The Factor Label method (also known as Dimensional Analysis):is a very powerful, very intuitive problem solving method: for Chemistry it is primarily used for unit conversions and for stoichiometry problems.

How it works:
1. You are given a problem with a starting point in units of "X" you need to get the answer which is in units of "Y"
2. In order to do this you must find one or more conversion factors that will get you to your final answer's units
3. A conversion factor could be "12 inches = 1 foot" or the mole relationships in a balanced chemical equation
4. Often to get to the desired unit several conversion factors are used in sequence
5. When the final conversion factor with the correct units is used the numerical answer is found by doing the math

Example:
How many inches are in 32 kilometers?
Given the following conversions:
1 kilometer = 0.62137 miles 1 mile = 5280 feet 1 foot = 12 inches
First draw an empty grid with what you are given in the top left and the unit of what you want after the equals sign. Leave yourself plenty of room since you usually don't know how many steps you'll need.

$$\frac{32\text{ kilometers}}{}\Bigg|\frac{}{}\Bigg|\frac{}{} = \quad \text{inches}$$

Rules of the grid: everything on top is multiplied, everything on bottom is divided, the vertical lines are used to separate terms and all relevant rules pertaining to significant digits apply here as well

so (5.00 x 5.00)/3.00 would look like this $\frac{5.00}{}\Bigg|\frac{5.00}{3.00} = 8.33$

We have no conversion factor between kilometers and inches but we have one for kilometers to miles so…

$$\frac{32\text{ kilometers}}{}\Bigg|\frac{0.62137\text{ miles}}{1\text{ kilometer}}\Bigg|\frac{}{} = \quad \text{inches}$$

Note that the units of kilometer cancel and we are left with the unit of miles,

$$\frac{32\cancel{\text{ kilometers}}}{}\Bigg|\frac{0.62137\text{ miles}}{1\cancel{\text{ kilometer}}}\Bigg|\frac{}{} = \quad \text{inches}$$

which leads us to the next conversion and the next

$$\frac{32\text{ kilometers}}{}\Bigg|\frac{0.62137\text{ miles}}{1\text{ kilometer}}\Bigg|\frac{5280\text{ feet}}{1\text{ mile}}\Bigg|\frac{12\text{ inches}}{1\text{ foot}} = \quad \text{inches}$$

all units except inches are canceled out, now do the math

$$\frac{32\text{ kilometers}}{}\Bigg|\frac{0.62137\text{ miles}}{1\text{ kilometer}}\Bigg|\frac{5280\text{ feet}}{1\text{ mile}}\Bigg|\frac{12\text{ inches}}{1\text{ foot}} = 1.3 \times 10^{6} \quad \text{inches}$$

(same as above just with the units canceled for clarity)

$$\frac{32\cancel{\text{ kilometers}}}{}\Bigg|\frac{0.62137\cancel{\text{ miles}}}{1\cancel{\text{ kilometer}}}\Bigg|\frac{5280\cancel{\text{ feet}}}{1\cancel{\text{ mile}}}\Bigg|\frac{12\text{ inches}}{1\cancel{\text{ foot}}} = 1.3 \times 10^{6} \quad \text{inches}$$

Using the Conversion factors found in your text: Convert 1.25×10^{-2} metric tons to pounds.

$$\frac{1.25 \times 10^{-2}\text{ metric tons}}{}\Bigg|\frac{1000\text{ kg}}{1\text{ metric ton}}\Bigg|\frac{1\text{ lb}}{0.45359\text{ kg}} = 27.6\ \text{lb}$$

Using Factor label with a balanced chemical equation (stoichiometry problems):

How many grams of hydrogen (H_2) are required to produce 75.0 grams of ammonia (NH_3) assuming an excess of nitrogen(N_2) is available?

The balanced reaction is $3\ H_2(g) + N_2(g) \longrightarrow 2\ NH_3(g)$

Here the conversion factors are in the mole relationships between products and reactants:
We begin as we did for the previous Factor label problems

$$\frac{75\text{ g }NH_3}{}\Bigg|\frac{\qquad}{} = \text{grams }H_2$$

we need a conversion from grams of NH_3 to moles of NH_3 i.e. the molar mass of NH_3
1 mole of NH_3 = 17.034 g NH_3

$$\frac{75.0\text{ g }NH_3}{}\Bigg|\frac{1\text{ mole }NH_3}{17.034\text{ g }NH_3}\Bigg|\frac{\qquad}{} = \text{grams }H_2$$

now use the mole relationship between NH_3 and H_2 from the balanced equation
here formally it would be written that 2 moles of NH_3 are *equivalent* to 3 moles of H_2

$$\frac{75.0\text{ g }NH_3}{}\Bigg|\frac{1\text{ mole }NH_3}{17.034\text{ g }NH_3}\Bigg|\frac{3\text{ mole }H_2}{2\text{ mole }NH_3}\Bigg|\frac{\qquad}{} = \text{grams }H_2$$

to finish the problem we need to convert from moles of H_2 to grams of H_2 (the molar mass) and then do the math

$$\frac{75.0\text{ g }NH_3}{}\Bigg|\frac{1\text{ mole }NH_3}{17.034\text{ g }NH_3}\Bigg|\frac{3\text{ mole }H_2}{2\text{ mole }NH_3}\Bigg|\frac{2.0158\text{ g }H_2}{1\text{ mole }H_2} = 13.3\text{ grams }H_2$$

(same as above with units canceled for clarity)

$$\frac{75.0\cancel{\text{ g }NH_3}}{}\Bigg|\frac{1\text{ mole }NH_3}{17.034\cancel{\text{ g }NH_3}}\Bigg|\frac{3\cancel{\text{ mole }H_2}}{2\cancel{\text{ mole }NH_3}}\Bigg|\frac{2.0158\text{ g }H_2}{1\cancel{\text{ mole }H_2}} = 13.3\text{ grams }H_2$$

Why factor label works so well: If we mistakenly invert one of the conversion factors lets say the moles of H_2 to moles of NH_3 relationship:

$$\frac{75.0\text{ g }NH_3}{}\Bigg|\frac{1\text{ mole }NH_3}{17.034\text{ g }NH_3}\Bigg|\frac{\mathit{2\ mole\ NH_3}}{\mathit{3\ mole\ H_2}}\Bigg|\frac{2.0158\text{ g }H_2}{1\text{ mole }H_2} = \frac{(\text{mole }NH_3)^2\ \ \text{grams }H_2}{(\text{mole }H_2)^2}$$

We can not cancel out units to yield only grams of H_2 this SCREAMS something is amiss. By keeping track of the units as the problem is solved you can avoid this type of error (inverting a relationship is the most common mistake).