

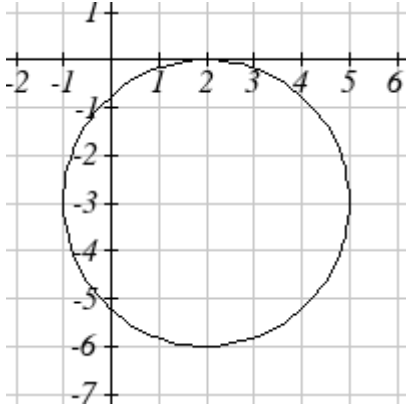
## **Solutions to Selected Exercises**

## Chapter 5

### Section 5.1

1. 10

5.  $(x-7)^2 + (y+2)^2 = 293$



9.

11.  $(0, 3 + \sqrt{5})$  and  $(0, 3 - \sqrt{5})$

15.  $(-1.07335, 2.8533)$

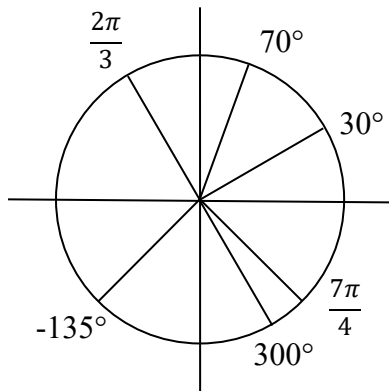
3.  $(x-8)^2 + (y+10)^2 = 8^2$

7.  $(x-5)^2 + (y-8)^2 = 13$

13.  $(1.3416407865, 7.683281573)$

17. 29.87 miles

### Section 5.2



1.

3.  $\pi$

9.  $54^\circ$

15. 35 miles

21.  $28.6479^\circ$

25. 3960 rad/min 630.254 RPM

27. 2.094 in/sec,  $\pi/12$  rad/sec, 2.5 RPM

29. 75,398.22 mm/min = 1.257 m/sec

31. Angular speed:  $\pi/12$  rad/hr. Linear speed: 1036.73 miles/hr

5.  $150^\circ$

11.  $\frac{8\pi}{9}$

17.  $8\pi$  cm

23.  $14.1372 \text{ cm}^2$

7.  $325^\circ$

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

19. 5.7596 miles

## Section 5.3

1. a. III b. II

3.  $-\frac{4}{5}$

5.  $-\frac{4\sqrt{3}}{7}$

7.  $-\frac{\sqrt{55}}{8}$

9. a. reference:  $45^\circ$ . Quadrant III.  $\sin(225^\circ) = -\frac{\sqrt{2}}{2}$ .  $\cos(225^\circ) = -\frac{\sqrt{2}}{2}$

b. reference:  $60^\circ$ . Quadrant IV.  $\sin(300^\circ) = -\frac{\sqrt{3}}{2}$ .  $\cos(300^\circ) = \frac{1}{2}$

c. reference:  $45^\circ$ . Quadrant II.  $\sin(135^\circ) = \frac{\sqrt{2}}{2}$ .  $\cos(135^\circ) = -\frac{\sqrt{2}}{2}$

d. reference:  $30^\circ$ . Quadrant III.  $\sin(210^\circ) = -\frac{1}{2}$ .  $\cos(210^\circ) = -\frac{\sqrt{3}}{2}$

11. a. reference:  $\frac{\pi}{4}$ . Quadrant III.  $\sin\left(\frac{5\pi}{4}\right) = -\frac{\sqrt{2}}{2}$ .  $\cos\left(\frac{5\pi}{4}\right) = -\frac{\sqrt{2}}{2}$

b. reference:  $\frac{\pi}{6}$ . Quadrant III.  $\sin\left(\frac{7\pi}{6}\right) = -\frac{1}{2}$ .  $\cos\left(\frac{7\pi}{6}\right) = -\frac{\sqrt{3}}{2}$

c. reference:  $\frac{\pi}{3}$ . Quadrant IV.  $\sin\left(\frac{5\pi}{3}\right) = -\frac{\sqrt{3}}{2}$ .  $\cos\left(\frac{5\pi}{3}\right) = \frac{1}{2}$

d. reference:  $\frac{\pi}{4}$ . Quadrant II.  $\sin\left(\frac{3\pi}{4}\right) = \frac{\sqrt{2}}{2}$ .  $\cos\left(\frac{3\pi}{4}\right) = -\frac{\sqrt{2}}{2}$

13. a.  $\sin\left(-\frac{3\pi}{4}\right) = -\frac{\sqrt{2}}{2}$   $\cos\left(-\frac{3\pi}{4}\right) = -\frac{\sqrt{2}}{2}$

b.  $\sin\left(\frac{23\pi}{6}\right) = -\frac{1}{2}$   $\cos\left(\frac{23\pi}{6}\right) = \frac{\sqrt{3}}{2}$

c.  $\sin\left(-\frac{\pi}{2}\right) = -1$   $\cos\left(-\frac{\pi}{2}\right) = 0$

d.  $\sin(5\pi) = 0$   $\cos(5\pi) = -1$

15. a.  $\frac{2\pi}{3}$  b.  $100^\circ$  c.  $40^\circ$  d.  $\frac{5\pi}{3}$  e.  $235^\circ$

17. a.  $\frac{5\pi}{3}$  b.  $280^\circ$  c.  $220^\circ$  d.  $\frac{2\pi}{3}$  e.  $55^\circ$

19.  $(-11.491, -9.642)$

**Section 5.4**

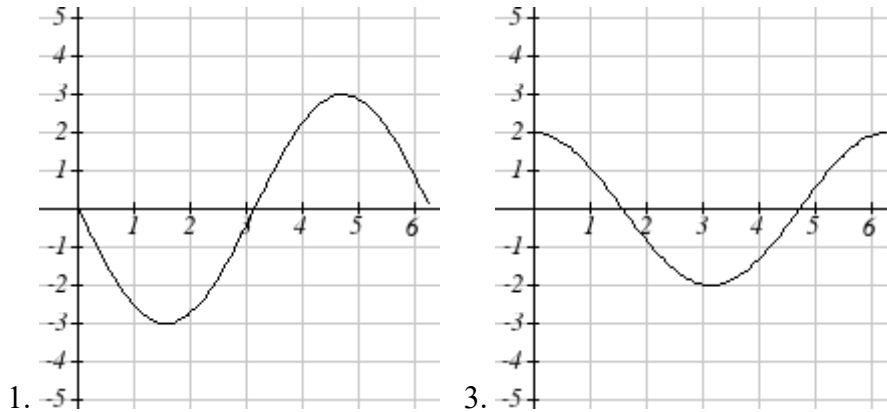
1.  $\sec(\theta) = \sqrt{2}$ ,  $\csc(\theta) = \sqrt{2}$ ,  $\tan(\theta) = 1$ ,  $\cot(\theta) = 1$
3.  $\sec(\theta) = -\frac{2\sqrt{3}}{3}$ ,  $\csc(\theta) = 2$ ,  $\tan(\theta) = -\frac{\sqrt{3}}{3}$ ,  $\cot(\theta) = -\sqrt{3}$
5.  $\sec(\theta) = -2$ ,  $\csc(\theta) = \frac{2\sqrt{3}}{3}$ ,  $\tan(\theta) = -\sqrt{3}$ ,  $\cot(\theta) = -\frac{\sqrt{3}}{3}$
7. a.  $\sec(135^\circ) = -\sqrt{2}$    b.  $\csc(210^\circ) = -2$    c.  $\tan(60^\circ) = \sqrt{3}$    d.  $\cot(225^\circ) = 1$
9.  $\cos(\theta) = -\frac{\sqrt{7}}{4}$ ,  $\sec(\theta) = -\frac{4\sqrt{7}}{7}$ ,  $\csc(\theta) = \frac{4}{3}$ ,  $\tan(\theta) = -\frac{3\sqrt{7}}{7}$ ,  $\cot(\theta) = -\frac{\sqrt{7}}{3}$
11.  $\sin(\theta) = -\frac{2\sqrt{2}}{3}$ ,  $\csc(\theta) = -\frac{3\sqrt{2}}{4}$ ,  $\sec(\theta) = -3$ ,  $\tan(\theta) = 2\sqrt{2}$ ,  $\cot(\theta) = \frac{\sqrt{2}}{4}$
13.  $\sin(\theta) = \frac{12}{13}$ ,  $\cos(\theta) = \frac{5}{13}$ ,  $\sec(\theta) = \frac{13}{5}$ ,  $\csc(\theta) = \frac{13}{12}$ ,  $\cot(\theta) = \frac{5}{12}$
15. a.  $\sin(0.15) = 0.1494$     $\cos(0.15) = 0.9888$     $\tan(0.15) = 0.1511$   
 b.  $\sin(4) = -0.7568$     $\cos(4) = -0.6536$     $\tan(4) = 1.1578$   
 c.  $\sin(70^\circ) = 0.9397$     $\cos(70^\circ) = 0.3420$     $\tan(70^\circ) = 2.7475$   
 d.  $\sin(283^\circ) = -0.9744$     $\cos(283^\circ) = 0.2250$     $\tan(283^\circ) = -4.3315$
17.  $\sec(t)$    19.  $\tan(t)$    21.  $\tan(t)$    23.  $\cot(t)$    25.  $(\sec(t))^2$

