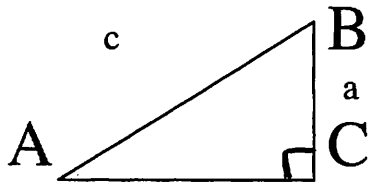


§8.1 Applications Involving Right Triangles

Example 1 Solving a right triangle. Find all angles and sides of the following right triangle.



$$34.2^\circ \quad b = 19.4$$

$$a^2 + b^2 = c^2 \quad (23.456)^2 = a^2 + (19.4)^2$$

Sohcahtoa

$$a^2 = 173.823$$

$$C = 90^\circ$$

$$b = 19.4$$

$$A = 34.2^\circ$$

$$c = 23.456$$

$$a = 13.184$$

$$B = ? \quad 180^\circ - 34.2^\circ - 90^\circ$$

$$= 55.8^\circ$$

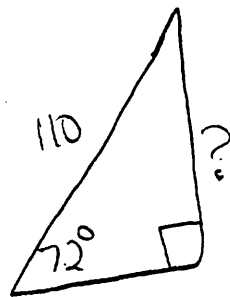
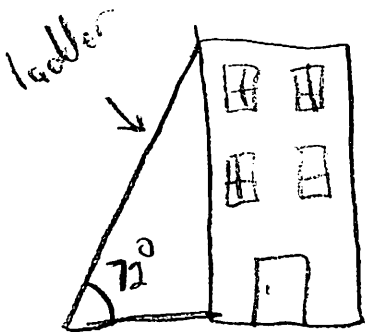
$$\cos A = \frac{\text{adj}}{\text{hyp}}$$

$$\frac{\cos 34.2^\circ}{1} = \frac{19.4}{c}$$

$$c (\cos 34.2^\circ) = 19.4$$

$$c = \frac{19.4}{\cos 34.2^\circ} = 23.456$$

Example 2 A safety regulation states that the maximum angle of elevation for a rescue ladder is 72° . A fire department's longest ladder is 110 feet. What is the maximum safe rescue height?

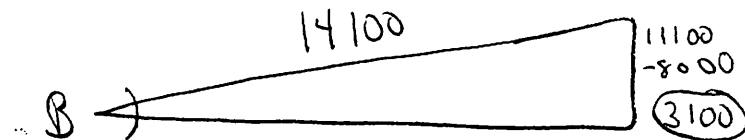
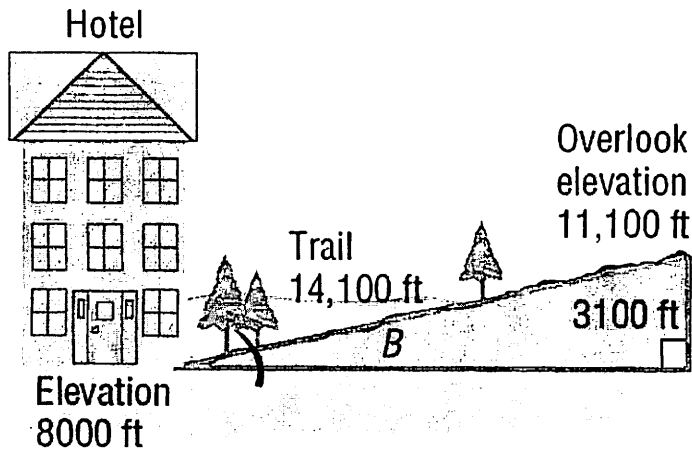


