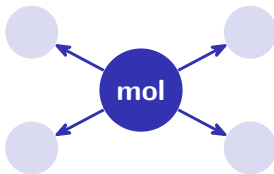


Stoichiometry

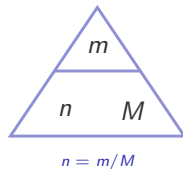
IGCSE Chemistry ■ Topic 3

IGCSE Chemistry



What we will cover

- 1 Formulae & equations
- 2 The mole & molar mass
- 3 Gas volumes & concentration
- 4 Reaction calculations
- 5 Limiting reactant & titration
- 6 Empirical formulae & percentages



the mole and molar mass

Chemical formulae

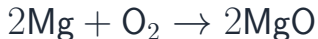
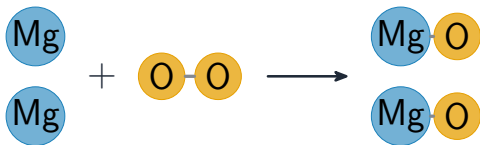


the charge numbers cross over
to become the subscripts (then
simplify if they share a factor)



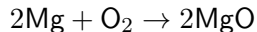
Mass is measured carefully in the lab

Writing and balancing equations



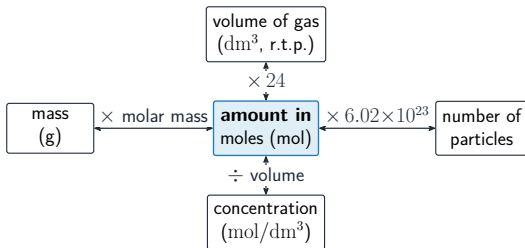
2 Mg and 2 O on each side: balanced

A **balanced** 配平 symbol equation has the **same** number of each atom on both sides.



State symbols 状态符号:
(s) (l) (g) (aq).

The mole and molar mass



One **mole** 摩尔 = 6.02×10^{23} particles
(the **Avogadro constant** 阿伏伽德罗常数).

$$n = \frac{\text{mass}}{\text{molar mass}}$$

Example

36 g of water: $n = \frac{36}{18} = 2 \text{ mol.}$

Gas volumes and concentration

At r.t.p. one mole of **any** gas fills 24 dm^3 .

$$V = n \times 24$$

Example

0.25 mol CO_2 : $V = 0.25 \times 24 = 6 \text{ dm}^3$.

$$\text{conc (mol/dm}^3\text{)} = \frac{n}{V(\text{dm}^3)}$$

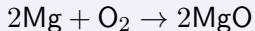
Convert volume first: $1 \text{ dm}^3 = 1000 \text{ cm}^3$.

Reaction calculations

Three steps:

- 1 known mass $\rightarrow$ moles
- 2 use the equation **ratio**
- 3 moles $\rightarrow$ mass / volume

12 g Mg burns: mass of MgO?

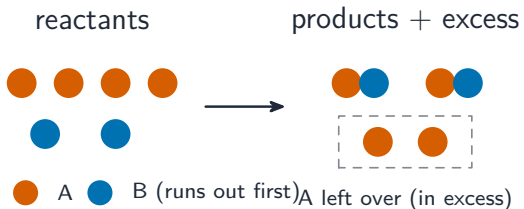


$$\text{moles Mg} = 12/24 = 0.5$$

$$\text{ratio } 1:1 \Rightarrow 0.5 \text{ mol MgO}$$

$$\text{mass} = 0.5 \times 40 = \mathbf{20 \text{ g}}$$

Limiting reactant



The **limiting reactant** 限量反应物 runs out first and **decides** how much product forms. The other reactant is left over **in excess** 过量.

Titration



**25.0 cm^3 NaOH neutralised by
 20.0 cm^3 of 0.10 HCl**

$$\text{moles HCl} = 0.10 \times \frac{20.0}{1000} = 0.0020$$

ratio 1:1 $\Rightarrow$ 0.0020 mol NaOH

$$\text{conc} = \frac{0.0020}{25.0/1000} = \mathbf{0.08 \text{ mol/dm}^3}$$

Empirical formula and percentages

40% Ca, 12% C, 48% O

$\div A_r$: 1, 1, 3

ratio 1:1:3 $\Rightarrow$ **CaCO₃**

$$\% \text{ by mass} = \frac{\text{mass of element}}{M_r} \times 100$$

% N in NH₄NO₃

$$\frac{28}{80} \times 100 = \mathbf{35\%}$$

Topic 3 – key takeaways

1 Mole

$$n = \text{mass} / \text{molar mass}; 6.02 \times 10^{23}$$

2 Gas & conc

$$24 \text{ dm}^3 \text{ per mole}; \text{conc} = n/V$$

3 Calculations

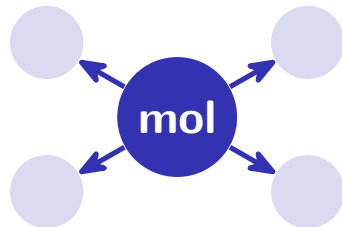
to moles, use the ratio, back again

4 Limiting

the reactant that runs out sets the yield

Check yourself

- 1 How many moles are in 18 g of water?
- 2 What volume does 1 mol of gas fill at r.t.p.?
- 3 What is a spectator ion?
- 4 How do you find an empirical formula from masses?



Answers 1. 1 mol 2. 24 dm^3 3. an ion unchanged on both sides 4. divide each mass by A_r , then by the smallest