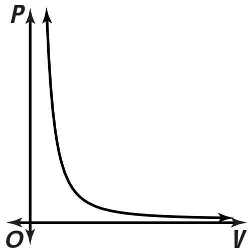
9. The parent graph is translated 2 units to the left and down 1 unit. The vertical asymptote is now at $x = -2$ and the horizontal asymptote is now $y = -1$.



11.

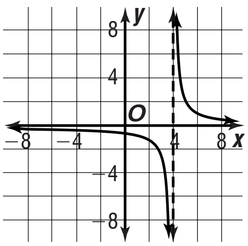


13a.

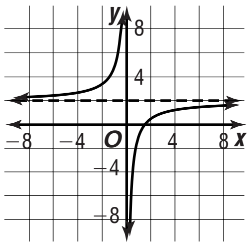


13b. $P = 0$, $V = 0$ **13c.** The pressure approaches 0. **15.** $x = -6$ **17.** $x = -1, x = -3, y = 0$ **19.** $x = 1, y = 1$ **21.** $f(x) = \frac{1}{x+3} + 1$ **23.** $f(x) = -\frac{1}{x} + 1$

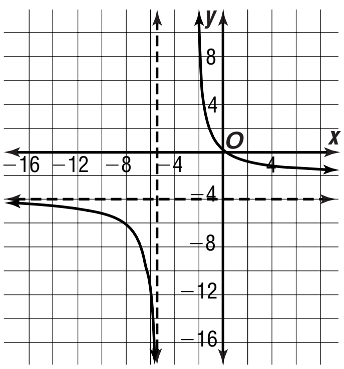
25. The parent graph is translated 4 units right and expanded vertically by a factor of 2. The vertical asymptote is now $x = 4$. The horizontal asymptote, $y = 0$, is unchanged.



27. The parent graph is expanded vertically by a factor of 3, reflected about the x-axis, and translated 2 units up. The vertical asymptote, $x = 0$, is unchanged. The horizontal asymptote is now $y = 2$.

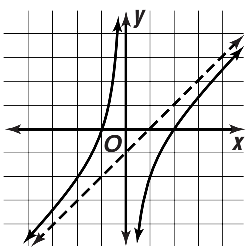


29. The parent graph is translated 5 units left. The translated graph is expanded vertically by a factor of 22 and then translated 4 units down. The vertical asymptote is $x = -5$ and the horizontal asymptote is $y = -4$.

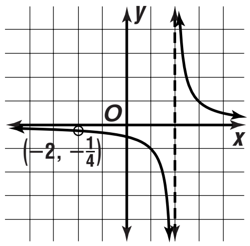


31. $y = x + 3$
33. $y = \frac{1}{2}x - \frac{5}{4}$

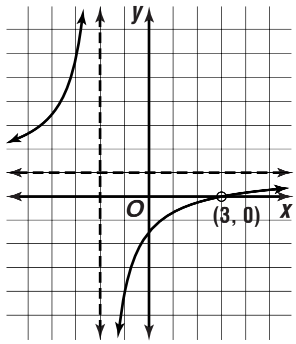
35.



37.



39.



41a. $C(t) = \frac{480 + 3t}{40 + t}$ **41b.** 11.43 L **43.** Sample answer: $f(x) = \frac{(x-2)(x+3)(x+5)^2}{(x-4)(x+5)}$ **45.** Sample answer: $f(x) = \frac{x}{x^2+1}$ **47a.** $\frac{a^2-9}{a-3}$ **47b.** The slope approaches 6. **49.** $y = \pm\sqrt{x+9}$ **51.** $\begin{bmatrix} 24 & -20 \\ -32 & 16 \end{bmatrix}$ **53.** (3, 2) **55.** $16 - 8x^2$, $2 - 64x^2$

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5. 12, $xy = 12$; $\frac{4}{5}$ **7.** 0.5; $y = 0.5xz^3$; 108 **9.** y varies directly as x^4, $\frac{1}{7}$ **11.** y varies inversely as x; -3 **13.** 0.2; $y = 0.2x$; 1.2 **15.** 15, $y = 15xz$; 18 **17.** 16; $r = 16t^2$; 1 **19.** $\frac{1}{12}$; $y = \frac{1}{12}x^3z^2$; -48 **21.** 2; $y = \frac{2xz}{w}$; 14 **23.** 15; $a = \frac{15b^2}{c}$; ± 8 **25.** C varies directly as d; π **27.** y varies jointly as x and the square of z; $\frac{4}{3}$ **29.** y varies inversely as the square of x, $\frac{5}{4}$ **31.** A varies jointly as h and the quantity $b_1 + b_2$; 0.5 **33.** y varies directly as x^2 and inversely as the cube of z; 7 **35a.** Joint variation; to reduce torque one must either reduce the distance or reduce the mass on the end of the fulcrum. Thus, torque varies directly as the mass and the distance from the fulcrum. Since there is more than one quantity in direct variation with the torque on the seesaw, the variation is joint.

35b. $T_1 = km_1d_1$ and $T_2 = km_2d_2$

$$T_1 = T_2$$
$$km_1d_1 = km_2d_2 \quad \textit{Substitution property of equality}$$
$$m_1d_1 = m_2d_2$$

35c. 1.98 meters **37.** If y varies directly as x then there is a nonzero constant k such that $y = kx$. Solving for x, we find $x = \frac{1}{k}y$. $\frac{1}{k}$ is a nonzero constant, so x varies directly as y. **39.** a is doubled

$$a = \frac{kb^2}{c^3};\ a = \frac{k\left(\frac{1}{2}b\right)^2}{\left(\frac{1}{2}c\right)^3};\ \frac{a = \frac{1}{4}kb^2}{\frac{1}{8}c^3};\ a = 2\frac{kb^2}{c^3}$$

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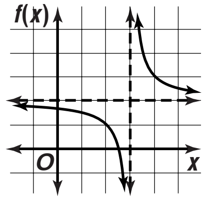
41. $1.78 \times 10^{-3}\,\Omega$ **43.** $f^{-1}(x) = \sqrt[3]{x-6} + 3$; $f^{-1}(x)$ is a function. **45.** consistent and dependent **47.** $y = -0.92x + 1858.60$

51. The parent graph is translated 3 units right and then translated 2 units up. The vertical asymptote is now $x = 3$ and the horizontal asymptote is $y = 2$.



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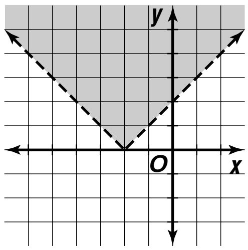
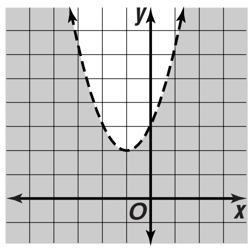
1. even **3.** point **5.** maximum **7.** inverse **9.** slant **11.** yes **13.** no **15.** $y = x$ and $y = -x$ **17.** none **19.** $g(x)$ is a translation of the graph of $f(x)$ up 5 units. **21.** $g(x)$ is the graph of $f(x)$ expanded vertically by a factor of 6.

23.

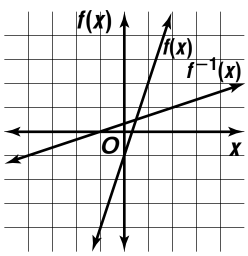


25.

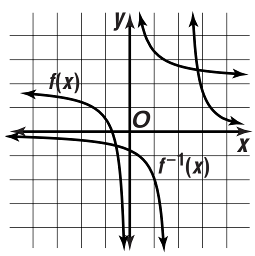


27. $\{x \mid x < -3 \text{ or } x > 0.5\}$

29.



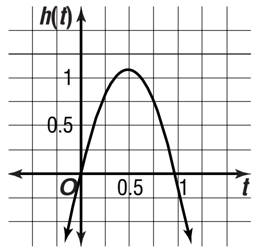
31.



33. $f^{-1}(x) = \sqrt[3]{x+8} + 2$; yes **35.** Yes. The function is defined when $x = 2$; the function approaches 6 as x approaches 2 from both sides; and $y = 6$ when $x = 2$. **37.** Yes. The function is defined when $x = 1$; the function approaches 2 as x approaches 1 from both sides; and $y = 2$ when $x = 1$. **39.** $y \to \infty$ as $x \to \infty$, $y \to -\infty$ as $x \to -\infty$ **41.** $y \to \infty$ as $x \to \infty$, $y \to -\infty$ as $x \to -\infty$ **43.** decreasing for $x < -3$ and $0 < x < 3$; increasing for $-3 < x < 0$ and $x > 3$ **45.** rel. max.: (0, 4), rel. min.: (2, 0) **47.** pt. of inflection **49.** $f(x) = -\frac{2}{x}$

53. $x = -2$
55. yes; $y = x + 2$
57. 140; $y = \frac{140}{\sqrt{x}}$; 196
59. $|x - 6.5| \leq 0.2$; $6.3 \leq x \leq 6.7$
61b. 1.08 m

61a.



Page 203 Chapter 3 SAT and ACT Practice

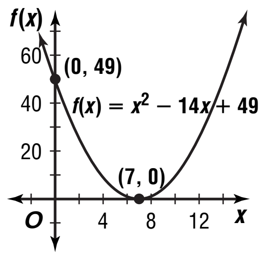
1. E **3.** B **5.** C **7.** B **9.** B

Chapter 4 Polynomial and Rational Functions

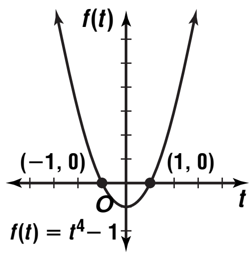
Pages 209–212 Lesson 4-1

5. 3; 1 **7.** no; $f(5) = -33$ **9.** $x^2 - 2x - 35 = 0$; even; 2

11. 2; 7, 7

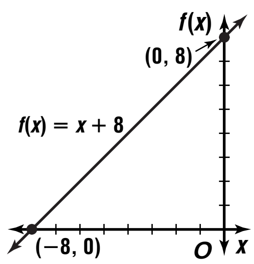


13. 4; $-1, 1, \boldsymbol{i}, -\boldsymbol{i}$

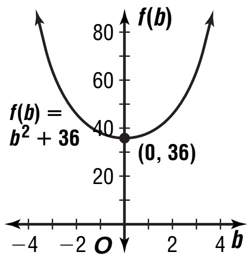


15. 4; 5 **17.** 3; 5 **19.** 6; −1 **21.** Yes; the coefficients are complex numbers and the exponents of the variable are nonnegative integers. **23.** yes; $f(0) = 0$ **25.** yes; $f(1) = 0$ **27.** no; $f(-3) = -72$ **29.** no **31a.** 3; 1 **31b.** 2; 2 **31c.** 4; 2 **33.** $x^3 - 5x^2 - x + 5 = 0$; odd; 3 **35.** $x^3 + 3x^2 + 4x + 12 = 0$; odd; 1 **37.** $x^5 - 5x^4 - 17x^3 + 85x^2 + 16x - 80 = 0$; odd; 5

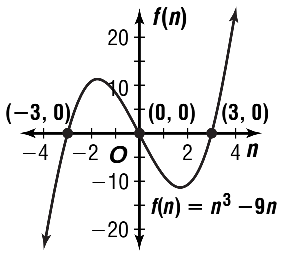
39. 1; −8



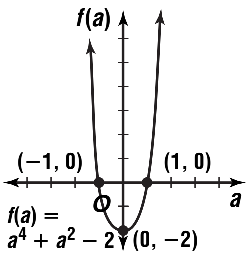
41. 2; $\pm 6\boldsymbol{i}$



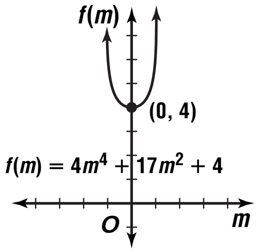
43. 3; −3, 0, 3



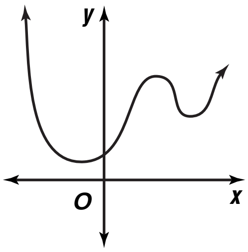
45. 4; −1, 1, $-\sqrt{2}i$, $\sqrt{2}i$



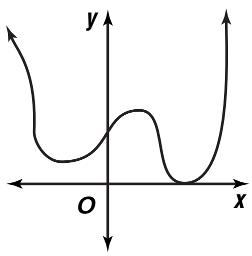
47. 4; $-0.5i$, $0.5i$, $-2i$, $2i$



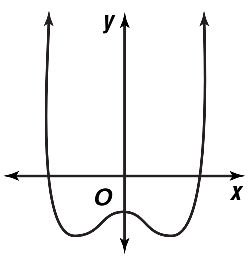
49a.



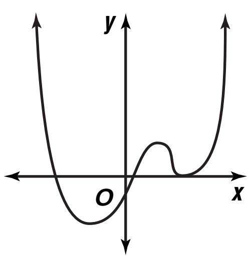
49b.



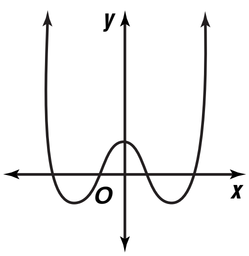
49c.



49d.

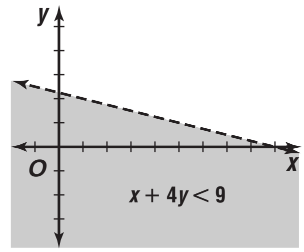


49e.



49f. not possible **51a.** $V(x) = 99{,}000x^3 + 55{,}000x^2 + 65{,}000x$ **51b.** about \$298,054.13 **53a.** 7380 ft; 29,520 ft; 118,080 ft **53b.** It quadruples; $(2t)^2 = 4t^2$. **55.** \$10 **57.** $y = \dfrac{x-2}{x(x+2)(x-2)}$ **59.** The graph of $y = 2x^3 + 1$ is the graph of $y = 2x^3$ shifted 1 unit up. **61.** 0; no

63.

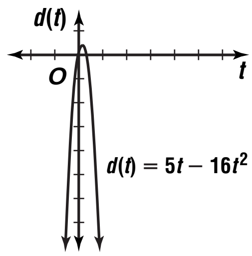


65. $\frac{1}{4}x^2 + 6x + 32$; $\frac{1}{2}x^2 + 4$

Pages 219–221 Lesson 4-2

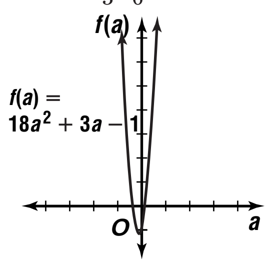
5. −10, 2 **7.** 0; 1 real; −6 **9.** 1, 5 **11.** 200 or 400 amps **13.** −8, 11 **15.** $\frac{1}{2}, \frac{1}{4}$ **17.** $\frac{3}{2} \pm \frac{\sqrt{37}}{2}$ **19.** 2 imaginary; the discriminant is negative. **21.** −11; 2 imaginary; $\frac{5 \pm i\sqrt{11}}{2}$ **23.** −140; 2 imaginary; $\frac{1 \pm i\sqrt{35}}{4}$ **25.** 97; 2 real; $\frac{-5 \pm \sqrt{97}}{4}$ **27.** $5 + 2i$ **29.** −4, 7 **31.** $-1, \frac{5}{4}$ **33.** $\sqrt{6} \pm 2\sqrt{2}$ **35.** $c > 16$

37a.



37b. 0 and about 0.3 **37c.** The x-intercepts indicate when the woman is at the same height as the beginning of the jump. **37d.** $-50 = 5t - 16t^2$ **37e.** about 1.93 s

39. 2; $-\frac{1}{3}, \frac{1}{6}$



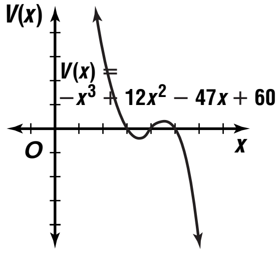
41. $f^{-1}(x) = \pm\sqrt{x + 9}$ **43.** \$643 **45.** A

Pages 226–228 Lesson 4-3

5. $x + 1$, R6 **7.** 0; yes **9.** $(x - 5), (x + 1), (x - 1)$ **11.** −4 **13.** $r = 1$ in., $h = 5$ in. **15.** $x^2 - 6x + 9$, R-1 **17.** $x^3 - 2x^2 - 4x + 8$ **19.** $2x^2 + 2x$, R −3 **21.** 0; yes **23.** 12; no **25.** 0; yes **27.** $(\sqrt{6})^4 - 36 = 36 - 36$ or 0 **29.** $(x - 2), (x + 1), (x + 2)$ **31.** $(x - 4), (x - 2), (x + 1)$ **33.** $(x - 1), (x + 1), (x + 4)$ **35.** 2 times **37.** −2 **39.** 34 **41.** 5 s **43a.** $V(x) = -x^3 + 12x^2 - 47x + 60$

CONTENTS

43b.



43c. $36 = -x^3 + 12x^2 - 47x + 60$ **43d.** about 0.60 ft

45. $a = 1, b = -6, c = 25$ **47a.** no **47b.** yes **47c.** no **47d.** yes **49.** wider than parent graph and moved 1 unit left **51.** $\left(-\frac{91}{11}, \frac{68}{11}, \frac{98}{11}\right)$ **53.** D

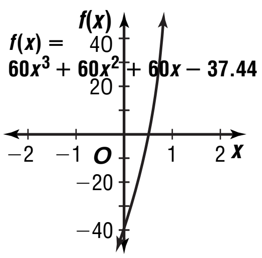
Page 233–235 Lesson 4-4

5. $\pm 1, \pm 2; 1$ **7.** 2 or 0; 1; $-1\frac{1}{2}, \frac{1}{4}, 2$ **9.** 9 cm **11.** $\pm 1, \pm 2, \pm 3, \pm 6, \pm 9, \pm 18; -2$ **13.** $\pm 1, \pm 2, \pm 4, \pm 5, \pm 10, \pm 20; -2, 2, 5$ **15.** $\pm 1, \pm\frac{1}{2}, \pm\frac{1}{3}, \pm\frac{1}{6}; -\frac{1}{3}, \frac{1}{2}$ **17.** 1; 2 or 0; $-2, -1, 3$ **19.** 1; 2 or 0; $-4, -2, 3$ **21.** 2 or 0; 2 or 0; $-4, -1, 1, 2$ **23a.** $2, -2, -1$ **23b.** $f(x) = x^4 + 2x^3 - 3x^2 - 8x - 4$ **23c.** 1; 3 or 1 **23d.** There are 2 negative zeros, but according to Descartes' rule of signs, there should be 3 or 1. This is because, -1 is actually a zero twice. **25a.** Sample answer: $x^4 + x^3 + x^2 + x + 3 = 0$ **25b.** Sample answer: $x^3 - x^2 - 2 = 0$ **25c.** Sample answer: $x^3 - x = 0$ **27.** 100 ft **29.** $x - 8$ **31.** $x^4 - 5x^2 + 4 = 0$ **33.** A

Pages 240–242 Lesson 4-5

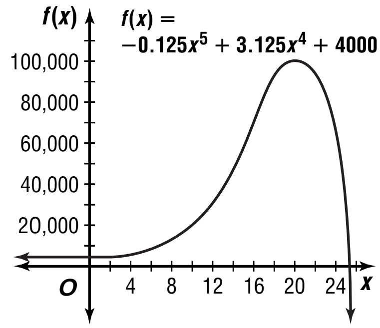
5. 4 and 5, -1 and 0 **7.** 2.3 **9.** Sample answers: 2; 0 **11a.** $V(x) = x^3 + 60x^2 + 1025x + 3750$ **11b.** $5625 = x^3 + 60x^2 + 1025x + 3750$ **11c.** about 26.7 cm by 31.7 cm by 6.7 cm **13.** 0 and 1, 2 and 3 **15.** -3 and -2, -2 and -1, 1 and 2, 2 and 3 **17.** no real zeros **19.** $-0.7, 0.7$ **21.** -2.5 **23.** $-1, 1$ **25.** -1.24 **27.** Sample answers: 2; -1 **29.** Sample answers: 2; -6 **31.** Sample answers: 1; -7 **33a.** The model is fairly close, although it is less accurate for 1950 and 1970. **33b.** $-253{,}800$ **33c.** The population becomes 0. **33d.** No; there are still many people living in Manhattan. **35a.** $37.44 = 60x^3 + 60x^2 + 60x$ **35b.** $f(x) = 60x^3 + 60x^2 + 60x - 37.44$

35c.



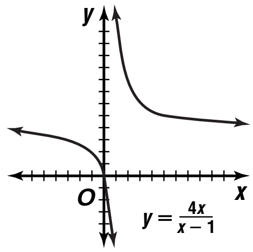
about $\frac{1}{2}$ **35d.** 0.4

37a.



37b. 4000 deer **37c.** about 67,281 deer **37d.** in 1930 **39.** 2 or 0; 1; $-3, 0.5, 5$

41.



43. (2.5, 1) **45.** B

Pages 247–250 Lesson 4-6

5. $-1, 5$ **7.** -3 **9.** $x < 0, x > 3$ **11a.** $\frac{3 \times 60 + 20}{3 + x} = 57.14$ **11b.** 0.50 h **13.** -34 **15.** $\frac{5}{3}$ **17.** $-\frac{1}{2}, 3$ **19.** $\frac{-3 \pm 3\sqrt{2}}{2}$ **21.** $\frac{5}{13}$ **23.** $\frac{3}{x} + \frac{-2}{x-2}$ **25.** $\frac{2}{3y-1} + \frac{-2}{y-1}$ **27a.** $a(a-6)$ **27b.** 3 **27c.** 0, 6 **27d.** $0 < a < 3, 6 < a$ **29.** $x \le 3, 4 \le x < 5$ **31.** $0 < a < \frac{7}{4}$ **33.** $-1 < y < 0$ **35.** $x < -5$, or $x > 5$ **37.** Sample answer: $\frac{x}{x-3} = \frac{1}{x+2}$ **39a.** $\frac{1}{10} = \frac{1}{2r} + \frac{1}{r} + \frac{1}{20}$ **39b.** 60 ohms, 30 ohms **41.** 36 mph **43a.** $\frac{1}{x} = \frac{1}{2}\left(\frac{1}{30} + \frac{1}{45}\right)$ **43b.** 36 **45.** 8 mph **47.** -3 and -2, -2 and -1, 1 and 2 **49.** 2; $\frac{5}{6}, -\frac{3}{2}$ **51.** no **53a.** 18 short answer and 2 essay for a score of 120 points **53b.** 12 short answer and 8 essay for a score of 180 points **55.** $2x - y + 7 = 0$ **57.** 24

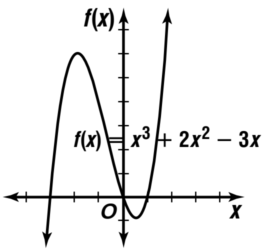
Pages 254–257 Lesson 4-7

5. -733 **7.** 3.5 **9.** $-0.8 \le x \le 12$ **11a.** $90 = \sqrt{100 + 64h}$ **11b.** 125 ft **13.** 71 **15.** 0 **17.** no real solution **19.** -1 **21.** 4 **23.** $\frac{9}{7}$ **25.** no real solution **27.** -2 **29.** $x \ge 16$ **31.** $5 \le a \le 21$ **33.** $1.8 \le y \le 5$ **35.** $c > 27$ **37.** about 7.88 **39a.** about 2.01 s **39b.** about 2.11 s **39c.** It must be multiplied by 4. **41.** $a + b < 0$ **43.** $\frac{3}{2}$ **45a.** point discontinuity

45b. jump discontinuity **45c.** infinite discontinuity
47. $\begin{bmatrix} 28 & 20 \\ 10 & 14 \end{bmatrix}$ **49.** 10 students **51.** C

Pages 262–264 Lesson 4-8
5. Sample answer: $f(x) = 1.98x^4 + 2.95x^3 - 5.91x^2 + 0.22x + 4.89$ **7a.** Sample answer: $f(x) = 0.49x + 57.7$ **7b.** Sample answer: 87.1% **7c.** Sample answer: 2006 **9.** quadratic **11.** quadratic **13.** $f(x) = 8x^2 - 3x - 9$ **15.** Sample answer: $f(x) = 0.09x^3 - 2.70x^2 + 24.63x - 65.21$ **17.** Sample answer: $f(x) = -0.02x^3 + 8.79x^2 + 3.35x + 27.43$ **19a.** Sample answer: $f(x) = 0.126x + 22.732$ **19b.** Sample answer: 36 **19c.** Sample answer: 38 **21a.** Sample answer: $f(x) = -0.03x^4 + 0.50x^3 - 2.79x^2 + 4.01x + 22.78$ **21b.** Sample answer: about 16% **23a.** Sample answer: $f(x) = 0.02x^3 - 0.46x^2 + 3.94x + 47.49$ **23b.** Sample answer: 2000 **23c.** Sample answer: No; according to the model, there should have been an attendance of only about 65 million. Since the actual attendance was much higher than the projected number, it is likely that the race to break the homerun record increased the attendance. **25.** 23 **27.** −1, 1 **29.** B

Pages 267–271 Chapter 4 Study Guide and Assessment
1. Quadratic Formula **3.** zero **5.** polynomial function **7.** Extraneous **9.** complex numbers **11.** no; $f(0) = -4$ **13.** no; $f(-2) = -18$ **15.** 3; −3, 0, 1



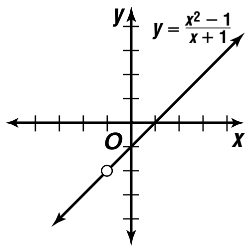
17. 40; 2 real; $\frac{5 \pm \sqrt{10}}{3}$ **19.** 73; 2 real; $\frac{3 \pm \sqrt{73}}{4}$ **21.** −199; 2 imaginary; $\frac{1 \pm i\sqrt{199}}{10}$

23. 161; no **25.** 0; yes **27.** ±1; 1 **29.** ±1, ±3, $\pm\frac{1}{2}$, $\pm\frac{3}{2}$; $-\frac{3}{2}$ **31.** ±1, ±2, ±4, ±8, $\pm\frac{1}{3}$, $\pm\frac{2}{3}$, $\pm\frac{4}{3}$, $\pm\frac{8}{3}$; −2, $-\frac{4}{3}$, 1 **33.** ±5, ±1; ±1 **35.** 2 or 0; 1; $-\frac{1}{2}$, 3 **37.** −1 and 0 **39.** −1 and 0, 3 and 4 **41.** −2 and −1, 0 and 1, 1 and 2 **43.** −4.9, −1.8, 2.2 **45.** 3 **47.** $y < -1, y > 0$ **49.** 23 **51.** 1 **53.** $a \geq -1.5$ **55.** $f(x) = 2x^2 - x + 3$ **57.** 18 ft by 24 ft **59.** about 0.64 m

Page 273 Chapter 4 SAT and ACT Practice
1. C **3.** E **5.** A **7.** E **9.** A

Chapter 5 The Trigonometric Functions

Pages 280–283 Lesson 5-1
5. 34° 57′ **7.** −128.513° **9.** −720° **11.** 22° + 360k°; Sample answers: 382°; −338° **13.** 93°; II **15.** 47° **17.** 15°; 0.25° or 15′; about 0.0042° or 15″ **19.** 168° 21′ **21.** 286° 52′ 48″ **23.** 246° 52′ 33.6″ **25.** −14.089° **27.** 173.410° **29.** 1002.508° **31.** 720° **33.** −2700° **35.** −2070° **37.** 30° + 360k°; Sample answers: 390°; −330° **39.** 113° + 360k°; Sample answers: 473°; −247° **41.** −199° + 360k°; Sample answers: 161°; −559° **43.** 310° **45.** 40°; I **47.** 220°; III **49.** 96°; II **51.** III **53.** 32° **55.** 60° **57.** 35° **59.** 4500°; 270,000° **61.** 17,100° **63.** 22,320°; 1,339,200°; 80,352,000°; 1,928,448,000° **65a.** 44° 26′ 59.64″; 68° 15′ 41.76″ **65b.** 24.559°; 81.760° **67a.** Sample answer: $f(x) = -0.0003x^3 + 0.0647x^2 - 3.5319x + 76.0203$ **67b.** Sample answer: about 32% **69.** 0, −4 **71.** $x^3 + x^2 - 80x - 300 = 0$ **73.** point discontinuity



75. expanded vertically by a factor of 3, translated down 2 units **77.** $0.56x$

Pages 288–290 Lesson 5-2
5. $\frac{15\sqrt{514}}{514}$; $\frac{17\sqrt{514}}{514}$; $\frac{15}{17}$ **7.** $\frac{1}{1.5} \approx 0.6667$

9. $I_t = 0.5I_o$ **11.** $\frac{5\sqrt{89}}{89}$; $\frac{8\sqrt{89}}{89}$; $\frac{5}{8}$ **13.** tangent

15. $\frac{7}{3}$ **17.** $\frac{1}{2.5} = 0.4$ **19.** $\frac{1}{0.125} = 8$

21. $\sin R = \frac{19}{20}$, $\cos R = \frac{\sqrt{39}}{20}$, $\tan R = \frac{19\sqrt{39}}{39}$, $\csc R = \frac{20}{19}$, $\sec R = \frac{20\sqrt{39}}{39}$, $\cot R = \frac{\sqrt{39}}{19}$

23. 1.3

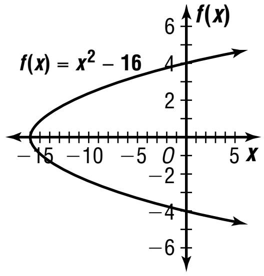
25.

θ	72°	74°	76°	78°
sin	0.951	0.961	0.970	0.978
cos	0.309	0.276	0.242	0.208
80°	**82°**	**84°**	**86°**	**88°**
0.985	0.990	0.995	0.998	0.999
0.174	0.139	0.105	0.070	0.035

25a. 1 **25b.** 0 **27.** about 1.5103 **29a.** about 5.4 m/s **29b.** about 5.9 m/s **29c.** about 6.4 m/s **29d.** increase **31a.** about 87.5°; about 40.5° **31b.** about 49.5°; about 2.5° **31c.** neither **33.** 88° 22′ 12″ **35a.** 23 employees **35b.** $1076 **37.** $y = -\frac{1}{2}x + 6$

Pages 296–298 Lesson 5-3

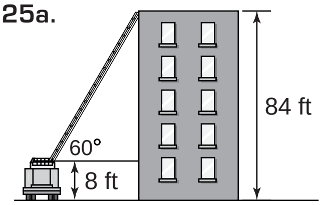
5. 0 **7.** $\sin 30° = \frac{1}{2}$, $\cos 30° = \frac{\sqrt{3}}{2}$, $\tan 30° = \frac{\sqrt{3}}{3}$, $\csc 30° = 2$, $\sec 30° = \frac{2\sqrt{3}}{3}$, $\cot 30° = \sqrt{3}$ **9.** $\sin\theta = \frac{4}{5}$, $\cos\theta = \frac{3}{5}$, $\tan\theta = \frac{4}{3}$, $\csc\theta = \frac{5}{4}$, $\sec\theta = \frac{5}{3}$, $\cot\theta = \frac{3}{4}$ **11.** $\sin\theta = -\frac{\sqrt{2}}{2}$, $\cos\theta = \frac{\sqrt{2}}{2}$, $\csc\theta = -\sqrt{2}$, $\sec\theta = \sqrt{2}$, $\cot\theta = -1$
13. The distances range from about 24,881 miles to 0 miles. **15.** 0 **17.** −1 **19.** −1 **21.** undefined
23. $\sin 150° = \frac{1}{2}$, $\cos 150° = -\frac{\sqrt{3}}{2}$, $\tan 150° = -\frac{\sqrt{3}}{3}$, $\csc 150° = 2$, $\sec 150° = -\frac{2\sqrt{3}}{3}$, $\cot 150° = -\sqrt{3}$ **25.** $\sin 210° = -\frac{1}{2}$, $\cos 210° = -\frac{\sqrt{3}}{2}$, $\tan 210° = \frac{\sqrt{3}}{3}$, $\csc 210° = -2$, $\sec 210° = -\frac{2\sqrt{3}}{3}$, $\cot 210° = \sqrt{3}$
27. $\sin 420° = \frac{\sqrt{3}}{2}$, $\cos 420° = \frac{1}{2}$, $\tan 420° = \sqrt{3}$, $\csc 420° = \frac{2\sqrt{3}}{3}$, $\sec 420° = 2$, $\cot 420° = \frac{\sqrt{3}}{3}$
29. 2 **31.** $\sin\theta = \frac{\sqrt{2}}{2}$, $\cos\theta = -\frac{\sqrt{2}}{2}$, $\tan\theta = -1$, $\csc\theta = \sqrt{2}$, $\sec\theta = -\sqrt{2}$, $\cot\theta = -1$
33. $\sin\theta = -\frac{8\sqrt{65}}{65}$, $\cos\theta = \frac{\sqrt{65}}{65}$, $\tan\theta = -8$, $\csc\theta = -\frac{\sqrt{65}}{8}$, $\sec\theta = \sqrt{65}$, $\cot\theta = -\frac{1}{8}$
35. $\sin\theta = \frac{15}{17}$, $\cos\theta = -\frac{8}{17}$, $\tan\theta = -\frac{15}{8}$, $\csc\theta = \frac{17}{15}$, $\sec\theta = -\frac{17}{8}$, $\cot\theta = -\frac{8}{15}$ **37.** in Quadrant III or IV **39.** $\sin\theta = \frac{1}{2}$, $\cos\theta = -\frac{\sqrt{3}}{2}$, $\tan\theta = -\frac{\sqrt{3}}{3}$, $\sec\theta = -\frac{2\sqrt{3}}{3}$, $\cot\theta = -\sqrt{3}$
41. $\sin\theta = \frac{2\sqrt{5}}{5}$, $\cos\theta = \frac{\sqrt{5}}{5}$, $\csc\theta = \frac{\sqrt{5}}{2}$, $\sec\theta = \sqrt{5}$, $\cot\theta = \frac{1}{2}$ **43.** $\sin\theta = -\frac{\sqrt{2}}{2}$, $\cos\theta = -\frac{\sqrt{2}}{2}$, $\tan\theta = 1$, $\csc\theta = -\sqrt{2}$, $\sec\theta = -\sqrt{2}$ **45.** 0° or 90° **47.** $\theta = 0°$ **49a.** 76 ft **49b.** 22 ft **49c.** 19 ft **49d.** $\frac{1}{2}r + 4$ **51.** 240°; III **53.** 1.25, 1
55.



57. $\left(\frac{3}{4}, -\frac{2}{3}, \frac{1}{2}\right)$ **59.** absolute value; $f(x) = \left|2\frac{1}{2} - x\right|$

Pages 302–304 Lesson 5-4

5. 52.1 **7.** 12.4 **9.** about 743.2 ft **11.** 6.3 **13.** 9.5 **15.** 18.4 **17.** 4.0 **19.** 6; 10.4; 6; 8.5 **21a.** about 9.9 m **21b.** about 6.7 m **21c.** about 48.8 m^2 **23.** about 1088.8 ft
25a.



25b. about 43.9 ft **25c.** about 87.8 ft
27. about 366.8 ft; no **29.** Markisha's; about 7.2 ft **31.** $\sin 120° = \frac{\sqrt{3}}{2}$, $\cos 120° = -\frac{1}{2}$, $\tan 120° = -\sqrt{3}$, $\csc 120° = \frac{2\sqrt{3}}{3}$, $\sec 120° = -2$, $\cot 120° = -\frac{\sqrt{3}}{3}$ **33.** 43.260 **35.** $1.32; $0.92

Pages 309–312 Lesson 5-5

5. 60°, 300° **7.** $\frac{\sqrt{3}}{2}$ **9.** 35.0° **11.** $A = 12°$, $b = 192.9$, $c = 197.2$ **13.** $B = 58°$, $a = 6.9$, $b = 11.0$ **15.** 90° **17.** 30°, 330° **19.** 225°, 315° **21.** Sample answers: 30°, 150°, 390°, 510° **23.** $\frac{2}{3}$ **25.** 1 **27.** $\frac{\sqrt{21}}{5}$ **29.** 34.8° **31.** 52.7° **33.** 36.5°
35. about 48.8°, 48.8°, and 82.4° **37.** $B = 55°$, $a = 5.6$, $c = 9.8$ **39.** $c = 5.7$, $A = 42.1°$, $B = 47.9°$ **41.** $B = 38.5°$, $b = 10.6$, $c = 17.0$ **43.** $B = 76°$, $a = 2.4$, $b = 9.5$ **45a.** Since the sine function is the side opposite divided by the hypotenuse, the sine cannot be greater than 1. **45b.** Since the secant function is the hypotenuse divided by the side opposite, the secant cannot be between 1 and −1. **45c.** Since cosine function is the side adjacent divided by the hypotenuse, the cosine cannot be less than −1. **47a.** about 4.6° **47b.** about 2.9°

CONTENTS

49. about 13.3° **51.** $y = 36.5, Z \approx 19.5°, Y \approx 130.5°$
53. $\sin F = \frac{4\sqrt{11}}{15}$, $\cos F = \frac{7}{15}$, $\tan F = \frac{4\sqrt{11}}{7}$, $\csc F = \frac{15\sqrt{11}}{44}$, $\sec F = \frac{15}{7}$, $\cot F = \frac{7\sqrt{11}}{44}$

55. y-axis **57.** $\begin{bmatrix} 2 & -1 & 0 \\ 3 & -1 & 1 \\ 2 & 8 & -5 \end{bmatrix}$ **59.** $y = -\frac{2}{5}x + 2$; $-\frac{2}{5}$; 2

Pages 316–318 Lesson 5-6

5. $C = 81°, a = 9.1, b = 12.1$ **7.** about 18.7 **9.** 30.4 units^2 **11.** $B = 70°, b = 29.2, c = 29.2$ **13.** $C = 120°, a = 8.8, c = 18.1$ **15.** $A = 93.9°$, $b = 3.4, c = 7.2$ **17.** about 97.8 **19.** 29.6 units^2 **21.** 5.4 units^2 **23.** 25.0 units^2 **25.** about 234.8 cm^2 **27.** about 70.7 ft^2

29. Applying the Law of Sines, $\frac{m}{\sin M} = \frac{n}{\sin N}$ and $\frac{r}{\sin R} = \frac{s}{\sin S}$. Thus, $\sin M = \frac{m \sin N}{n}$ and $\sin R = \frac{r \sin S}{s}$. Since $\angle M \cong \angle R$, $\sin M = \sin R$ and $\frac{m \sin N}{n} = \frac{r \sin S}{s}$. However, $\angle N \cong < S$ and $\sin N = \sin S$, so $\frac{m}{n} = \frac{r}{s}$ and $\frac{m}{r} = \frac{n}{s}$.
Similar proportions can be derived for p and t.
Therefore, $\triangle MNP \cong \triangle RST$.
31a. about 3.6 mi **31b.** about 1.4 mi **33a.** about 227.7 mi **33b.** about 224.5 mi

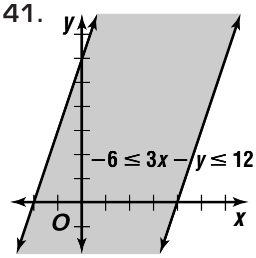
35a.
$$\frac{a}{\sin A} = \frac{b}{\sin B}$$
$$\frac{a}{b} = \frac{\sin A}{\sin B}$$

35b.
$$\frac{a}{\sin A} = \frac{c}{\sin C}$$
$$\frac{a}{c} = \frac{\sin A}{\sin C}$$
$$\frac{a}{c} - 1 = \frac{\sin A}{\sin C} - 1$$
$$\frac{a}{c} - \frac{c}{c} = \frac{\sin A}{\sin C} - \frac{\sin C}{\sin C}$$
$$\frac{a - c}{c} = \frac{\sin A - \sin C}{\sin C}$$

35c. From Exercise 34b, $\frac{a - c}{c} = \frac{\sin A - \sin C}{\sin C}$ or $\frac{\sin A - \sin C}{a - c} = \frac{\sin C}{c}$.
$$\frac{a}{\sin A} = \frac{c}{\sin C}$$
$$\frac{a}{c} = \frac{\sin A}{\sin C}$$
$$\frac{a}{c} + 1 = \frac{\sin A}{\sin C} + 1$$
$$\frac{a}{c} + \frac{c}{c} = \frac{\sin A}{\sin C} + \frac{\sin C}{\sin C}$$
$$\frac{a + c}{c} = \frac{\sin A + \sin C}{\sin C}$$
$$\frac{\sin C}{c} = \frac{\sin A + \sin C}{a + c}$$
Therefore, $\frac{\sin A - \sin C}{a - c} = \frac{\sin A + \sin C}{a + c}$ or $\frac{a + c}{a - c} = \frac{\sin A + \sin C}{\sin A - \sin C}$.

