3.1 Radian Measure

Convert the degree measure to radians. Leave answer as a multiple of $\pi$.

1) 36°

2) -30°

3) 252°

Find the exact value without using a calculator.

4) $\cos \left( \frac{2\pi}{3} \right)$

5) $\sin \left( -\frac{5\pi}{4} \right)$

6) $\tan \left( \frac{5\pi}{4} \right)$

7) $\cot \pi$

Solve the problem.

8) Through how many radians will the hour hand on a clock rotate in 48 hours?

3.2 Applications of Radian Measure

Find the length of an arc intercepted by a central angle $\theta$ in a circle of radius $r$. Round your answer to 1 decimal place.

9) $r = 36.67$ ft; $\theta = \frac{\pi}{3}$ radians

Assume that the cities lie on the same north-south line and that the radius of the earth is 6400 km.

10) Find the distance between City A, 62° N and City B, 29° N. (Round to the nearest kilometer.)

11) Find the latitude of Winnipeg, Canada if Winnipeg and Austin, TX, 30°N, are 2234 km apart.
Solve the problem.

12) A pendulum of length 14.0 inches swings 5°37' to each side of its vertical position. What is the length (to the nearest hundredth of an inch) of the arc through which the end of the pendulum swings?

13) A car wheel has a 13- inch radius. Through what angle (to the nearest tenth of a degree) does the wheel turn when the car rolls forward 2 ft?

14) Two wheels are rotating in such a way that the rotation of the smaller wheel causes the larger wheel to rotate. The radius of the smaller wheel is 7.2 centimeters and the radius of the larger wheel is 19.5 centimeters. Through how many degrees (to the nearest hundredth of a degree) will the larger wheel rotate if the smaller one rotates 225°?

15) A pulley rotates through 51° in one minute. How many rotations (to the nearest tenth of a rotation) does the pulley make in an hour?

Find the area of a sector of a circle having radius \( r \) and central angle \( \theta \). If necessary, express the answer to the nearest tenth.

16) \( r = 11.3 \text{ cm, } \theta = \frac{\pi}{10} \text{ radians} \)

17) \( r = 16.0 \text{ m, } \theta = 20^\circ \)

Solve the problem.

18) What is the difference in area covered by a single 3- inch windshield wiper operating with a central angle of 138° compared to a pair of 5- inch wipers operating together each having a central angle of 114°? Round to the nearest hundredth.

19) A center- pivot irrigation system waters a sector- shaped field. Find the area of the field if the central angle, \( \theta = 35^\circ \) and the radius, \( r = 150 \) meters. Round to the nearest whole number.

20) A circular sector has an area of 16 in\(^2\) and an arc length of 6 inches. What is the measure of the central angle in degrees? Round to the nearest degree.

3.3 The Unit Circle and Circular Functions

Find the exact circular function value.

21) \( \cos \frac{-2\pi}{3} \)

22) \( \sin \frac{3\pi}{4} \)
23) \( \cot \frac{-11\pi}{6} \)

Use a table or a calculator to evaluate the function. Round to four decimal places.
24) \( \sin 0.2008 \)

25) \( \sec 0.1566 \)

Suppose an arc of length \( s \) lies on the unit circle \( x^2 + y^2 = 1 \), starting at point (1, 0) and terminating at the point \( (x, y) \). Use a calculator to find the approximate coordinates \( (x, y) \). Round coordinates to four decimal places when appropriate.

\[
\begin{align*}
x &= \cos s \\
y &= \sin s
\end{align*}
\]

26) \( s = 5.8 \)

For the given value of \( s \), decide in which quadrant an angle of \( s \) radians lies by evaluating \( \sin s \) and \( \cos s \).
27) \( s = 41 \)

Find the value of \( s \) in the interval \( [0, \pi/2] \) that makes the statement true. Round to four decimal places.
28) \( \sin s = 0.8065 \)

29) \( \sec s = 3.9448 \)

Find the exact value of \( s \) in the given interval that has the given circular function value.
30) \( \left[ \frac{\pi}{2}, \pi \right] ; \cos s = -\frac{\sqrt{3}}{2} \)

31) \( \left[ \frac{3\pi}{2}, 2\pi \right] ; \tan s = -\frac{\sqrt{3}}{3} \)
Find the exact values of $s$ in the given interval that satisfy the given condition.

32) $(0, 2\pi); \cos s = \frac{1}{2}$

33) $(0, 2\pi); \tan^2 s = \frac{1}{3}$

34) $(0, 2\pi); 4 \sin^2 s = 3$

Solve the problem.

35) The temperature in Verlander is modeled by $T(x) = 49 \sin \left(\frac{2\pi}{365}(x - 102)\right) + 41$ where $T(x)$ is the temperature in degrees Fahrenheit on day $x$, with $x = 1$ representing January 1 and $x = 365$ representing December 31. Find the temperature on May 19.

3.4 Linear and Angular Speed

Use the formula $\omega = \frac{\theta}{t}$ to find the value of the missing variable. Give an exact answer unless otherwise indicated.

36) $\omega = \frac{\pi}{12}$ radian per min, $t = 7$ min

Use the formula $v = r\omega$ to find the value of the missing variable. Give an exact answer unless otherwise indicated.

37) $v = 19$ ft per sec, $r = 9.7$ ft (Round to four decimal places when necessary.)

Use the formula $s = rt\omega$ to find the value of the missing variable. Give an exact answer.

38) $s = \frac{\pi}{11}$ m, $r = 5$ m, $t = 2$ sec

Solve the problem.

39) Find $\omega$ for the minute hand of a clock.

40) A wheel is rotating at $5$ radians/sec, and the wheel has a 32-inch diameter. To the nearest foot, what is the speed of a point on the rim in ft/min?

41) Two pulleys of diameters 9 m and 3 m are connected by a belt. The larger pulley rotates 40 times per min. Find the angular speed of the smaller pulley.

42) Each tire of an automobile has a radius of 2 feet. How many revolutions per minute (rpm) does a tire make when the automobile is traveling at a speed of 116 feet per sec? Round your answer to the nearest tenth.
1) \( \frac{\pi}{5} \)
2) \(- \frac{\pi}{6}\)
3) \(\frac{7\pi}{5}\)
4) \(- \frac{1}{2}\)
5) \(\frac{\sqrt{2}}{2}\)
6) 1
7) undefined
8) \(8\pi\)
9) 38.4 ft
10) 3686 km
11) 50°N
12) 2.74 in.
13) 105.8°
14) 83.08°
15) 8.5 rotations
16) 20.1 cm²
17) 44.7 m²
18) 38.90 in.²
19) 6872 m²
20) 64°
21) \(- \frac{1}{2}\)
22) \(\frac{\sqrt{5}}{2}\)
23) \(\sqrt{3}\)
24) 0.1995
25) 1.0124
26) (0.8855, -0.4646)
27) III
28) 0.9382
29) 1.3145
30) \(s = \frac{5\pi}{6}\)
31) \(s = \frac{11\pi}{6}\)
Answer Key
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32) $\frac{\pi}{3}, \frac{5\pi}{3}

33) $\frac{\pi}{6}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6}

34) $\frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}

35) 70°F

36) $\frac{7\pi}{12}$ radians

37) 1.9588 radians per sec

38) $\frac{\pi}{110}$ radian per sec

39) $\frac{\pi}{30}$ radians per min

40) 400 ft./min

41) 240\(\pi\) radians per min

42) 553.9 rpm