Quadrant II – Transcript and Related Materials

Programme: Bachelor of Science (Second Year)

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Paper Title: Physical Chemistry and Inorganic Chemistry

Unit: Unit 3 – Crystal field Theory

Module Name: Factors affecting the magnitude of 10 Dq. Merits and demerits of crystal field theory.

Module No: 23

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Notes

Factors affecting the magnitude of 10 Dq

1. The crystal field splitting produced by the strong field ligands (CN^-) ions is about double than that for a weak field ligands (Cl^-).
2. The values of 10 Dq for M^{3+} complexes are approximately 50% larger than the values for M^{2+} complexes.
3. The value of 10 Dq also increases by about 30% between adjacent members down the group for the transition elements.

The magnitude of crystal field splitting in the tetrahedral field is 4/9 times the crystal field splitting in the octahedral field. This is related to the number of ligands and their direction to approach the metal centre.

Merits and demerits of crystal field theory

Merits

- Explains the split degeneracy of d-orbitals in a complex.
- Theory does explain the colour and spectra of complexes.
- Accounts for magnetic property of the complexes.

- Explains the stability of particular oxidation state in aqueous solutions.

Demerits

- Interaction of metal ligand is considered purely electrostatic.
- Only electrons from d orbital of the metal ion are considered (other orbitals such as s and p are not taken into consideration) and no significance to the orbits of the ligands.
- Complexes in which metal oxidation state is zero and ligand is neutral does not explain the electrostatic attraction between the metal and the ligands. Eg. $[Cr(C_6H_6)_2]$
- Does not explain the relative strength of ligands in spectrochemical series. (Why H_2O is strong field ligand than OH^-)
- Does not consider any π bonding (double bond and triple bond) in complexes.