35d.
$$\frac{a}{\sin A} = \frac{b}{\sin B}$$
$$\frac{a}{b} = \frac{\sin A}{\sin B}$$
$$\frac{a}{b} + 1 = \frac{\sin A}{\sin B} + 1$$
$$\frac{a}{b} + \frac{b}{b} = \frac{\sin A}{\sin B} + \frac{\sin B}{\sin B}$$
$$\frac{a + b}{b} = \frac{\sin A + \sin B}{\sin B}$$
$$\frac{b}{a + b} = \frac{\sin B}{\sin A + \sin B}$$

37. $\cos \theta = \frac{\sqrt{35}}{6}$, $\tan \theta = -\frac{\sqrt{35}}{35}$, $\csc \theta = -6$, $\sec \theta = \frac{6\sqrt{35}}{35}$, $\cot \theta = -\sqrt{35}$ **39.** 4 standard carts, 11 deluxe carts **41.**



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5. 0 **7.** none **9.** $A = 37.0°, B = 13.0°, a = 13.4$ **11.** 0 **13.** 0 **15.** 0 **17.** 2 **19.** $B = 71.1°$, $C = 50.9°, c = 23.8$; $B = 108.9°, C = 13.1°, c = 6.9$ **21.** $A = 78.2°, B = 31.8°, b = 13.5$; $A = 101.8°$, $B = 8.2°, b = 3.6$ **23.** none **25.** $B = 30.1°$, $C = 42.7°, b = 9.0$ **27.** $A = 27.2°, B = 105.8°$, $b = 21.1$ **29.** none **31.** about 63.9 units and 41.0 units **33.** about 100.6° **35.** about 9.6°

37. about 4.1 min **39a.** $B > 44.9°$ **39b.** $B \approx 44.9°$ **39c.** $B < 44.9°$ **41.** about 185.6 m **43.** no;

$$\frac{\frac{3x}{x-1}+1}{3\left(\frac{3x}{x-1}\right)} = \frac{\frac{3x}{x-1}+\frac{x-1}{x-1}}{\frac{9x}{x-1}} =$$

$$\frac{\frac{4x-1}{x-1}}{\frac{9x}{x-1}} = \frac{4x-1}{9x} \neq x$$

45. $5x + 2y = -22$

Pages 330–332 Lesson 5-8

5. $A = 43.5°, B = 54.8°, C = 81.7°$ **7.** about 81.0° **9.** 102.3 units^2 **11.** $B = 44.2°, C = 84.8°, a = 7.8$ **13.** $A = 34.1°, B = 44.4°, C = 101.5°$ **15.** $A = 51.8°, B = 70.9°, C = 57.3°$ **17.** about 13.8° **19.** 11.6 units^2 **21.** 290.5 units^2 **23.** 11,486.3 units^2 **25a.** about 68.1 in. **25b.** about 1247.1 in^2 **27.** about 342.3 ft **29a.** about 122.8 mi **29b.** about 2.8 mi **31.** the player 30 ft and 20 ft from the posts **33.** 2 **35.** 55° **37.** $\frac{4}{3}$

Pages 335–339 Chapter 5 Study Guide and Assessment

1. false; depression **3.** true **5.** true **7.** true **9.** false; terminal side **11.** 57° 9′ **13.** 140°; II **15.** 204°; III **17.** 60°; I **19.** 294°; IV **21.** 76°

23. $\sin A = \frac{5\sqrt{34}}{34}$, $\cos A = \frac{3\sqrt{34}}{34}$, $\tan A = \frac{5}{3}$

25. $\sin M = \frac{5}{6}$, $\cos M = \frac{\sqrt{11}}{6}$, $\tan M = \frac{5\sqrt{11}}{11}$, $\csc M = \frac{6}{5}$, $\sec M = \frac{6\sqrt{11}}{11}$, $\cot M = \frac{\sqrt{11}}{5}$

27. $\sin \theta = \frac{\sqrt{2}}{2}$, $\cos \theta = \frac{\sqrt{2}}{2}$, $\tan \theta = 1$, $\csc \theta = \sqrt{2}$, $\sec \theta = \sqrt{2}$, $\cot \theta = 1$

29. $\sin \theta = -\frac{\sqrt{17}}{17}$, $\cos \theta = \frac{4\sqrt{17}}{17}$, $\tan \theta = -\frac{1}{4}$, $\csc \theta = -\sqrt{17}$, $\sec \theta = \frac{\sqrt{17}}{4}$, $\cot \theta = -4$

31. $\sin \theta = \frac{5\sqrt{41}}{41}$, $\cos \theta = \frac{4\sqrt{41}}{41}$, $\tan \theta = \frac{5}{4}$, $\csc \theta = \frac{\sqrt{41}}{5}$, $\sec \theta = \frac{\sqrt{41}}{4}$, $\cot \theta = \frac{4}{5}$

33. $\sin \theta = \frac{\sqrt{2}}{2}$, $\cos \theta = -\frac{\sqrt{2}}{2}$, $\tan \theta = -1$, $\csc \theta = \sqrt{2}$, $\sec \theta = -\sqrt{2}$, $\cot \theta = -1$

35. $\sin \theta = \frac{\sqrt{55}}{8}$, $\tan \theta = -\frac{\sqrt{55}}{3}$, $\csc \theta = \frac{8\sqrt{55}}{55}$, $\sec \theta = -\frac{8}{3}$, $\cot \theta = -\frac{3\sqrt{55}}{55}$ **37.** 10.0 **39.** 10.2

41. 180° **43.** $a = 13.2, A = 41.4°, B = 48.6°$ **45.** $A = 52°, b = 100.2, c = 90.4$ **47.** 471.7 units^2 **49.** 2488.4 units^2 **51.** $B = 93.7°, C = 47.6°, b = 274.5$; $B = 8.9°, C = 132.4°, b = 42.3$ **53.** $B = 113.7°, C = 37.3°, b = 22.7$; $B = 8.3°, C = 142.7°, b = 3.6$ **55.** $a = 36.9, B = 57.4°, C = 71.6°$ **57.** $A = 30.5°, B = 36.9°, C = 112.6°$ **59a.** about 41.8° **59b.** about 8.9 ft

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1. C **3.** A **5.** C **7.** C **9.** B

Chapter 6 Graphs of Trigonometric Functions

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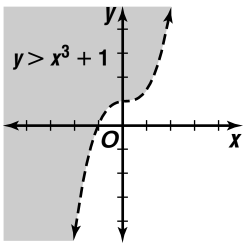
5. $\frac{4\pi}{3}$ **7.** 270° **9.** $\frac{\sqrt{2}}{2}$ **11.** 39.3 in. **13.** 2.1 units^2 **15.** about 0.7 m **17.** $\frac{7\pi}{6}$ **19.** $-\frac{5\pi}{2}$ **21.** $\frac{125\pi}{18}$ **23.** 660° **25.** −200.5° **27.** 1002.7° **29.** $\frac{\sqrt{3}}{3}$ **31.** $-\frac{1}{2}$ **33.** $-\frac{\sqrt{3}}{2}$ **35.** 18.3 cm **37.** 68.9 cm **39.** 78.2 cm **41.** about 36.0 m **43.** 65.4 units^2 **45.** 9.6 units^2 **47.** 70.7 units^2 **49a.** 5 ft **49b.** 15 ft^2 **51a.** about 12.2 in. **51b.** about 2.4 in. **53a.** about 7.9 ft **53b.** about 143.2° **55.** about 26.3° **57.** about 5.23 mi **59a.** about 530.1 ft^2 **59b.** about 17.8 ft **61.** $A = \frac{1}{2}r^2(\alpha - \sin \alpha)$ **63.** no solution **65.** I, III **67.** Sample answers: 4; −2 **69.** all **71.** b

Pages 355–358 Lesson 6-2

7. 4461.1 radians **9.** 293.2 radians/min **11.** 110.0 m/min **13.** 18.8 radians **15.** 82.9 radians **17.** 381.4 radians **19.** 1.3 radians/s **21.** 9.0 radians/s **23.** 39.3 radians/min **25.** about 0.1 radian/s **27.** about 811.7 rpm **29.** 109.6 ft/s **31.** 4021.6 in./s **33.** 18,014.0 mm/min **35a.** about 3.1 mm/s **35b.** about 0.05 mm/s **35c.** about 0.003 mm/s **37a.** about 7.1 ft/s **37b.** about 9.9 ft **37c.** about 4 ft/s **39a.** 2017 revolutions **39b.** about 14.7 mph **41a.** $\theta = \frac{\pi}{4}\cos \pi t$ **41b.** 0.5 s, 1.5 s **43a.** B clockwise; C counterclockwise **43b.** 180 rpm; 75 rpm **45.** about 31.68 cm^2 **47.** no real solution

49.



51. D

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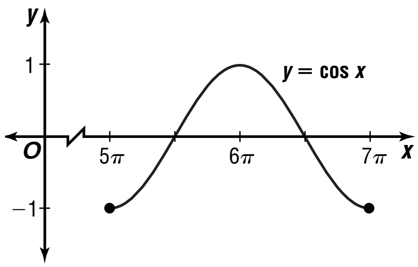
5. yes; 4 **7.** 1

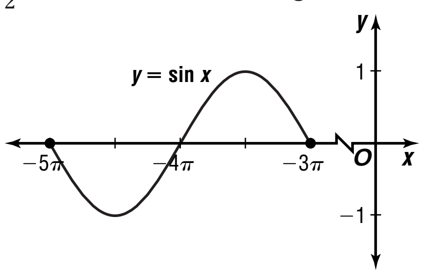
9.



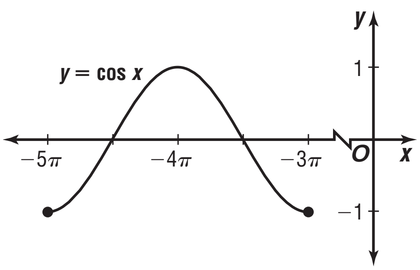
11. Neither; the period is not 2π **13.** yes; 6 **15.** yes; 20 **17.** no **19.** 1 **21.** 0 **23.** -1 **25.** -1 **27.** $\pi + 2\pi n$, where n is an integer

29. $\frac{\pi}{2} + \pi n$, where n is an integer

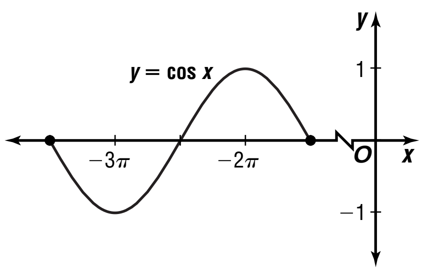
31.



33.



35.

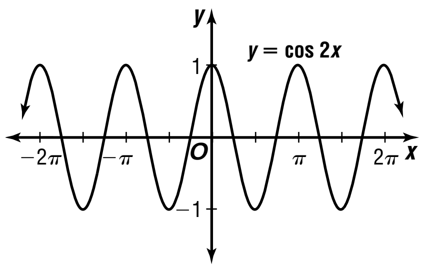


37. $y = \cos x$; the maximum value of 1 occurs when $x = 4\pi$, the minimum value of -1 occurs when $x = 5\pi$, and the x-intercepts are $\frac{7\pi}{2}$, $\frac{9\pi}{2}$, and $\frac{11\pi}{2}$. **39.** $y = \sin x$; the maximum value of 1 occurs when $x = -\frac{11\pi}{2}$, the minimum value of -1 occurs when $x = -\frac{13\pi}{2}$, and the x-intercepts are -7π, -6π, and -5π. **41.** $x = \frac{\pi}{2} + \pi n$, where n is an integer

43a. $\frac{\pi}{2} + 2\pi n$, where n is an integer

43b. $\frac{3\pi}{2} + 2\pi n$, where n is an integer **43c.** πn, where n is an integer **45.** $x = \frac{3\pi}{4}, \frac{7\pi}{4}$ **47.** none **49.** $x = 0, \frac{\pi}{2}, 2\pi$ **51a.** 62; it is twice the coefficient. **51b.** 86; it is twice the constant term. **53a.** 100; 120; 100; 80; 100 **53b.** 0.25 s **53c.** 0.75 s **55a.** $\frac{\pi}{4} + \frac{\pi n}{2}$, where n is an integer **55b.** 1 **55c.** -1 **55d.** π

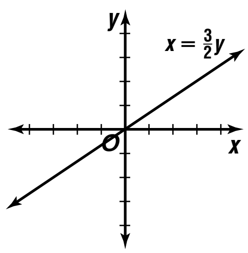
55e.



57. about 52.4 radians per second

59. 45°, 135° **61.** 1; 2 or 0; $-3, -\frac{1}{2}, 2$ **63.** $x = 0, x = -1, y = 1$ **65.** -11

67.



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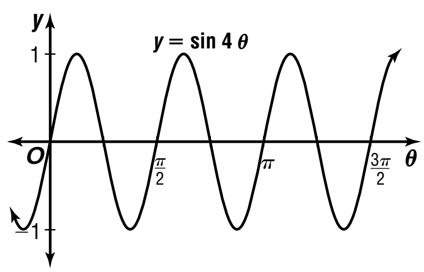
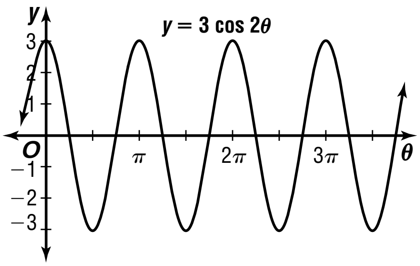
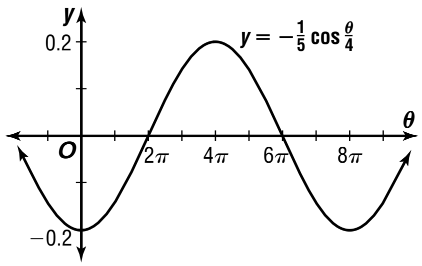
7. $\frac{\pi}{2}$



9. $3; \pi$

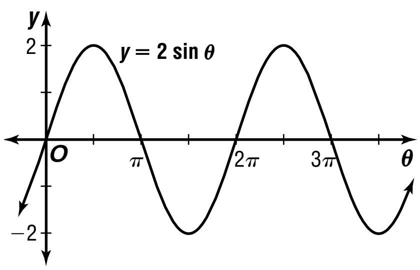


11. $\frac{1}{5}; 8\pi$

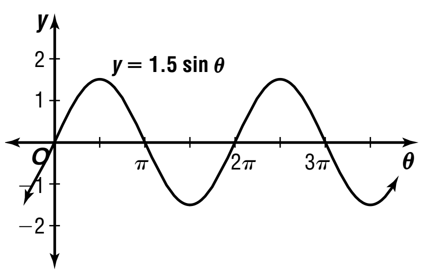


13. $y = \pm 7 \sin 6\theta$ **15.** $y = \pm\frac{3}{4} \cos \frac{\pi}{3}\theta$

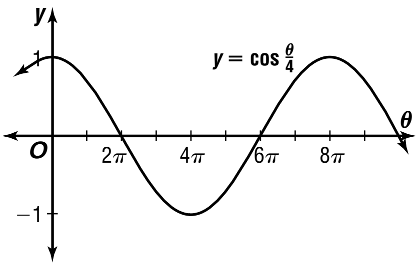
17. 2



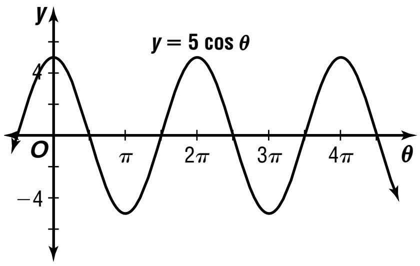
19. 1.5



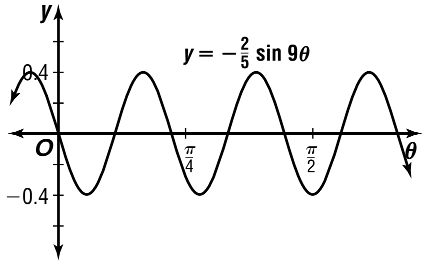
21. 8π



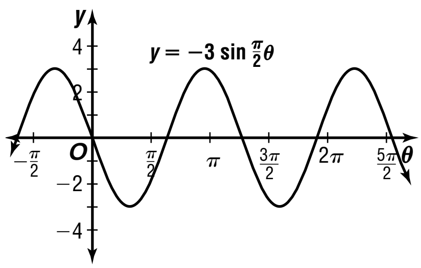
23. $5; 2\pi$



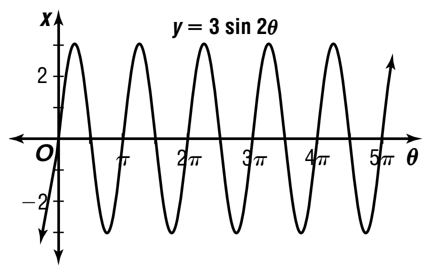
25. $\frac{2}{5}; \frac{2\pi}{9}$



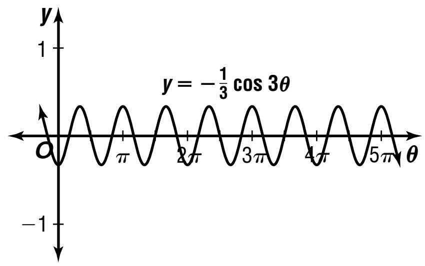
27. 3; 4



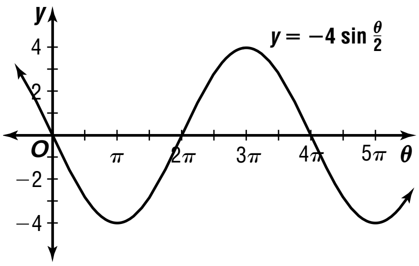
29. $3; \pi$



31. $\frac{1}{3}; \frac{2\pi}{3}$

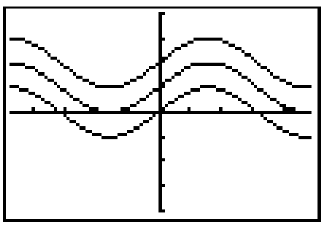


33. 4; 4π



35. 0.5; $\frac{1}{349}$ **37.** $y = \pm 35.7 \sin 8\theta$
39. $y = \pm 0.34 \sin \frac{8}{3}\theta$ **41.** $y = \pm 16 \sin \frac{\pi}{15}\theta$
43. $y = \pm\frac{5}{8} \cos 14\theta$ **45.** $y = \pm 0.5 \cos \frac{20}{3}\theta$
47. $y = \pm 17.9 \cos \frac{\pi}{8}\theta$ **49.** $y = 2 \cos \frac{\theta}{2}$
51. $y = -3 \cos \theta$ **53.** $y = \pm 3.8 \sin (240\pi \times t)$

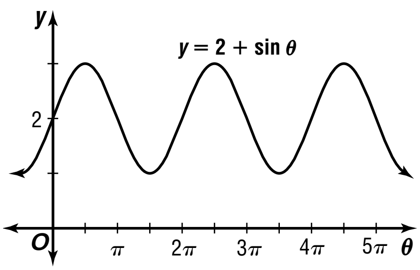
55.



The graphs have the same shape, but have been translated vertically.

57a. 3 **57b.** 1 **57c.** 2π

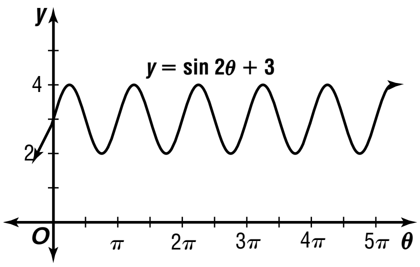
57d.



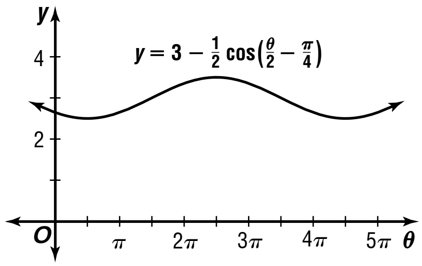
59a. $y = 1.5 \cos \left(t\sqrt{\frac{9.8}{6}}\right)$ **59b.** about 0.6 m to the right **59c.** about 1.2 m to the left **61a.** about 0.9 s/cycle; about 1.1 hertz **61b.** about 1.1 s/cycle; about 0.9 hertz **61c.** about 1.3 s/cycle; about 0.8 hertz **61d.** It increases. **61e.** It decreases. **63.** about 88.0 radians/s **65.** $c = 24.7$, $A = 37.8°$, $B = 52.2°$ **67.** -95; 2 imaginary roots **69.** $(-2, 1)$, $(1, 1)$, $(3, 4)$, $(-3, 2)$ **71.** \$434.10 **73.** C

Pages 383–386 Lesson 6-5

7. 3; $y = 3$

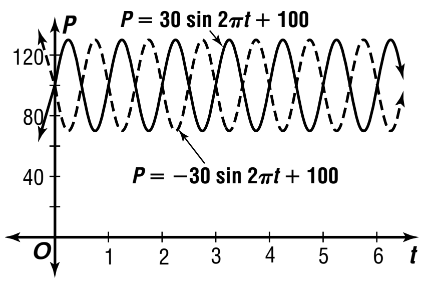


9. $\frac{1}{2}$; 4π; $\frac{\pi}{2}$; 3

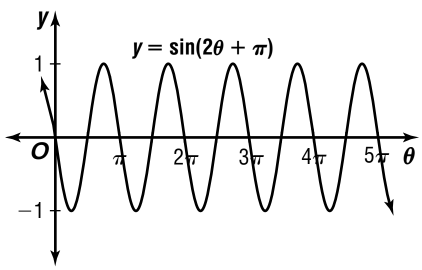


11. $y = \pm 0.6 \cos \left(\frac{\pi}{6.2}\theta + \frac{2.13\pi}{6.2}\right) + 7$
13a. $P = 100$ **13b.** $P = \pm 30 \sin 2\pi t + 100$

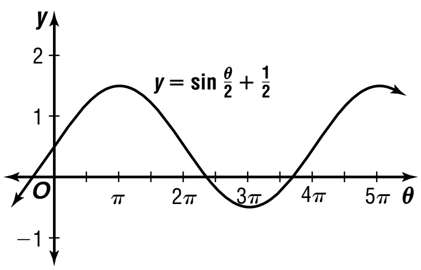
13c.



15. $-\frac{\pi}{2}$

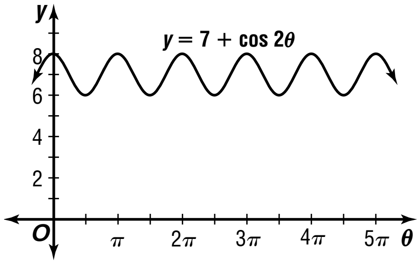


17. $\frac{1}{2}$; $y = \frac{1}{2}$

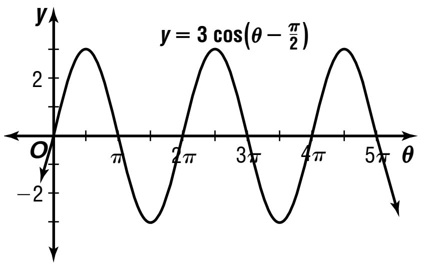


CONTENTS

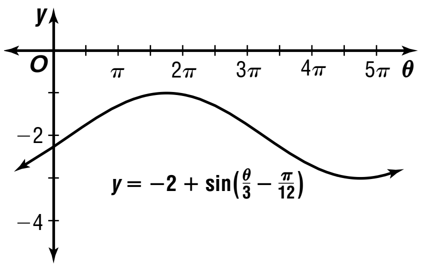
19. 7; $y = 7$



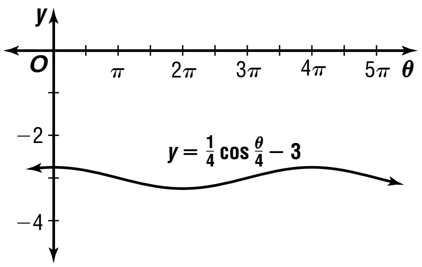
21. 3; 2π; $\frac{\pi}{2}$; 0



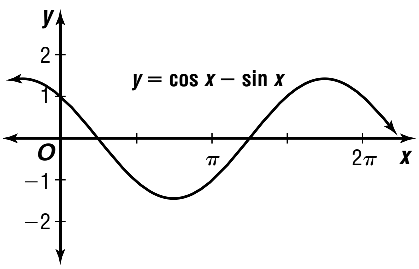
23. 1; 6π; $\frac{\pi}{4}$; -2



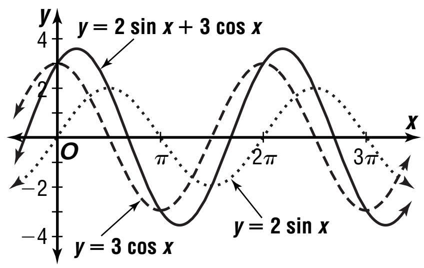
25. $\frac{1}{4}$; 4π; 0; -3



27. 4; 4π; $-\frac{\pi}{2}$; -2 **29.** $y = \pm 50 \sin \left(\frac{8}{3}\theta - \frac{4\pi}{3}\right) - 25$ **31.** $y = \pm 3.5 \cos (4\theta - \pi) + 7$
33. $y = \pm 100 \cos \left(\frac{2\pi}{45}\theta\right) - 110$
35. $y = 0.5 \sin 2\theta + 3$
37.

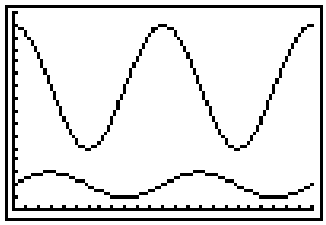


39.



41a. 3000; 1000 **41b.** 15,000; 5000

41c.



[0, 24] scl:1 by [0, 16,000] scl:1000

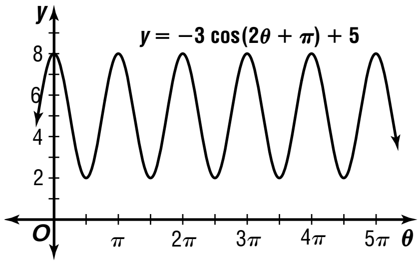
41d. months number 3 and 15 **41e.** months number 0, 12, 24 **41f.** When the sheep population is at a maximum, the wolf population is on the increase because of the maximum availability of food. The upswing in wolf population leads to a maximum later. **43a.** 4 ft **43b.** $t = 25$ **43c.** 20 s **43d.** $h = 25 + 21 \sin \left(\frac{\pi t}{10}\right)$ **43e.** 5 s **43f.** 25 ft

45a. $y = \sqrt{\sin x}$ **45b.** $y = \frac{\cos x}{x}$ **45c.** $y = \cos x^2$ **45d.** $y = \sin \sqrt{x}$ **47.** 134.4 cm/s **49.** $y = \frac{3}{x} + 1$ **51.** $(1.4, -0.04)$ **53.** $3x - y - 11 = 0$

Pages 391–394 Lesson 6-6

5. $P = 30 \sin 2\pi t + 110$ **7a.** 0.5 **7b.** $\frac{1}{330}$ **7c.** 330 hertz **9a.** 1200 **9b.** about 232 **9c.** 1500; 275; no **9d.** January 1, 1971 **9e.** 225; July 1, 1973 **11.** $y = 3.55 \sin \left(\frac{\pi}{6.2}t + \frac{2.34\pi}{3.1}\right) + 4.24$ **13a.** 4° **13b.** 77° **13c.** 12 months **13d.** Sample answer: $y = -4 \cos \left(\frac{\pi}{6}t - 0.5\right) + 77$ **13e.** Sample answer: About 80.4°; it is very close to the actual average. **13f.** Sample answer: About 79.1°; it is close to the actual average. **15a.** 5.685 ft **15b.** 7.565 ft **15c.** about 12.4 h **15d.** Sample answer: $h = 5.685 \sin \left(\frac{\pi}{6.2}t - 0.71\right) + 7.565$ **15e.** Sample answer: about 8.99 ft **17.** Sample answer: about -2.09 **19.** $V_R = 120 \sin \left(\frac{\pi}{30}t\right)$

21. $3; \pi; -\frac{\pi}{2}; 5$

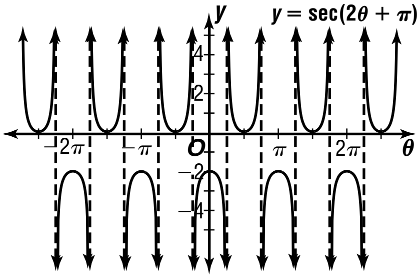


23. $\frac{40\pi}{9}$ **25.** $\frac{3}{m-4} + \frac{-1}{m+4}$ **27.** $x > -1; x < -1$

Pages 400–403 Lesson 6-7

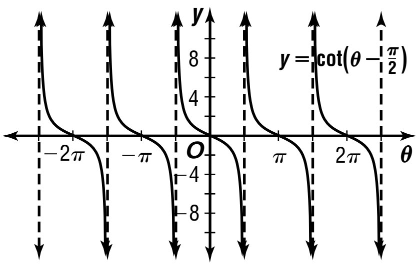
5. 1 **7.** $\frac{\pi}{4} + \pi n$, where n is an integer

9.

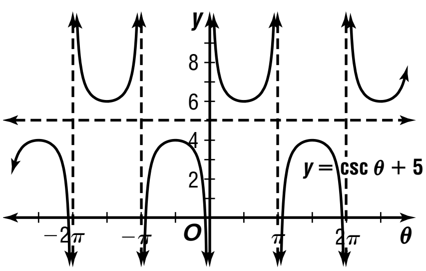


11. $y = \cot\left(\frac{1}{2}\theta + \frac{\pi}{8}\right)$ **13.** 0 **15.** undefined **17.** −1 **19.** undefined **21.** πn, where n is an integer **23.** $\frac{3\pi}{2} + 2\pi n$, where n is an integer **25.** $-\frac{\pi}{4} + \pi n$, where n is an integer **27.** $\frac{\pi}{2}n$, where n is an odd integer

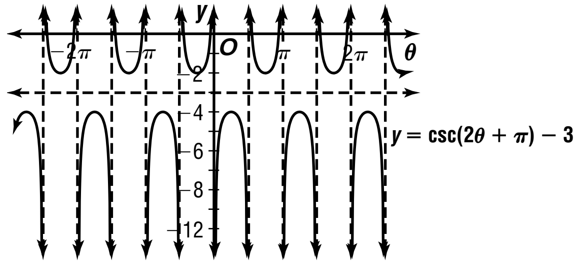
29.



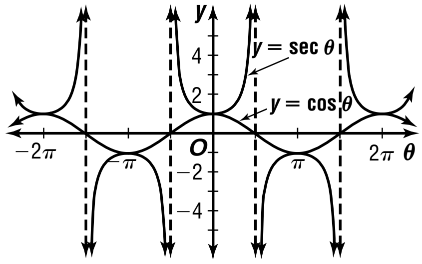
31.



33.



35.



$-2\pi, -\pi, 0, \pi, 2\pi$

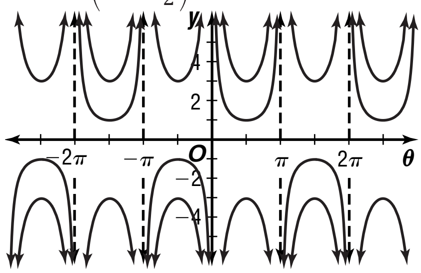
37. $y = \cot\left(2\theta - \frac{\pi}{4}\right) + 7$

39. $y = \csc\left(\frac{2}{3}\theta - \frac{2\pi}{3}\right) - 1$

41. $y = \csc(6\theta + 3\pi) - 5$

43. $y = \tan\left(2\theta - \frac{\pi}{2}\right) + 7$

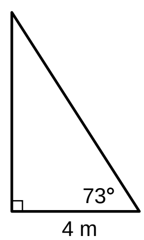
45.



The graph of $y = \csc\theta$ has no range values between −1 and 1, while the graphs of $y = 3\csc\theta$ and $y = -3\csc\theta$ have no range values between −3 and 3. The graphs of $y = 3\csc\theta$ and $y = -3\csc\theta$ are reflections of each other.

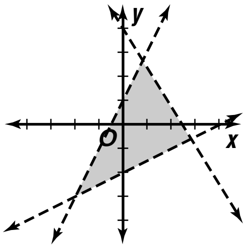
47a. 220 A **47b.** $\frac{1}{30}$ s **47c.** $\frac{1}{360}$ **47d.** about −110 A **49a.** 1.72 ft **49b.** 2.27 ft **49c.** about 12.3 hr **49d.** Sample answer: $h = 1.72\sin\left(\frac{2\pi}{12.3}t + 1.55\right) + 2.27$ **49e.** Sample answer: 3.96 ft **51.** 6π cm

53a.



53b. about 13.1 m **53c.** about 13.7 m **55.** $-2 < x < 5$

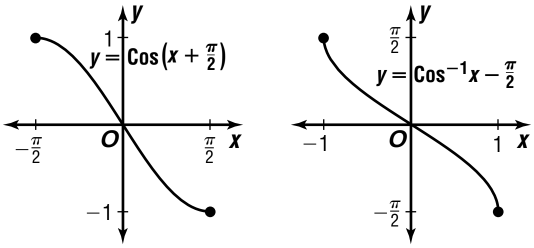
57.



59. B

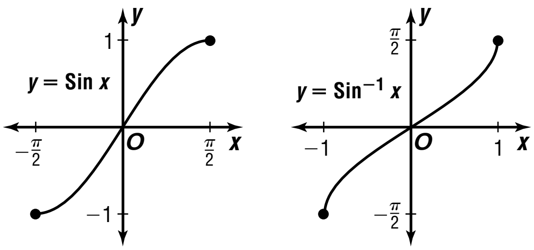
Pages 410–412 Lesson 6-8

7. $y = \text{Cos}^{-1}\, x - \frac{\pi}{2}$

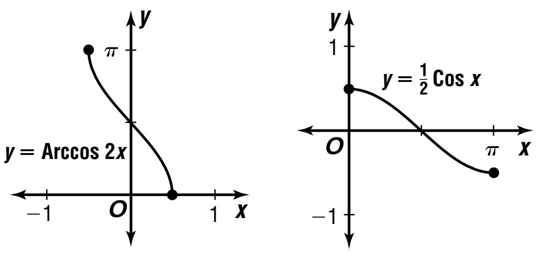


9. $\frac{\sqrt{2}}{2}$ **11.** true **13a.** about 40,212 km **13b.** $C = 40{,}212 \cos \theta$ **13c.** about 1.48 radians **13d.** about 40,212 km

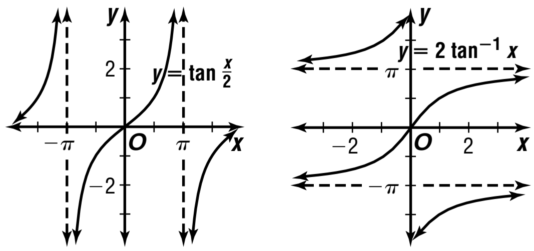
15. $y = \text{Sin}^{-1}\, x$



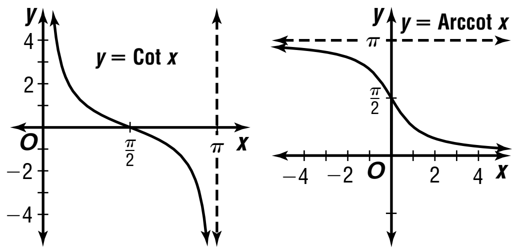
17. $y = \frac{1}{2}\, \text{Cos}\, x$



19. $y = 2 \tan^{-1} x$



21.

