Cambridge (CIE) A Level Chemistry

Your notes

The Mole & the Avogadro Constant

Contents

Your notes

The Mole & the Avogadro Constant

- The **Avogadro constant** (N_A or L) is the number of particles equivalent to the relative **atomic mass** or **molecular mass** of a substance
  - The Avogadro constant applies to atoms, molecules, ions and electrons
- The value of N_A is **6.02×10^{23} g mol^{-1}**
- The mass of a substance with this number of particles is called a **mole** (mol)
  - The **mass** of a substance containing the same number of fundamental units as there are atoms in exactly 12.00 g of ^{12}C
- One mole of any element is equal to the relative atomic mass of that element in grams
  - One mole of carbon, that is if you had 6.02×10^{23} atoms of carbon in your hand, would have a mass of 12 g
  - One mole of water would have a mass of $(2 \times 1 + 16) = 18$ g

Worked Example

Determine the number of atoms, molecules and the relative mass of 1 mole of:

1. Na
2. H_2
3. NaCl

Answer 1

- The relative atomic mass of Na is 23.0
- Therefore, 1 mol of Na has a mass of 23.0 g mol^{-1}
- 1 mol of Na will contain 6.02×10^{23} atoms of Na (Avogadro's constant)

Answer 2

- The relative atomic mass of H is 1.0
- Since there are 2 H atoms in H_2, the mass of 1 mol of H_2 is $(2 \times 1.0) = 2.0$ g mol^{-1}
- 1 mol of H_2 will contain 6.02×10^{23} molecules of H_2
- Since there are 2 H atoms in H_2, 1 mol of H_2 will contain $2 \times 6.02 \times 10^{23} = 1.204 \times 10^{24}$ H atoms

Answer 3

- The relative atomic mass of Na and Cl is 23.0 and 35.5 respectively
- Therefore, 1 mol of NaCl has a mass of $(23.0 + 35.5) = 58.5$ g mol^{-1}
- 1 mol of NaCl will contain 6.02×10^{23} molecules of NaCl
- Since there is one Na and one Cl atom in NaCl, 1 mol of NaCl will contain $2 \times 6.02 \times 10^{23} = 1.204 \times 10^{24}$ atoms in total

1 mole of	Number of atoms	Number of molecules	Relative mass (g mol^{-1})

Na	6.02×10^{23}	-	23.0
H_2	1.204×10^{24}	6.02×10^{23}	2.0
NaCl	1.204×10^{24}	6.02×10^{23}	58.5

Your notes