

75.  $\sec 30^\circ = \csc 60^\circ$

True, because  $\sec(90^\circ - \theta) = \csc \theta$ .

77.  $\cot^2 10^\circ - \csc^2 10^\circ = -1$

True, because  $1 + \cot^2 \theta = \csc^2 \theta$   
 $\cot^2 \theta = \csc^2 \theta - 1$   
 $\cot^2 \theta - \csc^2 \theta = -1$ .

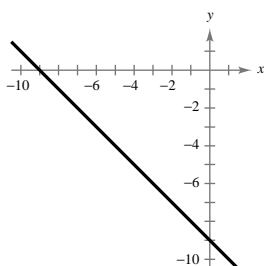
79.

| $\theta$                  | $0^\circ$ | $20^\circ$ | $40^\circ$ | $60^\circ$ | $80^\circ$ |
|---------------------------|-----------|------------|------------|------------|------------|
| $\cos \theta$             | 1         | 0.9397     | 0.7660     | 0.5000     | 0.1736     |
| $\sin(90^\circ - \theta)$ | 1         | 0.9397     | 0.7660     | 0.5000     | 0.1736     |

It seems that  $\cos \theta = \sin(90^\circ - \theta)$  for all  $\theta$ .  
 $\theta$  and  $90^\circ - \theta$  are called complementary angles.

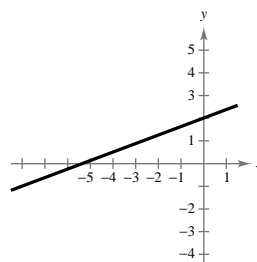
81.  $y = -x - 9$

Intercepts:  $(0, -9), (-9, 0)$



83.  $-3x + 8y = 16$

Intercepts:  $(0, 2), (-\frac{16}{3}, 0)$



85.  $146^\circ$  lies in quadrant II

87.  $-310^\circ 30'$  lies in quadrant I

### Section 4.4 Trigonometric Functions of Any Angle

- Know the Definitions of Trigonometric Functions of Any Angle.

If  $\theta$  is in standard position,  $(x, y)$  a point on the terminal side and  $r = \sqrt{x^2 + y^2} \neq 0$ , then:

$$\begin{aligned} \sin \theta &= \frac{y}{r} & \csc \theta &= \frac{r}{y}, y \neq 0 \\ \cos \theta &= \frac{x}{r} & \sec \theta &= \frac{r}{x}, x \neq 0 \\ \tan \theta &= \frac{y}{x}, x \neq 0 & \cot \theta &= \frac{x}{y}, y \neq 0 \end{aligned}$$

- You should know the signs of the trigonometric functions in each quadrant.
- You should know the trigonometric function values of the quadrant angles  $0, \frac{\pi}{2}, \pi,$  and  $\frac{3\pi}{2}$ .
- You should be able to find reference angles.
- You should be able to evaluate trigonometric functions of any angle. (Use reference angles.)
- You should know that the period of sine and cosine is  $2\pi$ .
- You should know which trigonometric functions are odd and even.  
 Even:  $\cos x$  and  $\sec x$   
 Odd:  $\sin x, \tan x, \cot x, \csc x$

## Solutions to Odd-Numbered Exercises

1. (a)  $(x, y) = (4, 3)$

$$r = \sqrt{16 + 9} = 5$$

$$\sin \theta = \frac{y}{r} = \frac{3}{5} \quad \csc \theta = \frac{r}{y} = \frac{5}{3}$$

$$\cos \theta = \frac{x}{r} = \frac{4}{5} \quad \sec \theta = \frac{r}{x} = \frac{5}{4}$$

$$\tan \theta = \frac{y}{x} = \frac{3}{4} \quad \cot \theta = \frac{x}{y} = \frac{4}{3}$$

(b)  $(x, y) = (-8, -15)$

$$r = \sqrt{64 + 225} = 17$$

$$\sin \theta = \frac{y}{r} = -\frac{15}{17} \quad \csc \theta = \frac{r}{y} = -\frac{17}{15}$$

$$\cos \theta = \frac{x}{r} = -\frac{8}{17} \quad \sec \theta = \frac{r}{x} = -\frac{17}{8}$$

$$\tan \theta = \frac{y}{x} = \frac{15}{8} \quad \cot \theta = \frac{x}{y} = \frac{8}{15}$$