**Section 5.5**

1.  $\sin(A) = \frac{5\sqrt{41}}{41}$ ,  $\cos(A) = \frac{4\sqrt{41}}{41}$ ,  $\tan(A) = \frac{5}{4}$   
 $\sec(A) = \frac{\sqrt{41}}{4}$ ,  $\csc(A) = \frac{\sqrt{41}}{5}$ ,  $\cot(A) = \frac{4}{5}$
3.  $c = 14$ ,  $b = 7\sqrt{3}$ ,  $B = 60^\circ$    5.  $a = 5.3171$ ,  $c = 11.3257$ ,  $A = 28^\circ$
7.  $a = 9.0631$ ,  $b = 4.2262$ ,  $B = 25^\circ$    9. 32.4987 ft
11. 836.2698 ft   13. 460.4069 ft
15. 660.35 feet   17. 28.025 ft
19. 143.0427   21. 86.6685

## Chapter 6

### Section 6.1



1.  $f(t) = 3 \sin(\pi t) - 4$
5. Amp: 3. Period= 2. Midline:  $y = -4$ .  $f(t) = 3 \sin(\pi t) - 4$
7. Amp: 2. Period=  $4\pi$ . Midline:  $y = 1$ .  $f(t) = 2 \cos\left(\frac{1}{2}t\right) + 1$
9. Amp: 2. Period= 5. Midline:  $y = 3$ .  $f(t) = -2 \cos\left(\frac{2\pi}{5}t\right) + 3$
11. Amp: 3, Period =  $\frac{\pi}{4}$ , Shift: 4 left, Midline:  $y = 5$
13. Amp: 2, Period =  $\frac{2\pi}{3}$ , Shift: 7 right, Midline:  $y = 4$
15. Amp: 1, Period = 12, Shift: 6 left, Midline:  $y = -3$
17.  $f(x) = 4 \sin\left(\frac{\pi}{5}(x+1)\right)$
19.  $f(x) = \cos\left(\frac{\pi}{5}(x+2)\right)$
21.  $D(t) = 50 - 7 \sin\left(\frac{\pi}{12}t\right)$
- 23 a. Amp: 12.5. Midline:  $y = 13.5$ . Period: 10
- b.  $h(t) = -12.5 \cos\left(\frac{\pi}{5}t\right) + 13.5$
- c.  $h(5) = 26$  meters

## Section 6.2

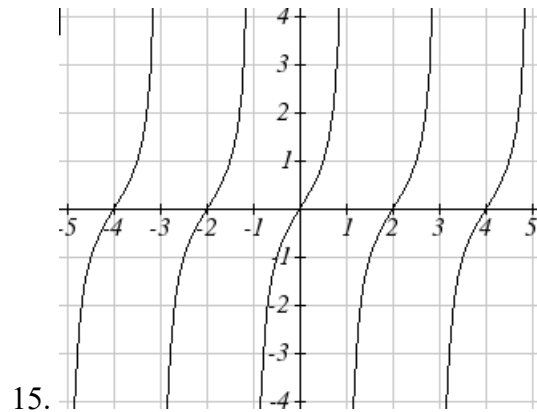
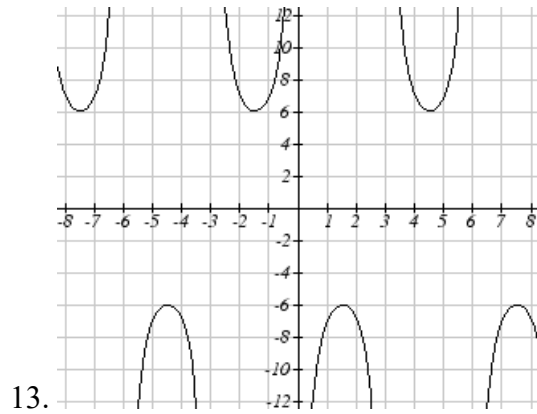
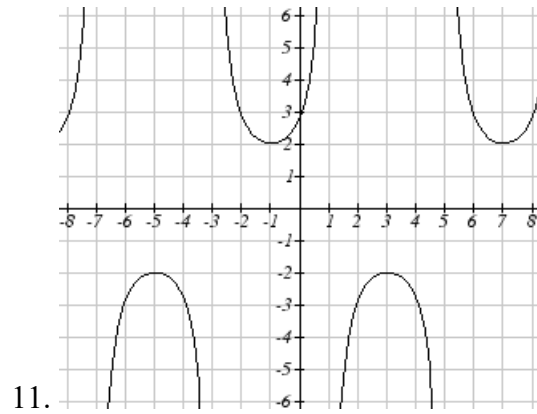
1. II

3. I

5. Period:  $\frac{\pi}{4}$ . Horizontal shift: 8 right

7. Period: 8. Horizontal shift: 1 left

9. Period: 6. Horizontal shift: 3 left



17.  $f(x) = 2 \sec\left(\frac{\pi}{2}x\right) - 1$

21.  $\tan(-x) = 1.5$

25.  $\csc(-x) = 5$

19.  $f(x) = 2 \csc\left(\frac{\pi}{4}x\right) + 1$

23.  $\sec(-x) = 2$

27.  $-\csc(x)$

**Section 6.3**

1.  $\frac{\pi}{4}$

3.  $-\frac{\pi}{6}$

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

7.  $\frac{3\pi}{4}$

9.  $\frac{\pi}{4}$

11.  $-\frac{\pi}{3}$

13. 1.9823

15. -0.9273

17. 44.427°

19.  $\frac{\pi}{4}$

21.  $-\frac{\pi}{6}$

23.  $\frac{2\sqrt{10}}{7}$

25.  $\frac{1}{\sqrt{17}}$

27.  $\frac{\sqrt{25-x^2}}{5}$

29.  $\frac{3x}{\sqrt{9x^2+1}}$

**Section 6.4**

1.  $\frac{5\pi}{4}, \frac{7\pi}{4}$

3.  $\frac{\pi}{3}, \frac{5\pi}{3}$

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

7.  $\frac{\pi}{2}, \frac{3\pi}{2}$

9.  $\frac{\pi}{4} + 2\pi k, \frac{7\pi}{4} + 2\pi k$ , where  $k$  is an integer

11.  $\frac{7\pi}{6} + 2\pi k, \frac{11\pi}{6} + 2\pi k$ , where  $k$  is an integer

13.  $\frac{\pi}{18} + \frac{2\pi}{3}k, \frac{5\pi}{18} + \frac{2\pi}{3}k$ , where  $k$  is an integer

15.  $\frac{5\pi}{12} + \frac{2\pi}{3}k, \frac{7\pi}{12} + \frac{2\pi}{3}k$ , where  $k$  is an integer

