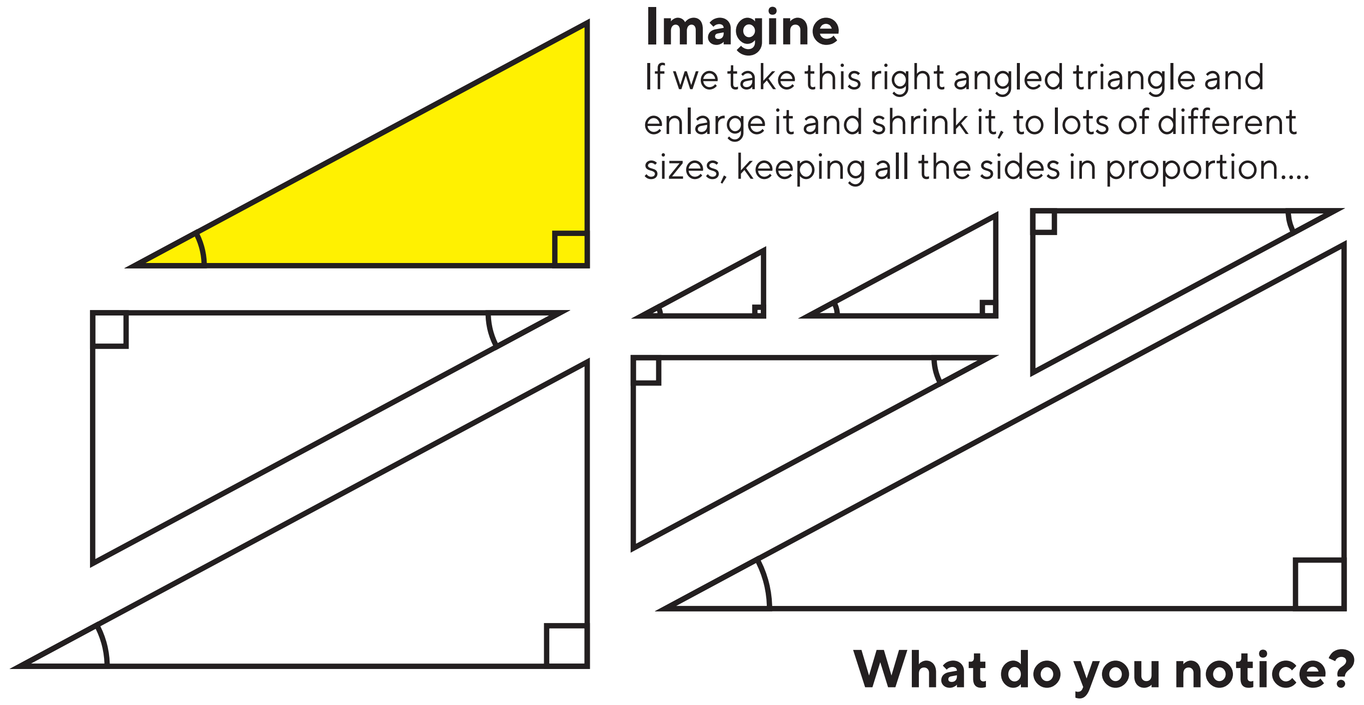
The word **trigonometry** has evolved from **trigonon** meaning three (tri) angles (gon) and **metria** meaning to measure.

Trigonometry

Imagine

If we take this right angled triangle and enlarge it and shrink it, to lots of different sizes, keeping all the sides in proportion....

