

ATOMS AND MOLECULES [Class 9th]

Atoms

- ⇒ Atoms are the building blocks of all matter.
- ⇒ Atoms are very small and which can't be seen even through very powerful microscopes.
- ⇒ Radius of atom = 1 nanometer = $10^{-9}m$

→ Lavoisier and Joseph L. Proust

Laws of Chemical Combination

↓
Law of Conservation of mass

↓
Law of constant proportions

Law of Conservation of mass:

⇒ During a chemical ~~conservation~~ reaction, the total mass of reactants will be equal to the mass of product.

OR

Mass can ~~neig~~ neither be created nor destroyed.

Law of Constant Proportions:-

⇒ The elements in a pure chemical compound are always present in the same proportions by mass, regardless of how the compound is created.

→ It was given by Joseph Proust.

Example:-

(i) 18 gm of $H_2O = 2$ gm of hydrogen + 16 gm of oxygen
 \Rightarrow mass of hydrogen : mass of oxygen = 2 : 16 = 1 : 8.

(ii) 36 gm of $H_2O = 4$ gm of hydrogen + 32 gm of oxygen
 \Rightarrow mass of hydrogen : mass of oxygen = 4 : 32 = 1 : 8

\therefore The ratio of mass of hydrogen to oxygen is same.

Dalton's Atomic Theory:-

- Matter is made up of very tiny particles called atoms.
- Atoms are indivisible particles, which cannot be created or destroyed in a chemical reaction.
- Atoms of a given element are identical in mass and chemical properties.
- Atoms of different elements have different masses and chemical properties.
- Atoms combine in ratio of small whole number to form compounds.
- The relative number & kinds of atoms are constant in a given compound.

Drawbacks of Dalton's Atomic Theory:-

- ⇒ No subatomic particles:- Dalton's theory said atoms are indivisible, but we now know about electrons, protons, and neutrons.
- ⇒ Isotopes not defined:- ~~Dalton~~ Dalton stated all atoms of an element have the same mass, but isotopes of elements have different masses.
- ⇒ No Isobars:- Dalton said atoms of different elements have different masses, but isobars have same masses.

Modern Day Symbols of Elements:-

- ⇒ Dalton firstly used symbols of elements.
- ⇒ Berzelius: suggested using one or ~~more~~ two letters from the element's name for its symbol.
- ⇒ IUPAC: Now responsible for approving elements names, symbol, and units. Symbols typically use one or two letters from the element's English or latin or German name.

Atomic Mass

- ⇒ Dalton's Atomic Theory: Introduced the concept of atomic mass, explaining the law of constant proportions.

⇒ Atomic mass: Mass of an atom of an element.

⇒ IUPAC (1961): Adopted term "atomic mass unit (amu)" to express atomic and molecular masses.

⇒ 1 atomic mass unit (amu) = $\frac{1}{12}$ of the mass of a carbon-12 atom.

Atoms Existence

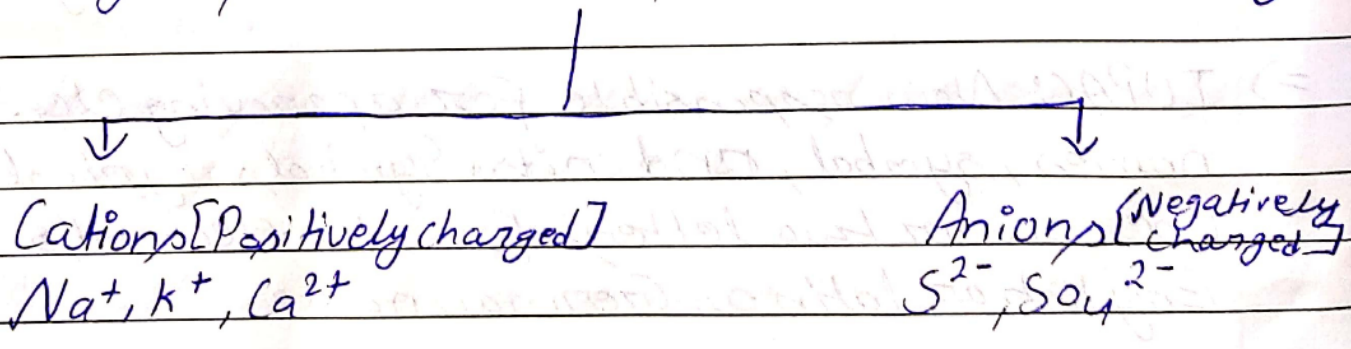
⇒ most elements' atoms are highly reactive.

