2 Atoms, molecules and moles – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary

Write each word three times.

English	**Write it 3 times** (English)		
stoichiometry			
limiting reagent			
excess			
concentration			
solute			
titration			

Recall

From Part 1 you can use $n = m/M$. Here we use the mole to work out **reacting masses**, gas volumes and solution concentrations.

- A balanced equation gives the **mole ratio** of the reactants and products.
- At IGCSE you did titrations – now we calculate the concentration.

New ideas

Read these first, then do the Practice.

■ 1 Reacting masses

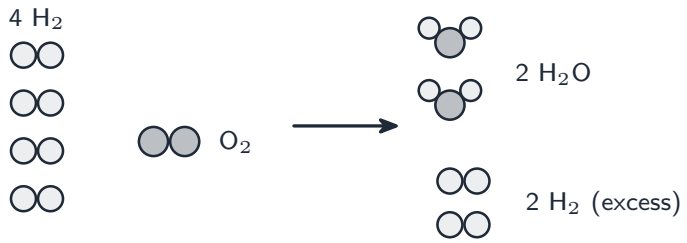
The numbers in a balanced equation give the **stoichiometry** (the mole ratio). To find a reacting mass: mass → moles → (use the ratio) → moles → mass.

Worked example. Mass of MgO from 4.8 g of Mg in $2Mg + O_2 \rightarrow 2MgO$ (A_r: Mg

= 24, O = 16): moles Mg = 4.8/24 = 0.20; ratio Mg : MgO = 1 : 1, so 0.20 mol MgO; mass = 0.20 × 40 = 8.0 g.

2 Limiting reagent

When two reactants are mixed, one runs out first – the **limiting reagent** .
It decides how much product forms. The other is in **excess** .



3 Gas volumes

At **room temperature and pressure** (r.t.p.), one mole of any gas takes up 24.0 dm^3:

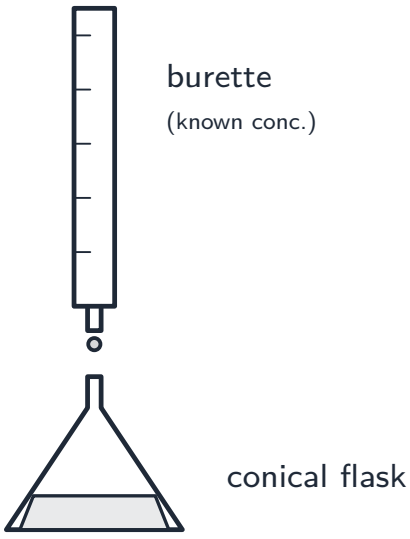
$$n = \frac{V}{24.0} \qquad (V \text{ in } dm^3)$$

4 Solution concentrations and titration

The **concentration** (c, in mol dm^{-3}) is the amount of **solute** per dm^3:

$$n = c \times V \qquad (V \text{ in } dm^3,\ 1000\ cm^3 = 1\ dm^3)$$

A **titration** finds an unknown concentration by reacting it with a solution of known concentration.



> **Watch out:** in $n = cV$ the volume must be in dm^3 – divide a cm^3 value by 1000 first (so 25.0 $\text{cm}^3 = 0.0250$ dm^3).

Practice

Try these in order. Use A_r: H = 1, C = 12, O = 16, Ca = 40.

2.1 State the volume of one mole of any gas at r.t.p. [1]

2.2 What volume does 0.25 mol of carbon dioxide occupy at r.t.p.? [2]

2.3 In $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$, what mass of CO_2 forms from 6.0 g of carbon? [3]

2.4 What is meant by the *limiting reagent*? [1]

2.5 How many moles of solute are in 25.0 cm^3 of a 0.200 mol dm^{-3} solution? [2]

2.6 In a titration, 20.0 cm^3 of NaOH is neutralised by 25.0 cm^3 of 0.100 mol dm^{-3} HCl (1 : 1). Find the concentration of the NaOH. [3]

2.7 Challenge. 4.0 g of hydrogen (H_2, $M = 2$) reacts with 16 g of oxygen (O_2, $M = 32$) in $2H_2 + O_2 \rightarrow 2H_2O$. Show by calculation which reactant is the limiting reagent. [3]