3. (a)  $(x, y) = (-\sqrt{3}, -1)$

$$r = \sqrt{3 + 1} = 2$$

$$\sin \theta = \frac{y}{r} = -\frac{1}{2} \quad \csc \theta = \frac{r}{y} = -2$$

$$\cos \theta = \frac{x}{r} = -\frac{\sqrt{3}}{2} \quad \sec \theta = \frac{r}{x} = -\frac{2\sqrt{3}}{3}$$

$$\tan \theta = \frac{y}{x} = \frac{\sqrt{3}}{3} \quad \cot \theta = \frac{x}{y} = \sqrt{3}$$

(b)  $(x, y) = (-2, 2)$

$$r = \sqrt{4 + 4} = 2\sqrt{2}$$

$$\sin \theta = \frac{y}{r} = \frac{\sqrt{2}}{2} \quad \csc \theta = \frac{r}{y} = \sqrt{2}$$

$$\cos \theta = \frac{x}{r} = -\frac{\sqrt{2}}{2} \quad \sec \theta = \frac{r}{x} = -\sqrt{2}$$

$$\tan \theta = \frac{y}{x} = -1 \quad \cot \theta = \frac{x}{y} = -1$$

5.  $(x, y) = (7, 24)$

$$r = \sqrt{49 + 576} = 25$$

$$\sin \theta = \frac{y}{r} = \frac{24}{25} \quad \csc \theta = \frac{r}{y} = \frac{25}{24}$$

$$\cos \theta = \frac{x}{r} = \frac{7}{25} \quad \sec \theta = \frac{r}{x} = \frac{25}{7}$$

$$\tan \theta = \frac{y}{x} = \frac{24}{7} \quad \cot \theta = \frac{x}{y} = \frac{7}{24}$$

7.  $(x, y) = (5, -12)$

$$r = \sqrt{5^2 + (-12)^2} = \sqrt{25 + 144} = \sqrt{169} = 13$$

$$\sin \theta = \frac{y}{r} = -\frac{12}{13} \quad \csc \theta = \frac{r}{y} = -\frac{13}{12}$$

$$\cos \theta = \frac{x}{r} = \frac{5}{13} \quad \sec \theta = \frac{r}{x} = \frac{13}{5}$$

$$\tan \theta = \frac{y}{x} = -\frac{12}{5} \quad \cot \theta = \frac{x}{y} = -\frac{5}{12}$$

9.  $(x, y) = (-4, 10)$

$$r = \sqrt{16 + 100} = 2\sqrt{29}$$

$$\sin \theta = \frac{y}{r} = \frac{5\sqrt{29}}{29} \quad \csc \theta = \frac{r}{y} = \frac{\sqrt{29}}{5}$$

$$\cos \theta = \frac{x}{r} = -\frac{2\sqrt{29}}{29} \quad \sec \theta = \frac{r}{x} = -\frac{\sqrt{29}}{2}$$

$$\tan \theta = \frac{y}{x} = -\frac{5}{2} \quad \cot \theta = \frac{x}{y} = -\frac{2}{5}$$

11.  $(x, y) = (-2, 9)$

$$r = \sqrt{(-2)^2 + 9^2} = \sqrt{4 + 81} = \sqrt{85}$$

$$\sin \theta = \frac{y}{r} = \frac{9}{\sqrt{85}} = \frac{9\sqrt{85}}{85} \quad \csc \theta = \frac{\sqrt{85}}{9}$$

$$\cos \theta = \frac{x}{r} = \frac{-2}{\sqrt{85}} = -\frac{2\sqrt{85}}{85} \quad \sec \theta = \frac{r}{x} = -\frac{\sqrt{85}}{2}$$

$$\tan \theta = \frac{y}{x} = -\frac{9}{2} \quad \cot \theta = \frac{x}{y} = -\frac{2}{9}$$

13.  $\sin \theta < 0 \Rightarrow \theta$  lies in Quadrant III or in Quadrant IV.  
 $\cos \theta < 0 \Rightarrow \theta$  lies in Quadrant II or in Quadrant III.  
 $\sin \theta < 0$  and  $\cos \theta < 0 \Rightarrow \theta$  lies in Quadrant III.

