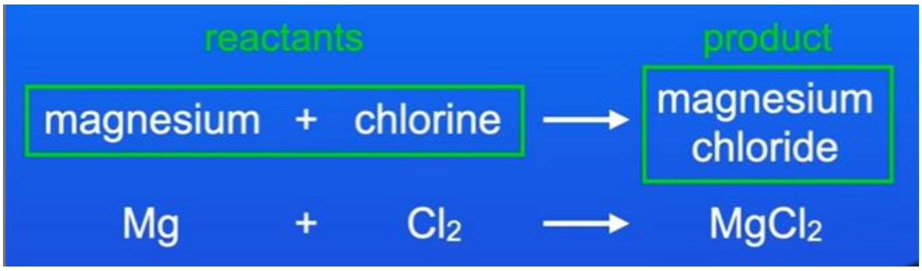
Conservation of mass:

The conservation of mass is when no atoms are lost or made during a chemical reaction so the mass of the products are equal to the mass of the reactants.



Charges on ions:

Ions are atoms with a charge

Metals form positive ions because they gain electrons so the charge becomes positive overall

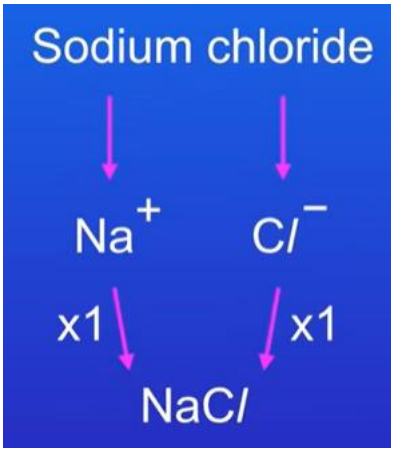
Non metals form negative ions because they gain electrons so the charge becomes overall negative

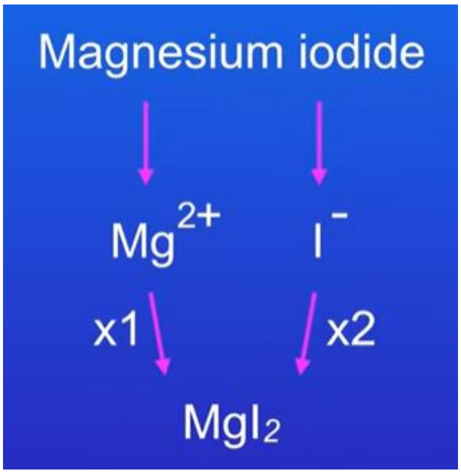
Some metals do not follow this pattern such as iron and copper

How many electrons on the outer shell

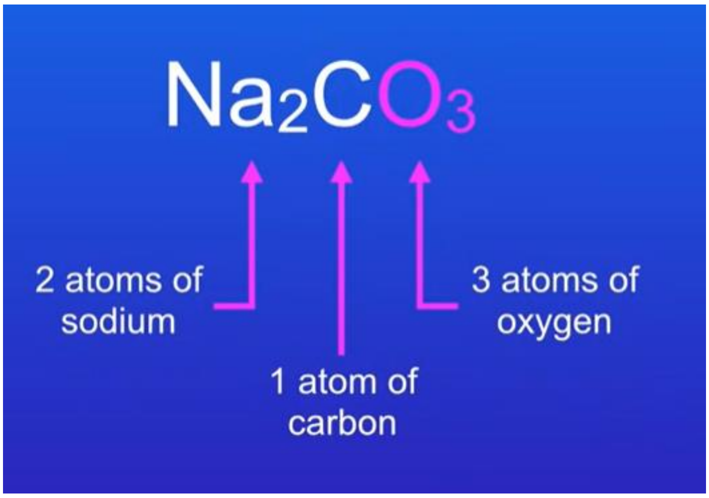
Formula of ionic compounds:

