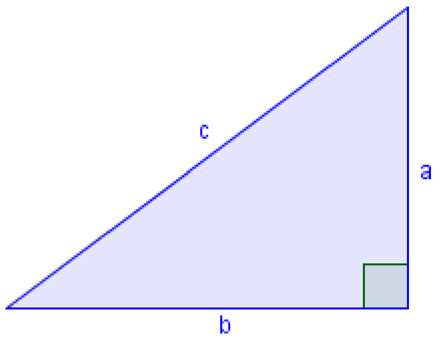
Pythagoras' Theorem

What it is:



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

Where c is the length of the hypotenuse and a and b are the lengths of the other two sides.

This formula is **not** provided in the exam paper, so make sure you memorise it.
You also need to recognise when it is needed and be confident applying it.

When to use:

Note: Only valid for right-angled triangles!

When you know the lengths of any two sides and want to find the length of the third.

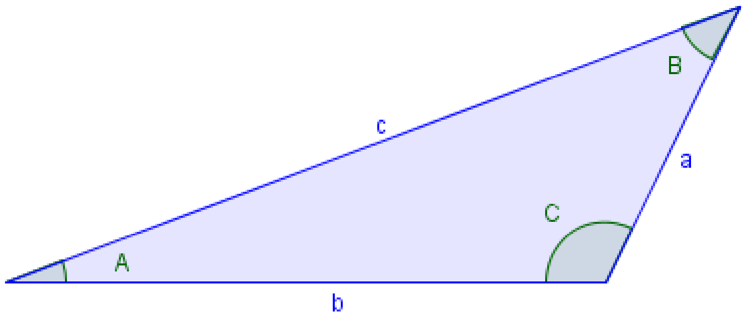
What to watch out for:

Make sure you label the sides correctly – the hypotenuse (which is always opposite the right angle and always the longest side) must be labelled c. a and b can go either way round.

If you're trying to find a or b, make sure you rearrange the equation properly, and don't forget that $\sqrt{a^2 + b^2}$ is **not** the same as $a + b$.

Area of a Triangle

What it is:



$$Area = \frac{1}{2}(base \times height)$$

OR

$$Area = \frac{1}{2}ab\sin C$$

Where a and b are two side lengths of a triangle and C is the angle in between.

These formulae are **not** provided in the exam paper, so make sure you memorise them. You also need to recognise when they are needed and be confident applying them.

When to use:

Note: These rules are valid for any triangle.

When you know the lengths of two sides and the size of the angle in between and you want to find the area of the triangle.

What to watch out for:

When using the first rule, remember that 'height' refers to the perpendicular height (that is, the vertical distance from the base to the top), and this is rarely the same as the side length.

When using the second rule, take care to substitute the correct numbers into the formula. Remember this will work for any triangle, but the angle must be the one in between the two side lengths used.

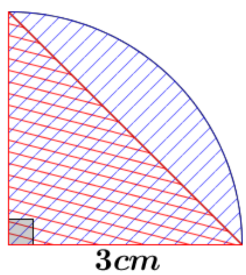
For both rules, don't forget the $\frac{1}{2}$. It seems simple, but is a very common mistake.

Whenever you calculate area, make sure your units of measurement are appropriate. If the side lengths were given in cm, the area will be in cm^2, etc.

Finding the area of a segment:

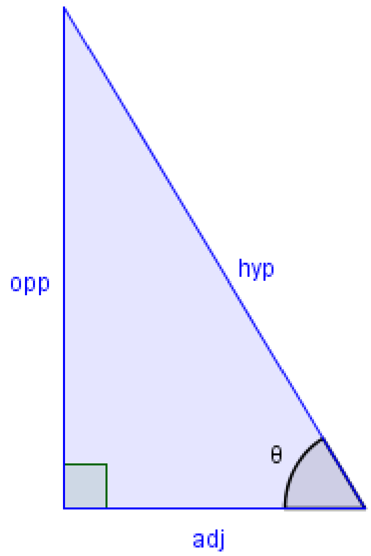
A **sector** of a circle (a slice cut from the middle like a cake) can be split into a **triangle** and a **segment**.
To work out the area of a **segment,** subtract the area of the triangle from the area of the sector:

$$Sector: \frac{1}{4}(\pi \times 3^2) = 2.25\pi \quad Triangle: \frac{1}{2}(3 \times 3) = 4.5$$
$$Segment: 2.25\pi - 4.5 \approx 2.57cm^2$$



SOHCAHTOA (right-angled trigonometry)

What it is:



$$\sin\theta = \frac{opp}{hyp}$$

$$\cos\theta = \frac{adj}{hyp}$$

$$\tan\theta = \frac{opp}{adj}$$

Where hyp is the length of the hypotenuse, adj is the length of the (other) side adjacent to θ and opp is the length of the side opposite θ.

These formulae are **not** given at the front of the exam paper, so make sure you memorise them. All three look similar, so use the acronym SOHCAHTOA to remember which sides go with which trigonometric function.

When to use:

Note: Only valid for right-angled triangles!

When you know the length of two sides and want to find the size of one of the angles.
OR
When you know the length of one side and the size of one angle (apart from the right angle), and want to find the length of another side.

