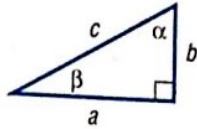


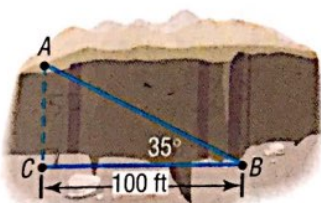
In Problems 29–38, use the right triangle shown. Then, using the given information, solve the triangle.



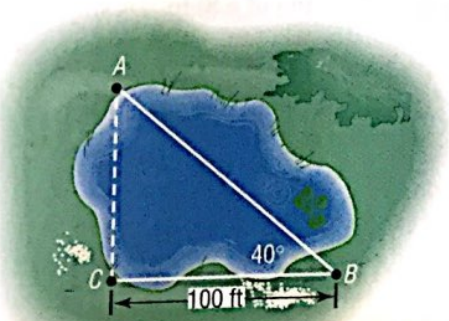
29. $b = 5$, $\beta = 20^\circ$; find a , c , and α
 31. $a = 6$, $\beta = 40^\circ$; find b , c , and α
 33. $b = 4$, $\alpha = 10^\circ$; find a , c , and β
 35. $a = 5$, $b = 3$; find c , α , and β
 37. $a = 2$, $c = 5$; find b , α , and β

30. $b = 4$, $\beta = 10^\circ$; find a , c , and α
 32. $a = 7$, $\beta = 50^\circ$; find b , c , and α
 34. $b = 6$, $\alpha = 20^\circ$; find a , c , and β
 36. $a = 2$, $b = 8$; find c , α , and β
 38. $b = 4$, $c = 6$; find a , α , and β

39. A right triangle has a hypotenuse of length 8 inches. If one angle is 35° , find the length of each leg.
 40. A right triangle has a hypotenuse of length 10 centimeters. If one angle is 40° , find the length of each leg.
 41. A right triangle contains a 25° angle. If one leg is of length 5 inches, what is the length of the hypotenuse? [Hint: Two answers are possible.]
 42. A right triangle contains an angle of $\pi/8$ radian. If one leg is of length 3 meters, what is the length of the hypotenuse? [Hint: Two answers are possible.]
 43. The hypotenuse of a right triangle is 5 inches. If one leg is 2 inches, find the degree measure of each angle.
 44. The hypotenuse of a right triangle is 3 feet. If one leg is 1 foot, find the degree measure of each angle.
 45. **Finding the Width of a Gorge** Find the distance from A to C across the gorge illustrated in the figure.



46. **Finding the Distance across a Pond** Find the distance from A to C across the pond illustrated in the figure.

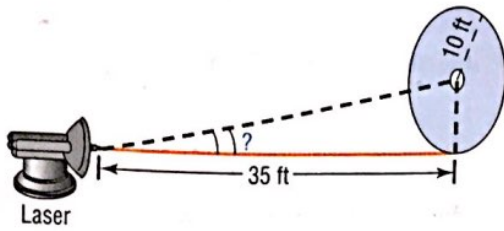


47. **The Eiffel Tower** The tallest tower built before the era of television masts, the Eiffel Tower was completed on March 31, 1889. Find the height of the Eiffel Tower (before a television mast was added to the top) using the information given in the illustration.



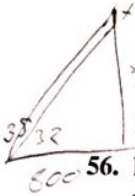
48. **Finding the Distance of a Ship from Shore** A ship, offshore from a vertical cliff known to be 100 feet in height, takes a sighting of the top of the cliff. If the angle of elevation is found to be 25° , how far offshore is the ship?
 49. **Finding the Distance to a Plateau** Suppose that you are headed toward a plateau 50 meters high. If the angle of elevation to the top of the plateau is 20° , how far are you from the base of the plateau?
 50. **Statue of Liberty** A ship is just offshore of New York City. A sighting is taken of the Statue of Liberty, which is about 305 feet tall. If the angle of elevation to the top of the statue is 20° , how far is the ship from the base of the statue?
 51. **Finding the Reach of a Ladder** A 22-foot extension ladder leaning against a building makes a 70° angle with the ground. How far up the building does the ladder touch?
 52. **Finding the Height of a Building** To measure the height of a building, two sightings are taken a distance of 50 feet apart. If the first angle of elevation is 40° and the second is 32° , what is the height of the building?

53. A laser beam is to be directed through a small hole in the center of a circle of radius 10 feet. The origin of the beam is 35 feet from the circle (see the figure). At what angle of elevation should the beam be aimed to ensure that it goes through the hole?

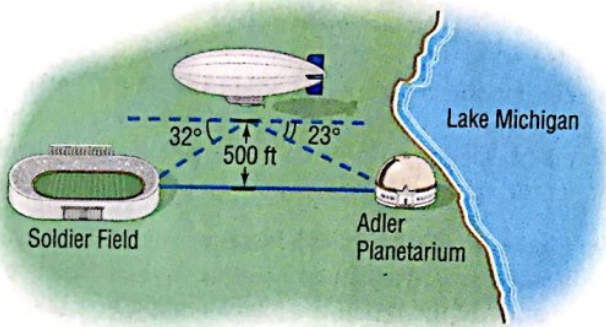


54. **Finding the Angle of Elevation of the Sun** At 10 AM on April 26, 2000, a building 300 feet high casts a shadow 50 feet long. What is the angle of elevation of the Sun?