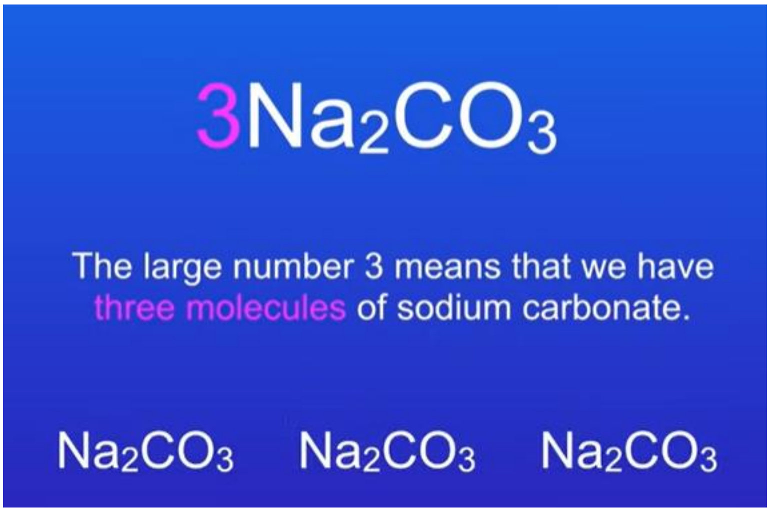
In an ionic compound, the charges have to cancel out to leave an overall charge of 0

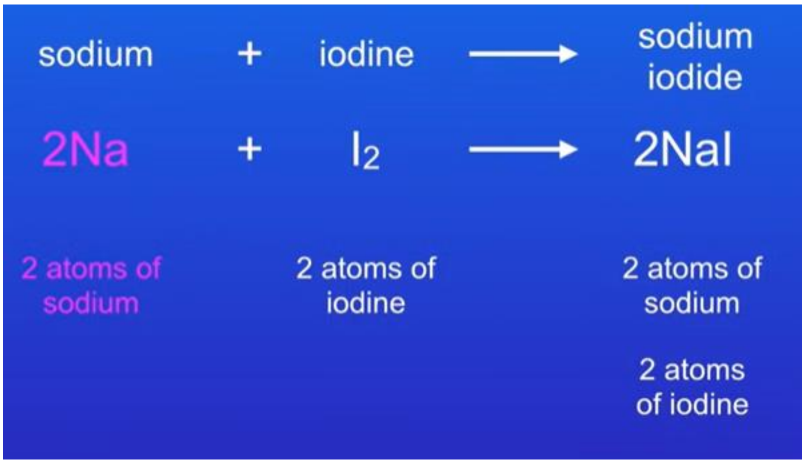




Balancing chemical equations:





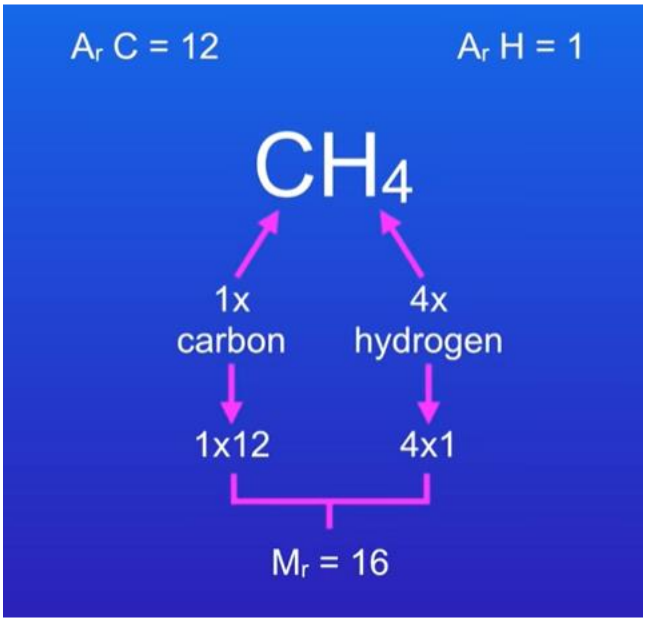


Relative formula mass:

Relative atomic mass of an element is the average mass of the isotopes (atoms of the same element with the same number of protons but different number of neutrons) and it also takes into account the abundance (percentage of each isotope)

Chlorine 35 is more abundant then chlorine 37. That is the relative atomic mass.

Relative formula mass (M_r) of a compound is the sum of all the relative atomic masses of the element and has no units.