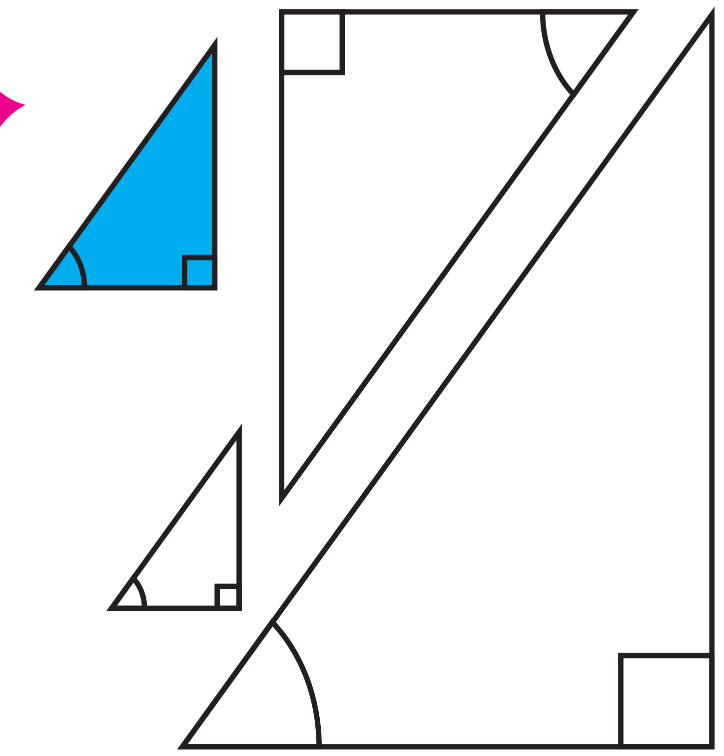


What do you notice?

Did you spot all the angles stayed the same.

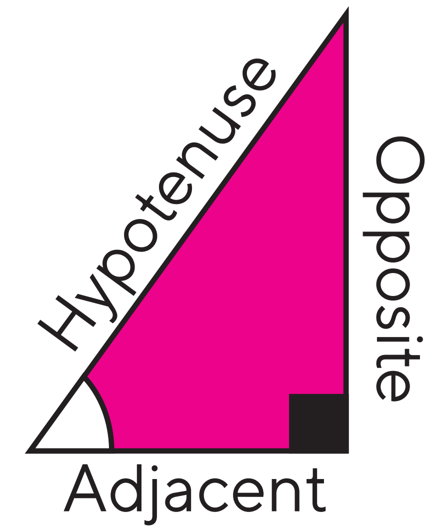
A Different Angle...?

If we change the size of the original angle in the triangle, and do some more enlargements, again the angle stays the same in all of the new triangles we create.



Give them a name!

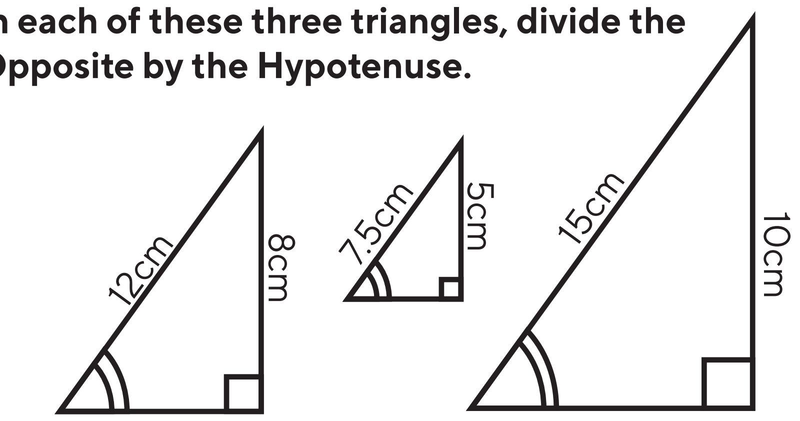
Naming the sides, depending on where they are in relation to the angle, helps us to calculate things.



The opposite side is opposite to the angle in question.

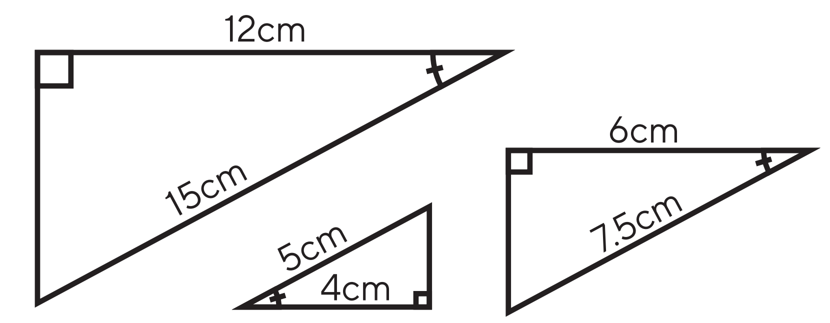
The adjacent side is next to the angle in question.

In each of these three triangles, divide the Opposite by the Hypotenuse.



