

CHAPTER 6

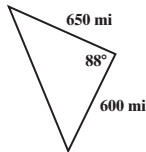
Section 6.1

Check Point Exercises

1. $B = 34^\circ, a \approx 12.7$ cm, $b \approx 7.4$ cm 2. $B = 117.5^\circ, a \approx 8.7, c \approx 5.2$ 3. $B \approx 41^\circ, C \approx 82^\circ, c \approx 39.0$ 4. no triangle
 5. two triangles; $B_1 \approx 50^\circ, C_1 \approx 95^\circ, c_1 = 20.8; B_2 \approx 130^\circ, C_2 \approx 15^\circ, c_2 \approx 5.4$ 6. approximately 34 sq m 7. approximately 11 mi

Exercise Set 6.1

1. $B = 42^\circ, a \approx 8.1, b \approx 8.1$ 3. $A = 44^\circ, b \approx 18.6, c \approx 22.8$ 5. $C = 95^\circ, b \approx 81.0, c \approx 134.1$ 7. $B = 40^\circ, b \approx 20.9, c \approx 31.8$
 9. $C = 111^\circ, b \approx 7.3, c \approx 16.1$ 11. $A = 80^\circ, a \approx 39.5, c \approx 10.4$ 13. $B = 30^\circ, a \approx 316.0, b \approx 174.3$ 15. $C = 50^\circ, a \approx 7.1, b \approx 7.1$
 17. one triangle; $B \approx 29^\circ, c \approx 111^\circ, c \approx 29.0$ 19. one triangle; $C \approx 52^\circ, B \approx 65^\circ, b \approx 10.2$ 21. one triangle; $C \approx 55^\circ, B \approx 13^\circ, b \approx 10.2$
 23. no triangle 25. two triangles; $B_1 \approx 77^\circ, C_1 \approx 43^\circ, c_1 \approx 12.6; B_2 \approx 103^\circ, C_2 \approx 17^\circ, c_2 \approx 5.4$
 27. two triangles; $B_1 \approx 54^\circ, C_1 \approx 89^\circ, c_1 \approx 19.9; B_2 \approx 126^\circ, C_2 \approx 17^\circ, c_2 \approx 5.8$
 29. two triangles; $C_1 \approx 68^\circ, B_1 \approx 54^\circ, b_1 \approx 21.0; C_2 \approx 112^\circ, B_2 \approx 10^\circ, b_2 \approx 4.5$ 31. no triangle 33. 297 sq ft 35. 5 sq yd 37. 10 sq m
 39. 481.6 41. 64.4 43. $A \approx 82^\circ, B \approx 41^\circ, C \approx 57^\circ, c \approx 255.7$ 45. 10
 47. Station A is about 6 miles from the fire, station B is about 9 miles from the fire. 49. The platform is about 3672 yards from one end of the beach and 3576 yards from the other. 51. about 184 ft 53. about 56 ft 55. about 30 ft 57. a. $a \approx 494$ ft b. about 343 ft
 59. either 9.9 mi or 2.4 mi 71. does not make sense 73. does not make sense 75. no 77. 41 ft 78. 127°
 79. $\sqrt{7280} = 4\sqrt{455} \approx 85$ 80.



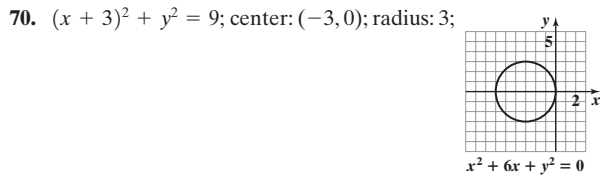
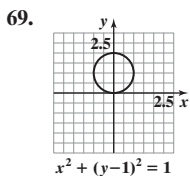
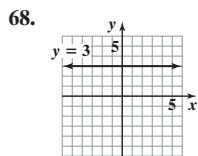
Section 6.2

Check Point Exercises

1. $a = 13, B \approx 28^\circ, C \approx 32^\circ$ 2. $A \approx 52^\circ, B \approx 98^\circ, C \approx 30^\circ$ 3. approximately 917 mi apart 4. approximately 47 sq m

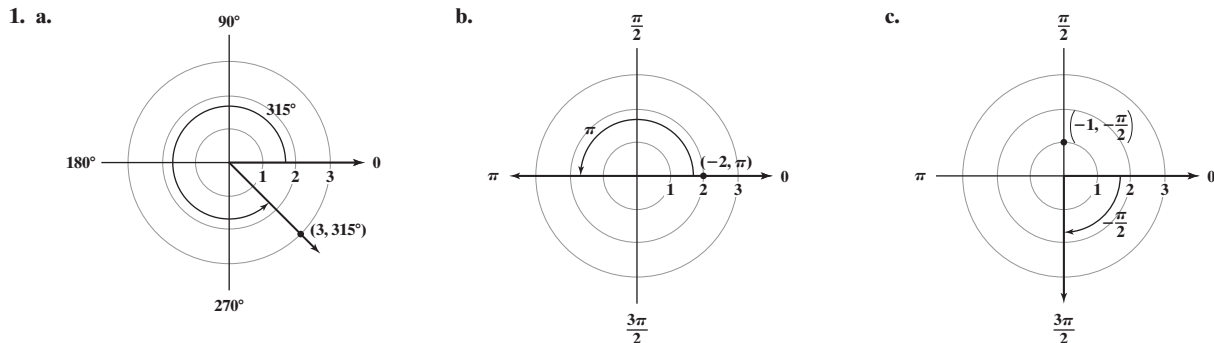
Exercise Set 6.2

1. $a \approx 6.0, B \approx 29^\circ, C \approx 105^\circ$ 3. $c \approx 7.6, A \approx 52^\circ, B \approx 32^\circ$ 5. $A \approx 44^\circ, B \approx 68^\circ, C \approx 68^\circ$ 7. $A \approx 117^\circ, B \approx 36^\circ, C \approx 27^\circ$
 9. $c \approx 4.7, A \approx 46^\circ, B \approx 92^\circ$ 11. $a \approx 6.3, C \approx 28^\circ, B \approx 50^\circ$ 13. $b \approx 4.7, C \approx 54^\circ, A \approx 76^\circ$ 15. $b \approx 5.4, C \approx 22^\circ, A \approx 68^\circ$
 17. $C \approx 112^\circ, A \approx 28^\circ, B \approx 40^\circ$ 19. $B \approx 100^\circ, A \approx 19^\circ, C \approx 61^\circ$ 21. $A = 60^\circ, B = 60^\circ, C = 60^\circ$ 23. $A \approx 117^\circ, B \approx 18^\circ, C = 45^\circ$
 25. 4 sq ft 27. 22 sq m 29. 31 sq yd 31. $A \approx 31^\circ, B \approx 19^\circ, C = 130^\circ, c \approx 19.1$
 33. $A \approx 51^\circ, B \approx 61^\circ, C \approx 68^\circ, AB = 9, AC = 8.5, BC = 7.5$ 35. $A \approx 145^\circ, B \approx 13^\circ, C \approx 22^\circ, a = \sqrt{61} \approx 7.8, b = \sqrt{10} \approx 3.2, c = 5$
 37. 157° 39. about 61.7 mi apart 41. about 193 yd 43. N12°E 45. a. about 19.3 mi b. S58°E
 47. The guy wire anchored downhill is about 417.4 feet. The one anchored uphill is about 398.2 feet. 49. about 63.7 ft 51. \$123,454
 61. makes sense 63. makes sense 65. $A \approx 29^\circ, B \approx 87^\circ, C \approx 64^\circ, a \approx 11.6, b \approx 23.9$



Section 6.3

Check Point Exercises



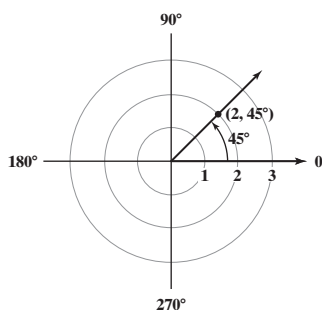
2. a. $(5, \frac{9\pi}{4})$ b. $(-5, \frac{5\pi}{4})$ c. $(5, -\frac{7\pi}{4})$ 3. a. $(-3, 0)$ b. $(-5\sqrt{3}, -5)$ 4. $(2, \frac{5\pi}{3})$ 5. $(4, \frac{3\pi}{2})$

6. a. $r = \frac{6}{3 \cos \theta - \sin \theta}$ b. $r = -2 \sin \theta$ 7. a. $x^2 + y^2 = 16$ b. $y = -x$ c. $x = -2$ d. $x^2 + (y - 5)^2 = 25$

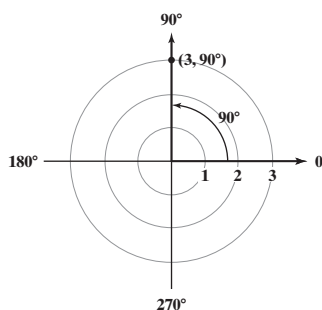
Exercise Set 6.3

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

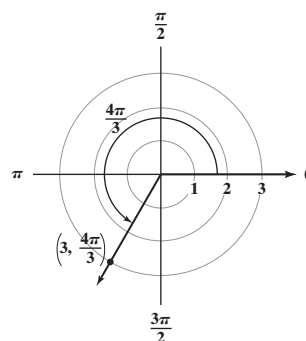
11.



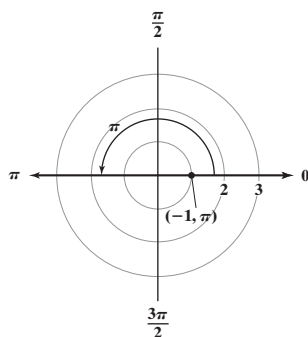
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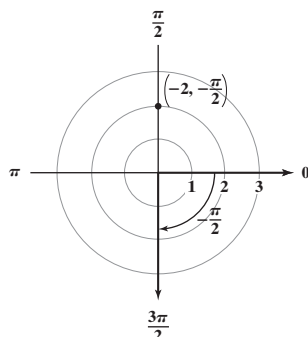
15.



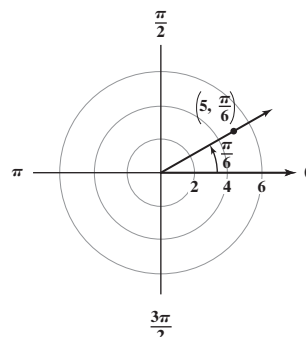
17.



19.

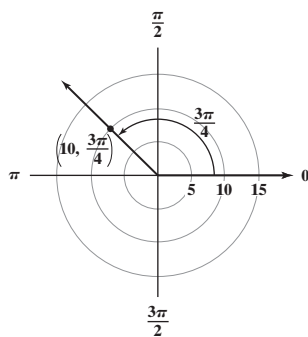


21.

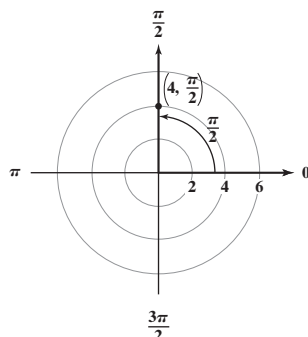


a. $(5, \frac{13\pi}{6})$ b. $(-5, \frac{7\pi}{6})$
 c. $(5, -\frac{11\pi}{6})$

23.



25.

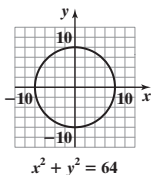


a. $(10, \frac{11\pi}{4})$ b. $(-10, \frac{7\pi}{4})$ c. $(10, -\frac{5\pi}{4})$
 a. $(4, \frac{5\pi}{2})$ b. $(-4, \frac{3\pi}{2})$ c. $(4, -\frac{3\pi}{2})$

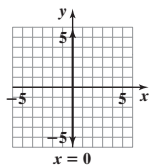
27. a, b, d 29. b, d 31. a, b 33. $(0, 4)$ 35. $(1, \sqrt{3})$ 37. $(0, -4)$ 39. approximately $(-5.9, 4.4)$ 41. $(\sqrt{8}, \frac{3\pi}{4})$

43. $(4, \frac{5\pi}{3})$ 45. $(2, \frac{7\pi}{6})$ 47. $(5, 0)$ 49. $r = \frac{7}{3 \cos \theta + \sin \theta}$ 51. $r = \frac{7}{\cos \theta}$ 53. $r = 3$ 55. $r = 4 \cos \theta$ 57. $r = \frac{6 \cos \theta}{\sin^2 \theta}$

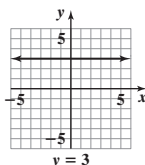
59. $x^2 + y^2 = 64$



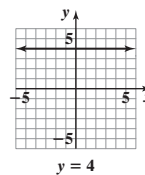
61. $x = 0$



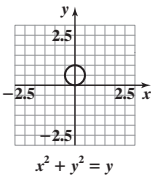
63. $y = 3$



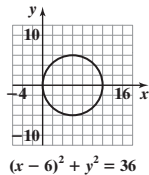
65. $y = 4$



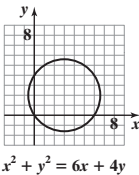
67. $x^2 + y^2 = y$



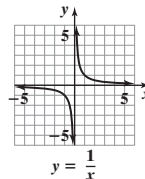
69. $(x - 6)^2 + y^2 = 36$



71. $x^2 + y^2 = 6x + 4y$



73. $y = \frac{1}{x}$

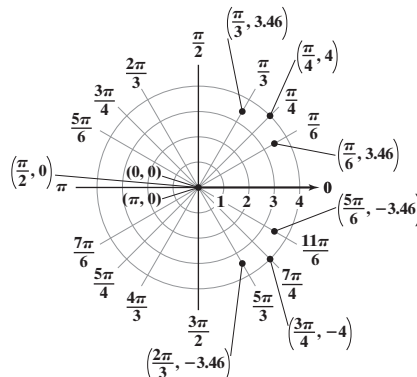
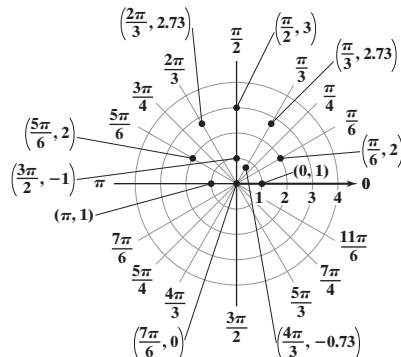
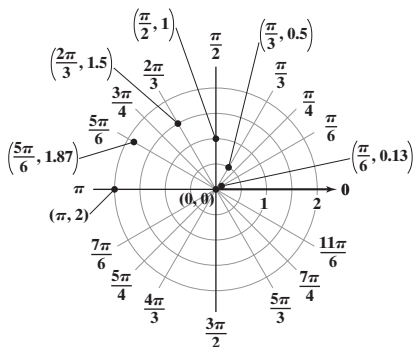


75. $r = a \sec \theta$; $r \cos \theta = a$; $x = a$; $x = a$ is a vertical line a units to the right of the y -axis when $a > 0$ and $|a|$ to the left of the y -axis when $a < 0$.

77. $r = a \sin \theta$; $r^2 = ar \sin \theta$; $x^2 + y^2 = ay$; $x^2 + y^2 - ay = 0$; $x^2 + \left(y - \frac{a}{2}\right)^2 = \left(\frac{a}{2}\right)^2$ 79. $y = x + 2\sqrt{2}$; slope: 1; y -intercept: $2\sqrt{2}$

81. $(-1, \sqrt{3}), (2\sqrt{3}, 2); 2\sqrt{5}$ 83. $\left(15, \frac{4\pi}{3}\right)$ 85. 6.3 knots at an angle of 50° to the wind 87. Answers may vary. 97. $(-2, 3.464)$

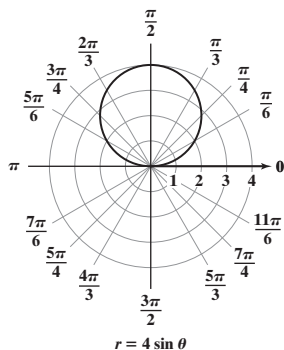
99. $(-1.857, -3.543)$ 101. $(3, 0.730)$ 103. does not make sense 105. makes sense
 109. 0; 0.13; 0.5; 1; 1.5; 1.87; 2 110. 1; 2; 2.73; 3; 2.73; 2; 1; 0; -0.73; -1 111. 0; 3.46; 4; 3; 3.46; 0; -3.46; -4; -3.46; 0



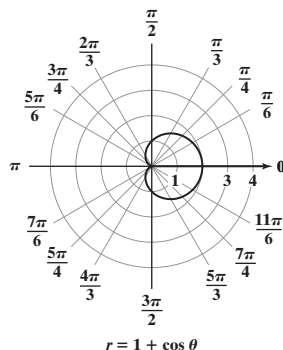
Section 6.4

Check Point Exercises

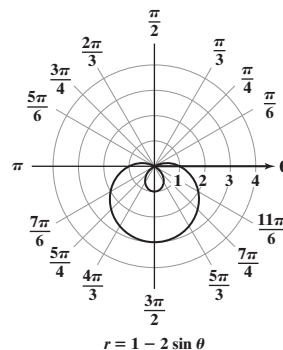
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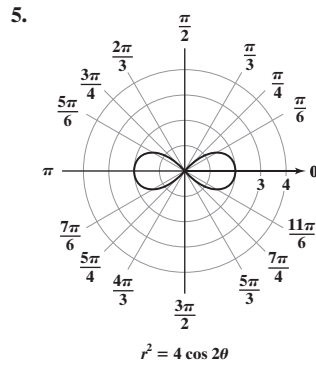
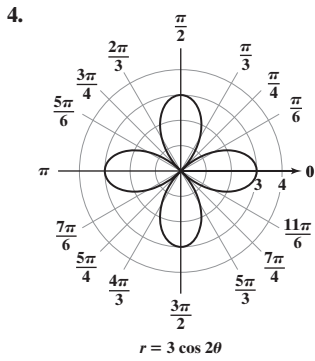


2.