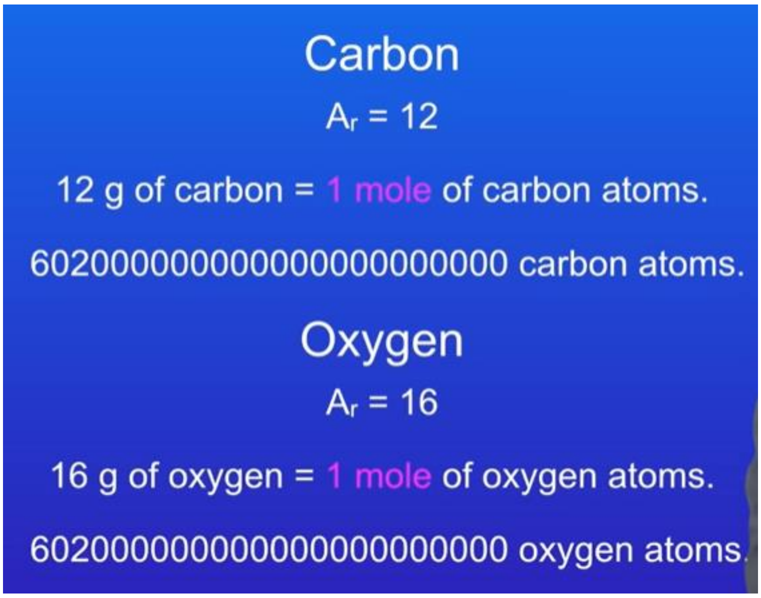
Big numbers at the front of the compound would not change the relative formula mass

Percentage of mass:

Percentage by mass of an element =

Element relative atomic mass / relative formula mass (M_r) of a compound x 100

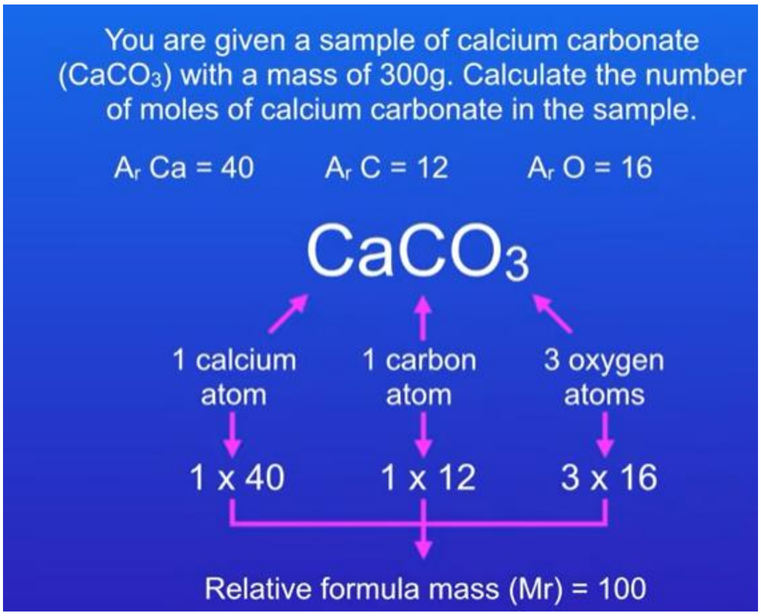
Calculating moles of an element:

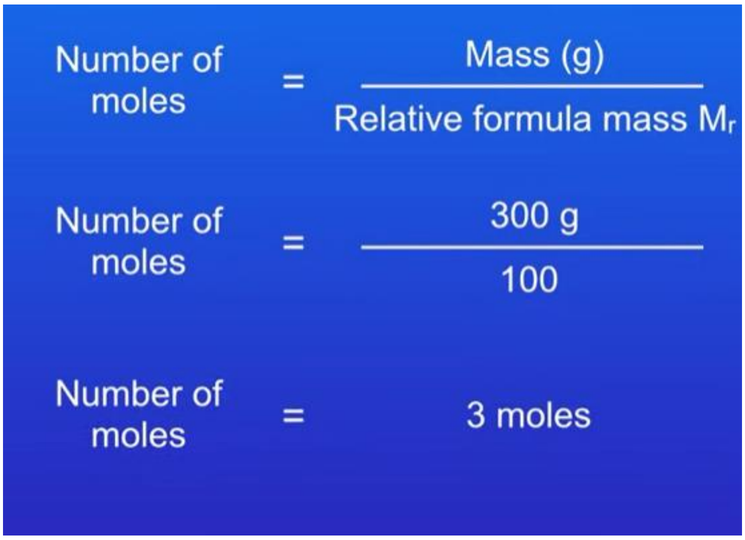


Number of moles in an element = Mass (g) / Relative atomic mass (A_r)

