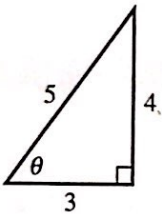


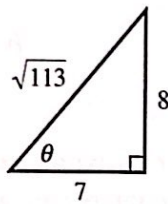
SECTION 4.2 EXERCISES

In Exercises 1–8, find the values of all six trigonometric functions of the angle θ .

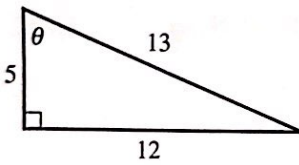
1.



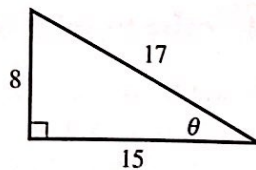
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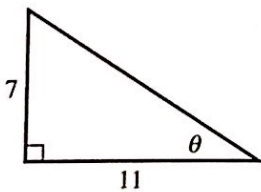
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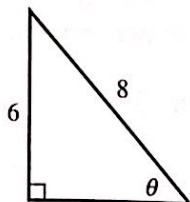
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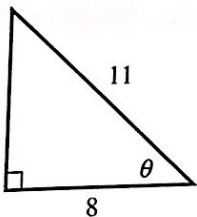
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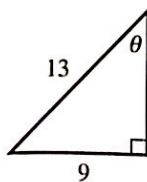
6.



7.



8.



In Exercises 9–18, assume that θ is an acute angle in a right triangle satisfying the given conditions. Evaluate the remaining trigonometric functions.

9. $\sin \theta = \frac{3}{7}$

10. $\sin \theta = \frac{2}{3}$

11. $\cos \theta = \frac{5}{11}$

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

13. $\tan \theta = \frac{5}{9}$

14. $\tan \theta = \frac{12}{13}$

15. $\cot \theta = \frac{11}{3}$

16. $\csc \theta = \frac{12}{5}$

17. $\csc \theta = \frac{23}{9}$

18. $\sec \theta = \frac{17}{5}$

In Exercises 19–24, evaluate *without* using a calculator.

19. $\sin\left(\frac{\pi}{3}\right)$

20. $\tan\left(\frac{\pi}{4}\right)$

21. $\cot\left(\frac{\pi}{6}\right)$

22. $\sec\left(\frac{\pi}{3}\right)$

23. $\cos\left(\frac{\pi}{4}\right)$

24. $\csc\left(\frac{\pi}{3}\right)$

In Exercises 25–28, evaluate using a calculator. Give an exact value, not an approximate answer. (See Example 4.)

25. $\sec 45^\circ$

26. $\sin 60^\circ$

27. $\csc\left(\frac{\pi}{3}\right)$

28. $\tan\left(\frac{\pi}{3}\right)$

In Exercises 29–40, evaluate using a calculator. Be sure the calculator is in the correct mode. Give answers correct to three decimal places.

29. $\sin 74^\circ$

31. $\cos 19^\circ 23'$

33. $\tan\left(\frac{\pi}{12}\right)$

35. $\sec 49^\circ$

37. $\cot 0.89$

39. $\cot\left(\frac{\pi}{8}\right)$

30. $\tan 8^\circ$

32. $\tan 23^\circ 42'$

34. $\sin\left(\frac{\pi}{15}\right)$

36. $\csc 19^\circ$

38. $\sec 1.24$

40. $\csc\left(\frac{\pi}{10}\right)$

In Exercises 41–48, find the acute angle θ that satisfies the given equation. Give θ in both degrees and radians. You should do these problems without a calculator.

41. $\sin \theta = \frac{1}{2}$

42. $\sin \theta = \frac{\sqrt{3}}{2}$

43. $\cot \theta = \frac{1}{\sqrt{3}}$

44. $\cos \theta = \frac{\sqrt{2}}{2}$

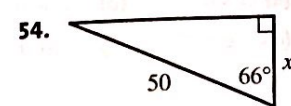
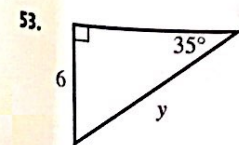
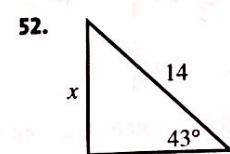
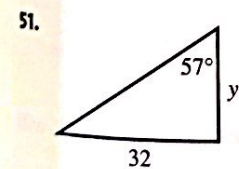
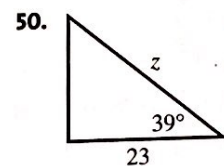
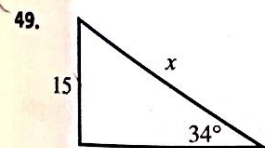
45. $\sec \theta = 2$

