A-LEVEL PHYSICS • EXERCISE SHEET

15.1 The mole

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

Objective

Build the skills to answer exam questions on **the mole** and the Avogadro constant.

You must be able to:

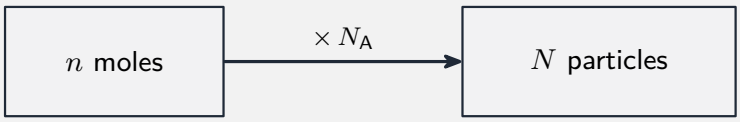
- use the **mole** as the SI unit of amount of substance
- use $N = nN_{\mathrm{A}}$ and find masses of moles and single particles

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.

The mole

Amount of substance is an SI base quantity; its unit is the **mole** (mol). One mole contains N_{A} particles:



$$N = nN_{\mathsf{A}}, \quad N_{\mathsf{A}} = 6.02 \times 10^{23}\ \mathsf{mol}^{-1}$$

$$N = nN_{\mathrm{A}}, \qquad N_{\mathrm{A}} = 6.02 \times 10^{23}\ \mathrm{mol}^{-1}.$$

The **molar mass** M_{m} is the mass of one mole; one particle has mass $m_0 = M_{\mathrm{m}}/N_{\mathrm{A}}$. Always say **what** you are counting (atoms or molecules).

2 Practice

Now apply the methods above.

2.1 State the SI **unit** of amount of substance. [1]

2.2 State the value of the **Avogadro constant**. [1]

2.3 How many molecules are there in 2.0 mol of a gas? [2]

3 Exam-style questions

3.1 One mole of oxygen gas (O_2) contains: [1]

- **A** 6.02×10^{23} atoms
- **B** 6.02×10^{23} molecules
- **C** 32 molecules
- **D** 16 molecules

3.2 A gas sample contains 3.0×10^{24} molecules. Find the number of **moles**. [2]

3.3 The molar mass of water is 18 g mol^{-1}. Calculate the mass of **one** water molecule. [2]

4 Go further

You are now ready for the real exam questions on this subtopic. Open the **15.1 The mole** past-paper sheet in the Library, or try this in **Practice mode**:

- 9702/42 M25 —Q3 (the mole and molecular quantities)

The mole also underpins almost every **15.2 Equation of state** and **15.3 Kinetic theory** question, so practise those sheets too.

Solutions

2.1 The **mole** (mol).

2.2 $N_\mathrm{A} = 6.02 \times 10^{23}\ \mathrm{mol}^{-1}$.

2.3 $N = nN_\mathrm{A} = 2.0 \times 6.02 \times 10^{23} = 1.2 \times 10^{24}$.

3.1 B —6.02×10^{23} molecules.

3.2 $n = N/N_\mathrm{A} = (3.0 \times 10^{24})/(6.02 \times 10^{23}) = 5.0$ mol.

3.3 $m_0 = M_\mathrm{m}/N_\mathrm{A} = (0.018)/(6.02 \times 10^{23}) = 3.0 \times 10^{-26}$ kg.