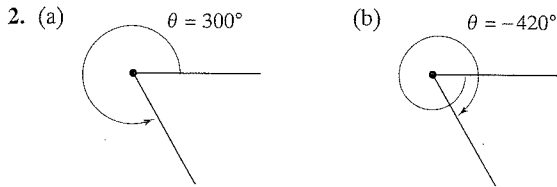
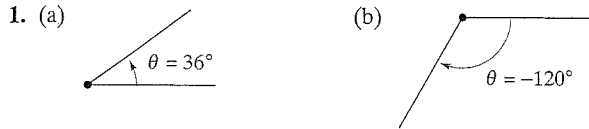
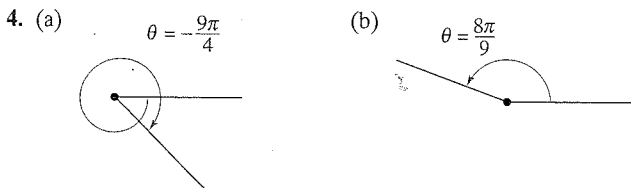
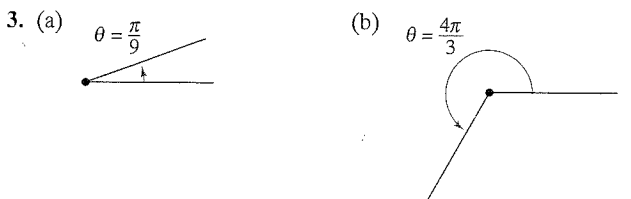


EXERCISES FOR APPENDIX A.3

In Exercises 1 and 2, determine two coterminal angles (one positive and one negative) for each given angle. Express your answers in degrees.



In Exercises 3 and 4, determine two coterminal angles (one positive and one negative) for each given angle. Express your answers in radians.



In Exercises 5 and 6, express the angles in radian measure as multiples of π and as decimals accurate to three decimal places.

5. (a) 30° (b) 150° (c) 315° (d) 120°
 6. (a) -20° (b) -240° (c) -270° (d) 144°

In Exercises 7 and 8, express the angles in degree measure.

7. (a) $\frac{3\pi}{2}$ (b) $\frac{7\pi}{6}$ (c) $-\frac{7\pi}{12}$ (d) -2.367
 8. (a) $\frac{7\pi}{3}$ (b) $-\frac{11\pi}{30}$ (c) $\frac{11\pi}{6}$ (d) 0.438

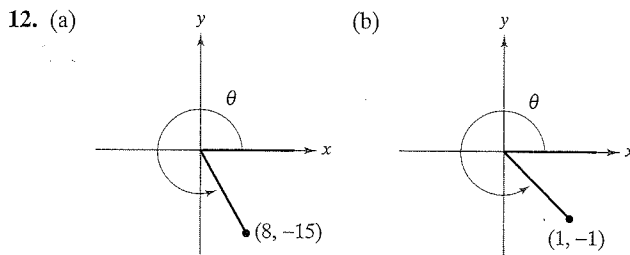
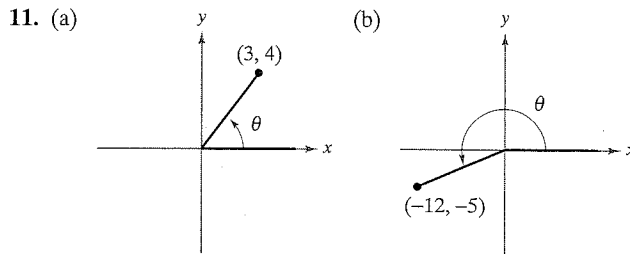
9. Let r represent the radius of a circle, θ the central angle (measured in radians), and s the length of the arc subtended by the angle. Use the relationship $s = r\theta$ to complete the table.

r	8 ft	15 in.	85 cm		
s	12 ft			96 in.	8642 mi
θ		1.6	$\frac{3\pi}{4}$	4	$\frac{2\pi}{3}$

10. **Angular Speed** A car is moving at the rate of 50 miles per hour, and the diameter of its wheels is 2.5 feet.

- (a) Find the number of revolutions per minute that the wheels are rotating.
 (b) Find the angular speed of the wheels in radians per minute.

In Exercises 11 and 12, determine all six trigonometric functions for the angle θ .

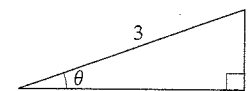
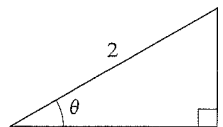


In Exercises 13 and 14, determine the quadrant in which θ lies.

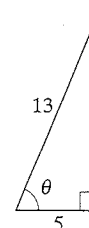
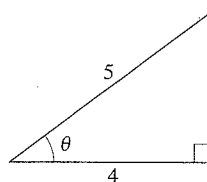
13. (a) $\sin \theta < 0$ and $\cos \theta < 0$
 (b) $\sec \theta > 0$ and $\cot \theta < 0$
 14. (a) $\sin \theta > 0$ and $\cos \theta < 0$
 (b) $\csc \theta < 0$ and $\tan \theta > 0$

In Exercises 15–18, evaluate the trigonometric function.

