

Definitions

- **Chemistry:** Study of matter
- **Organic Chemistry:** Study of compounds containing carbon. Chemical symbol of carbon is C
- **Chemical symbol:** Code for chemical element
- **Atom:** Is the smallest possible particle that defines a complete chemical element. Fundamental building blocks of chemistry.
 - o They are composed of neutrons, protons (+), and electrons (-)
- Every atom is composed of a **nucleus** (positively charged - composed of protons and neutrons) and one or more electrons bound to the nucleus
- **Molecules:** Discrete (bonded) arrangement of atoms. Bonds can be covalent or ionic.
 - o Changing the arrangement or connections changes the molecule and its physical properties (color, density, solubility, melting point, boiling point)
- **Compound:** Collection of molecules of the same type
 - o Water (H₂O), Cholesterol (27 carbons, white crystalline powder, average male contains 80 g)
- **Atomic Number:** Number of protons in the nucleus of an atom (Z)
- **Atomic Weight:** Mass of protons (p⁺) and neutron (N) (unit: amu)
 - o ¹H = Hydrogen = 1p⁺ + 1e
 - 90% of electron density of the hydrogen atom is within one Angstrom
 - o ²H = Deuterium = 1p⁺ + 1N + 1e (Isotope of Hydrogen)
 - o ³H = Tritium = 1p⁺ + 2N + 1e (Isotope of Hydrogen, radioactive, T_{1/2} = 12.2 yrs)
 - o ¹²C = 6p⁺ + 6N (¹²C : 12 amu atomic weight, atomic No. 6)
 - o ¹³C = 6p⁺ + 7N (Isotope of Carbon, Stable, 1.1% abundance)
 - o ¹⁴C = 6p⁺ + 8N (Radioactive isotope with long half-life, T_{1/2} = 5740 yrs)
 - 1N → 1p⁺ + 1e⁻ to become ¹⁴Nitrogen
- **Molecular Weight (MW):** Mass of atoms in a molecule
 - o H₂O: MW = [(2 x 1 g/mol)H + (1 x 16 g/mol)O] = 18 g/mol

Physical Properties

- o Defined by chemical structure
- o Melting point (mp) and boiling point (bp): Each compound has a characteristic mp and bp.
- o Taste, appearance, odour, and biological properties (how it interacts with other molecules).
- o Light Absorption (hv)
- o Density (symbol is ρ, rho) (unit = g/cm³)
- o Density of water is 1g/cm³, compounds that are less dense than water will float on top if they are not miscible (infinitely soluble)

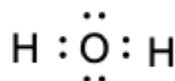
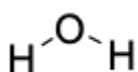
- Absorption of radiation (light)
- Solubility

Typical Molecule

- A few Angstroms (Å) in length: Bond length C-H is 1 Å, C-C is 1.5 Å
- 1 Å = 10^{-8} cm
- 1 Å = diameter of 1 hydrogen atom

Basic Principles

1. Like charges repel, unlike charges attract.
2. Atoms want inert gas configuration of electrons
 - Same configuration as Helium, Neon, Argon, Xenon, and Krypton.
 - Can be attained through either ionic bonding or covalent bonding



Mole Concept

- **1 mole = 6.02×10^{23} (Avogadro's number)** (can be atoms, molecules etc.)
- 1 mole H = 1 g
- Mole concept relates to MW and Atomic weight
- 18 g of H_2O is 6.02×10^{23} molecules = 1 mole of H_2O or 6.02×10^{23} molecules of water
- Carbon has 12 grams per mol, Oxygen has 16 g per mol, so for CO_2 we can calculate that it has 44 g/mol
- $\text{D} = {}^2\text{H}$, $1\text{p}^+ + 1\text{N} = 2$ g/mol, it's an isotope
- $\text{D}_2\text{O} = 20\text{g/mol}$, known as heavy water.

Purity of Compounds

- 1 mole of H_2O (6.02×10^{23} molecules) = 18 g, then add 1×10^6 other molecules (e.g. sugar) □ the purity of the water would be 99.999 999 999 999 999%.
- Purity: A pure compound shows no change in physical properties upon attempts to further purify (purity is a relative term).
- Purity: A pure compound has a discrete and unique physical properties.

Qualitative Test for Inorganic or Organic Compound

Qualitative: Determine if you have the compound of interest

Note that the structure of a molecule defines its physical properties

Organic	Inorganic
<ul style="list-style-type: none">- Contains carbon- Low mp < 200 °C, low bp- Burns frequently in air- Non-polar- Soluble in non-polar solvents	<ul style="list-style-type: none">- No carbon- High mp & bp (due to ionic bonding)- “Does not burn”- Polar- Soluble in H₂O

Non-Polar solvent: Hexane, Benzene, Diethyl ether etc

THERE ARE MANY EXCEPTIONS!!!

E.g. Common table sugar is an organic molecule, however it dissolves in water