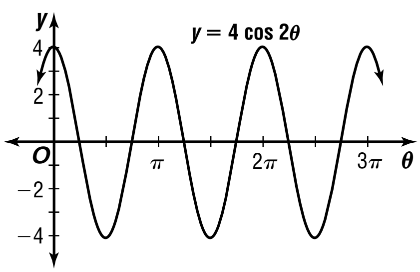


23. $\frac{\pi}{2}$ **25.** $\frac{\pi}{2}$ **27.** $\frac{1}{2}$ **29.** $-\frac{1}{2}$ **31.** No; there is no angle with the sine of 2. **33.** true **35.** true **37.** false; sample answer: $x = \frac{\pi}{2}$ **39.** April and October **41.** $\frac{\pi}{4} + \pi n$, where n is an integer **43a.** 6:42 P.M. **43b.** 12.4 h **43c.** 3.675 ft **43d.** Sample answer: $y = 3.375 + 3.675 \sin \left(\frac{\pi}{6.2}t - 1.62\right)$ **43e.** Sample answer: about 4:46 A.M. **45a.** about 1.47 radians **45b.** about 35.81 in. **47.** $y = \pm 5 \sin \left(\frac{2}{3}\theta + \frac{2\pi}{3}\right) - 8$ **49.** 25.4 units, 54.4 units **51.** $\pm 1, \pm 2, \pm 3, \pm 6, \pm\frac{1}{2}, \pm\frac{3}{2}$ **53.** $27x^3 - 1$; $3x^3 - 3$

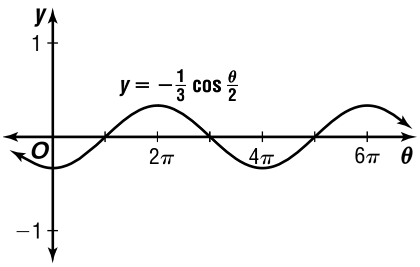
Pages 413–417 Chapter 6 Study Guide and Assessment

1. radian **3.** the same **5.** angle **7.** radian **9.** sunusoidal **11.** $\frac{\pi}{3}$ **13.** $\frac{4\pi}{3}$ **15.** $-315°$ **17.** 35.3 cm **19.** 39.3 cm **21.** 31.4 radians **23.** 316.7 radians **25.** 2.3 radians/s **27.** 6.5 radians/s **29.** -1 **31.** 1

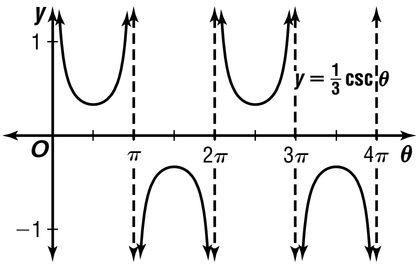
33. 4; π



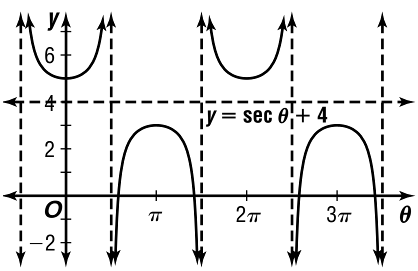
35. $\frac{1}{3}$; 4π



37. $y = \pm 0.5 \sin\left(2\theta - \frac{2\pi}{3}\right) + 3$
39. $y = 20 \sin 2\pi t + 100$
41.



43.



45. $-\frac{\pi}{4}$ 47. 0 49. 0 51. $\frac{\pi}{2}$

Page 419 Chapter 6 SAT and ACT Practice
1. B 3. B 5. D 7. A 9. D

Chapter 7 Trigonometric Identities and Equations

Pages 427–430 Lesson 7-1
7. Sample answer: $x = 45°$ 9. $-\frac{2\sqrt{5}}{5}$ 11. $\frac{\sqrt{65}}{7}$
13. csc 30° 15. 1

17. $B = \frac{F\csc\theta}{I\ell}$

$BI\ell = F\csc\theta$

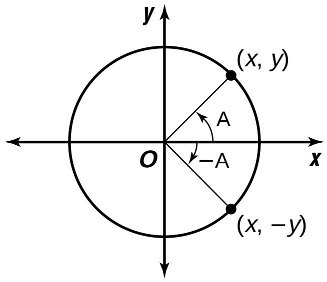
$F = \frac{BI\ell}{\csc\theta}$

$F = BI\ell\left(\frac{1}{\csc\theta}\right)$

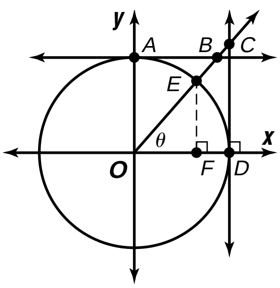
$F = BI\ell\sin\theta$

19. Sample answer: 45° 21. Sample answer: 30°
23. Sample answer: 45° 25. $\frac{5}{2}$ 27. $\frac{\sqrt{15}}{4}$

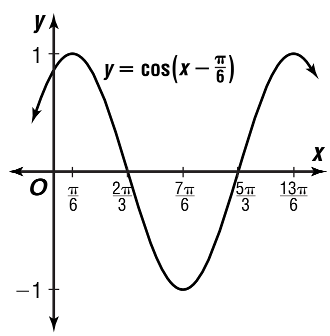
29. $-\frac{\sqrt{2}}{3}$ 31. $\frac{\sqrt{2}}{4}$ 33. $-\frac{2\sqrt{6}}{7}$ 35. $-\frac{3}{5}$
37. $\frac{1}{2}$ 39. $-\cos\frac{3\pi}{8}$ 41. $-\csc\frac{\pi}{3}$ 43. cot 60°
45. $\csc\theta$ 47. 2 49. $\sin x + \cos x$ 51. 1
53. 1 55. Let (x, y) be the point where the terminal side of A intersects the unit circle when A is in standard position. When A is reflected about the x-axis to obtain $-A$, the y-coordinate is multiplied by -1, but the x-coordinate is unchanged. So, $\sin(-A) = -y = -\sin A$ and $\cos(-A) = x = \cos A$.



57. $\mu_k = \tan\theta$ 59. $\sin\theta = EF$ and $\cos\theta = OF$ since the circle is a unit circle. $\tan\theta = \frac{CD}{OD} = \frac{CD}{1} = CD$.
$\sec\theta = \frac{CO}{OD} = \frac{CO}{1} = CO$.
$\Delta EOF \sim \Delta OBA$, so
$\frac{OF}{EF} = \frac{BA}{OA} = \frac{BA}{1} = BA$. Then $\cot\theta = \frac{\cos\theta}{\sin\theta} = \frac{OF}{EF} = BA$. Also by similar triangles, $\frac{EO}{EF} = \frac{OB}{OA}$, or $\frac{1}{EF} = \frac{OB}{1}$.
Then $\csc\theta = \frac{1}{\sin\theta} = \frac{1}{EF} = \frac{OB}{1} = OB$.



61.



63. $a = 12.0$, $B = 70°$, $b = 32.9$
65. −4, 0.5
67. (2, −5, −3)
69. C

Pages 434–436 Lesson 7-2

5. $\cos x \stackrel{?}{=} \dfrac{\cot x}{\csc x}$

$$\cos x \stackrel{?}{=} \frac{\frac{\cos x}{\sin x}}{\frac{1}{\sin x}}$$

$$\cos x \stackrel{?}{=} \frac{\cos x}{1}$$

$$\cos x = \cos x$$

7. $\csc \theta - \cot \theta \stackrel{?}{=} \dfrac{1}{\csc \theta + \cot \theta}$

$$\csc \theta - \cot \theta \stackrel{?}{=} \frac{1}{\csc \theta + \cot \theta} \cdot \frac{\csc\theta - \cot \theta}{\csc\theta - \cot \theta}$$

$$\csc \theta - \cot \theta \stackrel{?}{=} \frac{\csc \theta - \cot \theta}{\csc^2 \theta - \cot^2 \theta}$$

$$\csc \theta - \cot \theta \stackrel{?}{=} \frac{\csc \theta - \cot \theta}{(1 + \cot^2 \theta) - \cot^2 \theta}$$

$$\csc \theta - \cot \theta \stackrel{?}{=} \frac{\csc \theta - \cot \theta}{1}$$

$$\csc \theta - \cot \theta = \csc \theta - \cot \theta$$

9. $(\sin A - \cos A)^2 \stackrel{?}{=} 1 - 2 \sin^2 A \cot A$

$$\sin^2 A - 2 \sin A \cos A + \cos^2 A \stackrel{?}{=} 1 - 2 \sin^2 A \cot A$$

$$1 - 2 \sin A \cos A \stackrel{?}{=} 1 - 2 \sin^2 A \cot A$$

$$1 - 2 \sin A \cos A \frac{\sin A}{\sin A} \stackrel{?}{=} 1 - 2 \sin^2 A \cot A$$

$$1 - 2 \sin^2 A \frac{\cos A}{\sin A} \stackrel{?}{=} 1 - 2 \sin^2 A \cot A$$

$$1 - 2 \sin^2 A \cot A = 1 - 2 \sin^2 A \cot A$$

11. Sample answer: $\cos x = -1$

13. $\tan A \stackrel{?}{=} \dfrac{\sec A}{\csc A}$

$$\tan A \stackrel{?}{=} \frac{\frac{1}{\cos A}}{\frac{1}{\sin A}}$$

$$\tan A \stackrel{?}{=} \frac{\sin A}{\cos A}$$

$$\tan A = \tan A$$

15. $\sec x - \tan x \stackrel{?}{=} \dfrac{1 - \sin x}{\cos x}$

$$\sec x - \tan x \stackrel{?}{=} \frac{1}{\cos x} - \frac{\sin x}{\cos x}$$

$$\sec x - \tan x = \sec x - \tan x$$

17. $\sec x \csc x \stackrel{?}{=} \tan x + \cot x$

$$\sec x \csc x \stackrel{?}{=} \frac{\sin x}{\cos x} + \frac{\cos x}{\sin x}$$

$$\sec x \csc x \stackrel{?}{=} \frac{\sin x}{\cos x} \cdot \frac{\sin x}{\sin x} + \frac{\cos x}{\sin x} \cdot \frac{\cos x}{\cos x}$$

$$\sec x \csc x \stackrel{?}{=} \frac{\sin^2 x}{\cos x \sin x} + \frac{\cos^2 x}{\sin x \cos x}$$

$$\sec x \csc x \stackrel{?}{=} \frac{\sin^2 x + \cos^2 x}{\cos x \sin x}$$

$$\sec x \csc x \stackrel{?}{=} \frac{1}{\cos x \sin x}$$

$$\sec x \csc x \stackrel{?}{=} \frac{1}{\cos x} \cdot \frac{1}{\sin x}$$

$$\sec x \csc x = \sec x \csc x$$

19. $(\sin A + \cos A)^2 \stackrel{?}{=} \dfrac{2 + \sec A \csc A}{\sec A \csc A}$

$$(\sin A + \cos A)^2 \stackrel{?}{=} \frac{2}{\sec A \csc A} + \frac{\sec A \csc A}{\sec A \csc A}$$

$$(\sin A + \cos A)^2 \stackrel{?}{=} 2\,\frac{1}{\sec A} \cdot \frac{1}{\csc A} + 1$$

$$(\sin A + \cos A)^2 \stackrel{?}{=} 2 \cos A \sin A + 1$$

$$(\sin A + \cos A)^2 \stackrel{?}{=} 2 \cos A \sin A + \sin^2 A + \cos^2 A$$

$$(\sin A + \cos A)^2 = (\sin A + \cos A)^2$$

21. $\dfrac{\cos y}{1 - \sin y} \stackrel{?}{=} \dfrac{1 + \sin y}{\cos y}$

$$\frac{\cos y}{1 - \sin y} \cdot \frac{1 + \sin y}{1 + \sin y} \stackrel{?}{=} \frac{1 + \sin y}{\cos y}$$

$$\frac{\cos y\,(1 + \sin y)}{1 - \sin^2 y} \stackrel{?}{=} \frac{1 + \sin y}{\cos y}$$

$$\frac{\cos y\,(1 + \sin y)}{\cos^2 y} \stackrel{?}{=} \frac{1 + \sin y}{\cos y}$$

$$\frac{1 + \sin y}{\cos y} = \frac{1 + \sin y}{\cos y}$$

23. $\csc x - 1 \stackrel{?}{=} \dfrac{\cot^2 x}{\csc x + 1}$

$$\csc x - 1 \stackrel{?}{=} \frac{\csc^2 x - 1}{\csc x + 1}$$

$$\csc x - 1 \stackrel{?}{=} \frac{(\csc x + 1)(\csc x - 1)}{\csc x + 1}$$

$$\csc x - 1 = \csc x - 1$$

25. $\sin \theta \cos \theta \tan \theta + \cos^2 \theta \stackrel{?}{=} 1$

$$\sin \theta \cos \theta \frac{\sin \theta}{\cos \theta} + \cos^2 \theta \stackrel{?}{=} 1$$

$$\sin^2 \theta + \cos^2 \theta \stackrel{?}{=} 1$$

$$1 = 1$$

27. $\sin x + \cos x \stackrel{?}{=} \dfrac{\cos x}{1 - \tan x} + \dfrac{\sin x}{1 - \cot x}$

$$\sin x + \cos x \stackrel{?}{=} \frac{\cos x}{1 - \frac{\sin x}{\cos x}} + \frac{\sin x}{1 - \frac{\cos x}{\sin x}}$$

$$\sin x + \cos x \stackrel{?}{=} \frac{\cos x}{1 - \frac{\sin x}{\cos x}} \cdot \frac{\cos x}{\cos x} + \frac{\sin x}{1 - \frac{\cos x}{\sin x}} \cdot \frac{\sin x}{\sin x}$$

$$\sin x + \cos x \stackrel{?}{=} \frac{\cos^2 x}{\cos x - \sin x} + \frac{\sin^2 x}{\sin x - \cos x}$$

$$\sin x + \cos x \stackrel{?}{=} -\frac{\cos^2 x}{\sin x - \cos x} + \frac{\sin^2 x}{\sin x - \cos x}$$

$$\sin x + \cos x \stackrel{?}{=} \frac{\sin^2 x - \cos^2 x}{\sin x - \cos x}$$

$$\sin x + \cos x \stackrel{?}{=} \frac{(\sin x + \cos x)(\sin x - \cos x)}{\sin x - \cos x}$$

$$\sin x + \cos x = \sin x + \cos x$$

29. Sample answer: $\sec x = \sqrt{2}$ **31.** Sample answer: $\cos x = 0$ **33.** Sample answer: $\sin x = 1$

35. 1 **37.** yes **39.** no **41.** $\frac{1}{2} \sin \theta$

43. $y = -\frac{gx^2}{2v_0^2}(1 + \tan^2\theta) + x\tan\theta$ **45.** By the Law of Sines, $\frac{b}{\sin\beta} = \frac{a}{\sin\alpha}$, so $b = \frac{a\sin\beta}{\sin\alpha}$. Then

$$A = \frac{1}{2}ab\sin\gamma$$
$$A = \frac{1}{2}a\left(\frac{a\sin\beta}{\sin\alpha}\right)\sin\gamma$$
$$A = \frac{a^2\sin\beta\sin\gamma}{2\sin\alpha}$$
$$A = \frac{a^2\sin\beta\sin\gamma}{2\sin(180° - (\beta + \gamma))}$$
$$A = \frac{a^2\sin\beta\sin\gamma}{2\sin(\beta + \gamma)}$$

47. $y = \pm 2\sin(2x - 90°)$ **49.** 3 **51.** 40 shirts, 40 pants **53.** D

Pages 442–445 Lesson 7-3

5. $-\frac{\sqrt{2} + \sqrt{6}}{4}$ **7.** $\sqrt{6} + \sqrt{2}$ **9.** $-\frac{63}{16}$

11.
$$\tan\left(\theta + \frac{\pi}{2}\right) \stackrel{?}{=} -\cot\theta$$
$$\frac{\sin\left(\theta + \frac{\pi}{2}\right)}{\cos\left(\theta + \frac{\pi}{2}\right)} \stackrel{?}{=} -\cot\theta$$
$$\frac{\sin\theta\cos\frac{\pi}{2} + \cos\theta\sin\frac{\pi}{2}}{\cos\theta\cos\frac{\pi}{2} - \sin\theta\sin\frac{\pi}{2}} \stackrel{?}{=} -\cot\theta$$
$$\frac{(\sin\theta)\cdot 0 + (\cos\theta)\cdot 1}{(\cos\theta)\cdot 0 - (\sin\theta)\cdot 1} \stackrel{?}{=} -\cot\theta$$
$$-\frac{\cos\theta}{\sin\theta} \stackrel{?}{=} -\cot\theta$$
$$-\cot\theta = -\cot\theta$$

13. $-\cos n\omega_0 t$ **15.** $\frac{\sqrt{6} - \sqrt{2}}{4}$ **17.** $\frac{\sqrt{6} - \sqrt{2}}{4}$

19. $\frac{\sqrt{2} + \sqrt{6}}{4}$ **21.** $-2 + \sqrt{3}$ **23.** $\sqrt{2} - \sqrt{6}$

25. $2 - \sqrt{3}$ **27.** $\frac{24}{25}$ **29.** $\frac{12\sqrt{17} - 5\sqrt{34}}{102}$

31. $\frac{65}{56}$ **33.** $\frac{3 - 2\sqrt{14}}{12}$

35.
$$\cos(60° + A) \stackrel{?}{=} \sin(30° - A)$$
$$\cos 60°\cos A - \sin 60°\sin A \stackrel{?}{=} \sin 30°\cos A - \cos 30°\sin A$$
$$\frac{1}{2}\cos A - \frac{\sqrt{3}}{2}\sin A = \frac{1}{2}\cos A - \frac{\sqrt{3}}{2}\sin A$$

37.
$$\cos(180° + x) \stackrel{?}{=} -\cos x$$
$$\cos 180°\cos x - \sin 180°\sin x \stackrel{?}{=} -\cos x$$
$$-1\cdot\cos x - 0\cdot\sin x \stackrel{?}{=} -\cos x$$
$$-\cos x = -\cos x$$

39.
$$\sin(A + B) \stackrel{?}{=} \frac{\tan A + \tan B}{\sec A\sec B}$$
$$\sin(A + B) \stackrel{?}{=} \frac{\frac{\sin A}{\cos A} + \frac{\sin B}{\cos B}}{\frac{1}{\cos A}\cdot\frac{1}{\cos B}}$$
$$\sin(A + B) \stackrel{?}{=} \frac{\frac{\sin A}{\cos A} + \frac{\sin B}{\cos B}}{\frac{1}{\cos A}\cdot\frac{1}{\cos B}}\cdot\frac{\cos A\cos B}{\cos A\cos B}$$
$$\sin(A + B) \stackrel{?}{=} \frac{\sin A\cos B + \cos A\sin B}{1}$$
$$\sin(A + B) = \sin(A + B)$$

41.
$$\sec(A - B) \stackrel{?}{=} \frac{\sec A\sec B}{1 + \tan A\tan B}$$
$$\sec(A - B) \stackrel{?}{=} \frac{\frac{1}{\cos A}\cdot\frac{1}{\cos B}}{1 + \frac{\sin A}{\cos A}\cdot\frac{\sin B}{\cos B}}$$
$$\sec(A - B) \stackrel{?}{=} \frac{\frac{1}{\cos A}\cdot\frac{1}{\cos B}}{1 + \frac{\sin A}{\cos A}\cdot\frac{\sin B}{\cos B}}\cdot\frac{\cos A\cos B}{\cos A\cos B}$$
$$\sec(A - B) \stackrel{?}{=} \frac{1}{\cos A\cos B + \sin A\sin B}$$
$$\sec(A - B) \stackrel{?}{=} \frac{1}{\cos(A - B)}$$
$$\sec(A - B) = \sec(A - B)$$

43. $V_L = -I_0\omega L\sin\omega t$ **45.** $-\sin 2A$

47.
$$\tan(\alpha + \beta) = \frac{\sin(\alpha + \beta)}{\cos(\alpha + \beta)}$$
$$\tan(\alpha + \beta) = \frac{\sin\alpha\cos\beta + \cos\alpha\sin\beta}{\cos\alpha\cos\beta - \sin\alpha\sin\beta}$$
$$\tan(\alpha + \beta) = \frac{\frac{\sin\alpha\cos\beta}{\cos\alpha\cos\beta} + \frac{\cos\alpha\sin\beta}{\cos\alpha\cos\beta}}{\frac{\cos\alpha\cos\beta}{\cos\alpha\cos\beta} - \frac{\sin\alpha\sin\beta}{\cos\alpha\cos\beta}}$$
$$\tan(\alpha + \beta) = \frac{\tan\alpha + \tan\beta}{1 - \tan\alpha\tan\beta}$$

Replace β with $-\beta$ to find $\tan(\alpha - \beta)$.

$$\tan(\alpha + (-\beta)) = \frac{\tan\alpha + \tan(-\beta)}{1 - \tan\alpha\tan(-\beta)}$$
$$\tan(\alpha - \beta) = \frac{\tan\alpha - \tan\beta}{1 + \tan\alpha\tan\beta}$$

49.
$$\sec^2 x \stackrel{?}{=} \frac{1 - \cos^2 x}{1 - \sin^2 x} + \csc^2 x - \cot^2 x$$
$$\sec^2 x \stackrel{?}{=} \frac{1 - \cos^2 x}{\cos^2 x} + 1 + \cot^2 x - \cot^2 x$$
$$\sec^2 x \stackrel{?}{=} \frac{1}{\cos^2 x} - \frac{\cos^2 x}{\cos^2 x} + 1$$
$$\sec^2 x \stackrel{?}{=} \sec^2 x - 1 + 1$$
$$\sec^2 x = \sec^2 x$$

51. $\frac{\sqrt{3}}{2}$ **53.** $y = 18 \sin\left(\frac{\pi}{2}t - \pi\right) + 68$ **55.** 0
57. about 183 miles **59.** 54.87 ft
61. $\{x \mid x < -5 \text{ or } x > 3\}$ **63.** 1319, 221

Pages 453-455 Lesson 7-4

7. $\sqrt{3} - 2$ **9.** $\frac{24}{25}, -\frac{7}{25}, -\frac{24}{7}$

11.
$$1 + \frac{1}{2}\sin 2A \stackrel{?}{=} \frac{\sec A + \sin A}{\sec A}$$
$$1 + \frac{1}{2}\sin 2A \stackrel{?}{=} \frac{\frac{1}{\cos A} + \sin A}{\frac{1}{\cos A}}$$
$$1 + \frac{1}{2}\sin 2A \stackrel{?}{=} \frac{\frac{1}{\cos A} + \sin A}{\frac{1}{\cos A}} \cdot \frac{\cos A}{\cos A}$$
$$1 + \frac{1}{2}\sin 2A \stackrel{?}{=} 1 + \sin A \cos A$$
$$1 + \frac{1}{2}\sin 2A \stackrel{?}{=} 1 + \frac{1}{2} \cdot 2\sin A \cos A$$
$$1 + \frac{1}{2}\sin 2A = 1 + \frac{1}{2}\sin 2A$$

13. $P = \frac{1}{2}I_0^2R - \frac{1}{2}I_0^2R\cos 2\omega t$ **15.** $\frac{\sqrt{2+\sqrt{3}}}{2}$

17. $\frac{\sqrt{2+\sqrt{2}}}{2}$ **19.** $\sqrt{2} - 1$ **21.** $\frac{24}{25}, \frac{7}{25}, \frac{24}{7}$

23. $-\frac{4}{5}, -\frac{3}{5}, \frac{4}{3}$ **25.** $\frac{12}{13}, \frac{5}{13}, \frac{12}{5}$ **27.** $\frac{2\sqrt{14}}{5}$

29.
$$\cos A - \sin A \stackrel{?}{=} \frac{\cos 2A}{\cos A + \sin A}$$
$$\cos A - \sin A \stackrel{?}{=} \frac{\cos^2 A - \sin^2 A}{\cos A + \sin A}$$
$$\cos A - \sin A \stackrel{?}{=} \frac{(\cos A - \sin A)(\cos A + \sin A)}{\cos A + \sin A}$$
$$\cos A - \sin A = \cos A - \sin A$$

31.
$$\cos x - 1 \stackrel{?}{=} \frac{\cos 2x - 1}{2(\cos x + 1)}$$
$$\cos x - 1 \stackrel{?}{=} \frac{2\cos^2 x - 1 - 1}{2(\cos x + 1)}$$
$$\cos x - 1 \stackrel{?}{=} \frac{2\cos^2 x - 2}{2(\cos x + 1)}$$
$$\cos x - 1 \stackrel{?}{=} \frac{2(\cos^2 x - 1)}{2(\cos x + 1)}$$
$$\cos x - 1 \stackrel{?}{=} \frac{2(\cos x - 1)(\cos x + 1)}{2(\cos x + 1)}$$
$$\cos x - 1 = \cos x - 1$$

33.
$$\tan\frac{A}{2} \stackrel{?}{=} \frac{\sin A}{1 + \cos A}$$
$$\tan\frac{A}{2} \stackrel{?}{=} \frac{\sin 2\left(\frac{A}{2}\right)}{1 + \cos 2\left(\frac{A}{2}\right)}$$
$$\tan\frac{A}{2} \stackrel{?}{=} \frac{2\sin\frac{A}{2}\cos\frac{A}{2}}{1 + 2\cos^2\frac{A}{2} - 1}$$
$$\tan\frac{A}{2} \stackrel{?}{=} \frac{2\sin\frac{A}{2}\cos\frac{A}{2}}{2\cos^2\frac{A}{2}}$$
$$\tan\frac{A}{2} \stackrel{?}{=} \frac{\sin\frac{A}{2}}{\cos\frac{A}{2}}$$
$$\tan\frac{A}{2} = \tan\frac{A}{2}$$

35.
$$\cos 3x \stackrel{?}{=} 4\cos^3 x - 3\cos x$$
$$\cos(2x + x) \stackrel{?}{=} 4\cos^3 x - 3\cos x$$
$$\cos 2x \cos x - \sin 2x \sin x \stackrel{?}{=} 4\cos^3 x - 3\cos x$$
$$(2\cos^2 x - 1)\cos x - 2\sin^2 x \cos x \stackrel{?}{=} 4\cos^3 x - 3\cos x$$
$$(2\cos^2 x - 1)\cos x - 2(1 - \cos^2 x)\cos x \stackrel{?}{=} 4\cos^3 x - 3\cos x$$
$$2\cos^3 x - \cos x - 2\cos x + 2\cos^3 x \stackrel{?}{=} 4\cos^3 x - 3\cos x$$
$$4\cos^3 x - 3\cos x = 4\cos^3 x - 3\cos x$$

37. $\angle PBD$ is an inscribed angle that subtends the same arc as the central angle $\angle POD$, so $m\angle PBD = \frac{1}{2}\theta$. By right triangle trigonometry, $\tan\frac{1}{2}\theta = \frac{PA}{BA} = \frac{PA}{1 + OA} = \frac{\sin\theta}{1 + \cos\theta}$.

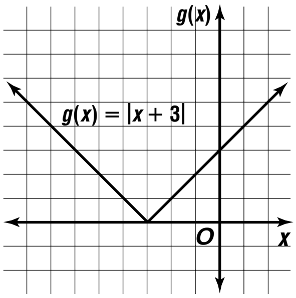
39a. $\frac{1 \pm \sqrt{\frac{1 - \cos L}{1 + \cos L}}}{1 \mp \sqrt{\frac{1 - \cos L}{1 + \cos L}}}$ **39b.** $2 + \sqrt{3}$

41. $\sqrt{6} - \sqrt{2}$ **43.** 97.4° **45.** $2x^4 - 11x^3 - 19x^2 + 84x - 36 = 0$ **47.** (7, 2)

Pages 459–461 Lesson 7-5

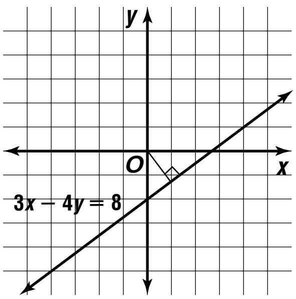
5. −30° **7.** 30°, 330° **9.** $\frac{\pi}{6}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6}$
11. $\frac{\pi}{2} + \pi k$ **13.** $(2k + 1)\pi$ **15.** $\frac{2\pi}{3} < \theta < \frac{4\pi}{3}$
17. 45° **19.** 45° **21.** 0°, 90° **23.** 135°, 225°
25. 0°, 45°, 180°, 225° **27.** 0°, 120°, 180°, 240°
29. 0°, 150°, 180°, 210° **31.** $\frac{7\pi}{6}, \frac{11\pi}{6}$ **33.** $0, \pi, \frac{7\pi}{6}, \frac{11\pi}{6}$ **35.** $\frac{3\pi}{4}, \frac{7\pi}{4}$ **37.** $\frac{7\pi}{6} + 2\pi k, \frac{11\pi}{6} + 2\pi k$
39. $\pi k, \frac{\pi}{6} + \pi k$ **41.** πk **43.** $\frac{\pi}{4} + \pi k$ **45.** $\frac{\pi}{2} + \pi k$

47. $2\pi k, \frac{\pi}{2} + 2\pi k$ **49.** $\frac{5\pi}{6} \le \theta \le \frac{7\pi}{6}$
51. $0 \le \theta < \frac{\pi}{4}$ or $\frac{3\pi}{4} < \theta < 2\pi$ **53.** 0, 1.8955
55. 0.01° **57.** 30.29° or 59.71° **59.** 0.0013 s
61. 341.32° **63.** Sample answer: $\sin x = \frac{\sqrt{2}}{5}$
65. about 18 rps **67.** $(x - 2)(x + 1)(x + 1)$
69. (4, 3) **71.**

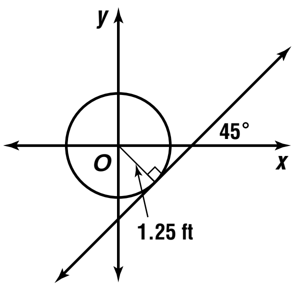


Pages 467–469 Lesson 7-6

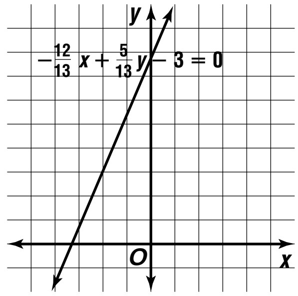
5. $\sqrt{3}x + y - 20 = 0$ **7.** $x - y - 10 = 0$
9. $\frac{3\sqrt{10}}{10}x + \frac{\sqrt{10}}{10}y - \frac{\sqrt{10}}{5} = 0; \frac{\sqrt{10}}{5}$; 18°
11a.



11b. 1.6 miles **13.** $\sqrt{2}x + \sqrt{2}y - 24 = 0$
15. $\sqrt{3}x - y + 4\sqrt{3} = 0$ **17.** $\sqrt{3}x + y + 10 = 0$
19. $x - \sqrt{3}y - 3 = 0$ **21.** $-\frac{5}{13}x - \frac{12}{13}y - 5 = 0$; 5; 247° **23.** $\frac{3}{5}x - \frac{4}{5}y - 3 = 0$; 3; 307°
25. $x - 3 = 0$; 3; 0° **27.** $-\frac{\sqrt{17}}{17}x + \frac{4\sqrt{17}}{17}y - \frac{28\sqrt{17}}{17} = 0; \frac{28\sqrt{17}}{17}$; 104° **29.** $\frac{6\sqrt{61}}{61}x + \frac{5\sqrt{61}}{61}y - \frac{120\sqrt{61}}{61} = 0; \frac{120\sqrt{61}}{61}$; 40°
31. $x - y - 8 = 0$
33a.



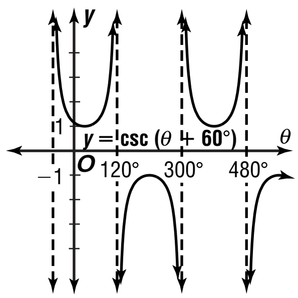
33b. $\sqrt{2}x - \sqrt{2}y - 2.5 = 0$ **35a.** $\frac{5}{13}x + \frac{12}{13}y - 3 = 0$ **35b.** $\theta = 67°$



35d. The line with normal form $x \cos \phi + y \sin \phi - p = 0$ makes an angle of ϕ with the positive x-axis and has a normal of length p. The graph of Armando's equation is a line whose normal makes an angle of $\phi + \delta$ with the x-axis and also has length p. Therefore, the graph of Armando's equation is the graph of the original line rotated $\delta°$ counterclockwise about the origin. Armando is correct. **37.** \$6927.82 **39.** $\frac{2\sqrt{35} + \sqrt{5}}{18}$
41. 3.05 cm **43.** 4.5 in. by 6.5 in. by 2.5 in.
45. (−6, −3)

Pages 474–476 Lesson 7-7

5. $\frac{2\sqrt{13}}{13}$ **7.** $\frac{2\sqrt{34}}{17}$ **9.** $(20 - 6\sqrt{13})x - (30 + 8\sqrt{13})y - 40 - 5\sqrt{13} = 0$; $(20 + 6\sqrt{13})x + (8\sqrt{13} - 30)y - 40 + 5\sqrt{13} = 0$ **11.** $\frac{21}{5}$
13. $\frac{3\sqrt{5}}{5}$ **15.** 0 **17.** $\frac{\sqrt{10}}{10}$ **19.** $\frac{6\sqrt{41}}{41}$
21. $\frac{\sqrt{10}}{5}$ **23.** $\frac{8\sqrt{13}}{13}$ **25.** $x + 8y = 0$; $16x - 2y - 65 = 0$ **27.** $(2\sqrt{10} + 3\sqrt{13})x + (\sqrt{13} - 3\sqrt{10})y + 3\sqrt{10} + 2\sqrt{13} = 0$; $(-2\sqrt{10} + 3\sqrt{13})x + (\sqrt{13} + 3\sqrt{10})y - 3\sqrt{10} + 2\sqrt{13} = 0$ **29.** 1.09 m **31.** $\frac{34}{5}, \frac{34\sqrt{53}}{53}, \frac{17\sqrt{26}}{26}$
33. $-\frac{2\sqrt{53}}{53}x + \frac{7\sqrt{53}}{53}y - \frac{5\sqrt{53}}{53} = 0$
35.



37. about 2.8 s **39.** (−6, −2, −5)

Pages 477–481 Chapter 7 Study Guide and Assessment

1. b **3.** d **5.** i **7.** h **9.** e **11.** 2 **13.** $\frac{4}{5}$

15. $\sin x$

17.
$$\begin{aligned}
\frac{1-\cos\theta}{1+\cos\theta} &\stackrel{?}{=} (\csc\theta-\cot\theta)^2\\
\frac{1-\cos\theta}{1+\cos\theta} &\stackrel{?}{=} \left(\frac{1}{\sin\theta}-\frac{\cos\theta}{\sin\theta}\right)^2\\
\frac{1-\cos\theta}{1+\cos\theta} &\stackrel{?}{=} \frac{(1-\cos\theta)^2}{\sin^2\theta}\\
\frac{1-\cos\theta}{1+\cos\theta} &\stackrel{?}{=} \frac{(1-\cos\theta)^2}{1-\cos^2\theta}\\
\frac{1-\cos\theta}{1+\cos\theta} &\stackrel{?}{=} \frac{(1-\cos\theta)^2}{(1-\cos\theta)(1+\cos\theta)}\\
\frac{1-\cos\theta}{1+\cos\theta} &= \frac{1-\cos\theta}{1+\cos\theta}
\end{aligned}$$

19.
$$\begin{aligned}
\frac{\sin^4 x-\cos^4 x}{\sin^2 x} &\stackrel{?}{=} 1-\cot^2 x\\
\frac{(\sin^2 x-\cos^2 x)(\sin^2 x+\cos^2 x)}{\sin^2 x} &\stackrel{?}{=} 1-\cot^2 x\\
\frac{\sin^2 x-\cos^2 x}{\sin^2 x} &\stackrel{?}{=} 1-\cot^2 x\\
1-\frac{\cos^2 x}{\sin^2 x} &\stackrel{?}{=} 1-\cot^2 x\\
1-\cot^2 x &= 1-\cot^2 x
\end{aligned}$$

21. $\frac{\sqrt{6}+\sqrt{2}}{4}$ **23.** $-2+\sqrt{3}$ **25.** $-\frac{180+82\sqrt{5}}{61}$

27. $\frac{\sqrt{2-\sqrt{2}}}{2}$ **29.** $2-\sqrt{3}$ **31.** $-\frac{7}{25}$

33. $-\frac{336}{625}$ **35.** 0°, 90°, 270° **37.** πk, $\frac{\pi}{4}+2\pi k$, $\frac{3\pi}{4}+2\pi k$ **39.** $2\pi k$ **41.** $y-5=0$ **43.** $x+y+8=0$ **45.** $-\frac{3\sqrt{13}}{13}x+\frac{2\sqrt{13}}{13}y-\frac{5\sqrt{13}}{26}=0$; $\frac{5\sqrt{13}}{26}$; 146° **47.** $-\frac{\sqrt{2}}{10}x+\frac{7\sqrt{2}}{10}y-\frac{\sqrt{2}}{2}=0$; $\frac{\sqrt{2}}{2}$; 98° **49.** $\frac{23\sqrt{13}}{13}$ **51.** $\frac{21\sqrt{10}}{10}$ **53.** $\frac{14}{5}$

55. $\frac{9\sqrt{13}}{13}$ **57.** $(-\sqrt{34}-3\sqrt{10})x+(3\sqrt{34}+5\sqrt{10})y-2\sqrt{34}-15\sqrt{10}=0$; $(-\sqrt{34}+3\sqrt{10})x+(3\sqrt{34}-5\sqrt{10})y-2\sqrt{34}+15\sqrt{10}=0$ **59.** 1431 ft

Page 483 Chapter 7 SAT and ACT Practice

1. B **3.** D **5.** B **7.** A **9.** C

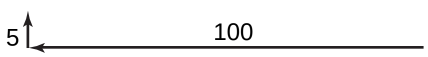
Chapter 8 Vectors and Parametric Equations

Pages 490–492 Lesson 8-1

5. 1.2 cm, 120° **7.** 1.4 cm, 20° **9.** 2.6 cm, 210°

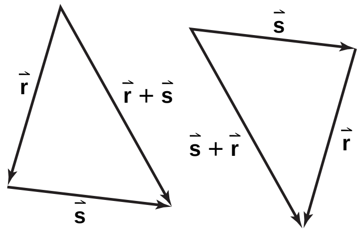
11. 2.9 cm, 12°

13a.