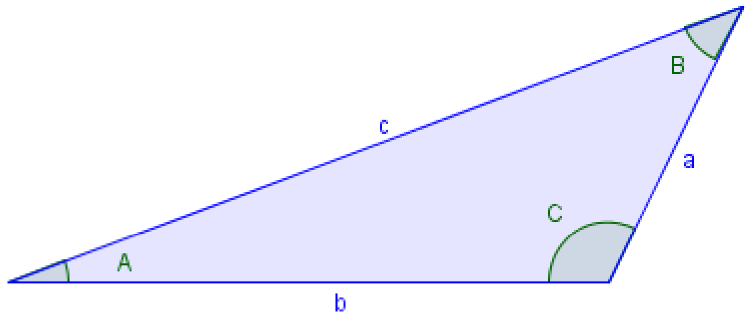
What to watch out for:

When labelling the sides, make sure they relate to the angle of interest (that is, the one you are given or the one you are trying to find). The hypotenuse will always be the same, but depending on which of the angles you are interested in, the opposite and adjacent may change.

When finding an unknown angle, remember to use the inverse trigonometric functions. For instance, if you know that $\sin\theta = 0.2$, calculate θ using $\theta = \sin^{-1} 0.2$.

Sine Rule

What it is:



$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

Where the side lengths are a, b and c and the angles opposite these sides are A, B and C.

This formula is **not** provided in the exam paper, so make sure you memorise it.
You also need to recognise when it is needed and be confident applying it.

When to use:

Note: Valid for any triangle, but there's no need to use it unless the triangle is non-right-angled.

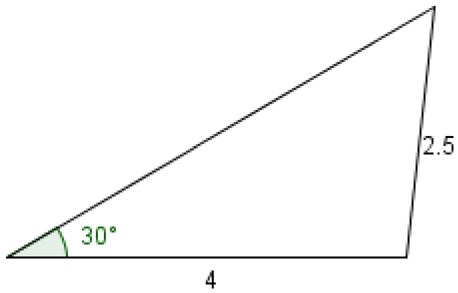
When you know a side and the angle opposite (eg b and B), and:
one other side and you want to find the angle opposite.
OR
one other angle and you want to find the opposite side.

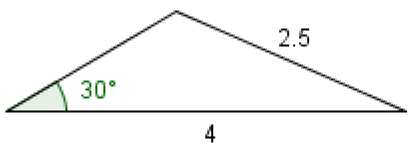
What to watch out for:

When quoting the rule, only use the part you need. For instance, $\frac{a}{\sin A} = \frac{c}{\sin C}$.

When substituting in numbers, take care rearranging, especially if you are looking for an unknown angle and need to use inverse sine.

Note: It is sometimes possible to have two equally valid alternatives for a given description of a triangle (consider congruency conditions). For instance, a triangle with side lengths $4cm$ and $2.5cm$, with a $30°$ angle opposite the $2.5cm$ line, could look like either of these:

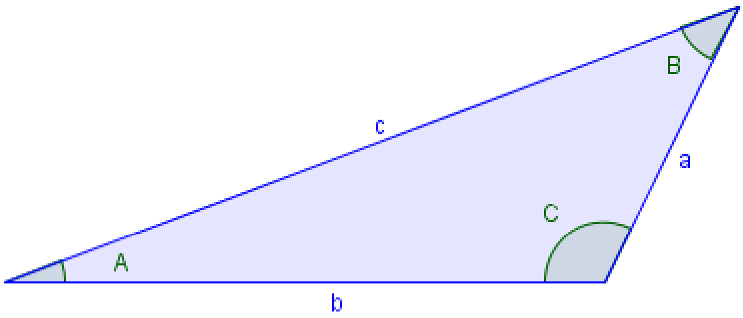




In one case, the angle opposite the $4cm$ line is $53°$, in the other it is $127°$. Notice that $\sin 53 = \sin 127$. *Our calculator tells us that* $\sin^{-1} 0.8 = 53°$, *which is correct, but it is not the* only *correct answer. This is known as the* ambiguous case, *and is not examinable at GCSE.*

Cosine Rule

What it is:



$$a^2 = b^2 + c^2 - 2bc\cos A$$

Alternative form:

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

Where the side lengths are a, b and c and the angles opposite these sides are A, B and C.

This formula is **not** provided in the exam paper, so make sure you memorise it.
You also need to recognise when it is needed and be confident applying it.

When to use:

Note: Valid for any triangle, but there's no need to use it unless the triangle is non-right-angled.

When you know all three side lengths and want to find an angle.
OR
When you know two sides and the angle in between, and want to find the length of the third side.

What to watch out for:

The rule is arranged for finding the side labelled a, so make sure you label the triangle with the missing side as a and the known angle A.

When using the rule to find an angle from three sides, it is necessary to rearrange. It may be easier to do this after substituting in numbers, but in this case take care not to incorrectly simplify $2 + 3\cos A$ to $5\cos A$. Recall that $2 + 3x \neq 5x$, and equally numbers and multiples of $\cos A$ cannot be combined. If you rearrange the formula before substituting in numbers, you should end up with: $\cos A = \frac{b^2+c^2-a^2}{2bc}$ or $\cos A = \frac{a^2-b^2-c^2}{-2bc}$.
With this rearranged version, don't forget to use inverse cos to find the angle A at the end.