⇒ Only noble gas atoms (He, Ne, Ar, Kr, Xe, Rn) are chemically inert and can exist as single atoms.

⇒ Atoms of all other elements combine to form molecules or ions.

Ions

⇒ Charged particles (either positively or negatively).



- Simple Ions: - Single elements. Ex: Mg^{2+} , Cl^-
- Compound Ions: - more than one element. Ex: NH_4^+ , OH^-

Molecule

⇒ A group of two or more atoms chemically bonded together by attractive forces.

↳ molecule of element

↳ When atoms of same element combine to form a molecule.

↳ Ex - O_2 , O_3 , H_2

↳ molecule of compound

↳ When atoms of different element combine to form a molecule.

↳ Ex - H_2O , NH_3

Atomicity

⇒ Atomicity refers to the number of atoms present in a single molecule of an element, substance or compound.

- Monoatomic - Consists of one atom. [Na, He, C, Al]
- Diatomic - Consists of two atoms. [H_2 , O_2 , F_2]
- Triatomic - Consists of three atoms. [O_3]
- Polyatomic - Consists of more than three atoms. [P_4 , S_8]
- Generally metals are monoatomic.

Molecular mass

⇒ Sum of all the atoms in a molecule of a substance.

Ex, $H_2O = 1 \times 2 + 16 = 2 + 16 = 18u$ [∴ mass of
H = $1u$, oxygen
= $16u$]

Formula Unit Mass

⇒ It is the sum of atomic mass of ions and atoms present in formula for a compound.

Example:- In NaCl,

$$\text{Na} = 23 \text{ a.m.u.}$$

$$\text{Cl} = 35.5 \text{ a.m.u.}$$

$$\therefore \text{Formula Unit mass} = 58.5 \text{ amu}$$

Why do Atoms Combine?

⇒ The atoms combine to attain noble or inert gas electronic configuration in order to be stable.

⇒ Valency:-

• Valency is the combining capacity of an element.

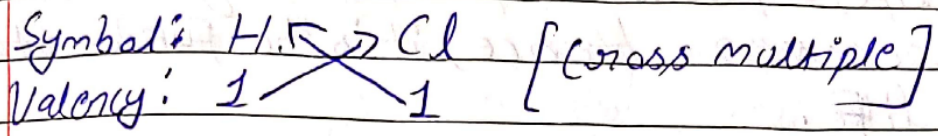
• Valency equals the number of electrons gained, lost, or shared to achieve noble gas state.

Chemical Formulae

⇒ It is the symbolic representation of the composition of a compound.

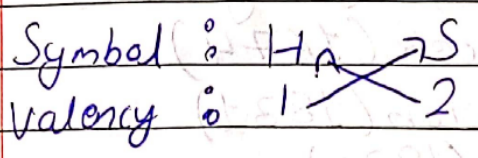
Example:-

① Formula of hydrogen chloride



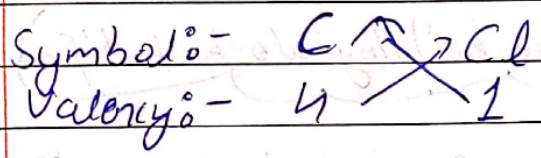
∴ Formula = HCl

② Formula of hydrogen Sulphide



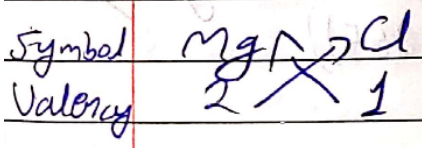
∴ Formula = H₂S

③ Formula of Carbon tetrachloride



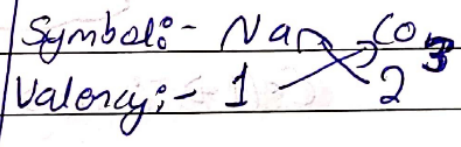
Formula: CCl₄

④ Magnesium chloride



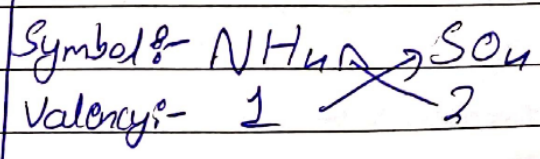
Formula: MgCl₂

⑤ Sodium carbonate



∴ Formula: Na₂CO₃

⑥ Ammonium Sulphate



∴ Formula: (NH₄)₂SO₄