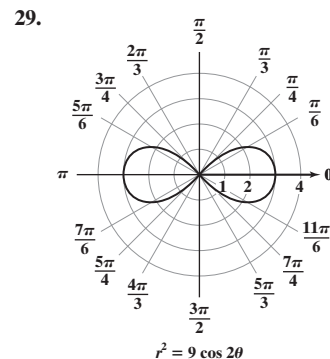
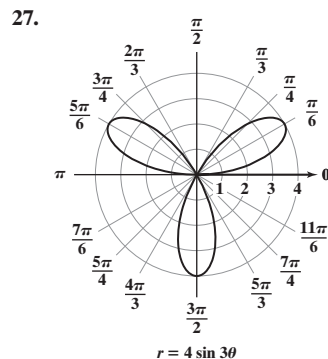
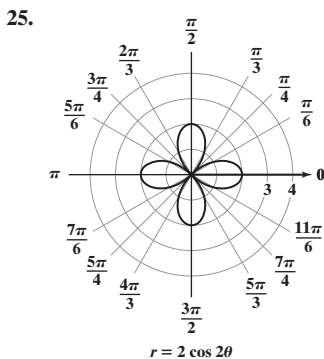
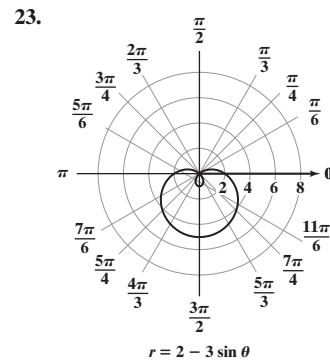
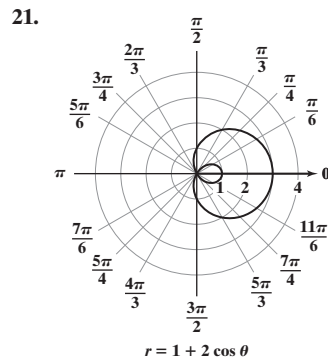
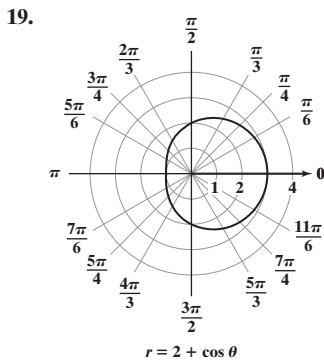
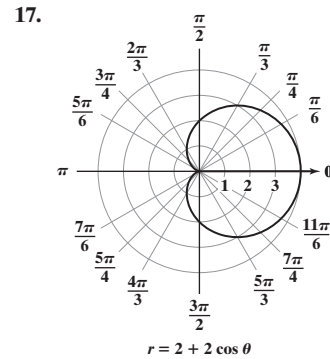
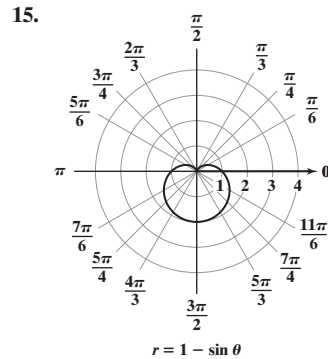
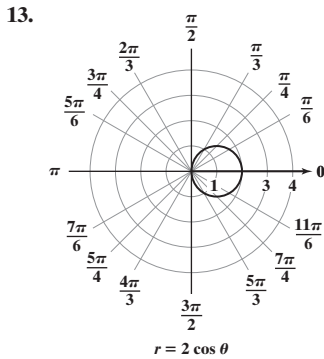
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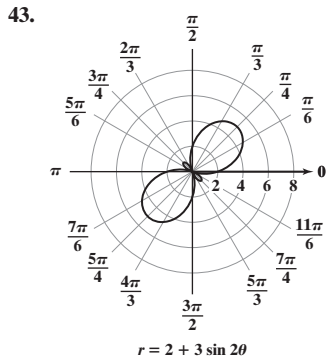
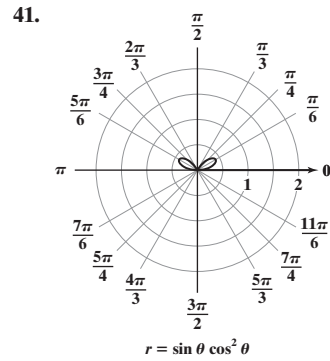
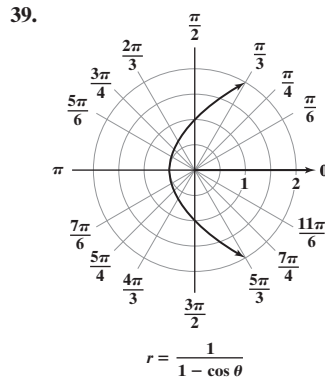
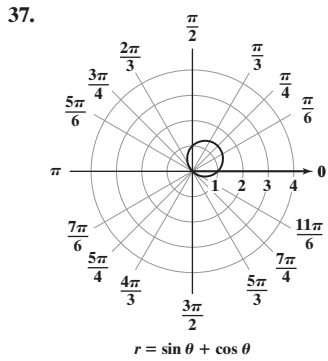
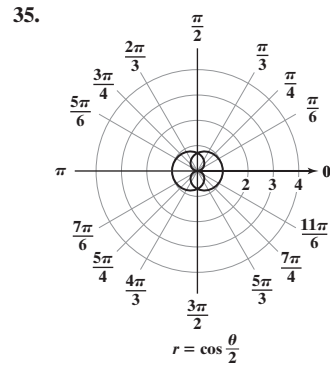
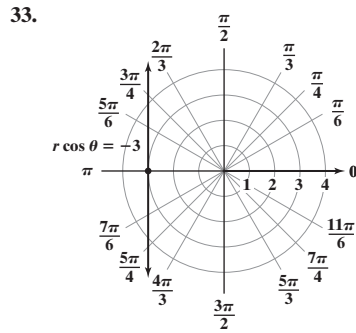
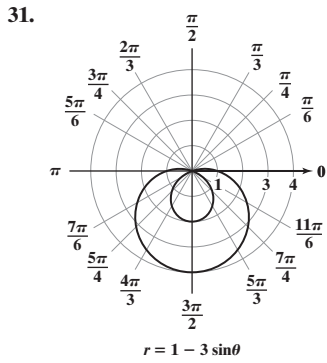




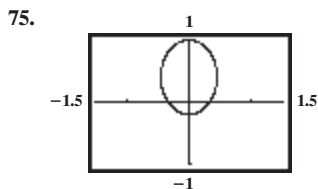
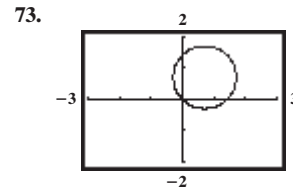
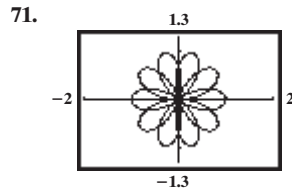
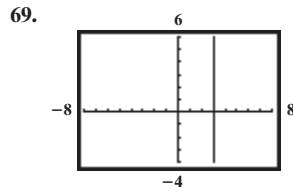
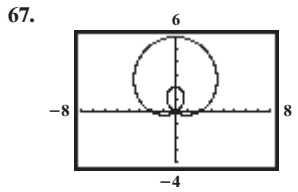
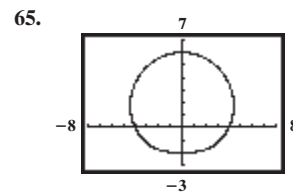
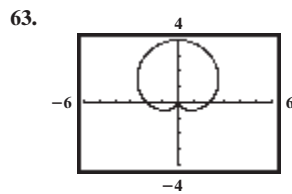
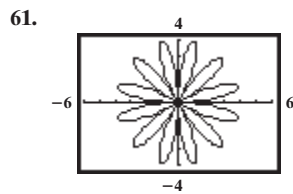
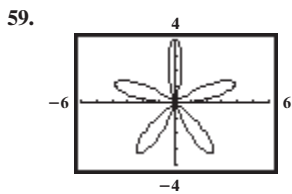
Exercise Set 6.4

1. $r = 1 - \sin \theta$ 3. $r = 2 \cos \theta$ 5. $r = 3 \sin 3\theta$ 7. **a.** May or may not have symmetry with respect to polar axis. **b.** Has symmetry with respect to the line $\theta = \frac{\pi}{2}$. **c.** May or may not have symmetry about the pole. 9. **a.** Has symmetry with respect to polar axis. **b.** May or may not have symmetry with respect to the line $\theta = \frac{\pi}{2}$. **c.** May or may not have symmetry about pole. 11. **a.** Has symmetry with respect to polar axis. **b.** Has symmetry with respect to the line $\theta = \frac{\pi}{2}$. **c.** Has symmetry about the pole.

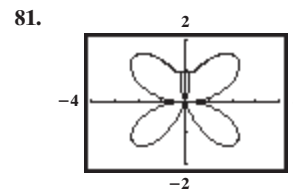
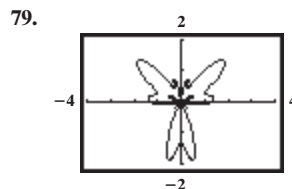




45. 6 knots
 47. 8 knots
 49. 90° ; about $7\frac{1}{2}$ knots

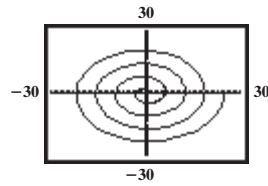
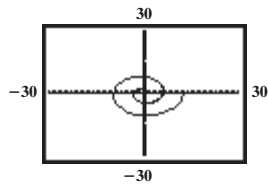
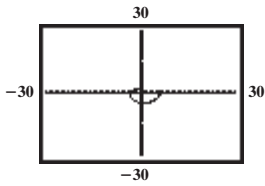


77. 2π



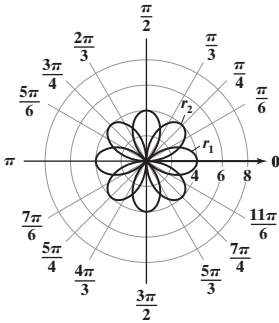
83. If n is odd, there are n loops and $\theta_{\max} = \pi$ traces the graph once; while if n is even, there are $2n$ loops and $\theta_{\max} = 2\pi$ traces the graph once. In each separate case, as n increases, $\sin n\theta$ increases its number of loops. 85. There are n small petals and n large petals for each value of n . For odd values of n , the small petals are inside the large petals. For even n , they are between the large petals.

87.



89. does not make sense 91. makes sense

93.



$$r_1 = 4 \cos 2\theta$$

$$r_2 = 4 \cos 2\left(\theta - \frac{\pi}{4}\right)$$

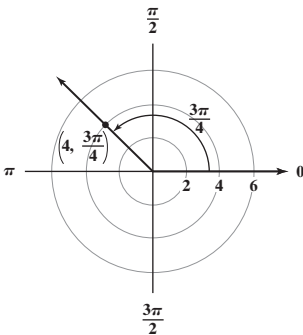
The graph of r_2 is the graph of r_1 rotated $\frac{\pi}{4}$ or 45° .

96. $4i$ 97. 8 98. 2

Mid-Chapter 6 Check Point

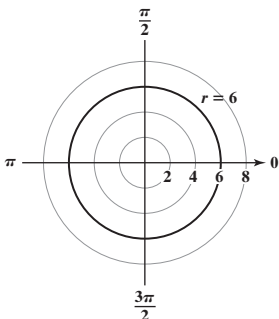
1. $C \approx 107^\circ, b \approx 24.8, c \approx 36.1$ 2. $B \approx 37^\circ, C \approx 101^\circ, c \approx 92.4$ 3. no triangle 4. $A \approx 26^\circ, C \approx 44^\circ, b \approx 21.6$ 5. Two triangles:
 $A_1 \approx 55^\circ, B_1 \approx 83^\circ, b_1 \approx 19.3; A_2 \approx 125^\circ, B_2 \approx 13^\circ, b_2 \approx 4.4$ 6. $A \approx 28^\circ, B \approx 42^\circ, C \approx 110^\circ$ 7. 10 ft^2 8. $14\sqrt{5} \approx 31 \text{ m}^2$ 9. 148 miles
 10. 15.0 miles 11. 327 ft 12. $\left(\frac{3\sqrt{2}}{2}, \frac{3\sqrt{2}}{2}\right)$ 13. $(0, -6)$ 14. $\left(4, -\frac{\pi}{3}\right)$ 15. $(6, \pi)$

16.

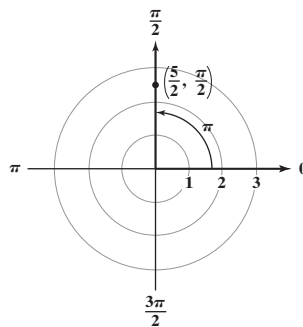


- a. $\left(4, \frac{11\pi}{4}\right)$ b. $\left(-4, \frac{7\pi}{4}\right)$
 c. $\left(4, -\frac{5\pi}{4}\right)$

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

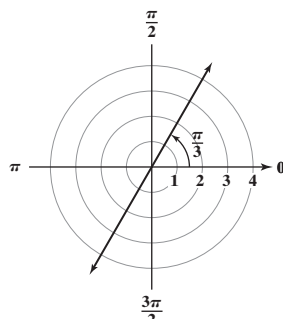


17.



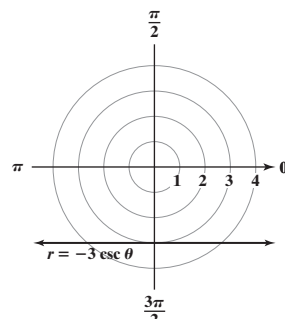
- a. $\left(\frac{5}{2}, \frac{5\pi}{2}\right)$ b. $\left(-\frac{5}{2}, \frac{3\pi}{2}\right)$
 c. $\left(\frac{5}{2}, -\frac{3\pi}{2}\right)$

22. $y = \sqrt{3}x$

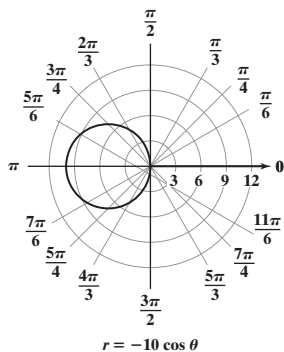


18. $r = \frac{7}{5 \cos \theta - \sin \theta}$ 19. $r = -7 \csc \theta$
 20. $r = -2 \cos \theta$

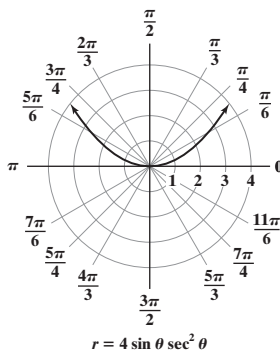
23. $y = -3$



24. $(x + 5)^2 + y^2 = 25$

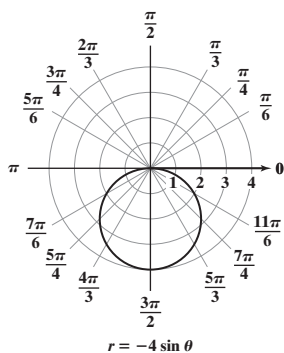


25. $y = \frac{1}{4}x^2$

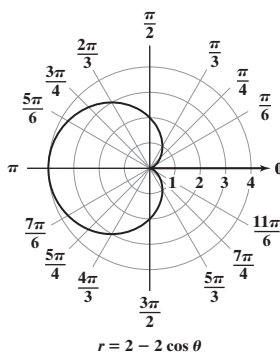


26. a. Has symmetry with respect to the polar axis. b. May or may not have symmetry with respect to the line $\theta = \frac{\pi}{2}$. c. May or may not have symmetry with respect to the pole.
27. a. Has symmetry with respect to the polar axis. b. Has symmetry with respect to the line $\theta = \frac{\pi}{2}$. c. Has symmetry with respect to the pole.

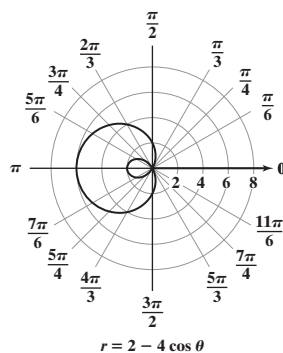
28.



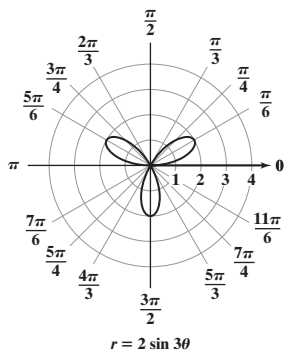
29.



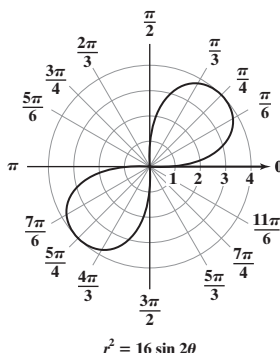
30.



31.

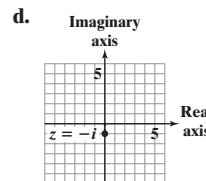
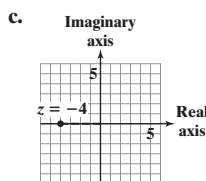
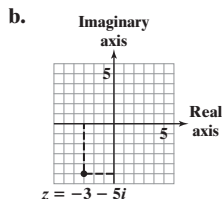
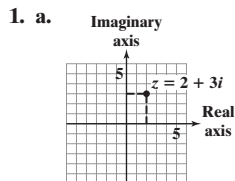


32.

