



স্বাধীনতা আন্দোলন (সংগ)

DEPARTMENT OF EDUCATION (S)

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CHAPTER 3

ATOMS AND MOLECULES

NOTES

Atom - It is defined as **the smallest particle of an element** which can take part in a chemical reaction.

Law of Chemical Combination

1. **Law of Conservation of Mass**
2. **Law of Constant Proportion**

Law of Conservation of Mass (Antoine L. Lavoisier, 1774)

This law states that mass can neither be created nor destroyed in a chemical reaction.

Law of Constant Proportion (Proust, 1799)

This law states that a pure compound always contains the same elements combined in the same proportions by mass e.g. hydrogen and oxygen combined together in the same proportion of 1:8 by mass.

Dalton's Atomic Theory (1808)

- Matter is made up of indivisible particles known as atoms.
- Atoms are neither created nor destroyed.
- Atoms of one element are all identical. They have the same mass and the same properties.
- Atoms of different elements combine in fixed ratios to form compounds.
- When elements combine to form compounds, the atoms of these elements unite in simple whole number ratios to form compound atoms.
- The relative number and kinds of atoms are constant in a given compound.

Molecule

- It is the smallest particle of an element- or a compound which can exist independently and shows all the properties of that substance.
- Molecule of an element is composed of same type of atoms.
- Molecules may be monoatomic, di-atomic or polyatomic.
- Molecules of compounds join together in definite proportions and constitutes different type of atoms



Atomicity - It is defined as **the number of atoms present in one molecule of the element or compound.**

Table 1 - Atomicity of some common elements

Types of elements	Element	Atomicity
Non-metal	Helium	1 (monoatomic)
	Neon	1 (monoatomic)
	Argon	1 (monoatomic)
	Hydrogen	2 (diatomic)
	Oxygen	2 (diatomic)
	Nitrogen	2 (diatomic)
	Chlorine	2 (diatomic)
	Ozone	3 (triatomic)
	Phosphorus	4 (tetra-atomic)
Metals	Iron	1 (monoatomic)
	Copper	1 (monoatomic)
	Silver	1 (monoatomic)

Atomic radii: It's a size of an element i.e. distance from the nucleus to the outermost shell of an atom. It is measured in nanometres (nm).

$$1\text{nm} = \frac{1}{10^9} \text{ meter}$$

Table 2 – Atomic radii of some common elements

Element	Atomic radius
Hydrogen	0.037nm
Carbon	0.077nm
Oxygen	0.073nm
Sulphur	0.104nm
Nitrogen	0.074nm

Atomic Mass

It is the average relative mass of an atom of an element as compared to the mass of an atom of carbon (C-12 isotope) taken as 12(u)

$$\text{Atomic mass} = \frac{\text{Mass of an atom of an element}}{1/12 \text{ of the mass of an atom of C} - 12}$$



Atomic Mass Unit (amu)

The atomic mass unit has been defined as $1/12$ (one twelfth) the mass of carbon-12 atom taken as 1 u.

Nowadays, the atomic mass unit which was abbreviated as **amu**, is written as “**u**” (**unified mass**), according to the **IUPAC**(**International union of Pure and Applied Chemistry**).

Thus, $1u=1/12$ the mass of carbon-12

Table 3 – atomic masses of some common elements

Element	Atomic mass(u)
Hydrogen	1
Carbon	12
Oxygen	16
Nitrogen	14
Chlorine	35.5

Gram Atomic Mass: The atomic mass of an element expressed in grams is known as gram atomic mass.

For example:

The atomic mass of oxygen (O) = 16u

Therefore, gram atomic mass of oxygen (O) = 16g