15.  $\sin \theta > 0 \Rightarrow \theta$  lies in Quadrant I or in Quadrant II.  
 $\tan \theta < 0 \Rightarrow \theta$  lies in Quadrant II or in Quadrant IV.  
 $\sin \theta > 0$  and  $\tan \theta < 0 \Rightarrow \theta$  lies in Quadrant II.

17.  $\cot \theta > 0 \Rightarrow \theta$  lies in Quadrant I or Quadrant III  
 $\cos \theta > 0 \Rightarrow \theta$  lies in Quadrant I or Quadrant IV  
 $\cot \theta > 0$  and  $\cos \theta > 0 \Rightarrow \theta$  lies in Quadrant I

19.  $\sin \theta = \frac{y}{r} = \frac{3}{5} \Rightarrow x^2 = 25 - 9 = 16$

$\theta$  in Quadrant II  $\Rightarrow x = -4$

$\sin \theta = \frac{y}{r} = \frac{3}{5}$        $\csc \theta = \frac{r}{y} = \frac{5}{3}$

$\cos \theta = \frac{x}{r} = -\frac{4}{5}$        $\sec \theta = \frac{r}{x} = -\frac{5}{4}$

$\tan \theta = \frac{y}{x} = -\frac{3}{4}$        $\cot \theta = \frac{x}{y} = -\frac{4}{3}$

21.  $\sin \theta < 0 \Rightarrow y < 0$

$\tan \theta = \frac{y}{x} = \frac{-15}{8} \Rightarrow r = 17$

$\sin \theta = \frac{y}{r} = -\frac{15}{17}$        $\csc \theta = \frac{r}{y} = -\frac{17}{15}$

$\cos \theta = \frac{x}{r} = \frac{8}{17}$        $\sec \theta = \frac{r}{x} = \frac{17}{8}$

$\tan \theta = \frac{y}{x} = -\frac{15}{8}$        $\cot \theta = \frac{x}{y} = -\frac{8}{15}$

23.  $\sec \theta = \frac{r}{x} = \frac{2}{-1} \Rightarrow y^2 = 4 - 1 = 3$

$\sin \theta \geq 0 \Rightarrow y = \sqrt{3}$

$\sin \theta = \frac{y}{r} = \frac{\sqrt{3}}{2}$        $\csc \theta = \frac{r}{y} = \frac{2\sqrt{3}}{3}$

$\cos \theta = \frac{x}{r} = -\frac{1}{2}$        $\sec \theta = \frac{r}{x} = -2$

$\tan \theta = \frac{y}{x} = -\sqrt{3}$        $\cot \theta = \frac{x}{y} = -\frac{\sqrt{3}}{3}$

25.  $\sin \theta = 0 \Rightarrow \theta = n\pi$

$\sec \theta = -1 \Rightarrow \theta = \pi$

$\sin \theta = \frac{y}{r} = \frac{0}{r} = 0$        $\csc \theta = \frac{r}{y}$  is undefined

$\cos \theta = \frac{x}{r} = \frac{-r}{r} = -1$        $\sec \theta = \frac{r}{x} = -1$

$\tan \theta = \frac{y}{x} = \frac{0}{x} = 0$        $\cot \theta = \frac{x}{y}$  is undefined

27. To find a point on the terminal side of  $\theta$ , use any point on the line  $y = -x$  that lies in Quadrant II.  $(-1, 1)$  is one such point.

$x = -1, y = 1, r = \sqrt{2}$

$\sin \theta = \frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$        $\csc \theta = \sqrt{2}$

$\cos \theta = -\frac{1}{\sqrt{2}} = -\frac{\sqrt{2}}{2}$        $\sec \theta = -\sqrt{2}$

$\tan \theta = -1$        $\cot \theta = -1$

29. To find a point on the terminal side of  $\theta$ , use any point on the line  $y = 2x$  that lies in Quadrant III.  $(-1, -2)$  is one such point.