<u>Calculating number of moles in a compound:</u>

Number of moles in a compound = Mass (g) of the compound / Relative formula mass (M_r) of the compound





Calculating mass of a number of moles:

$$\text{Number of moles} = \frac{\text{Mass (g)}}{\text{Relative formula mass } M_r}$$

Calculate the mass of four moles of sodium chloride ($NaCl$).

$$\text{Mass (g)} = \text{Number of moles} \times \text{Relative formula mass } M_r$$

$$\text{Mass (g)} = \text{Number of moles} \times \text{Relative formula mass } M_r$$

$$\text{Mass (g)} = 4 \times 58.5$$

$$\text{Mass (g)} = 234 \text{ g}$$

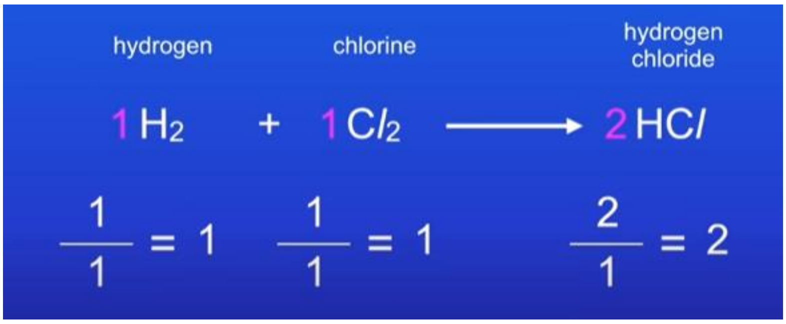
Using moles to balance equations:

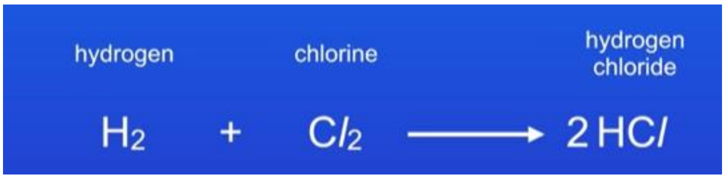
2 g of hydrogen reacts with 71 g of chlorine to make 73 g of hydrogen chloride. A_r H = 1. A_r Cl = 35.5.

hydrogen		chlorine		hydrogen chloride
$1\,H_2$	+	$1\,Cl_2$	$\longrightarrow$	$2\,HCl$

$$\text{Number of moles} = \frac{73 \text{ g}}{36.5}$$

$$\text{Number of moles} = 2$$





1. Find out the relative formula masses of each compound
2. Find the number of moles of a compound/element by doing:

   Moles = Mass / Relative formula mass

3. Find out the number of moles for all compounds
4. Divide the number of moles by the smallest number of moles to get the smallest ratio
5. Write the number in front of the compounds but don't write the one

<u>Avogadro's constant:</u>

Calculate the number of moles of atoms in one mole of water molecules.

H_2O

1 molecule of water contains 3 atoms.

1 mole of water molecules contains 3 moles of atoms.

Calculate the number of moles of atoms in one mole of calcium hydroxide.

$Ca(OH)_2$

1 molecule of calcium hydroxide contains 5 atoms.

1 mole of calcium hydroxide molecules contains 5 moles of atoms.

Calculate the number of atoms in one mole of hydrogen chloride.