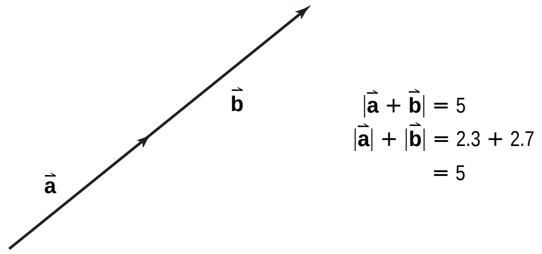


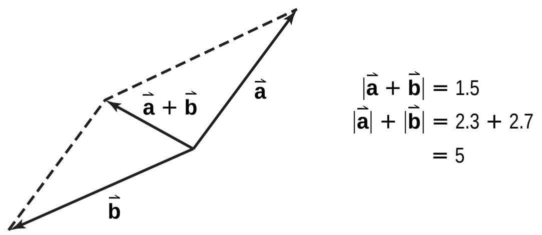
13b. ≈100.12 m/s **15.** 1.4 cm, 45° **17.** 3.0 cm, 340° **19.** 3.4 cm, 25° **21.** 5.5 cm, 324° **23.** 5.2 cm, 128° **25.** 8.2 cm, 322° **27.** 5.4 cm, 133° **29.** 3.4 cm, 301° **31.** −1.60 cm, 2.05 cm **33.** 2.04 cm, 0.51 cm **35.** 45.73 m

37. Yes; Sample answer:



39. Sometimes;





41. 36 mph, 30 mph **43.** 71 lb

45. $x-(1+\sqrt{2})y+2+5\sqrt{2}=0$ **47.** $\frac{\pi}{4}+\pi n$ where n is an integer **49.** 15.8 cm; 29.9 cm

51. $x=-3$, $x=1$, $y=0$

Pages 496–499 Lesson 8-2

5. $\langle -5,-1\rangle$, $\sqrt{26}$ **7.** $\langle 2,2\rangle$ **9.** $\langle 14,4\rangle$ **11.** 10, $8\vec{i}-6\vec{j}$ **13.** ≈927 N **15.** $\langle 4,-5\rangle$, $\sqrt{41}$

17. $\langle -5,-7\rangle$, $\sqrt{74}$ **19.** $\langle 5,7\rangle$, $\sqrt{74}$ **21.** $\langle 9,9\rangle$, $9\sqrt{2}$ **23.** $\langle 2,11\rangle$ **25.** $\langle -2,19\rangle$ **27.** $\langle -22,29\rangle$

29. $\langle 18,9\rangle$ **31.** $\langle 20,50\rangle$ **33.** $\left\langle \frac{32}{3}, -\frac{34}{3}\right\rangle$

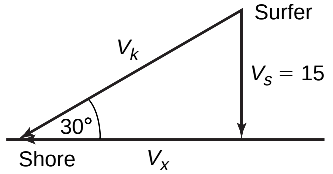
35. $\langle -30,4.5\rangle$ **37.** $\sqrt{13}$, $2\vec{i}-3\vec{j}$

39. 12.5, $3.5\vec{i}+12\vec{j}$ **41.** $2\sqrt{353}$, $-16\vec{i}-34\vec{j}$

43.
$$\begin{aligned}
(\vec{v}_1+\vec{v}_2)+\vec{v}_3 &= [\langle a,b\rangle+\langle c,d\rangle]+\langle e,f\rangle\\
&= \langle a+c,b+d\rangle+\langle e,f\rangle\\
&= \langle\langle a+c\rangle+e,\langle b+d\rangle+f\rangle\\
&= \langle a+\langle c+e\rangle,b+\langle d+f\rangle\rangle\\
&= \langle a,b\rangle+\langle c+e,d+f\rangle\\
&= \langle a,b\rangle+[\langle c,d\rangle+\langle e,f\rangle]\\
&= \vec{v}_1+(\vec{v}_2+\vec{v}_3)
\end{aligned}$$

CONTENTS

45a.

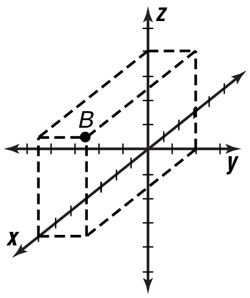


45b. 30 mph **47a.** 30 s **47b.** 30 m **47c.** 5.1 m/s **49.** None **51.** $\frac{-\sqrt{6}-\sqrt{2}}{4}$ **53.** $\approx$1434 ft; $\approx$86,751 sq ft **55.** max: (0, 3), min: (0.67, 2.85) **57.** A

Pages 502–504 Lesson 8-3

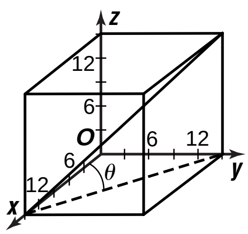
5. $\langle 5, 4, -11\rangle$, $9\sqrt{2}$ **7.** $\langle 6, 0, -25\rangle$ **9.** $11\vec{i} - 4\vec{j} + 2\vec{k}$ **11.** $\approx$3457 N

13. $\sqrt{69}$



15. $\langle 1, -4, -8\rangle$, 9 **17.** $\langle 1, -4, -4\rangle$, $\sqrt{33}$ **19.** $\langle 3, -9, -9\rangle$, $3\sqrt{19}$ **21.** $\langle 4, -8, -14\rangle$, $2\sqrt{69}$ **23.** $\left\langle 6, -7\frac{1}{2}, 11\frac{1}{2}\right\rangle$ **25.** $\left\langle 16\frac{2}{3}, -13, 23\frac{2}{3}\right\rangle$ **27.** $\langle -5, -24, 8\rangle$ **29.** $3\vec{i} - 8\vec{j} - 5\vec{k}$ **31.** $-2\vec{i} - 4\vec{j} + 9\vec{k}$ **33.** $-7\vec{i} + 3\vec{j} - 6\vec{k}$ **35.** $|\overrightarrow{G_1G_2}| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2} = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2} = |\overrightarrow{G_2G_1}|$ because $(x - y)^2 = (y - x)^2$ for all real numbers x and y. **37.** $\langle -9, 0, -9\rangle$ **39a.** $\vec{i} + 4\vec{j}$ **39b.** $-\vec{i}$

41a.



41b. About 26 ft **41c.** $\theta = 35.25°$ **43.** $\langle 2, 7\rangle$

45.

$$\frac{\sin 2X}{1 - \cos 2X} = \cot X$$

$$\frac{2\sin X\cos X}{1 - \cos^2 X + \sin^2 X} = \cot X$$

$$\frac{2\sin X\cos X}{2\sin^2 X} = \cot X$$

$$\frac{\cos X}{\sin X} = \cot X$$

$$\cot X = \cot X$$

47. 6, 4π **49.** yes, because substituting 7 for x and -2 for y results in the inequality $-2 < 180$ which is true.

Pages 508–511 Lesson 8-4

5. 0, yes **7.** $\langle 13, 1, -5\rangle$, yes; $\langle 13, 1, -5\rangle \cdot \langle 1, -3, 2\rangle = 13(1) + 1(-3) + (-5)(2) = 13 - 3 - 10 = 0$; $\langle 13, 1, -5\rangle \cdot \langle -2, 1, -5\rangle = 13(-2) + 1(1) + (-5)(-5) = -26 + 1 + 25 = 0$ **9.** Sample answer: $\langle 1, -8, 5\rangle$ **11.** 0, yes **13.** -21, no **15.** 32, no **17.** 6, no **19.** 9, no **21.** $\langle 2, 2, -1\rangle$, yes; $\langle 2, 2, -1\rangle \cdot \langle 0, 1, 2\rangle = 2(0) + 2(1) + (-1)(2) = 2 + 2 - 2 = 0$; $\langle 2, 2, -1\rangle \cdot \langle 1, 1, 4\rangle = 2(1) + 2(1) + (-1)(4) = 2 + 2 - 4 = 0$ **23.** $\langle 0, 0, 10\rangle$, yes; $\langle 0, 0, 10\rangle \cdot \langle 3, 2, 0\rangle = 0(3) + 0(2) + 10(0) = 0 + 0 + 0 = 0$; $\langle 0, 0, 10\rangle \cdot \langle 1, 4, 0\rangle = 0(1) + 0(4) + 10(0) = 0 + 0 + 0 = 0$ **25.** $\langle 8, 8, 16\rangle$, yes; $\langle 8, 8, 16\rangle \cdot \langle -3, -1, 2\rangle = 8(-3) + 8(-1) + 16(2) = -24 - 8 + 32 = 0$; $\langle 8, 8, 16\rangle \cdot \langle 4, -4, 0\rangle = 8(4) + 8(-4) + 16(0) = 32 - 32 + 0 = 0$ **27.** Sample answer: Let $\vec{v} = \langle v_1, v_2, v_3\rangle$ and $-\vec{v} = \langle -v_1, -v_2, -v_3\rangle$

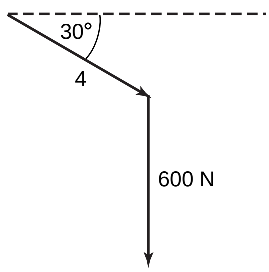
$$\vec{v} \times (-\vec{v}) = \begin{bmatrix} \vec{i} & \vec{j} & \vec{k} \\ v_1 & v_2 & v_3 \\ -v_1 & -v_2 & -v_3 \end{bmatrix}$$

$$= \begin{bmatrix} v_2 & v_3 \\ -v_2 & -v_3 \end{bmatrix}\vec{i} - \begin{bmatrix} v_1 & v_3 \\ -v_1 & -v_3 \end{bmatrix}\vec{j} + \begin{vmatrix} v_1 & v_2 \\ -v_1 & -v_2 \end{vmatrix}\vec{k}$$

$$= 0\vec{i} - 0\vec{j} + 0\vec{k} = \vec{0}$$

29. Sample answer: $\langle -2, -17, -14\rangle$ **31.** Sample answer: $\langle 0, 2, -1\rangle$

33a.



33b. 21 N · m

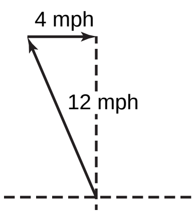
35a. $\vec{o} = \langle 120, 310, 60\rangle$, $\vec{c} = \langle 29, 18, 21\rangle$ **35b.** \$10,320 **37a.** Sample answer: $\langle 8, -7, -9\rangle$ **37b.** The cross product of two vectors is always a vector perpendicular to the two vectors and the plane in which they lie. **39.** $-\frac{19}{29}$ **41.** $\langle 2, 0, 3\rangle$

43. $\frac{4}{\sqrt{17}}x + \frac{1}{\sqrt{17}}y - \frac{6}{\sqrt{17}} = 0$; $\frac{6}{\sqrt{17}} \approx 1.46$ units; 76° **45.** 13.1 meters; 13.7 meters **47.** B

Pages 516–519 Lesson 8-5

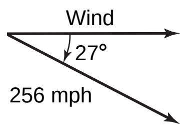
5. 421.19 N, 19.3° **7.** 13.79 N, 11.57 N

9a.



9b. ≈ 19.5°

11.



13. 576.82 N, 42.5° **15.** 199.19 km/h, 90° **17.** 194.87 N, 25.62° **19.** 220.5 lb, 16.7° **21.** 39.8 N, 270° **23.** 19.9 N, 5.3° west of south **25.** 1,542,690 N · m **27a.** 9.5° south of east **27b.** 18.2 mph **29.** Left side: 760 lb, Right side: 761 lb **31.** 3192.5 tons **33.** −2, no **35.** 239.4 ft **37.** 30% beef, 20% pork; $76

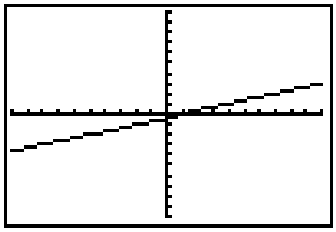
Pages 523–525 Lesson 8-6

5. $\langle x - 1, y - 5\rangle = t\langle -7, 2\rangle$; $x = 1 - 7t$, $y = 5 + 2t$ **7.** $x = t$, $y = \frac{2}{3}t + 2$ **9.** $y = \frac{4}{9}x + 2$ **11a.** Receiver: $x = 5$, $y = 50 - 10t$; Defensive player: $x = 10 - 0.9t$, $y = 54 - 10.72t$ **11b.** yes **13.** $\langle x + 1, y - 4\rangle = t\langle 6, -10\rangle$; $x = -1 + 6t$, $y = 4 - 10t$ **15.** $\langle x - 1, y - 5\rangle = t\langle -7, 2\rangle$; $x = 1 - 7t$, $y = 5 + 2t$ **17.** $\langle x - 3, y + 5\rangle = t\langle -2, 5\rangle$; $x = 3 - 2t$, $y = -5 + 5t$ **19.** $x = t$, $y = \frac{3}{4}t + \frac{7}{4}$ **21.** $x = t$, $y = -9t - 1$ **23.** $x = t$, $y = 4t - 2$ **25.** $y = -\frac{1}{2}x + 1$ **27.** $y = \frac{1}{4}x + \frac{23}{4}$ **29.** $y = \frac{5}{2}x - \frac{17}{2}$ **31a.** $\langle x - 11, y + 4\rangle = t\langle 3, 7\rangle$ **31b.** $x = 3t + 11$, $y = 7t - 4$ **31c.** $y = \frac{7}{3}x - \frac{89}{3}$

33.

T	X1T	Y1T
1.0000	8.0000	2.0000
2.0000	11.000	3.0000
3.0000	14.000	4.0000
4.0000	17.000	5.0000
5.0000	20.000	6.0000
6.0000	23.000	7.0000
14.000	47.000	15.000

Y1T=2



[−10, 10] tstep:1 [−20, 20] Xscl:2 [−20, 20] Yscl:2

35a. Right of point (2, 4) **35b.** $t < -\frac{2}{3}$ **37a.** Target drone: $x = 3 - t$, $y = 4$; Missile: $x = 2 + t$, $y = 2 + 2t$ **37b.** No **39.** $x = -\frac{1}{3} + \frac{1}{3}t$, $y = 1 + 4t$, $z = 1 - 9t$ **41.** −3, no **43.** 1 **45.** $x - y + 4 = 0$

Pages 531–533 Lesson 8-7

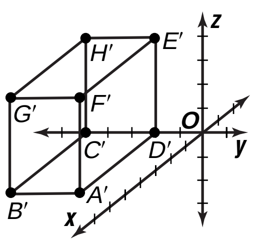
5. 12.86 m/s **7.** 7.05 m/s, 2.57 m/s **9.** 32.5 ft/s, 56.29 ft/s **11.** 891.77 ft/s, 802.96 ft/s **13.** 55.11 yd/s, 41.53 yd/s **15a.** $x = 175t \cos 35°$, $y = 175t \sin 35° - 16t^2$ **15b.** 899.32 ft or 299.77 yd **17a.** 158.32 ft/s **17b.** 127 yd. **19.** Sample answer: No, the projectile will travel four times as far. **21a.** 323.2 ft **21b.** 312.4 ft **21c.** 3.71 s **23a.** 140.7 ft/s **23b.** 131.3 yd **25.** $y = 6x - 58$ **27.** 37° **29.** B

Pages 540–542 Lesson 8-8

5a. $\begin{bmatrix} 5 & 5 & 0 & 0 & 0 & 5 & 5 & 0 \\ 2 & 5 & 5 & 2 & 2 & 2 & 5 & 5 \\ 0 & 0 & 0 & 0 & 4 & 4 & 4 & 4 \end{bmatrix}$

5b. $\begin{bmatrix} 9 & 9 & 4 & 4 & 4 & 9 & 9 & 4 \\ 1 & 4 & 4 & 1 & 1 & 1 & 4 & 4 \\ 2 & 2 & 2 & 2 & 6 & 6 & 6 & 6 \end{bmatrix}$

5c.



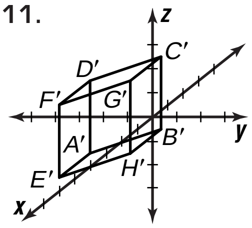
Reflection over the *xz*-plane.

5d. The dimensions of the resulting figure are half the original.

7. $\begin{bmatrix} 2 & 3 & 4 & 4 & 2 & 3 \\ -3 & 1 & 1 & 7 & 3 & 7 \\ 2 & 4 & -1 & -1 & 2 & 4 \end{bmatrix}$

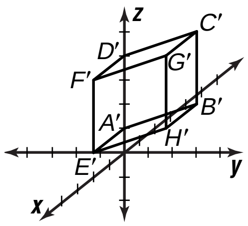
9. $\begin{bmatrix} 2 & 1 & 4 & 4 & 3 & 6 \\ -2 & 0 & -1 & -1 & 1 & 0 \\ 3 & 4 & 2 & 1 & 2 & 0 \end{bmatrix}$

11.



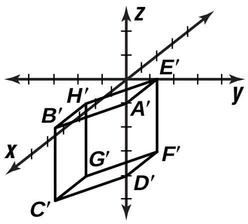
Translation 1 unit along the x-axis, -2 units along the y-axis, and -2 units along the z-axis.

13.



No change

15.



Reflection across all three coordinate planes

17. The figure is three times the original size and reflected over the xy-plane.

19a. $\begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 5 \end{bmatrix}$ **19b.** The transformation will magnify the x- and y-dimensions two-fold, and the z-dimension 5-fold.

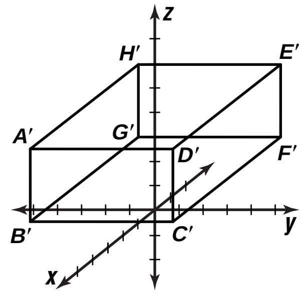
21. $\begin{bmatrix} -0.5 & 0 & 0 \\ 0 & 0.5 & 0 \\ 0 & 0 & 0.5 \end{bmatrix}$ **23.** The first transformation reflects the figure over all three coordinate planes. The second transformation stretches the dimensions along y- and z-axes and skews it along the xy-plane.
25a. dip-slip

25b. $\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 1.6 & 1.6 & 1.6 & 1.6 & 1.6 & 1.6 \\ -1.2 & -1.2 & -1.2 & -1.2 & -1.2 & -1.2 \end{bmatrix}$

27. $y = -\frac{2}{5}x + \frac{48}{5}$ **29.** ≈ 0.2

Pages 543–547 Chapter 8 Study Guide and Assessment

1. resultant **3.** magnitude **5.** inner **7.** parallel
9. direction **11.** 1.5 cm; 50° **13.** 4.1 cm; 23°
15. 2.5 cm; 98° **17.** 0.8 cm; 1 cm **19.** $\langle 5, 12 \rangle$; 13
21. $\langle -2, 12 \rangle$; $2\sqrt{37}$ **23.** $\langle 5, -6 \rangle$ **25.** $\langle 12, -17 \rangle$
27. $\langle 4, -1, -3 \rangle$; $\sqrt{26}$ **29.** $\langle 6, 2, 7 \rangle$; $\sqrt{89}$
31. $\langle 13, -37, 30 \rangle$ **33.** -16; no **35.** 0; yes
37. 42; no **39.** $\langle 9, -6, 0 \rangle$; yes; $\langle 9, -6, 0 \rangle \cdot \langle -2, -3, 1 \rangle = 9(-2) + (-6)(-3) + 0(1) = -18 + 18 + 0 = 0$ $\langle 9, -6, 0 \rangle \cdot \langle 2, 3, -4 \rangle = 9(2) + (-6)(3) + 0(-4) = 18 - 18 + 0 = 0$ **41.** $\langle 1, -19, 31 \rangle$; yes; $\langle 1, -19, 31 \rangle \cdot \langle 7, 2, 1 \rangle = \langle 1(7) + (-19)(2) + 31(1) = 7 - 38 + 31 = 0$; $\langle 1, -19, 31 \rangle \cdot \langle 2, 5, 3 \rangle = 1(2) + (-19)(5) + 31(3) = 2 - 95 + 95 = 0$ **43.** 412.31 N; 39.09°
45. $\langle x - 3, y + 5 \rangle = t\langle 4, 2 \rangle$; $x = 3 + 4t$, $y = -5 + 2t$
47. $\langle x - 4, y \rangle = t\langle 3, -6 \rangle$; $x = 4 + 3t$, $y = -6t$
49. $x = t$, $y = -\frac{1}{2}t + \frac{5}{2}$ **51.** 5.37 ft/s, 12.06 ft/s
53.



moves 2 units along x-axis and 3 units along the z-axis. **55.** 25 lb-ft **57a.** 13.7 km/h **57b.** 275.3 m

Page 549 Chapter 8 SAT and ACT Practice

1. A **3.** B **5.** E **7.** D **9.** B

Chapter 9 Polar Coordinates and Complex Numbers

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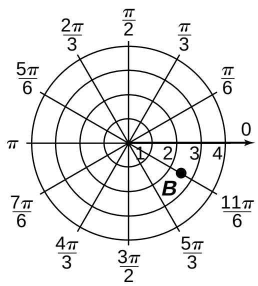
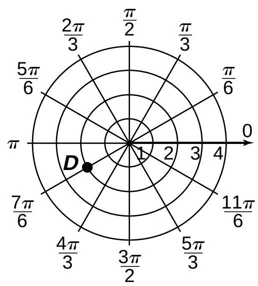
7.



9.



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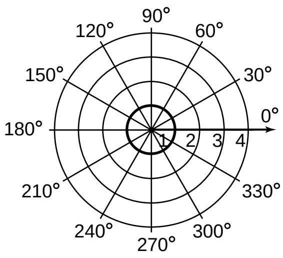
11.



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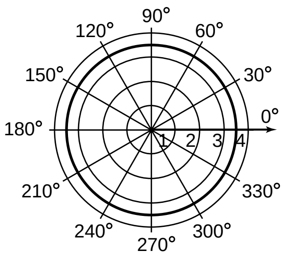
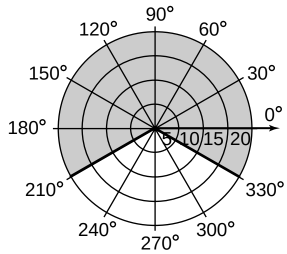
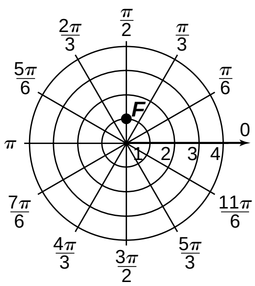


15a.



15b. about 838 ft^2

17.



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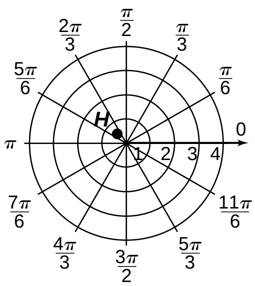

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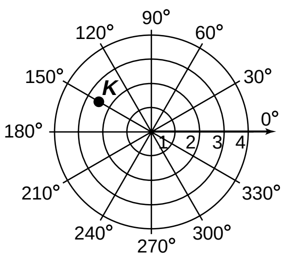

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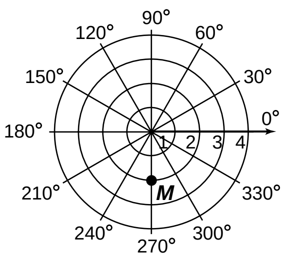

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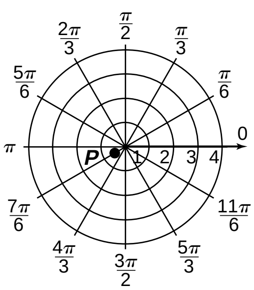
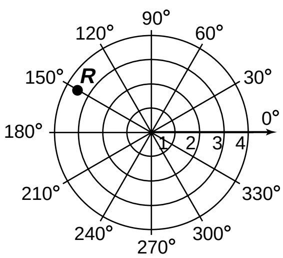
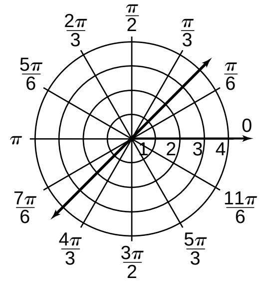


27.



29. Sample answer: $(1.5, 540°)$, $(1.5, 900°)$, $(-1.5, 0°)$, $(-1.5, 360°)$ **31.** Sample answer: $(4, 675°)$, $(4, 1035°)$, $(-4, 135°)$, $(-4, 495°)$

33.



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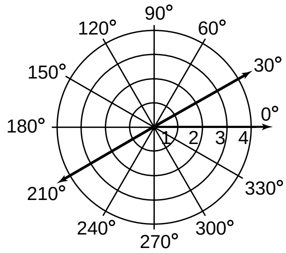
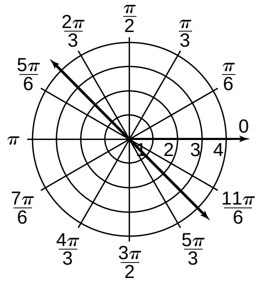


37.



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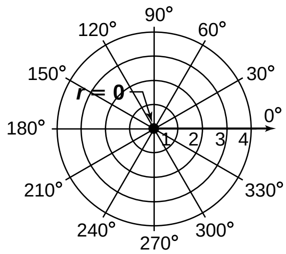


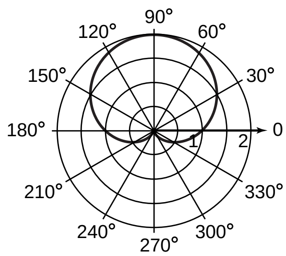
41. $r = \sqrt{2}$ or $r = -\sqrt{2}$ **43.** 5.35 **45.** 4.87 **47.** $\theta = 0°, \theta = 60°, \theta = 120°$ **49a.** 17 knots **49b.** 13 knots **51.** The distance formula is symmetric with respect to (r_1, θ_1) and (r_2, θ_2). That is,

$$\sqrt{r_2^2 + r_1^2 - 2r_2r_1 \cos(\theta_1 - \theta_2)} =$$
$$\sqrt{r_1^2 + r_2^2 - 2r_1r_2 \cos[-(\theta_2 - \theta_1)]} =$$
$$\sqrt{r_1^2 + r_2^2 - 2r_1r_2 \cos(\theta_2 - \theta_1)}$$

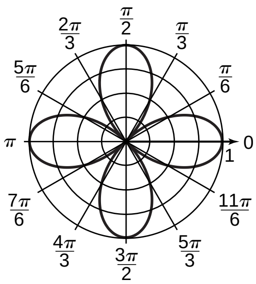
53. about 22.0° **55.** $\frac{16\sqrt{82}}{41}$ **57.** 30° **59.** one; $B = 90°$, $C = 60°$, $c = 16.1$ **61.** $y = x - 3$ **63.** -11 **65.** E

Pages 565–567 Lesson 9-2

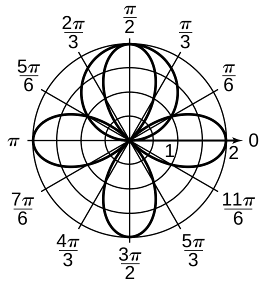
5. cardioid



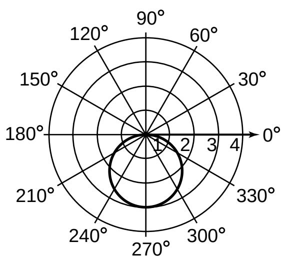
7. rose



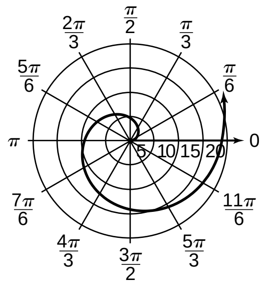
9. $\left(1, \frac{\pi}{6}\right), \left(1, \frac{5\pi}{6}\right), \left(-2, \frac{3\pi}{2}\right)$



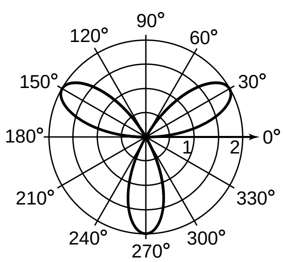
11. circle



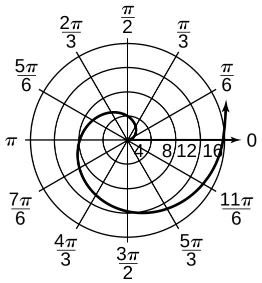
13. spiral of Archimedes



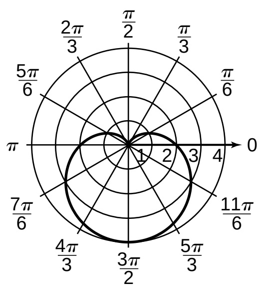
15. rose



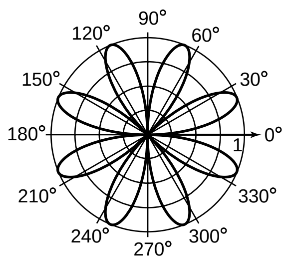
17. spiral of Archimedes



19. cardioid

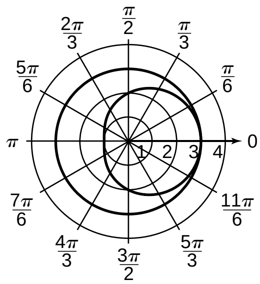


21. rose

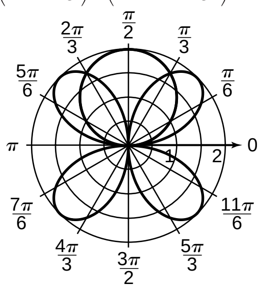


23. Sample answer: $r = \sin 3\theta$

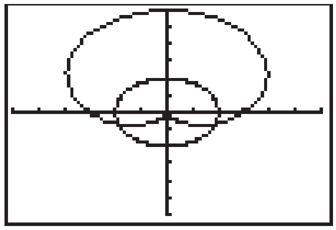
25. (3, 0)



27. $(0, 0), (0, \pi), \left(\sqrt{3}, \frac{\pi}{3}\right), \left(-\sqrt{3}, \frac{5\pi}{3}\right)$



29. (2, 3.5), (2, 5.9)



[−6, 6] scl:1 by [−6, 6] scl:1

31a. $r^2 = 9 \cos 2\theta$ or $r^2 = 9 \sin 2\theta$
31b. $r^2 = 16 \cos 2\theta$ or $r^2 = 16 \sin 2\theta$
33. $0 \le \theta \le 4\pi$ **35.** Sample answer: $r = -1 - \sin \theta$
37a. counterclockwise rotation by an angle of α
37b. reflection about the polar axis or x-axis
37c. reflection about the origin **37d.** dilation by a factor of c
39. $\langle 12, -8, 7\rangle$; $\langle 2, 3, 0\rangle \cdot \langle 12, -8, 7\rangle = 0$, $\langle -1, 2, 4\rangle \cdot \langle 12, -8, 7\rangle = 0$

41.
$$\frac{\sin^2 x}{\cos^4 x + \cos^2 x \sin^2 x} \stackrel{?}{=} \tan^2 x$$
$$\frac{\sin^2 x}{\cos^2 x(\cos^2 x + \sin^2 x)} \stackrel{?}{=} \tan^2 x$$
$$\frac{\sin^2 x}{(\cos^2 x)(1)} \stackrel{?}{=} \tan^2 x$$
$$\frac{\sin^2 x}{\cos^2 x} \stackrel{?}{=} \tan^2 x$$
$$\tan^2 x = \tan^2 x$$

43.

	NY	LA	Miami
Bus	\$240	\$199	\$260
Train	\$254	\$322	\$426

Pages 571–573 Lesson 9-3

5. $\left(2, \frac{3\pi}{4}\right)$ **7.** $\left(1, \sqrt{3}\right)$ **9.** $r = 2 \csc \theta$
11. $x^2 + y^2 = 36$

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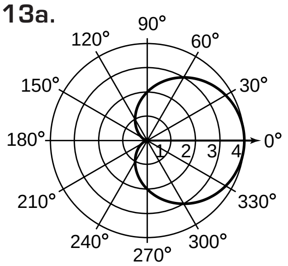
13a.



13b. No. The given point is on the negative *x*-axis, directly behind the microphone. The polar pattern indicates that the microphone does not pick up any sound from this direction.

15. $\left(1, \frac{\pi}{2}\right)$ **17.** $\left(\frac{1}{2}, \frac{4\pi}{3}\right)$ **19.** $(8.06, 5.23)$

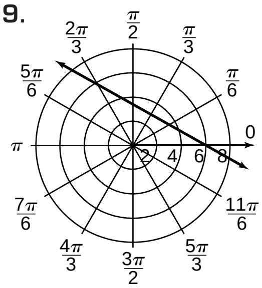
21. $\left(-\frac{\sqrt{2}}{4}, \frac{\sqrt{2}}{4}\right)$ **23.** $(0, 2)$ **25.** $(-9.00, 10.72)$

27. $r = 5 \csc \theta$ **29.** $r = 2 \sin \theta$ **31.** $r = 4 \sin \theta$
33. $x^2 + y^2 = 9$ **35.** $y = 2$ **37.** $xy = 4$
39. $x^2 + y^2 = y$ **41.** 0.52 unit **43.** 75 m east; 118.30 m north **45.** circle centered at (a, a) with radius $\sqrt{2}|a|$; $(x - a)^2 + (y - a)^2 = 2a^2$.
47. Sample answer: $(-2, 405°)$, $(-2, 765°)$, $(2, 225°)$, $(2, 585°)$ **49.** $0°$ **51.** $-\frac{\sqrt{3}}{2}$ **53.** $x^4 + 2x^3 + 4x^2 + 5x + 10$ **55.** C

Pages 577–579 Lesson 9-4

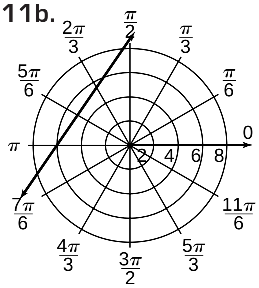
5. $2 = r \cos(\theta - 307°)$ **7.** $x + \sqrt{3}y - 6 = 0$

9.



11a. $\left(5, \frac{5\pi}{6}\right)$

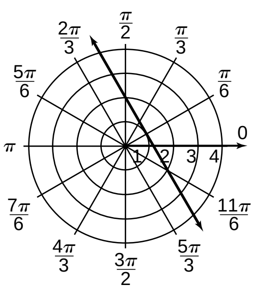
11b.



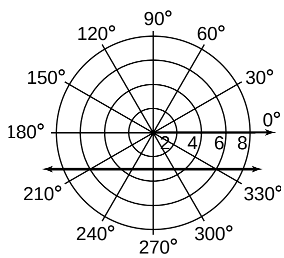
13. $3 = r \cos(\theta - 44°)$ **15.** $\frac{5\sqrt{13}}{13} = r \cos(\theta - 34°)$

17. $\frac{7\sqrt{10}}{10} = r \cos(\theta - 108°)$ **19.** $\sqrt{2}x - \sqrt{2}y - 8 = 0$ **21.** $\sqrt{3}x - y - 2 = 0$
23. $x + \sqrt{3}y - 10 = 0$

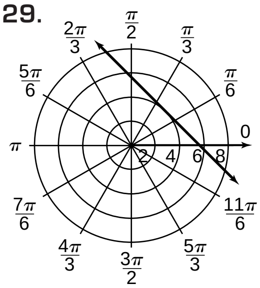
25.



27.

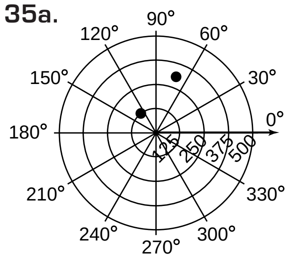


29.



31. $0.31 = r \cos(\theta - 2.25)$
33. Sample answer: $2 = r \cos(\theta - 45°)$ and $2 = r \cos(\theta - 135°)$

35a.



35b. $124.43 = r \cos(\theta - 135°)$
37. $32.36 = r \cos(\theta - 36°)$
39. rose
41. about 20.42 ft^2
43. $0, \frac{3}{2}, -4$

Pages 583–585 Lesson 9-5

5. -1 **7.** $-4 + 4\boldsymbol{i}$ **9.** $1 + 9\boldsymbol{i}$ **11.** $\frac{2}{5} + \frac{1}{5}\boldsymbol{i}$

13. -1 **15.** 1 **17.** $-1 + 8\boldsymbol{i}$ **19.** $-\frac{3}{2} + 2\boldsymbol{i}$

21. $5 + 10\boldsymbol{i}$ **23.** $\left(-2 + \sqrt{35}\right) + \left(-2\sqrt{7} - \sqrt{5}\right)\boldsymbol{i}$

25. $\frac{4}{5} - \frac{3}{5}\boldsymbol{i}$ **27.** $\frac{12}{13} - \frac{5}{13}\boldsymbol{i}$ **29.** $x^2 - 4x + 5 = 0$

31. $-12 - 16\boldsymbol{i}$ **33.** $\left(\frac{2}{5} - \frac{2\sqrt{3}}{15}\right) + \left(-\frac{\sqrt{2}}{5} - \frac{2\sqrt{6}}{15}\right)\boldsymbol{i}$ **35.** $-\frac{24}{169} + \frac{10}{169}\boldsymbol{i}$

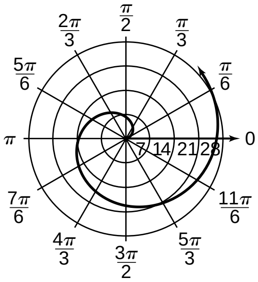
37a. $\pm 3 - 4\boldsymbol{i}$ **37b.** No. **37c.** The solutions need not be complex conjugates because the coefficients in the equation are not all real.
37d.

$$(3 - 4\boldsymbol{i})^2 + 8\boldsymbol{i}(3 - 4\boldsymbol{i}) - 25 \stackrel{?}{=} 0$$
$$-7 - 24\boldsymbol{i} + 24\boldsymbol{i} + 32 - 25 \stackrel{?}{=} 0$$
$$0 = 0$$

$$(-3 - 4\boldsymbol{i})^2 + 8\boldsymbol{i}(-3 - 4\boldsymbol{i}) - 25 \stackrel{?}{=} 0$$
$$-7 + 24\boldsymbol{i} - 24\boldsymbol{i} + 32 - 25 \stackrel{?}{=} 0$$
$$0 = 0$$

39a. $1 + 2\boldsymbol{i}$, $-2 + \boldsymbol{i}$, $-1 - 2\boldsymbol{i}$, $2 - \boldsymbol{i}$, $1 + 2\boldsymbol{i}$
39b. $0.5 - 0.866\boldsymbol{i}$, $-0.500 - 0.866\boldsymbol{i}$, $-1.000 - 0.000\boldsymbol{i}$, $-0.500 + 0.866\boldsymbol{i}$, $0.500 + 0.866\boldsymbol{i}$ **41.** $c_1 = c_2$

43.