$x = -1, y = -2, r = \sqrt{5}$

$\sin \theta = -\frac{2}{\sqrt{5}} = -\frac{2\sqrt{5}}{5}$        $\csc \theta = \frac{\sqrt{5}}{-2} = -\frac{\sqrt{5}}{2}$

$\cos \theta = -\frac{1}{\sqrt{5}} = -\frac{\sqrt{5}}{5}$        $\sec \theta = \frac{\sqrt{5}}{-1} = -\sqrt{5}$

$\tan \theta = \frac{-2}{-1} = 2$        $\cot \theta = \frac{-1}{-2} = \frac{1}{2}$

31.  $(x, y) = (-1, 0)$

$$\sec \pi = \frac{r}{x} = \frac{1}{-1} = -1$$

33.  $(x, y) = (0, 1)$

$$\cot \frac{\pi}{2} = \frac{x}{y} = \frac{0}{1} = 0$$

35.  $(x, y) = (1, 0)$

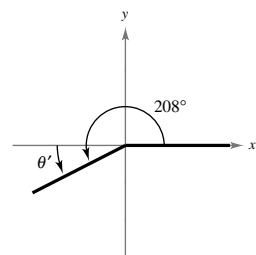
$$\sec \theta = \frac{r}{x} = \frac{1}{1} = 1$$

37.  $(x, y) = (-1, 0)$

$$\cot \pi = \frac{x}{y} = -\frac{1}{0} \text{ undefined}$$

39.  $\theta = 208^\circ$

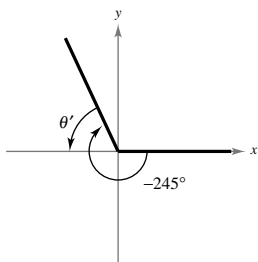
$$\theta' = 208^\circ - 180^\circ = 28^\circ$$



41.  $\theta = -245^\circ$

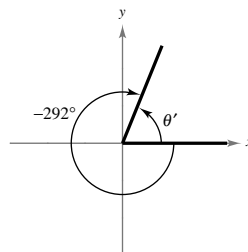
$$360^\circ - 245^\circ = 115^\circ \text{ (coterminal angle)}$$

$$\theta' = 180^\circ - 115^\circ = 65^\circ$$



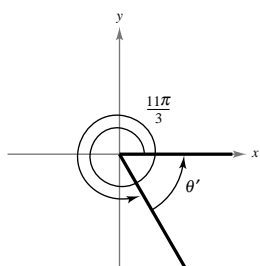
43.  $\theta = -292^\circ$

$$\theta' = 360^\circ - 292^\circ = 68^\circ$$



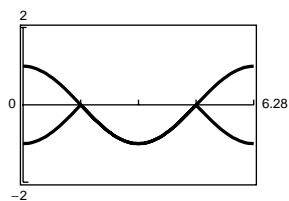
45.  $\theta = \frac{11\pi}{3}$  coterminal with  $\frac{5\pi}{3}$ .

$$\theta' = 2\pi - \frac{5\pi}{3} = \frac{\pi}{3}$$



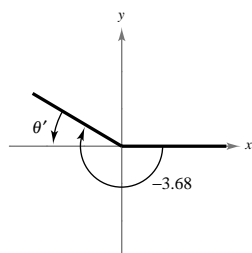
47.  $\theta = 3.5$

$$\theta' = 3.5 - \pi \approx 0.3584$$



49.  $\theta = -3.68$  coterminal with  $2\pi - 3.68 \approx 2.6032$

$$\theta' = \pi - (2\pi - 3.68) \approx 0.5384$$



51.  $\theta' = 45^\circ$ ,  
Quadrant III

$$\sin 225^\circ = -\sin 45^\circ = -\frac{\sqrt{2}}{2}$$

$$\cos 225^\circ = -\cos 45^\circ = -\frac{\sqrt{2}}{2}$$

$$\tan 225^\circ = \tan 45^\circ = 1$$

53.  $\theta = -750^\circ$  coterminal with  $330^\circ$ . Quadrant IV

$$\theta' = 360^\circ - 330^\circ = 30^\circ$$

$$\sin(-750^\circ) = -\sin 30^\circ = -\frac{1}{2}$$

$$\cos(-750^\circ) = \cos 30^\circ = \frac{\sqrt{3}}{2}$$

$$\tan(-750^\circ) = -\tan 30^\circ = -\frac{\sqrt{3}}{3}$$

57.  $\theta = \frac{5\pi}{3}$ . Quadrant IV

$$\theta' = 2\pi - \frac{5\pi}{3} = \frac{\pi}{3}$$

$$\sin\left(\frac{5\pi}{3}\right) = -\sin\left(\frac{\pi}{3}\right) = -\frac{\sqrt{3}}{2}$$

$$\cos\left(\frac{5\pi}{3}\right) = \cos\left(\frac{\pi}{3}\right) = \frac{1}{2}$$

$$\tan\left(\frac{5\pi}{3}\right) = -\tan\left(\frac{\pi}{3}\right) = -\sqrt{3}$$