17.  $\frac{\pi}{6} + \pi k, \frac{5\pi}{6} + \pi k$ , where  $k$  is an integer

19.  $\frac{\pi}{4} + \frac{2\pi}{3}k, \frac{5\pi}{12} + \frac{2\pi}{3}k$ , where  $k$  is an integer

21.  $4 + 8k$ , where  $k$  is an integer

23.  $\frac{1}{6} + 2k, \frac{5}{6} + 2k$ , where  $k$  is an integer

25. 0.2734, 2.8682

27. 3.7603, 5.6645

29. 2.1532, 4.1300

31. 0.7813, 5.5019

33. 0.04829, 0.47531

35. 0.7381, 1.3563

37. 0.9291, 3.0709

39. 1.3077, 4.6923

**Section 6.5**

1.  $c = \sqrt{89}$ ,  $A = 57.9946^\circ$ ,  $B = 32.0054^\circ$

3.  $b = \sqrt{176}$ ,  $A = 27.8181^\circ$ ,  $B = 62.1819^\circ$

5.  $y(x) = 6 \sin\left(\frac{\pi}{2}(x-1)\right) + 4$

7.  $D(t) = 50 - 13 \cos\left(\frac{\pi}{12}(t-5)\right)$

9. a.  $P(t) = 129 - 25 \cos\left(\frac{\pi}{6}t\right)$     b.  $P(t) = 129 - 25 \cos\left(\frac{\pi}{6}(t-3)\right)$

11. 75 degrees

13. 8

15. 2.80869431742

17. 5.035 months

**Chapter 7****Section 7.1**

1.  $\frac{7\pi}{6}, \frac{11\pi}{6}$

3.  $\frac{\pi}{3}, \frac{5\pi}{3}$

5.  $\frac{2}{3} + 8k$ , and  $\frac{10}{3} + 8k$ , where  $k$  is an integer

7.  $\frac{5\pi}{12} + k\pi$  and  $\frac{7\pi}{12} + k\pi$ , where  $k$  is an integer

9.  $1.3386 + 10k$  and  $8.6614 + 10k$ , where  $k$  is an integer

11.  $-0.0966 + \frac{2\pi}{3}k$  and  $1.1438 + \frac{2\pi}{3}k$ , where  $k$  is an integer

13.  $\frac{\pi}{2}, \frac{3\pi}{2}, 0.644, 2.498$

15. 0.056, 1.515, 3.197, 4.647

17.  $0, \pi, \frac{\pi}{3}, \frac{5\pi}{3}$

19.  $\frac{\pi}{6}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6}$

21. 1.183, 1.958, 4.325, 5.100

23.  $\frac{3\pi}{2}, \frac{7\pi}{6}, \frac{11\pi}{6}$

25.  $\pi, \frac{\pi}{3}, \frac{5\pi}{3}$

27. 1.823, 4.460

29. 2.301, 3.983, 0.723, 5.560

31. 3.305, 6.120



33.  $0, \frac{\pi}{3}, \frac{2\pi}{3}, \pi, \frac{4\pi}{3}, \frac{5\pi}{3}$

35.  $0, \frac{\pi}{4}, \frac{3\pi}{4}, \pi, \frac{5\pi}{4}, \frac{7\pi}{4}$

37.  $\frac{\pi}{6}, \frac{2\pi}{3}, \frac{5\pi}{6}, \frac{4\pi}{3}$

39.  $0, \pi, 1.231, 5.052$

41.  $\frac{\pi}{3}, \frac{5\pi}{3}$

**Section 7.2**

1.  $\frac{\sqrt{2} + \sqrt{6}}{4}$

3.  $\frac{-\sqrt{2} - \sqrt{6}}{4}$

5.  $\frac{\sqrt{2} - \sqrt{6}}{4}$

7.  $\frac{\sqrt{2} + \sqrt{6}}{4}$

9.  $\frac{\sqrt{3}}{2} \sin(x) - \frac{1}{2} \cos(x)$

11.  $-\frac{\sqrt{3}}{2} \cos(x) + \frac{1}{2} \sin(x)$

13.  $\sec(t)$

15.  $\tan(x)$

17.  $8(\cos(5x) - \cos(27x))$

19.  $\sin(8x) + \sin(2x)$

21.  $2 \cos(5t) \cos(t)$

23.  $2 \sin(5x) \cos(2x)$

25. a.  $\left(\frac{2}{3}\right)\left(-\frac{1}{4}\right) + \left(-\frac{\sqrt{5}}{3}\right)\left(\frac{\sqrt{15}}{4}\right) = \frac{-2 - 5\sqrt{3}}{12}$

b.  $\left(-\frac{\sqrt{5}}{3}\right)\left(-\frac{1}{4}\right) + \left(\frac{2}{3}\right)\left(\frac{\sqrt{15}}{4}\right) = \frac{\sqrt{5} + 2\sqrt{15}}{12}$

27.  $0.373 + \frac{2\pi}{3}k$  and  $0.674 + \frac{2\pi}{3}k$ , where  $k$  is an integer

29.  $2\pi k$ , where  $k$  is an integer

31.  $\frac{\pi}{7} + \frac{4\pi}{7}k$ ,  $\frac{3\pi}{7} + \frac{4\pi}{7}k$ ,  $\frac{\pi}{3} + \frac{4\pi}{3}k$ , and  $\pi + \frac{4\pi}{3}k$ , where  $k$  is an integer

33.  $\frac{7\pi}{12} + \pi k$ ,  $\frac{11\pi}{12} + \pi k$ , and  $\frac{\pi}{4}k$ , where  $k$  is an integer

35.  $2\sqrt{13}\sin(x + 5.3004)$  or  $2\sqrt{13}\sin(x - 0.9828)$

37.  $\sqrt{29}\sin(3x + 0.3805)$

39.  $0.3681, 3.8544$

41.  $0.7854, 1.8158$

43.  $\tan(6t)$

**Section 7.3**

1. a.  $\frac{3\sqrt{7}}{32}$    b.  $\frac{31}{32}$    c.  $\frac{3\sqrt{7}}{31}$       3.  $\cos(56^\circ)$
5.  $\cos(34^\circ)$       7.  $\cos(18x)$
9.  $2\sin(16x)$       11.  $0, \pi, 2.4189, 3.8643$
13.  $0.7297, 2.4119, 3.8713, 5.5535$
15.  $\frac{\pi}{6}, \frac{\pi}{2}, \frac{5\pi}{6}, \frac{3\pi}{2}$
17. a.  $\frac{2\pi}{9}, \frac{4\pi}{9}, \frac{8\pi}{9}, \frac{10\pi}{9}, \frac{14\pi}{9}, \frac{16\pi}{9}, 0, \frac{2\pi}{3}, \frac{4\pi}{3}$
19.  $\frac{1+\cos(10x)}{2}$
21.  $\frac{3}{8} - \frac{1}{2}\cos(16x) + \frac{1}{8}\cos(32x)$
23.  $\frac{1}{16} - \frac{1}{16}\cos(2x) - \frac{1}{16}\cos(4x) + \frac{1}{16}\cos(2x)\cos(4x)$
25. a.  $\sqrt{\frac{1}{2} + \frac{2\sqrt{3}}{7}}$    b.  $\sqrt{\frac{1}{2} - \frac{2\sqrt{3}}{7}}$    c.  $\frac{1}{7-4\sqrt{3}}$

**Section 7.4**

1.  $y = 3\sin\left(\frac{\pi}{6}(x-3)\right) - 1$
3. Amplitude: 8, Period:  $\frac{1}{3}$  second, Frequency: 3 Hz (cycles per second)
5.  $P(t) = -19\cos\left(\frac{\pi}{6}t\right) + \frac{40}{3}t + 650$       7.  $P(t) = -33\cos\left(\frac{\pi}{6}t\right) + 900(1.07)^t$

