CLASS 12 CHEMISTRY REVISION NOTES

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

Quick revision notes for Class 12 Chemistry Chapter 4 – The d- and f-Block Elements, covering general trends of the first transition series, potassium dichromate and permanganate, and the lanthanoids and actinoids. Ideal for last-minute board exam revision.

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Transition Elements: Definition and General Trends

Transition elements have an incompletely filled d-subshell in the ground state or in a common oxidation state (Zn, Cd, Hg are excluded, being d^{10} throughout). They show variable oxidation states differing by units of 1, form coloured compounds (via d-d electronic transitions, requiring partially filled d-orbitals), are largely paramagnetic (unpaired d-electrons), have high enthalpies of atomisation (strong metal-metal bonding using both ns and (n−1)d electrons), and are good catalysts (variable oxidation states plus the ability to form unstable intermediate complexes).

Oxidation States and Stability

The most stable oxidation states are those which give an **empty (d^0), half-filled (d^5) or fully-filled (d^{10}) configuration** — e.g. Mn^{2+} ($3d^5$) and Fe^{3+} ($3d^5$) are both especially stable, and Cu^+ ($3d^{10}$) is favoured for the same reason. **Copper** is the only first-series metal with a positive $E°(M^{2+}/M)$, so it cannot displace H_2 from dilute acids. Higher oxidation states are best stabilised by small, highly electronegative **O and F** ligands (pπ–dπ bonding), typically in oxides and oxoanions rather than simple cations.

Potassium Dichromate and Potassium Permanganate

$K_2Cr_2O_7$ is prepared from chromite ore ($FeCr_2O_4$) by fusion with Na_2CO_3 and air, followed by acidification and treatment with KCl. Chromate (yellow, CrO_4^{2-}) and dichromate (orange, $Cr_2O_7^{2-}$) interconvert with pH — basic favours chromate, acidic favours dichromate. **$KMnO_4$** is prepared from pyrolusite (MnO_2) by fusion with KOH and an oxidant to give green K_2MnO_4, which is oxidised (electrolytically or by disproportionation on acidification) to purple $KMnO_4$. Both are strong oxidising agents in acidic medium, reduced to Cr^{3+} and Mn^{2+} respectively.

Lanthanoids and Actinoids

Lanthanoids ($[Xe]4f^{1-14}5d^{0-1}6s^2$) show mainly the **+3** oxidation state, with Ce (+4) and Eu (+2) as notable exceptions tied to reaching stable f^0/f^7 configurations. **Lanthanoid contraction** — the steady fall in size across the series due to poor 4f-4f shielding — makes the 4d and 5d series elements of a group nearly identical in size and properties. **Actinoids** ($[Rn]5f^{1-14}6d^{0-2}7s^2$) show a much wider, less regular range of oxidation states (+3 to +6, occasionally +7, e.g. uranium), a larger actinoid contraction (5f shields even more poorly than 4f), and are all radioactive, making their chemistry less smooth to study than that of the lanthanoids.

One-Line Summary

Chapter 4 explains how partially filled d- and f-orbitals give transition and inner-transition elements their signature variable oxidation states, colour, paramagnetism and catalytic ability, culminating in the industrially and analytically important oxidising agents potassium dichromate and potassium permanganate, and in the closely related but chemically distinct lanthanoid and actinoid series.

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