Chapter Three

Right Triangle Trigonometry

Special Right Triangles

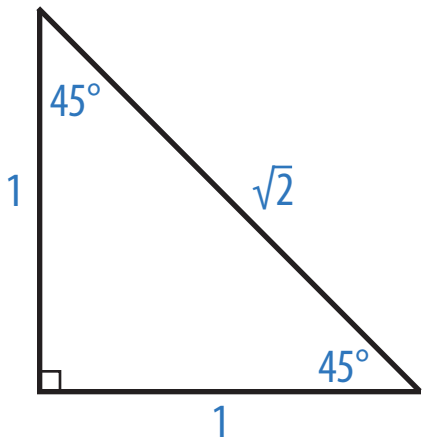
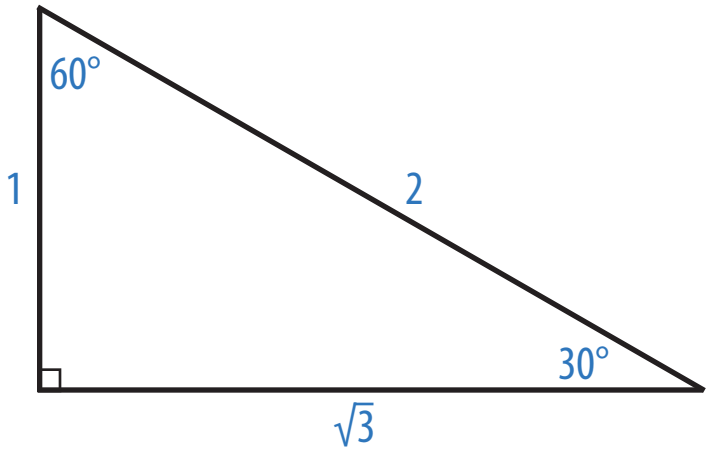
Trigonometric Functions

Inverse Trigonometric Functions

Special Right Triangles

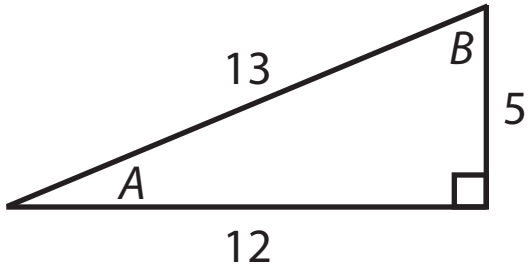
For all right triangles, $a^2 + b^2 = c^2$, where a and b are the legs and c is the hypotenuse.

For right triangles with an angle of 30° or 45°, there are special ratios that can be used.

Angles	Ratios	Example
45°, 45°, 90°	The hypotenuse is $\sqrt{2}$ times as long as the legs.	
30°, 60°, 90°	The hypotenuse is 2 times as long as the shorter leg. The longer leg is $\sqrt{3}$ times as long as the shorter leg.	

Trigonometric Functions in Right Triangles

For each acute angle in a right triangle, the leg that is part of the angle is **adjacent** to the angle and the leg that is not part of the angle is **opposite** the angle.



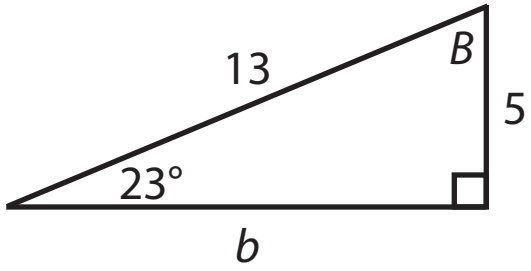
The **trigonometric functions** find the ratio between two sides in a right triangle based on an angle in the triangle.

Trig Function	Abbreviation	Definition	Example *A*	Example *B*
sine	sin	$\sin X = \frac{\text{opposite}}{\text{hypotenuse}}$	$\sin A = \frac{5}{13}$	$\sin B = \frac{12}{13}$
cosine	cos	$\cos X = \frac{\text{adjacent}}{\text{hypotenuse}}$	$\cos A = \frac{12}{13}$	$\cos B = \frac{5}{13}$
tangent	tan	$\tan X = \frac{\text{opposite}}{\text{adjacent}}$	$\tan A = \frac{5}{12}$	$\tan B = \frac{12}{5}$

The **inverse trigonometric functions** find an angle in a right triangle based on the ratio between two sides in the triangle. In the triangle above, $A = \sin^{-1}\frac{5}{13}$ and $B = \cos^{-1}\frac{5}{13}$.

Solving Right Triangles

One way to find an unknown side or length in a right triangle is to use the triangle to make a sine, cosine, or tangent equation that has no variables other than one being solved for, and then use a calculator to solve it.



Unknown	How to solve trig equation	Example
Side	Multiply each side by the denominator. If the denominator was the variable, also divide each side by the trig expression.	$\tan 23° = \frac{5}{b}$ $b \tan 23° = 5$ $b = \frac{5}{\tan 23°} \approx 12$
Angle	Apply the appropriate inverse trig function to each side. The trig function will be canceled by its inverse, resulting in the angle itself.	$\cos B = \frac{5}{13}$ $\cos^{-1} \cos B = \cos^{-1} \frac{5}{13}$ $B \approx 67°$

Trig functions are not always needed to solve a right triangle:

- If one acute angle is known, the missing angle can be found by subtracting the other from 90°.
- If two sides are known, the third side can be found by using the Pythagorean theorem.