9.  $D(t) = 10(0.85)^t \cos(36\pi t)$

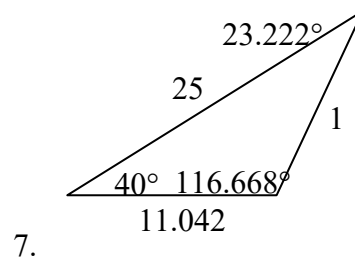
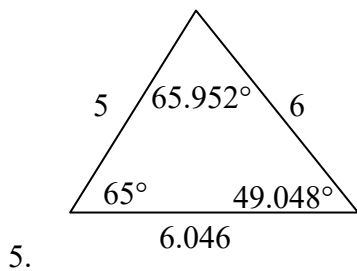
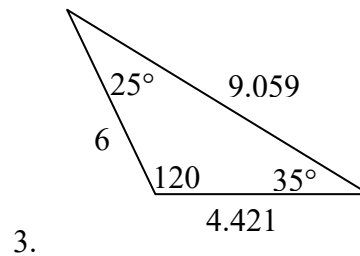
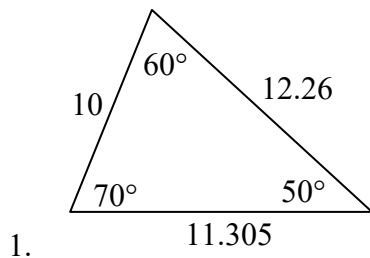
11.  $D(t) = 17(0.9145)^t \cos(28\pi t)$

13. a. IV   b. III

15.  $y = 6(4)^x + 5 \sin\left(\frac{\pi}{2}x\right)$

17.  $y = -3 \sin\left(\frac{\pi}{2}\right) + 2x + 7$

19.  $y = 8\left(\frac{1}{2}\right)^x \cos\left(\frac{\pi}{2}x\right) + 3$

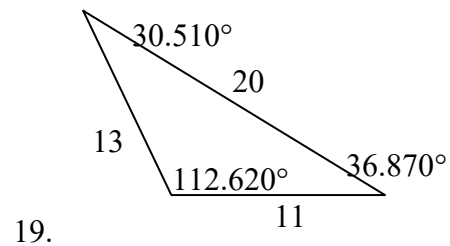
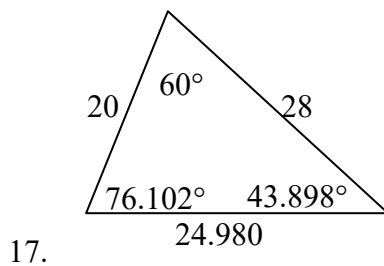
**Chapter 8****Section 8.1**

9.  $\beta = 68^\circ, a = 14.711, c = 20.138$

11.  $\beta = 28.096^\circ, \gamma = 32.904^\circ, c = 16.149$

13. Not possible.

15.  $\beta = 64.243^\circ, \gamma = 72.657^\circ, c = 257.328$  OR  $\beta = 115.757^\circ, \gamma = 21.143^\circ, c = 97.238$



21.  $c = 2.066, \alpha = 52.545^\circ, \beta = 86.255^\circ$

23.  $a = 11.269, \beta = 27.457^\circ, \gamma = 32.543^\circ$

25. 177.562

27. 978.515 ft

29. Distance to A: 565.258 ft. Distance to shore: 531.169 ft

31. 529.014 m

33. 173.877 feet

35. 4.642 km, 2.794 km

37. 757.963 ft

39. 2371.129 miles

41.  $65.375 \text{ cm}^2$

43. 7.72

**Section 8.2**

1.  $\left(-\frac{7\sqrt{3}}{2}, -\frac{7}{2}\right)$

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

5.  $(3\sqrt{2}, -3\sqrt{2})$

7. (0, 3)

9.  $\left(-\frac{3\sqrt{3}}{2}, -\frac{3}{2}\right)$

11. (-1.248, 2.728)

13.  $(2\sqrt{5}, 0.464)$

15.  $(2\sqrt{13}, 2.159)$

17.  $(\sqrt{34}, 5.253)$

19.  $(\sqrt{269}, 4.057)$

21.  $r = 3\sec(\theta)$

23.  $r = \frac{\sin(\theta)}{4\cos^2(\theta)}$

25.  $r = 4\sin(\theta)$

27.  $r = \frac{\cos(\theta)}{(\cos^2(\theta) - \sin^2(\theta))}$

29.  $x^2 + y^2 = 3y$

31.  $y + 7x = 4$

33.  $x = 2$

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

37. A

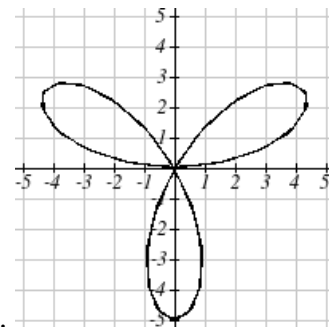
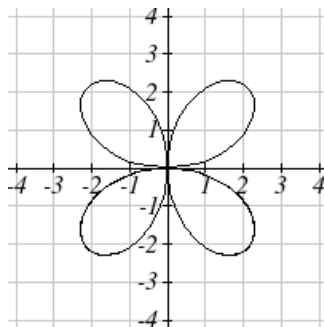
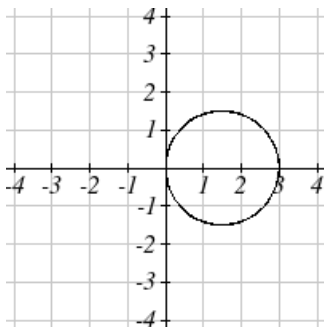
39. C

41. E

43. C

45. D

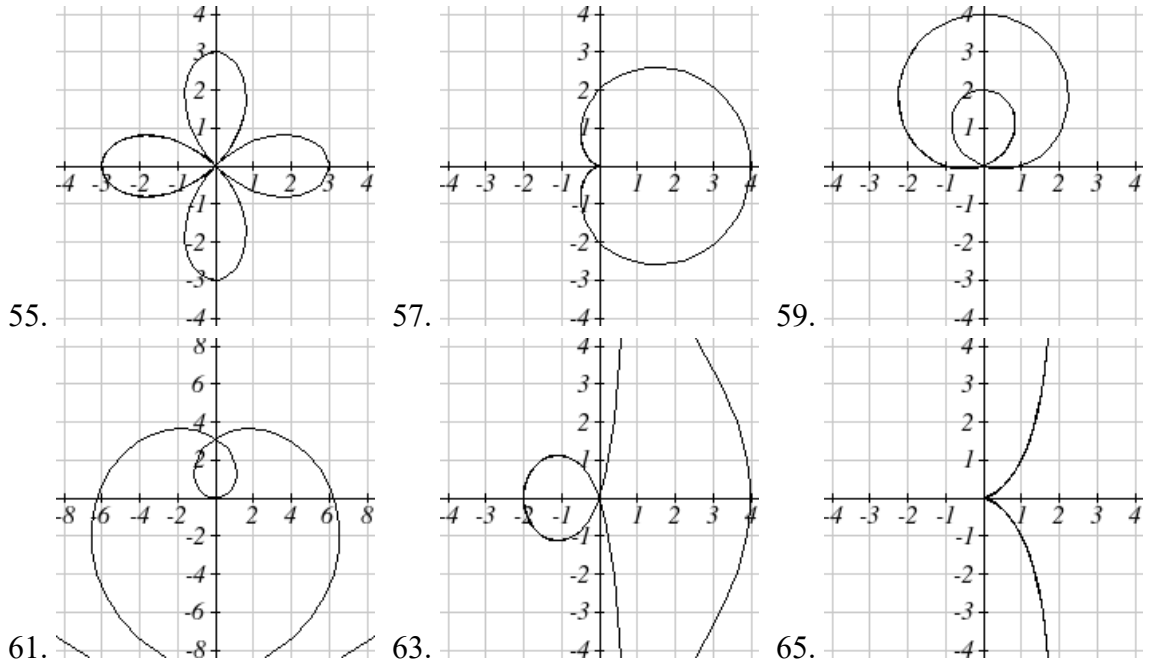
47. F



49.

