10-1 Right-Angle Trigonometry

Warm Up

1. Given the measure of one of the acute angles in a right triangle, find the measure of the other acute angle.

a. 45° 45°

b. 30° 60°

c. 66° 24°

d. 38° 52°

10-1 Right-Angle Trigonometry

2. Find the unknown length for each right triangle with legs *a* and *b* and hypotenuse *c*.

a. $b = 12, c = 13$ $a = 5$

b. $a = 3, b = 3$ $c = 3\sqrt{2}$

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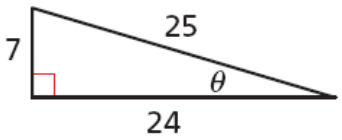
10-1 Right-Angle Trigonometry

3. Find the value of the sine, cosine, and tangent functions for θ.



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$\sin\theta = \frac{7}{25}$

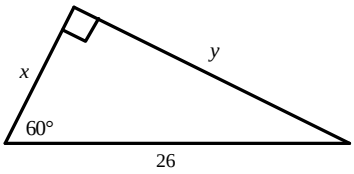
$\cos\theta = \frac{24}{25}$

$\tan\theta = \frac{7}{24}$

10-1 Right-Angle Trigonometry

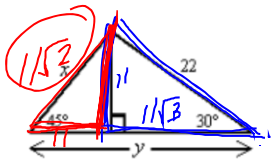
4. Find the value of *x* and *y*. Answers should be exact and given in simplest radical form when necessary.

$x = 13 \quad y = 13\sqrt{3}$



5. Find the value of *x* and *y*. Answers should be exact and given in simplest radical form when necessary.

$y = 11 + 11\sqrt{3}$



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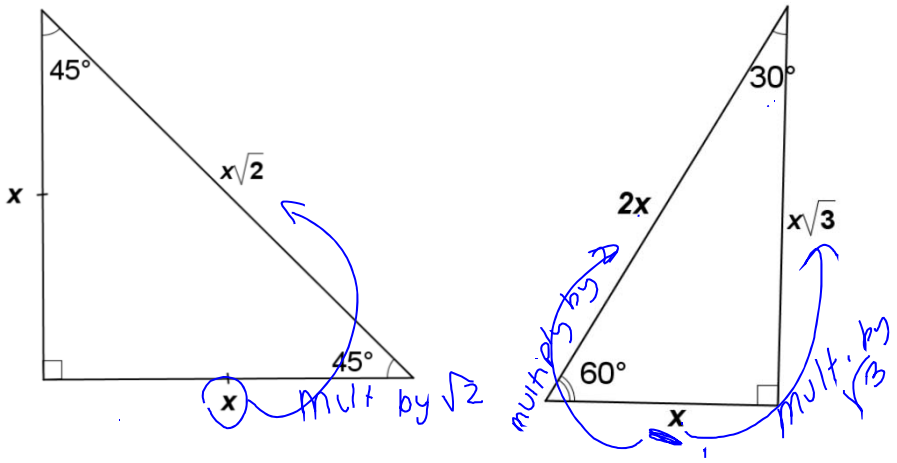
Special Right Triangle Road Map



10-1 Right-Angle Trigonometry

A **trigonometric function** is a function whose rule is given by a trigonometric ratio. A *trigonometric ratio* compares the lengths of two sides of a right triangle. The Greek letter theta θ is traditionally used to represent the measure of an acute angle in a right triangle. The values of trigonometric ratios depend upon θ.

10-1 Right-Angle Trigonometry

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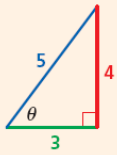
Trigonometric Functions

WORDS	NUMBERS	SYMBOLS
The **sine** (sin) of angle θ is the ratio of the length of the opposite leg to the length of the hypotenuse.	$\sin\theta = \frac{4}{5}$	$\sin\theta = \frac{\text{opp.}}{\text{hyp.}}$
The **cosine** (cos) of angle θ is the ratio of the length of the adjacent leg to the length of the hypotenuse.	$\cos\theta = \frac{3}{5}$	$\cos\theta = \frac{\text{adj.}}{\text{hyp.}}$
The **tangent** (tan) of angle θ is the ratio of the length of the opposite leg to the length of the adjacent leg.	$\tan\theta = \frac{4}{3}$	$\tan\theta = \frac{\text{opp.}}{\text{adj.}}$



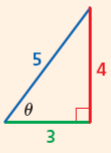
$\sin\theta = \frac{O}{H}$ $\cos\theta = \frac{A}{H}$ $\tan\theta = \frac{O}{A}$

10-1 Right-Angle Trigonometry

The reciprocals of the sine, cosine, and tangent ratios are also trigonometric ratios. They are trigonometric functions, *cosecant, secant,* and *cotangent.*

Reciprocal Trigonometric Functions

WORDS	NUMBERS	SYMBOLS
The **cosecant** (csc) of angle θ is the reciprocal of the sine function.	$\csc\theta = \frac{5}{4}$	$\csc\theta = \frac{1}{\sin\theta} = \frac{\text{hyp.}}{\text{opp.}}$
The **secant** (sec) of angle θ is the reciprocal of the cosine function.	$\sec\theta = \frac{5}{3}$	$\sec\theta = \frac{1}{\cos\theta} = \frac{\text{hyp.}}{\text{adj.}}$
The **cotangent** (cot) of angle θ is the reciprocal of the tangent function.	$\cot\theta = \frac{3}{4}$	$\cot\theta = \frac{1}{\tan\theta} = \frac{\text{adj.}}{\text{opp.}}$



$\csc\theta = \frac{H}{O}$

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10-1 Right-Angle Trigonometry

Example 1: Finding All Trigonometric Functions

Find the values of the six trigonometric functions for θ.