HCl

6.02×10^{23} molecules of hydrogen chloride

$2 \times 6.02 \times 10^{23}$ atoms

1.204×10^{24} atoms

Calculate the number of atoms in 48g of magnesium. A_r Mg = 24

$$\text{Number of moles} = \frac{\text{Mass (g)}}{\text{Relative atomic mass } A_r}$$

$$\text{Number of moles} = \frac{48}{24}$$

$$\text{Number of moles} = 2 \text{ moles}$$

Calculate the number of atoms in 48g of magnesium. A_r Mg = 24

Number of moles = 2 moles

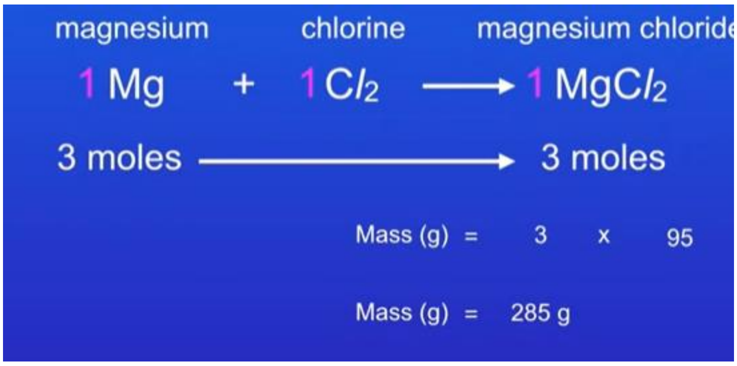
Number of atoms = $2 \times 6.02 \times 10^{23}$

Number of atoms = 1.204×10^{24}

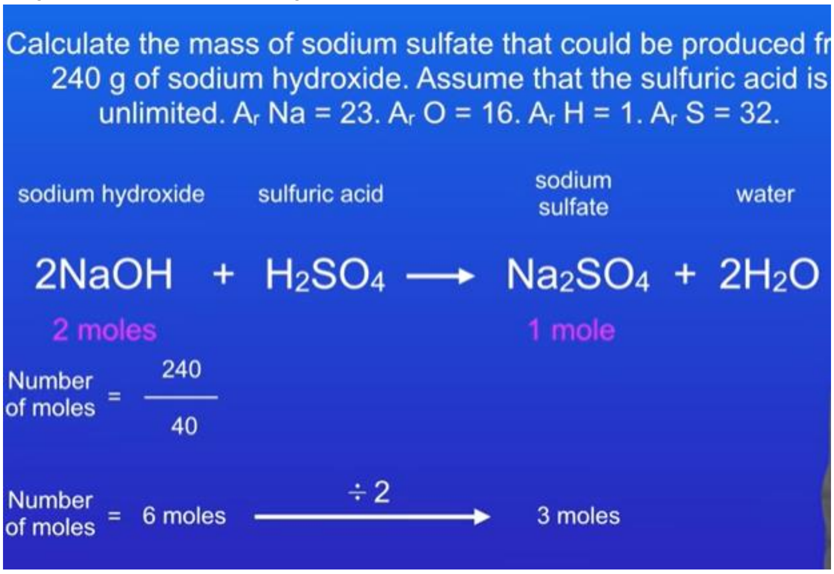
Reacting masses:

Calculate the mass of magnesium chloride that could be produced from 72g of magnesium. Assume that the chlorine is unlimited. A_r Mg = 24. A_r Cl = 35.5

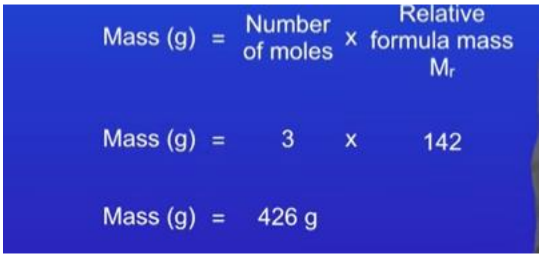
magnesium		chlorine		magnesium chloride
1 Mg	+	1 Cl_2	$\longrightarrow$	1 $MgCl_2$
1 mole				1 mole



1. Find out how many moles there are of the compound by seeing if there is a large number at the front of the compound (if there is no number then it is 1 mole)
2. Use the equation moles = mass / relative formula mass and then either multiply or divide by how many moles is needed