15. $\sin \theta = \frac{1}{2}$ 16. $\sin \theta = \frac{1}{3}$
 $\cos \theta =$ $\tan \theta =$



17. $\cos \theta = \frac{4}{5}$ 18. $\sec \theta = \frac{13}{5}$
 $\cot \theta =$ $\csc \theta =$



In Exercises 19–22, evaluate the sine, cosine, and tangent of each angle *without* using a calculator.

- | | |
|----------------------|----------------------|
| 19. (a) 60° | 20. (a) -30° |
| (b) 120° | (b) 150° |
| (c) $\frac{\pi}{4}$ | (c) $-\frac{\pi}{6}$ |
| (d) $\frac{5\pi}{4}$ | (d) $\frac{\pi}{2}$ |
- | | |
|-----------------------|-----------------------|
| 21. (a) 225° | 22. (a) 750° |
| (b) -225° | (b) 510° |
| (c) $\frac{5\pi}{3}$ | (c) $\frac{10\pi}{3}$ |
| (d) $\frac{11\pi}{6}$ | (d) $\frac{17\pi}{3}$ |

In Exercises 23–26, use a calculator to evaluate the trigonometric functions to four significant digits.

- | | |
|-------------------------|--------------------------|
| 23. (a) $\sin 10^\circ$ | 24. (a) $\sec 225^\circ$ |
| (b) $\csc 10^\circ$ | (b) $\sec 135^\circ$ |
- | | |
|------------------------------|----------------------|
| 25. (a) $\tan \frac{\pi}{9}$ | 26. (a) $\cot(1.35)$ |
| (b) $\tan \frac{10\pi}{9}$ | (b) $\tan(1.35)$ |

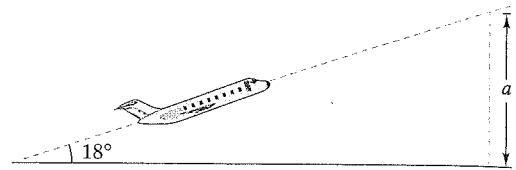
In Exercises 27–30, find two solutions of each equation. Express the results in radians ($0 \leq \theta < 2\pi$). Do not use a calculator.

- | | |
|--------------------------------------------|---------------------------|
| 27. (a) $\cos \theta = \frac{\sqrt{2}}{2}$ | 28. (a) $\sec \theta = 2$ |
| (b) $\cos \theta = -\frac{\sqrt{2}}{2}$ | (b) $\sec \theta = -2$ |
- | | |
|-------------------------------|--------------------------------------------|
| 29. (a) $\tan \theta = 1$ | 30. (a) $\sin \theta = \frac{\sqrt{3}}{2}$ |
| (b) $\cot \theta = -\sqrt{3}$ | (b) $\sin \theta = -\frac{\sqrt{3}}{2}$ |

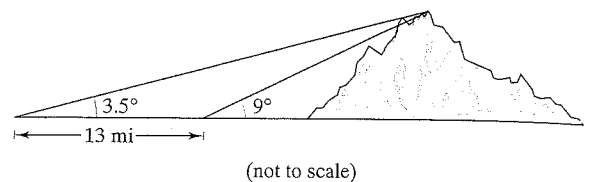
In Exercises 31–38, solve the equation for θ ($0 \leq \theta < 2\pi$).

- | | |
|-----------------------------------------------|-----------------------------------------------|
| 31. $2 \sin^2 \theta = 1$ | 32. $\tan^2 \theta = 3$ |
| 33. $\tan^2 \theta - \tan \theta = 0$ | 34. $2 \cos^2 \theta - \cos \theta = 1$ |
| 35. $\sec \theta \csc \theta = 2 \csc \theta$ | 36. $\sin \theta = \cos \theta$ |
| 37. $\cos^2 \theta + \sin \theta = 1$ | 38. $\cos \frac{\theta}{2} - \cos \theta = 1$ |

39. **Airplane Ascent** An airplane leaves the runway climbing at 18° with a speed of 275 feet per second (see figure). Find the altitude a of the plane after 1 minute.

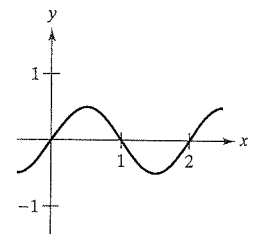
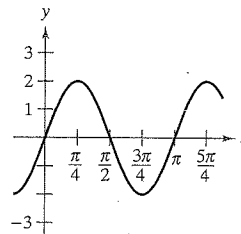


40. **Height of a Mountain** In traveling across flat land, you notice a mountain directly in front of you. Its angle of elevation (to the peak) is 3.5° . After you drive 13 miles closer to the mountain, the angle of elevation is 9° . Approximate the height of the mountain.