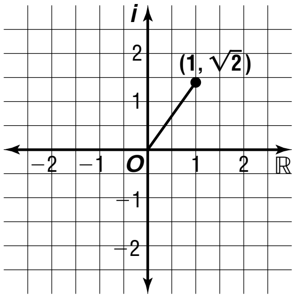


45. $\left\langle -6, \frac{27}{2}, -5 \right\rangle$
47. $y = 3.5 \cos\left(\frac{\pi}{6}t\right)$
49. quadratic
51. 64 **53.** 3, -11
55. A

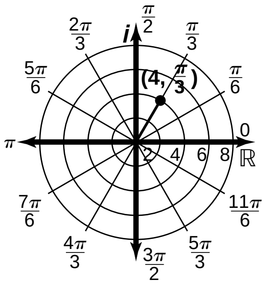
Pages 589–591 Lesson 9-6

5. $x = 1, y = 3$ **7.** $\sqrt{3}$

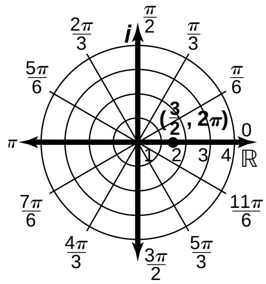
9. $\sqrt{41}(\cos 0.90 + \boldsymbol{i} \sin 0.90)$



11. $2 + 2\sqrt{3}\boldsymbol{i}$



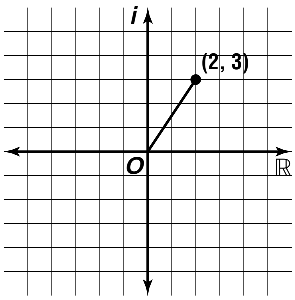
13. $\frac{3}{2}$



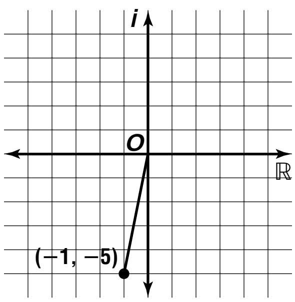
15a. about 18.03 N **15b.** about 56.31°

17. $x = \frac{1}{2}, y = 1$

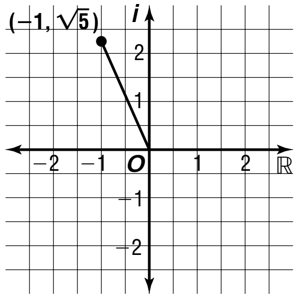
19. $\sqrt{13}$



21. $\sqrt{26}$



23. $\sqrt{6}$



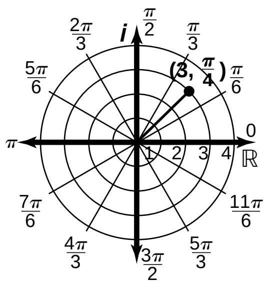
25. $2\sqrt{13}$ **27.** $2\left(\cos \frac{4\pi}{3} + \boldsymbol{i} \sin \frac{4\pi}{3}\right)$

29. $\sqrt{17}(\cos 2.90 + \boldsymbol{i} \sin 2.90)$

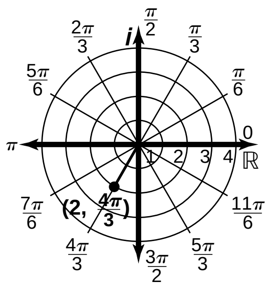
31. $2\sqrt{5}(\cos 2.03 + \boldsymbol{i} \sin 2.03)$

33. $4\sqrt{2}(\cos \pi + \boldsymbol{i} \sin \pi)$

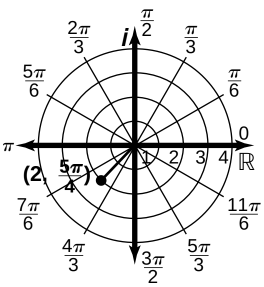
35. $\frac{3\sqrt{2}}{2} + \frac{3\sqrt{2}}{2}\boldsymbol{i}$



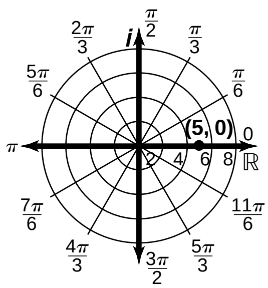
37. $-1 - \sqrt{3}\boldsymbol{i}$



39. $-\sqrt{2} - \sqrt{2}\boldsymbol{i}$



41. 5



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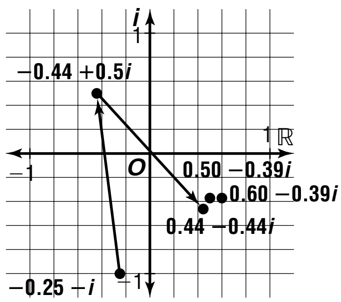

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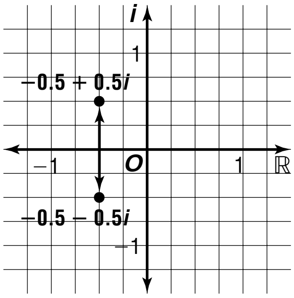
45.



47. The moduli are the same, but the amplitudes are opposites. **49a.** Translate 2 units to the right and down 3 units. **49b.** Rotate 90° counterclockwise about the origin. **49c.** Dilate by a factor of 3. **49d.** Reflect about the real axis. **51.** $-6 + 22\boldsymbol{i}$ **53.** $\sqrt{58}$, $-3\vec{\mathbf{i}} + 7\vec{\mathbf{j}}$ **55.** about 13.57 m/s **57.** 4 **59.** D

Pages 596–598 Lesson 9-7

5. $-\frac{3}{4}\boldsymbol{i}$ **7.** $-\frac{3\sqrt{3}}{2} - \frac{3}{2}\boldsymbol{i}$

9. $6\left(\cos\frac{\pi}{6} + \boldsymbol{j}\sin\frac{\pi}{6}\right)$ volts **11.** $3\boldsymbol{i}$

13. $5\sqrt{2} - 5\sqrt{2}\boldsymbol{i}$ **15.** $\frac{3\sqrt{3}}{2} - \frac{3}{2}\boldsymbol{i}$

17. -2 **19.** $3.10 + 2.53\boldsymbol{i}$ **21.** $-2 - 2\boldsymbol{i}$

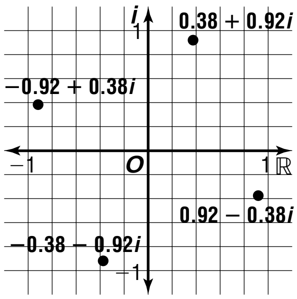
23. $-4 - 4\sqrt{3}\boldsymbol{i}$ **25.** -12 **27.** $\frac{2\sqrt{2}}{3}\boldsymbol{i}$

29. $16 + 12\boldsymbol{j}$ ohms **31a.** The point is rotated counterclockwise about the origin by an angle of θ. **31b.** The point is rotated 60° counterclockwise about the origin. **33.** $13(\cos 5.11 + \boldsymbol{i}\sin 5.11)$ **35.** about 27.21 lb **37.** $y = \arccos x$

Pages 605–606 Lesson 9-8

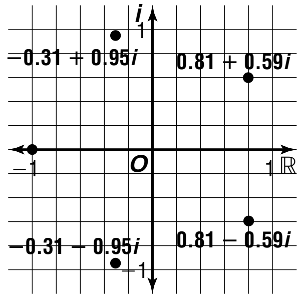
5. $-8\boldsymbol{i}$ **7.** $0.97 + 0.26\boldsymbol{i}$

9. $0.38 + 0.92\boldsymbol{i}$, $-0.92 + 0.38\boldsymbol{i}$, $-0.38 - 0.92\boldsymbol{i}$, $0.92 - 0.38\boldsymbol{i}$

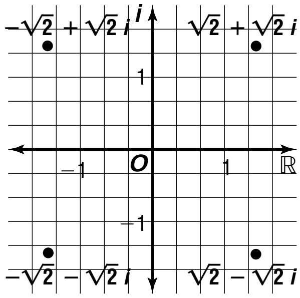


11. Escape set; the iterates escape to infinity. **13.** $-16\sqrt{2} - 16\sqrt{2}\boldsymbol{i}$ **15.** $-8 - 8\sqrt{3}\boldsymbol{i}$ **17.** $-0.03 - 0.07\boldsymbol{i}$ **19.** $1.83 + 0.81\boldsymbol{i}$ **21.** $0.96 + 0.76\boldsymbol{i}$ **23.** $1.37 + 0.37\boldsymbol{i}$ **25.** $0.71 + 0.71\boldsymbol{i}$

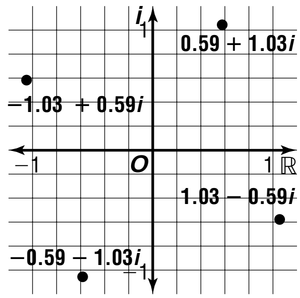
27. $0.81 + 0.59\boldsymbol{i}$, $-0.31 + 0.95\boldsymbol{i}$, -1, $-0.31 - 0.95\boldsymbol{i}$, $0.81 - 0.59\boldsymbol{i}$



29. $\sqrt{2} + \sqrt{2}\boldsymbol{i}$, $-\sqrt{2} + \sqrt{2}\boldsymbol{i}$, $-\sqrt{2} - \sqrt{2}\boldsymbol{i}$, $\sqrt{2} - \sqrt{2}\boldsymbol{i}$



31. $0.59 + 1.03\boldsymbol{i}$, $-1.03 + 0.59\boldsymbol{i}$, $-0.59 - 1.03\boldsymbol{i}$, $1.03 - 0.59\boldsymbol{i}$



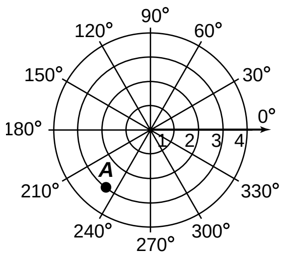
33. $1.26 + 0.24\boldsymbol{i}$, $0.43 + 1.21\boldsymbol{i}$, $-0.83 + 0.97\boldsymbol{i}$, $-1.26 - 0.24\boldsymbol{i}$, $-0.43 - 1.21\boldsymbol{i}$, $0.83 - 0.97\boldsymbol{i}$ **35.** Prisoner set; the iterates approach 0. **37.** 1, $\frac{1}{2} + \frac{\sqrt{3}}{2}\boldsymbol{i}$, $-\frac{1}{2} + \frac{\sqrt{3}}{2}\boldsymbol{i}$, -1, $-\frac{1}{2} - \frac{\sqrt{3}}{2}\boldsymbol{i}$, $\frac{1}{2} - \frac{\sqrt{3}}{2}\boldsymbol{i}$ **39.** The roots are the vertices of a regular polygon. Since one of the roots must be a positive real number, a vertex of the polygon lies on the positive real axis and the polygon is symmetric about the real axis. This means the non-real complex roots occur in conjugate pairs. Since the imaginary part of the sum of two complex conjugates is 0, the imaginary part of the sum of all the roots must be 0. **41.** $5 - \boldsymbol{i}$

43. $\frac{\sqrt{2 + \sqrt{2}}}{2}$ **45.** 800 large bears, 400 small bears

Pages 607–611 Chapter 9 Study Guide and Assessment

1. absolute value **3.** prisoner **5.** pure imaginary **7.** rectangular **9.** Argand

11.



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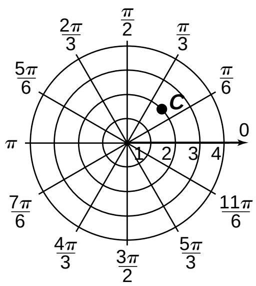
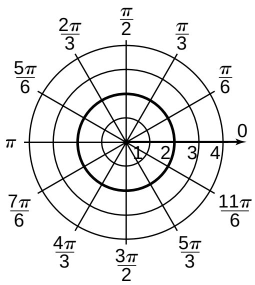


15. Sample answer: $(4, 585°)$, $(4, 945°)$, $(-4, 45°)$, $(-4, 405°)$

17.



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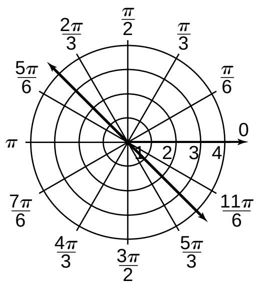
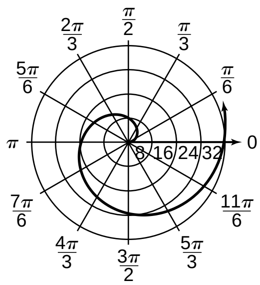
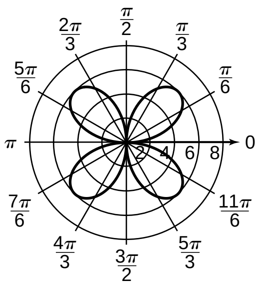


21. spiral of Archimedes



23. rose



25. $\left(\sqrt{3}, -1\right)$ **27.** $(0, 1)$ **29.** $\left(5\sqrt{2}, \frac{\pi}{4}\right)$

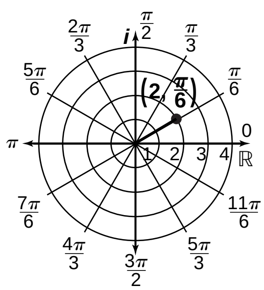
31. $(4.47, 0.46)$ **33.** $\frac{2\sqrt{10}}{5} = r\cos(\theta - 198°)$

35. $y + 4 = 0$ **37.** $-2 + 7\boldsymbol{i}$ **39.** $-3 - 4\boldsymbol{i}$

41. $\frac{16}{29} + \frac{18}{29}\boldsymbol{i}$ **43.** $2\sqrt{2}\left(\cos\frac{\pi}{4} + \boldsymbol{i}\sin\frac{\pi}{4}\right)$

45. $2\left(\cos\frac{2\pi}{3} + \boldsymbol{i}\sin\frac{2\pi}{3}\right)$ **47.** $\sqrt{17}(\cos 3.39 + \boldsymbol{i}\sin 3.39)$ **49.** $2\sqrt{2}(\cos\pi + \boldsymbol{i}\sin\pi)$

51. $\sqrt{3} + \boldsymbol{i}$

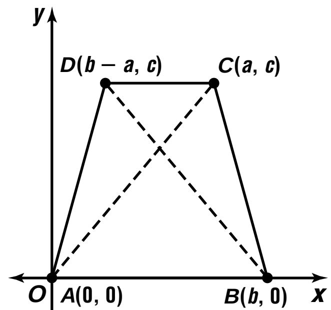


53. $-6 + 6\sqrt{3}\boldsymbol{i}$
55. $-8.01 + 5.98\boldsymbol{i}$
57. $\frac{3}{4} + \frac{3\sqrt{3}}{4}\boldsymbol{i}$
59. 4096 **61.** -4
63. $0.92 + 0.38\boldsymbol{i}$
65. lemniscate
67. $y = -5$

Page 613 Chapter 9 SAT and ACT Practice
1. A **3.** E **5.** A **7.** E **9.** D

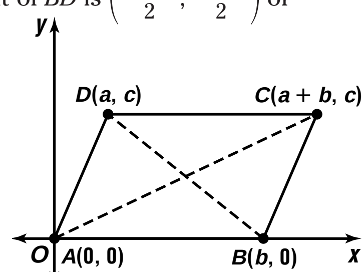
Chapter 10 Conics

Pages 620–622 Lesson 10-1
5. 10, (5, 6) **7.** $2\sqrt{2}$, $(-1, 3)$ **9.** yes; $\overline{XY} \cong \overline{XZ}$, since $XY = 2\sqrt{17}$ and $DC = 2\sqrt{17}$, therefore $\triangle XYZ$ is isosceles. **11a.** (40, 60) **11b.** $20\sqrt{13}$ yd or about 72 yards **13.** $2\sqrt{10}$; (0, 0) **15.** $3\sqrt{5}$; $(2, -4.5)$ **17.** 16; $(a, -1)$ **19.** $\sqrt{5}$; $\left(c + 1, d - \frac{1}{2}\right)$ **21.** $a = \pm 4$ **23.** yes **25.** -5 **27.** $\overline{EF} \cong \overline{HG}$ since $EF = \sqrt{5}$ and $HG = \sqrt{5}$. $\overline{EF} \parallel \overline{HG}$ since the slope of $\overline{EF}$ is $-\frac{1}{2}$ and the slope of $\overline{HG}$ is $-\frac{1}{2}$. Thus the points form a parallelogram. $\overline{EF} \perp \overline{FG}$ since the product of the slopes of $\overline{EF}$ and $\overline{FG}$, $-\frac{1}{2} \cdot \frac{2}{1}$, is -1. Therefore, the points form a rectangle. **29.** In trapezoid $ABCD$, let A and B have coordinates (0, 0) and $(b, 0)$, respectively. To make the trapezoid isosceles, let C have coordinates $(b - a, c)$ and let D have coordinates (a, c).



$AC = \sqrt{(a - 0)^2 + (c - 0)^2} = \sqrt{a^2 + c^2}$
$BD = \sqrt{(b - a - b)^2 + (c - 0)^2} = \sqrt{a^2 + c^2}$
$AC = \sqrt{a^2 + c^2} = \sqrt{a^2 + c^2} = BD$, so the diagonals of an isosceles trapezoid are congruent.

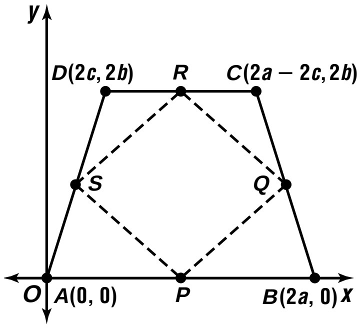
31. Let A and B have coordinates (0, 0) and $(b, 0)$ respectively. To make a parallelogram, let C have coordinates $(a + b, c)$ and let D have coordinates (a, c). The midpoint of $\overline{BD}$ is $\left(\frac{a + b}{2}, \frac{0 + c}{2}\right)$ or $\left(\frac{a + b}{2}, \frac{c}{2}\right)$.



The midpoint of $\overline{AC}$ is $\left(\frac{a + b + 0}{2}, \frac{c + 0}{2}\right)$ or $\left(\frac{a + b}{2}, \frac{c}{2}\right)$. Since the diagonals have the same midpoint, the diagonals bisect each other.

CONTENTS

33. 16 square units **35.** Let the vertices of the isosceles trapezoid have the coordinates $A(0, 0)$, $B(2a, 0)$, $C(2a - 2c, 2b)$, $D(2c, 2b)$. The coordinates of the midpoints are: $P(a, 0)$, $Q(2a - c, b)$, $R(a, 2b)$, and $S(c, b)$.



$$
\begin{aligned}
PQ &= \sqrt{(2a - c - a)^2 + (b - 0)^2} \\
&= \sqrt{(a - c)^2 + b^2} \\
QR &= \sqrt{(2a - c - a)^2 + (b - 2b)^2} \\
&= \sqrt{(a - c)^2 + b^2} \\
RS &= \sqrt{(a - c)^2 + (2b - b)^2} \\
&= \sqrt{(a - c)^2 + b^2} \\
PS &= \sqrt{(a - c)^2 + (0 - b)^2} \\
&= \sqrt{(a - c)^2 + b^2}
\end{aligned}
$$

So, all of the sides are congruent and quadrilateral *PQRS* is a rhombus.

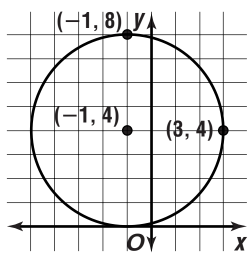
37a.

$$
\begin{aligned}
MA &= \sqrt{t^2 + (3t - 15)^2} \\
&= \sqrt{t^2 + 9t^2 - 90t + 225} \\
&= \sqrt{10t^2 - 90t + 225} \\
MB &= \sqrt{(t - 9)^2 + (3t - 12)^2} \\
&= \sqrt{t^2 - 18t + 81 + 9t^2 - 72t + 144} \\
&= \sqrt{10t^2 - 90t + 225} \\
MA &= MB \\
\sqrt{10t^2 - 90t + 225} &= \sqrt{10t^2 - 90t + 225}
\end{aligned}
$$

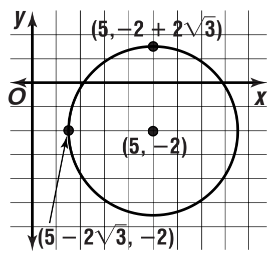
Since the above equation is a true statement, t can take on any real values. **37b.** A line; this line is the perpendicular bisector of $\overline{AB}$. **39.** about 2021 N **41.** 54.9° **43.** $4 \pm \sqrt{2}$

Pages 627–630 Lesson 10-2

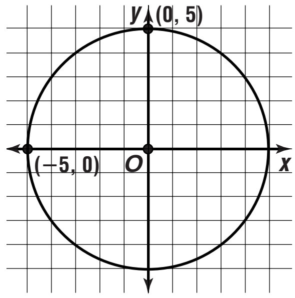
7. $(x + 1)^2 + (y - 4)^2 = 16$



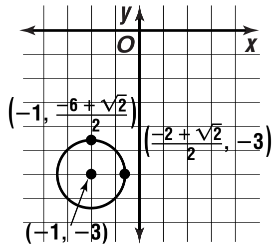
9. $(x - 5)^2 + (y + 2)^2 = 12$



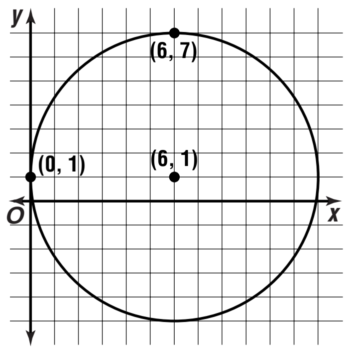
11. $(x - 3)^2 + (y - 4)^2 = 5$; $(3, 4)$; $\sqrt{5}$
13. $(x - 4)^2 + (y + 2)^2 = 100$
15. $x^2 + y^2 = 25$



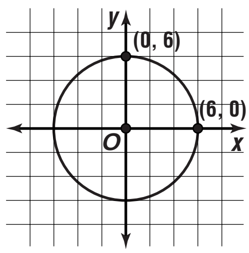
17. $(x + 1)^2 + (y + 3)^2 = \frac{1}{2}$



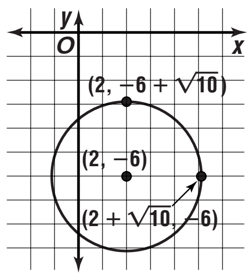
19. $(x - 6)^2 + (y - 1)^2 = 36$



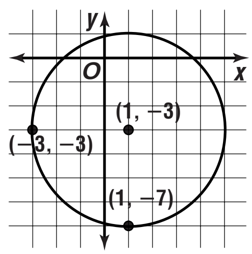
21. $x^2 + y^2 = 36$



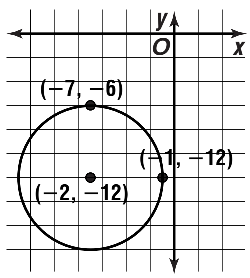
23. $(x - 2)^2 + (y + 6)^2 = 10$



25. $(x - 1)^2 + (y + 3)^2 = 16$

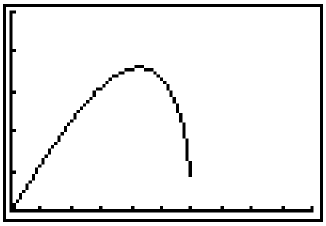


27. $(x + 7)^2 + (y + 12)^2 = 36$



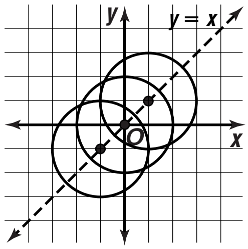
29. $(x - 7)^2 + (y + 5)^2 = 16$; $(7, -5)$; 4
31. $(x - 5)^2 + (y - 2)^2 = 50$; $(5, 2)$, $5\sqrt{2}$
33. $\left(x + \frac{1}{6}\right)^2 + \left(y - \frac{7}{6}\right)^2 = \frac{169}{18}$; $\left(-\frac{1}{6}, \frac{7}{6}\right)$; $\frac{13\sqrt{2}}{6}$

35. $(x + 4)^2 + (y - 3)^2 = 25$ **37.** $(x + 2)^2 + (y + 1)^2 = 32$ **39.** $(x - 5)^2 + (y - 1)^2 = 10$
41a. $x^2 + y^2 = 36$ **41b.** $2x$ by $2\sqrt{36 - x^2}$
41c. $A(x) = 4x\sqrt{36 - x^2}$
41d.



[0, 10] scl:1 by [0, 100] scl:20

41e. 4.2; 72 units^2 **43a.** $x^2 + y^2 = 144$
43b. about 145.50 in.^{2} **45a.** $(x - k)^2 + (y - k)^2 = 4$
45b. Sample graph:

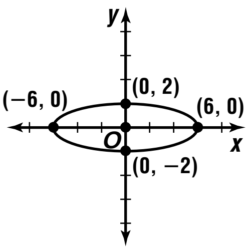


45c. All the circles in this family have a radius of 2 and centers located on the line $y = x$. **47.** radius: 0; center: $(4, -3)$; graph is a point located at $(4, -3)$ **49a.** $x^2 + y^2 = 25$

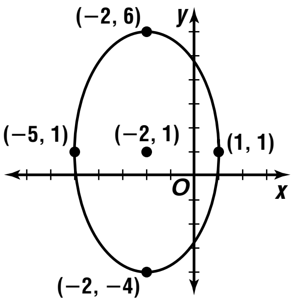
49b. If $\overline{PA} \perp \overline{PB}$, then A, P, and B are on the circle $x^2 + y^2 = 25$. **51.** $20 + 15\boldsymbol{i}$ **53.** $y = 2.5 \cos\left(\frac{\pi}{10}t\right)$
55. 137.5 ft **57a.** 10 cases of drug A, 5 cases of drug B **57b.** $5700

Pages 637–641 Lesson 10-3

7. center: $(0, 0)$; foci: $(\pm 4\sqrt{2}, 0)$; vertices: $(\pm 6, 0)$, $(0, \pm 2)$

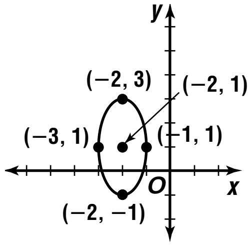


9. center: $(-2, 1)$; foci: $(-2, 5)$, $(-2, -3)$; vertices: $(-2, 6)$, $(-2, -4)$, $(1, 1)$, $(-5, 1)$

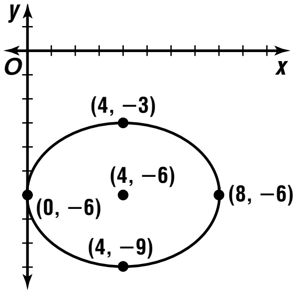


11. $\frac{(y + 3)^2}{16} + \frac{(x + 2)^2}{1} = 1$ **13.** $\frac{(x - 1)^2}{16} + \frac{(y - 2)^2}{4} = 1$ **15.** $\frac{x^2}{1.524^2} + \frac{y^2}{1.517^2} = 1$
17. $\frac{(x + 2)^2}{16} + \frac{y^2}{4} = 1$; foci: $\left(-2 \pm 2\sqrt{3}, 0\right)$

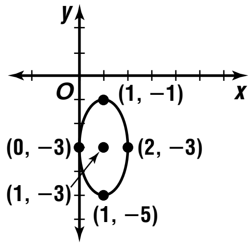
19. center: $(-2, 1)$; foci: $\left(-2, 1 \pm \sqrt{3}\right)$; vertices: $(-2, 3)$, $(-2, -1)$, $(-1, 1)$, $(-3, 1)$



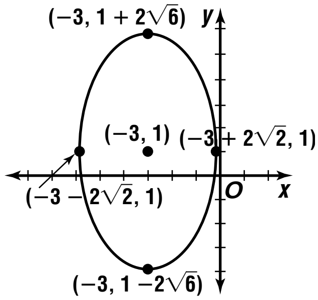
21. center: $(4, -6)$, foci: $(4 \pm \sqrt{7}, -6)$; vertices: $(0, -6)$, $(8, -6)$, $(4, -3)$, $(4, -9)$



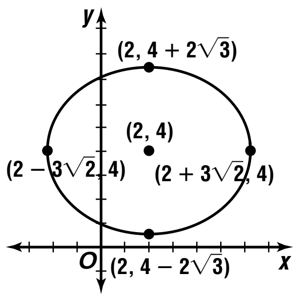
23. center: $(1, -3)$; foci: $\left(1, -3 \pm \sqrt{3}\right)$; vertices: $(2, -3)$, $(0, -3)$, $(1, -1)$, $(1, -5)$



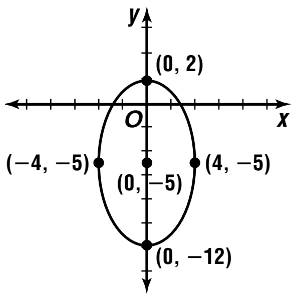
25. center: $(-3, 1)$; foci: $(-3, 5)$, $(-3, -3)$; vertices: $\left(-3 \pm 2\sqrt{2}, 1\right)$, $\left(-3, 1 \pm 2\sqrt{6}\right)$



27. center: $(2, 4)$; foci: $\left(2 \pm \sqrt{6}, 4\right)$; vertices: $\left(2 \pm 3\sqrt{2}, 4\right)$, $\left(2, 4 \pm 2\sqrt{3}\right)$



29. center: $(0, -5)$; foci: $\left(0, -5 \pm \sqrt{33}\right)$; vertices: $(\pm 4, -5)$, $(0, -12)$, $(0, 2)$



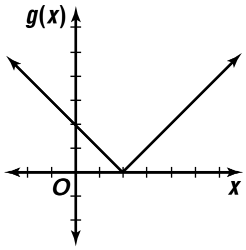
31. $\frac{(x+3)^2}{49} + \frac{(y+1)^2}{25} = 1$ **33.** $\frac{x^2}{64} + \frac{y^2}{36} = 1$
35. $\frac{(x+2)^2}{81} + \frac{(y-5)^2}{16} = 1$ **37.** $\frac{x^2}{100} + \frac{y^2}{75} = 1$
39. $\frac{y^2}{4} + \frac{x^2}{1.75} = 1$ or $\frac{y^2}{1.75} + \frac{x^2}{4} = 1$
41. $\frac{y^2}{100} + \frac{(x-3)^2}{51} = 1$ **43.** $(5, -3)$, $(1, -3)$, $(3, -2)$, $(3, -4)$ **45.** $(-1, -1)$, $(5, -1)$, $(2, -3)$, $(2, 1)$ **47.** The target ball should be placed opposite the pocket, $\sqrt{5}$ feet from the center along the major axis of the ellipse. The cue ball can be placed anywhere on the side opposite the pocket. The ellipse has semi-major axis of length 3 ft and a semi-minor axis of length 2 ft. Using the equation $c^2 = a^2 - b^2$, the focus of the ellipse is found to be $\sqrt{5}$ ft from the center of the ellipse. Thus the hole is located at one focus of the ellipse. The reflective properties of an ellipse should insure that a ball placed $\sqrt{5}$ ft from the center of the ellipse and hit so that it rebounds once off the wall, should fall into the pocket at the other focus of the ellipse.
49a. $\frac{x^2}{2304} + \frac{y^2}{529} = 1$ **49b.** about 42 ft on either side of the center along the major axis **49c.** about 84 ft **51.** If (x, y) is a point on the ellipse, then show that $(-x, -y)$ is also on the ellipse.

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

$$\frac{(-x)^2}{a^2} + \frac{(-y)^2}{b^2} = 1 \quad \textit{Replace } x \textit{ with } -x \textit{ and } y \textit{ with } -y.$$

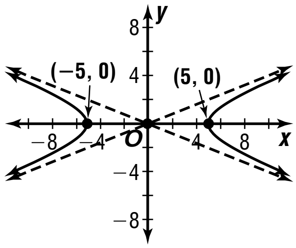
$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \quad (-x)^2 = x^2 \textit{ and } (-y)^2 = y^2$$

Thus $(-x, -y)$ is also a point on the ellipse and the ellipse is therefore symmetric with respect to the origin.
53a. GOES 4; its eccentricity is closest to 0 **53b.** 960 km
55. no
57. $y = \pm 4 \cos(2x - 40°)$
59. 74, no
61.

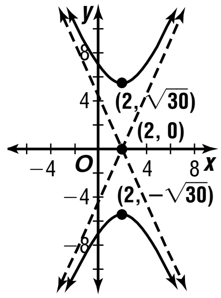


63. C

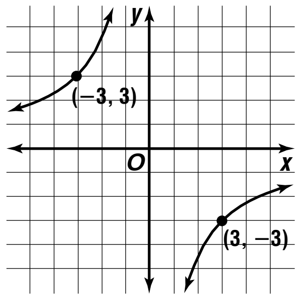
Pages 649–652 Lesson 10-4
5. center: $(0, 0)$; foci: $(\pm\sqrt{29}, 0)$; vertices: $(\pm 5, 0)$; asymptotes: $y = \pm\frac{2}{5}x$



7. center: $(2, 0)$; foci: $(2, \pm 6)$; vertices: $(2, \pm\sqrt{30})$; asymptotes: $y = \pm\sqrt{5}(x - 2)$

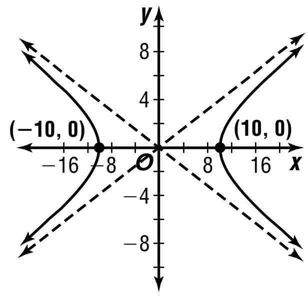


9.

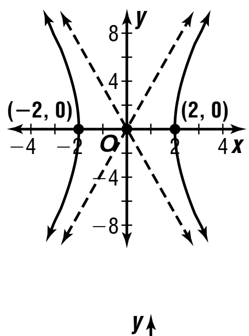


11. $\frac{(y-2)^2}{4} - \frac{(x-3)^2}{9} = 1$
13. $\frac{x^2}{36} - \frac{y^2}{64} = 1$

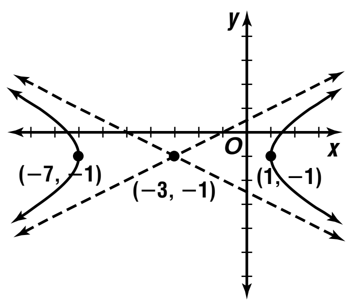
15. center: $(0, 0)$; foci: $(\pm 2\sqrt{29}, 0)$; vertices: $(\pm 10, 0)$; asymptotes: $y = \pm\frac{2}{5}x$



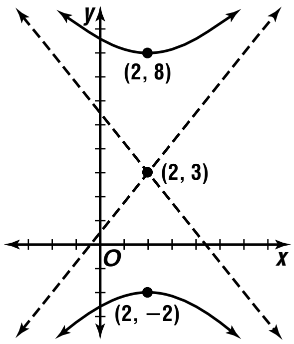
17. center: $(0, 0)$, foci: $(\pm\sqrt{53}, 0)$; vertices: $(\pm 2, 0)$; asymptotes: $y = \pm\frac{7}{2}x$



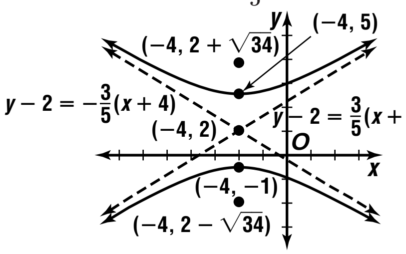
19. center: $(-3, -1)$; foci: $(-3 \pm 2\sqrt{5}, -1)$, vertices: $(1, -1)$, $(-7, -1)$; asymptotes: $y + 1 = \pm\frac{1}{2}(x + 3)$



21. center: $(2, 3)$; foci: $\left(2, 3 \pm \sqrt{41}\right)$, vertices: $(2, 8)$, $(2, -2)$; asymptotes: $y - 3 = \pm\frac{5}{4}(x - 2)$

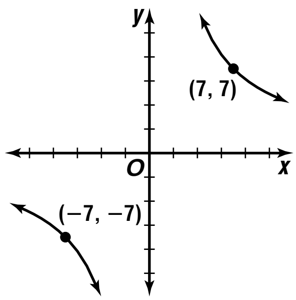


23. center: $(-4, 2)$; foci: $(-4, 2 \pm \sqrt{34})$; vertices: $(-4, 5)$, $(-4, -1)$; asymptotes: $y - 2 = \pm\frac{3}{5}(x - 4)$

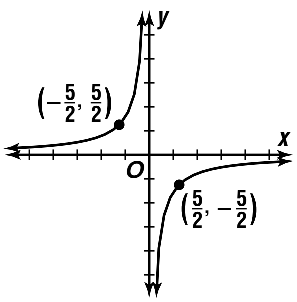


25. $\frac{x^2}{9} - \frac{y^2}{9} = 1$

27.



29.

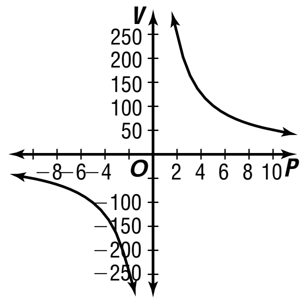


31. $\frac{(y + 2)^2}{4} - \frac{(x - 4)^2}{9} = 1$ **33.** $\frac{x^2}{9} - \frac{(y - 2)^2}{16} = 1$

35. $\frac{x^2}{32} - \frac{y^2}{32} = 1$ **37.** $\frac{(y - 2)^2}{9} - \frac{(x - 4)^2}{16} = 1$

39. $\frac{y^2}{36} - \frac{x^2}{28} = 1$ **41.** $\frac{2x^2}{81} - \frac{2y^2}{81} = 1$

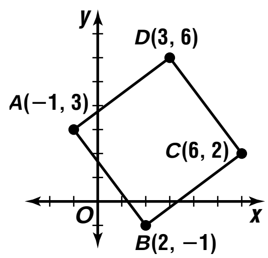
43a.



43b. 5.0 dm^3 **43c.** 10.0 dm^3 **43d.** $V =$ 2(original V) **45a.** $\frac{x^2}{75^2} - \frac{y^2}{100^2} = 1$ **45b.** top: 106.07 ft; base: 273.00 ft **47.** $\frac{x^2}{25} - \frac{y^2}{11} = 1$

49. $\frac{y^2}{16} + \frac{(x - 2)^2}{7} = 1$

51.