3. Find the mass by doing mass = moles x relative formula mass

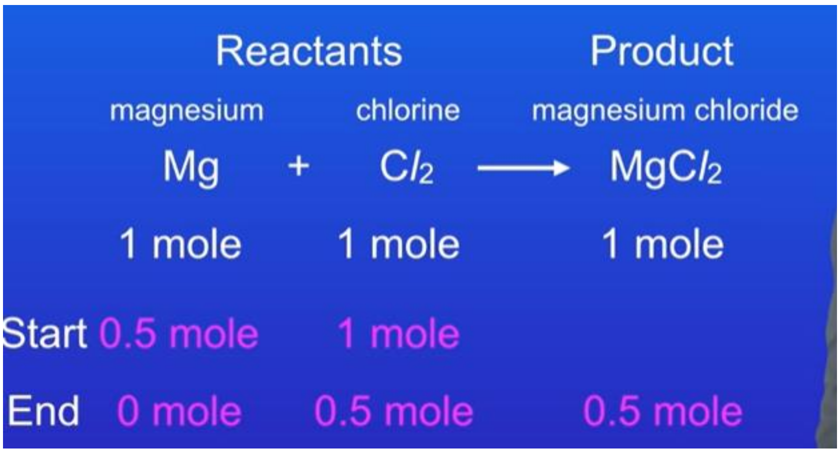


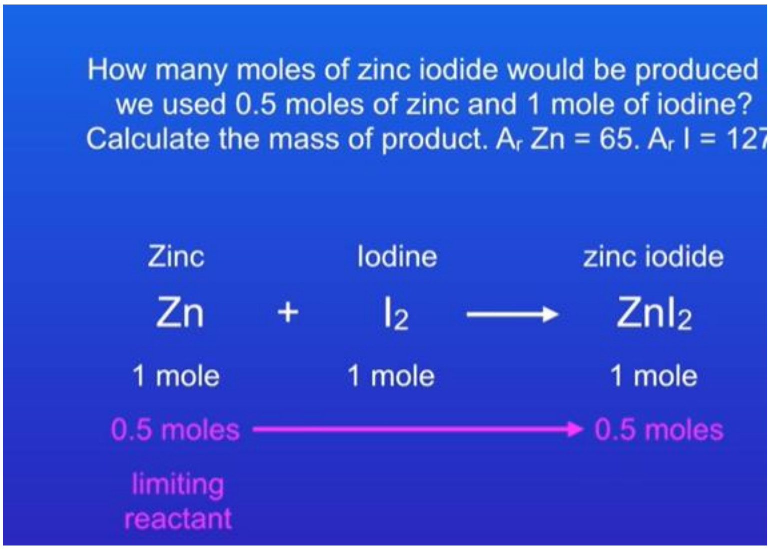
Note: If an element is unlimited, we don't count it in the calculations

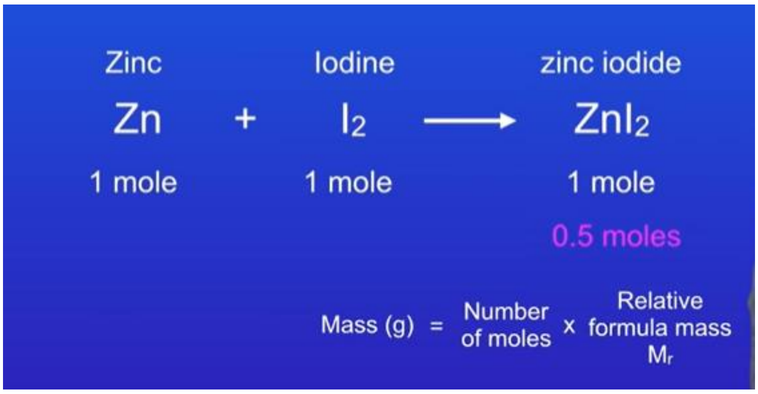
Limiting reactant:

The reactant that is fully used up is the limiting reactant

The reactant that is not fully used up is the excess reactant



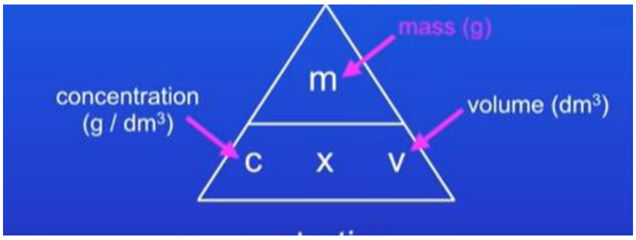




<u>**Concentration of solutions:**</u>

Concentration tells us the mass of a solute in a volume (g/dm^3)