61.  $\theta' = \frac{\pi}{4}$ , Quadrant II

$$\sin\frac{11\pi}{4} = \sin\frac{\pi}{4} = \frac{\sqrt{2}}{2}$$

$$\cos\frac{11\pi}{4} = -\cos\frac{\pi}{4} = -\frac{\sqrt{2}}{2}$$

$$\tan\frac{11\pi}{4} = -\tan\frac{\pi}{4} = -1$$

65.  $\sin 10^\circ \approx 0.1736$

69.  $\cos(-110^\circ) \approx -0.3420$

73.  $\sin 0.65 \approx 0.6052$

77.  $\csc\left(-\frac{8\pi}{9}\right) = \frac{1}{\sin\left(-\frac{8\pi}{9}\right)} \approx -2.9238$

55.  $\theta = -240^\circ$  coterminal with  $120^\circ$ . Quadrant II

$$\theta' = 180^\circ - 120^\circ = 60^\circ$$

$$\sin(-240^\circ) = \sin 60^\circ = \frac{\sqrt{3}}{2}$$

$$\cos(-240^\circ) = -\cos 60^\circ = -\frac{1}{2}$$

$$\tan(-240^\circ) = -\tan 60^\circ = -\sqrt{3}$$

59.  $\theta' = \frac{\pi}{6}$ , Quadrant IV

$$\sin\left(-\frac{\pi}{6}\right) = -\sin\frac{\pi}{6} = -\frac{1}{2}$$

$$\cos\left(-\frac{\pi}{6}\right) = \cos\frac{\pi}{6} = \frac{\sqrt{3}}{2}$$

$$\tan\left(-\frac{\pi}{6}\right) = -\tan\frac{\pi}{6} = -\frac{\sqrt{3}}{3}$$

63.  $\theta = -\frac{7\pi}{6}$ . Quadrant II

$$\theta' = \frac{\pi}{6}$$

$$\sin\left(-\frac{7\pi}{6}\right) = \sin\left(\frac{\pi}{6}\right) = \frac{1}{2}$$

$$\cos\left(-\frac{7\pi}{6}\right) = -\cos\left(\frac{\pi}{6}\right) = -\frac{\sqrt{3}}{2}$$

$$\tan\left(-\frac{7\pi}{6}\right) = -\tan\left(\frac{\pi}{6}\right) = -\frac{\sqrt{3}}{3}$$

67.  $\tan 240^\circ \approx 1.7321$

71.  $\sec(-280^\circ) = \frac{1}{\cos(-280^\circ)} \approx 5.7588$

75.  $\tan\frac{\pi}{9} \approx 0.3640$

79. (a)  $\sin \theta = \frac{1}{2} \Rightarrow$  reference angle is  $30^\circ$  or  $\frac{\pi}{6}$  and  $\theta$  is in Quadrant I or Quadrant II.

Values in degrees:  $30^\circ, 150^\circ$

Values in radian:  $\frac{\pi}{6}, \frac{5\pi}{6}$

(b)  $\sin \theta = -\frac{1}{2} \Rightarrow$  reference angle is  $30^\circ$  or  $\frac{\pi}{6}$  and  $\theta$  is in Quadrant III or Quadrant IV.

Values in degrees:  $210^\circ, 330^\circ$

Values in radians:  $\frac{7\pi}{6}, \frac{11\pi}{6}$

81. (a)  $\csc \theta = \frac{2\sqrt{3}}{3} \Rightarrow$  reference angle is  $60^\circ$  or  $\frac{\pi}{3}$  and  $\theta$  is in Quadrant I or Quadrant II.

Values in degrees:  $60^\circ, 120^\circ$

Values in radians:  $\frac{\pi}{3}, \frac{2\pi}{3}$

(b)  $\cot \theta = -1 \Rightarrow$  reference angle is  $45^\circ$  or  $\frac{\pi}{4}$  and  $\theta$  is in Quadrant II or Quadrant IV.

Values in degrees:  $135^\circ, 315^\circ$

Values in radians:  $\frac{3\pi}{4}, \frac{7\pi}{4}$

83. (a)  $\sec \theta = -\frac{2\sqrt{3}}{3} \Rightarrow$  reference angle is  $\frac{\pi}{6}$  or  $30^\circ$ ,  
and  $\theta$  is in Quadrant II or Quadrant III.