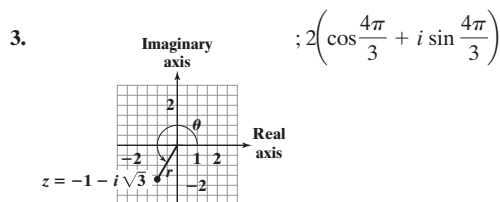


Section 6.5

Check Point Exercises



2. a. 13 b. $\sqrt{13}$

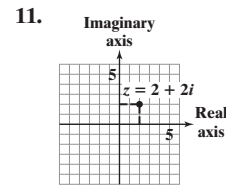
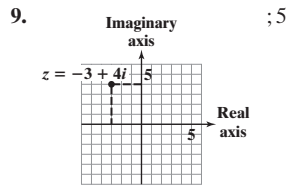
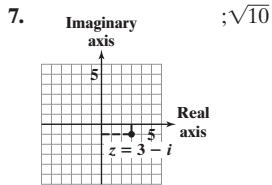
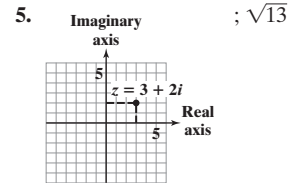
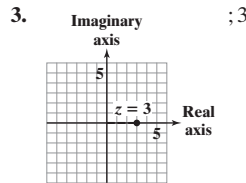
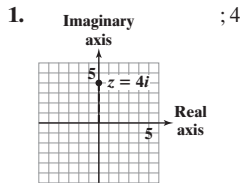


4. $z = 2\sqrt{3} + 2i$ 5. $30(\cos 60^\circ + i \sin 60^\circ)$

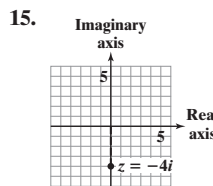
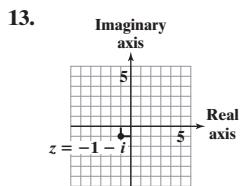
6. $10(\cos \pi + i \sin \pi)$ 7. $-16\sqrt{3} + 16i$ 8. -4

9. $2(\cos 15^\circ + i \sin 15^\circ)$; $2(\cos 105^\circ + i \sin 105^\circ)$; $2(\cos 195^\circ + i \sin 195^\circ)$; $2(\cos 285^\circ + i \sin 285^\circ)$ 10. 3 ; $-\frac{3}{2} + \frac{3\sqrt{3}}{2}i$; $-\frac{3}{2} - \frac{3\sqrt{3}}{2}i$

Exercise Set 6.5

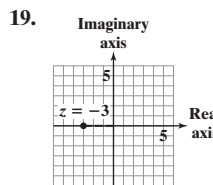
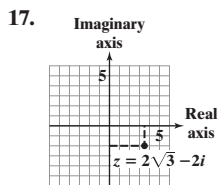


$2\sqrt{2}\left(\cos \frac{\pi}{4} + i \sin \frac{\pi}{4}\right)$
or $2\sqrt{2}(\cos 45^\circ + i \sin 45^\circ)$



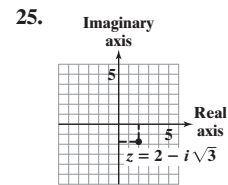
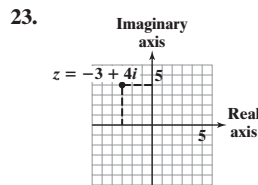
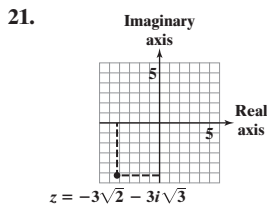
$\sqrt{2}\left(\cos \frac{5\pi}{4} + i \sin \frac{5\pi}{4}\right)$ or $\sqrt{2}(\cos 225^\circ + i \sin 225^\circ)$

$4\left(\cos \frac{3\pi}{2} + i \sin \frac{3\pi}{2}\right)$ or $4(\cos 270^\circ + i \sin 270^\circ)$



$4\left(\cos \frac{11\pi}{6} + i \sin \frac{11\pi}{6}\right)$ or $4(\cos 330^\circ + i \sin 330^\circ)$

$3(\cos \pi + i \sin \pi)$ or $3(\cos 180^\circ + i \sin 180^\circ)$



$\approx 3\sqrt{5}(\cos 230.8^\circ + i \sin 230.8^\circ)$

$\approx 5(\cos 126.9^\circ + i \sin 126.9^\circ)$

$\approx \sqrt{7}(\cos 319.1^\circ + i \sin 319.1^\circ)$

27. $3\sqrt{3} + 3i$ 29. $-2 - 2i\sqrt{3}$ 31. $4\sqrt{2} - 4i\sqrt{2}$ 33. $5i$ 35. $z \approx -18.1 - 8.5i$ 37. $30(\cos 70^\circ + i \sin 70^\circ)$

39. $12\left(\cos \frac{3\pi}{10} + i \sin \frac{3\pi}{10}\right)$ 41. $\cos \frac{7\pi}{12} + i \sin \frac{7\pi}{12}$ 43. $2(\cos \pi + i \sin \pi)$ 45. $5(\cos 50^\circ + i \sin 50^\circ)$ 47. $\frac{3}{4}\left(\cos \frac{\pi}{10} + i \sin \frac{\pi}{10}\right)$

49. $\cos 240^\circ + i \sin 240^\circ$ 51. $2(\cos 0^\circ + i \sin 0^\circ)$ 53. $32\sqrt{2} + 32i\sqrt{2}$ 55. $-4 - 4i\sqrt{3}$ 57. $\frac{1}{64}i$ 59. $-2 - 2i\sqrt{3}$ 61. $-4 - 4i$

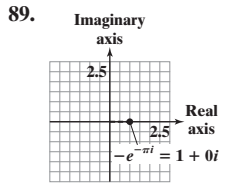
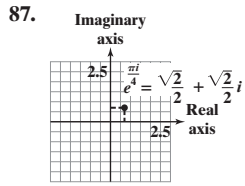
63. -64 65. $3(\cos 15^\circ + i \sin 15^\circ)$; $3(\cos 195^\circ + i \sin 195^\circ)$ 67. $2(\cos 70^\circ + i \sin 70^\circ)$; $2(\cos 190^\circ + i \sin 190^\circ)$; $2(\cos 310^\circ + i \sin 310^\circ)$

69. $\frac{3}{2} + \frac{3\sqrt{3}}{2}i$; $-\frac{3\sqrt{3}}{2} + \frac{3}{2}i$; $-\frac{3}{2} - \frac{3\sqrt{3}}{2}i$; $\frac{3\sqrt{3}}{2} - \frac{3}{2}i$ 71. 2 ; $\approx 0.6 + 1.9i$; $\approx -1.6 + 1.2i$; $\approx -1.6 - 1.2i$; $\approx 0.6 - 1.9i$

73. 1 ; $-\frac{1}{2} + \frac{\sqrt{3}}{2}i$; $-\frac{1}{2} - \frac{\sqrt{3}}{2}i$ 75. $\approx 1.1 + 0.2i$; $\approx -0.2 + 1.1i$; $\approx -1.1 - 0.2i$; $\approx 0.2 - 1.1i$

77. $[(\cos 90^\circ + i \sin 90^\circ)][2\sqrt{2}(\cos 45^\circ + i \sin 45^\circ)][2(\cos 150^\circ + i \sin 150^\circ)]$; $4\sqrt{2}(\cos 285^\circ + i \sin 285^\circ)$; $\approx 1.4641 - 5.4641i$

79. $\frac{[2(\cos 60^\circ + i \sin 60^\circ)][\sqrt{2}(\cos(-45^\circ) + i \sin(-45^\circ))]}{8(\cos(-30^\circ) + i \sin(-30^\circ))}; \frac{\sqrt{2}}{2}(\cos 45^\circ + i \sin 45^\circ); \frac{1}{2} + \frac{1}{2}i$
 81. $\cos 0^\circ + i \sin 0^\circ, \cos 60^\circ + i \sin 60^\circ, \cos 120^\circ + i \sin 120^\circ, \cos 180^\circ + i \sin 180^\circ, \cos 240^\circ + i \sin 240^\circ, \cos 300^\circ + i \sin 300^\circ;$
 $1, \frac{1}{2} + \frac{\sqrt{3}}{2}i, -\frac{1}{2} + \frac{\sqrt{3}}{2}i, -1, -\frac{1}{2} - \frac{\sqrt{3}}{2}i, \frac{1}{2} - \frac{\sqrt{3}}{2}i;$
 83. $2(\cos 67.5^\circ + i \sin 67.5^\circ), 2(\cos 157.5^\circ + i \sin 157.5^\circ), 2(\cos 247.5^\circ + i \sin 247.5^\circ), 2(\cos 337.5^\circ + i \sin 337.5^\circ);$
 $0.7654 + 1.8478i, -1.8478 + 0.7654i, -0.7654 - 1.8478i, 1.8478 - 0.7654i$
 85. $\sqrt[3]{2}(\cos 20^\circ + i \sin 20^\circ), \sqrt[3]{2}(\cos 140^\circ + i \sin 140^\circ), \sqrt[3]{2}(\cos 260^\circ + i \sin 260^\circ); 1.1839 + 0.4309i, -0.9652 + 0.8099i, -0.2188 - 1.2408i$



91. a. $i; -1 + i; -i; -1 + i; -i; -1 + i$ b. Complex numbers may vary.
 107. does not make sense 109. does not make sense
 111.

Section 6.6

Check Point Exercises

1. $\|u\| = 5 = \|v\|$ and $m_u = \frac{4}{3} = m_v$ 2. ; $\|v\| = 3\sqrt{2}$ 3. $v = 3i + 4j$ 4. a. $11i - 2j$ b. $3i + 8j$
 5. a. $56i + 80j$ b. $-35i - 50j$ 6. $30i + 33j$

7. $\frac{4}{5}i - \frac{3}{5}j; \sqrt{\left(\frac{4}{5}\right)^2 + \left(-\frac{3}{5}\right)^2} = \sqrt{\frac{16}{25} + \frac{9}{25}} = \sqrt{\frac{25}{25}} = 1$ 8. $30\sqrt{2}i + 30\sqrt{2}j$ 9. 82.55 lb; 46.2°

Exercise Set 6.6

1. a. $\sqrt{41}$ b. $\sqrt{41}$ c. $u = v$ 3. a. 6 b. 6 c. $u = v$
 5. 7. 9. 11.
13. $10i + 6j$ 15. $6i - 3j$ 17. $-6i - 14j$ 19. $9i$ 21. $-i + 2j$ 23. $5i - 12j$ 25. $-5i + 12j$ 27. $-15i + 35j$ 29. $4i + 24j$
 31. $-9i - 4j$ 33. $-5i + 45j$ 35. $2\sqrt{29}$ 37. $\sqrt{10}$ 39. i 41. $\frac{3}{5}i - \frac{4}{5}j$ 43. $\frac{3\sqrt{13}}{13}i - \frac{2\sqrt{13}}{3}j$ 45. $\frac{\sqrt{2}}{2}i + \frac{\sqrt{2}}{2}j$
 47. $3\sqrt{3}i + 3j$ 49. $-6\sqrt{2}i - 6\sqrt{2}j$ 51. $\approx -0.20i + 0.46j$ 53. $-23i + 14j$ 55. -60 57. commutative property
 59. distributive property 61. 18.03; 123.7° 63. $6; 90^\circ$ 65. $22\sqrt{3}i + 22j$ 67. $148.5i + 20.9j$ 69. $\approx 1.4i + 0.6j; 1.4$ in.
 71. ≈ 108.21 lbs; $S 77.4^\circ E$ 73. 2038.28 lb; 162.8° 75. ≈ 30.9 lbs 77. a. 335 lb b. 3484 lb 79. a. $F = 9i - 3j$ b. $F_3 = -9i + 3j$
 81. a. $F = -2j$ b. $F_5 = 2j$
 83. a. $v = 180 \cos 40^\circ i + 180 \sin 40^\circ j \approx 137.89i + 115.70j$, $w = 40 \cos 0^\circ i + 40 \sin 0^\circ j = 40i$ b. $v + w \approx 177.89i + 115.70j$
 c. 212 mph d. $33.0^\circ; N 57^\circ E$ 85. 78 mph, 75.4° 105. does not make sense 107. does not make sense 109. true 111. true
 113. The plane's true speed relative to the ground is about 269 miles per hour.; The compass heading relative to the ground is 278.3° .
 115. a. 76° b. increase 116. 137.7° 117. $\frac{7}{5}i - \frac{21}{5}j$

118. a. $\|u\|^2 = \|v\|^2 + \|w\|^2 - 2\|v\|\|w\|\cos\theta$ b. $\|u\| = \sqrt{(a_1 - a_2)^2 + (b_1 - b_2)^2}; \|u\|^2 = (a_1 - a_2)^2 + (b_1 - b_2)^2; \|v\| = \sqrt{a_1^2 + b_1^2};$
 $\|v\|^2 = a_1^2 + b_1^2; \|w\| = \sqrt{a_2^2 + b_2^2}; \|w\|^2 = a_2^2 + b_2^2$

Section 6.7

Check Point Exercises

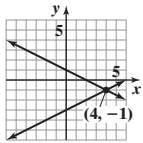
1. a. 18 b. 18 c. 5 2. 100.3° 3. orthogonal 4. $\frac{7}{2}i - \frac{7}{2}j$ 5. $v_1 = \frac{7}{2}i - \frac{7}{2}j; v_2 = -\frac{3}{2}i - \frac{3}{2}j$ 6. approximately 2598 ft-lb

Exercise Set 6.7

1. 6; 10 3. $-6; 41$ 5. 100; 61 7. 0; 25 9. 3 11. 3 13. 20 15. 20 17. 79.7° 19. 160.3° 21. 38.7° 23. orthogonal
 25. orthogonal 27. not orthogonal 29. not orthogonal 31. orthogonal 33. $v_1 = \text{proj}_w v = \frac{5}{2}i - \frac{5}{2}j; v_2 = \frac{1}{2}i + \frac{1}{2}j$
 35. $v_1 = \text{proj}_w v = -\frac{26}{29}i + \frac{65}{29}j; v_2 = \frac{55}{29}i + \frac{22}{29}j$ 37. $v_1 = \text{proj}_w v = i + 2j; v_2 = 0$ 39. 25 41. $5i - 5j$ 43. 30° 45. parallel

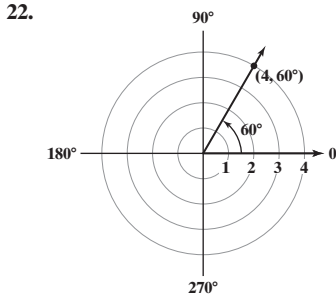
47. neither 49. orthogonal 51. 1617; $\mathbf{v} \cdot \mathbf{w} = 1617$ means that \$1617 in revenue is generated when 240 gallons of regular gasoline are sold at \$2.90 per gallon and 300 gallons of premium gasoline are sold at \$3.09 per gallon. 53. 7600 foot-pounds 55. 3392 foot-pounds
57. 1079 foot-pounds 59. 40 foot-pounds 61. 22.05 foot-pounds 63. a. $\frac{\sqrt{3}}{2}\mathbf{i} + \frac{1}{2}\mathbf{j}$ b. $-175\sqrt{3}\mathbf{i} - 175\mathbf{j}$ c. 350; A force of 350 pounds is required to keep the boat from rolling down the ramp. 75. makes sense 77. makes sense
79. $\mathbf{u} \cdot \mathbf{w} = (a_1\mathbf{i} + b_1\mathbf{j}) \cdot (a_2\mathbf{i} + b_2\mathbf{j})$
 $= a_1a_2 + b_1b_2$
 $= a_2a_1 + b_2b_1$
 $= (a_2\mathbf{i} + b_2\mathbf{j}) \cdot (a_1\mathbf{i} + b_1\mathbf{j})$
 $= \mathbf{v} \cdot \mathbf{u}$
81. $\mathbf{u} \cdot (\mathbf{v} + \mathbf{w}) = (a_1\mathbf{i} + b_1\mathbf{j}) \cdot [(a_2\mathbf{i} + b_2\mathbf{j}) + (a_3\mathbf{i} + b_3\mathbf{j})]$
 $= (a_1\mathbf{i} + b_1\mathbf{j}) \cdot [(a_2 + a_3)\mathbf{i} + (b_2 + b_3)\mathbf{j}]$
 $= a_1(a_2 + a_3) + b_1(b_2 + b_3)$
 $= a_1a_2 + a_1a_3 + b_1b_2 + b_1b_3$
 $= a_1a_2 + b_1b_2 + a_1a_3 + b_1b_3$
 $= (a_1\mathbf{i} + b_1\mathbf{j}) \cdot (a_2\mathbf{i} + b_2\mathbf{j}) + (a_1\mathbf{i} + b_1\mathbf{j}) \cdot (a_3\mathbf{i} + b_3\mathbf{j})$
 $= \mathbf{u} \cdot \mathbf{v} + \mathbf{u} \cdot \mathbf{w}$

83. $b = -20$ 85. any two vectors, \mathbf{v} and \mathbf{w} , having the same direction 87. a. yes b. yes
88. $(4, -1)$; 89. $\{4\}$

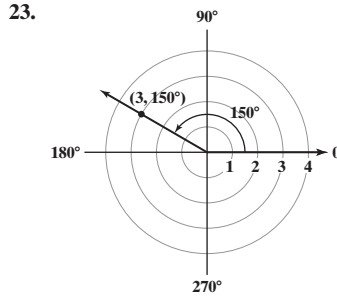


Chapter 6 Review Exercises

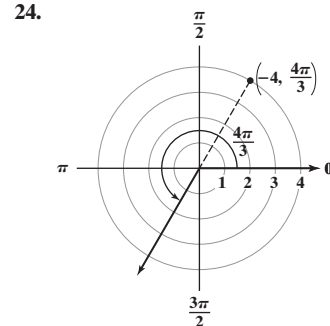
1. $C = 55^\circ$, $b \approx 10.5$, and $c \approx 10.5$ 2. $A = 43^\circ$, $a \approx 171.9$, and $b \approx 241.0$ 3. $b \approx 16.3$, $A \approx 72^\circ$, and $C \approx 42^\circ$
 4. $C \approx 98^\circ$, $A \approx 55^\circ$, and $B \approx 27^\circ$ 5. $C = 120^\circ$, $a \approx 45.0$, and $b \approx 33.2$ 6. two triangles; $B_1 \approx 55^\circ$, $C_1 \approx 86^\circ$, and $c_1 \approx 31.7$;
 $B_2 \approx 125^\circ$, $C_2 \approx 16^\circ$, and $c_2 \approx 8.8$ 7. no triangle 8. $a \approx 59.0$, $B \approx 3^\circ$, and $C \approx 15^\circ$ 9. $B \approx 78^\circ$, $A \approx 39^\circ$, and $C \approx 63^\circ$
 10. $B \approx 25^\circ$, $C \approx 115^\circ$, and $c \approx 8.5$ 11. two triangles; $A_1 \approx 59^\circ$, $C_1 \approx 84^\circ$, $c_1 \approx 14.4$; $A_2 \approx 121^\circ$, $C_2 \approx 22^\circ$, $c_2 \approx 5.4$
 12. $B \approx 9^\circ$, $C \approx 148^\circ$, and $c \approx 73.6$ 13. 8 sq ft 14. 4 sq ft 15. 4 sq m 16. 2 sq m 17. 35 ft 18. 35.6 mi
 19. 861 mi 20. 404 ft; 551 ft 21. \$214,194



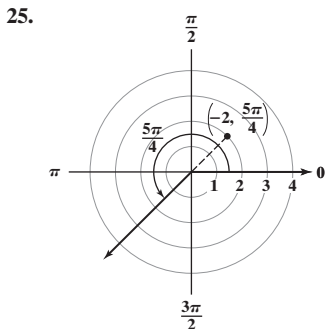
$(2, 2\sqrt{3})$



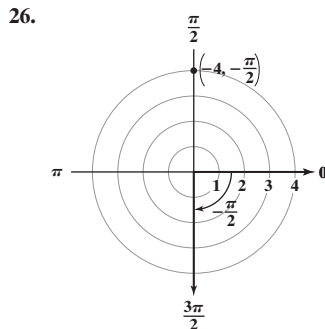
$(-\frac{3\sqrt{3}}{2}, \frac{3}{2})$



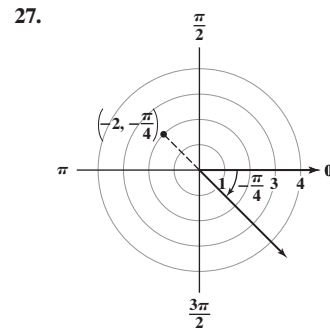
$(2, 2\sqrt{3})$



$(\sqrt{2}, \sqrt{2})$

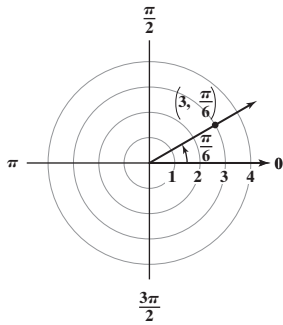


$(0, 4)$



$(-\sqrt{2}, \sqrt{2})$

28.



a. $(3, \frac{13\pi}{6})$ b. $(-3, \frac{7\pi}{6})$

c. $(3, -\frac{11\pi}{6})$

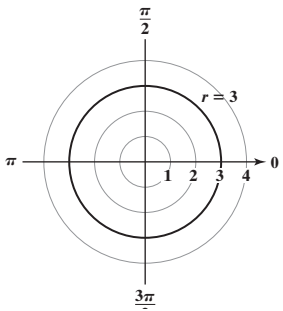
31. $(4\sqrt{2}, \frac{3\pi}{4})$ 32. $(3\sqrt{2}, \frac{7\pi}{4})$

37. $r = \frac{8}{2 \cos \theta + 3 \sin \theta}$

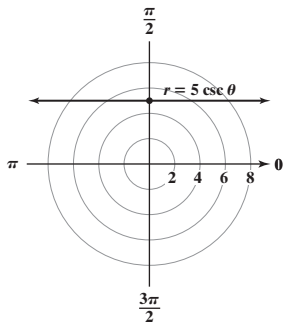
38. $r = 10$

39. $r = 12 \cos \theta$

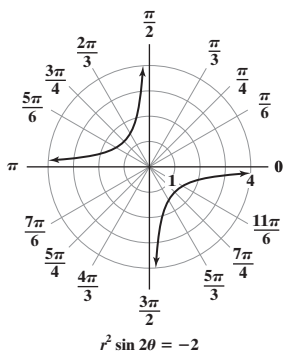
40. $x^2 + y^2 = 9$



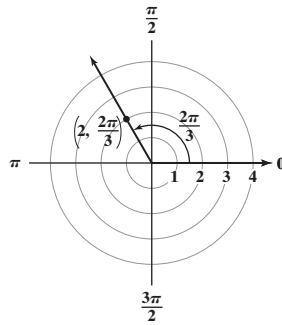
43. $y = 5$



46. $y = -\frac{1}{x}$



29.



