A-LEVEL CHEMISTRY • EXERCISE SHEET

2.2 The mole and the Avogadro constant

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

KEY WORDS mole 摩尔 • avogadro constant 阿伏伽德罗常量 • solution 溶液 • molar mass 摩尔质量 • atom 原子

Objective

Build the skills to answer exam questions on **the mole and the Avogadro constant** — the **mole** 摩尔, the **Avogadro constant** 阿伏伽德罗常量, and the equation $n = m/M$.

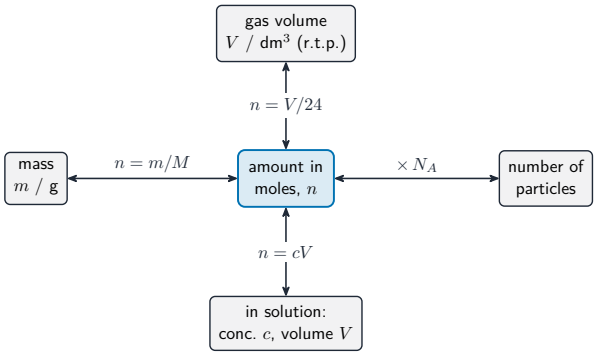
You must be able to:

- define the mole in terms of the Avogadro constant
- convert between mass, moles and number of particles

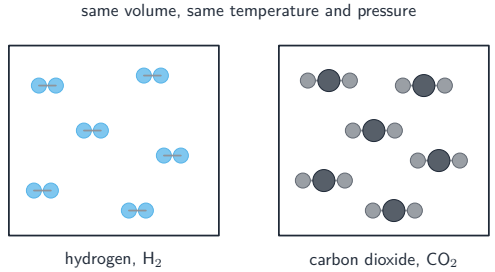
1 Worked examples

■ The mole

One **mole** is the amount of substance containing $N_A = 6.02 \times 10^{23}$ particles (the **Avogadro constant**). The particles may be atoms, molecules or ions — always say which.



The mole is the hub: convert to mass ($n = m/M$), particles ($\times N_A$), gas volume ($n = V/24$) or solution ($n = cV$)



Equal volumes of gas contain equal numbers of molecules

The mass of one mole equals the relative mass — the **molar mass** M (g mol^{-1}):

$$n = \frac{m}{M}$$

Example. Moles in 8.0 g of CH_4 ($M = 16$): $n = 8.0/16 = 0.50$ mol.

2 Practice

2.1 State the value of the Avogadro constant and what it counts. [2]

2.2 Calculate the number of moles in 36 g of water, H_2O ($M = 18$). [1]

3 Exam-style questions

3.1 How many molecules are in 2.0 mol of carbon dioxide? [1]

- **A** 3.0×10^{23}
- **B** 6.02×10^{23}
- **C** 1.2×10^{24}
- **D** 2.0×10^{23}

3.2 The mass of 0.25 mol of a compound is 22 g. Its molar mass is: [1]

- **A** 5.5 g mol^{-1}
- **B** 44 g mol^{-1}
- **C** 88 g mol^{-1}
- **D** 5.5 $\times$ 10^{23} g mol^{-1}

3.3 Calculate the number of moles in 5.85 g of sodium chloride, NaCl ($M = 58.5$). [2]

3.4 Calculate the number of chloride ions in 5.85 g of NaCl ($N_A = 6.02 \times 10^{23}$). [2]

Solutions

2.1 6.02×10^{23} mol^{-1}; the number of particles (atoms/molecules/ions) in one mole.

2.2 $n = 36/18 = 2.0$ mol.

3.1 C. $2.0 \times 6.02 \times 10^{23} = 1.2 \times 10^{24}$.

3.2 C. $M = m/n = 22/0.25 = 88$ g mol^{-1}.

3.3 $n = m/M = 5.85/58.5 = 0.100$ mol.

3.4 moles of NaCl = 0.100, so moles of Cl^- = 0.100; number = $0.100 \times 6.02 \times 10^{23} = 6.02 \times 10^{22}$.