Value in degrees:  $150^\circ, 210^\circ$

Value in radians:  $\frac{5\pi}{6}, \frac{7\pi}{6}$

(b)  $\cos \theta = -\frac{1}{2} \Rightarrow$  reference angle is  $\frac{\pi}{3}$  or  $60^\circ$ ,  
and  $\theta$  is in Quadrant II or Quadrant III.

Value in degrees:  $120^\circ, 240^\circ$

Value in radians:  $\frac{2\pi}{3}, \frac{4\pi}{3}$

87.  $\tan \theta = 0.6524$

Quadrant I:  $\theta = \tan^{-1}(0.6524) \approx 33.1204^\circ$

Quadrant III:  $\theta = \tan^{-1}(0.6524) + 180^\circ \approx 213.1204^\circ$

89.  $\sec \theta = -1.2241 \Rightarrow \cos \theta = -0.8169$

Quadrant II:  $\theta \approx 144.7783^\circ$

Quadrant III:  $\theta \approx 215.2217^\circ$

85.  $\sin \theta = 0.8191$

Quadrant I:  $\theta = \sin^{-1} 0.8191 \approx 54.99^\circ$

Quadrant II:  $\theta = 180^\circ - \sin^{-1} 0.8191 \approx 125.01^\circ$

91.  $\sin \theta = -0.4793$

Quadrant III:  $\theta \approx 208.6397^\circ$

Quadrant IV:  $\theta \approx 331.3603^\circ$

93.  $\cos \theta = 0.9848 \Rightarrow \theta \approx 10.0026^\circ$

Quadrant I:  $\theta = \cos^{-1}(0.9848) \approx 10.0026^\circ$

Quadrant IV:  $\theta \approx 360^\circ - 10.0026^\circ = 349.9974^\circ$

95.  $\tan \theta = 1.192 \Rightarrow \theta \approx 50.0058^\circ$

Quadrant I:  $\theta = \tan^{-1}1.192 \approx 50.0058^\circ$

Quadrant III:  $\theta \approx 180^\circ + 50.0058^\circ \approx 230.0058^\circ$

99.  $\tan \theta = \frac{3}{2}$

$$\sec^2 \theta = 1 + \tan^2 \theta$$

$$\sec^2 \theta = 1 + \left(\frac{3}{2}\right)^2$$

$$\sec^2 \theta = 1 + \frac{9}{4}$$

$$\sec^2 \theta = \frac{13}{4}$$

$\sec \theta < 0$  in Quadrant III.

$$\sec \theta = -\frac{\sqrt{13}}{2}$$

103. (a)  $t = 1$

$$T = 45 - 23 \cos \left[ \frac{2\pi}{365}(1 - 32) \right] \approx 25.2^\circ \text{ F}$$

(b)  $t = 185$

$$T = 45 - 23 \cos \left[ \frac{2\pi}{365}(185 - 32) \right] \approx 65.1^\circ \text{ F}$$

(c)  $t = 291$

$$T = 45 - 23 \cos \left[ \frac{2\pi}{365}(291 - 32) \right] \approx 50.8^\circ \text{ F}$$

107. False.  $\sin \left( \frac{7\pi}{6} \right) \neq \sin \left( \frac{11\pi}{6} \right)$

97.  $\sin \theta = -\frac{3}{5}$

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

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

$$\cos^2 \theta = 1 - \left(-\frac{3}{5}\right)^2$$

$$\cos^2 \theta = 1 - \frac{9}{25}$$

$$\cos^2 \theta = \frac{16}{25}$$

$\cos \theta > 0$  in Quadrant IV.