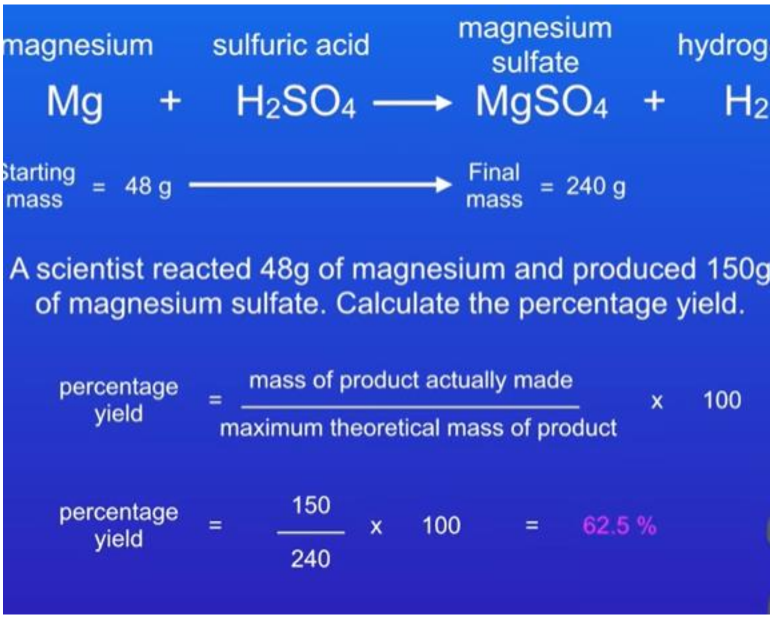
$$\text{concentration } (g / dm^3) = \frac{\text{mass (g)}}{\text{volume } (dm^3)}$$



Calculating percentage yield:

It is not possible to always achieve a 100% yield because:

- The product may be lost when it is separated from the reaction mixture
- The reactants may react in a different way to the expected reaction so we don't get the product we expect
- Reversible reactions may not go to completion



Note: It is not possible to achieve greater than 100% yield

Atom economy:

Atom economy is a measure of the amount of starting materials that end up as the useful products. This is good because:

- We save money by minimising the production of unwanted products
- We also increase sustainability by not wasting resources

$$\text{Atom economy} = \frac{\text{relative formula mass of desired products (from equation)}}{\text{sum of relative formula masses of all reactants (from equation)}} \times 100$$

A_r C = 12, A_r H = 1, A_r O = 16

$$\underset{\text{glucose}}{C_6H_{12}O_6} \longrightarrow \underset{\text{ethanol}}{2C_2H_5OH} + \underset{\text{carbon dioxide}}{2CO_2}$$

$$\text{Atom economy} = \frac{92}{180} \times 100$$

Using concentration of solutions:

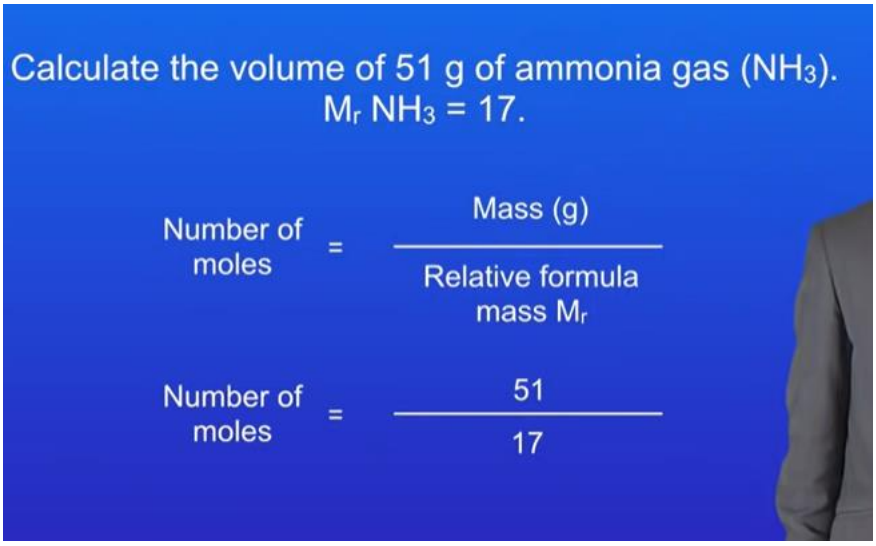
Concentration also tells us the number of moles of solute in a given volume of solution (mol/dm^3)