$AB = \sqrt{(2 + 1)^2 + (-1 - 3)^2} = 5$
$BC = \sqrt{(2 - 6)^2 + (-1 - 2)^2} = 5$
$CD = \sqrt{(6 - 3)^2 + (2 - 6)^2} = 5$
$AD = \sqrt{(3 + 1)^2 + (6 - 3)^2} = 5$
Thus, $ABCD$ is a rhombus. The slope of $\overline{AD} = \frac{6 - 3}{3 + 1}$ or $\frac{3}{4}$ and the slope of $\overline{AB} = \frac{3 + 1}{-1 - 2}$ or $-\frac{4}{3}$. Thus, $\overline{AD}$ is perpendicular to $\overline{AB}$ and $ABCD$ is a square. **53.** -6; No, the inner product of the two vectors is not zero. **55.** about 346 m/s **57.** C

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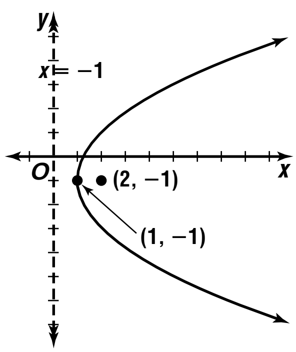
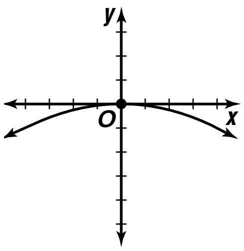
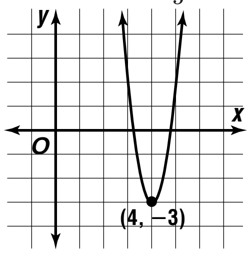
7. vertex: $(1, -1)$; focus: $(2, -1)$; directrix: $x = 0$; axis of symmetry: $y = -1$



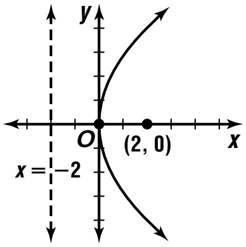
9. $x^2 = -16y$



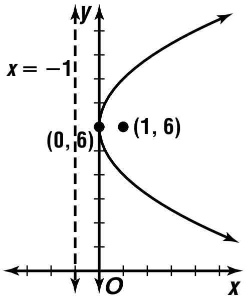
11. $(x - 4)^2 = \frac{1}{5}(y + 3)$



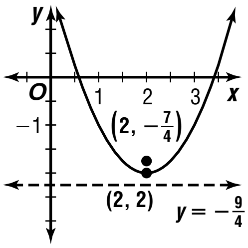
13. vertex: (0, 0);
focus: (2, 0);
directrix: $x = -2$;
axis of symmetry: $y = 0$



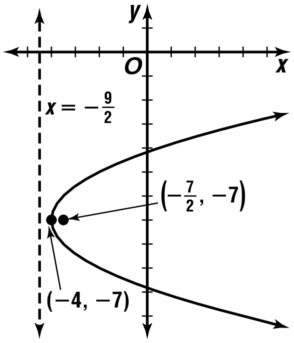
15. vertex: (0, 6);
focus: (1, 6);
directrix: $x = -1$;
axis of symmetry: $y = 6$



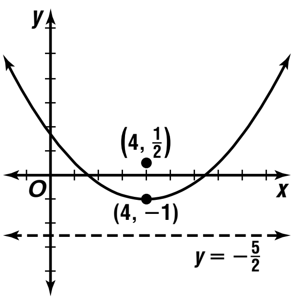
17. vertex: (2, −2);
focus: $\left(2, -\frac{7}{4}\right)$;
directrix: $y = -\frac{9}{4}$;
axis of symmetry: $x = 2$



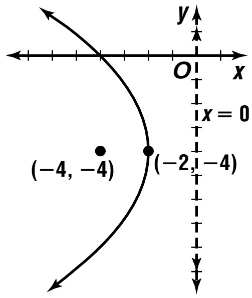
19. vertex: (−4, −7);
focus: $\left(-\frac{7}{2}, -7\right)$;
directrix: $x = -\frac{9}{2}$;
axis of symmetry: $y = -7$



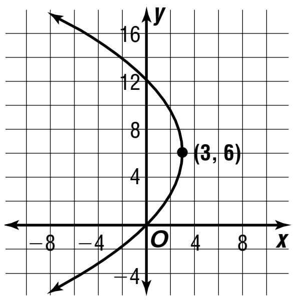
21. vertex: (4, −1);
focus: $\left(4, \frac{1}{2}\right)$, directrix:
$y = -\frac{5}{2}$; axis of symmetry:
$x = 4$



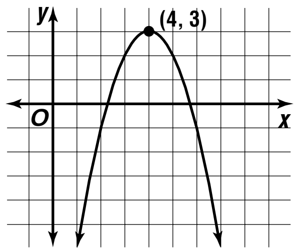
23. vertex: (−2, −4); focus: (−4, −4); directrix: $x = 0$; axis of symmetry: $y = -4$



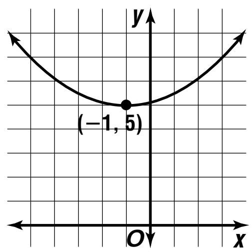
25. $(y - 6)^2 = -12(x - 3)$



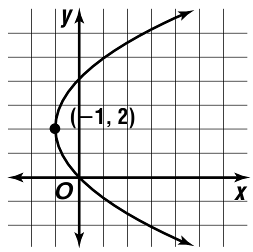
27. $(x - 4)^2 = -(y - 3)$



29. $(x + 1)^2 = 8(y - 5)$

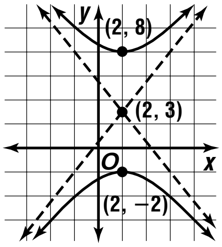


31. $(y - 2)^2 = 4(x + 1)$

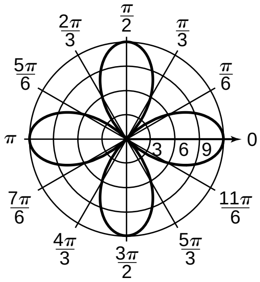


33a. $8\sqrt{2}$ in. **33b.** $4\sqrt{10}$ in. **35a.** The opening becomes narrower. **35b.** The opening becomes wider.

39. center: (2, 3), foci: $\left(2, 3 \pm \sqrt{41}\right)$; vertices: (2, 8) and (2, −2); asymptotes: $y - 3 = \pm\frac{5}{4}(x - 2)$



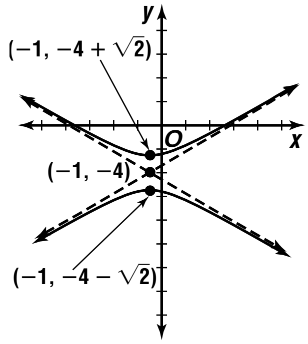
41.



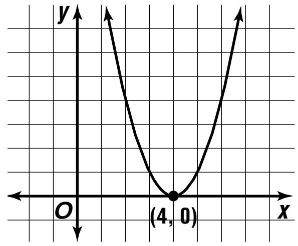
43. 5.5 cm

45. C

15. hyperbola; $\frac{(y + 4)^2}{2} - \frac{(x + 1)^2}{6} = 1$



17. parabola; $(x - 4)^2 = y$



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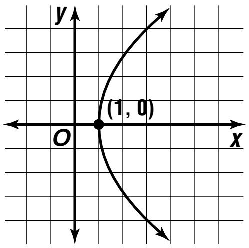
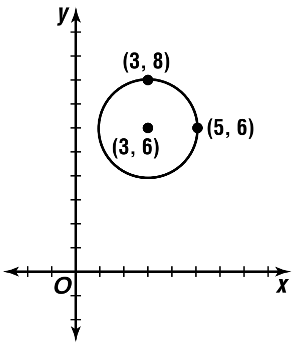
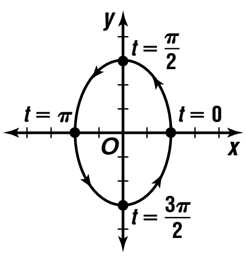
5. parabola; $y^2 = 8(x - 1)$



7. circle; $(x - 3)^2 + (y - 6)^2 = 4$

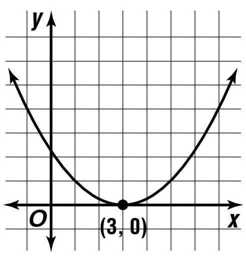


9. $\frac{x^2}{4} + \frac{y^2}{9} = 1$

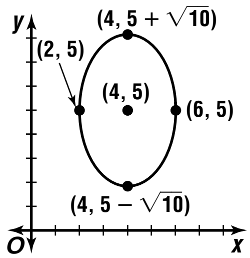


11. Sample answer:
$x = 6 \cos t$,
$y = 6 \sin t, 0 \le t \le 2\pi$

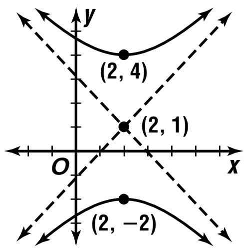
13. parabola; $(x - 3)^2 = 4y$



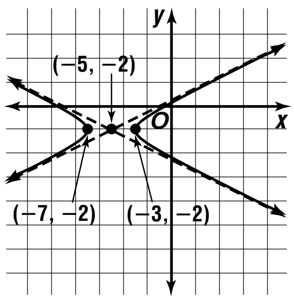
19. ellipse; $\frac{(y - 5)^2}{10} + \frac{(x - 4)^2}{4} = 1$



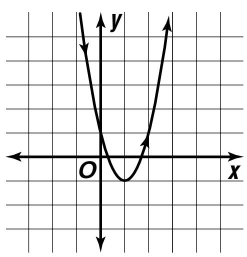
21. hyperbola; $\frac{(y - 1)^2}{9} - \frac{(x - 2)^2}{8} = 1$



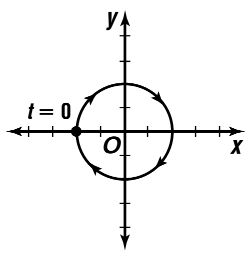
23. hyperbola; $\frac{(x + 5)^2}{4} - \frac{(y + 2)^2}{1} = 1$



25. $y = 2x^2 - 4x + 1$

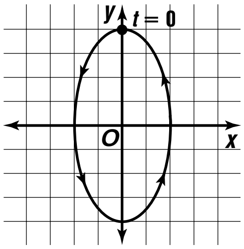


27. $x^2 + y^2 = 1$



CONTENTS

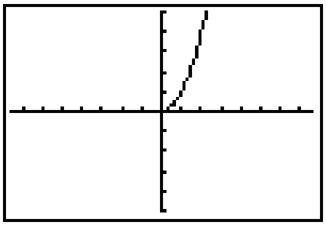
29. $x^2 + \frac{y^2}{4} = 1$



31. $x^2 + y^2 = 9$

33. Sample answer: $x = 4 \cos t$, $y = 4 \sin t$, $0 \leq t \leq 2\pi$ **35.** Sample answer: $x = \cos t$, $y = 4 \sin t$, $0 \leq t \leq 2\pi$ **37.** Sample answer: $x = t^2 + 2t - 1$, $y = t$, $-\infty < t < \infty$ **39a.** Answers will vary. Sample answers: $x = t$, $y = t^2$, $t \geq 0$; $x = \sqrt{t}$, $y = t$, $t \geq 0$.

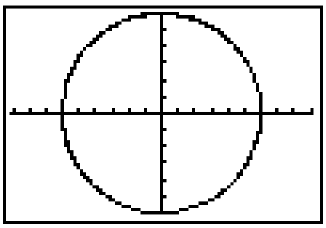
39b.



Tmin: [0, 5] step: 0.1
[−7.58, 7.58] scl:1 by [−5, 5] scl:1

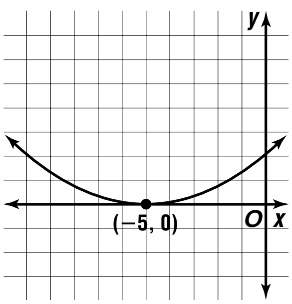
39c. yes **39d.** There is usually more than one parametric representation for the graph of a rectangular equation. **41a.** Ellipse; point at (0, 0); the equation is that of a degenerate ellipse. **41b.** Circle; point at (2, 3); the equation is that of a degenerate circle. **41c.** Hyperbola; two intersecting lines $y = \pm 3x$; the equation is that of a degenerate hyperbola. **43a.** $x^2 + y^2 = 36$ **43b.** $x = 6 \sin t$, $y = 6 \cos t$, $0 \leq t \leq 4\pi$

43c.

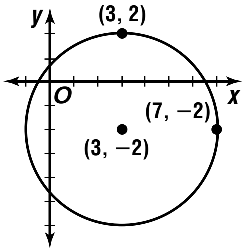


Tmin: [0, 4π] step: 0.1
[29.10, 9.10] scl:1 by [26, 6] scl:1

45. vertex: $(-5, 0)$; focus: $(-5, 3)$; axis of symmetry: $x = -5$, directrix: $y = -3$



47.



49. Car 1; the point (135, 19) is about 9 units closer to the line $y = -0.13x + 37.8$ than the point (245, 16). **51.** 685 units^2 **53.** 38.4 **55.** $y - 4 = \frac{1}{3}(x + 6)$ or $y - 7 = \frac{1}{3}(x - 3)$, $y = \frac{1}{3}x + 6$

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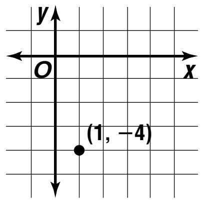
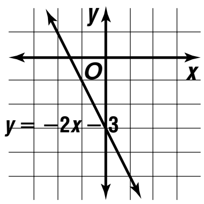
5. circle; $x^2 + y^2 - 6x - 4y + 6 = 0$ **7.** hyperbola; $(x')^2 - 2\sqrt{3}x'y' - (y')^2 + 18 = 0$ **9.** ellipse; 19° **11.** point



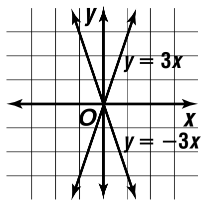
13. parabola; $3x^2 - 14x - y + 18 = 0$ **15.** ellipse; $3x^2 + y^2 + 6x - 6y + 3 = 0$ **17.** hyperbola; $9x^2 - 25y^2 + 250y - 850 = 0$ **19.** parabola; $(y')^2 + 8x' = 0$

21. parabola; $(x')^2 - 2\sqrt{3}x'y' + 3(y')^2 + 16\sqrt{3}x' + 16y' = 0$ **23.** circle; $2(x')^2 + 2(y')^2 - 5x' - 5\sqrt{3}y' - 6 = 0$ **25.** $23(x')^2 + 2\sqrt{3}x'y' + 21(y')^2 - 120 = 0$ **27.** hyperbola; −6° **29.** ellipse; −18° **31.** parabola; −30°

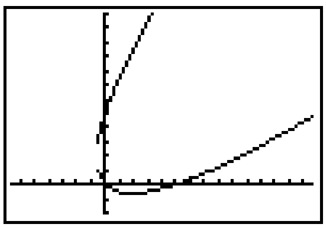
33. line



35. intersecting lines

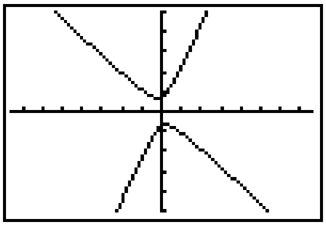


37.



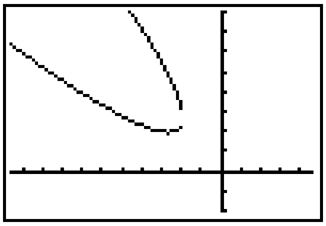
[−6.61, 14.6] scl:1 by [−2, 12] scl:1

39.



[−7.58, 7.58] scl:1 by [−5, 5] scl:1

41.



[−10.58, 4.58] scl:1 by [−2, 8] scl:1

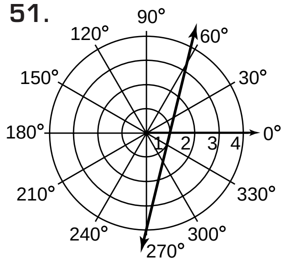
43a. $T_{(1320,\,1320)}$ **43b.** $(x - 1320)^2 + (y - 1320)^2 = 1{,}742{,}400$ **45.** Let $x = x'\cos\theta + y'\sin\theta$ and $y = -x'\sin\theta + y'\cos\theta$.

$$x^2 + y^2 = r^2$$
$$(x'\cos\theta + y'\sin\theta)^2 + (-x'\sin\theta + y'\cos\theta)^2 = r^2$$
$$(x')^2\cos^2\theta + x'y'\cos\theta\sin\theta + (y')^2\sin^2\theta + (x')^2\sin^2\theta - x'y'\cos\theta\sin\theta + (y')^2\cos\theta = r^2$$
$$[(x')^2 + (y')^2]\cos^2\theta + [(x')^2 + (y')^2]\sin^2\theta = r^2$$
$$[(x')^2 + (y')^2](\cos^2\theta + \sin^2\theta) = r^2$$
$$[(x')^2 + (y')^2](1) = r^2$$
$$(x')^2 + (y')^2 = r^2$$

47a. $-30°$ **47b.** $\frac{(x')^2}{3} + \frac{(y')^2}{2} = 1$

49. hyperbola

51.



53. cos 70°

55. $\frac{-1}{y+2} + \frac{3}{y+1}$

57. $\left(\frac{3}{4}, -\frac{2}{3}, \frac{1}{2}\right)$

59. B

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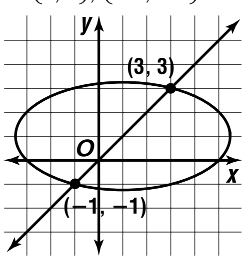
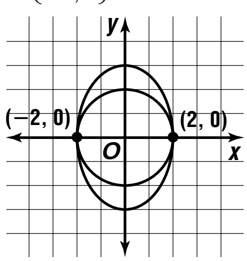
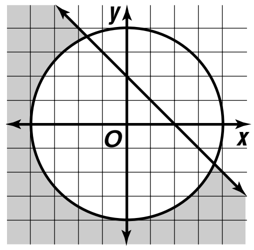
5. (3, 3), (−1, −1)



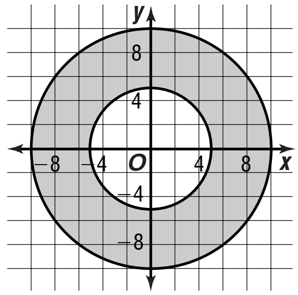
7. (±2, 0)



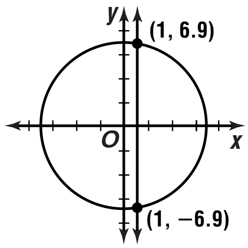
9.



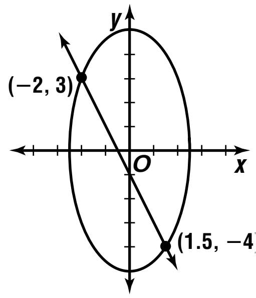
11.



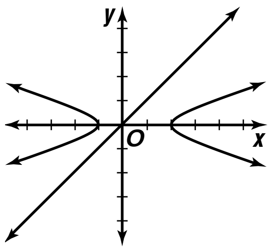
13. (1, ±6.9)



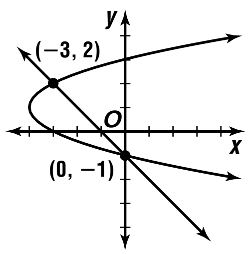
15. (1.5, −4), (−2, 3)



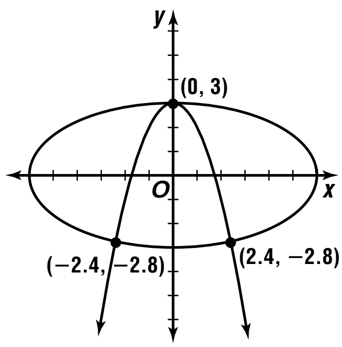
17. no solution



19. (0, −1), (−3, 2)

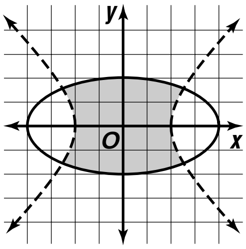


21. (0, 3), (±2.4, −2.8)

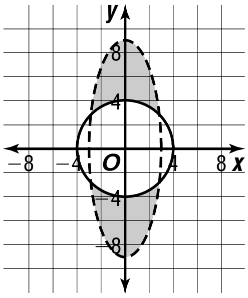


23. (3, −1.3), (4, −1), (−3, 1.3), (−4, 1)

25.



27.



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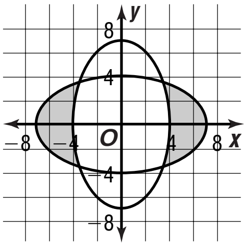

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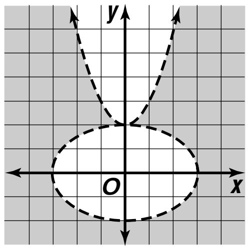

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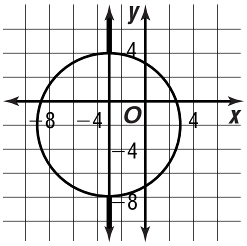
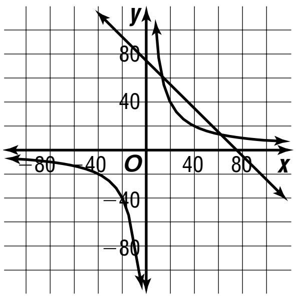


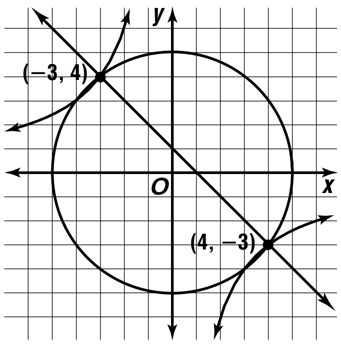
35. $x^2 + y^2 = 8$, $xy = 4$ **37a.** $2x + 2y = 150$; $xy = 800$ **37b.** 0, 1, 2

37c.



37d. 12.9 m by 62.1 m or 62.1 m by 12.9 m

39. (4, −3), (−3, 4)

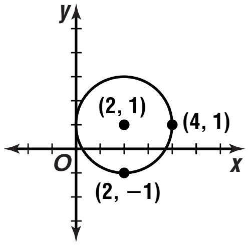


41. $-\frac{9}{8}$ **43.** $3(x')^2 - 4\sqrt{3}x'y' + 7(y')^2 - 9 = 0$ **45.** 4 **47.** 1 and 2 **49.** No; the domain value 4 is mapped to two elements in the range, 0 and −3.

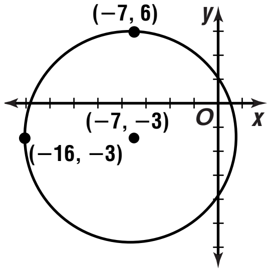
Pages 687–691 Chapter 10 Study Guide and Assessment

1. true **3.** false; transverse **5.** false, hyperbola **7.** true **9.** true **11.** $2\sqrt{5}$; (−1, −5) **13.** yes; $AB = DC = 10$ and $BC = AD = 5\sqrt{2}$. Since opposite sides of quadrilateral *ABCD* are congruent, *ABCD* is a parallelogram.

15. $(x - 2)^2 + (y - 1)^2 = 4$

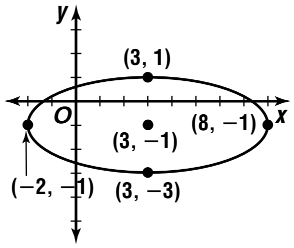


17. $(x + 7)^2 + (y + 3)^2 = 81$

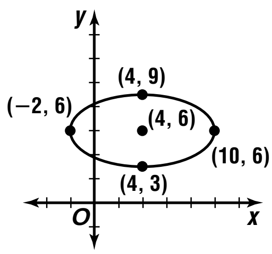


19. $(x + 2)^2 + (y + 3)^2 = 25$; (−2, −3); 5

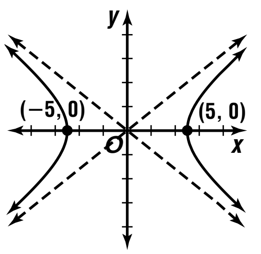
21. center: (3, −1), foci: $(3 \pm \sqrt{21}, -1)$, vertices: (3, 1), (8, −1), (3, −3), (−2, −1)



23. center: (4, 6); foci: $(4 \pm 3\sqrt{3})$; vertices: (−2, 6), (10, 6), (4, 3), (4, 9)

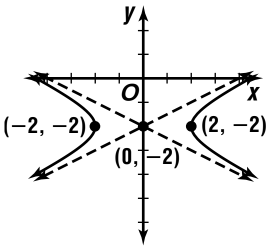


25. center: (0, 0); foci: $(\pm\sqrt{41}, 0)$; vertices: (−5, 0), (5, 0); asymptotes: $y = \pm\frac{4}{5}x$

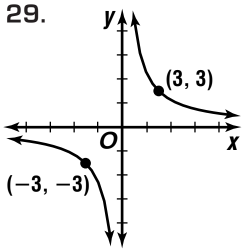


CONTENTS

27. center: $(0, -2)$; foci: $\left(\pm\sqrt{5}, -2\right)$; vertices: $(-2, -2)$, $(2, -2)$ asymptotes: $y + 2 = \pm\frac{1}{2}x$



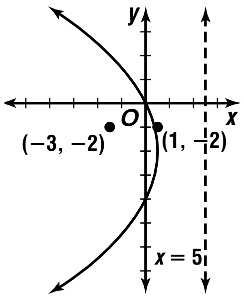
29.

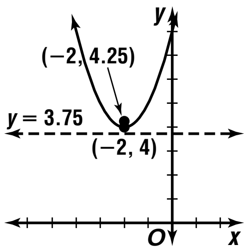


31. $\frac{(x-2)^2}{16} - \frac{(y+3)^2}{20} = 1$

33. vertex: $(-3, -2)$, focus: $(-3, -2)$, directrix: $x = 5$; axis of symmetry: $y = -2$

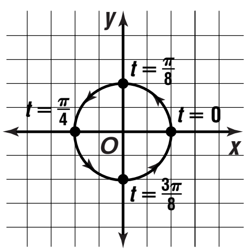
35. vertex: $(-2, 4)$, focus: $(-2, 4.25)$, directrix: $y = 3.75$; axis of symmetry: $x = -2$



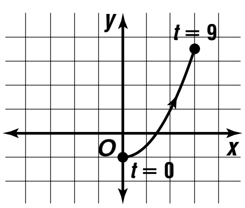


37. $(x - 5)^2 = 12(y + 1)$ **39.** equilateral hyperbola **41.** parabola

43. $x^2 + y^2 = 1$

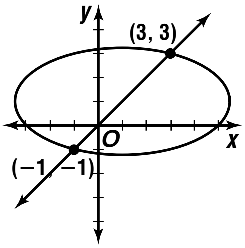


45. $y = \frac{x^2}{2} - 1$

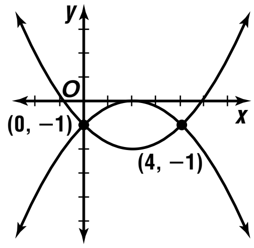


47. Sample answer: $x = 7 \sin t$, $y = 7 \cos t$, $0 \leq t \leq 2\pi$ **49.** Sample answer: $x = -t^2$, $y = t$, $-\infty < t < \infty$ **51.** parabola; $(x')^2 - 2x'y' + (y')^2 - 4\sqrt{2}x' - 4\sqrt{2}y' = 0$ **53.** ellipse; $-30°$

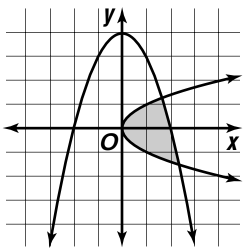
55. $(3, 3)$, $(-1, -1)$



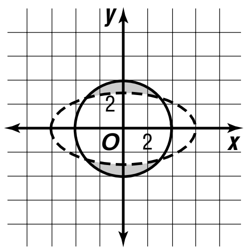
57. $(0, -1)$ $(4, -1)$



59.



61.



63a. $x^2 + y^2 = 400$ **63b.** about 37% **65.** about 1.8 feet from the center

Page 693 Chapter 10 SAT and ACT Practice

1. C **3.** A **5.** A **7.** D **9.** A

Chapter 11 Exponential and Logarithmic Functions

Pages 700–703 Lesson 11-1

5. $\frac{256}{81}$ **7.** 9 **9.** $81a^{-1}$ or $\frac{81}{a}$ **11.** $2^{2n+3}\sqrt{2^{n+1}}$

13. $13x^{\frac{5}{2}}$ **15.** $\sqrt[4]{6b^3c}$ **17.** $pq^2r\sqrt[3]{pr^2}$

19. 4.717×10^{-13} m^2 **21.** $-\frac{1}{1296}$ **23.** 32 **25.** $\frac{9}{4}$

27. 9 **29.** $2\sqrt{6}$ **31.** $\frac{1}{2}$ **33.** 36 **35.** $\frac{1}{16}$

37. 1 **39.** $3pq^2r^{-\frac{1}{3}}$ **41.** $6|x|^3$ **43.** $\frac{\sqrt{n}}{2}$

45. $4f^4|g||h|^{-1}$ or $\frac{4f^4|g|}{|h|}$ **47.** $6x^{\frac{1}{2}}y$ **49.** $|m|^3n^{\frac{1}{2}}$

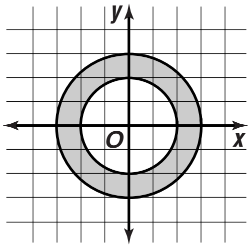
51. $2xy^2$ **53.** $a^2b^{\frac{2}{5}}|c|^{\frac{1}{2}}$ **55.** $\sqrt[5]{16}$ **57.** $\sqrt[6]{p^4q^3r^2}$

59. $13\sqrt[21]{a^3b^7}$ **61.** -0.69 **63.** $ab^2\sqrt[3]{a^2bc}$

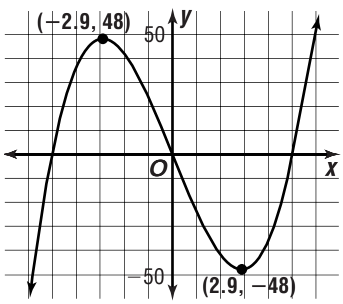
65. 0.17 **67.** 3.79 **69a.** $0 < y < 1$

69b. $1 < y < 3$ **69c.** $y > 3$ **69d.** If the exponent is less than 0, the power is greater than 0 and less than 1. If the exponent is greater than 0 and less than 1, the power is greater than 1 and less than the base. If the exponent is greater than 1, the power is greater than the base. Any number to the zero power is 1. Thus, if the exponent is less than zero, the power is less than 1. A power of a positive number is never negative, so the power is greater than 0. Any number to the zero power is 1 and to the first power is itself. Thus, if the exponent is greater than zero and less than 1, the power is between 1 and the base. Any number to the first power is itself. Thus, if the exponent is greater than 1, the power is greater than the base. **71.** 2, −6 **73a.** 42,250,474.31 m **73b.** 35,870 km

75.

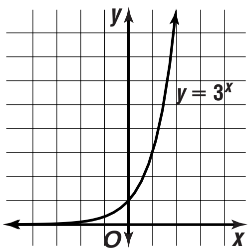


77. $1.31 + 0.14\boldsymbol{i}$ **79.** about 4.43 s **81.** Sample answer: $\sin S = \frac{1}{2}$ **83.** 25π m/h **85.** 3; −5, 0, 5 **87.** E

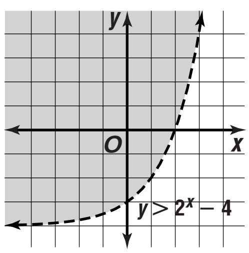


Pages 708–711 Lesson 11-2

5.

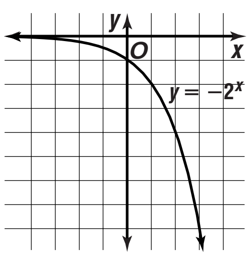


7.

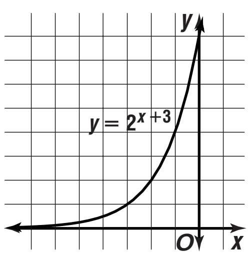


9a. 0.45% **9b.** 9,695,766

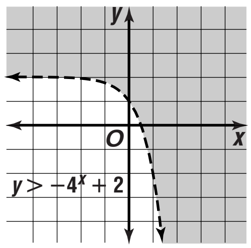
11.



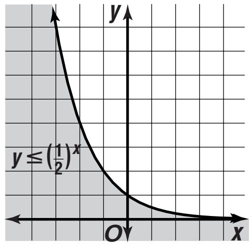
13.



15.

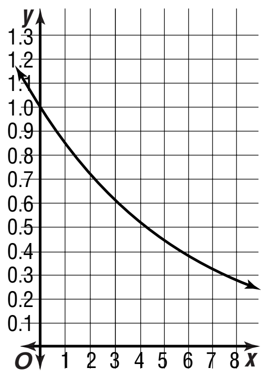


17.



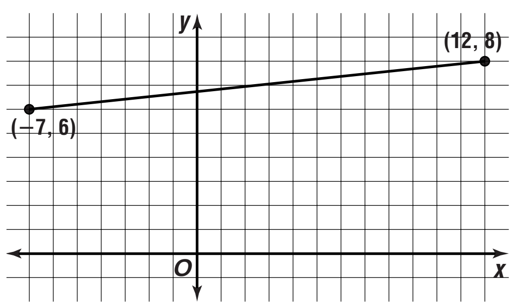
19. B **21.** A **23a.** The graph of $y = 6^x + 4$ is shifted up four units from the graph of $y = 6^x$. **23b.** The graph of $y = -3^x$ is a reflection of the graph of $y = 3^x$ across the x-axis. **23c.** The graph of $y = 7^{-x}$ is a reflection of the graph of $y = 7^x$ across the y-axis. **23d.** The graph of $y = \left(\frac{1}{2}\right)^x$ is a reflection of the graph of $y = 2^x$ across the y-axis. **25a.** $y = (0.85)^x$

25b.



25c. 14% **25d.** No; the graph has an asymptote at $y = 0$, so the percent of impurities y will never reach 0. **27a.** 2700 units **27b.** 5800 units **29a.** \$535,215.92 **29b.** \$76,376.20 **31a.** \$50; \$50.63; \$50.94; \$51.16; \$51.26 **31b.** Money Market Savings **31c.** 4.88% **33.** $15 = r \sin \theta$ **35.** $\sqrt{3}\left(\cos \frac{5\pi}{8} + \boldsymbol{i} \sin \frac{5\pi}{8}\right)$; $-0.66 + 1.60\boldsymbol{i}$

37a.



37b. (2.5, 7) **39.** 139,000 cm/s **41.** Sample answer: $y = 948.4x + 4960.6$ **43.** E

Pages 714–717 Lesson 11-3

7. \$25,865.41 **9a.** 78.7°F **9b.** Too cold; after 5 minutes, his coffee will be about 90°F.

11a.

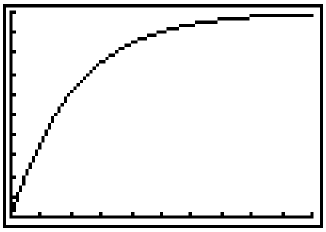
Interest Compounded	Interest	Effective Annual Yield
Annually	\$80.00	8%
Semi-annually	\$81.60	8.16%
Quarterly	\$82.43	8.243%
Monthly	\$83.00	8.3%
Daily	\$83.28	8.328%
Continually	\$83.29	8.329%

11b. continuously **11c.** $E = \left(1 + \frac{r}{n}\right)^n - 1$

11d. $E = e^r - 1$ **13a.** 95% **13b.** about 1.2 min

15a. 20.9%; 60.9%; 98.5%

15b. about 29 days



15c. Sample answer: The probability that a person who is going to respond has responded approaches 100% as t approaches infinity. New ads may be introduced after a high percentage of those who will respond have responded. The graph appears to level off after about 50 days. So, new ads can be introduced after an ad has run about 50 days.

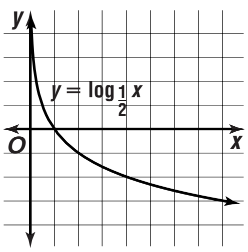
17. \$13,257.20 **19.** $6x^2 + 12xy + 6y^2 + \sqrt{2}x - \sqrt{2}y = 0$ **21.** 704.2 ft · lb **23.** $\frac{13}{2}$ **25.** $J'(-9, -6)$, $K'(-6, 18)$, $L'(6, 15)$, $M'(9, -3)$; the dilated image has sides that are 3 times the length of the original figure. **27.** $\{-4, 2, 5\}$; $\{5, 7\}$; yes

Pages 722–724 Lesson 11-4

7. $\left(\frac{1}{25}\right)^{-\frac{1}{2}} = 5$ **9.** $\log_8 \frac{1}{4} = -\frac{2}{3}$ **11.** -2 **13.** 32

15. 15

17.



19. 264 h **21.** $16^{\frac{1}{2}} = 4$ **23.** $4^{\frac{5}{2}} = 32$

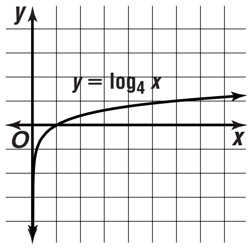
25. $(\sqrt{6})^4 = 36$ **27.** $\log_{36} 216 = \frac{3}{2}$

29. $\log_6 \frac{1}{36} = -2$ **31.** $\log_x 14.36 = 1.238$ **33.** $\frac{1}{3}$

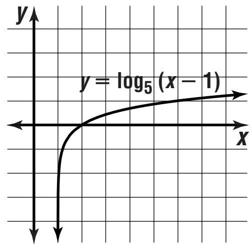
35. 3.5 **37.** 1.5 **39.** 8 **41.** 7 **43.** 6 **45.** 3

47. $\frac{1}{3}$ **49.** 4 **51.** 32

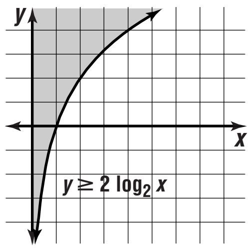
53.



55.



57.



59. 90 min

61. Let $\log_b m = x$ and $\log_b n = y$.
So, $b^x = m$ and $b^y = n$.

$$\frac{m}{n} = \frac{b^x}{b^y} = b^{x-y}$$

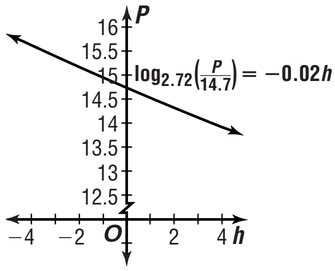
$$\frac{m}{n} = b^{x-y}$$

$$\log_b \frac{m}{n} = x - y$$

$$\log_b \frac{m}{n} = \log_b m - \log_b n$$

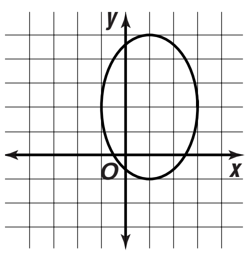
63a. 2 **63b.** less light; $\frac{1}{8}$

65a.