51.

53.



### Section 8.3

1.  $3i$

5.  $1 + \sqrt{3}i$

9.  $-11 + 4i$

13.  $30 - 10i$

17. 20

21.  $\frac{3}{2} + \frac{5}{2}i$

25.  $-1$

29.  $3 \cos(2) + 3 \sin(2)i = -1.248 + 2.728i$

31.  $3\sqrt{3} + 3i$

35.  $6e^{0i}$

39.  $2\sqrt{2}e^{\frac{\pi}{4}i}$

43.  $\sqrt{34}e^{0.540i}$

47.  $\sqrt{17}e^{4.467i}$

51.  $6e^{\frac{5\pi}{12}i}$

55.  $1024e^{\frac{5\pi}{2}i}$

3.  $-12$

7.  $8 - i$

11.  $-12 + 8i$

15.  $11 + 10i$

19.  $\frac{3}{2} + 2i$

23.  $-\frac{1}{25} - \frac{18}{25}i$

27.  $i$

33.  $-\frac{3\sqrt{2}}{2} - \frac{3\sqrt{2}}{2}i$

37.  $4e^{\frac{3\pi}{2}i}$

41.  $3\sqrt{2}e^{\frac{3\pi}{4}i}$

45.  $\sqrt{10}e^{2.820i}$

49.  $\sqrt{26}e^{6.086i}$

53.  $2e^{\frac{7\pi}{12}i}$

57.  $4e^{\frac{\pi}{3}i}$

59. 4096

61.  $0.788+1.903i$

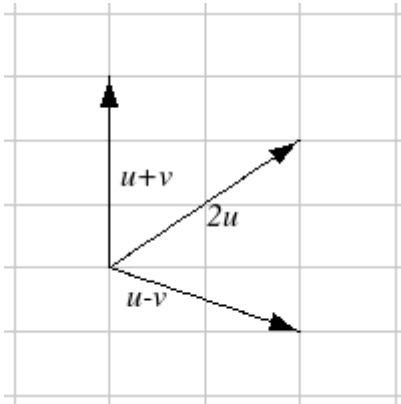
63.  $1.771+0.322i$

65.  $\sqrt[5]{2} \approx 1.149, 0.355 + 1.092i, -0.929 + 0.675i, -0.929 - 0.675i, 0.355 - 1.092i$

67.  $1, \frac{1}{2} + \frac{\sqrt{3}}{2}i, -\frac{1}{2} + \frac{\sqrt{3}}{2}i, -1, -\frac{1}{2} - \frac{\sqrt{3}}{2}i, \frac{1}{2} - \frac{\sqrt{3}}{2}i$

**Section 8.4**

1.  $-4, 2$



3. The vectors do not need to start at the same point

5.  $3\vec{v} - \vec{u}$

7.  $3\sqrt{2}, 3\sqrt{2}$

9.  $-6.128, -5.142$

11. Magnitude: 4, Direction:  $90^\circ$

13. Magnitude: 7.810, Direction:  $39.806^\circ$

15. Magnitude: 2.236, Direction:  $153.435^\circ$

17. Magnitude: 5.385, Direction:  $291.801^\circ$

19. Magnitude: 7.211, Direction:  $236.310^\circ$

21.  $\vec{u} + \vec{v} = \langle 3, 2 \rangle, \vec{u} - \vec{v} = \langle 1, -8 \rangle, 2\vec{u} - 3\vec{v} = \langle 1, -21 \rangle$

23. 4.635 miles,  $17.764 \text{ deg N of E}$

25. 17 miles. 10.318 miles

27.  $\vec{F}_{net} = -4, -11$

29. Distance: 2.868. Direction:  $86.474^\circ$  North of West, or  $3.526^\circ$  West of North

31. 4.924 degrees. 659 km/hr

33. 4.424 degrees

35.  $(0.081, 8.602)$

37. 21.801 degrees, relative to the car's forward direction

**Section 8.5**

1.  $6 \cdot 10 \cdot \cos(75^\circ) = 15.529$       3.  $(0)(-3) + (4)(0) = 0$       5.  $(-2)(-10) + (1)(13) = 33$

7.  $\cos^{-1}\left(\frac{0}{\sqrt{4}\sqrt{3}}\right) = 90^\circ$       9.  $\cos^{-1}\left(\frac{(2)(1) + (4)(-3)}{\sqrt{2^2 + 4^2}\sqrt{1^2 + (-3)^2}}\right) = 135^\circ$

11.  $\cos^{-1}\left(\frac{(4)(8) + (2)(4)}{\sqrt{4^2 + 8^2}\sqrt{2^2 + 4^2}}\right) = 0^\circ$       13.  $(2)(k) + (7)(4) = 0, k = -14$

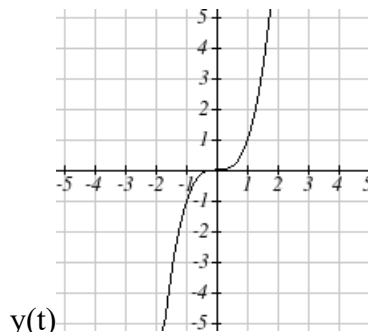
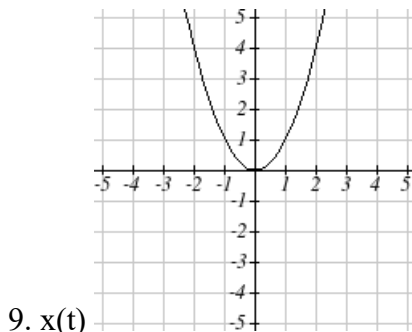
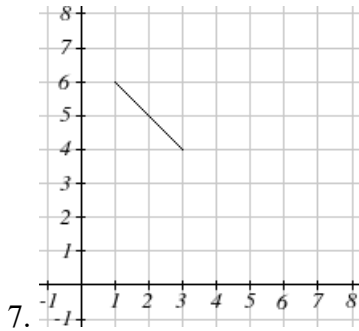
15.  $\frac{(8)(1) + (-4)(-3)}{\sqrt{1^2 + (-3)^2}} = 6.325$       17.  $\left(\frac{(-6)(1) + (10)(-3)}{\sqrt{1^2 + (-3)^2}}\right)\langle 1, -3 \rangle = \langle -3.6, 10.8 \rangle$

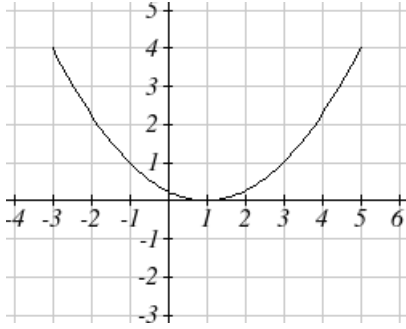
19. The vectors are  $\langle 2, 3 \rangle$  and  $\langle -5, -2 \rangle$ . The acute angle between the vectors is  $34.509^\circ$ 21. 14.142 pounds      23.  $\langle 10\cos(10^\circ), 10\sin(10^\circ) \rangle \cdot \langle 0, -20 \rangle$ , so 34.7296 ft-lbs

25.  $40 \cdot 120 \cdot \cos(25^\circ) = 4350.277$  ft-lbs

**Section 8.6**

1. C      3. E      5. F





11.

