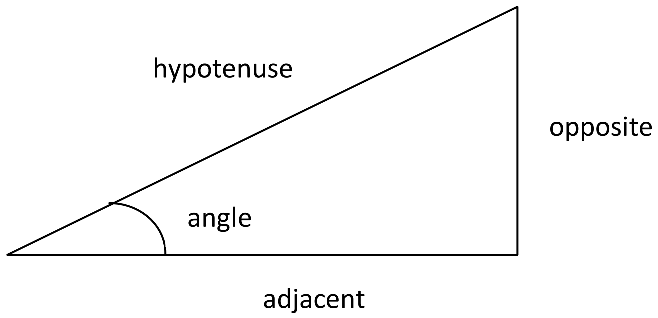
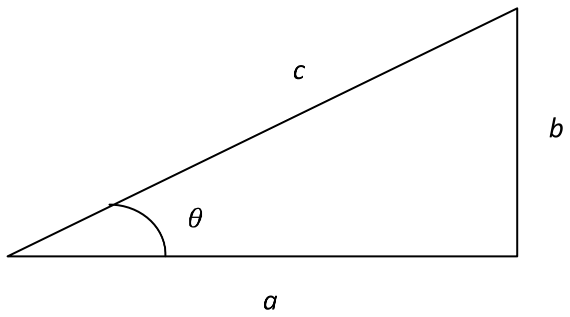
Trigonometry

Trigonometry relates the lengths of sides and angles of triangles. Consider a right-angles triangle, as illustrated in the following diagram.



The longest side is termed the *hypotenuse*. With respect to the angle shown, the other two sides are termed the *adjacent* and *opposite* sides.

To simplify the formulae to follow, we will use θ to represent the angle, and *a*,*b* and *c* to represent the lengths of the adjacent, opposite and hypotenuse, as shown in the following diagram.



Pythagoras's Thorem

Pythagoras's result is a straightforward relationship between the lengths of the sides:

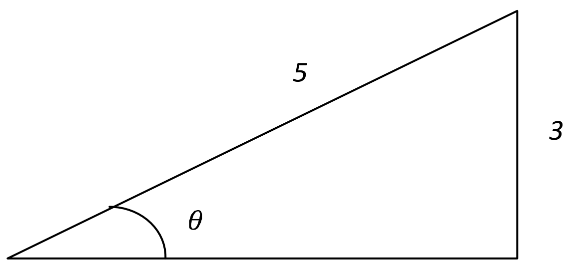
$$c^2 = a^2 + b^2.$$

Example- '345 triangle'

For example if a triangle has an opposite side of length 3 ($b = 3$), an adjacent side of length 4 ($a = 4$) then

$$c^2 = 4^2 + 3^2 = 16 + 9 = 25$$

hence $c = 5$. The triangle is illustrated in the following diagram.



Sine, cosine and tangent

For a right-angled triangle, the *sine, cosine* and *tangent* of the angle are defined as follows:

definition	formula
sine of the angle = opposite/hypotenuse	$\sin(\theta) = \frac{b}{c}$
cosine of the angle = adjacent/hypotenuse	$\cos(\theta) = \frac{a}{c}$
tangent of the angle = opposite/adjacent	$\tan(\theta) = \frac{b}{a}$

Hence for the previous example of the '345 triangle'

$\sin(\theta) = \frac{3}{5} = 0.6$
$\cos(\theta) = \frac{4}{5} = 0.8$
$\tan(\theta) = \frac{3}{4} = 0.75$

In order to determine the angle, given the value of the sin, cos or tan the inverse or arc- of the functions are used. The sin, cos, tan and their inverse functions can be found on typical scientific calculators.

For example for the *'345'* triangle the angle can be determined from the inverse, sin, cos or tan and is found to be $53.14°$. The three angles in a triangle add up to $180°$ so the other remaining unknown angle can be found to be $37.86°$.