65b. 14.4 psi **65c.** 16.84 psi **67.** 69.6164

69. ellipse, $\frac{(x-1)^2}{4} + \frac{(y-2)^2}{9} = 1$



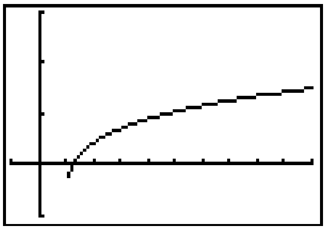
71. $AB = 6$, $BC = 5$, $AC = 5$ **73.** $64 - 27j$ volts

75. $\frac{31}{481}$ **77.** $c = 9.5$, $A = 38°20'$, $B = 36°22'$

Pages 730–732 Lesson 11-5

5. 4.9031 **7.** -2.0915 **9.** 74,816.95 **11.** 1.1632 **13.** 7.83 **15.** $x < 2.97$ **17.** 5.5850 **19.** 5.6021 **21.** 0.0792 **23.** 1.5563 **25.** -2.3188 **27.** 3.2553 **29.** 2.9515 **31.** 2.001 **33.** 2.1745 **35.** 4 **37.** 0.7124 **39.** -3.9069 **41.** 18.6377 **43.** 0.3434 **45.** 0.2076 **47.** $1 < x < 6$ **49.** $x \geq 3.8725$ **51.** $x < 3.6087$

53.



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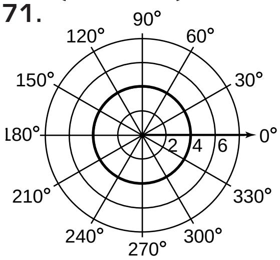
55. 0.3210 **57.** 2 **59a.** 1.58 **59b.** 0.0219 **61.** Sample answer: x is between 2 and 3 because 372 is between 100 and 1000, and log 100 = 2 and log 1000 = 3. **63.** 3819 yr **65.** 3 **67.** $a\sqrt[3]{ab^2c^2}$ **69.** $(2\sqrt{5}, -11)$

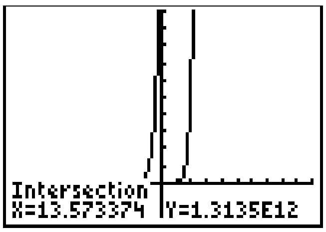
71.



73. 31.68 cm^2 **75.** Neither; the graph of the function is not symmetric with respect to either the origin or the y-axis.

Pages 735–737 Lesson 11-6

5. -4.7217 **7.** -1.5606 **9.** 3.0339 **11.** 0.9635 **13.** $x < 1.3863$ **15.** 13.57



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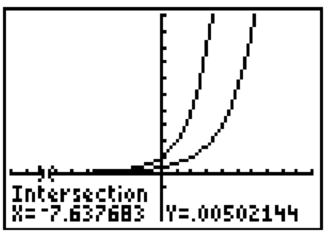
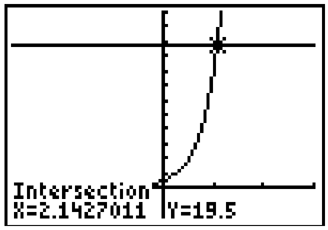
17a. 503.1 torrs **17b.** 4.2 km **19.** -0.2705 **21.** 0.9657 **23.** 2.2322 **25.** 1.2134 **27.** 0.9966 **29.** 0.2417 **31.** 2.2266 **33.** -0.3219 **35.** 1.7593 **37.** 4.7549 **39.** 1.3155 **41.** $40.9933 < t$ **43.** -0.3466 **45.** $x \leq 1.7657$ **47.** $x \geq 144.9985$ **49.** -7.64



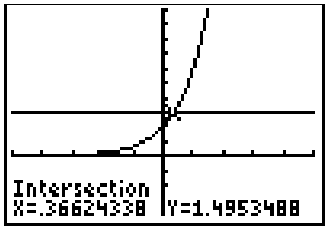
[−10, 10] scl:1, [−3, 10] scl:1

51. 2.14



[−6, 6] scl:2, [−4, 24] scl:2

53. $x \geq 0.37$



[−5, 5] scl:1, [−2, 5] scl:0.5

55. 324 hr **57.** 0 or -1.0986 **59.** $\approx$ 70%

61. y is a logarithmic function of x. The pattern in the table can be determined by $3^y = x$ which can be expressed as $\log_3 x = y$. **63.** $16^{\frac{3}{4}} = 8$ **65.** 0.00765 N · m **67.** $\langle 13, 7 \rangle$ **69.** $y = \pm 70 \cos 4\theta$

Pages 744–748 Lesson 11-7

5. 8.66 yr **7.** 30.81 yr **9.** 9.73 yr **11.** logarithmic; the graph has a vertical asymptote **13.** exponential; the graph has a horizontal asymptote **15a.** $y = 1.0091(0.9805)^x$ **15b.** $y = 1.0091e^{-0.0197x}$ **15c.** 35.10 min **17.** $y = 40 + 14.4270 \ln x$ **19.** Take the square root of each side.

21a.

x	0	50	100	150	190
ln y	1.81	2.07	3.24	3.75	4.25

21b. $\ln y = 0.0137x + 1.6833$ **21c.** $y = e^{0.0137x + 1.6833}$ **21d.** 117.4 persons per square mile **23a.** ln y is a linear function of ln x. **23b.** The result of part **a** indicates that we should take the natural logarithms of both the x- and y-values.

ln x	6.21	6.91	8.52	9.21	9.62
ln y	4.49	4.84	5.65	5.99	6.19

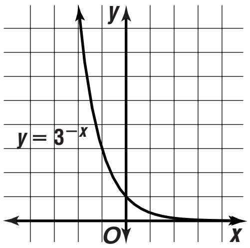
23c. $\ln y = 0.4994 \ln x + 1.3901$ **23d.** $y = 4.0153x^{0.4994}$ **25.** 0.01 **27a.** \$11.50 **27b.** \$2645 **29.** about 109.6 ft **31.** 4 units left and 8 units down **33.** C

CONTENTS

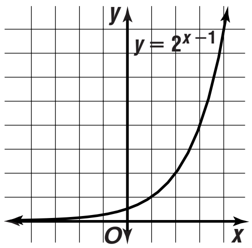
Pages 749–753 Chapter 11 Study Guide and Assessment

1. common logarithm **3.** logarithmic function **5.** mantissa **7.** linearizing data **9.** nonlinear regression **11.** 16 **13.** 81 **15.** $\frac{1}{3}$ **17.** $\frac{1}{8}x^{12}$ **19.** $2a^3b$

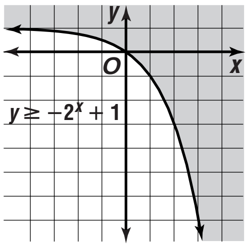
21.



23.



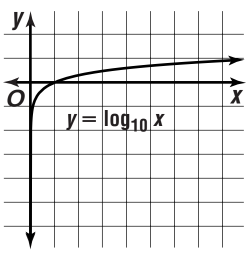
25.



27. \$4788.85 **29.** \$21,647.86 **31.** $3^{-4} = \frac{1}{81}$ **33.** $\log_5 \frac{1}{25} = -2$ **35.** -3

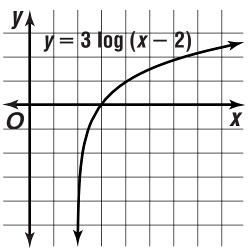
37. -1 **39.** -1 **41.** 3 **43.** 16 **45.** 8

47.



49. -3.5229 **51.** -1.8539 **53.** -8.04 **55.** $x \leq -4$

57.



59. -3.42 **61.** 1.5283 **63.** 1.7829

65. 3.8982 **67.** -0.8967 **69.** $x \geq 2.5903$ **71.** $x < 2.20$ **73.** 13.52 **75.** 3561 yr **77.** 2014

Page 755 Chapter 11 SAT and ACT Practice

1. B **3.** E **5.** B **7.** D **9.** C

Chapter 12 Sequences and Series

Page 763–765 Lesson 12-1

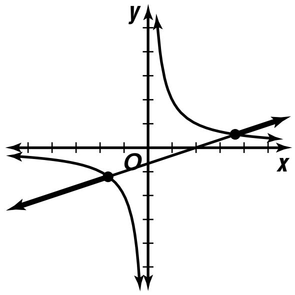
7. 9, 17, 25, 33 **9.** -38 **11.** 15 **13.** 9, 14, 19, 24 **15.** 21 **17.** $-13, -19, -25, -31$ **19.** 7.5, 9, 10.5, 12 **21.** $b + 12, b + 16, b + 20, b + 24$ **23.** $-13n, -19n, -25n, -31n$ **25.** $2a + 16, 2a + 23, 2a + 30, 2a + 37$ **27.** 80 **29.** 13 **31.** 80 **33.** 4 **35.** $17 + \sqrt{5}$ **37.** -42.2 **39.** 12, 16.5, 21 **41.** $\sqrt{3}, \frac{12 + 2\sqrt{3}}{3}, \frac{24 + \sqrt{3}}{3}, 12$ **43.** -11 **45.** 1456 **47.** 7 **49.** $-8n + 14$ **51.** Let d be the common difference. Then, $y = x + d$, $z = x + 2d$, and $w = x + 3d$. Substitute these values into the expression $x + w - y$ and simplify. $x + (x + 3d) - (x + d) = x + 2d$ or z. **53.** 12 **55a.** 25 **55b.** 100 **55c.** Conjecture: The sum of the first n term of the sequence of natural numbers is n^2. Proof: Let $a_n = 2n - 1$. The first term of the sequence of natural numbers is 1, so $a_1 = 1$. Then, using the formula for the sum of an arithmetic series,

$$S_n = \frac{n}{2}(a_1 + a_n)$$
$$S_n = \frac{n}{2}[1 + (2n - 1)]$$
$$= \frac{n}{2}(2n) \text{ or } n^2$$

57. least: \$101, greatest: \$1001 **59.** \$285.77 **61.** $0.5\left(\cos \frac{\pi}{8} + \boldsymbol{i} \sin \frac{\pi}{8}\right), 0.46 + 0.19\boldsymbol{i}$ **63.** $\sqrt{3}x + y - 10 = 0$ **65.** $A = 70°28'$, $a = 4.2$, $b = 1.5$ **67.** $y = x - 1$ **69.** C

Pages 771–773 Lesson 12-2

7. 6; 144, 864, 5184 **9.** -4; $-115.2, 460.8, -1843.2$ **11.** $\frac{3}{2}$ **13.** 1, 3, 9, 27 **15.** \$28,211.98; \$39,795.78; \$79,185.19 **17.** -2.5; $-125, 312.5, -781.25$ **19.** $\frac{2}{5}; \frac{6}{125}, \frac{12}{625}, \frac{24}{3125}$ **21.** $\sqrt{2}$; $12, 12\sqrt{2}, 24$ **23.** $\boldsymbol{i}$; $1, \boldsymbol{i}, -1$ **25.** $\frac{1}{ab}, \frac{1}{a^3}, \frac{b}{a^5}, \frac{b^2}{a^7}, \frac{b^3}{a^9}$ **27.** $-\frac{243}{2048}$ **29.** $16\sqrt{5}$ **31.** $8\sqrt{2}$ **33.** 200, 40, 8 **35.** $-2, 6, -18, 54$ **37.** $\frac{605}{3}$ **39.** $-\frac{11{,}605}{512}$ **41a.** $b_t = b_0 \cdot 2^{2t}$ **41b.** 30,720 **41c.** Sample answer: It is assumed that favorable conditions are maintained for the growth of the bacteria, such as an adequate food and oxygen supply, appropriate surrounding temperature, and adequate room for growth. **43a.** \$11.79, \$30.58, \$205.72 **43b.** \$7052.15 **43c.** Each payment made is rounded to the nearest penny, so the sum of the payments will actually be more than the sum found in part **b**. **45.** $a_n = (-2)(-3)^{n-1}$ **47a.** \$25.05 **47b.** No. At the end of two years, she will have only \$615.23 in her account. **47c.** \$30.54 **49.** 13 weeks

51. 

53. $x = t$, $y = -\frac{3}{4}t + \frac{5}{4}$

55. $y = 25 \sin\left(\frac{\pi}{2}t - 3.14\right) + 61$ **57.** 6

Pages 780–783 Lesson 12-3

5. 0; as $n \to \infty$, 5^n becomes increasingly large and thus the value $\frac{1}{5^n}$ becomes smaller and smaller, approaching zero. So the sequence has a limit of zero.

7. $\frac{3}{7}$; $\lim_{n\to\infty} \frac{3n - 6}{7n} = \lim_{n\to\infty} \left(\frac{3}{7} - \frac{6}{7} \cdot \frac{1}{n}\right)$

$= \lim_{n\to\infty} \frac{3}{7} - \lim_{n\to\infty} \frac{6}{7} \cdot \lim_{n\to\infty} \frac{1}{n}$

$= \frac{3}{7} - \frac{6}{7} \cdot 0$ or $\frac{3}{7}$

9. $5\frac{14}{111}$ **11.** $1\frac{1}{8}$ **13.** 125 m **15.** does not exist; simplifying the limit, we find that

$\lim_{n\to\infty} \frac{n^3 - 2}{n^2} = \lim_{n\to\infty} \left(n - \frac{2}{n}\right)$. $\lim_{n\to\infty} \frac{2}{n} = \lim_{n\to\infty} 2 \cdot \frac{1}{n} = 2 \cdot 0$

or 0, but as n approaches infinity, n becomes increasingly large, so the sequence has no limit.

17. $\frac{9}{2}$; $\lim_{n\to\infty} \frac{9n^3 + 5n - 2}{2n^3} = \lim_{n\to\infty} \left(\frac{9}{2} + \frac{5}{2n^2} - \frac{1}{n^3}\right)$

$= \lim_{n\to\infty} \frac{9}{2} + \lim_{n\to\infty} \frac{5}{2} \cdot \lim_{n\to\infty} \frac{1}{n^2} - \lim_{n\to\infty} \frac{1}{n^3}$

$= \frac{9}{2} + \frac{5}{2} \cdot 0 - 0$ or $\frac{9}{2}$

19. Does not exist; dividing by the highest powered term, n^2, we find $\lim_{n\to\infty} \frac{8 + \frac{5}{n} + \frac{2}{n^2}}{\frac{3}{n^2} + \frac{2}{n}}$ which as n approaches infinity simplifies to $\frac{8 + 0 + 0}{0 + 0} = \frac{8}{0}$. Since this fraction is undefined, the limit does not exist.

21. 0; as $n \to \infty$, 3^n becomes increasingly large and thus the value $\frac{1}{3^n}$ becomes smaller and smaller, approaching zero. So the sequence has a limit of zero.

23. 0,

$\lim_{n\to\infty} \frac{5n + (-1)^n}{n^2} = \lim_{n\to\infty} \frac{5n}{n^2} + \lim_{n\to\infty} \frac{(-1)^n}{n^2}$

$= \lim_{n\to\infty} \frac{5}{n} + \lim_{n\to\infty} \frac{(-1)^n}{n^2}$

$= \lim_{n\to\infty} \frac{(-1)^n}{n^2}$

As n increases, the value of the numerator alternates between -1 and 1. As n approaches infinity, the value of the denominator becomes increasingly large, causing the value of the fraction to become increasingly small. Thus the terms of the sequence alternate between smaller and smaller positive and negative values, approaching zero. So the sequence has a limit of zero.

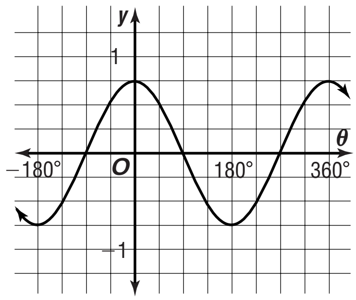
25. $\frac{17}{33}$ **27.** $6\frac{7}{27}$ **29.** $\frac{29}{110}$ **31.** 64 **33.** 20

35. Does not exist; this series is geometric with a common ratio of 2. Since this ratio is greater than 1, the sum of the series does not exist. **37.** $3\frac{3}{5}$

39. $32 - 16\sqrt{3}$ **41a.** The limit of a difference equals the difference of the limits only if the two limits exist. Since neither $\lim_{n\to\infty} \frac{n^2}{2n + 1}$ nor $\lim_{n\to\infty} \frac{n^2}{2n - 1}$ exists, this property of limits does not apply.

41b. $-\frac{1}{2}$ **43.** No; if n is even, $\lim_{n\to\infty} \cos \frac{n\pi}{2} = \frac{1}{2}$, but if n is odd, $\lim_{n\to\infty} \cos \frac{n\pi}{2} = -\frac{1}{2}$. **45a.** $10\sqrt{2}$ ft

45b. $40 + 20\sqrt{2}$ ft or about 68 ft **47.** $-2, -1\frac{1}{3}, -\frac{8}{9}, -\frac{16}{27}$ **49.** $(6, -2)$; $\left(6 \pm \sqrt{5}, -2\right)$; $(8, -2)$, $(4, -2)$; $y = -\frac{1}{2}x + 5$, $y = \frac{1}{2}x - 1$ **51.** 42.75 miles, 117.46 miles

53. 

55. B

Pages 791–793 Lesson 12-4

5. convergent **7.** divergent **9.** convergent **11.** convergent **13.** convergent **15.** divergent **17.** convergent **19.** convergent **21.** convergent **23.** divergent **25.** convergent **27.** convergent **29.** divergent **31a.** No, MagicSoft let a_1 = 1,000,000 to arrive at their figure. The first term of this series is 1,000,000 · 0.70 or 700,000.

31b. \$2.3 million **33a.** Culture A: 1400 cells, Culture B: 713 cells **33b.** Culture B; at the end of one month, culture A will have produced 6000 cells while culture B will have produced 9062 cells.

35a. $\frac{1}{3}$ **35b.** $\frac{1}{36}$ **35c.** $\frac{1}{432}, \frac{1}{5184}$ **35d.** at $4 + \frac{4}{11}$ o'clock, approximately 21 min 49 s after 4:00
37. $16\sqrt{2}$ **39.** 51.02 **41.** $\langle -3, 2 \rangle$

Pages 798–800 Lesson 12-5

5. $8 + 12 + 16 + 20$ **7.** $5 + \frac{15}{4} + \frac{45}{16} + \frac{135}{64} + \cdots$
9. $\sum_{k=0}^{3} (3^k + 1)$ **11.** $\sum_{n=2}^{\infty} 3\left(\frac{1}{2}\right)^n$
13a. $\sum_{n=1}^{60} 389(0.63)^{n-1}$; about 1051 ft **13b.** about 1051 ft **15.** $10 + 15 + 20 + 25$ **17.** $6 + 12 + 20 + 30 + 42$ **19.** $16 + 32 + 64 + 128 + 256$
21. $4\frac{1}{2} + 16\frac{1}{2} + 64\frac{1}{2}$ **23.** $6 + 24 + 120 + 720 + 5040$ **25.** $\frac{8}{5} + \frac{16}{25} + \frac{32}{125} + \cdots$
27. $\sum_{k=1}^{4} (3k + 3)$ **29.** $\sum_{k=4}^{12} 2k$ **31.** $\sum_{k=1}^{4} 2 \cdot 5^k$
33. $\sum_{k=2}^{10} \frac{1}{5k - 1}$ **35.** $\sum_{k=2}^{\infty} (-1)^k k^2$
37. $\sum_{n=0}^{\infty} \left[(-1)^{n+1} \frac{32}{2^n}\right]$ **39.** $\sum_{k=1}^{\infty} \frac{k}{2^k + 3}$
41. $\sum_{k=1}^{\infty} \frac{2^{\frac{k}{2}}}{3k!}$ **43.** $a(a + 1)(a - 1)$ **45.** 43.64

47a.
$$\begin{aligned}(x - 3) + (x - 6) + (x - 9) + (x - 12) +&\\ (x - 15) + (x - 18) &= -3\\ 6x - 63 &= -3\\ 6x &= 60\\ x &= 10\end{aligned}$$

47b.
$$\begin{aligned}0 + 1(1 - x) + 2(2 - x) + 3(3 - x) +&\\ 4(4 - x) + 5(5 - x) &= 25\\ 1 - x + 4 - 2x + 9 - 3x + 16 - 4x + 25 - 5x &= 25\\ 55 - 15x &= 25\\ -15x &= -30\\ x &= 2\end{aligned}$$

49a. 6! **49b.** 120 **49c.** 24, "LISTEN"
51. divergent **53.** $8\sqrt{2}, -16, 16\sqrt{2}, -32$
55. $x^2 + (y - 2)^2 = 49$ **57.** 52.57 ft/s, 26.79 ft/s
59. D

Pages 804–805 Lesson 12-6

5. $c^5 + 5c^4d + 10c^3d^2 + 10c^2d^3 + 5cd^4 + d^5$
7. $125 - 75y + 15y^2 - y^3$ **9.** $-21a^2b^5$ **11a.** 1 **11b.** 10 **11c.** 6 **11d.** 26 **13.** $n^6 - 24n^5 + 240n^4 - 1280n^3 + 3840n^2 - 6144n + 4096$
15. $512 + 2304a + 4608a^2 + 5376a^3 + 4032a^4 + 2016a^5 + 672a^6 + 144a^7 + 18a^8 + a^9$ **17.** $243 - 405x + 270x^2 - 90x^3 + 15x^4 - x^5$ **19.** $8x^3 - 36x^2y + 54xy^2 - 27y^3$ **21.** $c^3 - 6c^2\sqrt{c} + 15c^2 - 20c\sqrt{c} + 15c - 6\sqrt{c} + 1$ **23.** $81a^4 + 72a^3b + 24a^2b^2 + \frac{32}{9}ab^3 + \frac{16}{81}b^4$ **25.** $x^6y^6 - 12x^5y^5z^3 + 60x^4y^4z^6 - 160x^3y^3z^9 + 240x^2y^2z^{12} - 192xyz^{15} + 64z^{18}$

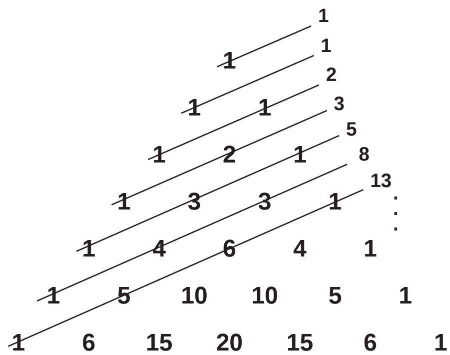
27. $-112\sqrt{2}a^5$ **29.** $145{,}152c^3d^6$
31. $-7{,}185{,}024p^6q^5$ **33.** 163 **35a.** 495
35b. 2510 **37a.** Sample answer: $1 + 0.01$
37b. Sample answer: 1.04060401 **37c.** 1.04060401; the two values are equal. **39.** convergent
41. \$1100.65 **43.** 1681 feet

Pages 811–814 Lesson 12-7

5. $i\pi + 1.9459$ **7.** 2.22 **9.** 0.0069; 0 **11.** $2e^{i\frac{2\pi}{3}}$
13. $i\pi + 1.3863$ **15.** $i\pi - 1.3863$ **17.** $i\pi + 5.4723$
19. 2.99 **21.** 39.33 **23.** 24.02 **25.** -0.9760; -1
27. 0.8660; 0.8660 **29.** $5e^{i\frac{5\pi}{3}}$ **31.** $\sqrt{2}e^{i\frac{\pi}{4}}$
33. $2e^{i\frac{3\pi}{4}}$ **35.** $3\sqrt{2}e^{i\frac{\pi}{4}}$

37.
$$\begin{aligned}\frac{e^{ix} - e^{-ix}}{2i} &= \frac{\cos x + i\sin x - (\cos x - i\sin x)}{2i}\\ &= \frac{2i\sin x}{2i}\\ &= \sin x\end{aligned}$$
$$\begin{aligned}\frac{e^{ix} + e^{-ix}}{2} &= \frac{\cos x + i\sin x + \cos x - i\sin x}{2}\\ &= \frac{2\cos x}{2}\\ &= \cos x\end{aligned}$$

39. If you add the numbers on the diagonal lines as shown, the sums are the terms of the Fibonacci sequence.



41a. approximately \$9572.29 **41b.** No, she will be short by more than \$30,000! **41c.** about 42 years; 47 years old **41d.** \$20,882 **43.** $64x^6 + 192x^5y + 240x^4y^2 + 160x^3y^3 + 60x^2y^4 + 12xy^5 + y^6$
45a. 0.020 cm, 0.040 cm **45b.** $0.005(2)^{n-1}$
45c. 2.56, 3.169×10^{27} cm **47.** $y^2 + 3x + 7y = 0$
49. 75.5 N, 14°48′ **51.** 24 multiple choice, 6 essay

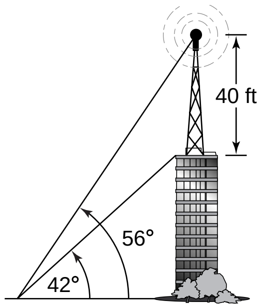
Pages 819–821 Lesson 12-8

5. $-1, -7, -19, -43$ **7.** $15 + 26i, 9 + 17.6i, 5.4 + 12.56i$ **9.** $-1 + i, 2 - 5i, -19 - 23i$ **11.** 5, 8, 17, 44 **13.** 1; 16; 121; 13,456 **15.** $-0.08, 0.09, -0.07, 0.08$ **17.** $3 + 8i, 9 + 14i, 21 + 26i$
19. $5 + 2i, 13 + 2i, 29 + 2i$ **21.** $15 + 2i, 33 + 2i, 69 + 2i$ **23.** $1, 3 - 2i, 9 - 8i$ **25.** $-3i, -8 - 3i, 56 + 45i$ **27.** $-2i, -4 - 4i, 28i$ **29.** $2 + i, 5 + 7i, -22 + 73i$ **31.** about 54% **33.** $\pm\sqrt{2}$

35a. 1.414213562, 1.189207115, 1.090507733, 1.044273782 **35b.** $f(z) = \sqrt{z}$, $z_0 = 2$ **35c.** 1

36d. 1 **37.** $90{,}720a^4b^4$ **39.** $\frac{x^2}{4225} - \frac{y^2}{4056} = 1$

41a.



41b. No, the height of the building is about 62 feet for a total of about 102 feet with the tower.

43. 92, 56

Pages 826–828 Lesson 12-9

7. Step 1: Verify that the formula is valid for $n = 1$. Since 2 is the first term in the sequence and $2(2^1 - 1) = 2$, the formula is valid for $n = 1$. Step 2: Assume that the formula is valid for $n = k$ and derive a formula for $n = k + 1$.

$S_k \Rightarrow 2 + 2^2 + 2^3 + \cdots + 2^k = 2(2^k - 1)$

$S_{k+1} \Rightarrow 2 + 2^2 + 2^3 + \cdots +$

$2^k + 2^{k+1} = 2(2^k - 1) + 2^{k+1}$

$= 2 \cdot 2^{k+1} - 2$

$= 2(2^{k+1} - 1)$

When the original formula is applied for $n = k + 1$, the same result is obtained. Thus if the formula is valid for $n = k$, it is also valid for $n = k + 1$. Since the formula is valid for $n = 1$, it is also valid for $n = 2$, $n = 3$, and so on indefinitely. Thus, the formula is valid for all positive integral values of n.

9. S_n: $3^n - 1 = 2r$ for some integer r. Step 1: Verify that S_n is valid for $n = 1$. $S_1 \Rightarrow 3^1 - 1$ or 2. Since $2 = 2 \cdot 1$, S_n is valid for $n = 1$. Step 2: Assume that S_n is valid for $n = k$ and show that it is also valid for $n = k + 1$.

$S_k \Rightarrow 3^k - 1 = 2r$ for some integer r

$S_{k+1} \Rightarrow 3^{k+1} - 1 = 2t$ for some integer t

$3^k - 1 = 2r$

$3(3^k - 1) = 3 \cdot 2r$

$3^{k+1} - 3 = 6r$

$3^{k+1} - 1 = 6r + 2$

$3^{k+1} - 1 = 2(3r + 1)$

Thus, $3^{k+1} - 1 = 2t$, where $t = 3r + 1$ is an integer, and we have shown that if S_n is valid, then S_{k+1} is also valid. Since S_n is valid for $n = 1$, it is also valid for $n = 2$, $n = 3$, and so on indefinitely. Hence, $3n - 1$ is divisible by 2 for all integral values of n.

11. Step 1: Verify that the formula is valid for $n = 1$. Since 1 is the first term in the sequence and $(1)[2(1) - 1] = 1$, the formula is valid for $n = 1$. Step 2: Assume that the formula is valid for $n = k$ and derive a formula for $n = k + 1$.

$S_k \Rightarrow 1 + 5 + 9 + \cdots + (4k - 3) = k(2k - 1)$

$S_{k+1} \Rightarrow 1 + 5 + 9 + \cdots + (4k - 3) + (4k + 1)$

$= k(2k - 1) + (4k + 1)$

$= 2k^2 + 3k + 1$

$= (k + 1)(2k + 1)$

Apply the original formula for $n = k + 1$.

$(k + 1)[2(k + 1) - 1] = (k + 1)(2k + 1)$

The formula gives the same result as adding the $(k + 1)$ term directly. Thus if the formula is valid for $n = k$, it is also valid for $n = k + 1$. Since the formula is valid for $n = 1$, it is also valid for $n = 2$, $n = 3$, and so on indefinitely. Thus, the formula is valid for all positive integral values of n.

13. Step 1: Verify that the formula is valid for $n = 1$. Since $-\frac{1}{2}$ is the first term in the sequence and $\frac{1}{2^1} - 1 = -\frac{1}{2}$, the formula is valid for $n = 1$. Step 2: Assume that the formula is valid for $n = k$ and derive a formula for $n = k + 1$.

$S_k \Rightarrow -\frac{1}{2} - \frac{1}{4} - \frac{1}{8} - \cdots - \frac{1}{2^k} = \frac{1}{2^k} - 1$

$S_{k+1} \Rightarrow \frac{1}{2} - \frac{1}{4} - \frac{1}{8} - \cdots - \frac{1}{2^k} - \frac{1}{2^{k+1}}$

$= \frac{1}{2^k} - 1 - \frac{1}{2^{k+1}}$

$= \frac{2}{2 \cdot 2^k} - 1 - \frac{1}{2^{k+1}}$

$= \frac{2}{2^{k+1}} - 1 - \frac{1}{2^{k+1}}$

$= \frac{1}{2^{k+1}} - 1$

When the original formula is applied for $n = k + 1$, the same result is obtained. Thus if the formula is valid for $n = k$, it is also valid for $n = k + 1$. Since the formula is valid for $n = 1$, it is also valid for $n = 2$, $n = 3$, and so on indefinitely. Thus, the formula is valid for all positive integral values of n.

15. Step 1: Verify that the formula is valid for $n = 1$. Since 1 is the first term in the sequence and $\frac{1[2(1) - 1][2(1) + 1]}{3} = 1$, the formula is valid for $n = 1$. Step 2: Assume that the formula is valid for $n = k$ and derive a formula for $n = k + 1$.

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$S_k \Rightarrow 1^2 + 3^2 + 5^2 + \cdots +$

$(2k-1)^2 = \dfrac{k(2k-1)(2k+1)}{3}$

$S_{k+1} \Rightarrow 1^2 + 3^2 + 5^2 + \cdots + (2k-1)^2 +$

$$(2k+1)^2 = \frac{k(2k-1)(2k+1)}{3} + (2k+1)^2$$
$$= \frac{k(2k-1)(2k+1) + 3(2k+1)^2}{3}$$
$$= \frac{[k(2k-1) + 3(2k+1)](2k+1)}{3}$$
$$= \frac{(2k^2+5k+3)(2k+1)}{3}$$
$$= \frac{(2k+3)(k+1)(2k+1)}{3}$$

Apply the original formula for $n = k + 1$.

$$\frac{(k+1)[2(k+1)-1][2(k+1)+1]}{3}$$
$$= \frac{(k+1)(2k+1)(2k+3)}{3}$$

The formula gives the same result as adding the $(k + 1)$ term directly. Thus if the formula is valid for $n = k$, it is also valid for $n = k + 1$. Since the formula is valid for $n = 1$, it is also valid for $n = 2$, $n = 3$, and so on indefinitely. Thus, the formula is valid for all positive integral values of n.

17. $S_n \Rightarrow 7^n + 5 = 6r$ for some integer r. Step 1: Verify that S_n is valid for $n = 1$. $S_1 \Rightarrow 7^1 + 5$ or 12. Since $12 = 6 \cdot 2$, S_n is valid for $n = 1$. Step 2: Assume that S_n is valid for $n = k$ and show that it is also valid for $n = k + 1$.

$S_k \Rightarrow 7^k + 5 = 6r$ for some integer r

$S_{k+1} \Rightarrow 7^{k+1} + 5 = 6t$ for some integer t

$$7^k + 5 = 6r$$
$$7(7^k + 5) = 7 \cdot 6r$$
$$7^{k+1} + 35 = 42r$$
$$7^{k+1} + 5 = 42r - 30$$
$$7^{k+1} + 5 = 6(7r - 5)$$

Thus, $7^{k+1} + 5 = 6t$, where $t = 7r - 5$ is an integer, and we have shown that if S_n is valid, then S_{k+1} is also valid. Since S_n is valid for $n = 1$, it is also valid for $n = 2$, $n = 3$, and so on indefinitely. Hence, $7^n + 5$ is divisible by 6 for all integral values of n.

19. $S_n \Rightarrow 5^n - 2^n = 3r$ for some integer r. Step 1: Verify that S_n is valid for $n = 1$. $S_1 \Rightarrow 5^1 - 2^1$ or 3. Since $3 = 3 \cdot 1$, S_n is valid for $n = 1$. Step 2: Assume that S_n is valid for $n = k$ and show that it is also valid for $n = k + 1$.

$S_k \Rightarrow 5^k - 2^k = 3r$ for some integer r

$S_{k+1} \Rightarrow 5^{k+1} - 2^{k+1} = 3t$ for some integer t

$$5^k - 2^k = 3r$$
$$5^k = 2^k + 3r$$
$$5^k \cdot 5 = (2^k + 3r)(2 + 3)$$
$$5^{k+1} = 2^{k+1} + 3(2^k) + 6r + 9r$$
$$5^{k+1} - 2^{k+1} = 2^{k+1} + 3(2^k) + 6r + 9r - 2^{k+1}$$
$$= 3(2^k) + 15r$$
$$= 3(2^k + 5r)$$

Thus, $5^{k+1} - 2^{k+1} = 3t$, where $t = 2^k + 5r$ is an integer, and we have shown that if S_n is valid, then S_{k+1} is also valid. Since S_n is valid for $n = 1$, it is also valid for $n = 2$, $n = 3$, and so on indefinitely. Hence, $5^n - 2^n$ is divisible by 3 for all integral values of n.

21. Step 1: Verify that the formula is valid for $n = 1$. Since $\frac{1}{2}$ is the first term in the sequence and $\frac{1}{1+1} = \frac{1}{2}$, the formula is valid for $n = 1$. Step 2: Assume that the formula is valid for $n = k$ and derive a formula for $n = k + 1$.

$$S_k \Rightarrow \frac{1}{1\cdot 2} + \frac{1}{2\cdot 3} + \frac{1}{3\cdot 4} + \cdots + \frac{1}{k(k+1)} = \frac{k}{k+1}$$

$$S_{k+1} \Rightarrow \frac{1}{1\cdot 2} = \frac{1}{2\cdot 3} + \frac{1}{3\cdot 4} + \cdots + \frac{1}{k(k+1)} +$$
$$\frac{1}{(k+1)(k+2)} = \frac{k}{k+1} + \frac{1}{(k+1)(k+2)}$$
$$= \frac{k(k+2)+1}{(k+1)(k+2)}$$
$$= \frac{k^2+2k+1}{(k+1)(k+2)}$$
$$= \frac{(k+1)^2}{(k+1)(k+2)}$$
$$= \frac{k+1}{k+2}$$

Apply the original formula for $n = k + 1$.

$$\frac{(k+1)}{(k+1)+1} = \frac{k+1}{k+2}$$

The formula gives the same result as adding the $(k + 1)$ term directly. Thus if the formula is valid for $n = k$, it is also valid for $n = k + 1$. Since the formula is valid for $n = 1$, it is also valid for $n = 2$, $n = 3$, and so on indefinitely. Thus, the formula is valid for all positive integral values of n.

23. Step 1: Verify that the formula is valid for $n = 1$. Since $S_1 \Rightarrow [r(\cos\theta + \boldsymbol{i}\sin\theta)]^1$ or $r(\cos\theta + \boldsymbol{i}\sin\theta)$ and $r^1[\cos(1)\theta + \boldsymbol{i}\sin(1)\theta] = r(\cos\theta + \boldsymbol{i}\sin\theta)$, the formula is valid for $n = 1$. Step 2: Assume that the formula is valid for $n = k$ and derive a formula for $n = k + 1$. That is, assume that $[r(\cos\theta + \boldsymbol{i}\sin\theta)]^k = r^k(\cos k\theta + \boldsymbol{i}\sin k\theta)$. Multiply each side of the equation by $r(\cos\theta + \boldsymbol{i}\sin\theta)$.

$$[r(\cos\theta + \boldsymbol{i}\sin\theta)]^{k+1}$$
$$= [r^k(\cos k\theta + \boldsymbol{i}\sin k\theta)] \cdot [r(\cos\theta + \boldsymbol{i}\sin\theta)]$$
$$= r^{k+1}[\cos k\theta\cos\theta + (\cos k\theta)(\boldsymbol{i}\sin\theta) +$$
$$\boldsymbol{i}\sin k\theta\cos\theta + \boldsymbol{i}^2\sin k\theta\sin\theta]$$
$$= r^{k+1}[(\cos k\theta\cos\theta - \sin k\theta\sin\theta) +$$
$$\boldsymbol{i}(\sin k\theta\cos\theta + \cos k\theta\sin\theta)]$$
$$= r^{k+1}[\cos(k+1)\theta + \boldsymbol{i}\sin(k+1)\theta]$$

When the original formula is applied for $n = k + 1$, the same result is obtained. Thus if the formula is valid for $n = k$, it is also valid for $n = k + 1$. Since the formula is valid for $n = 1$, it is also valid for

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$n = 2$, $n = 3$ and so on indefinitely. Thus, the formula is valid for all positive integral values of n.

