CHEMISTRY

2.1 Structure of Atom

1. Elements and Atoms

- All elements are made of atoms.
- Elements differ from each other due to the differences in their atoms.
- Some elements are solids, some are liquids, and some are gases.

2. Discovery of Atom

- **Democritus** (Greek philosopher): Said matter is made of tiny, indivisible particles called atoms.
- **John Dalton** (1800s): Gave experimental proof of atoms.

3. Subatomic Particles

- **Electron**: Negatively charged, discovered in **1897** by **J.J. Thomson** using **discharge tube** experiment.
- **Proton**: Positively charged, discovered by **E. Goldstein** in **1886** using **anode rays**.
- **Neutron**: Neutral particle (no charge), discovered in **1933**. Mass is nearly equal to that of proton.

4. Rutherford's Experiment (1911)

- Found atoms have a **small central nucleus** containing most of the mass.
- Nucleus has **protons and neutrons**.
- Electrons revolve around the nucleus.

5. Properties of Subatomic Particles

Particle	Charge	Mass (kg)
Electron	-1.6022×10^{-19}	9.109×10^{-31}
Proton	$+1.6022 \times 10^{-19}$	1.673×10^{-27}
Neutron	0	1.675×10^{-27}

2.2 Bohr's Atomic Model

6. Orbits (Shells)

- Electrons move in fixed paths (called **shells** or **energy levels**).
- Closest shell to nucleus has the lowest energy (called **ground state**).
- Shells are named as **K, L, M, N…** (n = 1, 2, 3, 4…).

7. Sub-Shells and Orbitals

- Each shell has sub-shells (s, p, d, f).
- Sub-shells hold fixed number of electrons:
    - s: 2 electrons
    - p: 6 electrons
    - d: 10 electrons
    - f: 14 electrons

8. Electron Capacity Formula

- Formula: **$2n^2$**, where n is shell number.
    - K (n = 1): 2 electrons
    - L (n = 2): 8 electrons
    - M (n = 3): 18 electrons

2.3 Atomic Number and Mass Number

9. Atomic Number (Z)

- Number of protons in an atom.
- Atomic number = number of electrons (in neutral atom).

10. Mass Number (A)

- Total number of **protons + neutrons**.
- **Formula**: $A = Z + N$
    - N = number of neutrons
- Example: Oxygen has Z = 8, A = 16 → Neutrons = 16 - 8 = 8

2.4 Isotopes

11. Isotopes

- Atoms of same element with **same atomic number** but **different mass numbers**.
- Example: Carbon has isotopes:
    - ^{12}C (6 protons + 6 neutrons)
    - ^{13}C (6 protons + 7 neutrons)
    - ^{14}C (6 protons + 8 neutrons)

12. Radioactive Isotopes

- Some isotopes emit radiation. They are called **radioactive isotopes**.
- Radiation changes them into new elements (called **radioactive decay**).
- Example: Uranium-238 → Thorium-234 + energy

13. Uses of Radioactive Isotopes

- Medical: diagnose and treat diseases (e.g., cancer).
- Industry: check metal strength, find oil fields.
- Archaeology: **Carbon-14 dating** finds age of fossils.

2.5 Ionization by Radiation

14. Ionization

- Radiation can remove electrons from atoms → forms **ions**.
- Loss of electron = positive ion (cation).

2.6 Relative Atomic Mass

15. Relative Atomic Mass (Ar)

- Compared to **1/12th** of mass of one carbon-12 atom.
- Unit = **atomic mass unit (amu)**

16. Isotopic Abundance

- **Formula** to calculate Ar:
  - $Ar = (m_1p_1 + m_2p_2 + m_3p_3...) / 100$
  - m = mass of isotope
  - p = percentage of isotope
