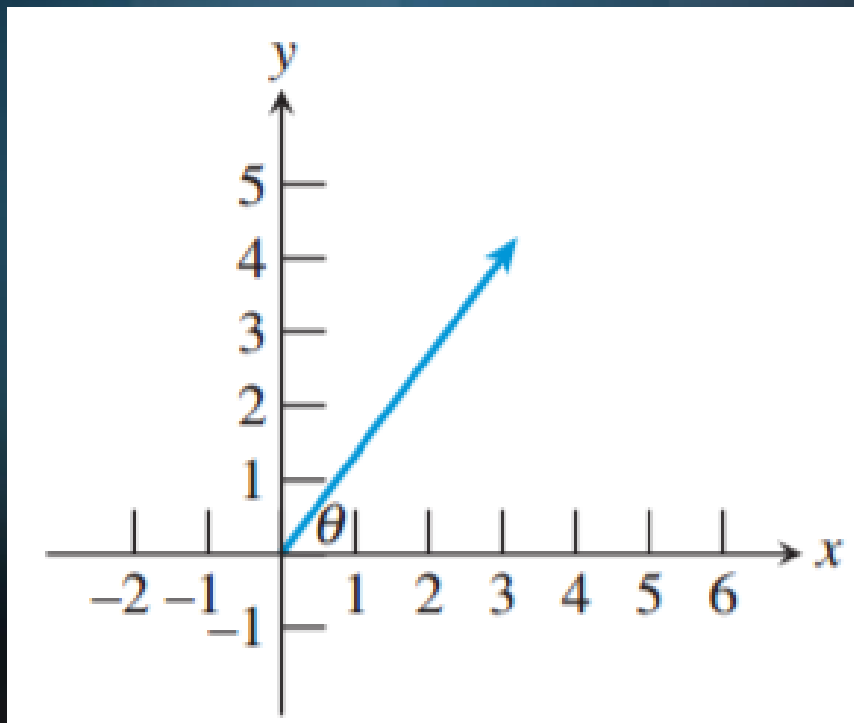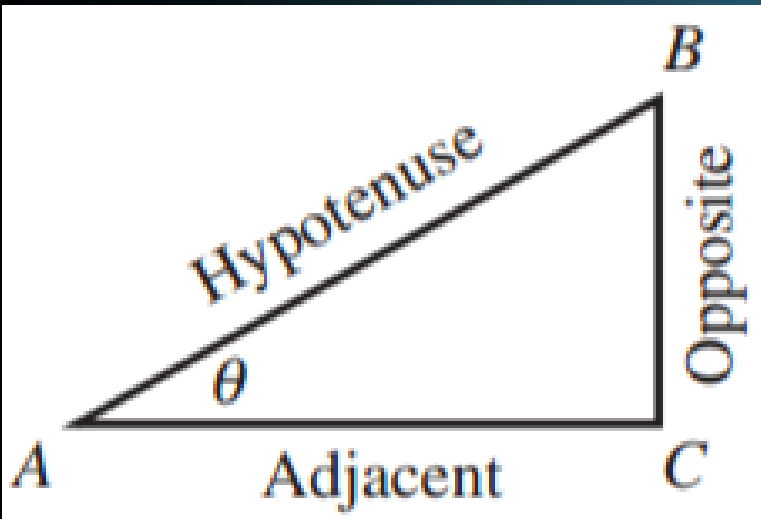# 4.2
Trigonometric Functions of Acute Angles

To bring the power of coordinate geometry into the picture, we will often put our acute angles in **standard position** in the xy-plane, with the vertex at the origin, one ray along the positive x-axis, and the other ray extending into the first quadrant. (See Figure 4.7.)

DEFINITION Trigonometric Functions

Let θ be an acute angle in the right $\triangle ABC$ (Figure 4.8). Then

$$\text{sine } (\theta) = \sin \theta = \frac{opp}{hyp}$$

$$\text{cosine } (\theta) = \cos \theta = \frac{adj}{hyp}$$

$$\text{tangent } (\theta) = \tan \theta = \frac{opp}{adj}$$

$$\text{cosecant } (\theta) = \csc \theta = \frac{hyp}{opp}$$

$$\text{secant } (\theta) = \sec \theta = \frac{hyp}{adj}$$

$$\text{cotangent } (\theta) = \cot \theta = \frac{adj}{opp}$$

EXAMPLE 1 Evaluating Trigonometric Functions of 45°

Find the values of all six trigonometric functions for an angle of 45°.

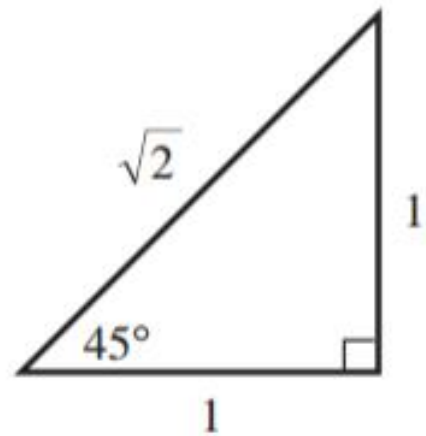FIGURE 4.9 An isosceles right triangle.
(Example 1)

