Factor Label Method (Dimensional Analysis)

The Factor Label Method is used to convert a measurement to a different set of units. When using the Factor Label Method you must keep in mind two simple facts:

- Always include the units in every measurement!
- Form the correct equality.

To use this method you must know metric equalities, i.e. 1 km = 1000 m. You may divide both sides by 1000 m to get:

$$\frac{1\,\text{km}}{1000\,\text{m}} = \frac{\cancel{1000\,\text{m}}}{\cancel{1000\,\text{m}}} = 1$$

or you can divide both sides by 1 km to get:

$$\frac{1\,\cancel{\text{km}}}{1\,\cancel{\text{km}}} = \frac{1000\,\text{m}}{1\,\text{km}} = 1$$

This means that when you multiply a measurement by $\frac{1\,\text{km}}{1000\,\text{m}}$ or $\frac{1\,\text{km}}{1000\,\text{m}}$ you are multiplying by 1.

To put the measurement in common units, suppose you measure the width of a desk and get 5.0 ft. Your equality might be 5.0 ft = 60.0 in. When you write the equality

$\frac{5.0\,\text{ft}}{60.0\,\text{in}}$ or $\frac{60.0\,\text{in}}{5.0\,\text{ft}}$ you will be multiplying by 1.

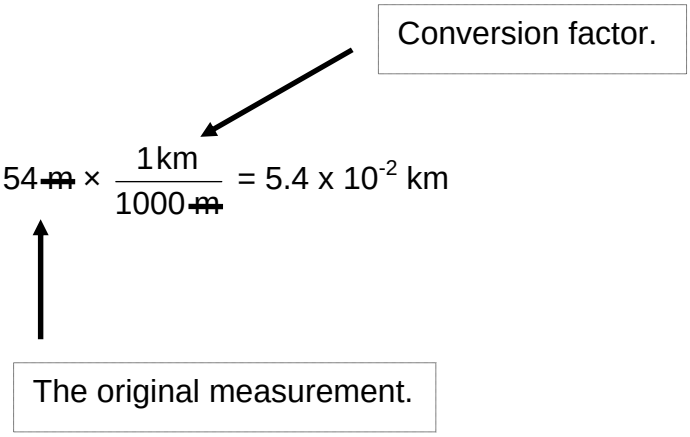
How do you know how to write the equality? You write it such that the unit you started with cancels and you are left with the desired unit.

The steps are easy.

- Write the measurement you are given and multiply by the appropriate conversion factor.
- The appropriate conversion factor will have the unit in the denominator of what is being cancelled out (the unit being changed from).
- The numerator of the conversion factor must have the units that are needed in the final answer (the unit being changed to).

Example One

Convert 54 m to km.



An important fact to remember is that you are not allowed to change the number of significant digits. These were determined at the time you made the measurement by the precision of your equipment. After the measurement is taken, the number of significant digits are etched in concrete!

Example Two

437 mm = ? cm

$$437\ \cancel{mm} \times \frac{1\ cm}{10\ \cancel{mm}} = 4.37 \times 10^{1}\ cm$$

Example Three

437 mm = ? km

$$437\ \cancel{mm} \times \frac{1\ \cancel{m}}{1000\ \cancel{mm}} \times \frac{1\ km}{1000\ \cancel{m}} = 4.37 \times 10^{-4}\ km$$