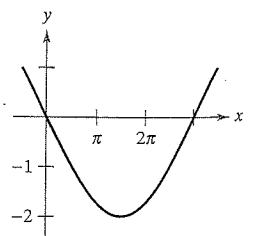
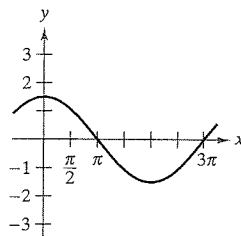


In Exercises 41–44, determine the period and amplitude of each function.

41. (a) $y = 2 \sin 2x$ (b) $y = \frac{1}{2} \sin \pi x$



42. (a) $y = \frac{3}{2} \cos \frac{x}{2}$ (b) $y = -2 \sin \frac{x}{3}$



43. $y = 3 \sin 4\pi x$

44. $y = \frac{2}{3} \cos \frac{\pi x}{10}$

Section A.3 (page A25)

1. (a) $396^\circ, -324^\circ$ (b) $240^\circ, -480^\circ$

3. (a) $\frac{19\pi}{9}, -\frac{17\pi}{9}$ (b) $\frac{10\pi}{3}, -\frac{2\pi}{3}$

5. (a) $\frac{\pi}{6}, 0.524$ (b) $\frac{5\pi}{6}, 2.618$

(c) $\frac{7\pi}{4}, 5.498$ (d) $\frac{2\pi}{3}, 2.094$

7. (a) 270° (b) 210° (c) -105° (d) -135.6°

9.

r	8 ft	15 in.	85 cm	24 in.	$\frac{12,963}{\pi}$ mi
s	12 ft	24 in.	63.75π cm	96 in.	8642 mi
θ	1.5	1.6	$\frac{3\pi}{4}$	4	$\frac{2\pi}{3}$

11. (a) $\sin \theta = \frac{4}{5}$ $\csc \theta = \frac{5}{4}$ $\cos \theta = \frac{3}{5}$ $\sec \theta = \frac{5}{3}$ $\tan \theta = \frac{4}{3}$ $\cot \theta = \frac{3}{4}$ (b) $\sin \theta = -\frac{5}{13}$ $\csc \theta = -\frac{13}{5}$ $\cos \theta = -\frac{12}{13}$ $\sec \theta = -\frac{13}{12}$ $\tan \theta = \frac{5}{12}$ $\cot \theta = \frac{12}{5}$

13. (a) Quadrant III (b) Quadrant IV

15. $\frac{\sqrt{3}}{2}$ 17. $\frac{4}{3}$

19. (a) $\sin 60^\circ = \frac{\sqrt{3}}{2}$ $\cos 60^\circ = \frac{1}{2}$ $\tan 60^\circ = \sqrt{3}$ (b) $\sin 120^\circ = \frac{\sqrt{3}}{2}$ $\cos 120^\circ = -\frac{1}{2}$ $\tan 120^\circ = -\sqrt{3}$

(c) $\sin \frac{\pi}{4} = \frac{\sqrt{2}}{2}$ $\cos \frac{\pi}{4} = \frac{\sqrt{2}}{2}$ $\tan \frac{\pi}{4} = 1$ (d) $\sin \frac{5\pi}{4} = -\frac{\sqrt{2}}{2}$ $\cos \frac{5\pi}{4} = -\frac{\sqrt{2}}{2}$ $\tan \frac{5\pi}{4} = 1$

21. (a) $\sin 225^\circ = -\frac{\sqrt{2}}{2}$ $\cos 225^\circ = -\frac{\sqrt{2}}{2}$ $\tan 225^\circ = 1$ (b) $\sin(-225^\circ) = \frac{\sqrt{2}}{2}$ $\cos(-225^\circ) = -\frac{\sqrt{2}}{2}$ $\tan(-225^\circ) = -1$

(c) $\sin \frac{5\pi}{3} = -\frac{\sqrt{3}}{2}$ $\cos \frac{5\pi}{3} = \frac{1}{2}$ $\tan \frac{5\pi}{3} = -\sqrt{3}$ (d) $\sin \frac{11\pi}{6} = -\frac{1}{2}$ $\cos \frac{11\pi}{6} = \frac{\sqrt{3}}{2}$ $\tan \frac{11\pi}{6} = -\frac{\sqrt{3}}{3}$

23. (a) 0.1736 (b) 5.759 25. (a) 0.3640 (b) 0.3640

27. (a) $\theta = \frac{\pi}{4}, \frac{7\pi}{4}$ (b) $\theta = \frac{3\pi}{4}, \frac{5\pi}{4}$

29. (a) $\theta = \frac{\pi}{4}, \frac{5\pi}{4}$ (b) $\theta = \frac{5\pi}{6}, \frac{11\pi}{6}$

31. $\theta = \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$ 33. $\theta = 0, \frac{\pi}{4}, \pi, \frac{5\pi}{4}$

35. $\theta = \frac{\pi}{3}, \frac{5\pi}{3}$ 37. $\theta = 0, \frac{\pi}{2}, \pi$ 39. 5099 feet

41. (a) Period: π Amplitude: 2 (b) Period: 2 Amplitude: $\frac{1}{2}$ 43. Period: $\frac{1}{2}$ Amplitude: 3