13.  $y = -2 + 2x$

17.  $x = 2e^{\frac{1-y}{5}}$  or  $y = 1 - 5 \ln\left(\frac{x}{2}\right)$

21.  $y = x^3$

25. 
$$\begin{cases} x(t) = t \\ y(t) = 3t^2 + 3 \end{cases}$$

29. 
$$\begin{cases} x(t) = 2 \cos(t) \\ y(t) = 3 \sin(t) \end{cases}$$

33. 
$$\begin{cases} x(t) = t - 1 \\ y(t) = -t^2 \end{cases}$$

37. 
$$\begin{cases} x(t) = 4 \cos(3t) \\ y(t) = 6 \sin(t) \end{cases}$$

41.  $y(x) = -16\left(\frac{x}{15}\right)^2 + 20\left(\frac{x}{15}\right)$

15.  $y = 3\sqrt{\frac{x-1}{2}}$

19.  $x = \left(\frac{y}{2}\right)^3 - \frac{y}{2}$

23.  $\left(\frac{x}{4}\right)^2 + \left(\frac{y}{5}\right)^2 = 1$

27. 
$$\begin{cases} x(t) = 3 \log(t) + t \\ y(t) = t \end{cases}$$

31. 
$$\begin{cases} x(t) = t^3 \\ y(t) = t + 2 \end{cases}$$

35. 
$$\begin{cases} x(t) = -1 + 3t \\ y(t) = 5 - 2t \end{cases}$$

39. 
$$\begin{cases} x(t) = 4 \cos(2t) \\ y(t) = 3 \sin(3t) \end{cases}$$

43. 
$$\begin{cases} x(t) = 20 \sin\left(\frac{2\pi}{5}t\right) + 8 \sin(\pi t) \\ y(t) = 35 - 20 \cos\left(\frac{2\pi}{5}t\right) - 8 \cos(\pi t) \end{cases}$$

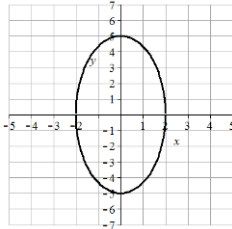


## Chapter 9

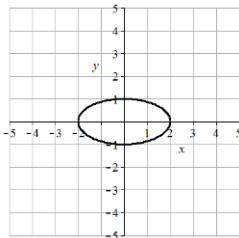
### Section 9.1

1. D            3. B

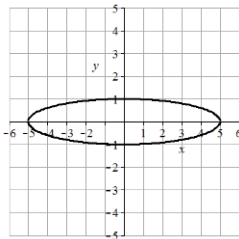
5. Vertices  $(0, \pm 5)$ , minor axis endpoints  $(\pm 2, 0)$ , major length = 10, minor length = 4



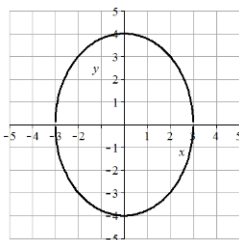
7. Vertices  $(\pm 2, 0)$ , minor axis endpoints  $(0, \pm 1)$ , major length = 4, minor length = 2



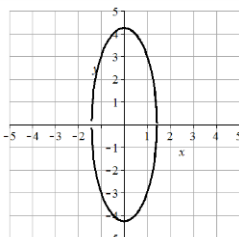
9. Vertices  $(\pm 5, 0)$ , minor axis endpoints  $(0, \pm 1)$ , major length = 10, minor length = 2



11. Vertices  $(0, \pm 4)$ , minor axis endpoints  $(\pm 3, 0)$ , major length = 8, minor length = 6



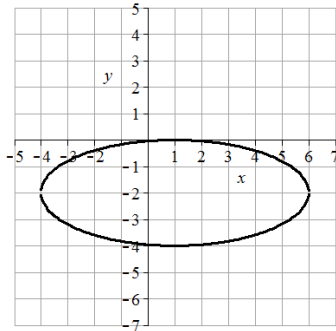
13. Vertices  $(0, \pm 3\sqrt{2})$ , minor axis endpoints  $(\pm\sqrt{2}, 0)$ , major length =  $6\sqrt{2}$ , minor length =  $2\sqrt{2}$



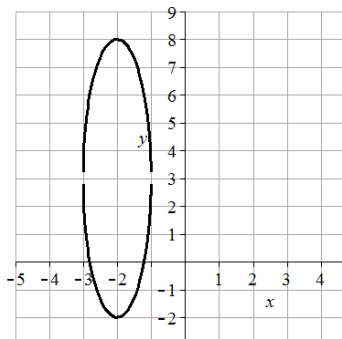
$$15. \frac{x^2}{16} + \frac{y^2}{4} = 1 \quad 17. \frac{x^2}{1024} + \frac{y^2}{49} = 1 \quad 19. \frac{x^2}{4} + \frac{y^2}{9} = 1$$

21. B      23. C      25. F      27. G

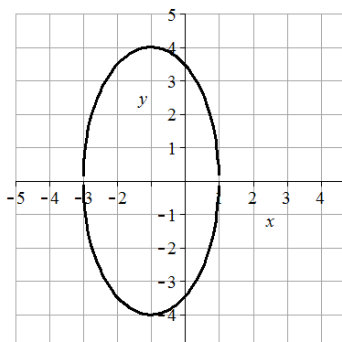
29. Center (1,-2), vertices (6,-2) and (-4,-2), minor axis endpoints (1,0) and (1,-4), major length = 10, minor length = 4



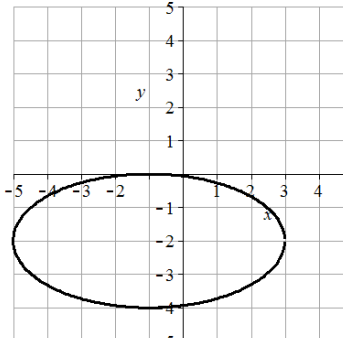
31. Center (-2,3), vertices (-2,8) and (-2,-2), minor axis endpoints (-1,3) and (-3,3), major length = 10, minor length = 2



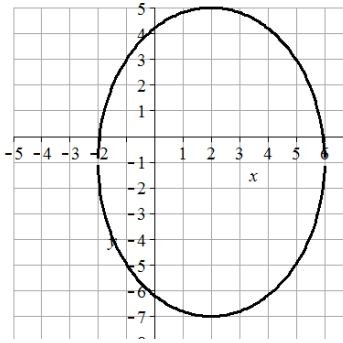
33. Center (-1,0), vertices (-1,4) and (-1,-4), minor axis endpoints (-1,0) and (3,0), major length = 8, minor length = 4



35. Center (-1,-2), vertices (3,-2) and (-5,-2), minor axis endpoints (-1,0) and (-1,-4), major length = 8, minor length = 4



37. Center (2,-1), vertices (2,5) and (2,-7), minor axis endpoints (6,-1) and (-2,-1), major length = 12, minor length = 8



$$39. (x-3)^2 + \frac{(y+1)^2}{16} = 1$$

$$41. \frac{(x+4)^2}{16} + \frac{(y-3)^2}{25} = 1$$

$$43. 2.211083 \text{ feet}$$

$$45. 17 \text{ feet}$$

$$47. 64 \text{ feet}$$

$$49. (\pm 4, 0)$$

$$51. (-6, 6) \text{ and } (-6, -4)$$

$$53. \frac{x^2}{9} + \frac{y^2}{5} = 1$$

$$55. \frac{x^2}{11} + \frac{y^2}{36} = 1$$

$$57. \frac{x^2}{49} + \frac{y^2}{24} = 1$$

$$59. \frac{x^2}{4} + \frac{y^2}{20} = 1$$

$$61. \frac{x^2}{16} + \frac{y^2}{8} = 1$$

$$63. \frac{(x+2)^2}{12} + \frac{(y-1)^2}{16} = 1$$

$$65. \frac{(x-3)^2}{36} + \frac{(y-2)^2}{11} = 1$$

$$67. \frac{(x-3)^2}{21} + \frac{(y+1)^2}{25} = 1$$

$$69. \frac{(x-1)^2}{4} + \frac{(y-3)^2}{5} = 1$$

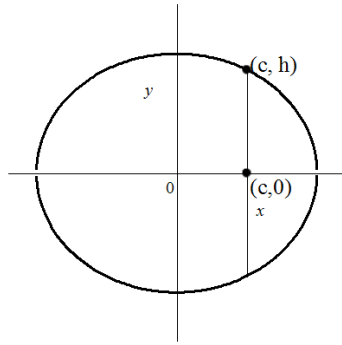
$$71. \frac{(x+2)^2}{289} + \frac{(y+1)^2}{120} = 1$$

$$73. 31.22 \text{ feet}$$

$$75. \frac{x^2}{8640.632025} + \frac{y^2}{8638.214} = 1$$

$$77. \frac{x^2}{25} + \frac{y^2}{9} = 1$$

79. The center is at (0,0). Since  $a > b$ , the ellipse is horizontal. Let (c,0) be the focus on the positive x-axis. Let (c, h) be the endpoint in Quadrant 1 of the latus rectum passing through (c,0).



