

# 1.1 Moles and Molar Mass

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 16 marks

**KEY WORDS** mole 摩尔 • molar mass 摩尔质量 • avogadro's number 阿伏伽德罗常数

## Objective

Build the skills to answer exam questions on **moles and molar mass**.

**You must be able to:**

- use the **mole** 摩尔 as a fixed count,  $6.022 \times 10^{23}$  particles (**Avogadro's number** 阿伏伽德罗常数)
- use the **molar mass** 摩尔质量 (g/mol) to convert between grams and moles
- convert with  $n = \frac{m}{M}$ , and moles to particles by multiplying by Avogadro's number
- find the molar mass of a compound by adding atomic masses

## 1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

### ■ Moles from mass

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

36 g of water ( $M = 18$  g/mol) is  $n = 36/18 = 2$  mol.

### ■ Molar mass of a compound

Add the atomic masses. For  $\text{H}_2\text{O}$ :  $2(1) + 16 = 18$  g/mol. For  $\text{CO}_2$ :  $12 + 2(16) = 44$  g/mol.

### ■ Moles to particles

Multiply by Avogadro's number: 2 mol is  $2 \times 6.022 \times 10^{23} \approx 1.2 \times 10^{24}$  molecules.

## 2 Practice

Now apply the methods above.

**2.1** How many moles are in 44 g of  $\text{CO}_2$  ( $M = 44$  g/mol)? [2]

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**2.2** Find the molar mass of water,  $\text{H}_2\text{O}$  ( $\text{H} = 1$ ,  $\text{O} = 16$ ). [2]

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**2.3** Find the mass of 3 mol of carbon atoms ( $M = 12 \text{ g/mol}$ ). [2]

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**2.4** State the number of particles in one mole. [1]

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### 3 Exam-style questions

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**3.1** One mole of any substance contains [1]

- A 1000 particles
  - B  $6.022 \times 10^{23}$  particles
  - C  $6.022 \times 10^{-23}$  particles
  - D 12 particles
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**3.2** The molar mass of  $\text{CO}_2$  ( $\text{C} = 12$ ,  $\text{O} = 16$ ) is [1]

- A 28 g/mol
  - B 44 g/mol
  - C 12 g/mol
  - D 60 g/mol
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**3.3** A sample contains 88 g of  $\text{CO}_2$  ( $M = 44 \text{ g/mol}$ ).

(a) Find the number of moles. [2]

- (b) Find the number of molecules (use  $6.022 \times 10^{23}$ ). [2]

**3.4** A student needs 0.5 mol of NaCl ( $M = 58.5$  g/mol).

- (a) Find the mass required. [2]  
(b) State the units of molar mass. [1]

## Solutions

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**2.1**  $n = m/M = 44/44 = 1 \text{ mol.}$

**2.2**  $2(1) + 16 = 18 \text{ g/mol.}$

**2.3**  $m = nM = 3 \times 12 = 36 \text{ g.}$

**2.4**  $6.022 \times 10^{23}.$

**3.1 B** — a mole is Avogadro's number of particles.

**3.2 B** —  $12 + 2(16) = 44 \text{ g/mol.}$

**3.3** (a)  $n = 88/44 = 2 \text{ mol.}$  (b)  $2 \times 6.022 \times 10^{23} = 1.2 \times 10^{24} \text{ molecules.}$

**3.4** (a)  $m = nM = 0.5 \times 58.5 = 29.25 \text{ g.}$  (b) g/mol (grams per mole).