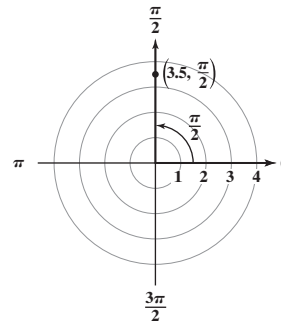
a. $(2, \frac{8\pi}{3})$ b. $(-2, \frac{5\pi}{3})$

c. $(2, -\frac{4\pi}{3})$

33. approximately $(13, 67^\circ)$

34. approximately $(5, 127^\circ)$

30.

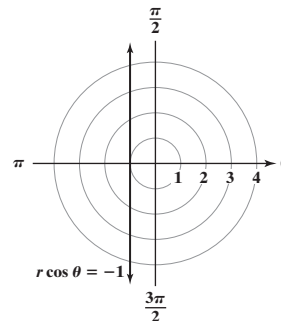


a. $(3.5, \frac{5\pi}{2})$ b. $(-3.5, \frac{3\pi}{2})$

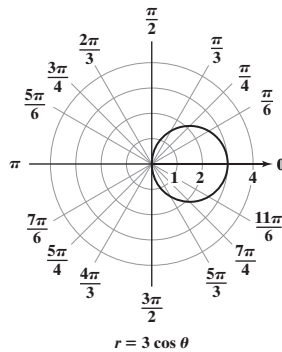
c. $(3.5, -\frac{3\pi}{2})$

35. $(5, \frac{3\pi}{2})$ 36. $(1, 0)$

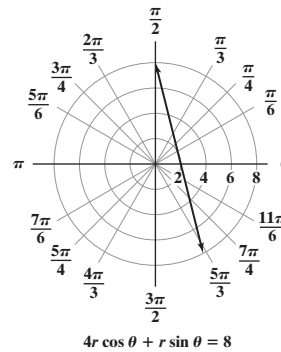
42. $x = -1$



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



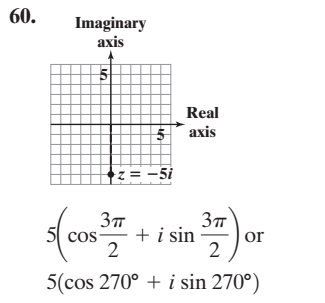
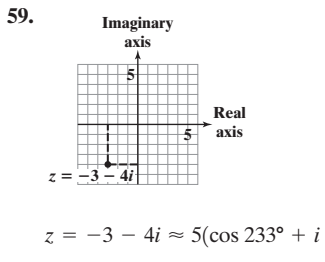
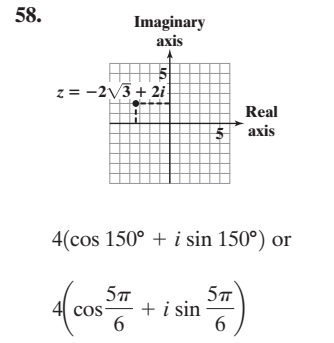
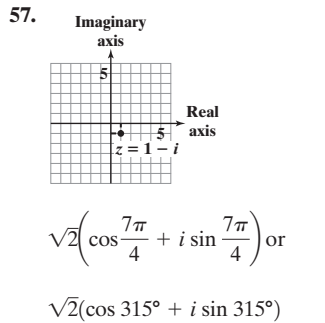
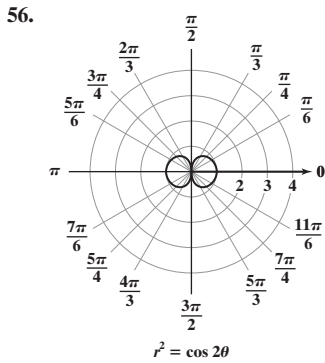
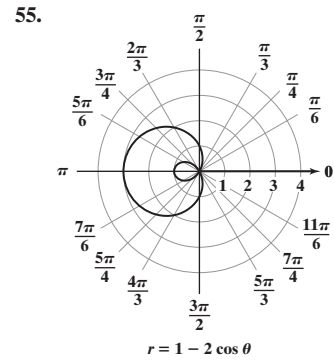
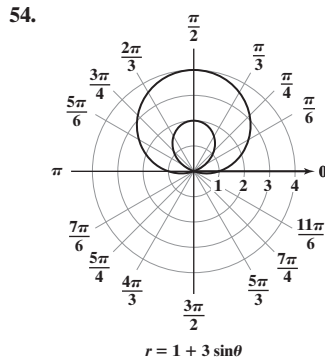
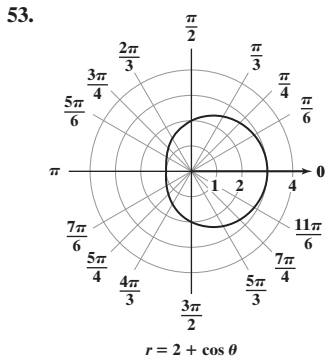
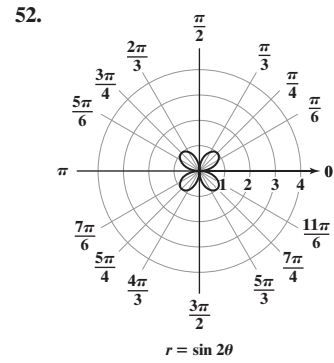
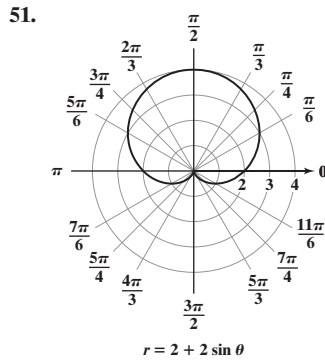
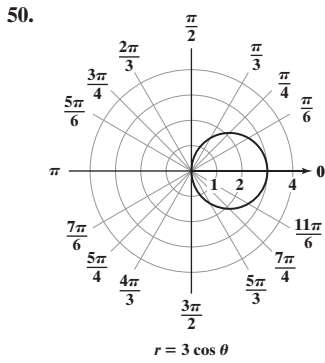
45. $y = -4x + 8$



47. a. has symmetry b. may or may not have symmetry c. may or may not have symmetry

48. a. may or may not have symmetry b. has symmetry c. may or may not have symmetry

49. a. has symmetry b. has symmetry c. has symmetry

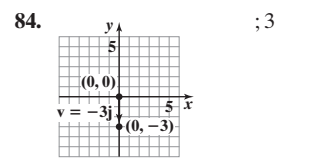
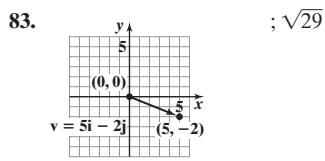
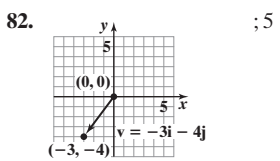


- 61. $z = 4 + 4\sqrt{3}i$
- 62. $z = -2\sqrt{3} - 2i$
- 63. $z = -3 + 3\sqrt{3}i$
- 64. $z \approx -0.1 + 0.6i$
- 65. $15(\cos 110^\circ + i \sin 110^\circ)$
- 66. $\cos 265^\circ + i \sin 265^\circ$
- 67. $40(\cos \pi + i \sin \pi)$
- 68. $2(\cos 5^\circ + i \sin 5^\circ)$

- 69. $\frac{1}{2}(\cos \pi + i \sin \pi)$
- 70. $2 \left(\cos \frac{7\pi}{6} + i \sin \frac{7\pi}{6} \right)$
- 71. $4 + 4i\sqrt{3}$
- 72. $-32\sqrt{3} + 32i$
- 73. $\frac{1}{128}i$
- 74. $64 - 64i\sqrt{3}$
- 75. $128 + 128i$
- 76. $7(\cos 25^\circ + i \sin 25^\circ); 7(\cos 205^\circ + i \sin 205^\circ)$
- 77. $5(\cos 55^\circ + i \sin 55^\circ); 5(\cos 175^\circ + i \sin 175^\circ); 5(\cos 295^\circ + i \sin 295^\circ)$

- 78. $\sqrt{3} + i; -1 + i\sqrt{3}; -\sqrt{3} - i; 1 - i\sqrt{3}$
- 79. $\sqrt{3} + i; -\sqrt{3} + i; -2i$
- 80. $\frac{1}{2} + \frac{\sqrt{3}}{2}i; -1; \frac{1}{2} - \frac{\sqrt{3}}{2}i$

81. $\frac{\sqrt[5]{8}}{2} + \frac{\sqrt[5]{8}}{2}i; \approx -0.49 + 0.95i; \approx -1.06 - 0.17i; \approx -0.17 - 1.06i; \approx 0.95 - 0.49i$



- 85. $3i - 2j$
- 86. $i - 2j$
- 87. $-i + 2j$
- 88. $-3i + 12j$
- 89. $12i - 51j$
- 90. $2\sqrt{26}$
- 91. $\frac{4}{5}i - \frac{3}{5}j$
- 92. $-\frac{1}{\sqrt{5}}i + \frac{2}{\sqrt{5}}j$

93. $6\mathbf{i} + 6\sqrt{3}\mathbf{j}$ 94. 270 lb; 27.7° 95. a. $13.59\mathbf{i} + 6.34\mathbf{j}$ b. 14.0 mph c. 13.9° 96. 4 97. 2; 86.1° 98. -32 ; 124.8°
 99. 1; 71.6° 100. orthogonal 101. not orthogonal 102. $\mathbf{v}_1 = \text{proj}_{\mathbf{w}}\mathbf{v} = \frac{50}{41}\mathbf{i} + \frac{40}{41}\mathbf{j}$; $\mathbf{v}_2 = -\frac{132}{41}\mathbf{i} + \frac{165}{41}\mathbf{j}$

103. $\mathbf{v}_1 = \text{proj}_{\mathbf{w}}\mathbf{v} = -\frac{3}{2}\mathbf{i} + \frac{1}{2}\mathbf{j}$; $\mathbf{v}_2 = \frac{1}{2}\mathbf{i} + \frac{3}{2}\mathbf{j}$ 104. 1115 ft-lb 105. Answers may vary.

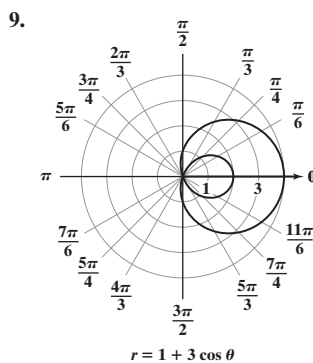
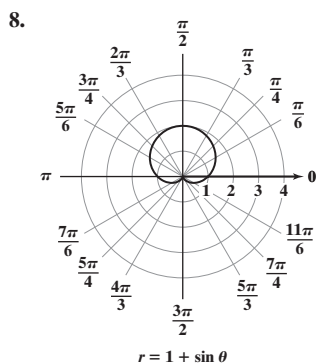
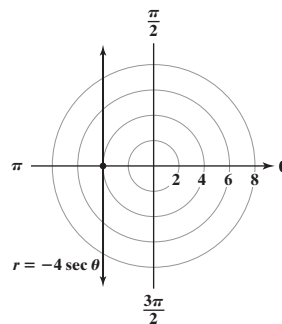
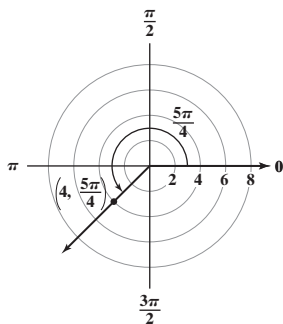
Chapter 6 Test

1. 8.0 2. 6.2 3. 206 sq in.

4. ; Ordered pairs may vary.

5. $(\sqrt{2}, \frac{7\pi}{4})$ 7. $x = -4$

6. $r = -16 \sin \theta$



10. $2(\cos 150^\circ + i \sin 150^\circ)$ or $2\left(\cos \frac{5\pi}{6} + i \sin \frac{5\pi}{6}\right)$

11. $50(\cos 20^\circ + i \sin 20^\circ)$

12. $\frac{1}{2}\left(\cos \frac{\pi}{6} + i \sin \frac{\pi}{6}\right)$

13. $32(\cos 50^\circ + i \sin 50^\circ)$

14. 3 ; $-\frac{3}{2} + \frac{\sqrt{3}}{2}i$; $-\frac{3}{2} - \frac{\sqrt{3}}{2}i$

15. a. $\mathbf{i} + 2\mathbf{j}$ b. $\sqrt{5}$

16. $-23\mathbf{i} + 22\mathbf{j}$

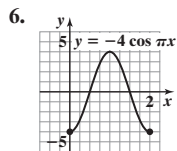
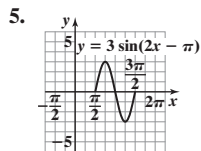
17. -18

18. 138° 19. $-\frac{9}{5}\mathbf{i} + \frac{18}{5}\mathbf{j}$

20. 1.0 mi 21. 323 pounds; 3.4° 22. 1966 ft-lb

Cumulative Review Exercises (Chapters P-6)

1. $\{-1, 2, i, -i\}$ 2. $\frac{\pi}{6}, \frac{5\pi}{6}, \frac{\pi}{2}$ 3. $\{x|x < -4 \text{ or } x > 2\}$ 4. $\frac{3\pi}{4}, \frac{7\pi}{4}$



7. $\sin \theta \csc \theta - \cos^2 \theta = \sin \theta \left(\frac{1}{\sin \theta}\right) - \cos^2 \theta = 1 - \cos^2 \theta = \sin^2 \theta$

8. $\cos\left(\theta + \frac{3\pi}{2}\right) = \cos \theta \cos \frac{3\pi}{2} - \sin \theta \sin \frac{3\pi}{2} = \cos \theta(0) - \sin \theta(-1) = \sin \theta$

9. slope is $-\frac{1}{2}$; y-intercept is 2. 10. 0 11. $\frac{\sqrt{5}}{5}$ 12. $\{x|x \leq 5\}$ 13. $\{x|x \neq 3, x \neq -3\}$ 14. 1.5 sec; 44 ft

15. a. 4 m b. $\frac{5}{2\pi}$ c. $\frac{2\pi}{5}$ sec 16. $\frac{\sqrt{\sqrt{2}+2}}{2}$ 17. a. $5\mathbf{i} + 23\mathbf{j}$ b. -12 18. $\log_b \frac{\sqrt{x}}{x^2+1}$ 19. $y = -\frac{1}{2}x + 1$

20. a. 0.014 b. 73 words c. about 144 min

CHAPTER 7

Section 7.1

Check Point Exercises

1. a. solution b. not a solution 2. $\{(-2, 5)\}$ 3. $\{(2, -1)\}$ 4. $\left\{\left(\frac{60}{17}, -\frac{11}{17}\right)\right\}$ 5. no solution or \emptyset
 6. $\{(x, y)|x = 4y - 8\}$ or $\{(x, y)|5x - 20y = -40\}$ 7. 4 l of 18% solution; 8 l of 45% solution 8. boat: 35 mph; current: 7 mph
 9. a. $C(x) = 300,000 + 30x$ b. $R(x) = 80x$ c. (6000, 480,000); The company will break even if it produces and sells 6000 pairs of shoes.