$\frac{\text{Opposite}}{\text{Hypotenuse}}$ $= \frac{8}{12} = \frac{2}{3}$ $= \frac{5}{7.5} = \frac{2}{3}$ $= \frac{10}{15} = \frac{2}{3}$

In each of these three triangles, divide the Adjacent by the Hypotenuse.



$\frac{\text{Adjacent}}{\text{Hypotenuse}}$ $= \frac{12}{15} = \frac{4}{5}$ $= \frac{4}{5}$ $= \frac{6}{7.5} = \frac{4}{5}$

So

When the angle stays the same, all the sides stay in the same proportions.

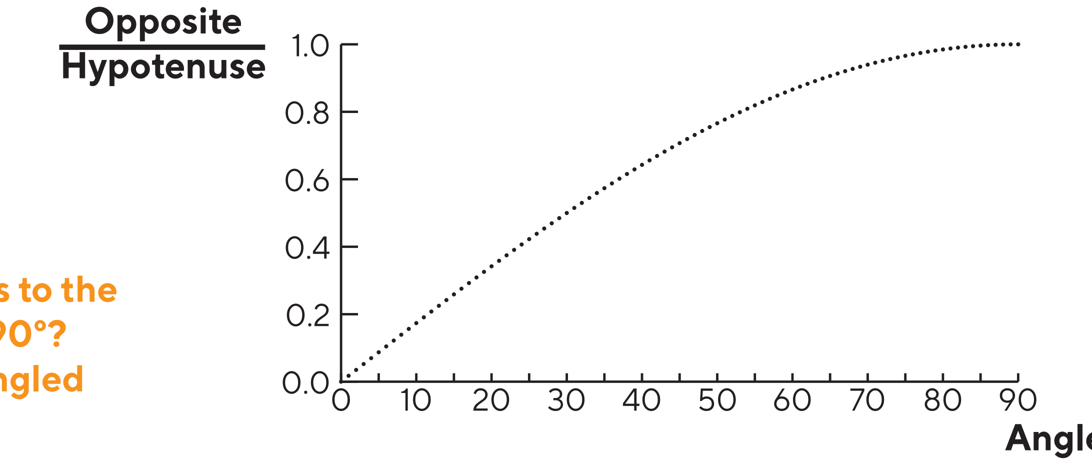
For any given angle

The ratio of any two sides is always the same. This is because when the angle is fixed we know all the triangles are similar, and therefore sides must be in proportion.

When we find the ratio of any two sides for a fixed angle, we will always get the same answer. If we change the angle the ratio will change.

Let's plot it

If we draw a graph of the different **angles** on the horizontal axis and the **ratio** of the opposite and hypotenuse on the vertical axis, we get:

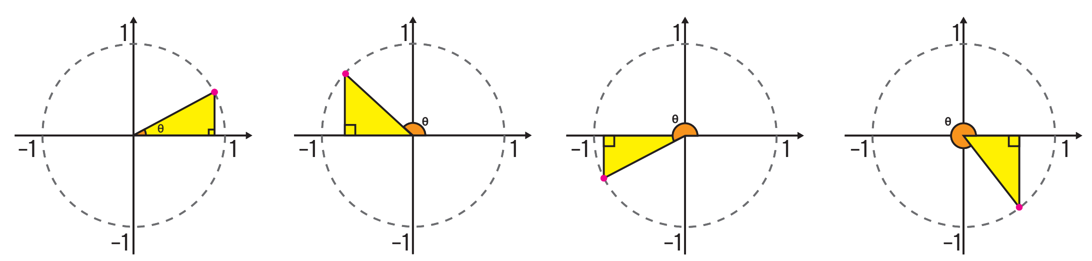


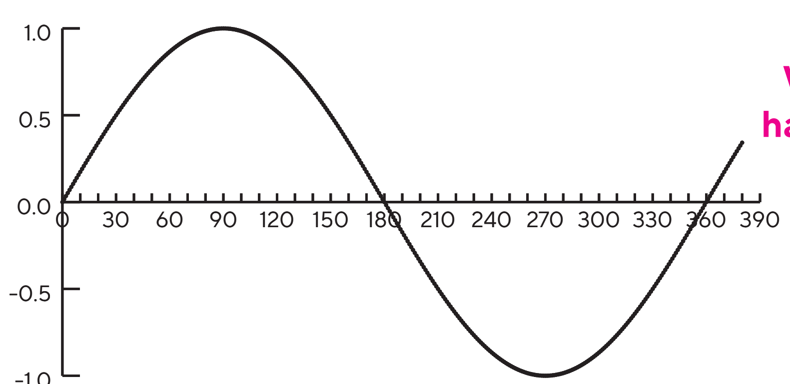
As the angle gets closer to 90°, the ratio seems to get no higher than 1.

