

6. True or False: $\pi = 180$.

7. True or False: $180^\circ = \pi$ radians.

8. True or False: On the unit circle, if s is the length of the arc subtended by a central angle θ , measured in radians, then $s = \theta$.

9. True or False: The area A of the sector of a circle of radius r formed by a central angle of θ degrees is $A = \frac{1}{2}r^2\theta$.

10. True or False: For circular motion on a circle of radius r , linear speed equals angular speed divided by r .

Exercises

In Problems 11–22, draw each angle.

11. 30°

12. 60°

13. 135°

14. -120°

15. 450°

16. 540°

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

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

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

20. $-\frac{2\pi}{3}$

21. $\frac{16\pi}{3}$

22. $\frac{21\pi}{4}$

In Problems 23–28, convert each angle to a decimal in degrees. Round your answer to two decimal places.

23. $40^\circ 10' 25''$

24. $61^\circ 42' 21''$

25. $1^\circ 2' 3''$

26. $73^\circ 40' 40''$

27. $9^\circ 9' 9''$

28. $98^\circ 22' 45''$

In Problems 29–34, convert each angle to $D^\circ M' S''$ form. Round your answer to the nearest second.

29. 40.32°

30. 61.24°

31. 18.255°

32. 29.411°

33. 19.99°

34. 44.01°

In Problems 35–46, convert each angle in degrees to radians. Express your answer as a multiple of π .

35. 30°

36. 120°

37. 240°

38. 330°

39. -60°

40. -30°

41. 180°

42. 270°

43. -135°

44. -225°

45. -90°

46. -180°

In Problems 47–58, convert each angle in radians to degrees.

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

48. $\frac{5\pi}{6}$

49. $-\frac{5\pi}{4}$

50. $-\frac{2\pi}{3}$

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

52. 4π

53. $\frac{\pi}{12}$

54. $\frac{5\pi}{12}$

55. $-\frac{\pi}{2}$

56. $-\pi$

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

58. $-\frac{3\pi}{4}$

In Problems 59–64, convert each angle in degrees to radians. Express your answer in decimal form, rounded to two decimal places.

59. 17°

60. 73°

61. -40°

62. -51°

63. 125°

64. 350°

In Problems 65–70, convert each angle in radians to degrees. Express your answer in decimal form, rounded to two decimal places.

65. 3.14

66. 0.75

67. 2

68. 3

69. 6.32

70. $\sqrt{2}$

In Problems 71–78, s denotes the length of the arc of a circle of radius r subtended by the central angle θ . Find the missing quantity. Round answers to three decimal places.

71. $r = 10$ meters, $\theta = \frac{1}{2}$ radian, $s = ?$

72. $r = 6$ feet, $\theta = 2$ radians, $s = ?$

73. $\theta = \frac{1}{3}$ radian, $s = 2$ feet, $r = ?$

74. $\theta = \frac{1}{4}$ radian, $s = 6$ centimeters, $r = ?$

75. $r = 5$ miles, $s = 3$ miles, $\theta = ?$

76. $r = 6$ meters, $s = 8$ meters, $\theta = ?$

77. $r = 2$ inches, $\theta = 30^\circ$, $s = ?$

78. $r = 3$ meters, $\theta = 120^\circ$, $s = ?$

In Problems 79–86, A denotes the area of the sector of a circle of radius r formed by the central angle θ . Find the missing quantity. Round answers to three decimal places.

79. $r = 10$ meters, $\theta = \frac{1}{2}$ radian, $A = ?$

80. $r = 6$ feet, $\theta = 2$ radians, $A = ?$

81. $\theta = \frac{1}{3}$ radian, $A = 2$ square feet, $r = ?$

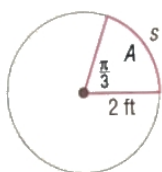
82. $\theta = \frac{1}{4}$ radian, $A = 6$ square centimeters, $r = ?$

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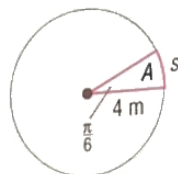
83. $r = 5$ miles, $A = 3$ square miles, $\theta = ?$
 85. $r = 2$ inches, $\theta = 30^\circ$, $A = ?$

In Problems 87–90, find the length s and area A . Round answers to three decimal places.