Exercise Set 7.1

1. solution 3. not a solution 5. $\{(1, 3)\}$ 7. $\{(5, 1)\}$ 9. $\{(-22, -5)\}$ 11. $\{(0, 0)\}$ 13. $\{(3, -2)\}$ 15. $\{(5, 4)\}$ 17. $\{(7, 3)\}$
 19. $\{(2, -1)\}$ 21. $\{(3, 0)\}$ 23. $\{(-4, 3)\}$ 25. $\{(3, 1)\}$ 27. $\{(1, -2)\}$ 29. $\left\{\left(\frac{7}{25}, -\frac{1}{25}\right)\right\}$ 31. \emptyset 33. $\{(x, y)|y = 3x - 5\}$

35. $\{(1, 4)\}$ 37. $\{(x, y) | x + 3y = 2\}$ 39. $\{(-5, -1)\}$ 41. $\left\{\left(\frac{29}{22}, -\frac{5}{11}\right)\right\}$ 43. $x + y = 7; x - y = -1; 3$ and 4
 45. $3x - y = 1; x + 2y = 12; 2$ and 5 47. $\{(6, -1)\}$ 49. $\left\{\left(\frac{1}{a}, 3\right)\right\}$ 51. $m = -4, b = 3$ 53. $y = x - 4; y = -\frac{1}{3}x + 4$
 55. California: 100 gal; French: 100 gal 57. 18-karat gold: 96 g; 12-karat gold: 204 g 59. cheaper candy: 30 lb; more expensive candy: 45 lb
 61. plane: 130 mph; wind: 30 mph 63. crew: 6 km/hr; current: 2 km/hr 65. velocity in still water: 4.5 mph; current: 1.5 mph
 67. 500 radios 69. -6000 ; When the company produces and sells 200 radios, the loss is \$6000. 71. a. $P(x) = 20x - 10,000$ b. \$190,000
 73. a. $C(x) = 18,000 + 20x$ b. $R(x) = 80x$ c. (300, 24,000); When 300 canoes are produced and sold, both revenue and cost are \$24,000.
 75. a. $C(x) = 30,000 + 2500x$ b. $R(x) = 3125x$ c. (48, 150,000); For 48 sold-out performances, both cost and revenue are \$150,000.
 77. a. 4 million workers; \$4.50 per hour b. \$4.50; 4; 4 c. 2 million d. 5.7 million e. 3.7 million 79. 2009; 18.5% pro-choice and 18.5% pro-life
 81. a. $y = 0.45x + 0.8$ b. $y = 0.15x + 2.6$ c. week 6; 3.5 symptoms; by the intersection point (6, 3.5) 83. a. $y = -0.54x + 38$
 b. $y = -0.79x + 40$ c. 1993; 33.68% 85. Mr. Goodbar: 264 cal; Mounds: 258 cal 87. 3 Mr. Goodbars and 2 Mounds bars 89. 50 rooms with kitchen facilities, 150 rooms without kitchen facilities
 91. 100 ft long by 80 ft wide 93. $80^\circ, 50^\circ, 50^\circ$ 105. does not make sense
 107. makes sense 109. $y = \frac{a_1c_2 - a_2c_1}{a_1b_2 - a_2b_1}; x = \frac{b_2c_1 - b_1c_2}{a_1b_2 - a_2b_1}$ 111. Yes; 8 hexagons and 4 squares 113. yes 114. $11x + 4y = -3$
 115. $1682 = 16a + 4b + c$

Section 7.2

Check Point Exercises

1. $(-1) - 2(-4) + 3(5) = 22; 2(-1) - 3(-4) - 5 = 5; 3(-1) + (-4) - 5(5) = -32$ 2. $\{(1, 4, -3)\}$ 3. $\{(4, 5, 3)\}$ 4. $y = 3x^2 - 12x + 13$

Exercise Set 7.2

1. solution 3. solution 5. $\{(2, 3, 3)\}$ 7. $\{(2, -1, 1)\}$ 9. $\{(1, 2, 3)\}$ 11. $\{(3, 1, 5)\}$ 13. $\{(1, 0, -3)\}$ 15. $\{(1, -5, -6)\}$
 17. $\left\{\left(\frac{1}{2}, \frac{1}{3}, -1\right)\right\}$ 19. $y = 2x^2 - x + 3$ 21. $y = 2x^2 + x - 5$ 23. 7, 4, and 5 25. $\{(4, 8, 6)\}$ 27. $y = -\frac{3}{4}x^2 + 6x - 11$
 29. $\left\{\left(\frac{8}{a}, -\frac{3}{b}, -\frac{5}{c}\right)\right\}$ 31. a. $y = -16x^2 + 40x + 200$ b. $y = 0$ when $x = 5$; The ball hits the ground after 5 seconds.
 33. water: 58%; fat: 23%; protein: 14% 35. 200 \$8 tickets; 150 \$10 tickets; 50 \$12 tickets 37. \$1200 at 8%, \$2000 at 10%, and \$3500 at 12%
 39. $x = 60, y = 55, z = 65$ 47. does not make sense 49. makes sense 51. 13 triangles, 21 rectangles, and 6 pentagons
 53. $\frac{x + 14}{(x - 4)(x + 2)}$ 54. $\frac{5x^3 - 3x^2 + 7x - 3}{(x^2 + 1)^2}$ 55. $\{(5, -2, 3)\}$

Section 7.3

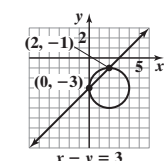
Check Point Exercises

1. $\frac{2}{x-3} + \frac{3}{x+4}$ 2. $\frac{2}{x} - \frac{2}{x-1} + \frac{3}{(x-1)^2}$ 3. $\frac{2}{x+3} + \frac{6x-8}{x^2+x+2}$ 4. $\frac{2x}{x^2+1} + \frac{-x+3}{(x^2+1)^2}$

Exercise Set 7.3

1. $\frac{A}{x-2} + \frac{B}{x+1}$ 3. $\frac{A}{x+2} + \frac{B}{x-3} + \frac{C}{(x-3)^2}$ 5. $\frac{A}{x-1} + \frac{Bx+C}{x^2+1}$ 7. $\frac{Ax+B}{x^2+4} + \frac{Cx+D}{(x^2+4)^2}$ 9. $\frac{3}{x-3} - \frac{2}{x-2}$
 11. $\frac{7}{x-9} - \frac{4}{x+2}$ 13. $\frac{24}{7(x-4)} + \frac{25}{7(x+3)}$ 15. $\frac{4}{7(x-3)} - \frac{8}{7(2x+1)}$ 17. $\frac{3}{x} + \frac{2}{x-1} - \frac{1}{x+3}$ 19. $\frac{3}{x} + \frac{4}{x+1} - \frac{3}{x-1}$
 21. $\frac{6}{x-1} - \frac{5}{(x-1)^2}$ 23. $\frac{1}{x-2} - \frac{2}{(x-2)^2} - \frac{5}{(x-2)^3}$ 25. $\frac{7}{x} - \frac{6}{x-1} + \frac{10}{(x-1)^2}$ 27. $\frac{1}{4(x+1)} + \frac{3}{4(x-1)} + \frac{1}{2(x-1)^2}$
 29. $\frac{3}{x-1} + \frac{2x-4}{x^2+1}$ 31. $\frac{2}{x+1} + \frac{3x-1}{x^2+2x+2}$ 33. $\frac{1}{4x} + \frac{1}{x^2} - \frac{x+4}{4(x^2+4)}$ 35. $\frac{4}{x+1} + \frac{2x-3}{x^2+1}$ 37. $\frac{x+1}{x^2+2} - \frac{2x}{(x^2+2)^2}$
 39. $\frac{x-2}{x^2-2x+3} + \frac{2x+1}{(x^2-2x+3)^2}$ 41. $\frac{3}{x-2} + \frac{x-1}{x^2+2x+4}$ 43. $x^3 + x - \frac{1}{2(x+1)} + \frac{3}{2(x-1)}$ 45. $x + 1 - \frac{2}{x} - \frac{2}{x^2} + \frac{2}{x-1}$
 47. $\frac{\frac{1}{2c}}{x-c} - \frac{\frac{1}{2c}}{x+c}$ 49. $\frac{a}{x-c} + \frac{ac+b}{(x-c)^2}$ 51. $\frac{1}{x} - \frac{1}{x+1}; \frac{99}{100}$ 61. does not make sense 63. does not make sense
 65. $\frac{2}{x-3} + \frac{2x+5}{x^2+3x+3}$ 66. $\{(2.5, -2)\}$ 67. $\{(4, -3)\}$

68. $(0, -3)$ and $(2, -1); 0 - (-3) = 3$ and $(0 - 2)^2 + (-3 + 3)^2 = 4$ are true;
 $2 - (-1) = 3$ and $(2 - 2)^2 + (-1 + 3)^2 = 4$ are true.



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

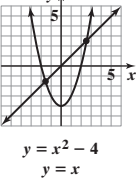
Section 7.4

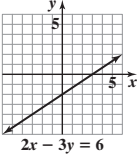
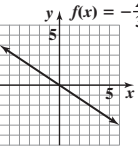
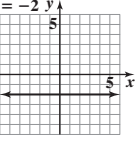
Check Point Exercises

1. $\{(0, 1), (4, 17)\}$ 2. $\left\{\left(-\frac{6}{5}, \frac{3}{5}\right), (2, -1)\right\}$ 3. $\{(3, 2), (3, -2), (-3, 2), (-3, -2)\}$ 4. $\{(0, 5)\}$ 5. length: 7 ft; width: 3 ft or length: 3 ft; width: 7 ft

Exercise Set 7.4

1. $\{(-3, 5), (2, 0)\}$ 3. $\{(1, 1), (2, 0)\}$ 5. $\{(4, -10), (-3, 11)\}$ 7. $\{(4, 3), (-3, -4)\}$ 9. $\left\{\left(-\frac{3}{2}, -4\right), (2, 3)\right\}$ 11. $\{(-5, -4), (3, 0)\}$
 13. $\{(3, 1), (-3, -1), (1, 3), (-1, -3)\}$ 15. $\{(4, -3), (-1, 2)\}$ 17. $\{(0, 1), (4, -3)\}$ 19. $\{(3, 2), (3, -2), (-3, 2), (-3, -2)\}$
 21. $\{(3, 2), (3, -2), (-3, 2), (-3, -2)\}$ 23. $\{(2, 1), (2, -1), (-2, 1), (-2, -1)\}$ 25. $\{(3, 4), (3, -4)\}$
 27. $\{(0, 2), (0, -2), (-1, \sqrt{3}), (-1, -\sqrt{3})\}$ 29. $\{(2, 1), (2, -1), (-2, 1), (-2, -1)\}$ 31. $\{(-2\sqrt{2}, -\sqrt{2}), (-1, -4), (1, 4), (2\sqrt{2}, \sqrt{2})\}$
 33. $\{(2, 2), (4, 1)\}$ 35. $\{(0, 0), (-1, 1)\}$ 37. $\{(0, 0), (-2, 2), (2, 2)\}$ 39. $\left\{(-4, 1), \left(-\frac{5}{2}, \frac{1}{4}\right)\right\}$ 41. $\left\{\left(\frac{12}{5}, -\frac{29}{5}\right), (-2, 3)\right\}$
 43. 4 and 6 45. 2 and 1, 2 and -1, -2 and 1, or -2 and -1

47. $\{(2, -1), (-2, 1)\}$ 49. $\{(2, 20), (-2, 4), (-3, 0)\}$ 51. $\left\{\left(-1, -\frac{1}{2}\right), \left(-1, \frac{1}{2}\right), \left(1, -\frac{1}{2}\right), \left(1, \frac{1}{2}\right)\right\}$
 53.  $y = x^2 - 4$
 $y = x$
 55. $(0, -4), (-2, 0), (2, 0)$ 57. 11 ft and 7 ft 59. width: 6 in.; length: 8 in.
 61. $x = 5$ m, $y = 2$ m 63. a. between the 1940s and the 1960s b. 1949; 43%; 43% c. 1920; 28%
 d. 1919; white collar: 27.5%; farmers: 27.4%; fairly well, although answers may vary.
 69. makes sense 71. makes sense 73. false 75. false 77. 18 sq units 79. $\{(8, 2)\}$

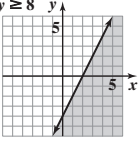
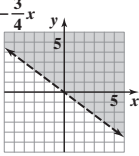
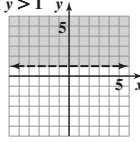
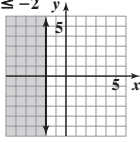
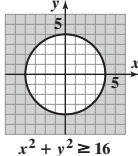
81.  $2x - 3y = 6$
 82.  $f(x) = -\frac{2}{3}x$
 83.  $f(x) = -2$

Mid-Chapter 7 Check Point

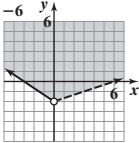
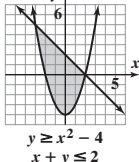
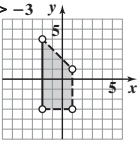
1. $\{(-1, 2)\}$ 2. $\{(1, -2)\}$ 3. $\{(6, 10)\}$ 4. $\{(x, y) | y = 4x - 5\}$ or $\{(x, y) | 8x - 2y = 10\}$ 5. $\left\{\left(\frac{11}{19}, \frac{7}{19}\right)\right\}$ 6. \emptyset 7. $\{(-1, 2, -2)\}$
 8. $\{(4, -2, 3)\}$ 9. $\left\{\left(-\frac{9}{5}, \frac{12}{5}\right), (3, 0)\right\}$ 10. $\{(-2, -1), (-2, 1), (2, -1), (2, 1)\}$ 11. $\{(-\sqrt{7}, 1), (-2, -2), (2, -2), (\sqrt{7}, 1)\}$
 12. $\{(0, -2), (6, 1)\}$ 13. $\frac{1}{x-2} - \frac{2}{(x-2)^2} - \frac{5}{(x-2)^3}$ 14. $\frac{5}{x+2} + \frac{3}{x+1} + \frac{2}{x-1}$ 15. $-\frac{2}{x+3} + \frac{3x-5}{x^2+4}$ 16. $\frac{x}{x^2+4} - \frac{4x}{(x^2+4)^2}$
 17. a. $C(x) = 400,000 + 20x$ b. $R(x) = 100x$ c. $P(x) = 80x - 400,000$ d. (5000, 500,000); The company will break even when it produces and sells 5000 PDAs. At this level, both revenue and cost are \$500,000.
 18. 6 roses and 14 carnations 19. north campus: 300 students; south campus: 900 students 20. rowing rate in still water: 3 mph; current: 1.5 mph 21. $x = 55^\circ, y = 35^\circ$ 22. $y = -x^2 + 2x + 3$
 23. length: 8 m; width: 2.5 m

Section 7.5

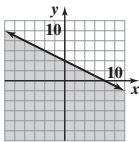
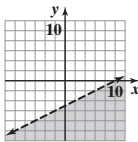
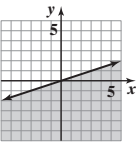
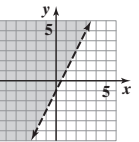
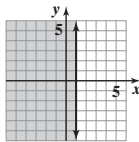
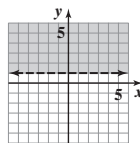
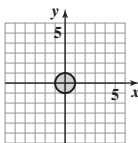
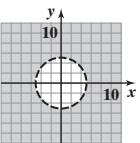
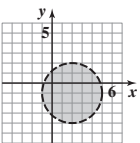
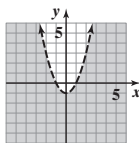
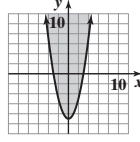
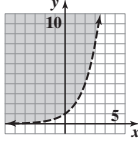
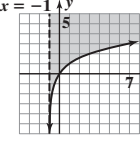
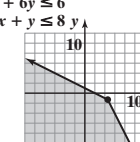
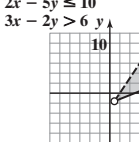
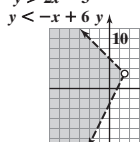
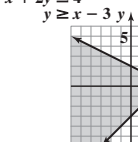
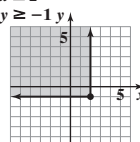
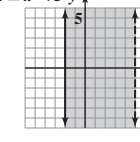
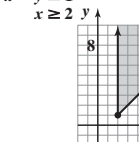
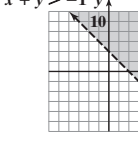
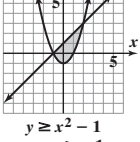
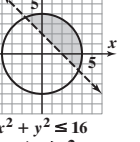
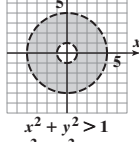
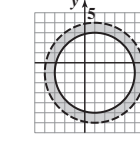
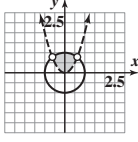
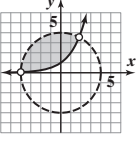
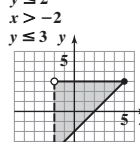
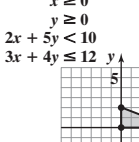
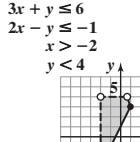
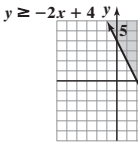
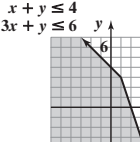
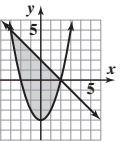
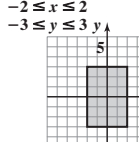
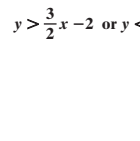
Check Point Exercises

1. $4x - 2y \geq 8$ 
 2. $y > -\frac{3}{4}x$ 
 3. a. $y > 1$ 
 b. $x \leq -2$ 
 4.  $x^2 + y^2 \geq 16$

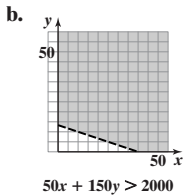
5. Point $B = (66, 130)$; $4.9(66) - 130 \geq 165$, or $193.4 \geq 165$, is true; $3.7(66) - 130 \leq 125$, or $114.2 \leq 125$, is true.

6. $x - 3y < 6$
 $2x + 3y \geq -6$ 
 7.  $y \geq x^2 - 4$
 $x + y \leq 2$
 8. $x + y < 2$
 $-2 \leq x < 1$
 $y > -3$ 

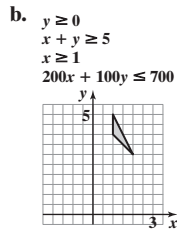
Exercise Set 7.5

1.  $x + 2y \leq 8$
3.  $x - 2y > 10$
5.  $y \leq \frac{1}{3}x$
7.  $y > 2x - 1$
9.  $x \leq 1$
11.  $y > 1$
13.  $x^2 + y^2 \leq 1$
15.  $x^2 + y^2 > 25$
17.  $(x - 2)^2 + (y + 1)^2 < 9$
19.  $y < x^2 - 1$
21.  $y \geq x^2 - 9$
23.  $y > 2^x$
25.  $y \geq \log_2(x + 1)$
27.  $3x + 6y \leq 6$
 $2x + y \leq 8$
29.  $2x - 5y \leq 10$
 $3x - 2y > 6$
31.  $y > 2x - 3$
 $y < -x + 6$
33.  $x + 2y \leq 4$
 $y \geq x - 3$
35.  $x \leq 2$
 $y \geq -1$
37.  $-2 \leq x < 5$
 $y \geq 2$
39.  $x - y \leq 1$
 $x \geq 2$
41. \emptyset
43.  $x + y > 4$
 $x + y > -1$
45.  $y \geq x^2 - 1$
 $x - y \geq -1$
47.  $x^2 + y^2 \leq 16$
 $x + y > 2$
49.  $x^2 + y^2 > 1$
 $x^2 + y^2 < 16$
51.  $(x - 1)^2 + (y + 1)^2 < 25$
 $(x - 1)^2 + (y + 1)^2 \geq 16$
53.  $x^2 + y^2 \leq 1$
 $y - x^2 > 0$
55.  $x^2 + y^2 < 16$
 $y \geq 2x$
57.  $x - y \leq 2$
 $x > -2$
 $y \leq 3$
59.  $x \geq 0$
 $y \geq 0$
 $2x + 5y < 10$
 $3x + 4y \leq 12$
61.  $3x + y \leq 6$
 $2x - y \leq -1$
 $x > -2$
 $y < 4$
63.  $y \geq -2x + 4$
65.  $x + y \leq 4$
 $3x + y \leq 6$
67.  $x + y \leq 2$
 $y \geq x^2 - 4$
69.  $-2 \leq x \leq 2$
 $-3 \leq y \leq 3$
71.  $y > \frac{3}{2}x - 2$ or $y < 4$
73. no solution
75. infinitely many solutions
77. Point $A = (66, 160)$; $5.3(66) - 160 \geq 180$, or $189.8 \geq 180$, is true; $4.1(66) - 160 \leq 140$, or $110.6 \leq 140$, is true.
79. no

81. a. $50x + 150y > 2000$



83. a. $y \geq 0; x + y \geq 5; x \geq 1; 200x + 100y \leq 700$



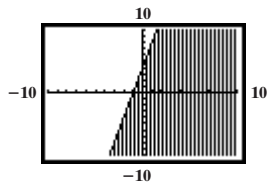
85. a. 27.1 b. overweight

c. 2 nights

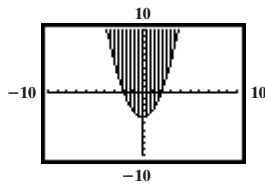
c. Answers may vary. Example:

(20, 20): 20 children and 20 adults will cause the elevator to be overloaded.

