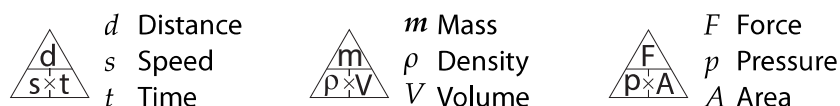## 18   Formula Triangles

Formula triangles are used to save time re-arranging formulae which involve exactly three quantities. Here are some common formula triangles:

d Distance m Mass F Force
s Speed ρ Density p Pressure
t Time V Volume A Area

Note: Some books write formula triangles with a vertical line on the bottom instead of a multiplication symbol. The meaning is the same.

To find a formula from a formula triangle, cover up the quantity to be found. The pattern of the remaining letters shows how to calculate this quantity.

Example 1 - Use the formula triangle relating speed s, distance d and time t to write formulae for each of the three quantities in terms of the other two.

$$s = \frac{d}{t} \qquad d = s \times t \qquad t = \frac{d}{s}$$
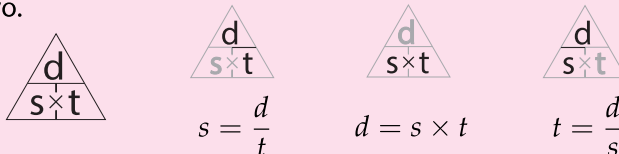
Then performing a calculation using a formula triangle, it is necessary to make sure that the units you are using are consistent.

Example 2 - Find the time taken to travel 0.63 km at 4.2 m/s.

There is a mixture of units of length in the question (m and km). We will choose to do the calculation in metres. 0.63 km = 630 m.

$$t = \frac{d}{s} = \frac{630}{42} = 15 \text{ s}$$

18.1   Using the speed-distance-time triangle, or otherwise, find:
   (a) s in m/s if $d = 200$ m and $t = 25$ s.
   (b) d in m if $s = 10$ m/s and $t = 1010$ s.
   (c) t in s if $d = 540$ m and $s = 12$ m/s.

18.2 Using the speed-distance-time triangle, or otherwise, find:
   (a) The speed in m/s if $d = 0.45$ km   and $t = 2.5$ minutes.
   (b) The distance travelled in m if $s = 0.3$ m/s and $t = 5$ minutes.
   (c) The time a journey takes in s if $d = 720$ m, $s = 21.6$ km/hour.

18.3 Using a formula triangle or otherwise, find:
   (a) The pressure in N/m^2 exerted by a force of 16.2 N on an area of 1.50 m^2.

   (b) The force in Newtons (N) required to maintain a pressure of 15.0 N/m^2 on an area of 0.150 m^2.

   (c) The volume of a lead block with a mass of 4.52 kg. Lead has a density of 11.3 g/cm^3

It is also possible to write your own formula triangles.

18.4 Write the following formulae as formula triangles.
   (a) $V = IR$ (b) $a = F/m$ (c) $\frac{P}{V} = I$

18.5 Which of these formulae can be written as a formula triangle? Write a formula triangle where it is possible.
   (a) $v = u + at$ (b) $\frac{Q}{C} = V$ (c) $L = a - b$
   (d) Magnification, $M = \frac{\text{Image size, } i}{\text{Object size, } o}$

18.6 The concentration of salt in water, C g/cm^3, is found by dividing the mass of salt in grams, m, by the volume of water in cm^3, V.
   (a) Create a formula triangle for concentration, mass and volume.

   (b) Write a formula for volume in terms of mass and concentration.

   (c) Find the volume of a solution with concentration 0.0020 g/cm^3 if the total mass of salt dissolved is 2.4 g.

   (d) Write a formula for m in terms of C and V.

   (e) Find m if $V = 1$ litre and $C = 0.004$ g/cm^3.