25. $S_1 \Rightarrow n^2 + 5n = 2r$ for some positive integer r. Step 1: Verify that S_1 is valid for $n = 1$. $S_1 \Rightarrow 1^2 + 5 \cdot 1$ or 6. Since $6 = 2 \cdot 3$, S_1 is valid for $n = 1$. Step 2: Assume that S_n is valid for $n = k$ and show that it is valid for $n = k + 1$.

$S_k \Rightarrow k^2 + 5k = 2r$ for some positive integer r

$S_{k+1} \Rightarrow (k + 1)^2 + 5(k + 1) = 2t$ for some positive integer t

$$\begin{aligned}(k + 1)^2 + 5(k + 1) &= k^2 + 2k + 1 + 5k + 5\\ &= (k^2 + 5k) + (2k + 6)\\ &= 2r + 2(k + 3)\\ &= 2(r + k + 3)\end{aligned}$$

Thus, if $k^2 + 5k = 2t$, where $t = r + k + 3$ is an integer, and we have shown that if S_n is valid, then S_{k+1} is also valid. Since S_n is valid for $n + 1$, it is also valid for $n = 2$, $n = 3$, and so on indefinitely. Hence, $n^2 + 5n$ is divisible by 2 for all positive integral values of n.

27. Step 1: Verify that $S_n \Rightarrow (x + y)^n = x^n + nx^{n-1}y + \frac{n(n-1)}{2!}x^{n-2}y^2 + \frac{n(n-1)(n-2)}{3!}x^{n-3}y^3 + \cdots + y^n$ is valid for n = 1. Since $S_1 \Rightarrow (x - y)^1 = x^1 = 1x^0y^1$ or $x + y$, S_n is valid for $n = 1$. Step 2: Assume that the formula is valid for $n = k$ and derive a formula for $n = k + 1$.

$$S_k \Rightarrow (x + y)^k = x^k + kx^{k-1}y + \frac{k(k-1)}{2!}x^{k-2}y^2 + \frac{k(k-1)(k-2)}{3!}x^{k-3}y^3 + \cdots + y^k$$

$$S_{k+1} \Rightarrow (x + y)^k(x + y) = (x + y)\left(x^k + kx^{k-1}y + \frac{k(k-1)}{2!}x^{k-2}y^2 + \frac{k(k-1)(k-2)}{3!}x^{k-3}y^3 + \cdots + y^k\right)$$

$$\begin{aligned}(x + y)^{k+1} &= x\left(x^k + kx^{k-1}y + \frac{k(k-1)}{2!}x^{k-2}y^2 + \frac{k(k-1)(k-2)}{3!}x^{k-3}y^3 + \cdots + y^k\right) + y\left(x^k + kx^{k-1}y + \frac{k(k-1)}{2!}x^{k-2}y^2 + \frac{k(k-1)(k-2)}{3!}x^k - {}^3y^3 + \cdots + y^k\right)\\ &= x^{k+1} + kx^ky + \frac{k(k-1)}{2!}x^{k-1}y^2 + \cdots + xy^k + x^ky + kx^{k-1}y^2 + \frac{k(k-1)}{2!}x^{k-2}y^3 + \cdots + y^{k+1}\\ &= x^{k+1} + (k + 1)x^ky + kx^{k-1}y^2 + \frac{k(k-1)}{2!}x^{k-1}y^2 + \cdots + y^{k+1}\\ &= x^{k+1} + (k + 1)x^ky + \frac{k(k+1)}{2!}x^{k-1}y^2 + \cdots + y^{k+1}\end{aligned}$$

When the original formula is applied for $n = k + 1$, the same result is obtained. Thus if the formula is valid for $n = k$, it is also valid for $n = k + 1$. Since the formula is valid for $n = 1$, it is also valid for $n = 2$, $n = 3$, and so on indefinitely. Thus, the formula is valid for all positive integral values of n.

29. $8 - \boldsymbol{i}$, $16 - \boldsymbol{i}$, $32 - \boldsymbol{i}$ **31.** $\frac{(x-2)^2}{4} + \frac{(y-5)^2}{25} = 1$; ellipse **33.** $y = \pm\frac{3}{4}\sin 2x$ **35.** B

Pages 829–833 Chapter 12 Study Guide and Assessment

1. d **3.** m **5.** k **7.** c **9.** b **11.** 6.9, 8.2, 9.5, 10.8 **13.** 6, 3.5, 1, −1.5, −4 **15.** 18 **17.** 36,044.8 **19.** 0.2, 1, 5, 25, 125 **21.** $62(1 + \sqrt{2})$ **23.** 6 **25.** 0 **27.** 2100 **29.** divergent **31.** $(3 \cdot 5 - 3) + (3 \cdot 6 - 3) + (3 \cdot 7 - 3) + (3 \cdot 8 - 3) + (3 \cdot 9 - 3)$ **33.** $\sum_{a=0}^{\infty}(2n - 1)$ **35.** $a^6 - 24a^5 + 240a^4 - 1280a^3 + 3840a^2 - 6144a + 4096$ **37.** $3360x^6$ **39.** $102{,}400m^6$ **41.** $2e^{\boldsymbol{i}\frac{3\pi}{4}}$ **43.** $2\sqrt{2}e^{\boldsymbol{i}\frac{7\pi}{4}}$ **45.** 0, 6, −12, 42 **47.** 4, $6 - 2\boldsymbol{i}$, $7 - 3\boldsymbol{i}$ **49.** $2 + \boldsymbol{i}$, $5 - 1.5\boldsymbol{i}$, $6.5 - 2.75\boldsymbol{i}$

51. Step 1: Verify that the formula is valid for $n = 1$. Since the first term in the sequence is 1 and $\frac{1(1+1)}{2} = 1$, the formula is valid for $n = 1$. Step 2: Assume that the formula is valid for $n = k$ and derive a formula for $n = k + 1$.

$$S_k \Rightarrow 1 + 2 + 3 + \cdots + k = \frac{k(k+1)}{2}$$

$$\begin{aligned}S_{k+1} \Rightarrow 1 + 2 + 3 + \cdots + k + (k + 1) &= \frac{k(k+1)}{2} + \frac{2(k+1)}{2}\\ &= \frac{k^2 + k}{2} + \frac{2k + 2}{2}\\ &= \frac{k^2 + k + 2k + 2}{2}\\ &= \frac{k^2 + 3k + 2}{2}\\ &= \frac{(k+1)(k+2)}{2}\end{aligned}$$

Apply the original formula for $n = k + 1$.

$$\frac{(k+1)[(k+1)+1]}{2} = \frac{(k+1)(k+2}{2}$$

The formula gives the same result as adding the $(k + 1)$ term directly. Thus, if the formula is valid for $n = k$, it is also valid for $n = k + 1$. Since the formula is valid for $n = 1$, it is also valid for $n = 2$, $n = 3$, and so on indefinitely. Thus, the formula is valid for all positive integral values of n.

53. $S_n \Rightarrow 9^n - 4^n = 5r$ for some integer r. Step 1: Verify that S_n is valid for $n = 1$. $S_1 \Rightarrow 9^1 - 4^1$ or 5. Since $5 = 5 \cdot 1$, S_n is valid for $n = 1$. Step 2: Assume that S_n is valid for $n = k$ and show that it is also valid for $n = k + 1$.

$S_k \Rightarrow 9^k - 4^k = 5r$ for some integer r

$S_{k+1} \Rightarrow 9^{k+1} - 4^{k+1} = 5t$ for some integer t

$$9^k - 4^k = 5r$$
$$9^k = 4^k + 5r$$
$$9(9^k) = (4^k + 5r)(4 + 5)$$
$$9^{k+1} = 4^{k+1} + 5(4^k) + 20r + 25r$$
$$9^{k+1} - 4^{k+1} = 4^{k+1} + 5(4^k) + 20r + 25r - 4^{k+1}$$
$$= 5(4^k) + 45r$$
$$= 5(4^k + 9r)$$

Thus, $9^{k+1} - 4^{k+1} = 5t$, where $t = 4^k + 9r$ is an integer, and we have shown that if S_n is valid, then S_{k+1} is also valid. Since S_n is valid for $n = 1$, it is also valid for $n = 2$, $n = 3$, and so on indefinitely. Hence, $9^n - 4^n$ is divisible by 5 for all integral values of n.

55. \$117,987,860.30

Page 835 Chapter 12 SAT and ACT Practice

1. D **3.** A **5.** C **7.** D **9.** A

Chapter 13 Combinatorics and Probability

Pages 843–845 Lesson 13-1

5. 300 **7.** 720 **9.** 55,440 **11.** 15,504 **13.** 3,628,800 **15a.** 100,000 **15b.** 7290 **15c.** 999,900,000 **17.** 5040 **19.** dependent **21.** dependent **23.** 360 **25.** 840 **27.** 604,800 **29.** 6 **31.** 10 **33.** 6 **35.** 1 **37.** 168 **39.** 840 **41.** 2002 **43.** 420 **45a.** 22,308 **45b.** 144 **45c.** 792 **47.** 216,216 **49.** $P(n, n-1) \stackrel{?}{=} P(n, n)$

$$\frac{n!}{[n-(n-1)]!} \stackrel{?}{=} \frac{n!}{(n-n)!}$$
$$\frac{n!}{1!} \stackrel{?}{=} \frac{n!}{0!}$$
$$n! = n!$$

51a. 330 **52b.** 150 **53a.** 592

53b. Yes. Let h, t, and u be the digits.

$$\begin{array}{l} 100h + 10t + u \\ 100h + 10u + t \\ 100t + 10h + u \\ 100t + 10u + h \\ 100u + 10t + h \\ +\ 100u + 10h + t \\ \hline 200(h+t+u) + 20(h+t+u) + 2(h+t+u) = \\ 222(h+t+u) \end{array}$$

$$\frac{222(h+t+u)}{6} = 37(h+t+u)$$

55. 3025 **57.** 1.4 **59.** (2, 180°), (2, 0°) **61.** 0°, 180°, 360° **63.** $B = 63°$, $a = 7.7$, $c = 17.1$

Pages 849–851 Lesson 13-2

5. 22,680 **7.** circular; 3,628,800 **9.** circular; 39,916,800 **11.** 756 **13.** 907,200 **15.** 302,400 **17.** 3780 **19.** 126 **21.** circular; 39,916,800 **23.** circular; 40,320 **25.** circular; 5040 **27.** linear; 3,628,800 **29.** circular; 3,113,510,400 **31.** circular; $\approx 8.22 \times 10^{33}$ **33.** 2520 **35.** 46,200 **37a.** $\approx 7.85 \times 10^{17}$ **37b.** $\approx 1.41 \times 10^{51}$ **37c.** $\approx 6.04 \times 10^{52}$ **39.** 20 **41.** $x < 8.69$ **43.** $44 - 58\boldsymbol{i}$ **45.** about 3.31 inches

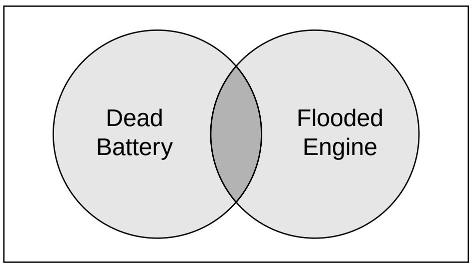
Pages 855–858 Lesson 13-3

5. $\frac{1}{3}$ **7.** 0 **9.** $\frac{4}{31}$ **11.** $\frac{18}{17}$ **13.** $\frac{3}{13}$ **15.** $\frac{5}{13}$ **17.** $\frac{1}{2}$ **19.** $\frac{7}{10}$ **21.** $\frac{1}{130}$ **23.** $\frac{3}{13}$ **25.** $\frac{1}{36}$ **27.** $\frac{2}{3}$ **29.** $\frac{11}{4}$ **31.** $\frac{22}{53}$ **33.** $\frac{92}{233}$ **35.** $\frac{4}{1}$ **37.** $\frac{1}{5}$ **39a.** $\frac{1}{720}$ **39b.** $\frac{999}{1}$ **41a.** $\frac{21}{1292}$ **41b.** $\frac{225}{421}$ **43.** $\frac{2}{9}$ **45.** 210 **47.** $2x$ **49.** $6\left(\cos \frac{5\pi}{4} + \boldsymbol{i} \sin \frac{5\pi}{4}\right)$, $-3\sqrt{2} - 3\sqrt{2}\boldsymbol{i}$ **51.** B

Pages 863–867 Lesson 13-4

5. dependent, $\frac{2}{15}$ **7.** exclusive, $\frac{10}{13}$ **9.** exclusive, $\frac{2}{13}$ **11.** ≈ 0.518 **13.** ≈ 0.032 **15.** $\frac{34}{39}$ **17.** independent, $\frac{25}{81}$ **19.** dependent, $\frac{2}{7}$ **21.** dependent, $\frac{19}{1{,}160{,}054}$ **23.** independent, $\frac{35}{1024}$ **25.** inclusive, $\frac{11}{36}$ **27.** inclusive, $\frac{8}{13}$ **29.** exclusive, $\frac{1}{4}$ **31.** exclusive, $\frac{11}{32}$ **33.** exclusive, $\frac{19}{33}$ **35.** $\frac{2}{221}$ **37.** $\frac{55}{221}$ **39.** $\frac{4}{7}$ **41.** $\frac{71}{210}$ **43.** $\frac{1}{21}$ **45.** $\frac{5}{7}$ **47.** $\frac{4}{5}$ **49.** $\frac{59}{143}$ **51.** $\frac{531}{1250}$ **53.** 0.93 **55a.** exclusive

55b.



55c. $\frac{4}{5}$ **57.** 720 **59.** No, the spill will spread no more than 2000 meters away. **61.** \$11.50, \$2645 **63.** $\langle x - 1, y + 5\rangle = t\langle -2, -4\rangle$ **65.** B

Pages 871–874 Lesson 13-5

5. $\frac{1}{3}$ **7.** $\frac{1}{7}$ **9.** $\frac{1}{5}$ **11.** $\frac{2}{5}$ **13a.** $\frac{69}{70}$ **13b.** $\frac{2}{25}$ **13c.** $\frac{1}{25}$ **15.** $\frac{1}{2}$ **17.** $\frac{3}{5}$ **19.** $\frac{5}{8}$ **21.** $\frac{1}{13}$ **23.** 0 **25.** $\frac{2}{13}$ **27.** $\frac{5}{7}$ **29.** $\frac{2}{5}$ **31.** $\frac{3}{10}$ **33.** $\frac{1}{6}$ **35.** $\frac{1}{2}$ **37.** $\frac{19}{51}$

39. A = person buys something
B = person asks questions

$$P(A|B) = \frac{\frac{120}{500}}{\frac{150}{500}} \text{ or } \frac{4}{5}$$

Four out of five people who ask questions will make a purchase. Therefore, they are more likely to buy something if they ask questions. **41.** $\frac{5}{6}$ **43.** $P(A|B) = \frac{P(A \text{ and } B)}{P(B)}$ by definition. So, if $P(A) = P(A|B)$ then by substitution $P(A) = \frac{P(A \text{ and } B)}{P(B)}$ or $P(A \text{ and } B) = P(A) \cdot P(B)$. Therefore, the events are independent. **45.** 126 **47.** They are reflections of each other over the x-axis. **49.** $y = -5$ **51.** 54.7 ft^2 **53.** $\frac{1}{2}$ ft or 6 in. **55.** B

Pages 878–880 Lesson 13-6

5. $\frac{625}{648}$ **7.** $\frac{1}{7776}$ **9.** $\frac{1029}{2500}$ **11.** $\frac{768}{3125}$ **13.** $\frac{1}{81}$ **15.** $\frac{65}{81}$ **17.** $\frac{15}{128}$ **19.** $\frac{1}{1024}$ **21.** $\frac{1}{81}$ **23.** $\frac{11}{27}$ **25.** ≈ 0.058 **27.** $\approx 1.049 \times 10^{-4}$ **29.** ≈ 0.201 **31.** $\frac{1}{4}$ **33.** $\frac{3}{8}$ **35.** about 45% **37.** ≈ 0.0062 **39.** 0.807 **41a.** 0.246 **41b.** 0.246 **41c.** 0.41 **43.** $\frac{7}{26}$ **45.** 0.38 **47.** $0 - i\sqrt{2}$ **49.** about 101.1 cm and 76.9 cm **51.** 7/12

Pages 881–885 Chapter 13 Study Guide and Assessment

1. independent **3.** 1 **5.** permutation **7.** mutually exclusive **9.** conditional **11.** 6 **13.** 720 **15.** 20,160 **17.** 165 **19.** 3 **21.** 63 **23.** 50,400 **25.** 60 **27.** $\frac{1}{16}$ **29.** $\frac{1}{140}$ **31.** $\frac{1}{15}$ **33.** $\frac{1}{139}$ **35.** independent, $\frac{5}{1296}$ **37.** $\frac{9}{14}$ **39.** $\frac{1}{7}$ **41.** $\frac{2}{5}$ **43.** $\frac{2}{15}$ **45.** $\frac{1}{16}$ **47.** $\frac{5}{16}$ **49.** 2520 **51a.** $\frac{7}{15}$ **51b.** $\frac{1}{30}$

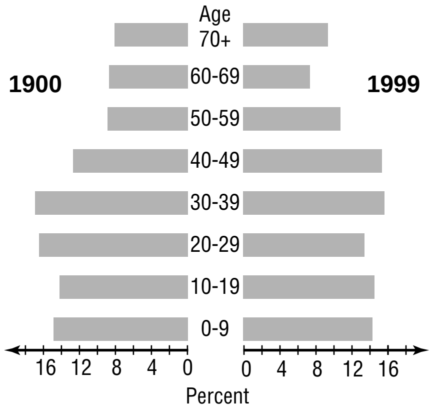
Page 887 Chapter 13 SAT and ACT Practice

1. D **3.** C **5.** E **7.** A **9.** B

Chapter 14 Statistics and Data Analysis

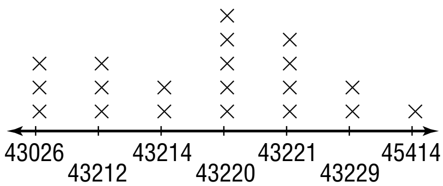
Pages 893–896 Lesson 14-1

5a.



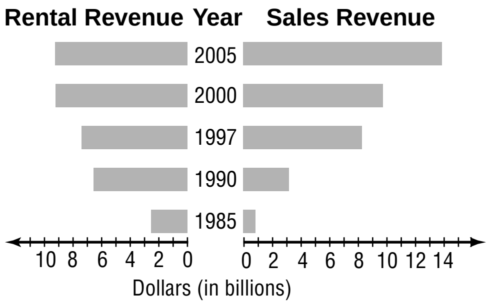
5b. In 1999, there are larger percents of older citizens than in 1990.

7a.



7b. 43220 **7c.** Sample answer: to determine where most of their customers live so they can target their advertising accordingly

9a.

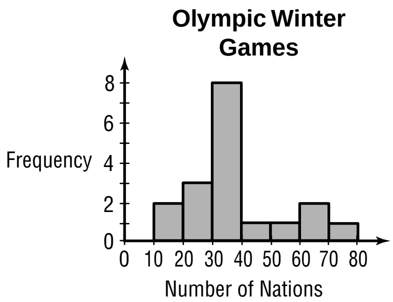


9b. Sales; the sales revenue is growing at a faster rate than the rental revenue. **11a.** 56 **11b.** Sample answer: 10 **11c.** Sample answer: 10, 20, 30, 40, 50, 60, 70, 80 **11d.** Sample answer: 15, 25, 35, 45, 55, 65, 75

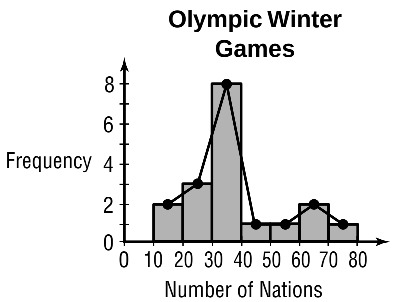
11e. Sample answer:

Number of Nations	Frequency
10–20	2
20–30	3
30–40	8
40–50	1
50–60	1
60–70	2
70–80	1

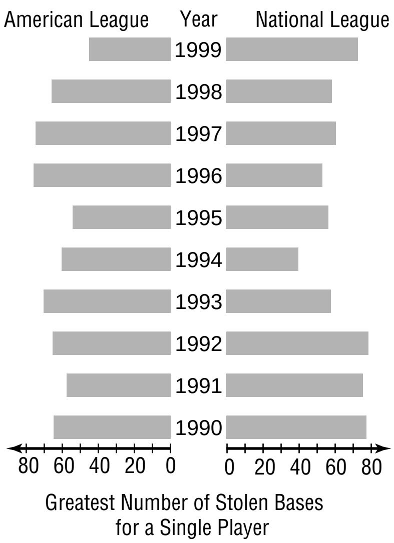
11f. Sample answer:



11g. Sample answer:



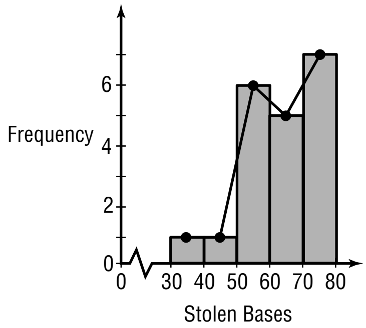
13a.



13b. Sample answer:

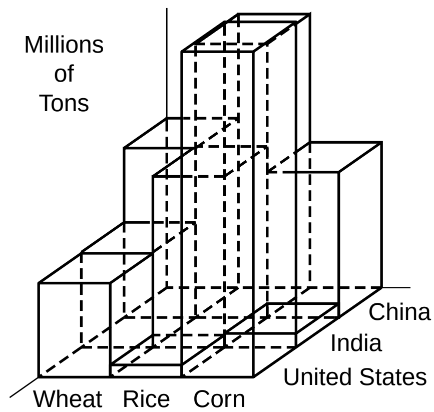
Stolen Bases	Frequency
30–40	1
40–50	1
50–60	6
60–70	5
70–80	7

13c. Sample answer:

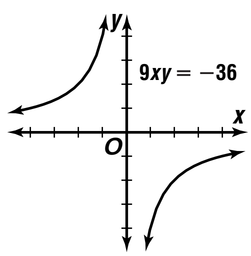


13d. 7 players **13e.** 2 players

15.



19. $-14c^6d$ **21.**



Pages 903–907 Lesson 14-2

5. 30.75; 27.5; 10 **7.** about 10,323; 10,500; 10,700

9a.

stem	leaf
0	6 7 7 7 9
1	3 3 4 4 5 6 7 8 9 9
2	0 0 0 1 1 1 1 1 3 3 8
3	0 1 1 1 2 4 4 6 8
4	1 1 1 2 7

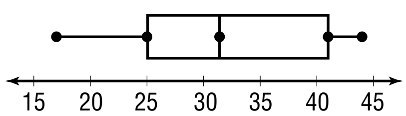
1|3 = 13

9b. 23.55 **9c.** 21 **9d.** 21

9e. Since the mean 23.55, the median 21, and the mode 21 are all representative values, any of them could be used as an average. **11.** 5.4; 3; 3 **13.** 10.75; 11; 5 and 18 **15.** 8.5; 8.5; 6 and 11 **17.** about 45.8; 45; 45 **19.** 1088; 1090; 1180 **21a.** \$1485, \$3480, \$4650, \$1650, \$2275, \$1480, \$780 **21b.** \$15,800 **21c.** 100 employees **21d.** about \$158 **21e.** \$150–\$160 **21f.** \$155 **21g.** Both values represent central values of the data. **23.** 3 **25a.** about 425.6 **25b.** 400–450 **25c.** about 420.5 **27a.** Sample answer: {1, 2, 2, 2, 3} **27b.** Sample answer: {4, 5, 9} **27c.** Sample answer: {2, 10, 10, 12} **27d.** Sample answer: {3, 4, 5, 6, 9, 9} **29a.** about 215.2 **29b.** 200–220 **29c.** about 213 **29d.** about 215.9; 211 **29e.** The mean calculated using the frequency distribution is very close to the one calculated with the actual data. The median calculated with the actual data is less than the one calculated with the frequency distribution. **31a.** \$87,800 **31b.** \$61,500 **31c.** \$59,000 **31d.** mean **31e.** mode **31f.** Median; the mean is affected by the extreme values of \$162,000 and \$226,000, and only two people make less than the mode. **31g.** Sample answer: I have been with the company for many years, and I am still making less than the mean salary. **33.** He is shorter than the mean (5'11.6") and the median (5'11.5"). **35.** dependent; $\frac{3}{55}$ **37.** \$40,305.56 **39.** A

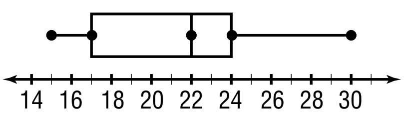
Pages 914–917 Lesson 14-3

5. 16; 8

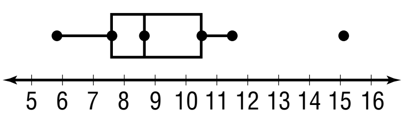


7. 30,250; about 13,226.39

9. 7; 3.5

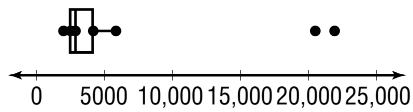


11. 2.9; 4.75



13. 211; about 223.14 **15.** 20.25; about 25.31 **17.** about 19.33; about 6.48 **19.** about 129.65; about 23.29 **21.** Sample answer: {15, 15, 15, 16, 17, 20, 24, 26, 30, 35, 45} **23a.** \$2414, \$2838, \$4147 **23b.** 1733 **23c.** \$20,480, \$21,914

23d.

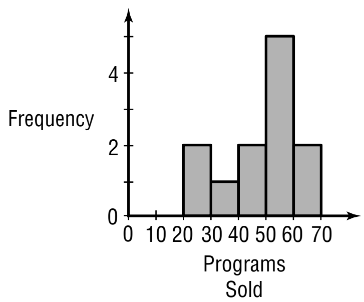


23e. about 3507.18 **23f.** about 5643.35 **23g.** The data in the upper quartile is diverse. **25a.** 11 **25b.** about 2.94 **29a.** 45 **29b.** Sample answer: 10 **29c.** Sample answer: 20, 30, 40, 50, 60, 70

29d. Sample answer:

Programs Sold	Frequency
20–30	2
30–40	1
40–50	2
50–60	5
60–70	2

29e. Sample answer:

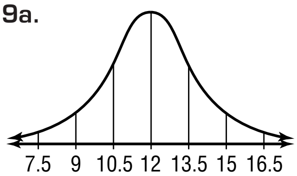


31. 3, 0.5, −0.75

Pages 923–925 Lesson 14-4

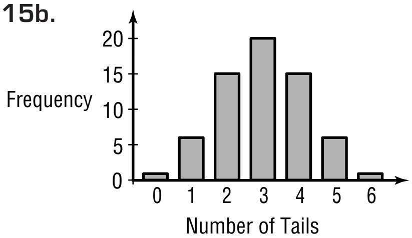
7a. 68.3% **7b.** 92.9% **7c.** 22.6–25.4 **7d.** 20.08–27.92

9a.



9b. 10.5–13.5 **9c.** 99.7% **9d.** 95.5% **11a.** 79.6–84.4 **11b.** 76.8–87.2 **11c.** 86.6% **11d.** 31.1% **13a.** 66.9% **13b.** 28.6% **13c.** 154 **15a.** $\frac{1}{64}$, $\frac{3}{32}$, $\frac{15}{64}$, $\frac{5}{16}$, $\frac{15}{64}$, $\frac{3}{32}$, $\frac{1}{64}$

15b.



15c. 3 **15d.** about 1.2 **15e.** They are similar.

17a. 0.8% **17b.** 99.2% **19a.** 72 **19b.** 58 **19c.** 68–71 **21a.** about 2.55 mL **21b.** 57.6%

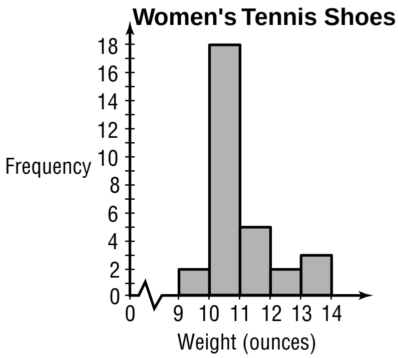
23. about 48.2; 45; 42 **25a.** Sample answer: $y = 0.05x^3 - 2.22x^2 + 29.72x + 366.92$
25b. Sample answer: 2553 students

Pages 930–932 Lesson 14-5

5. 7.3 **7.** 42.85–47.15 **9a.** about 0.29 **9b.** about 27.30–27.70 min **9c.** about 26.76–28.24 min **11.** about 0.37 **13.** about 0.53 **15.** about 0.70 **17.** about 333.07–336.93 **19.** about 77.81–82.19 **21.** 67.34–68.66 in. **23.** about 4524.21–4527.79 **25.** about 5.23–5.53 **27.** about 8.9% **29a.** 4.5 **29b.** 338.39–361.61 hours **29c.** Sample answer: 338 hours; there is only 0.5% chance the mean is less than this number. **31a.** about 0.57 **31b.** With a 5% level of confidence, the average family in the town will have their televisions on from 2.98 to 5.22 hours. **31c.** Sample answer: None; the sample is too small to generalize to the population of the city. **33a.** 750 h **33b.** 64 h **35.** 8.25; about 9.59 **37.** $\theta = 45°$ **39.** C

Pages 933–937 Chapter 14 Study Guide and Assessment

1. box-and-whisker plot **3.** standard error of the mean **5.** measure of central tendency **7.** bimodal **9.** histogram **11.** 5
13.



15. 210; 200; 200 **17.** 6.45; 6.5; 6.3 and 6.6 **19.** 3 **21.** 1.6 **23.** 95.5% **25.** 79.75–96.25 **27.** 143.25 **29.** about 0.16 **31.** 1.25 **33.** about 94.53–105.47 **35.** about 35.62–44.38 **37.** about 1.74–1.86 h **39.** about 1.71–1.89 h

41a.

stem	leaf
1	0 3 5 6 7 9
2	1 3 4 5
3	9 9

1|0 = 10

41b. 21.75 **41c.** 20 **41d.** 39

Page 939 Chapter 14 SAT and ACT Practice

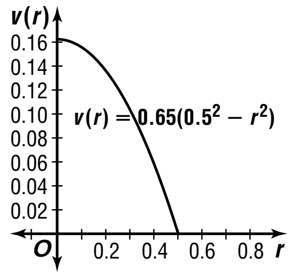
1. D **3.** D **5.** E **7.** D **9.** C

Chapter 15 Introduction to Calculus

Pages 946–948 Lesson 15-1

5. −17 **7.** $-\frac{1}{4}$ **9.** $\frac{4}{15}$

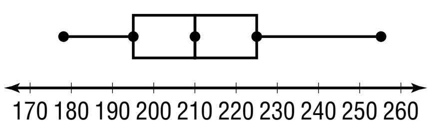
11a.



11b. 0 in./s **13.** 0; undefined **15.** −16 **17.** 0 **19.** 10 **21.** $\frac{3}{8}$ **23.** 0 **25.** −1 **27.** 4 **29.** −3 **31.** −1 **33.** 5 **35.** 2 **37.** −0.5 **39.** πa^2; letting c approach 0 moves the foci together, so the ellipse becomes a circle. πa^2 is the area of a circle of radius a. **41.** No; the graph of $f(x) = \sin\left(\frac{1}{x}\right)$ oscillates infinitely many times between −1 and 1 as x approaches 0, so the values of the function do not approach a unique number. **43.** 64 ft/s **45.** 15.684–16.716 mm **47.** $90x^3y^2$ **49.** $\frac{(x-5)^2}{16} + \frac{(y+2)^2}{9} = 1$ **51.** $\langle -7, -6\rangle$; $\sqrt{85}$ **53.** −1 **55.** $y \to \infty$ as $x \to \infty$, $y \to -\infty$ as $x \to -\infty$ **57.** Yes; opposite sides have the same slope.

Pages 957–960 Lesson 15-2

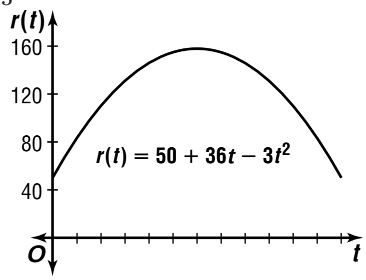
5. $f'(x) = 2x + 1$ **7.** $f'(x) = -3x^2 - 4x + 3$ **9.** 4 **11.** $F(x) = \frac{1}{4}x^4 + \frac{4}{3}x^3 - \frac{1}{2}x^2 - 3x + C$ **13.** $8 **15.** $f'(x) = 7$ **17.** $f'(x) = -4$ **19.** $f'(x) = 3x^2 + 10x$ **21.** $f'(x) = 2$ **23.** $f'(x) = -6x + 2$ **25.** $f'(x) = 3x^2 - 4x + 5$ **27.** $f'(x) = 6x^2 - 14x + 6$ **29.** $f'(x) = 81x^2 - 216x + 144$ **31.** 3 **33.** 1 **35.** $F(x) = \frac{1}{7}x^7 + C$ **37.** $F(x) = \frac{4}{3}x^3 - 3x^2 + 7x + C$ **39.** $F(x) = 2x^4 + \frac{5}{3}x^3 - \frac{9}{2}x^2 + 3x + C$ **41.** $F(x) = 2x^3 - \frac{5}{2}x^2 - 21x + C$ **43.** $F(x) = \frac{1}{3}x^3 + 2x^2 + x + C$ **45.** Any function of the form $F(x) = \frac{1}{6}x^6 + \frac{1}{4}x^4 - \frac{1}{3}x^3 - x + C$, where C is a constant. **47.** $f'(x) = -\frac{1}{x^2}$ **49a.** $v(t) = 80 - 32t$ **49b.** 48 ft/s **49c.** $t = 2.5$ s **49d.** 103 ft **51a.** $r(p) = p(100 - 2p)$ **51b.** 25 cents
53a.



55. $-\frac{1}{27}$ **57.** $\left(x+\frac{1}{6}\right)^2+\left(y-\frac{7}{6}\right)^2=\frac{169}{18}$
59. $x = 8t - 3, y = 3t - 2$ **61.** about 214.9 m
63. D

Pages 966–968 Lesson 15-3

5. $\frac{26}{3}$ units^2 **7.** 72 **9a.** 576 ft **9b.** Yes; integration shows that the ball would fall 1600 ft in 10 seconds of free-fall. Since this exceeds the height of the building, the ball must hit the ground in less than 10 seconds. **11.** 9 units^2 **13.** 4 units^2
15. 312 units^2 **17.** $\frac{208}{3}$ units^2
19. $\lim_{n\to\infty}\sum_{i=1}^{n}\left(\sin i\frac{\pi}{n}\right)\cdot\frac{\pi}{n}$ **21.** $\frac{27}{2}$ **23.** 1088
25. $\frac{40}{3}$ **27.** 10.125 ft^2 **29.** 8000 ft^3
31a.

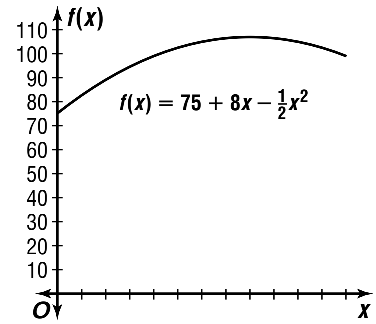


31b. \$1464 **31c.** \$122 **33.** $\frac{1}{2}\pi r^2$ **35.** 0
37. $\vec{\mathbf{u}} = \langle -1, -1, -10\rangle = -\vec{\mathbf{i}} - \vec{\mathbf{j}} - 10\vec{\mathbf{k}}$
39. $\frac{1}{2}, \frac{\pi}{5}$ **41.** C

Pages 973–976 Lesson 15-4

5. $\frac{2}{3}x^3 - 2x^2 + 3x + C$ **7.** $\frac{16}{3}$ units^2 **9.** $\frac{26}{3}$ units^2
11. $\frac{63}{2}$ **13.** 54 **15.** $\frac{1}{6}x^6 + C$ **17.** $\frac{1}{3}x^3 - x^2 + 4x + C$ **19.** $\frac{1}{5}x^5 + \frac{2}{3}x^3 - 3x + C$ **21.** $\frac{1}{3}x^3 - 3x^2 + 3x + C$ **23.** $\frac{13}{3}$ units^2 **25.** 64 units^2
27. $\frac{20}{3}$ units^2 **29.** $\frac{3}{4}$ unit^2 **31.** 686 **33.** 20
35. $\frac{34}{3}$ **37.** $\frac{9}{20}$ **39.** $\frac{413}{6}$ **41.** $\frac{15}{4}$ **43.** 18
45a. 44,152.52; 44,100 **45b.** 338,358.38; 338,350
47a. All are negative. **47b.** $-\frac{22}{3}$ **47c.** $\frac{22}{3}$

49a.



49b. \$93 **49c.** \$105 **51a.** 4.1×10^{16} Nm^2
51b. 6.3×10^9 J **53.** $f'(x) = 12x^5 - 6x$
55. $\frac{253}{4606}$ **57.** $(y+1)^2 = -12(x-6)$
59. 35.46 ft/s

Pages 977–981 Chapter 15 Study Guide and Assessment

1. false; sometimes **3.** false; indefinite **5.** false; secant **7.** false; derivative **9.** false; rate of change
11. $-1, -3$ **13.** -1 **15.** 0 **17.** 0 **19.** 4
21. $\frac{1}{5}$ **23.** $f'(x) = 8x + 3$ **25.** $f'(x) = 12x^5$
27. $f'(x) = 6x - 5$ **29.** $f'(x) = 2x^3 - 6x^2 + \frac{1}{3}$
31. $f'(x) = 35x^6 - 75x^4$ **33.** $F(x) = 4x^2 + C$
35. $F(x) = -\frac{1}{8}x^4 + \frac{2}{3}x^3 - \frac{3}{2}x^2 - 2x + C$
37. $F(x) = \frac{1}{3}x^3 - x^2 - 8x + C$ **39.** 4 units^2
41. $\frac{37}{3}$ units^2 **43.** 36 **45.** 28 **47.** $\frac{6}{5}x^5 + C$
49. $\frac{1}{3}x^3 + \frac{5}{2}x^2 - 2x + C$ **51.** $0.0000125m$
53a. 17.6 ft/s^2 **53b.** $v(t) = 17.6t$
53c. $d(t) = 8.8t^2$

Page 983 Chapter 15 SAT and ACT Practice

1. A **3.** D **5.** C **7.** C **9.** D

SELECTED ANSWERS