



UNDERSTAND

12. **Reason** Nadeem said the tangent of 270° is 0. Is he correct? Explain your reasoning.
13. **Make Sense and Persevere** In your own words explain how you can convert an angle measured in radians to an angle measured in degrees.
14. **Error Analysis** Describe and correct the error a student made in evaluating the secant of a 135° angle.

The coordinates of the terminal point on the unit circle are

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

$$\sec 135^\circ = \frac{-\frac{\sqrt{2}}{2}}{\frac{1}{2}} = -\frac{\sqrt{2}}{2}$$

X

15. **Generalize** In which quadrant(s) are all six trigonometric functions positive? Explain.
16. **Construct Arguments** Can a reference angle have a negative measure? Justify your reasoning.
17. **Communicate Precisely** How many coterminal angles does a given angle have? Explain.
18. **Model With Mathematics** Through how many radians does the minute hand of an analog clock rotate in 50 min?
19. **Error Analysis** If the coordinates of the terminal point of an angle θ on the unit circle are $(-3, 4)$, describe and correct the error a student made in finding $\tan \theta$.

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

X

PRACTICE

Find the sine and cosine of each angle.

SEE EXAMPLE 1

20. $\frac{5\pi}{6}$
21. 225°
22. 270°
23. $\frac{29\pi}{4}$
24. What is $\sin \theta$ if $\cos \theta = \frac{8}{17}$ and θ is in Quadrant I?
SEE EXAMPLE 2
25. What is $\cos \theta$ if $\sin \theta = -\frac{24}{25}$ and θ is in Quadrant IV? SEE EXAMPLE 2

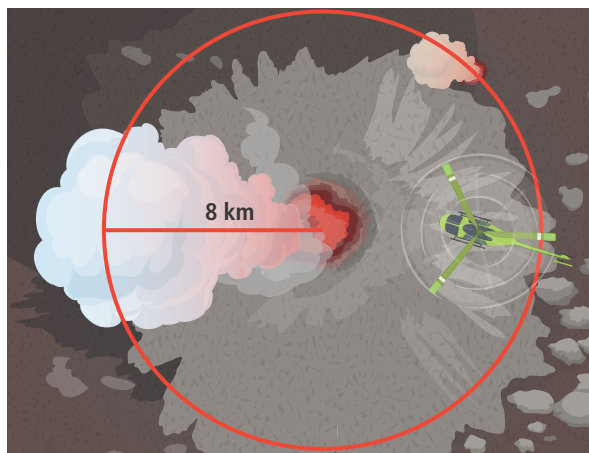
Find the tangent of each angle. SEE EXAMPLE 3

26. $\frac{7\pi}{3}$
27. 405°

Find the secant, cosecant, and cotangent for each angle. SEE EXAMPLE 4

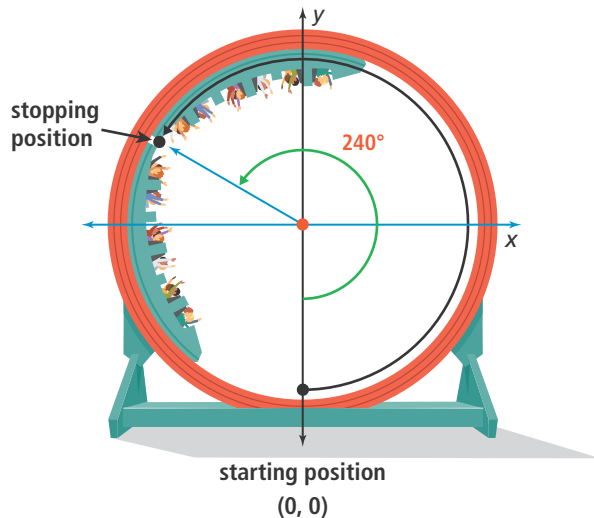
28. -315°
29. $\frac{13\pi}{4}$
30. 750°
31. $-\frac{2\pi}{3}$

32. Scientists are making an aerial study of a volcano. Their helicopter is circling at an 8 km radius around the volcano's crater, and one of the scientists notices a new vent that is 45° east of due north from the crater. What is the position of the new vent relative to the crater? SEE EXAMPLE 5



APPLY

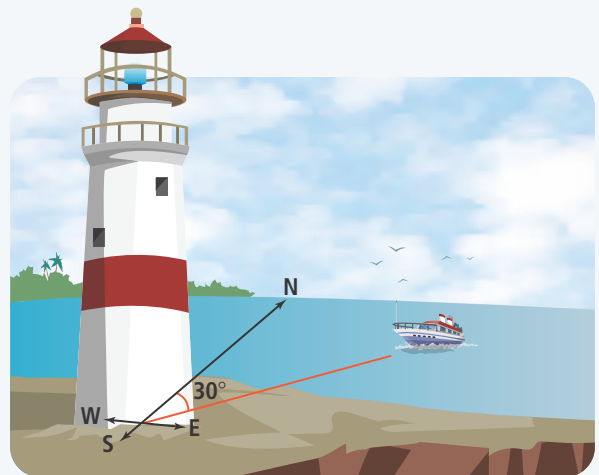
- 33. Model With Mathematics** The horizontal distance d (in feet) traveled by a projectile launched at an angle θ and with an initial speed v (in feet per second) is given by the formula: $d = \frac{v^2}{32} \sin 2\theta$. Suppose you kick a soccer ball with an initial speed of 35 ft/sec projected at an angle of 45° . How many feet will the soccer ball travel horizontally before hitting the ground? Round to the nearest foot.
- 34. Make Sense and Persevere** A circular carnival ride has a diameter of 120 ft. Suppose you board a gondola at the bottom of the circular ride, which is 6 ft above the ground, and rotate 240° counterclockwise before the ride temporarily stops. How many feet above ground are you when the ride stops?



- 35. Make Sense and Persevere** Twelve people sit at a round table. Alani, in the five o'clock seat, passes a piece of paper to Carla, at nine o'clock. What are the degree and radian measures of the angle through which the piece of paper passes?
- 36. Model With Mathematics** Kelsey boards one of the outer horses of a carousel that has a 32 ft diameter. She represents her starting position at the point $(16, 0)$ on a coordinate plane. The carousel rotates 300° and stops.
- Find the coordinates (x, y) of Kelsey's horse when the ride stopped.
 - How far from her starting position was she when the ride stopped?

ASSESSMENT PRACTICE

- 37.** What is $\sin \theta$ if $\cos \theta = -\frac{5}{13}$ and θ is in Quadrant II?
- $-\frac{12}{13}$
 - $-\frac{8}{13}$
 - $\frac{8}{13}$
 - $\frac{12}{13}$
- 38. SAT/ACT** Which of the following is $\tan\left(\frac{4\pi}{6}\right)$?
- $-\sqrt{3}$
 - $-\frac{\sqrt{3}}{2}$
 - $-\frac{\sqrt{3}}{3}$
 - $-\frac{1}{2}$
- 39. Performance Task** In navigation, the term *bearing* is used to describe the location of an object, or the clockwise-directed measure of the angle from due north. Suppose a ship's bearing is 30° from a lighthouse, as shown.



Part A Sketch the diagram on a coordinate plane, placing the lighthouse at the origin.

Part B What is the measure of the angle in standard position that describes the ship's location?

Part C If the distance from the lighthouse to the ship is 20 mi, find the coordinates of the point that represent its position on the coordinate plane.