87.

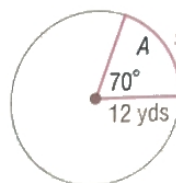


88.



84. $r = 6$ meters, $A = 8$ square meters, $\theta = ?$
 86. $r = 3$ meters, $\theta = 120^\circ$, $A = ?$

89.



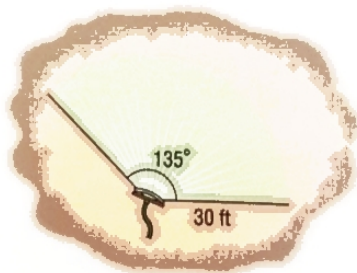
90.



91. **Minute Hand of a Clock** The minute hand of a clock is 6 inches long. How far does the tip of the minute hand move in 15 minutes? How far does it move in 25 minutes?



92. **Movement of a Pendulum** A pendulum swings through an angle of 20° each second. If the pendulum is 40 inches long, how far does its tip move each second?
 93. **Area of a Sector** Find the area of the sector of a circle of radius 4 meters formed by an angle of 45° . Round the answer to two decimal places.
 94. **Area of a Sector** Find the area of the sector of a circle of radius 3 centimeters formed by an angle of 60° . Round the answer to two decimal places.
 95. **Watering a Lawn** A water sprinkler sprays water over a distance of 30 feet while rotating through an angle of 135° . What area of lawn receives water?



96. **Designing a Water Sprinkler** An engineer is asked to design a water sprinkler that will cover a field of 100 square yards that is in the shape of a sector of a circle of radius 50 yards. Through what angle should the sprinkler rotate?

97. **Motion on a Circle** An object is traveling around a circle with a radius of 5 centimeters. If in 20 seconds a central angle of $\frac{1}{3}$ radian is swept out, what is the angular speed of the object? What is its linear speed?

98. **Motion on a Circle** An object is traveling around a circle with a radius of 2 meters. If in 20 seconds the object

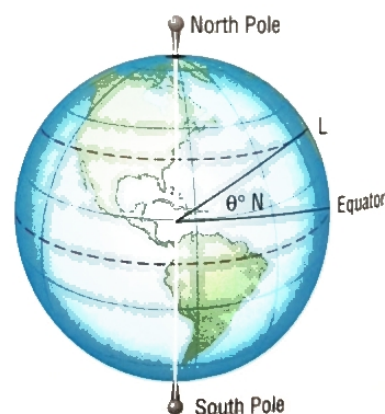
travels 5 meters, what is its angular speed? What is its linear speed?

99. **Bicycle Wheels** The diameter of each wheel of a bicycle is 26 inches. If you are traveling at a speed of 15 miles per hour on this bicycle, through how many revolutions per minute are the wheels turning?



100. **Car Wheels** The radius of each wheel of a car is 14 inches. If the wheels are turning at the rate of 3 revolutions per second, how fast is the car moving? Express your answer in inches per second and in miles per hour.

In Problems 101–104, the latitude of a location L is the angle formed by a ray drawn from the center of Earth to the Equator and a ray drawn from the center of Earth to L . See the figure.



101. **Distance between Cities** Memphis, Tennessee, is 35°9' north of New Orleans, Louisiana. Find the distance between Memphis (35°9' north latitude) and New Orleans (29°57' north latitude). Assume that the radius of Earth is 3960 miles.

- ✓ 116. Do you prefer to measure angles using degrees or radians? Provide justification and a rationale for your choice.
117. What is 1 radian?
118. Which angle has the larger measure: 1 degree or 1 radian? Or are they equal?
119. Explain the difference between linear speed and angular speed.
120. For a circle of radius r , a central angle of θ degrees subtends an arc whose length s is $s = \frac{\pi}{180}r\theta$. Discuss whether this is a true or false statement. Give reasons to defend your position.
121. Discuss why ships and airplanes use nautical miles to measure distance. Explain the difference between a nautical mile and a statute mile.
122. Investigate the way that speed bicycles work. In particular, explain the differences and similarities between 5-speed and 9-speed derailleurs. Be sure to include a discussion of linear speed and angular speed.