# 13.1 Use Trigonometry with Right Triangles

TEKS a.1, a.4, 2A.2.A; G.5.D

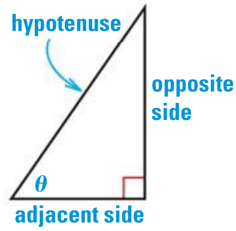
**Before** You used the Pythagorean theorem to find lengths.

**Now** You will use trigonometric functions to find lengths.

**Why?** So you can measure distances indirectly, as in Example 5.

**Key Vocabulary**
- sine
- cosine
- tangent
- cosecant
- secant
- cotangent

Consider a right triangle that has an acute angle $\theta$ (the Greek letter *theta*). The three sides of the triangle are the *hypotenuse*, the side *opposite* $\theta$, and the side *adjacent* to $\theta$.




Ratios of a right triangle's side lengths are used to define the six trigonometric functions: **sine**, **cosine**, **tangent**, **cosecant**, **secant**, and **cotangent**. These six functions are abbreviated sin, cos, tan, csc, sec, and cot, respectively.

## KEY CONCEPT *For Your Notebook*

### Right Triangle Definitions of Trigonometric Functions

Let $\theta$ be an acute angle of a right triangle. The six trigonometric functions of $\theta$ are defined as follows:

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}} \qquad \cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}} \qquad \tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$

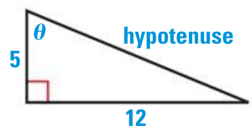
$$\csc\theta = \frac{\text{hypotenuse}}{\text{opposite}} \qquad \sec\theta = \frac{\text{hypotenuse}}{\text{adjacent}} \qquad \cot\theta = \frac{\text{adjacent}}{\text{opposite}}$$

The abbreviations *opp*, *adj*, and *hyp* are often used to represent the side lengths of the right triangle. Note that the ratios in the second row are reciprocals of the ratios in the first row:

$$\csc\theta = \frac{1}{\sin\theta} \qquad \sec\theta = \frac{1}{\cos\theta} \qquad \cot\theta = \frac{1}{\tan\theta}$$

## EXAMPLE 1 Evaluate trigonometric functions

**Evaluate the six trigonometric functions of the angle θ.**




**Solution**

**REVIEW GEOMETRY**
For help with the Pythagorean theorem, see p. 995.

From the Pythagorean theorem, the length of the hypotenuse is $\sqrt{5^2 + 12^2} = \sqrt{169} = 13$.

$$\sin\theta = \frac{\text{opp}}{\text{hyp}} = \frac{12}{13} \qquad \cos\theta = \frac{\text{adj}}{\text{hyp}} = \frac{5}{13} \qquad \tan\theta = \frac{\text{opp}}{\text{adj}} = \frac{12}{5}$$

$$\csc\theta = \frac{\text{hyp}}{\text{opp}} = \frac{13}{12} \qquad \sec\theta = \frac{\text{hyp}}{\text{adj}} = \frac{13}{5} \qquad \cot\theta = \frac{\text{adj}}{\text{opp}} = \frac{5}{12}$$