Definitions

- Chemistry: Study of matter
- Organic Chemistry: Study of compounds containing carbon
- Atom: Is the smallest possible particle that defines a complete chemical element
- Molecules: Discrete (bonded) arrangement of atoms
 - Changing the arrangement or connections changes the molecule and its physical properties
- Compound: Collection of molecules of the same type
 - Water (H₂O), Cholesterol (27 carbons, white crystalline powder, average male contains 80 g)
- Atomic Number: Number of protons in the nucleus of an atom
- Atomic Weight: Mass of protons and neutrons
- Molecular Weight (MW): Mass of atoms in a molecule
 - $H_2O: MW = [(2 \times 1 \text{ g/mol})H + (1 \times 16 \text{ g/mol})O] = 18 \text{ g/mol}$

Mole Concept

- 1 mole = 6.02×10^{23} (Avogadro's number) (can be atoms, molecules etc.)
- 1 mole H = 1 g
- 18 g of H₂O is 6.02×10^{23} molecules = 1 mole of H₂O or 6.02×10^{23} molecules of water

Typical Molecule

- A few Angstroms (Å) in length: Bond length C-H is 1 Å, C-C is 1.5 Å

- $1 \text{ Å} = 10^{-8} \text{ cm}$

Example: Cholesterol is 17 Å across. If you lined all of the cholesterol molecules in an 80 g bottle end to end it would wrap around the earth roughly 5,000,000 times.

Physical Properties

- Defined by chemical structure
- Melting point (mp) and boiling point (bp): Each compound has a characteristic mp and bp.
- Taste, appearance, odour, and biological properties (how it interacts with other molecules).
- Density (g/cm^3)
- Absorption of radiation
- Solubility

Purity of Compounds

- 1 mole of H₂O (6.02 x 10^{23} molecules) = 18 g, then add 1 x 10^6 other molecules (e.g. sugar) \rightarrow 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).

Purification

- 1) Physical State Separation
 - Distillation
 - Crystallization
 - Precipitation
- 2) Chromatography
 - Media + Adsorption

Chemical Analysis

- Qualitative Analysis
- Quantitative Analysis

Qualitative Test for Inorganic or Organic Compound

Qualitative: Determine if you have the compound of interest

Organic	Inorganic
- Contains carbon	- No carbon
- Low mp $< 200 ^{\circ}$ C, low bp	- High mp & bp
- Burns frequently in air	- "Does not burn"
- Soluble in non-polar solvents	- Soluble in H ₂ O

THERE ARE MANY EXCEPTIONS!!!

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

Quantitative Analysis





Note: Matter cannot be created or destroyed in a chemical reaction, therefore the amount of carbon in the CO_2 is equal to the amount of carbon in the starting sample.

Percent Composition

Weight of carbon (in sample) = $\frac{12 \text{ g/mol of C}}{44 \text{ g/mol CO}_2}$ x 10.35 mg of CO₂ = 2.82 mg of C

Weight of hydrogen = $\frac{2(1 \text{ g/mol of H})}{18 \text{ g/mol of H}_2\text{O}}$ x 3.42 mg of H₂O = 0.383 mg of H

Weight of oxygen = 4.34 mg - (2.82 mg of C + 0.383 mg of H) = 1.14 mg of O