The distance between the focus and latus rectum endpoint can be found by substituting

$(c,0)$  and  $(c,h)$  into the distance formula  $h = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$  which yields

$h = \sqrt{(c - c)^2 + (h - 0)^2} = h$ . So  $h$  is half the latus rectum distance. Substituting  $(c,h)$

into the ellipse equation to find  $h$  gives  $\frac{c^2}{a^2} + \frac{h^2}{b^2} = 1$ . Solve for  $h$  yields

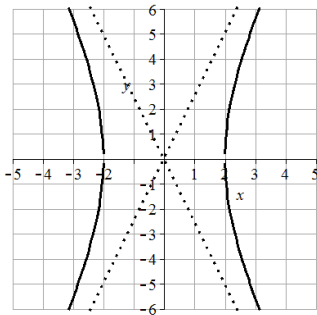
$$h^2 = b^2 \left( 1 - \frac{c^2}{a^2} \right) = b^2 \left( \frac{a^2 - c^2}{a^2} \right) = b^2 \left( \frac{a^2 - c^2}{a^2} \right) = b^2 \left( \frac{b^2}{a^2} \right) = \frac{b^4}{a^2} \quad \text{so } h = \sqrt{\frac{b^4}{a^2}} = \frac{b^2}{a}.$$

The distance of the latus rectum is  $2h = \frac{2b^2}{a}$ .

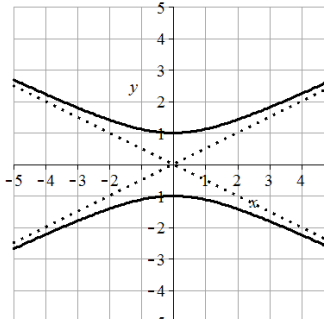
## Section 9.2

1. B            3. D

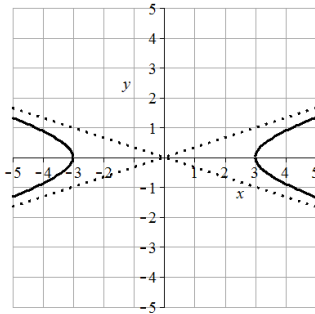
5. Vertices  $(\pm 2, 0)$ , transverse length = 4, asymptotes  $y = \pm 5/2x$ ,



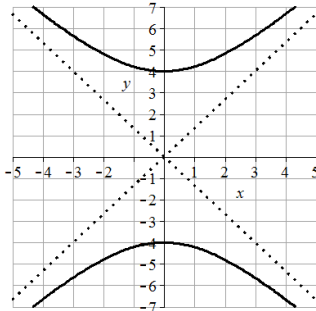
7. Vertices  $(0, \pm 1)$ , transverse length = 2, asymptotes  $y = \pm 1/2x$ ,



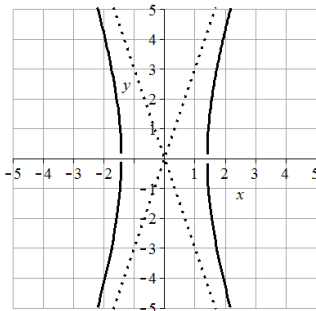
9. Vertices  $(\pm 3, 0)$ , transverse length = 6, asymptotes  $y = \pm 1/3x$ ,



11. Vertices  $(0, \pm 4)$ , transverse length = 8, asymptotes  $y = \pm 4/3x$



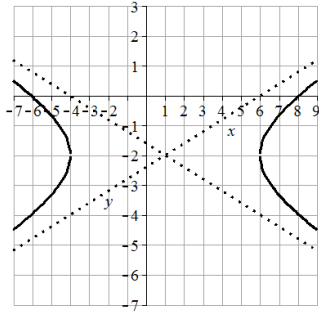
13. Vertices  $(\pm \sqrt{2}, 0)$ , transverse length =  $2\sqrt{2}$ , asymptotes  $y = \pm 3x$ ,



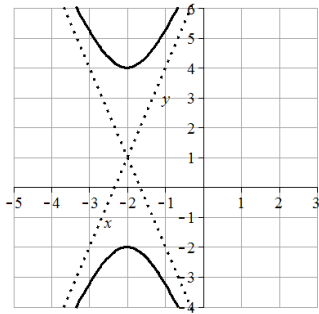
15.  $\frac{y^2}{4} - \frac{x^2}{9} = 1$       17.  $\frac{y^2}{16} - \frac{x^2}{64} = 1$       19.  $\frac{x^2}{9} - \frac{y^2}{36} = 1$       21.  $\frac{x^2}{16} - \frac{y^2}{16} = 1$

23. C      25. H      27. B      29. A

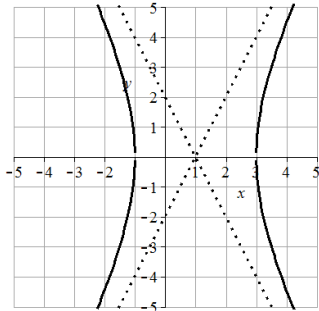
31. Center  $(1, -2)$ , vertices  $(6, -2)$  and  $(-4, -2)$ , transverse length = 10, asymptotes  $y = \pm 2/5(x-1) - 2$



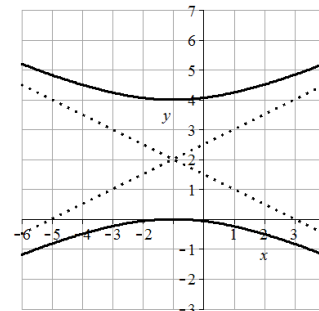
33. Center  $(-2,1)$ , vertices  $(-2,4)$  and  $(-2,-2)$ , transverse length = 6, asymptotes  $y = \pm 3(x+2)+1$



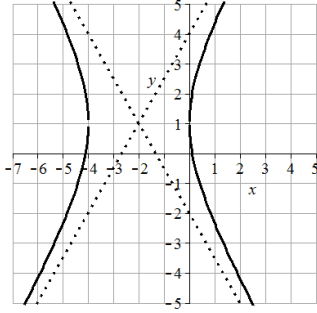
35. Center  $(1,0)$ , vertices  $(3,0)$  and  $(-1,0)$ , transverse length = 4, asymptotes  $y = \pm 2(x-1)$



37. Center  $(-1,2)$ , vertices  $(-1,4)$  and  $(-1,0)$ , transverse length = 4, asymptotes  $y = \pm 1/2(x+1)+2$



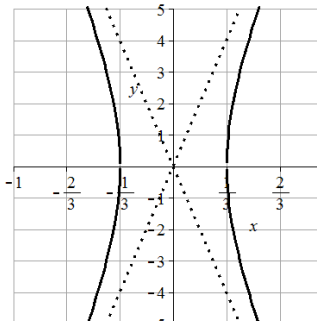
39. Center  $(-2,1)$ , vertices  $(0,1)$  and  $(-4,1)$ , transverse length = 4, asymptotes  $y = \pm 3/2(x+2)+1$



