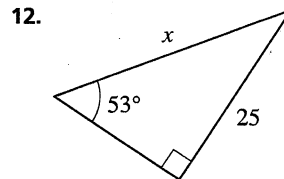
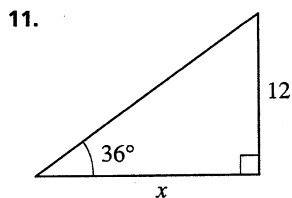
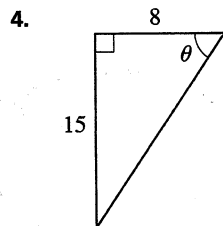
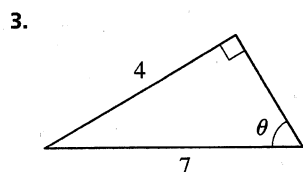
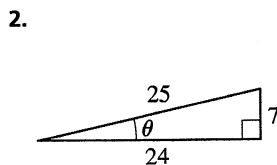
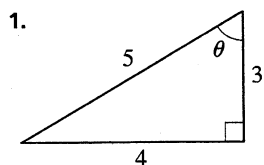
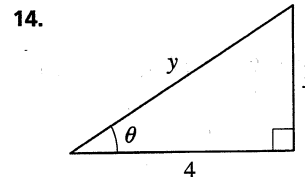
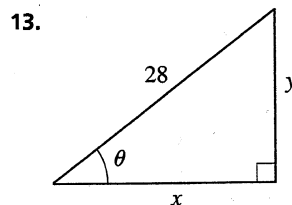


1–4 ■ Find the values of the six trigonometric ratios of the angle θ in the triangle.



13–14 ■ Express x and y in terms of trigonometric ratios of θ .



15–20 ■ Sketch a triangle that has acute angle θ , and find the other five trigonometric ratios of θ .

15. $\sin \theta = \frac{3}{5}$

16. $\cos \theta = \frac{2}{7}$

17. $\cot \theta = 1$

18. $\tan \theta = \sqrt{3}$

19. $\sec \theta = 7$

20. $\csc \theta = \frac{13}{12}$

21–26 ■ Evaluate the expression.

21. $\sin \frac{\pi}{6} + \cos \frac{\pi}{6}$

22. $\sin 30^\circ \csc 30^\circ$

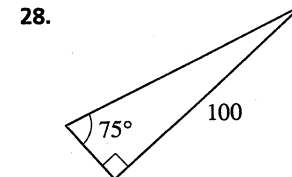
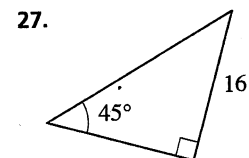
23. $\sin 30^\circ \cos 60^\circ + \sin 60^\circ \cos 30^\circ$

24. $(\sin 60^\circ)^2 + (\cos 60^\circ)^2$

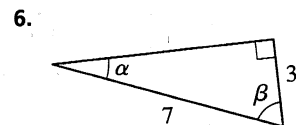
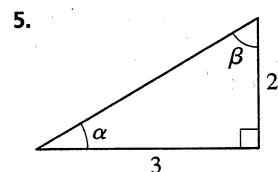
25. $(\cos 30^\circ)^2 - (\sin 30^\circ)^2$

26. $\left(\sin \frac{\pi}{3} \cos \frac{\pi}{4} - \sin \frac{\pi}{4} \cos \frac{\pi}{3}\right)^2$

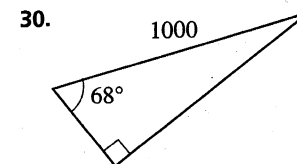
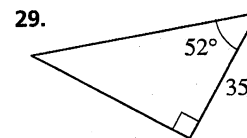
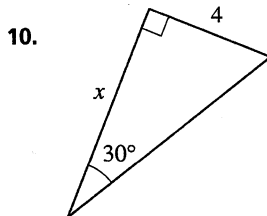
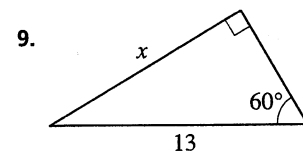
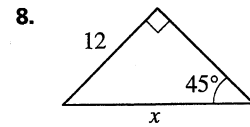
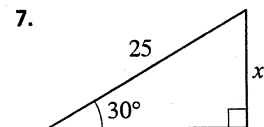
27–30 ■ Solve the right triangle.



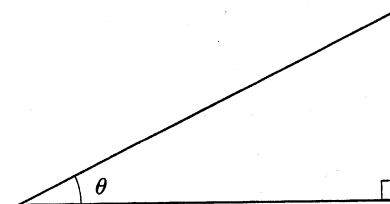
5–6 ■ Find (a) $\sin \alpha$ and $\cos \beta$, (b) $\tan \alpha$ and $\cot \beta$, and (c) $\sec \alpha$ and $\csc \beta$.



7–12 ■ Find the side labeled x . In Exercises 11 and 12 state your answer correct to five decimal places.



31. Use a ruler to carefully measure the sides of the triangle, and then use your measurements to estimate the six trigonometric ratios of θ .



32. Using a protractor, sketch a right triangle that has the acute angle 40° . Measure the sides carefully and use your results to estimate the six trigonometric ratios of 40° .

33. The angle of elevation to the top of the Empire State Building in New York is found to be 11° from the ground at a distance of 1 mi from the base of the building. Using this information, find the height of the Empire State Building.

