The factor label method

- A way to solve math problems in chemistry
- Used to convert
  km to miles, m to km, mol to g, g to mol, etc.
- To use this we need: 1) desired quantity, 2) given quantity, 3) conversion factors
- Conversion factors are valid relationships or equities expressed as a fraction

E.g. for 1 km=0.6 miles the conversion factor is

$$\frac{1\text{ km}}{0.6\text{ miles}} \text{ or } \frac{0.6\text{ miles}}{1\text{ km}}$$

Q. write conversion factors for 1 foot =12 inches

Q. what conversion factors can you think of that involve meters?

Conversion factors

- We have looked at conversion factors that are always true. There are conversion factors that are only true for specific questions
- E.g. A recipe calls for 2 eggs, 1 cup of flour and 0.5 cups of sugar
- We can use these conversion factors

$$\frac{2\text{ eggs}}{1\text{ cup flour}}, \frac{0.5\text{ cups sugar}}{1\text{ cup flour}}, \frac{2\text{ eggs}}{0.5\text{ cups sugar}}$$

- Q - the chemical equation between H_2 and O_2 involves 2 H_2 molecules combining with 1 O_2 molecule to make 2 H_2O molecules. Write all possible conversion factors

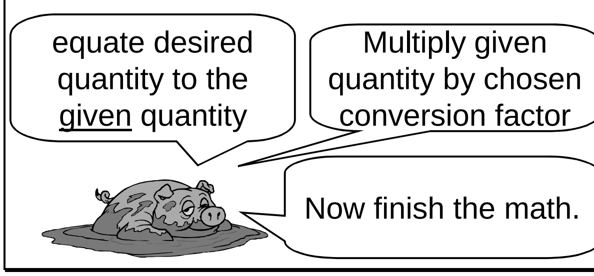
The steps to follow

Now we are ready to solve problems using the factor label method. The steps involved are:

1. Write down the desired quantity/units
2. Equate the desired quantity to given quantity
3. Determine what conversion factors you can use (both universal and question specific)
4. Multiply given quantity by the appropriate conversion factors to eliminate units you don't want and leave units you do want
5. Complete the math

Factor label example

Q - How many kilometers are in 47 miles? (note: 1 km = 0.621 miles)



More examples

1. You want to buy 100 U.S. dollars. If the exchange rate is 1 Can$ = 0.65 US$, how much will it cost?
2. One mole of a gas has a volume of 22.4 L. How many L will 300 grams of CO_2 occupy? (hint: the molar mass of CO_2 is ____ g/mol).
3. There are 12 inches in a foot, 0.394 inches in a centimeter, and 3 feet in a yard. How many cm are in one yard?
4. A chemical reaction requires 3.000 moles of sodium chloride. How many grams is this?

Assignment

Answer questions using the factor label method:

1. How many moles of H_2 are in 100 g of H_2?
2. 300 g of $CuSO_4$ is needed in an experiment. How many moles does this represent?
3. A chemical reaction requires 23.78 moles of silver chloride. How many grams is this?
4. Calculate how many feet are in 1 meter (use information from the examples above).
5. With a U.S. dollar you can buy 1.1 Euros, 130 Yen, or 25 Rubles. How many Yen can you buy with one Ruble?
6. How many molecules are in 73 grams H_2O? (hint: form a conversion factor using Avogadro's #)
7. 255 g of calcium phosphate are produced in a chemical reaction. How many moles of calcium phosphate does this represent?
8. According to the equation $2H_2 + O_2 \rightarrow 2H_2O$, how many grams of H_2O would be produced if 7.35 mol of O_2 is used up? (hint: you will need two conversion factors – 1 from the balanced equation and 1 from a molar mass)