46. $\cot \theta = 1$

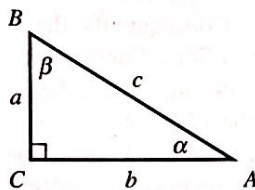
47. $\tan \theta = \frac{\sqrt{3}}{3}$

48. $\cos \theta = \frac{\sqrt{3}}{2}$

In Exercises 49–54, solve for the variable shown.



In Exercises 55–58, solve the right $\triangle ABC$ for all of its unknown parts.



55. $\alpha = 20^\circ; a = 12.3$

56. $\alpha = 41^\circ; c = 10$

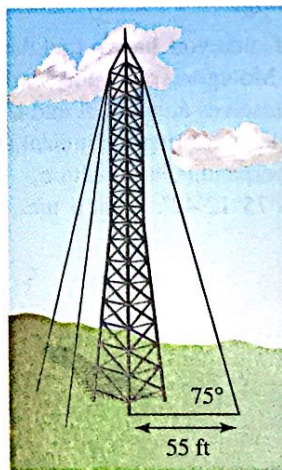
57. $\beta = 55^\circ; a = 15.58$

58. $a = 5; \beta = 59^\circ$

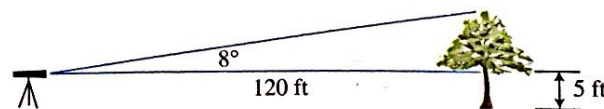
59. **Writing to Learn** What is $\lim_{\theta \rightarrow 0} \sin \theta$? Explain your answer in terms of right triangles in which θ gets smaller and smaller and smaller.

60. **Writing to Learn** What is $\lim_{\theta \rightarrow 0} \cos \theta$? Explain your answer in terms of right triangles in which θ gets smaller and smaller.

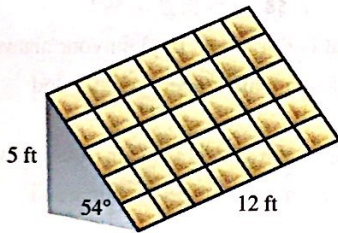
61. **Height** A guy wire from the top of the transmission tower at WJBC forms a 75° angle with the ground at a 55-foot distance from the base of the tower. How tall is the tower?



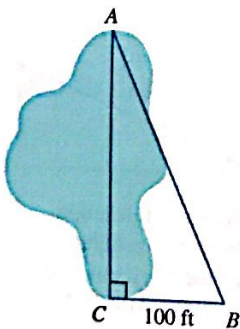
62. **Height** Kirsten places her surveyor's telescope on the top of a tripod 5 feet above the ground. She measures an 8° elevation above the horizontal to the top of a tree that is 120 feet away. How tall is the tree?



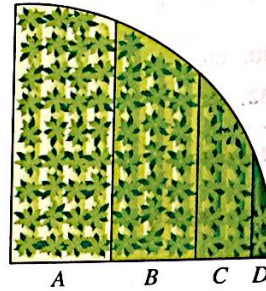
- 63. Group Activity Area** For locations between 20° and 60° north latitude a solar collector panel should be mounted so that its angle with the horizontal is 20° greater than the local latitude. Consequently, the solar panel mounted on the roof of Solar Energy, Inc., in Atlanta (latitude 34°) forms a 54° angle with the horizontal. The bottom edge of the 12-ft long panel is resting on the roof, and the high edge is 5 ft above the roof. What is the total area of this rectangular collector panel?



- 64. Height** The Chrysler Building in New York City was the tallest building in the world at the time it was built. It casts a shadow approximately 130 feet long on the street when the sun's rays form an 82.9° angle with the earth. How tall is the building?
- 65. Distance** DaShanda's team of surveyors had to find the distance AC across the lake at Montgomery County Park. Field assistants positioned themselves at points A and C while DaShanda set up an angle-measuring instrument at point B , 100 feet from C in a perpendicular direction. DaShanda measured $\angle ABC$ as $75^\circ 12' 42''$. What is the distance AC ?



