Trigonometry

What's trigonometry?

Trigonometry is a method for finding sides or angles in a right-angled triangle. It consists of three formulae that are used in three different situations.

What you know	What you want to find	What you use
two sides	the third side	Pythagoras' theorem
two sides	an angle	trigonometry
one side and an angle	another side	trigonometry

In a right-angled triangle, one of the angles is always 90°. You need to know another angle to use trigonometry.

In fact, if you know one of the non-90° angles, you can calculate the other: you just subtract the angle you know from 90° .

Labelling your triangle

In order to know which of the three formulae to use in a particular situation, you first need to label your triangle carefully. There are names and symbols for each of the three sides.

The longest side (which also happens to be the side opposite the right angle) is called the hypotenuse. This name is also used in Pythagoras' theorem.



side	symbol	definition	
hypotenuse	h	longest side	
		side opposite the right angle	
opposite	0	side opposite angle θ	
adjacent	a	side next to angle θ that is not the hypotenuse	



What's θ ?

The symbol θ is often used to represent an angle. This looks like a tablet or an egg sliced in half, but it is actually the Greek letter *theta*. Our alphabet (the Roman alphabet) has no letter equivalent to theta, but it is usually transliterated as *th*. In fact, the Py**th**agoras' own name is spelt with a letter theta, since he was Greek: $\Pi \upsilon \theta \alpha \gamma \delta \rho \alpha \varsigma$.

What are the formulae?

When doing trigonometry, you always know two things and want to find a third, unknown thing. There are three formulae to choose from:

$$\sin\theta = \frac{o}{h}$$
 $\cos\theta = \frac{a}{h}$ $\tan\theta = \frac{o}{a}$

A simple way to remember these rules is the mnemonic SOH CAH TOA, where S stand for $\sin\theta$, O stands for opposite and so on.

It is important to understand that $\sin\theta$ does not mean $\sin \times \theta$ as you would expect. It is actually a kind of number machine. You put in an angle between 0° and 90° and you get out a number between 0 and 1.

$$32^{\circ} \rightarrow \text{sine} \rightarrow 0.5299$$

This is normally written as

$\sin 32^{\circ} = 0.5299$

How do I use trigonometry?

You are given a triangle whose longest side is 10 cm. Another side is 7 cm long, and you need to find the angle between the two known sides.

First of all, label your triangle:



As you can see from the *labelled* triangle, h = 10 cm and a = 10 cm.

You need the formula that contains *h* and *a*:

$$\cos\theta = \frac{a}{h}$$

If you substitute in the values for *a* and *h* given in the diagram, you get

 $\cos\theta = \frac{7 \text{ cm}}{10 \text{ cm}}$ therefore $\cos\theta = 0.7$

We need to find θ , not $\cos\theta$. The next step requires a calculator. You use the \cos^{-1} button to convert $\cos\theta$ to θ :

$$\cos\theta = 0.7$$
 therefore $\theta = \cos^{-1}(0.7)$.

In order to find θ , you have to use a calculator to find $\cos^{-1}(0.7)$.

Normally, you key in something like this: SHIFT COS 0 . 7.

When you press =, the result you get is the angle θ :

$$\cos^{-1}(0.7) = 45.572996^{\circ}$$

You almost always round this value to the nearest decimal place or two.

 $\cos^{-1}(0.7) = 45.6^{\circ}$ to 1 decimal place

Rearranging the formulae for different situations

There are nine possible situations in which you can use trigonometry. Each one requires a formula to be rearranged in a slightly different way. The trick is to get the unknown quantity alone on one side of the equals sign, with everything else on the other side.

All nine formulae shown are just rearrangements of the three main formulae we tend to refer to as SOHCAHTOA.