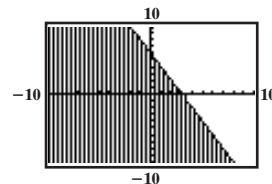
97.



99.



101.



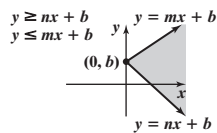
107. does not make sense

109. makes sense

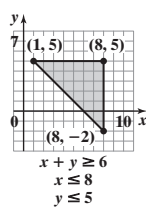
111. $y > x - 3; y \leq x$

113. $x + 2y \leq 6$ or $2x + y \leq 6$

115.

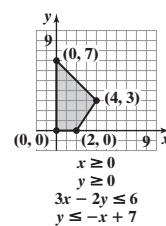


116. a.



b. (1, 5), (8, 5), (8, -2)

117. a.



b. (0, 0), (2, 0), (4, 3), (0, 7)

118. $20x + 10y \leq 80,000$

Section 7.6

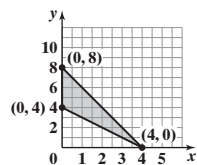
Check Point Exercises

1. $z = 25x + 55y$ 2. $x + y \leq 80$ 3. $30 \leq x \leq 80; 10 \leq y \leq 30$; objective function: $z = 25x + 55y$; constraints: $x + y \leq 80; 30 \leq x \leq 80; 10 \leq y \leq 30$ 4. 50 bookshelves and 30 desks; \$2900 5. 30

Exercise Set 7.6

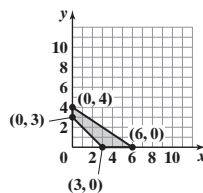
1. (1, 2): 17; (2, 10): 70; (7, 5): 65; (8, 3): 58; maximum: $z = 70$; minimum: $z = 17$
 3. (0, 0): 0; (0, 8): 400; (4, 9): 610; (8, 0): 320; maximum: $z = 610$; minimum: $z = 0$

5. a.



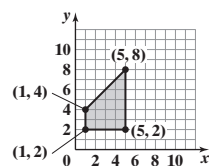
- b. (0, 8): 16; (0, 4): 8; (4, 0): 12
 c. maximum value: 16 at $x = 0$ and $y = 8$

7. a.



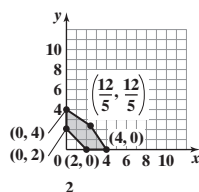
- b. (0, 4): 4; (0, 3): 3; (3, 0): 12; (6, 0): 24
 c. maximum value: 24 at $x = 6$ and $y = 0$

9. a.



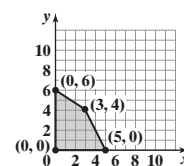
- b. (1, 2): -1; (1, 4): -5; (5, 8): -1; (5, 2): 11
 c. maximum value: 11 at $x = 5$ and $y = 2$

11. a.

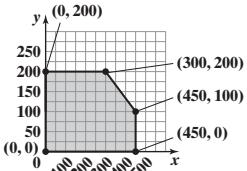


- b. (0, 4): 8; (0, 2): 4; (2, 0): 8; (4, 0): 16;
 c. maximum value: 16 at $x = 4$ and $y = 0$

13. a.



- b. (0, 6): 72; (0, 0): 0; (5, 0): 50; (3, 4): 78
 c. maximum value: 78 at $x = 3$ and $y = 4$

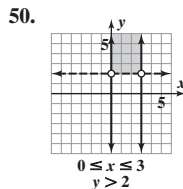
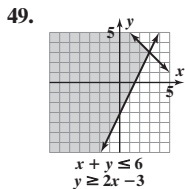
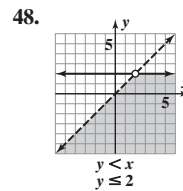
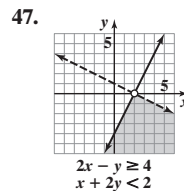
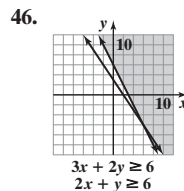
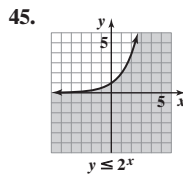
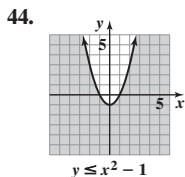
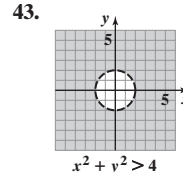
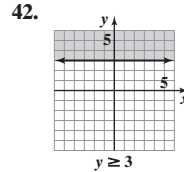
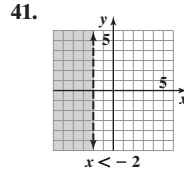
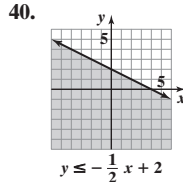
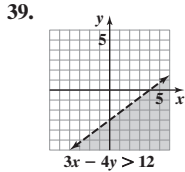
15. a. $z = 125x + 200y$ b. $x \leq 450; y \leq 200; 600x + 900y \leq 360,000$
 c.  d. $(0, 0): 0; (0, 200): 40,000;$
 $(300, 200): 77,500; (450, 100): 76,250;$
 $(450, 0): 56,250$
 e. 300; 200; \$77,500

17. 40 model A bicycles and no model B bicycles
 19. 300 cartons of food and 200 cartons of clothing
 21. 50 students and 100 parents
 23. 10 Boeing 727s and 42 Falcon 20s
 29. does not make sense 31. makes sense
 33. \$5000 in stocks and \$5000 in bonds
 37. $\{(6, 3, 5)\}$; Answers may vary.

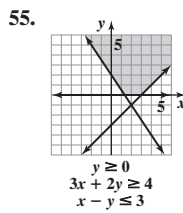
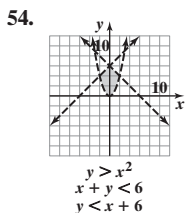
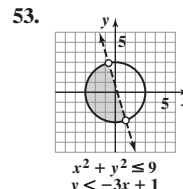
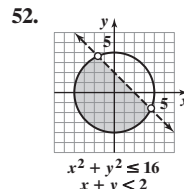
38. $\{(-2, 1, 4, 3)\}$; Answers may vary. 39. $\begin{bmatrix} 1 & 2 & -1 \\ 0 & -11 & -11 \end{bmatrix}$

Chapter 7 Review Exercises

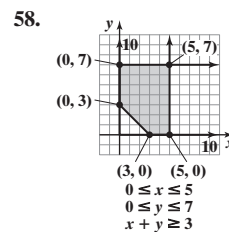
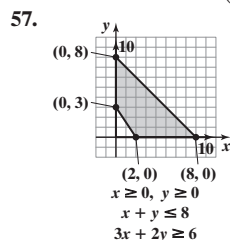
1. $\{(1, 5)\}$ 2. $\{(2, 3)\}$ 3. $\{(2, -3)\}$ 4. \emptyset 5. $\{(x, y) | 3x - 6y = 12\}$ 6. a. $C(x) = 60,000 + 200x$ b. $R(x) = 450x$
 c. $(240, 108,000)$; This means the company will break even if it produces and sells 240 desks. 7. Klimt: \$135 million; Picasso: \$104 million
 8. a. Answers will vary; approximately $(2004, 180)$; 2004; 180 million b. $y = 19.8x + 98$ c. 2004; 180 million d. Answers will vary from "quite well" to "extremely well."
 9. \$80 per day for the room, \$60 per day for the car 10. 10 ml of 34%; 90 ml of 4% 11. plane: 630 mph; wind: 90 mph 12. $\{(0, 1, 2)\}$ 13. $\{(2, 1, -1)\}$ 14. $y = 3x^2 - 4x + 5$ 15. 18–29: \$8300; 30–39: \$16,400; 40–49: \$19,500
 16. $\frac{3}{5(x-3)} + \frac{2}{5(x+2)}$ 17. $\frac{6}{x-4} + \frac{5}{x+3}$ 18. $\frac{2}{x} + \frac{3}{x+2} - \frac{1}{x-1}$ 19. $\frac{2}{x-2} + \frac{5}{(x-2)^2}$ 20. $-\frac{4}{x-1} + \frac{4}{x-2} - \frac{2}{(x-2)^2}$
 21. $\frac{6}{5(x-2)} + \frac{-6x+3}{5(x^2+1)}$ 22. $\frac{5}{x-3} + \frac{2x-1}{x^2+4}$ 23. $\frac{x}{x^2+4} - \frac{4x}{(x^2+4)^2}$ 24. $\frac{4x+1}{x^2+x+1} + \frac{2x-2}{(x^2+x+1)^2}$ 25. $\{(4, 3), (1, 0)\}$
 26. $\{(0, 1), (-3, 4)\}$ 27. $\{(1, -1), (-1, 1)\}$ 28. $\{(3, \sqrt{6}), (3, -\sqrt{6}), (-3, \sqrt{6}), (-3, -\sqrt{6})\}$ 29. $\{(2, 2), (-2, -2)\}$ 30. $\{(9, 6), (1, 2)\}$
 31. $\{(-3, -1), (1, 3)\}$ 32. $\left\{\left(\frac{1}{2}, 2\right), (-1, -1)\right\}$ 33. $\left\{\left(\frac{5}{2}, -\frac{7}{2}\right), (0, -1)\right\}$ 34. $\{(2, -3), (-2, -3), (3, 2), (-3, 2)\}$
 35. $\{(3, 1), (3, -1), (-3, 1), (-3, -1)\}$ 36. 8 m and 5 m 37. $(1, 6), (3, 2)$ 38. $x = 46$ and $y = 28$ or $x = 50$ and $y = 20$



51. no solution

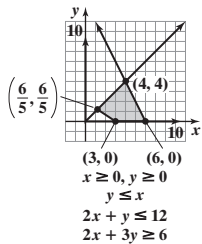


56. $(2, 2): 10; (4, 0): 8; \left(\frac{1}{2}, \frac{1}{2}\right): \frac{5}{2}; (1, 0): 2$; maximum value: 10; minimum value: 2



Maximum is 24 at $x = 0, y = 8$. Maximum is 33 at $x = 5, y = 7$.

59.



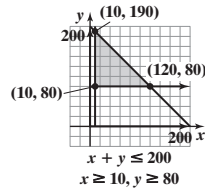
Maximum is 44 at $x = y = 4$.

61. 480 of model A and 240 of model B

60. a. $z = 500x + 350y$

b. $x + y \leq 200; x \geq 10; y \geq 80$

c.



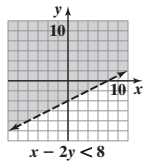
d. (10, 80): 33,000; (10, 190): 71,500; (120, 80): 88,000

e. 120; 80; 88,000

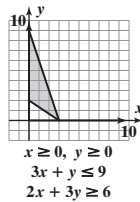
Chapter 7 Test

1. $\{(1, -3)\}$ 2. $\{(4, -2)\}$ 3. $\{(1, 3, 2)\}$ 4. $\{(4, -3), (-3, 4)\}$ 5. $\{(3, 2), (3, -2), (-3, 2), (-3, -2)\}$ 6. $\frac{-1}{10(x+1)} + \frac{x+9}{10(x^2+9)}$

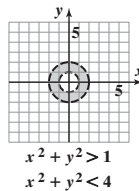
7.



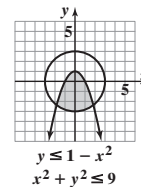
8.



9.



10.

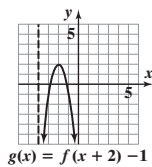


11. 26 12. shrimp: 42 mg; scallops: 15mg 13. a. $C(x) = 360,000 + 850x$ b. $R(x) = 1150x$ c. (1200, 1,380,000); The company will break even if it produces and sells 1200 computers. 14. 40 oz of 20%; 20 oz of 50% 15. plane: 725 km/hr; wind: 75 km/hr
 16. $y = x^2 - 3$ 17. $x = 7.5$ ft and $y = 24$ ft or $x = 12$ ft and $y = 15$ ft 18. 50 regular and 100 deluxe jet skis; \$35,000

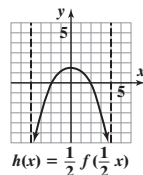
Cumulative Review Exercises (Chapters P-7)

1. domain: $(-2, 2)$; range: $(-\infty, 3]$ 2. -1 and 1 3. maximum of 3 at $x = 0$ 4. (0, 2)
 5. positive 6. 3 7. $x \rightarrow -2^+; x \rightarrow 2^-$ 8. even

9.



10.



11. $\{3, 4\}$ 12. $\left\{\frac{2 + i\sqrt{3}}{2}, \frac{2 - i\sqrt{3}}{2}\right\}$

13. $(-18, 6)$ 14. (1, 7)

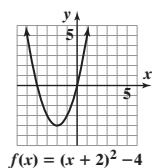
15. $\left\{-3, \frac{1}{2}\right\}$ 16. $\{-2\}$

17. $\{2\}$ 18. $\{-2 + \log_3 11\}$

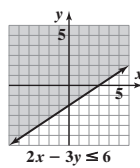
19. $\{625\}$ 20. $\left\{\left(-\frac{1}{2}, \frac{1}{2}\right), (2, 8)\right\}$

21. $\{(8, -2, -2)\}$

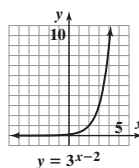
22.



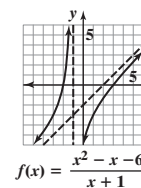
23.



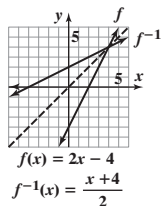
24.



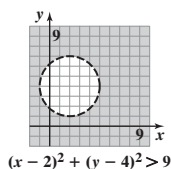
25.



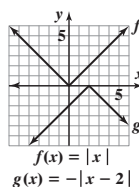
26.



27.



28.



29. $(f \circ g)(x) = 2x^2 - 3x;$

$(g \circ f)(x) = -2x^2 + x + 2$

30. $4x + 2h - 1$

31. $y = -3x + 10$

32. $y = 3x + 3$

33. \$2600 at 12%; \$1400 at 14%

34. 4 m by 9 m

35. 10.99%

36. $\sec \theta - \cos \theta = \frac{1}{\cos \theta} - \cos \theta = \frac{1 - \cos^2 \theta}{\cos \theta} = \frac{\sin^2 \theta}{\cos \theta} = \frac{\sin \theta}{\cos \theta} \sin \theta = \tan \theta \sin \theta$

37. $\tan x + \tan y = \frac{\sin x}{\cos x} + \frac{\sin y}{\cos y} = \frac{\sin x \cos y + \sin y \cos x}{\cos x \cos y} = \frac{\sin(x+y)}{\cos x \cos y}$ 38. $\{0, \pi\}$ 39. $\left\{0, \frac{\pi}{3}, \frac{5\pi}{3}\right\}$ 40. 92.9

CHAPTER 8**Section 8.1****Check Point Exercises**

$$1. \text{ a. } \left[\begin{array}{ccc|c} 1 & 6 & -3 & 7 \\ 4 & 12 & -20 & 8 \\ -3 & -2 & 1 & -9 \end{array} \right] \quad \text{b. } \left[\begin{array}{ccc|c} 1 & 3 & -5 & 2 \\ 1 & 6 & -3 & 7 \\ -3 & -2 & 1 & -9 \end{array} \right] \quad \text{c. } \left[\begin{array}{ccc|c} 4 & 12 & -20 & 8 \\ 1 & 6 & -3 & 7 \\ 0 & 16 & -8 & 12 \end{array} \right] \quad 2. \{(5, 2, 3)\} \quad 3. \{(1, -1, 2, -3)\} \quad 4. \{(5, 2, 3)\}$$

