Revision Notes for Class 12 Chemistry
Chapter 4 – The d and f Block Elements

1. Transition Elements (d-Block Elements)

- **Location in Periodic Table**: Transition elements are positioned between the s-block and p-block elements, specifically between groups 2 and 13 of the Periodic Table.
- **Transition Series**: There are three distinct transition series:
  1. **First Transition Series**: Involves the filling of 3d-orbitals, ranging from Scandium (Z = 21) to Zinc (Z = 30).
  2. **Second Transition Series**: Involves the filling of 4d-orbitals, starting from Yttrium (Z = 39) to Cadmium (Z = 48).
  3. **Third Transition Series**: Involves the filling of 5d-orbitals, beginning with Lanthanum (Z = 57). Following Lanthanum, the 14 elements known as Lanthanides fill the 4f-orbitals. The series continues with elements from Hafnium (Z = 72) to Mercury (Z = 80).

2. Inner Transition Elements (f-Block Elements)

- **Definition**: The f-block elements are referred to as inner transition elements.

3. General Characteristics of Transition Elements

- **Metallic Nature**: All transition elements are metals, exhibiting high electrical and thermal conductivity.
- **Gradual Decrease in Electropositive Character**: As we move across a period, transition elements show a gradual reduction in electropositive character.

- **Physical Properties**: Transition metals are generally hard, possess high densities, high enthalpies of atomisation, and high melting and boiling points, all due to strong metallic bonding. They also form alloys with other metals.
- **Melting Points**: Melting points increase to a maximum and then decrease towards the end of the series. The strength of metallic bonds is linked to the number of half-filled d-orbitals.
- **Ionic Radii**: The ionic radii decrease progressively across a given series, primarily due to the poor shielding effect of d-electrons.
- **Ionisation Energies**: Transition elements have higher ionisation energies than s-block elements but lower than p-block elements. The ionisation energy generally increases across the series.
- **Oxidation States**: Transition metals exhibit multiple oxidation states due to the involvement of ns and (n-1)d-electrons in bonding.
- **Electropositive Nature**: Most transition metals are sufficiently electropositive to react with mineral acids, releasing hydrogen gas.
- **Paramagnetism**: Many transition elements and their compounds are paramagnetic.
- **Coloured Compounds**: Transition metals often form coloured compounds in both solid state and aqueous solution, due to d-d transitions of electrons.
- **Complex Formation**: Unlike s- and p-block elements, transition metals have a strong ability to form complexes, attributed to their small, highly charged ions and vacant d-orbitals.
- **Catalytic Properties**: Many transition metals and their compounds act as catalysts in various chemical reactions.
- **Interstitial Compounds**: Transition metals are known to form a large number of interstitial compounds.

- **Alloy Formation**: Transition metals form numerous alloys because their atoms can easily replace each other in the crystal lattice.
- **Oxides Nature**: The oxides of transition metals in lower oxidation states are generally basic, while those in higher oxidation states are either amphoteric or acidic.

4. Lanthanides and Actinides (f-Block Elements)

Lanthanides:

- **General Electronic Configuration**: [Xe] $4f^{1-14}$ $5d^{0-1}$ $6s^2$.
- **Physical Properties**: Silvery-white, malleable, ductile metals with high melting points and densities.
- **Oxidation States**: Primarily exhibit a +3 oxidation state, but some can also show +2 (e.g., Eu^{2+}) or +4 (e.g., Ce^{4+}).
- **Colour**: Many lanthanide ions are coloured due to electronic transitions between different 4f-levels.
- **Magnetism**: Most lanthanide ions are paramagnetic, except for those with no 4f-electrons (e.g., La^{3+}, Ce^{4+}) or a full 4f-level (e.g., Yb^{2+}, Lu^{3+}).
- **Reactivity**: Lanthanides readily tarnish in air and react to form trioxides. The oxides and hydroxides of lanthanides are basic.
- **Ionic Nature**: Lanthanide compounds are predominantly ionic.
- **Lanthanoid Contraction**: A gradual decrease in atomic and ionic sizes across the lanthanide series, known as lanthanoid contraction.

Actinides:

- **General Electronic Configuration**: [Rn] $5f^{0-14}$ $6d^{0-1}$ $7s^2$.
- **Physical Properties**: Silvery-white metals with moderately high melting points.
- **Ionic Size**: The ionic size of actinides decreases gradually along the series.
- **Oxidation States**: Actinides exhibit multiple oxidation states, with +4 being the most common. Some can also exhibit +6 oxidation states (e.g., uranium, neptunium, plutonium).
- **Radioactivity**: Many actinides are radioactive, with elements beyond uranium being man-made.
- **Complex Formation**: Actinides have a higher tendency to form complexes compared to lanthanides.