Class 9 Science – Chapter 3: Atoms and Molecules

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1. Laws of Chemical Combination

Before understanding atoms and molecules, scientists studied how elements combine.

(A) Law of Conservation of Mass

Statement:
Mass can neither be created nor destroyed in a chemical reaction.

Example:
If 12 g carbon reacts with 32 g oxygen,
CO_2 formed = **44 g** (total mass same)

(B) Law of Constant Proportions

Statement:
A chemical compound always contains the same elements combined in a fixed ratio by mass.

Example:
Water (H_2O) always has hydrogen and oxygen in the mass ratio **1 : 8**

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2. What is an Atom?

An **atom** is the smallest particle of an element that takes part in a chemical reaction.

- Atoms are extremely small
- Cannot be seen with naked eye
- Symbol represents an atom

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3. Symbols of Elements

Symbols are one or two-letter representations.

Element	Symbol
Hydrogen	H
Oxygen	O
Nitrogen	N
Sodium	Na
Potassium	K

Element	Symbol
Iron	Fe

4. Atomic Mass

Atomic mass = relative mass of an atom compared to 1/12th mass of carbon-12.

Example:
H = 1 u
O = 16 u
C = 12 u

5. What is a Molecule?

A **molecule** is the smallest particle of a substance that can exist independently and shows properties of the substance.

Types of Molecules

(A) Molecules of Elements

Element	Molecule
Oxygen	O_2
Nitrogen	N_2
Hydrogen	H_2

(B) Molecules of Compounds

Compound	Formula
Water	H_2O
Carbon dioxide	CO_2
Ammonia	NH_3

6. Atomicity

Number of atoms in one molecule.

Type	Example
Monoatomic	He
Diatomic	O_2
Triatomic	O_3
Polyatomic	P_4, S_8

7. Ions

Charged particles formed by loss or gain of electrons.

Type	Meaning	Example
Cation	Positive ion	Na^+
Anion	Negative ion	Cl^-

8. Writing Chemical Formulae

Valency

Valency = combining capacity of an element.

Element	Valency
H	1
O	2
N	3
C	4

Rules for Writing Formula

1. Write symbols
2. Write valencies
3. Cross the valencies
4. Simplify ratio

Example: Calcium chloride
Ca (2), Cl (1) → $CaCl_2$

9. Molecular Mass

Sum of atomic masses.

Example: H_2O
= 2×1 + 16 = **18 u**

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10. Mole Concept

A **mole** = 6.022 × 10²³ particles (Avogadro number)

- 1 mole of atoms = atomic mass in grams
- 1 mole of molecules = molecular mass in grams

Example:
1 mole O_2 = 32 g

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11. Molar Mass

Mass of 1 mole of a substance.

CO_2 = 44 g/mol

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12. Numerical Relations

$$\text{No. of moles} = \frac{\text{Given mass}}{\text{Molar mass}}$$
$$\text{No. of particles} = \text{moles} \times 6.022 \times 10^{23}$$

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13. Key Differences

Atom	Molecule
Smallest part of element	Smallest part of substance
Cannot exist independently (usually)	Can exist independently

Chapter Summary

- Matter is made of **atoms**
- Atoms combine to form **molecules**
- Chemical reactions follow **laws of combination**
- **Valency** helps in writing formulae

- **Mole concept** connects mass with particles