Exercise Set 8.1

$$1. \left[\begin{array}{ccc|c} 2 & 1 & 2 & 2 \\ 3 & -5 & -1 & 4 \\ 1 & -2 & -3 & -6 \end{array} \right] \quad 3. \left[\begin{array}{ccc|c} 1 & -1 & 1 & 8 \\ 0 & 1 & -12 & -15 \\ 0 & 0 & 1 & 1 \end{array} \right] \quad 5. \left[\begin{array}{ccc|c} 5 & -2 & -3 & 0 \\ 1 & 1 & 0 & 5 \\ 2 & 0 & -3 & 4 \end{array} \right]$$

$$7. \left[\begin{array}{cccc|c} 2 & 5 & -3 & 1 & 2 \\ 0 & 3 & 1 & 0 & 4 \\ 1 & -1 & 5 & 0 & 9 \\ 5 & -5 & -2 & 0 & 1 \end{array} \right] \quad 9. \begin{array}{l} 5x + 3z = -11 \\ y - 4z = 12 \\ 7x + 2y = 3 \end{array} \quad 11. \begin{array}{l} w + x + 4y + z = 3 \\ -w + x - y = 7 \\ 2w + 5z = 11 \\ 12y + 4z = 5 \end{array}$$

$$13. \left[\begin{array}{ccc|c} 1 & -3 & 2 & 5 \\ 1 & 5 & -5 & 0 \\ 3 & 0 & 4 & 7 \end{array} \right] \quad 15. \left[\begin{array}{ccc|c} 1 & -3 & 2 & 0 \\ 0 & 10 & -7 & 7 \\ 2 & -2 & 1 & 3 \end{array} \right] \quad 17. \left[\begin{array}{cccc|c} 1 & -1 & 1 & 1 & 3 \\ 0 & 1 & -2 & -1 & 0 \\ 0 & 2 & 1 & 2 & 5 \\ 0 & 6 & -3 & -1 & -9 \end{array} \right]$$

$$19. R_2: -3, -18; R_3: -12, -15; R_2: -\frac{3}{5}, -\frac{18}{5}; R_3: -12, -15 \quad 21. \{(1, -1, 2)\} \quad 23. \{(3, -1, -1)\} \quad 25. \{(2, -1, 1)\} \quad 27. \{(2, 1, 1)\} \\ 29. \{(2, -1, 1)\} \quad 31. \{(-1, 2, -2)\} \quad 33. \{(1, 2, -1)\} \quad 35. \{(1, 2, 3, -2)\} \quad 37. \{(0, -3, 0, -3)\} \quad 39. f(x) = -x^2 + x + 2 \\ 41. f(x) = x^3 - 2x^2 + 3 \quad 43. \{(e^{-1}, e, e^{-3}, e^{-2})\} \quad 45. \text{ a. } a = -32, v_0 = 56, s_0 = 0 \quad \text{b. } 0; \text{ The ball hits the ground 3.5 seconds after it is thrown.} \\ \text{c. } 1.75 \text{ sec; } 49 \text{ ft}$$

$$47. 40x + 200y + 400z = 660; 4 \text{ oz of Food A; } \frac{1}{2} \text{ oz of Food B; } 1 \text{ oz of Food C} \\ 5x + 2y + 4z = 25 \\ 30x + 10y + 300z = 425$$

$$49. \text{ Asians: } 122; \text{ Africans: } 28; \text{ Europeans: } 24; \text{ Americans: } 9 \quad 59. \text{ makes sense} \quad 61. \text{ makes sense} \quad 63. \text{ false} \quad 65. \text{ false} \quad 67. 60 \text{ units; } \$7700 \\ 68. \text{ For } z = 0, (12z + 1, 10z - 1, z) \text{ is } (1, -1, 0); 3(1) - 4(-1) + 4(0) = 7 \text{ is true; } 1 - (-1) - 2(0) = 2 \text{ is true; } 2(1) - 3(-1) + 6(0) = 5 \text{ is true.} \\ 69. \text{ For } z = 1, (12z + 1, 10z - 1, z) \text{ is } (13, 9, 1); 3(13) - 4(9) + 4(1) = 7 \text{ is true; } 13 - 9 - 2(1) = 2 \text{ is true; } 2(13) - 3(9) + 6(1) = 5 \text{ is true.} \\ 70. \text{ a. Answers may vary.} \quad \text{b. This system has more than one solution.}$$

Section 8.2**Check Point Exercises**

$$1. \emptyset \quad 2. \{(11t + 13, 5t + 4, t)\} \quad 3. \{(t + 50, -2t + 10, t)\} \\ 4. \text{ a. } w + z = 15 \quad \text{b. } \{(-t + 15, t + 15, -t + 30, t)\} \quad \text{c. } w = 5; x = 25; y = 20 \\ w + x = 30 \\ x + y = 45 \\ y + z = 30$$

Exercise Set 8.2

$$1. \emptyset \quad 3. \left\{ \left(-2t + 2, 2t + \frac{1}{2}, t \right) \right\} \quad 5. \{(-3, 4, -2)\} \quad 7. \{(5 - 2t, -2 + t, t)\} \quad 9. \{(-1, 2, 1, 1)\} \quad 11. \{(1, 3, 2, 1)\}$$

$$13. \{(1, -2, 1, 1)\} \quad 15. \left\{ \left(1 + \frac{1}{3}t, \frac{1}{3}t, t \right) \right\} \quad 17. \{(-13t + 5, 5t, t)\} \quad 19. \left\{ \left(2t - \frac{5}{4}, \frac{13}{4}, t \right) \right\} \quad 21. \{(1, -t - 1, 2, t)\}$$

$$23. \left\{ \left(-\frac{2}{11}t + \frac{81}{11}, \frac{1}{22}t + \frac{10}{11}, \frac{4}{11}t - \frac{8}{11}, t \right) \right\}$$

$$25. \text{ a. } 4w - 2x + 2y - 3z = 0; 7w - x - y - 3z = 0; w + x + y - z = 0 \quad \text{b. } \{(0.5t, 0, 0.5t, t)\} \\ 27. \text{ a. } w + 2x + 5y + 5z = -3; w + x + 3y + 4z = -1; w - x - y + 2z = 3 \quad \text{b. } \{(1 - 3s - t, -2 - s - 2t, t, s)\} \\ 29. z + 12 = x + 6 \quad 31. \{(t + 6, t + 2, t)\} \\ 33. \text{ a. } w + z = 380 \quad \text{b. } \{(380 - t, 220 + t, 50 + t, t)\} \quad \text{c. } w = 330, x = 270, y = 100 \\ w + x = 600 \\ x - y = 170 \\ y - z = 50 \\ 35. \text{ a. The system has no solution, so there is no way to satisfy these dietary requirements with no Food 1 available.} \\ \text{b. } 4 \text{ oz of Food 1, } 0 \text{ oz of Food 2, } 10 \text{ oz of Food 3; } 2 \text{ oz of Food 1, } 5 \text{ oz of Food 2, } 9 \text{ oz of Food 3 (other answers are possible).} \\ 41. \text{ does not make sense} \quad 43. \text{ does not make sense} \quad 45. a = 1 \text{ or } a = 3 \quad 47. -1 \quad 48. -12 \quad 49. 8$$

Section 8.3

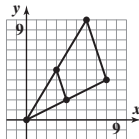
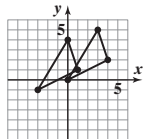
Check Point Exercises

1. a. 3×2 b. $a_{12} = -2; a_{31} = 1$ 2. a. $\begin{bmatrix} 2 & 0 \\ 9 & -10 \end{bmatrix}$ b. $\begin{bmatrix} 9 & -4 \\ -9 & 7 \\ 5 & -2 \end{bmatrix}$ 3. a. $\begin{bmatrix} 6 & 12 \\ -48 & -30 \end{bmatrix}$ b. $\begin{bmatrix} -14 & -1 \\ 25 & 10 \end{bmatrix}$ 4. $\begin{bmatrix} -4 & 3 \\ -3 & \frac{13}{3} \end{bmatrix}$

5. $\begin{bmatrix} 7 & 6 \\ 13 & 12 \end{bmatrix}$ 6. $[30]; \begin{bmatrix} 2 & 0 & 4 \\ 6 & 0 & 12 \\ 14 & 0 & 28 \end{bmatrix}$ 7. a. $\begin{bmatrix} 2 & 18 & 11 & 9 \\ 0 & 10 & 8 & 2 \end{bmatrix}$ b. The product is undefined.

8. $\begin{bmatrix} 2 & 1 & 1 \\ 2 & 1 & 1 \\ 2 & 2 & 1 \end{bmatrix} + \begin{bmatrix} -1 & 2 & 2 \\ -1 & 2 & 2 \\ -1 & -1 & 2 \end{bmatrix} = \begin{bmatrix} 1 & 3 & 3 \\ 1 & 3 & 3 \\ 1 & 1 & 3 \end{bmatrix}$

9. a. $\begin{bmatrix} 0 & 3 & 4 \\ 0 & 5 & 2 \end{bmatrix} + \begin{bmatrix} -3 & -3 & -3 \\ -1 & -1 & -1 \end{bmatrix} = \begin{bmatrix} -3 & 0 & 1 \\ -1 & 4 & 1 \end{bmatrix}$ b. $2 \begin{bmatrix} 0 & 3 & 4 \\ 0 & 5 & 2 \end{bmatrix} = \begin{bmatrix} 0 & 6 & 8 \\ 0 & 10 & 4 \end{bmatrix}$



c. $\begin{bmatrix} 0 & 3 & 4 \\ 0 & -5 & -2 \end{bmatrix}$; Multiplying by B reflects the triangle over the x -axis.

Exercise Set 8.3

1. a. 2×3 b. a_{32} does not exist; $a_{23} = -1$ 3. a. 3×4 b. $a_{32} = \frac{1}{2}; a_{23} = -6$ 5. $x = 6; y = 4$ 7. $x = 4; y = 6; z = 3$

9. a. $\begin{bmatrix} 9 & 10 \\ 3 & 9 \end{bmatrix}$ b. $\begin{bmatrix} -1 & -8 \\ 3 & -5 \end{bmatrix}$ c. $\begin{bmatrix} -16 & -4 \\ -12 & -8 \end{bmatrix}$ d. $\begin{bmatrix} 22 & 21 \\ 9 & 20 \end{bmatrix}$ 11. a. $\begin{bmatrix} 3 & 2 \\ 6 & 2 \\ 5 & 7 \end{bmatrix}$ b. $\begin{bmatrix} -1 & 4 \\ 0 & 6 \\ 5 & 5 \end{bmatrix}$ c. $\begin{bmatrix} -4 & -12 \\ -12 & -16 \\ -20 & -24 \end{bmatrix}$ d. $\begin{bmatrix} 7 & 7 \\ 15 & 8 \\ 15 & 20 \end{bmatrix}$

13. a. $\begin{bmatrix} -3 \\ -1 \\ 0 \end{bmatrix}$ b. $\begin{bmatrix} 7 \\ -7 \\ 2 \end{bmatrix}$ c. $\begin{bmatrix} -8 \\ 16 \\ -4 \end{bmatrix}$ d. $\begin{bmatrix} -4 \\ -6 \\ 1 \end{bmatrix}$ 15. a. $\begin{bmatrix} 8 & 0 & -4 \\ 14 & 0 & 6 \\ -1 & 0 & 0 \end{bmatrix}$ b. $\begin{bmatrix} -4 & -20 & 0 \\ 14 & 24 & 14 \\ 9 & -4 & 4 \end{bmatrix}$ c. $\begin{bmatrix} -8 & 40 & 8 \\ -56 & -48 & -40 \\ -16 & 8 & -8 \end{bmatrix}$ d. $\begin{bmatrix} 18 & -10 & -10 \\ 42 & 12 & 22 \\ 2 & -2 & 2 \end{bmatrix}$

17. $\begin{bmatrix} -8 & -8 \\ 2 & -9 \\ 8 & -4 \end{bmatrix}$ 19. $\begin{bmatrix} -1 & 3 \\ -1 & \frac{9}{2} \\ -1 & -2 \end{bmatrix}$ 21. $\begin{bmatrix} \frac{1}{3} & \frac{13}{3} \\ -\frac{4}{3} & 6 \\ -\frac{7}{3} & -\frac{4}{3} \end{bmatrix}$ 23. $\begin{bmatrix} 7 & 27 \\ -8 & 36 \\ -17 & -4 \end{bmatrix}$ 25. $\begin{bmatrix} \frac{27}{2} & \frac{31}{2} \\ -4 & 18 \\ -\frac{29}{2} & 6 \end{bmatrix}$ 27. a. $\begin{bmatrix} 0 & 16 \\ 12 & 8 \end{bmatrix}$ b. $\begin{bmatrix} -7 & 3 \\ 29 & 15 \end{bmatrix}$

29. a. $[30]$ b. $\begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 4 & 6 & 8 \\ 3 & 6 & 9 & 12 \\ 4 & 8 & 12 & 16 \end{bmatrix}$ 31. a. $\begin{bmatrix} 4 & -5 & 8 \\ 6 & -1 & 5 \\ 0 & 4 & -6 \end{bmatrix}$ b. $\begin{bmatrix} 5 & -2 & 7 \\ 17 & -3 & 2 \\ 3 & 0 & -5 \end{bmatrix}$ 33. a. $\begin{bmatrix} 6 & 8 & 16 \\ 11 & 16 & 24 \\ 1 & -1 & 12 \end{bmatrix}$ b. $\begin{bmatrix} 38 & 27 \\ -16 & -4 \end{bmatrix}$

35. a. $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ b. $\begin{bmatrix} 4 & -1 & -3 & 1 \\ -1 & 4 & -3 & 2 \\ 14 & -11 & -3 & -1 \\ 25 & -25 & 0 & -5 \end{bmatrix}$ 37. $\begin{bmatrix} 17 & 7 \\ -5 & -11 \end{bmatrix}$ 39. $\begin{bmatrix} 11 & -1 \\ -7 & -3 \end{bmatrix}$

41. $A - C$ is not defined because A is 3×2 and C is 2×2 . 43. $\begin{bmatrix} 16 & -16 \\ -12 & 12 \\ 0 & 0 \end{bmatrix}$ 45. $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

47. Answers will vary.; Example:

$$A(B + C) = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \left(\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} + \begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix} \right) = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

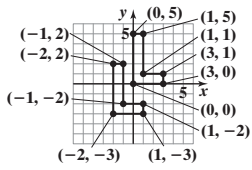
$$AB + AC = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} + \begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

So, $A(B + C) = AB + AC$.

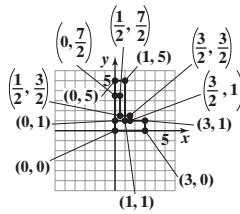
49. $\begin{bmatrix} x \\ -y \end{bmatrix}$; It changes the sign of the y -coordinate.

51. a. $\begin{bmatrix} 1 & 3 & 1 \\ 3 & 3 & 3 \\ 1 & 3 & 1 \end{bmatrix}$ b. $\begin{bmatrix} 1 & 3 & 1 \\ 3 & 3 & 3 \\ 1 & 3 & 1 \end{bmatrix} + \begin{bmatrix} -1 & -1 & -1 \\ -1 & -1 & -1 \\ -1 & -1 & -1 \end{bmatrix} = \begin{bmatrix} 0 & 2 & 0 \\ 2 & 2 & 2 \\ 0 & 2 & 0 \end{bmatrix}$ c. $\begin{bmatrix} 1 & 3 & 1 \\ 3 & 3 & 3 \\ 1 & 3 & 1 \end{bmatrix} + \begin{bmatrix} 1 & -2 & 1 \\ -2 & -2 & -2 \\ 1 & -2 & 1 \end{bmatrix} = \begin{bmatrix} 2 & 1 & 2 \\ 1 & 1 & 1 \\ 2 & 1 & 2 \end{bmatrix}$

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

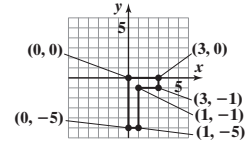


55. $\begin{bmatrix} 0 & \frac{3}{2} & \frac{3}{2} & \frac{1}{2} & \frac{1}{2} & 0 \\ 1 & 1 & \frac{3}{2} & \frac{3}{2} & \frac{7}{2} & \frac{7}{2} \end{bmatrix}$

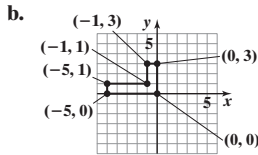


57. a. $\begin{bmatrix} 0 & 3 & 3 & 1 & 1 & 0 \\ 0 & 0 & -1 & -1 & -5 & -5 \end{bmatrix}$

b. The effect is a reflection across the x -axis.



59. a. $\begin{bmatrix} 0 & 0 & -1 & -1 & -5 & -5 \\ 0 & 3 & 3 & 1 & 1 & 0 \end{bmatrix}$



61. a. $A = \begin{bmatrix} 2 & 6 \\ 31 & 46 \end{bmatrix}$ b. $B = \begin{bmatrix} 9 & 29 \\ 65 & 77 \end{bmatrix}$

c. $B - A = \begin{bmatrix} 7 & 23 \\ 34 & 31 \end{bmatrix}$

The difference between the percentage of people completing the transition to adulthood in 1960 and 2000 by age and gender

The effect is a 90° counterclockwise rotation about the origin.

63. a. System 1: The midterm and final both count for 50% of the course grade. System 2: The midterm counts for 30% of the course grade and the final counts for 70%.

b. $\begin{bmatrix} 84 & 87.2 \\ 79 & 81 \\ 90 & 88.4 \\ 73 & 68.6 \\ 69 & 73.4 \end{bmatrix}$ System 1 grades are listed first (if different). Student 1: B; Student 2: C or B; Student 3: A or B; Student 4: C or D; Student 5: D or C

77. makes sense 79. makes sense 83. $AB = -BA$ so they are anticommutative.

85. $\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$; Nothing happens to the elements in the first matrix. 86. $\{(15, -12, -4)\}$ 87. $\begin{cases} a_1x + b_1y + c_1z = d_1 \\ a_2x + b_2y + c_2z = d_2 \\ a_3x + b_3y + c_3z = d_3 \end{cases}$

Mid-Chapter 8 Check Point

1. $\{(1, -1, 2)\}$ 2. \emptyset 3. $\left\{ \left(-\frac{4}{7} - \frac{4}{7}t, \frac{5}{7} + \frac{5}{7}t, t \right) \right\}$ 4. $\{(3, 6, -4, 1)\}$ 5. \emptyset 6. $\begin{bmatrix} -4 & -\frac{1}{2} \\ 3 & 3 \end{bmatrix}$ 7. $\begin{bmatrix} -12 & -2 \\ -21 & -4 \\ 3 & 1 \end{bmatrix}$ 8. $\begin{bmatrix} 12 & -4 \\ 22 & -7 \\ -4 & 1 \end{bmatrix}$

9. $A + C$ does not exist because A is 3×2 and C is 2×2 . 10. $\begin{bmatrix} \frac{1}{2} & \frac{1}{2} \\ -3 & \frac{1}{2} \end{bmatrix}$

Section 8.4

Check Point Exercises

1. $AB = I_2; BA = I_2$ 2. $\begin{bmatrix} 3 & -7 \\ -2 & 5 \end{bmatrix}$ 3. $\begin{bmatrix} 1 & 2 \\ 1 & 3 \end{bmatrix}$ 4. $\begin{bmatrix} 3 & -2 & -4 \\ 3 & -2 & -5 \\ -1 & 1 & 2 \end{bmatrix}$ 5. $\{(4, -2, 1)\}$ 6. The encoded message is $-7, 10, -53, 77$.

