Using trigonometry to find an unknown angle in a triangle

Handy maths study tips

Trigonometry can be used to find an unknown angle of a right-angled triangle when you know only the length of two sides.

Given a right-angled triangle such as:

![Right-angled triangle with sides 5, 12, and \( \theta \)](image)

How do we find the size of angle \( \theta \)?

The sides that are known are, in relation to \( \theta \), the opposite side and the hypotenuse.

So, use a formula which uses both the opposite side and the hypotenuse.

\[
\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}}
\]

can be used here.

Substituting in the values of the known sides gives: \( \sin \theta = \frac{5}{12} \approx 0.42 \).

To get from \( \sin \theta \approx 0.42 \) to a value for \( \theta \) you need the inverse sine operation.

This is on most calculators as \( \sin^{-1} \) and is usually accessed using a 2\(^{nd}\) function or shift key, then the sin key.

\( \sin^{-1}(\frac{5}{12}) = 24.62^\circ \) to 2 d.p. So \( \theta = 24.62^\circ \)

Note that I used \( \frac{5}{12} \) in the calculation rather than 0.42. This is because 0.42 is rounded and so is less accurate than \( \frac{5}{12} \).

Another example:

![Right-angled triangle with sides 6, 16, and \( \theta \)](image)

Here the known sides are the adjacent and the hypotenuse, so we use cosine.

\[
\cos \theta = \frac{6}{16} = 0.375.
\]

So, \( \theta = \cos^{-1}(0.375) = 67.98^\circ \) to 2 d.p.

Notes:

Remember to check that your calculator is in degrees if you are using degrees or in radians if you are using radians. This can normally be altered via the mode button.

Depending on your calculator you may need to type in either 2\(^{nd}\)/shift \( \sin \) 30 or 30 2\(^{nd}\)/shift \( \sin \) to get the value of \( \sin^{-1}30^\circ \).