$$\cos \theta = \frac{4}{5}$$

101.  $\cos \theta = \frac{5}{8}$

$$\cos \theta = \frac{1}{\sec \theta} \Rightarrow \sec \theta = \frac{1}{\cos \theta}$$

$$\sec \theta = \frac{1}{5/8} = \frac{8}{5}$$

105.  $\sin \theta = \frac{6}{d} \Rightarrow d = \frac{6}{\sin \theta}$

(a)  $\theta = 30^\circ$

$$d = \frac{6}{\sin 30^\circ} = \frac{6}{(1/2)} = 12 \text{ miles}$$

(b)  $\theta = 90^\circ$

$$d = \frac{6}{\sin 90^\circ} = \frac{6}{1} = 6 \text{ miles}$$

(c)  $\theta = 120^\circ$

$$d = \frac{6}{\sin 120^\circ} \approx 6.9 \text{ miles}$$

109. (a)

|                            |           |            |            |            |            |
|----------------------------|-----------|------------|------------|------------|------------|
| $\theta$                   | $0^\circ$ | $20^\circ$ | $40^\circ$ | $60^\circ$ | $80^\circ$ |
| $\sin \theta$              | 0         | 0.3420     | 0.6428     | 0.8660     | 0.9848     |
| $\sin(180^\circ - \theta)$ | 0         | 0.3420     | 0.6428     | 0.8660     | 0.9848     |

111. Answers will vary.

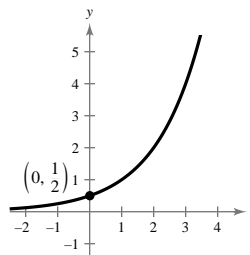
(b) It appears that  $\sin \theta = \sin(180^\circ - \theta)$  for all  $\theta$ .

113.  $y = 2^{x-1}$

|     |               |               |   |   |   |
|-----|---------------|---------------|---|---|---|
| $x$ | -1            | 0             | 1 | 2 | 3 |
| $y$ | $\frac{1}{4}$ | $\frac{1}{2}$ | 1 | 2 | 4 |

Intercept:  $(0, \frac{1}{2})$

Asymptote:  $y = 0$



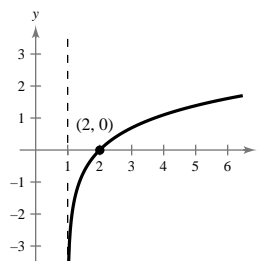
115.  $y = \ln(x - 1)$

Domain:  $x - 1 > 0 \Rightarrow x > 1$

|     |       |       |   |      |      |
|-----|-------|-------|---|------|------|
| $x$ | 1.1   | 1.5   | 2 | 3    | 4    |
| $y$ | -2.30 | -0.69 | 0 | 0.69 | 1.10 |

Intercept:  $(2, 0)$

Asymptote:  $x = 1$



117.  $4^{3-x} = 726$

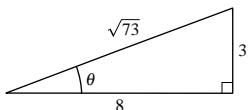
$3 - x = \log_4 726$

$x = 3 - \log_4 726 = 3 - \frac{\ln 726}{\ln 4} \approx -1.752$

119.  $\ln x = -6$

$x = e^{-6} \approx 0.002479 \approx 0.002$

121.



$\cot \theta = \frac{\text{adj}}{\text{opp}} = \frac{8}{3}$

$\text{hyp} = \sqrt{8^2 + 3^2} = \sqrt{73}$

$\sin \theta = \frac{\text{opp}}{\text{hyp}} = \frac{3}{\sqrt{73}} = \frac{3\sqrt{73}}{73}$

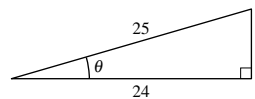
$\cos \theta = \frac{\text{adj}}{\text{hyp}} = \frac{8}{\sqrt{73}} = \frac{8\sqrt{73}}{73}$

$\tan \theta = \frac{\text{opp}}{\text{adj}} = \frac{3}{8}$

$\sec \theta = \frac{\text{hyp}}{\text{adj}} = \frac{\sqrt{73}}{8}$

$\csc \theta = \frac{\text{hyp}}{\text{opp}} = \frac{\sqrt{73}}{3}$

123.



$\tan \theta = \frac{7}{24} = \frac{\text{opp}}{\text{adj}}$

$\text{hyp} = \sqrt{7^2 + 24^2} = 25$

$\sin \theta = \frac{\text{opp}}{\text{hyp}} = \frac{7}{25}$

$\cos \theta = \frac{\text{adj}}{\text{hyp}} = \frac{24}{25}$

$\cot \theta = \frac{\text{adj}}{\text{opp}} = \frac{24}{7}$

$\sec \theta = \frac{\text{hyp}}{\text{adj}} = \frac{25}{24}$

$\csc \theta = \frac{\text{hyp}}{\text{opp}} = \frac{25}{7}$