

2 Atoms, molecules and moles – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
stoichiometry	化学计量	_____
limiting reagent	限量试剂	_____
excess	过量	_____
concentration	浓度	_____
solute	溶质	_____
titration	滴定	_____

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

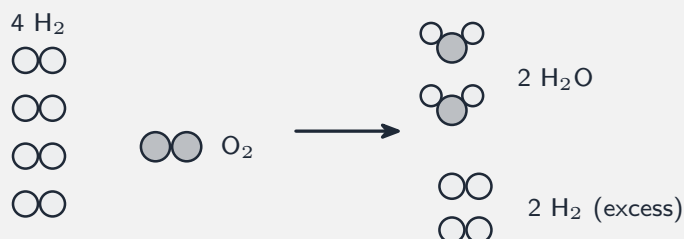
The numbers in a balanced equation give the **stoichiometry** 化学计量 (the mole ratio). To find a reacting mass: mass $\rightarrow$ moles $\rightarrow$ (use the ratio) $\rightarrow$ moles $\rightarrow$ mass.

Worked example. Mass of MgO from 4.8 g of Mg in $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ (A_r : Mg = 24, O = 16): moles Mg = $4.8/24 = 0.20$; ratio Mg : MgO = 1 : 1, so 0.20 mol

MgO; mass = $0.20 \times 40 = 8.0$ g.

■ 2 Limiting reagent

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



■ 3 Gas volumes

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

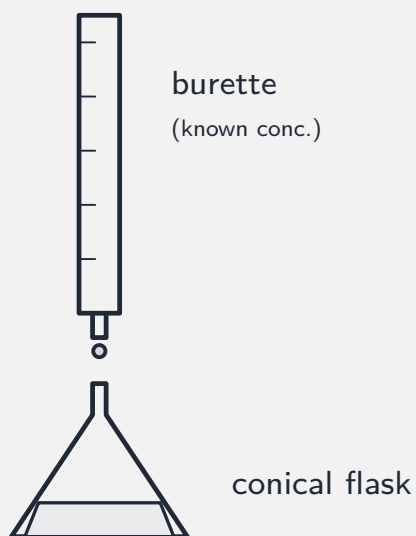
$$n = \frac{V}{24.0} \quad (V \text{ in } \text{dm}^3)$$

■ 4 Solution concentrations and titration

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

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

A **titration** 滴定 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 $25.0 \text{ cm}^3 = 0.0250 \text{ dm}^3$).

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 cm³ of a 0.200 mol dm⁻³ solution? [2]

2.6 In a titration, 20.0 cm³ of NaOH is neutralised by 25.0 cm³ of 0.100 mol dm⁻³ HCl (1 : 1). Find the concentration of the NaOH. [3]

2.7 Challenge. 4.0 g of hydrogen (H₂, $M = 2$) reacts with 16 g of oxygen (O₂, $M = 32$) in $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$. Show by calculation which reactant is the limiting reagent. [3]