$$\frac{\sin 72^\circ}{1} = \frac{x}{110}$$

$$x = 110 (\sin 72^\circ)$$

$$x = 104.616$$

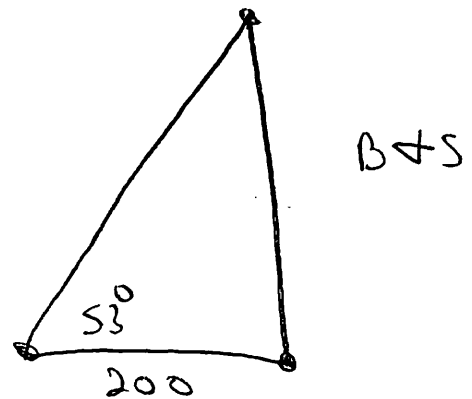
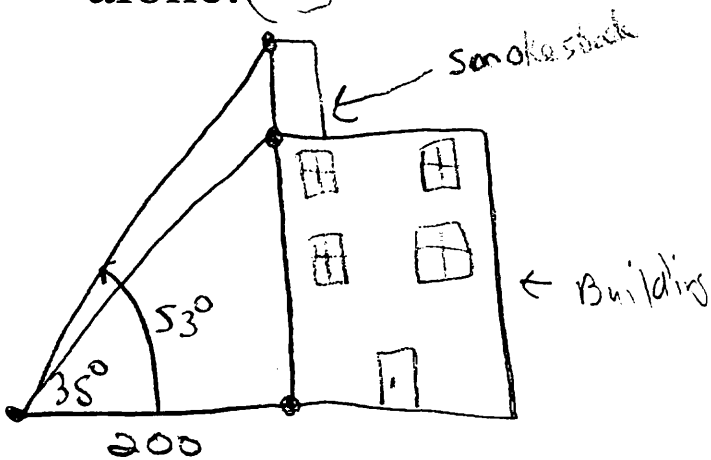
Example 3 A straight trail leads from the Alpine Hotel, elevation 8000 feet, to a scenic overlook, elevation 11,100 feet. The length of the trail is 14,100 feet. What is the inclination (grade) of the trail? That is, what is the angle B in the figure?



$$\sin B = \frac{3100}{14100}$$

$$\sin^{-1}\left(\frac{3100}{14100}\right) = 12.7^\circ$$

Example 4 At a point 200 feet from the base of a building, the angle of elevation to the bottom of a smokestack is 35° , whereas the angle of elevation to the top is 53° . Find the height s of the smoke stack alone.

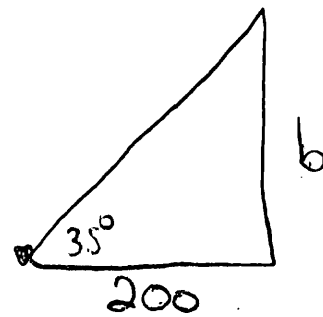


$$\tan 53^\circ = \frac{t}{200}$$

$$t = 200 \tan 53^\circ$$

$$s = 200 \tan 53^\circ - 200 \tan 35^\circ$$

$$s = \boxed{125.367}$$



$$\tan 35^\circ = \frac{b}{200}$$

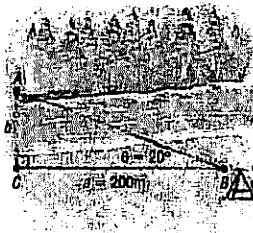
$$b = 200 \tan 35^\circ$$

problems, pay attention to the known measures. This will indicate what trigonometric function to use. For example, if we know the measure of an angle and the length of the side adjacent to the angle, and wish to find the length of the opposite side, we would use the tangent function. Do you know why?

EXAMPLE 6**Finding the Width of a River**

A surveyor can measure the width of a river by setting up a transit* at a point C on one side of the river and taking a sighting of a point A on the other side. Refer to Figure 10. After turning through an angle of 90° at C , the surveyor walks a distance of 200 meters to point B . Using the transit at B , the angle θ is measured and found to be 20° . What is the width of the river rounded to the nearest meter?

Figure 10



Solution We seek the length of side b . We know a and θ . So we use the fact that b is opposite θ and a is adjacent to θ and write

$$\tan \theta = \frac{b}{a}$$

which leads to

$$\tan 20^\circ = \frac{b}{200}$$

$$b = 200 \tan 20^\circ \approx 72.79 \text{ meters}$$

The width of the river is 73 meters, rounded to the nearest meter. □

Now Work PROBLEM 49

EXAMPLE 7**Finding the Inclination of a Mountain Trail**

A straight trail leads from the Alpine Hotel, elevation 8000 feet, to a scenic overlook, elevation 11,100 feet. The length of the trail is 14,100 feet. What is the inclination (grade) of the trail? That is, what is the angle B in Figure 11?

Solution As we can see in Figure 11, we know the length of the side opposite angle B and the length of the hypotenuse. The angle B obeys the equation

$$\sin B = \frac{3100}{14,100}$$

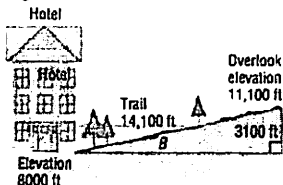
Using a calculator,

$$B = \sin^{-1} \frac{3100}{14,100} \approx 12.7^\circ$$

The inclination (grade) of the trail is approximately 12.7° . □

Now Work PROBLEM 55

Figure 11



* An instrument used in surveying to measure angles.