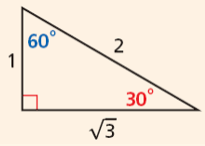
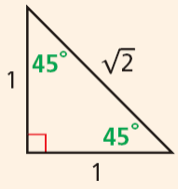
$\sin\theta = \frac{70}{74} = \frac{35}{37}$ $\quad \csc\theta = \frac{37}{35}$

$\cos\theta = \frac{24}{74} = \frac{12}{37}$ $\quad \sec\theta = \frac{37}{12}$

$\tan\theta = \frac{70}{24} = \frac{35}{12}$ $\quad \cot\theta = \frac{12}{35}$

10-1 Right-Angle Trigonometry

Trigonometric Ratios of Special Right Triangles

Diagram	Sine	Cosine	Tangent
	$\sin 60° = \frac{\sqrt{3}}{2}$ $\sin 30° = \frac{1}{2}$	$\cos 60° = \frac{1}{2}$ $\cos 30° = \frac{\sqrt{3}}{2}$	$\tan 60° = \sqrt{3}$ $\tan 30° = \frac{\sqrt{3}}{3}$
	$\sin 45° = \frac{1}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}}$ $\sin 45° = \frac{\sqrt{2}}{2}$	$\cos 45° = \frac{\sqrt{2}}{2}$	$\tan 45° = 1$

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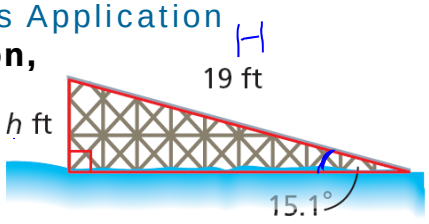
Example 2: Sports Application

In a waterskiing competition, a jump ramp has the measurements shown. To the nearest foot, what is the height *h* above water that a skier leaves the ramp?



$\sin 15.1° = \frac{h}{19}$

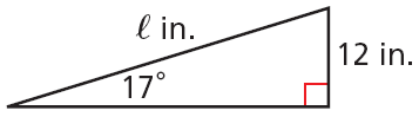
$h = 19(\sin 15.1°)$

$h \approx 5$ feet

10-1 Right-Angle Trigonometry

Check It Out! Example 2

A skateboard ramp will have a height of 12 in., and the angle between the ramp and the ground will be 17°. To the nearest inch, what will be the length ℓ of the ramp?



$\frac{\sin 17°}{1} = \frac{12}{\ell}$

$\ell = \frac{12}{\sin 17°}$

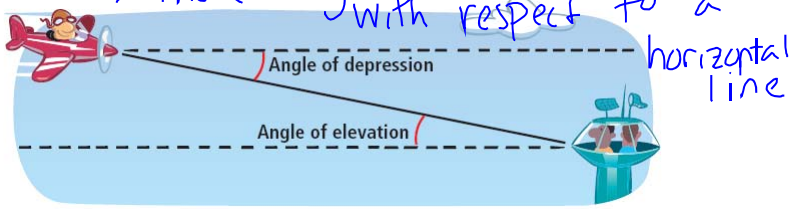
$\frac{12 = \ell \sin 17°}{\sin 17° \quad \sin 17°}$

$\ell \approx 41$ inches

10-1 Right-Angle Trigonometry

When an object is above or below another object, you can find distances indirectly by using the ***angle of elevation*** **or the** ***angle of depression*** **between the objects.**

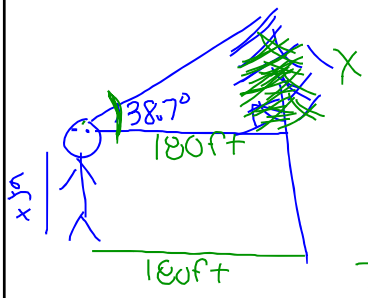
*these angles are always made with respect to a horizontal line



10-1 Right-Angle Trigonometry

Example 4: Geology Application

A biologist whose eye level is 6 ft above the ground measures the angle of elevation to the top of a tree to be 38.7°. If the biologist is standing 180 ft from the tree's base, what is the height of the tree to the nearest foot?



$\tan 38.7° = \frac{x}{180}$

$x = 180(\tan 38.7°)$

$x = 144$ feet

tree's height is 150 feet

10-1 Right-Angle Trigonometry

Example 4

Mr. Domino is standing on a 40-foot ocean bluff near his home. He can see his two dogs on the beach below. If his line of sight is 6 feet above the ground and the angles of depression to his dogs are 34° and 48°, how far apart are the dogs?