NAME ______________________________ DATE ____________

Reteaching with Practice

For use with pages 769–775

GOAL **Use trigonometric relationships to evaluate trigonometric functions of acute angles**

VOCABULARY

Right Triangle Definition of Trigonometric Functions

Let θ be an acute angle of a right triangle. The six trigonometric functions of θ are defined as follows.

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

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

The abbreviations *opp, adj,* and *hyp* represent the lengths of the three sides of the right triangle. Note that the ratios in the second row are the reciprocals of the ratios in the first row. That is:

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

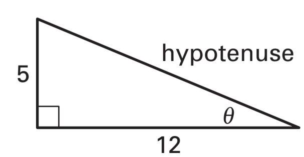
The table below gives values of the six trigonometric functions for the common angles 30°, 45°, and 60°.

θ	$\sin\theta$	$\cos\theta$	$\tan\theta$	$\csc\theta$	$\sec\theta$	$\cot\theta$
30°	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{3}}{3}$	2	$\frac{2\sqrt{3}}{3}$	$\sqrt{3}$
45°	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$	1	$\sqrt{2}$	$\sqrt{2}$	1
60°	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$\sqrt{3}$	$\frac{2\sqrt{3}}{3}$	2	$\frac{\sqrt{3}}{3}$

Finding all missing side lengths and angle measures is called **solving a right triangle**.

EXAMPLE 1 *Evaluating Trigonometric Functions*

Evaluate the six trigonometric functions of the angle θ shown in the right triangle.



SOLUTION

The sides opposite and adjacent to the angle θ are given.
To find the length of the hypotenuse, use the Pythagorean Theorem.

$$\sqrt{5^2 + 12^2} = \sqrt{25 + 144} = \sqrt{169} = 13$$

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Using adj = 12, opp = 5, and hyp = 13, you can evaluate the trigonometric functions.

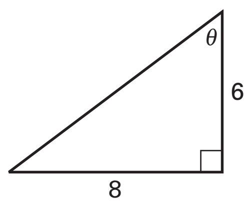
$$\sin\theta = \frac{\text{opp}}{\text{hyp}} = \frac{5}{13} \qquad \cos\theta = \frac{\text{adj}}{\text{hyp}} = \frac{12}{13} \qquad \tan\theta = \frac{\text{opp}}{\text{adj}} = \frac{5}{12}$$

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

Exercises for Example 1

Evaluate the six trigonometric functions of the given angle θ.

1.



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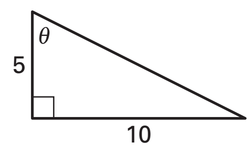

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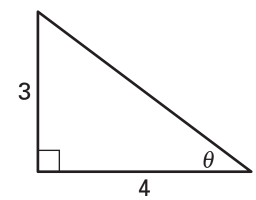
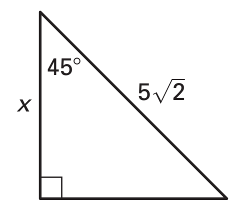


EXAMPLE 2 *Finding a Missing Side Length of a Right Triangle*

Find the value of x for the right triangle shown.



SOLUTION

Because you are given the hypotenuse and the side adjacent to $\theta = 45°$, write the equation of the trigonometric function involving the ratio of these sides, then solve the equation for x.

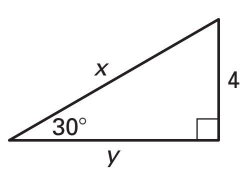
$\cos 45° = \dfrac{\text{adj}}{\text{hyp}}$	Write trigonometric equation.
$\dfrac{1}{\sqrt{2}} = \dfrac{x}{5\sqrt{2}}$	Substitute $\frac{1}{\sqrt{2}}$ for cos 45° and $5\sqrt{2}$ for hypotenuse.
$5 = x$	Multiply each side by $5\sqrt{2}$.

The length of the side is $x = 5$.

Exercises for Example 2

Find the missing side lengths x and y.

4.



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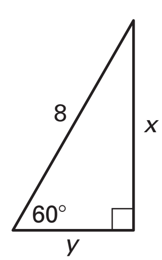

6.