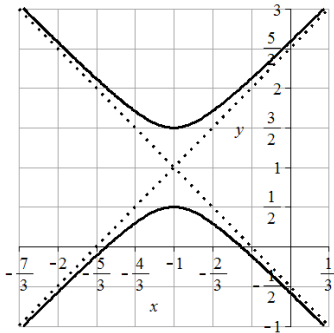
$$41. \frac{(y+1)^2}{9} - \frac{(x-4)^2}{4} = 1$$

$$43. \frac{(y-2)^2}{16} - \frac{(x+1)^2}{4} = 1$$

45. Center (0,0), vertices  $(\pm 1/3, 0)$ , transverse length =  $2/3$ , asymptotes  $y = \pm 12x$



47. Center (-1,1), vertices  $(-1, 3/2)$  and  $(-1, 1/2)$ , transverse length = 1, asymptotes  $y = \pm 3/2(x+1) + 1$



49. Foci  $(0, \pm 5)$

51. Foci  $(5, 6)$  and  $(-3, 6)$

53. Foci  $(-4, 6)$  and  $(-4, -4)$

$$55. \frac{x^2}{16} - \frac{y^2}{9} = 1$$

$$57. \frac{y^2}{144} - \frac{x^2}{25} = 1$$

$$59. \frac{x^2}{225} - \frac{y^2}{64} = 1$$

$$61. \frac{x^2}{64} - \frac{y^2}{36} = 1$$

$$63. \frac{(y-2)^2}{16} - \frac{(x-1)^2}{9} = 1$$

$$65. \frac{(x+1)^2}{25} - \frac{(y-3)^2}{144} = 1$$

$$67. \frac{x^2}{900} - \frac{y^2}{1600} = 1$$

$$69. \frac{x^2}{900} - \frac{y^2}{14400.3636} = 1$$

$$71. \frac{x^2}{3025} - \frac{y^2}{6975} = 1$$

73.  $5y^2 - x^2 + 25 = 0$  can be put in the form  $\frac{y^2}{5} - \frac{x^2}{25} = -1$ .  $x^2 - 5y^2 + 25 = 0$  can be put in the form  $\frac{y^2}{5} - \frac{x^2}{25} = 1$  showing they are conjugate.

$$75. \sqrt{2} \quad 77. \text{ No matter the value of } k, \text{ the foci are at } (\pm\sqrt{6}, 0)$$

### Section 9.3

1. C    3. A

5. Vertex: (0,0). Axis of symmetry:  $y = 0$ . Directrix:  $x = -4$ . Focus: (4,0)

7. Vertex: (0,0). Axis of symmetry:  $x = 0$ . Directrix:  $y = -1/8$ . Focus: (0,1/8)

9. Vertex: (0,0). Axis of symmetry:  $y = 0$ . Directrix:  $x = 1/16$ . Focus: (-1/16,0)

11. Vertex: (2,-1). Axis of symmetry:  $x = 2$ . Directrix:  $y = -3$ . Focus: (2,1)

13. Vertex: (-1,4). Axis of symmetry:  $x = -1$ . Directrix:  $y = 3$ . Focus: (-1,5)

15.  $(y-1)^2 = -(x-3)$       17.  $(y-3)^2 = 12(x-2)$       19.  $x^2 = 4(y-3)$

21. At the focus, (0,1)      23. 2.25 feet above the vertex.      25. 0.25 ft

27.  $\left(\frac{1}{\sqrt{3}}, \frac{2}{\sqrt{3}}\right), \left(\frac{-1}{\sqrt{3}}, \frac{-2}{\sqrt{3}}\right)$       29.  $(3, \sqrt{2}), (3, -\sqrt{2}), (-3, \sqrt{2}), (-3, -\sqrt{2})$

31.  $(2\sqrt{2}, 8), (-2\sqrt{2}, 8)$

33.  $\left(\sqrt{\frac{5}{3}}, \sqrt{\frac{2}{3}}\right), \left(-\sqrt{\frac{5}{3}}, \sqrt{\frac{2}{3}}\right), \left(\sqrt{\frac{5}{3}}, -\sqrt{\frac{2}{3}}\right), \left(-\sqrt{\frac{5}{3}}, -\sqrt{\frac{2}{3}}\right)$

35.  $(-64.50476622, 93.37848007) \approx (-64.50, 93.38)$



### Section 9.4

1.  $e = 3$ . Directrix:  $x = 4$ . Hyperbola.      3.  $e = 3/4$ . Directrix:  $y = -2/3$ . Ellipse.

5.  $e = 1$ . Directrix:  $x = -1/5$ . Parabola.      7.  $e = 2/7$ . Directrix:  $x = 2$ . Ellipse.

$$9. r = \frac{20}{1 - 5 \cos(\theta)}$$

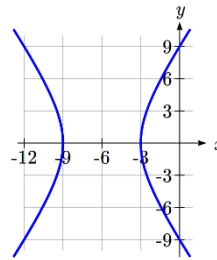
$$11. r = \frac{1}{1 + \frac{1}{3} \sin(\theta)}, \text{ or } r = \frac{3}{3 + \sin(\theta)}$$

$$13. r = \frac{2}{1 - \sin(\theta)}$$

15. Hyperbola. Vertices at  $(-9,0)$  and  $(-3,0)$

Center at  $(-6,0)$ .  $a = 3$ .  $c = 6$ , so  $b = \sqrt{27}$

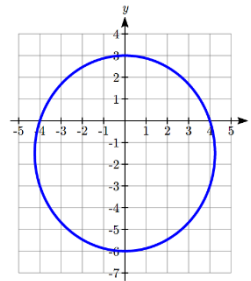
$$\frac{(x+6)^2}{9} - \frac{y^2}{27} = 1$$



17. Ellipse. Vertices at  $(0,3)$  and  $(0,-6)$

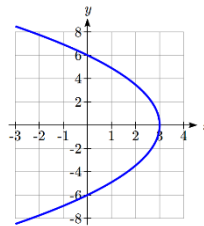
Center at  $(0,-1.5)$ .  $a = 4.5$ ,  $c = 1.5$ ,  $b = \sqrt{18}$

$$\frac{x^2}{18} + \frac{(y+1.5)^2}{20.25} = 1$$

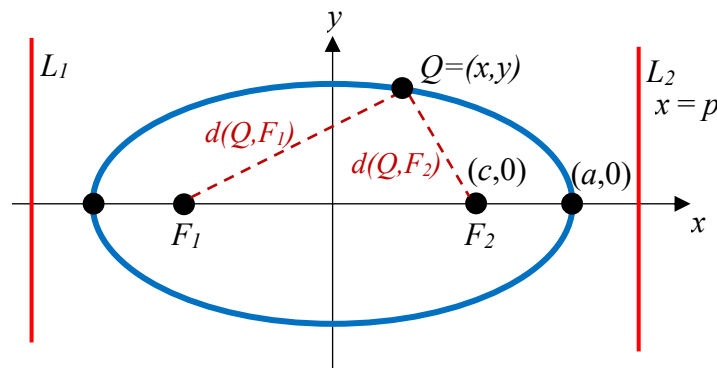


19. Parabola. Vertex at  $(3,0)$ .  $p = 3$ .

$$y^2 = -12(x-3)$$



21. a)



$$\text{b) } d(Q, L_1) = x - (-p) = x + p, \quad d(Q, L_2) = p - x$$

$$\text{c) } d(Q, F_1) = ed(Q, L_1) = e(x + p), \quad d(Q, F_2) = ed(Q, L_2) = e(p - x)$$

$$\text{d) } d(Q, F_1) + d(Q, F_2) = e(x + p) + e(p - x) = 2ep, \text{ a constant.}$$

$$\text{e) At } Q = (a, 0), \quad d(Q, F_1) = a - (-c) = a + c, \text{ and } d(Q, F_2) = a - c, \text{ so}$$

$$d(Q, F_1) + d(Q, F_2) = (a + c) + (a - c) = 2a$$

$$\text{Combining with the result above, } 2ep = 2a, \text{ so } p = \frac{a}{e}.$$

$$\text{f) } d(Q, F_2) = a - c, \text{ and } d(Q, L_2) = p - a$$

$$\frac{d(Q, F_2)}{d(Q, L_2)} = e, \text{ so } \frac{a - c}{p - a} = e.$$

$$a - c = e(p - a). \text{ Using the result from (e),}$$

$$a - c = e\left(\frac{a}{e} - a\right)$$

$$a - c = a - ea$$

$$e = \frac{c}{a}$$