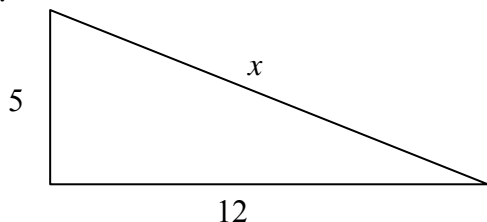# Trigonometry Basics

When you need a side and have two other sides, you need to use Pythagoras.

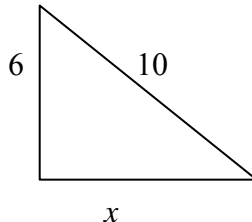For a long side: $h^2 = a^2 + b^2$ For a short side: $a^2 = h^2 - b^2$

e.g.

$x^2 = 12^2 + 5^2 = 169$ $x^2 = 10^2 - 6^2 = 64$

$x = \sqrt{169} = 13$ $x = \sqrt{64} = 8$

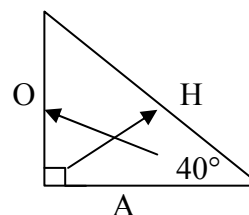
When you need a side and you have another side and an angle, you use Trigonometry.

You label the triangle, so that:
        the long side, opposite the right angle = Hypotenuse
        the side opposite the other angle given = Opposite
   the side beside the angle given = Adjacent

We then select the trig triangle to use by taking the side we are given, and the side we are interested in and seeing where they both are in:

$$\begin{array}{ccc} O & A & O \\ S\ H & C\ H & T\ A \end{array}$$

Having selected your triangle, you cover the letter you need to find, and the remaining letters give the values to put into the calculator and their position indicates if they are multiplied or divided.
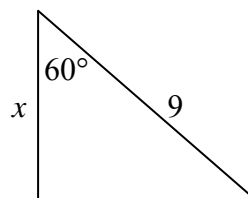
e.g.
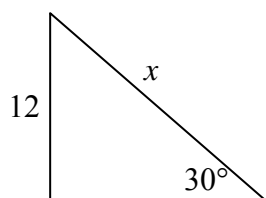
We need the H (*x*) and have the O (12)   We need the A (*x*) and have the H (9)

That means we use $S\ \overset{O}{}\ H$ That means we use $C\ \overset{A}{}\ H$

$H = \dfrac{O}{S} = \dfrac{12}{Sin\ 30} = 24$ $H = C \times H = Cos\ 60 \times 9 = 4.5$

When you need an angle and you have two sides, you use (inverse) Trigonometry.

You label the triangle's sides as before as Hypotenuse, Opposite and Adjacent.

As for finding a side you then select the trig triangle we want by taking the two sides we have and seeing which one they both are in:

$$\overset{O}{S}\ H \quad \overset{A}{C}\ H \quad \overset{O}{T}\ A$$

Having selected your triangle, you find the trig function and the fraction of the sides to put in.

For finding an angle you then apply the **inverse** trig function to the fraction. This is SHIFT then SIN / COS / TAN on your calculator, which will appear as "SIN^{-1}" etc.

(This is because, if COS $x = 0.4$, then $x = $ COS^{-1} 0.4. We do the opposite when we move an operation across an equals sign.)

e.g.
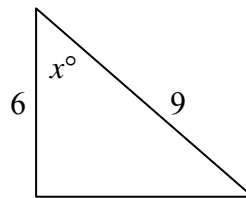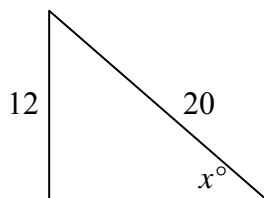
We have the H (20) and O (12)

That means we use $\overset{O}{S}\ H$

$\text{Sin } x = \dfrac{O}{H}$

$x = \text{Sin}^{-1}\ (\dfrac{12}{20}) = 36.87°$

We have the H (9) and A (6)

That means we use $\overset{A}{C}\ H$

$\text{Cos } x = \dfrac{A}{H}$

$x = \text{Cos}^{-1}\ (\,6 \div 9\,) = 48.19°$

(Note: you cannot type in "SIN $-$ 1" as such, you must use the SHIFT button.)

Always check to see that your answer looks right!

If your answer seems wrong, check to see if you have:
- put your division the wrong way round.
- forgotten to take the inverse when finding angles.
- been trying to take the sin / cos / tan of the side, rather than the angle.
- forgotten to square root when using Pythagoras.
- are adding the other two squares, not subtracting, when you are trying to find a short side.

You cannot solve a problem by drawing a scale diagram, but you can check your answer that way.

A "Maths error" doing Pythagoras is because you are trying to square root a negative. It is always $a^2 = h^2 - b^2$ (**not** $a^2 = b^2 - h^2$). When doing inverse trig it is when your division is upside down.