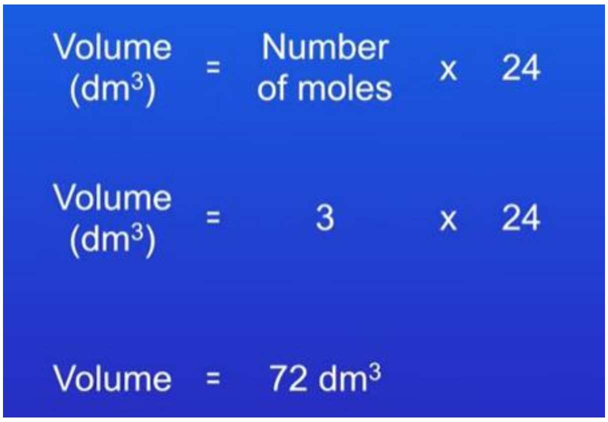
$$\text{concentration (mol / dm}^3\text{)} = \frac{\text{number of moles}}{\text{volume (dm}^3\text{)}}$$

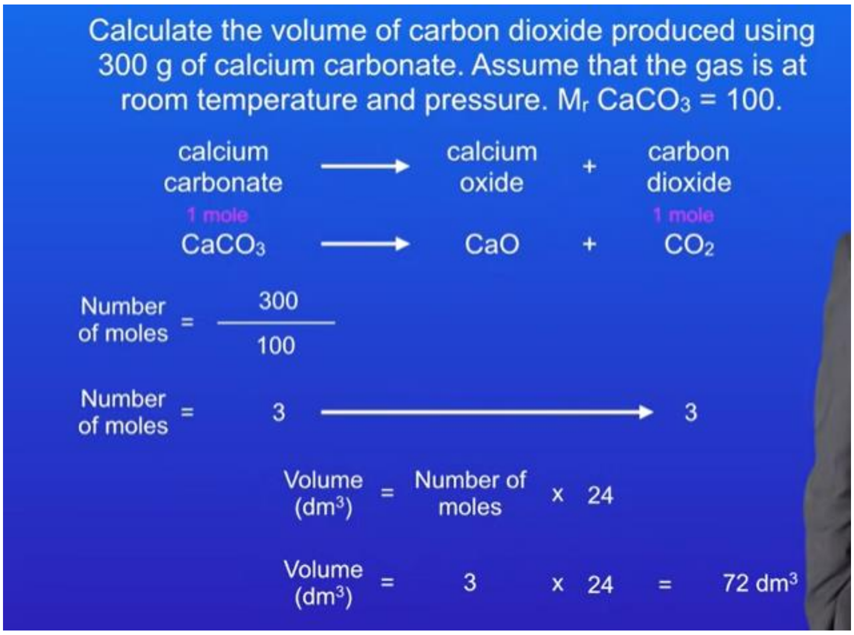
Using gas volumes:

1 mole of any gas takes up a volume of 24 dm^3 at room temperature and pressure

$$\text{Volume (dm}^3\text{)} = \text{Number of moles} \times 24$$




Volume (dm³) = Number of moles x 24
Volume (dm³) = 3 x 24
Volume = 72 dm³


Calculate the volume of carbon dioxide produced using 300 g of calcium carbonate. Assume that the gas is at room temperature and pressure. Mr CaCO3 = 100.
calcium carbonate → calcium oxide + carbon dioxide
1 mole
1 mole
CaCO3 → CaO + CO2
Number of moles = 300 / 100
Number of moles = 3 → 3
Volume (dm³) = Number of moles x 24
Volume (dm³) = 3 x 24 = 72 dm³