- 66. Group Activity Garden Design** Allen's garden is in the shape of a quarter-circle with radius 10 ft. He wishes to plant his garden in four parallel strips, as shown in the diagram on the left below, so that the four arcs along the circular edge of the garden are all of equal length. After measuring four equal arcs, he carefully measures the widths of the four strips and records his data in the table shown at the right below.



Strip	Width
A	3.827 ft
B	3.344 ft
C	2.068 ft
D	0.761 ft

Alicia sees Allen's data and realizes that he could have saved himself some work by figuring out the strip widths by trigonometry. By checking his data with a calculator she is able to correct two measurement errors he has made. Find Allen's two errors and correct them.

Standardized Test Questions

- 67. True or False** If θ is an angle in any triangle, then $\tan \theta$ is the length of the side opposite θ divided by the length of the side adjacent to θ . Justify your answer.
- 68. True or False** If A and B are angles of a triangle such that $A > B$, then $\cos A > \cos B$. Justify your answer.

You should answer these questions without using a calculator.

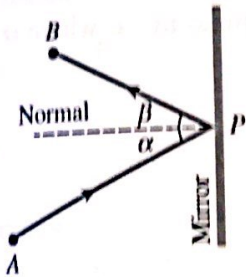
- 69. Multiple Choice** Which of the following expressions does not represent a real number?
- (a) $\sin 30^\circ$ (b) $\tan 45^\circ$ (c) $\cos 90^\circ$
 (d) $\csc 90^\circ$ (e) $\sec 90^\circ$
- 70. Multiple Choice** If θ is the smallest angle in a 3-4-5 right triangle, then $\sin \theta =$
- (a) $\frac{3}{5}$ (b) $\frac{3}{4}$ (c) $\frac{4}{5}$
 (d) $\frac{5}{4}$ (e) $\frac{5}{3}$
- 71. Multiple Choice** If a nonhorizontal line has slope $\sin \theta$, it will be perpendicular to a line with slope
- (a) $\cos \theta$ (b) $-\cos \theta$ (c) $\csc \theta$
 (d) $-\csc \theta$ (e) $-\sin \theta$

72. **Multiple Choice** Which of the following trigonometric ratios could *not* be π ?

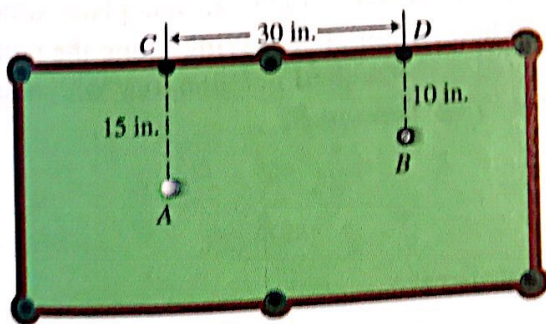
- (a) $\tan \theta$ (b) $\cos \theta$ (c) $\cot \theta$
 (d) $\sec \theta$ (e) $\csc \theta$

Explorations

73. **Mirrors** In the figure, a light ray shining from point A to point P on the mirror will bounce to point B in such a way that the *angle of incidence* α will equal the *angle of reflection* β . This is the *law of reflection* derived from physical experiments. Both angles are measured from the *normal line*, which is perpendicular to the mirror at the point of reflection P . If A is 2 m farther from the mirror than is B , and if $\alpha = 30^\circ$ and $AP = 5$ m, what is the length PB ?



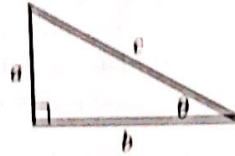
74. **Pool** On the pool table shown in the figure, where along the portion CD of the railing should you direct ball A so that it will bounce off CD and strike ball B ? Assume that A obeys the law of reflection relative to rail CD .



Extending the Ideas

75. Using the labeling of the triangle below, prove that if θ is an acute angle in any right triangle,

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



76. Using the labeling of the triangle below, prove that the area of the triangle is equal to $(1/2)ab \sin \theta$. [Hint: Start by drawing the altitude to side b and finding its length.]