34. A plane is flying within sight of the Gateway Arch in St. Louis, Missouri, at an elevation of 35,000 ft. The pilot would like to estimate her distance from the Gateway Arch. She finds that the angle of depression to a point on the ground below the arch is 22° .

(a) What is the distance between the plane and the arch?

(b) What is the distance between a point on the ground directly below the plane and the arch?

35. A laser beam is to be directed toward the center of the moon, but the beam strays 0.5° from its intended path.

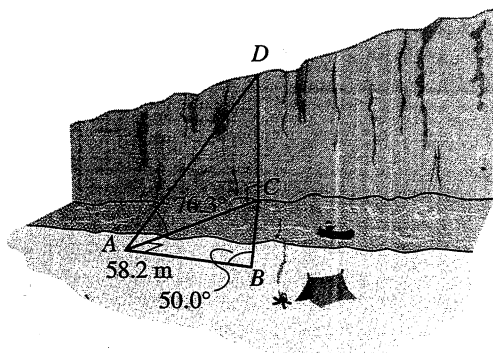
(a) How far has the beam diverged from its assigned target when it reaches the moon? (The distance from the earth to the moon is 240,000 mi.)

(b) The radius of the moon is about 1000 mi. Will the beam strike the moon?

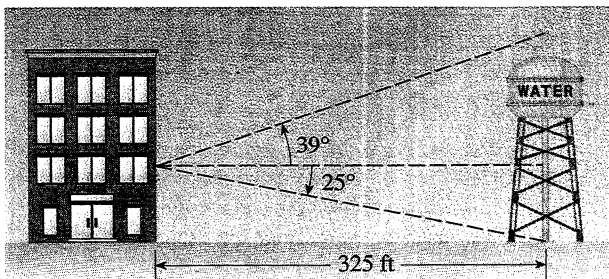
36. From the top of a 200-ft lighthouse, the angle of depression to a ship in the ocean is 23° . How far is the ship from the base of the lighthouse?

37. A 20-ft ladder leans against a building so that the angle between the ground and the ladder is 72° . How high does the ladder reach on the building?

38. A 20-ft ladder is leaning against a building. If the base of the ladder is 6 ft from the base of the building, what is the angle of elevation of the ladder? How high does the ladder reach on the building?
39. A 96-ft tree casts a shadow that is 120 ft long. What is the angle of elevation of the sun?
40. A 600-ft guy wire is attached to the top of a communication tower. If the wire makes an angle of 65° with the ground, how tall is the communication tower?
41. A man is lying on the beach, flying a kite. He holds the end of the kite string at ground level, and estimates the angle of elevation of the kite to be 50° . If the string is 450 ft long, how high is the kite above the ground?
42. The height of a steep cliff is to be measured from a point on the opposite side of the river. Find the height of the cliff from the information given in the figure.



43. A water tower is located 325 ft from a building (see the figure). From a window in the building it is observed that the angle of elevation to the top of the tower is 39° and the angle of depression to the bottom of the tower is 25° . How tall is the tower? How high is the window?

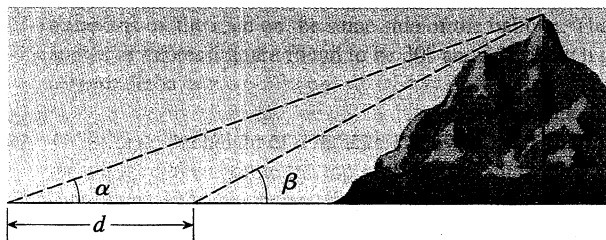


44. An airplane is flying at an elevation of 5150 ft, directly above a straight highway. Two motorists are driving cars on the highway on opposite sides of the plane, and the angle of depression to one car is 35° and to the other is 52° . How far apart are the cars?
45. If both cars in Exercise 44 are on one side of the plane and if the angle of depression to one car is 38° and to the other car is 52° , how far apart are the cars?
46. A hot-air balloon is floating above a straight road. To estimate their height above the ground, the balloonists simultaneously measure the angle of depression to two consecutive mileposts on the road on the same side of the balloon. The angles of depression are found to be 20° and 22° . How high is the balloon?
47. To estimate the height of a mountain above a level plain, the angle of elevation to the top of the mountain is measured to be 32° . One thousand feet closer to the mountain along the plain, it is found that the angle of elevation is 35° . Estimate the height of the mountain.

48. (a) Show that the height h of the mountain in the figure is given by

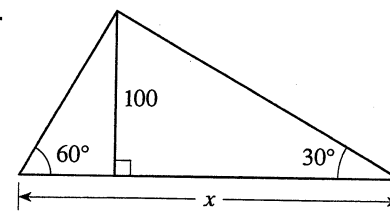
$$h = d \frac{\tan \beta \tan \alpha}{\tan \beta - \tan \alpha} = \frac{d}{\cot \alpha - \cot \beta}$$

- (b) Use the formula in part (a) to find the height h of the mountain if $\alpha \approx 25^\circ$, $\beta \approx 29^\circ$, and $d \approx 800$ ft.

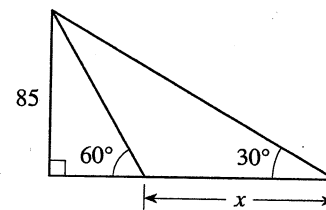


53–56 ■ Find x correct to one decimal place.

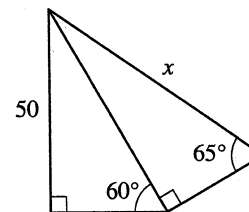
53.



54.



55.



56.