$$\sin 45° = \frac{opp}{hyp} =$$

$$\cos 45° = \frac{adj}{hyp}$$

$$\tan 45° = \frac{opp}{adj}$$

$$\csc 45° = \frac{hyp}{opp}$$

$$\sec 45° = \frac{hyp}{adj}$$

$$\cot 45° = \frac{adj}{opp}$$

EXAMPLE 2   Evaluating Trigonometric Functions of 30°

Find the values of all six trigonometric functions for an angle of 30°.
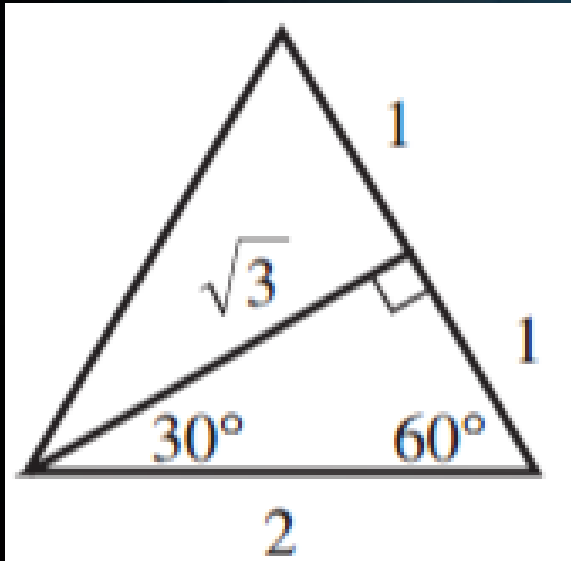
$$\sin 30° = \frac{opp}{hyp}$$

$$\cos 30° = \frac{adj}{hyp}$$

$$\tan 30° = \frac{opp}{adj}$$

$$\csc 30° = \frac{hyp}{opp}$$

$$\sec 30° = \frac{hyp}{adj}$$

$$\cot 30° = \frac{adj}{opp}$$

EXAMPLE 3 Using One Trigonometric Ratio to Find Them All

Let θ be an acute angle such that $\sin \theta = 5/6$. Evaluate the other five trigonometric functions of θ.
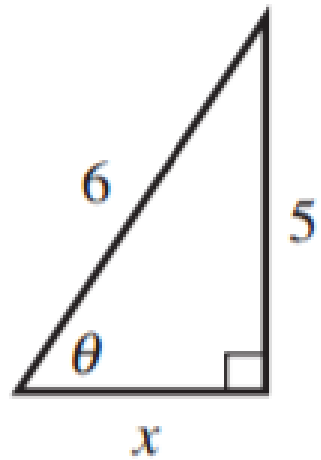
$$\sin \theta = \frac{opp}{hyp} \qquad \csc \theta = \frac{hyp}{opp}$$

$$\cos \theta = \frac{adj}{hyp} \qquad \sec \theta = \frac{hyp}{adj}$$

$$\tan \theta = \frac{opp}{adj} \qquad \cot \theta = \frac{adj}{opp}$$

FIGURE 4.11 How to create an acute angle θ such that $\sin \theta = 5/6$. (Example 3)

Common Calculator Errors When Evaluating Trig Functions

EXAMPLE 5   Solving a Right Triangle

A right triangle with a hypotenuse of 8 includes a 37° angle (Figure 4.17). Find the measures of the other two angles and the lengths of the other two sides.
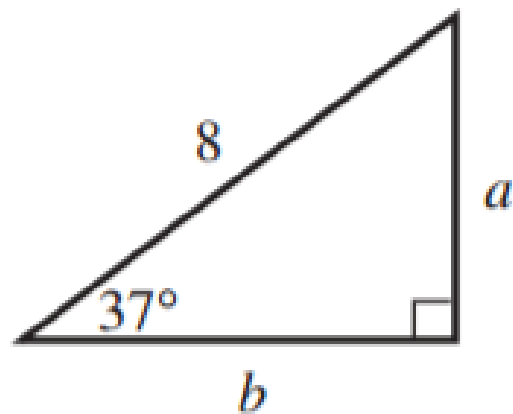

FIGURE 4.17 (Example 5)

EXAMPLE 6 Finding the Height of a Building

From a point 340 feet away from the base of the Peachtree Center Plaza in Atlanta, Georgia, the angle of elevation to the top of the building is 65°. (See Figure 4.18.) Find the height h of the building.
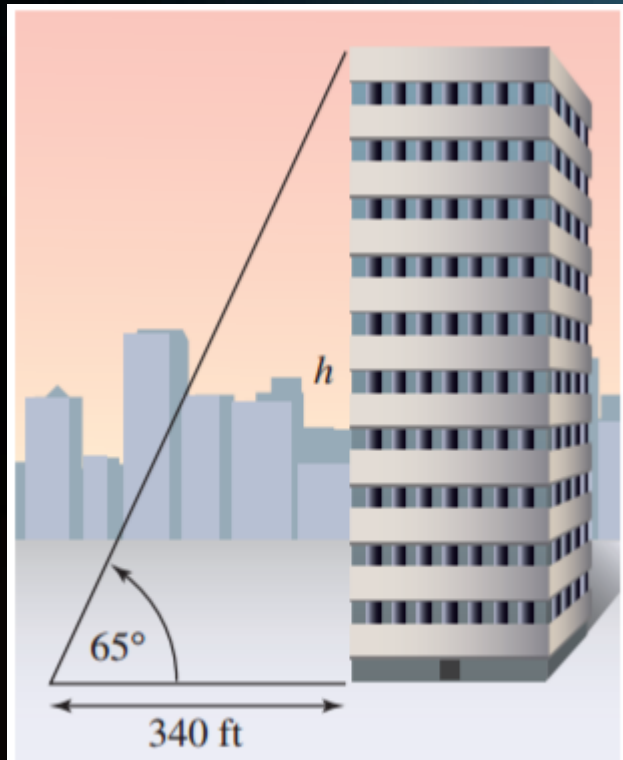

FIGURE 4.18 (Example 6)