## Moles of gas

One mole of any gas has approximately the same volume as any other gas at a particular temperature and pressure. (This is **Avogadro's Law**).

Example: $2\ C_4H_{10} + 13\ O_2 \rightarrow 8\ CO_2 + 10\ H_2O$

*What volume of oxygen is needed to react with 15 cm$^3$ of butane under room conditions?*

*From the equation, 1 mole of butane reacts with 6.5 moles of oxygen.*

*Therefore, 1 volume of butane needs 6.5 volumes oxygen.*

*Therefore, 15 cm$^3$ of butane needs $15 \times 6.5 = 97.5$ cm$^3$ oxygen.*

At room temperature and 1Atm this is 24dm$^3$ (24000cm$^3$). (At 0$^o$C and 1Atm this is 22.4dm$^3$).

So the number of moles of a gas at room temperature can be found from the formula.

$$\boxed{\text{Moles} = \frac{\text{Volume (in dm}^3)}{24}}$$

Example. *Calculate the moles of carbon dioxide in 480cm$^3$ of the gas.*

*Moles = 480 / 24,000 = 0.002*



## Moles in solution

The concentration of solutions is also expressed in terms of moles.

$$\boxed{\text{Concentration} = \frac{\text{Moles}}{\text{Volume (in dm}^3)}}$$

The concentration of a solution can be stated as the mass of solute per cubic decimeter of solution (g/dm$^3$) or the amount in moles of a solute present in 1dm$^3$ of solution (mol/dm$^3$).

To make a solution of 1mol dm$^{-3}$ concentration, 1mol of substance is dissolved and the solution made up to a total volume of 1dm$^3$.

Examples

*1. Calculate the concentration of a solution containing 2.4g $MgSO_4$ in 500cm$^3$ of solution.*

*Moles = 2.4 / 120 = 0.02mol*
*Concentration = 0.02mol / 0.5dm$^3$ = 0.04moldm$^{-3}$*

*2. Calculate the mass of NaOH required to make 100cm$^3$ of a 0.2 mol dm$^{-3}$ solution.*

*Moles = Concentration x Volume (dm$^3$)*
*= 0.2 x 0.1 = 0.02mol*

*Mass = Moles x Formula mass*
*= 0.02 x 40 = 0.8g*