What do you think happens to the graph with angles over 90°? Would it still be a right angled triangle?

To 360° and beyond

We can continue to increase the angle and move the triangle around the origin, if we continue to plot the height of the triangle the graph below is drawn.





What do you think happens as the angle exceeds 360°?

The Sine Wave

sin cos tan

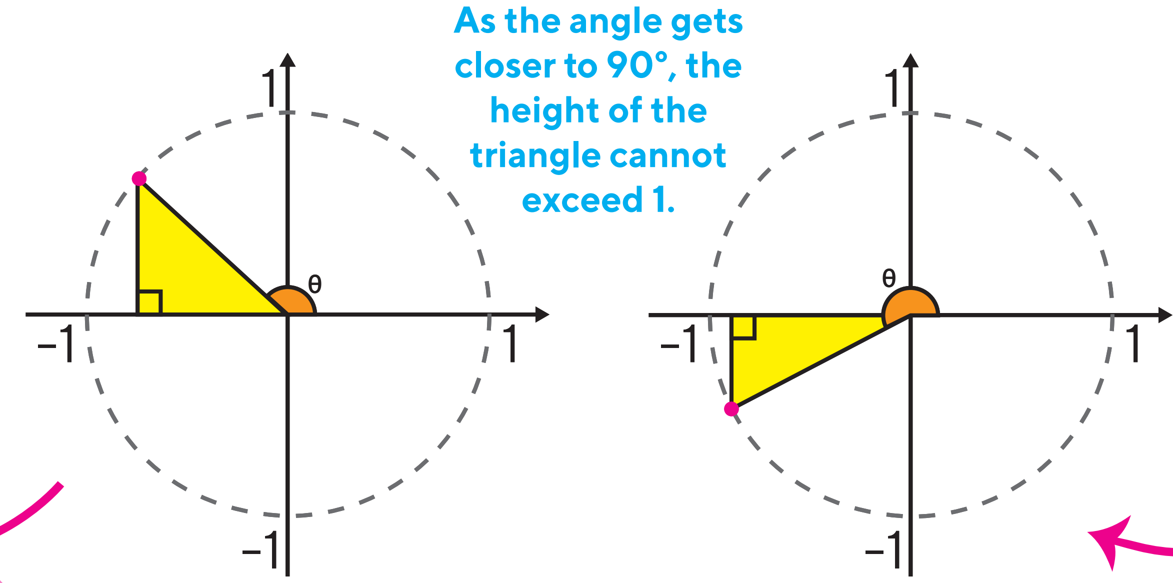
This function is called the Sine function (shortened to **sin**). It carries on forever, as you continue around and around the circle. Luckily we have a button on the calculator which stores this graph and determines it's values when we need them.

If Sine, relates to the opposite and hypotenuse sides, how do you think Cos(ine) and Tan(gent) are related?

Bigger than 90°?

If we draw our triangles in a unit circle, (often, in maths **unit** is a word used for 1, so a **unit circle** has a radius of 1). As the hypotenuse is 1, the height of the triangle represents the ratio of the opposite and hypotenuse. If we define the angle as always being measured from the positive horizontal axis we can move the triangle around the origin.

As the angle gets closer to 90°, the height of the triangle cannot exceed 1.



α β γ δ ε ζ η θ ι κ λ μ ν ξ ο π ρ σ τ υ φ χ ψ ω

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Level 2 Additional Maths can be studied during key stage four.

In key stage five A Level Mathematics is the most popular[1] A-level and A Level Further Mathematics is the perfect accompaniment.

The Further Mathematics Support Programme Wales (FMSPW) is here to support students, teachers and departments across Wales in enriching and developing their Mathematical domain across all key stages.

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[1] https://www.wjec.co.uk/media/invh1fni/gce-a-level-provisional-results-june-2022.pdf