7. The decoded message is 2, 1, 19, 5 or BASE.

Exercise Set 8.4

1. $AB = I_2; BA = I_2; B = A^{-1}$ 3. $AB = \begin{bmatrix} 8 & -16 \\ -2 & 7 \end{bmatrix}; BA = \begin{bmatrix} 12 & 12 \\ 1 & 3 \end{bmatrix}; B \neq A^{-1}$ 5. $AB = I_2; BA = I_2; B = A^{-1}$

7. $AB = I_3; BA = I_3; B = A^{-1}$ 9. $AB = I_3; BA = I_3; B = A^{-1}$ 11. $AB = I_4; BA = I_4; B = A^{-1}$

13. $\begin{bmatrix} \frac{2}{7} & -\frac{3}{7} \\ \frac{1}{7} & \frac{2}{7} \end{bmatrix}$ 15. $\begin{bmatrix} 1 & \frac{1}{2} \\ 2 & \frac{3}{2} \end{bmatrix}$ 17. A does not have an inverse. 19. $\begin{bmatrix} \frac{1}{2} & 0 & 0 \\ 0 & \frac{1}{4} & 0 \\ 0 & 0 & \frac{1}{6} \end{bmatrix}$ 21. $\begin{bmatrix} 1 & 1 & 2 \\ 1 & 1 & 1 \\ 2 & 3 & 4 \end{bmatrix}$ 23. $\begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 2 \\ 3 & 2 & 6 \end{bmatrix}$

25. $\begin{bmatrix} -3 & 2 & -4 \\ -1 & 1 & -1 \\ 8 & -5 & 10 \end{bmatrix}$ 27. $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & \frac{1}{3} & 0 \\ -1 & 0 & 0 & 1 \end{bmatrix}$ 29. $\begin{bmatrix} 6 & 5 \\ 5 & 4 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 13 \\ 10 \end{bmatrix}$ 31. $\begin{bmatrix} 1 & 3 & 4 \\ 1 & 2 & 3 \\ 1 & 4 & 3 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -3 \\ -2 \\ -6 \end{bmatrix}$ 33. $\begin{cases} 4x - 7y = -3 \\ 2x - 3y = 1 \end{cases}$

35. $\begin{cases} 2x - z = 6 \\ 3y = 9 \\ x + y = 5 \end{cases}$ 37. a. $\begin{bmatrix} 2 & 6 & 6 \\ 2 & 7 & 6 \\ 2 & 7 & 7 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 8 \\ 10 \\ 9 \end{bmatrix}$ b. $\{(1, 2, -1)\}$ 39. a. $\begin{bmatrix} 1 & -1 & 1 \\ 0 & 2 & -1 \\ 2 & 3 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 8 \\ -7 \\ 1 \end{bmatrix}$ b. $\{(2, -1, 5)\}$

41. a. $\begin{bmatrix} 1 & -1 & 2 & 0 \\ 0 & 1 & -1 & 1 \\ -1 & 1 & -1 & 2 \\ 0 & -1 & 1 & -2 \end{bmatrix} \begin{bmatrix} w \\ x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -3 \\ 4 \\ 2 \\ -4 \end{bmatrix}$ b. $\{(2, 3, -1, 0)\}$ 43. $\begin{bmatrix} \frac{1}{2}e^{-x} & -\frac{1}{2}e^{-3x} \\ \frac{1}{2}e^{-3x} & \frac{1}{2}e^{-5x} \end{bmatrix}$ 45. $\begin{bmatrix} \frac{1}{8} & \frac{5}{8} \\ \frac{3}{8} & \frac{7}{8} \end{bmatrix}$

47. $(AB)^{-1} = \begin{bmatrix} -23 & 16 \\ 13 & -9 \end{bmatrix}; A^{-1}B^{-1} = \begin{bmatrix} -3 & 11 \\ 8 & -29 \end{bmatrix}; B^{-1}A^{-1} = \begin{bmatrix} -23 & 16 \\ 13 & -9 \end{bmatrix}; (AB)^{-1} = B^{-1}A^{-1}$ 49. $AA^{-1} = I_3$ and $A^{-1}A = I_3$

51. The encoded message is 27, -19, 32, -20.; The decoded message is 8, 5, 12, 16 or HELP.

53. The encoded message is 14, 85, -33, 4, 18, -7, -18, 19, -9.

65. $\begin{bmatrix} 1 & 1 \\ 2 & 3 \end{bmatrix}$ 67. $\begin{bmatrix} 1 & 0 & 1 \\ 2 & 1 & 3 \\ -1 & 1 & 1 \end{bmatrix}$ 69. $\begin{bmatrix} 0 & -1 & 0 & 1 \\ -1 & -5 & 0 & 3 \\ -2 & -4 & 1 & -2 \\ -1 & -4 & 0 & 1 \end{bmatrix}$ 71. $\{(2, 3, -5)\}$ 73. $\{(1, 2, -1)\}$ 75. $\{(2, 1, 3, -2, 4)\}$

79. does not make sense 81. makes sense 83. false 85. false 87. false 91. $a = 3$ or $a = -2$ 93. 2 94. 6 95. -31

Section 8.5

Check Point Exercises

1. a. -4 b. -17 2. $\{(4, -2)\}$ 3. 80 4. -24 5. $\{(2, -3, 4)\}$ 6. -250

Exercise Set 8.5

1. 1 3. -29 5. 0 7. 33 9. $-\frac{7}{16}$ 11. $\{(5, 2)\}$ 13. $\{(2, -3)\}$ 15. $\{(3, -1)\}$ 17. The system is dependent. 19. $\{(4, 2)\}$

21. $\{(7, 4)\}$ 23. The system is inconsistent. 25. The system is dependent. 27. 72 29. -75 31. 0 33. $\{(-5, -2, 7)\}$

35. $\{(2, -3, 4)\}$ 37. $\{(3, -1, 2)\}$ 39. $\{(2, 3, 1)\}$ 41. -200 43. 195 45. -42 47. $2x - 4y = 8; 3x + 5y = -10$

49. -11 51. 4 53. 28 sq units 55. yes 57. The equation of the line is $y = -\frac{11}{5}x + \frac{8}{5}$. 69. 13, 200 71. does not make sense

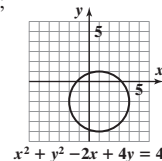
73. does not make sense 75. a. a^2 b. a^3 c. a^4 d. Each determinant has zeros below the main diagonal and a 's everywhere else.

e. Each determinant equals a raised to the power equal to the order of the determinant. 77. The sign of the value is changed when

2 columns are interchanged in a 2nd order determinant.

79. $\begin{bmatrix} x & y & 1 \\ x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \end{bmatrix} = x(y_1 - y_2) - y(x_1 - x_2) + (x_1y_2 - x_2y_1) = 0$; solving for y , $y = \frac{y_1 - y_2}{x_1 - x_2}x + \frac{x_1y_2 - x_2y_1}{x_1 - x_2}$, and $m = \frac{y_1 - y_2}{x_1 - x_2}$ and $b = \frac{x_1y_2 - x_2y_1}{x_1 - x_2}$.

81. a. -3 and 3 b. -2 and 2 82. $\frac{x^2}{16} + \frac{y^2}{25} = 1$ 83. $(x - 1)^2 + (y + 2)^2 = 9$; center: (1, -2); radius: 3;



Chapter 8 Review Exercises

1. $\begin{bmatrix} 1 & 2 & 2 & | & 2 \\ 0 & 1 & -1 & | & 2 \\ 0 & 0 & 9 & | & -9 \end{bmatrix}$ 2. $\begin{bmatrix} 1 & -1 & \frac{1}{2} & | & -\frac{1}{2} \\ 1 & 2 & -1 & | & 2 \\ 6 & 4 & 3 & | & 5 \end{bmatrix}$ 3. $\{(1, 3, -4)\}$ 4. $\{(-2, -1, 0)\}$ 5. $\{(2, -2, 3, 4)\}$

6. a. $a = -2; b = 32; c = 42$ b. 2:00 p.m.; 170 parts per million 7. capitalist: 1%; upper middle: 15%; lower middle: 34%; working: 30%

8. \emptyset 9. $\{(2t + 4, t + 1, t)\}$ 10. $\{(-37t + 2, 16t, -7t + 1, t)\}$ 11. $\{(7t + 18, -3t - 7, t)\}$

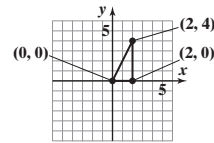
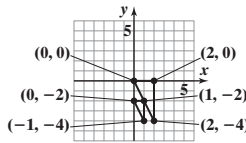
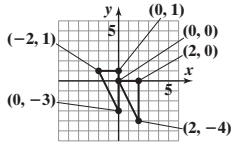
12. a. $x + z = 750$
 $y - z = -250$
 $x + y = 500$
 b. $\{(-t + 750, t - 250, t)\}$ c. $x = 350; y = 150$ 13. $x = -5; y = 6; z = 6$ 14. $\begin{bmatrix} 0 & 2 & 3 \\ 8 & 1 & 3 \end{bmatrix}$ 15. $\begin{bmatrix} 0 & -4 \\ 6 & 4 \\ 2 & -10 \end{bmatrix}$

16. $\begin{bmatrix} -4 & 4 & -1 \\ -2 & -5 & 5 \end{bmatrix}$ 17. Not possible since B is 3×2 and C is 3×3 . 18. $\begin{bmatrix} 2 & 3 & 8 \\ 21 & 5 & 5 \end{bmatrix}$ 19. $\begin{bmatrix} -12 & 14 & 0 \\ 2 & -14 & 18 \end{bmatrix}$ 20. $\begin{bmatrix} 0 & -10 & -15 \\ -40 & -5 & -15 \end{bmatrix}$

21. $\begin{bmatrix} -1 & -16 \\ 8 & 1 \end{bmatrix}$ 22. $\begin{bmatrix} -10 & -6 & 2 \\ 16 & 3 & 4 \\ -23 & -16 & 7 \end{bmatrix}$ 23. $\begin{bmatrix} -6 & 4 & -8 \\ 0 & 5 & 11 \\ -17 & 13 & -19 \end{bmatrix}$ 24. $\begin{bmatrix} 10 & 5 \\ -2 & -30 \end{bmatrix}$ 25. Not possible since AB is 2×2 and BA is 3×3 .

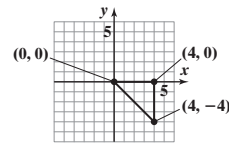
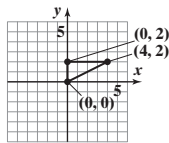
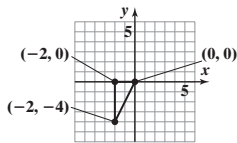
26. $\begin{bmatrix} 7 & 6 & 5 \\ 2 & -1 & 11 \end{bmatrix}$ 27. $\begin{bmatrix} -6 & -22 & -40 \\ 9 & 43 & 58 \\ -14 & -48 & -94 \end{bmatrix}$ 28. $\begin{bmatrix} -2 & -6 \\ 3 & \frac{1}{3} \end{bmatrix}$ 29. $\begin{bmatrix} 2 & 2 & 2 \\ 1 & 2 & 1 \\ 1 & 2 & 1 \end{bmatrix}$ 30. $\begin{bmatrix} 1 & 1 & 1 \\ -1 & 1 & -1 \\ -1 & 1 & -1 \end{bmatrix}$

31. $\begin{bmatrix} -2 & 0 & 0 \\ 1 & 1 & -3 \end{bmatrix}$ 32. $\begin{bmatrix} 0 & 1 & 1 \\ -2 & -2 & -4 \end{bmatrix}$ 33. $\begin{bmatrix} 0 & 2 & 2 \\ 0 & 0 & 4 \end{bmatrix}$



The effect is a reflection over the x -axis

34. $\begin{bmatrix} 0 & -2 & -2 \\ 0 & 0 & -4 \end{bmatrix}$ 35. $\begin{bmatrix} 0 & 0 & 4 \\ 0 & 2 & 2 \end{bmatrix}$ 36. $\begin{bmatrix} 0 & 4 & 4 \\ 0 & 0 & -4 \end{bmatrix}$



The effect is a reflection over the y -axis

The effect is a 90° counterclockwise rotation about the origin

The effect is a horizontal stretch by a factor of 2.

37. $AB = \begin{bmatrix} 1 & 7 \\ 0 & 5 \end{bmatrix}; BA = \begin{bmatrix} 1 & 0 \\ 1 & 5 \end{bmatrix}; B \neq A^{-1}$ 38. $AB = I_3; BA = I_3; B = A^{-1}$ 39. $\begin{bmatrix} 3 & 1 \\ 2 & 1 \end{bmatrix}$ 40. $\begin{bmatrix} -\frac{3}{5} & \frac{1}{5} \\ 1 & 0 \end{bmatrix}$ 41. $\begin{bmatrix} 3 & 0 & -2 \\ -6 & 1 & 4 \\ 1 & 0 & -1 \end{bmatrix}$

42. $\begin{bmatrix} 8 & -8 & 5 \\ -3 & 2 & -1 \\ -1 & -1 & 1 \end{bmatrix}$ 43. a. $\begin{bmatrix} 1 & 1 & 2 \\ 0 & 1 & 3 \\ 3 & 0 & -2 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 7 \\ -2 \\ 0 \end{bmatrix}$ b. $\{(-18, 79, -27)\}$ 44. a. $\begin{bmatrix} 1 & -1 & 2 \\ 0 & 1 & -1 \\ 1 & 0 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 12 \\ -5 \\ 10 \end{bmatrix}$

b. $\{(4, -2, 3)\}$ 45. The encoded message is 96, 135, 46, 63; The decoded message is 18, 21, 12, 5 or RULE. 46. 17 47. 4
 48. -86 49. -236 50. 4 51. 16 52. $\left\{\left(\frac{7}{4}, -\frac{25}{8}\right)\right\}$ 53. $\{(2, -7)\}$ 54. $\{(23, -12, 3)\}$ 55. $\{(-3, 2, 1)\}$

56. $a = \frac{5}{8}; b = -50; c = 1150$; 30- and 50-year-olds are involved in an average of 212.5 automobile accidents per day.

Chapter 8 Test

1. $\left\{\left(-3, \frac{1}{2}, 1\right)\right\}$ 2. $\{(t, t - 1, t)\}$ 3. $\begin{bmatrix} 5 & 4 \\ 1 & 11 \end{bmatrix}$ 4. $\begin{bmatrix} 5 & -2 \\ 1 & -1 \\ 4 & -1 \end{bmatrix}$ 5. $\begin{bmatrix} \frac{3}{5} & -\frac{2}{5} \\ \frac{1}{5} & \frac{1}{5} \end{bmatrix}$ 6. $\begin{bmatrix} -1 & 2 \\ -5 & 4 \end{bmatrix}$ 7. $AB = I_3; BA = I_3$

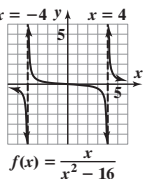
8. a. $\begin{bmatrix} 3 & 5 \\ 2 & -3 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 9 \\ -13 \end{bmatrix}$ b. $\begin{bmatrix} \frac{3}{19} & \frac{5}{19} \\ \frac{2}{19} & -\frac{3}{19} \end{bmatrix}$ c. $\{(-2, 3)\}$ 9. 18 10. $x = 2$

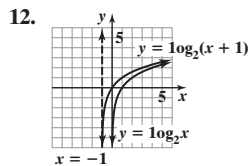
Cumulative Review Exercises (Chapters P-8)

1. $\left\{\frac{-1 + \sqrt{33}}{4}, \frac{-1 - \sqrt{33}}{4}\right\}$ 2. $\left[\frac{1}{2}, \infty\right)$ 3. $[-2, -1] \cup [2, \infty)$ 4. $\left\{-4, \frac{1}{3}, 1\right\}$ 5. $\{\ln 5, \ln 9\}$ 6. $\{1\}$ 7. $\{(7, -4, 6)\}$

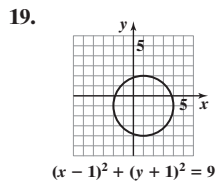
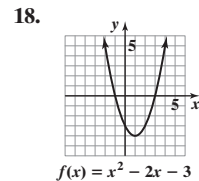
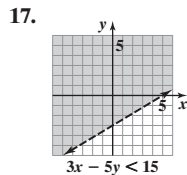
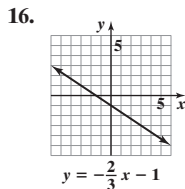
8. $y = -1$ 9. $f^{-1}(x) = \frac{x^2 + 7}{4} (x \geq 0)$

10. $x = -4$ $y = 4$ 11. $f(x) = (x + 2)(x - 3)(2x + 1)(2x - 1)$ 13. a. $A = 900e^{-0.017t}$ b. 759.30 g

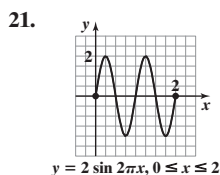




14. $\begin{bmatrix} 2 & -1 \\ 13 & 1 \end{bmatrix}$ 15. $\frac{8}{x-3} + \frac{-2}{x-2} + \frac{-3}{x+2}$



20. $x^2 + 2x - 2$



22. $\frac{3}{5}$

23. $\frac{\cos 2x}{\cos x - \sin x} = \frac{\cos^2 x - \sin^2 x}{\cos x - \sin x} = \frac{(\cos x + \sin x)(\cos x - \sin x)}{\cos x - \sin x} = \cos x + \sin x$

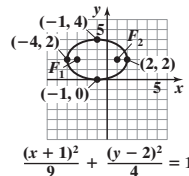
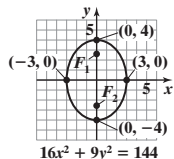
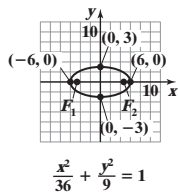
24. $\frac{3\pi}{2}$ 25. $2i - 13j$

CHAPTER 9

Section 9.1

Check Point Exercises

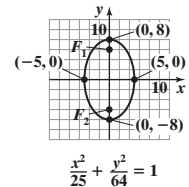
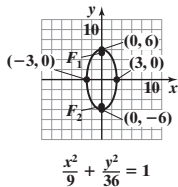
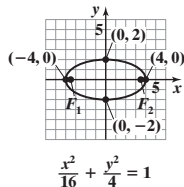
1. foci at $(-3\sqrt{3}, 0)$ and $(3\sqrt{3}, 0)$ 2. foci at $(0, -\sqrt{7})$ and $(0, \sqrt{7})$ 3. $\frac{x^2}{9} + \frac{y^2}{5} = 1$ 4. foci at $(-1 - \sqrt{5}, 2)$ and $(-1 + \sqrt{5}, 2)$



5. Yes

Exercise Set 9.1

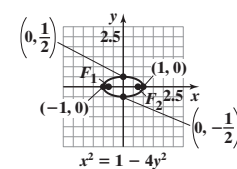
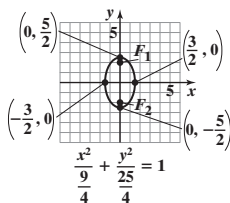
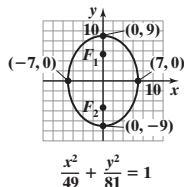
1. foci at $(-2\sqrt{3}, 0)$ and $(2\sqrt{3}, 0)$ 3. foci at $(0, -3\sqrt{3})$ and $(0, 3\sqrt{3})$ 5. foci at $(0, -\sqrt{39})$ and $(0, \sqrt{39})$



7. foci at $(0, -4\sqrt{2})$ and $(0, 4\sqrt{2})$

9. foci at $(0, -2)$ and $(0, 2)$

11. foci at $(-\frac{\sqrt{3}}{2}, 0)$ and $(\frac{\sqrt{3}}{2}, 0)$



13. foci at $(0, -\sqrt{21})$ and $(0, \sqrt{21})$

15. foci at $(-2\sqrt{3}, 0)$ and $(2\sqrt{3}, 0)$

17. foci at $(0, -\sqrt{2})$ and $(0, \sqrt{2})$

