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.

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

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.

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

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