55. **Mt. Rushmore** To measure the height of Lincoln's caricature on Mt. Rushmore, two sightings 800 feet from the base of the mountain are taken. If the angle of elevation to the bottom of Lincoln's face is 32° and the angle of elevation to the top is 35° , what is the height of Lincoln's face?



56. **Finding the Distance between Two Objects** A blimp, suspended in the air at a height of 500 feet, lies directly over a line from Soldier Field to the Adler Planetarium on Lake Michigan (see the figure). If the angle of depression from the blimp to the stadium is 32° and from the blimp to the planetarium is 23° , find the distance between Soldier Field and the Adler Planetarium.



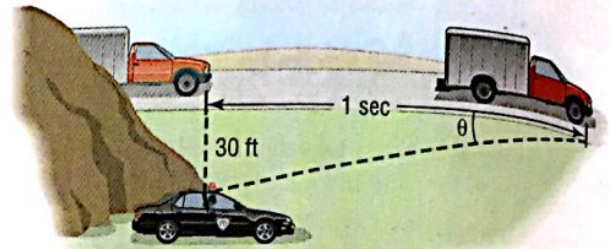
57. **Finding the Length of a Guy Wire** A radio transmission tower is 200 feet high. How long should a guy wire be if it is to be attached to the tower 10 feet from the top and is to make an angle of 21° with the ground?

58. **Finding the Height of a Tower** A guy wire 80 feet long is attached to the top of a radio transmission tower, making an angle of 25° with the ground. How high is the tower?

59. **Washington Monument** The angle of elevation of the Washington Monument is 35.1° at the instant it casts a shadow 789 feet long. Use this information to calculate the height of the monument.

60. **Finding the Length of a Mountain Trail** A straight trail with a uniform inclination of 17° leads from a highway at an elevation of 9000 feet to a mountain lake at an elevation of 11,200 feet. What is the length of the trail?

61. **Finding the Speed of a Truck** A state trooper is hidden 30 feet from a highway. One second after a truck passes the angle θ between the highway and the line of observation from the patrol car to the truck is measured. See the illustration.



- (a) If the angle measures 15° , how fast is the truck traveling? Express the answer in feet per second and in miles per hour.

- (b) If the angle measures 20° , how fast is the truck traveling? Express the answer in feet per second and in miles per hour.

- (c) If the speed limit is 55 miles per hour and a speeding ticket is issued for speeds of 5 miles per hour or more over the limit, for what angles should the trooper issue a ticket?

62. **Security** A security camera in a neighborhood bank is mounted on a wall 9 feet above the floor. What angle of depression should be used if the camera is to be directed to a spot 6 feet above the floor and 12 feet from the wall?

63. **Finding the Bearing of an Aircraft** A DC-9 aircraft leaves Midway Airport from runway 4 RIGHT, whose bearing is $N40^\circ E$. After flying for $1/2$ mile, the pilot requests permission to turn 90° and head toward the southeast. The permission is granted. After the airplane goes 1 mile in this direction, what bearing should the control tower use to locate the aircraft?

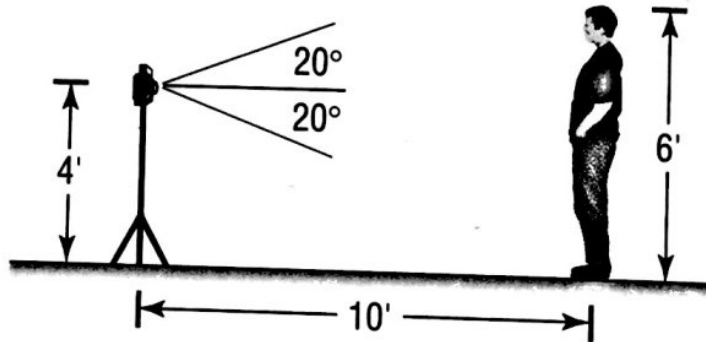
64. **Finding the Bearing of a Ship** A ship leaves the port of Miami with a bearing of $S80^\circ E$ and a speed of 15 knots. After 1 hour, the ship turns 90° toward the south. After 2 hours, maintaining the same speed, what is the bearing to the ship from port?

65. **Shooting Free Throws in Basketball** The eyes of a basketball player are 6 feet above the floor. The player is at the free-throw line, which is 15 feet from the center of the basket rim (see the figure). What is the angle of elevation from the player's eyes to the center of the rim? [Hint: The rim is 10 feet above the floor.]

Trigonometric Functions

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- 73. Photography** A camera is mounted on a tripod 4 feet high at a distance of 10 feet from George, who is 6 feet tall. See the illustration. If the camera lens has angles of depression and elevation of 20° , will George's feet and head be seen by the lens? If not, how far back will the camera need to be moved to include George's feet and head?



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- 74. Construction** A ramp for wheel chair accessibility is to be constructed with an angle of elevation of 15° and a final height of 5 feet. How long is the ramp?



- 75. The Gibb's Hill Lighthouse, Southampton, Bermuda** In operation since 1846, the Gibb's Hill Lighthouse stands 117 feet high on a hill 245 feet high, so its beam of light is 362 feet above sea level. A brochure states that ships 40 miles away can see the light and planes flying at 10,000 feet can see it 120 miles away. Verify the accuracy of these statements. What assumption did the brochure make about the height of the ship?

- 76. Area of an Isosceles Triangle** Show that the area A of an isosceles triangle, whose equal sides are of length s and the angle between them is θ , is

$$A = \frac{1}{2} s^2 \sin \theta$$

[Hint: See the illustration. The height h bisects the angle θ and is the perpendicular bisector of the base.]



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