Help Sheet: How to solve equations

To use any equation, the quantity that you need to calculate must be on its own on the left-hand side of the equation.

Unfortunately, some examination questions are deliberately written in a way that asks you to calculate a quantity that is not normally on the left-hand side of a remembered equation.

For example, most people remember "work done = force x distance moved" but a question might give you the work done and the force then ask you to calculate the distance moved.

There are three different ways to approach this situation;

i.	rearrange the equation in symbol form before starting	(quickest method, but abstract)
ii.	insert the numbers then rearrange to solve the equation	(good if you prefer numbers)
iii.	use an equation triangle to reveal the calculation	(safest way if you're not sure)

It is up to you to choose whichever method works for you. Once you have decided on the method you will use, it's a good idea to use that same method every time so that the routine becomes automatic whenever you see a calculation question.

Let's use an equation from a different part of physics so you can focus on the method used.

Calculate the mass of a car that accelerates at 9 m/s² when a force of 8.1 kN is used. Use the equation, force = mass x acceleration (F = m x a)

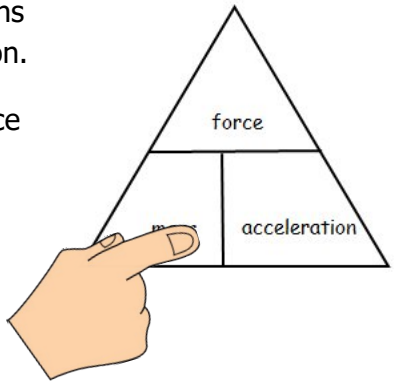
Before you do anything else, notice that the force has been stated in kN so this value must be converted to newtons before doing any calculations! Write the correct value here: ☐ N

Method 1: Rearrange the symbol equation to get m = F / a **then** substitute and calculate.

Method 2: Insert the values in F = m x a (giving 8100 = m x 9) **then** rearrange and calculate.

Method 3: Use an **equation triangle** to solve this same question.

The equation triangle you need is the one that has the three quantities mentioned in the question arranged so they match the equation you are given.* Draw the appropriate equation triangle then cover the quantity you are trying to find and look to see the positions of the two quantities for the numbers you were given in the question.



In this case, you need to cover mass and you are then left with force above acceleration.

This means that to find the answer you must do the calculation; "force divided by acceleration".

Write down; $\text{mass} = \frac{\text{force}}{\text{acceleration}}$ then put in the numbers $\frac{8100}{9}$

Finally, put this into your calculator to get the answer; 900. Don't forget the units… **900 kg**.

*** If you don't know how to draw the right equation triangle, see the next page…**

Help Sheet: How to draw an equation triangle

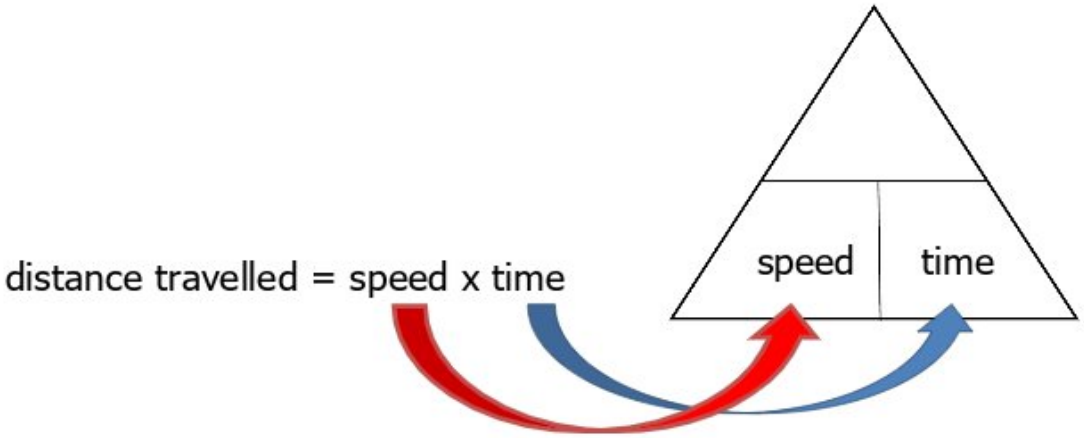
Equation triangles are a way to avoid having to rearrange equations. They are used when the equation you are given doesn't have the quantity you need to calculate on the left-hand side.

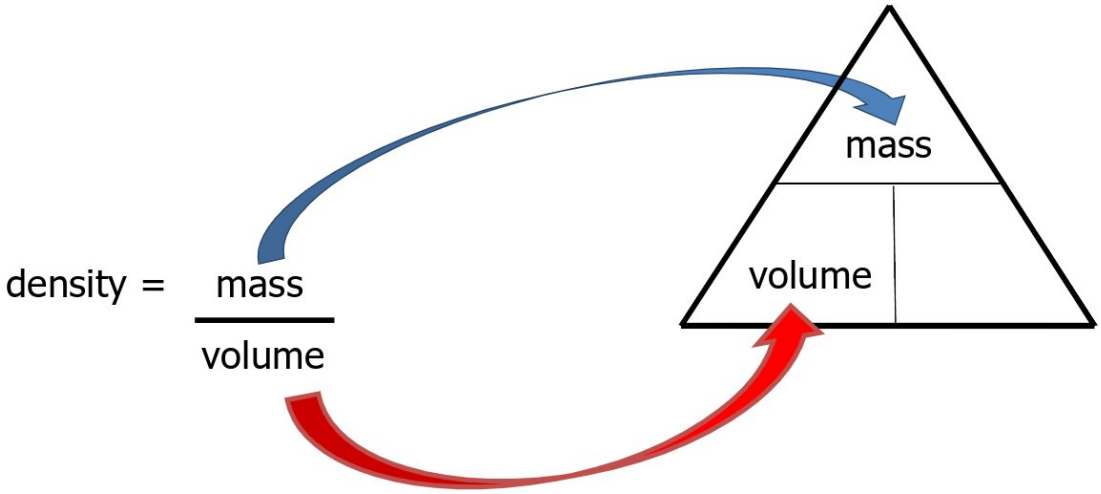
For example, suppose there is a question about mass, volume and density. You are given values for the density and mass but you have to calculate the volume. The usual equation in this case is density = mass divided by volume (density = mass / volume). But to calculate the volume, you need to rearrange the equation so that volume is on the left-hand side of the equation. Or you can use the equation triangle technique explained on the first page (covering the thing you want to find). To do that, you first need to put the quantities in the right place in an equation triangle.

The rules for drawing an equation triangle are;

- Start by ignoring the quantity on the left of the equation
- If two quantities are multiplied together on the right, place them both on the bottom row
- If one quantity is above the other on the right, use those same positions on the triangle
- Then put the quantity on the left of the equation into the remaining space of the triangle

Here are some examples of different types of equations being converted into triangle form;





In both cases, the remaining empty space is then filled with the quantity that was on the left-hand side of the original equation and the triangle can then be used as explained on Page 1.