

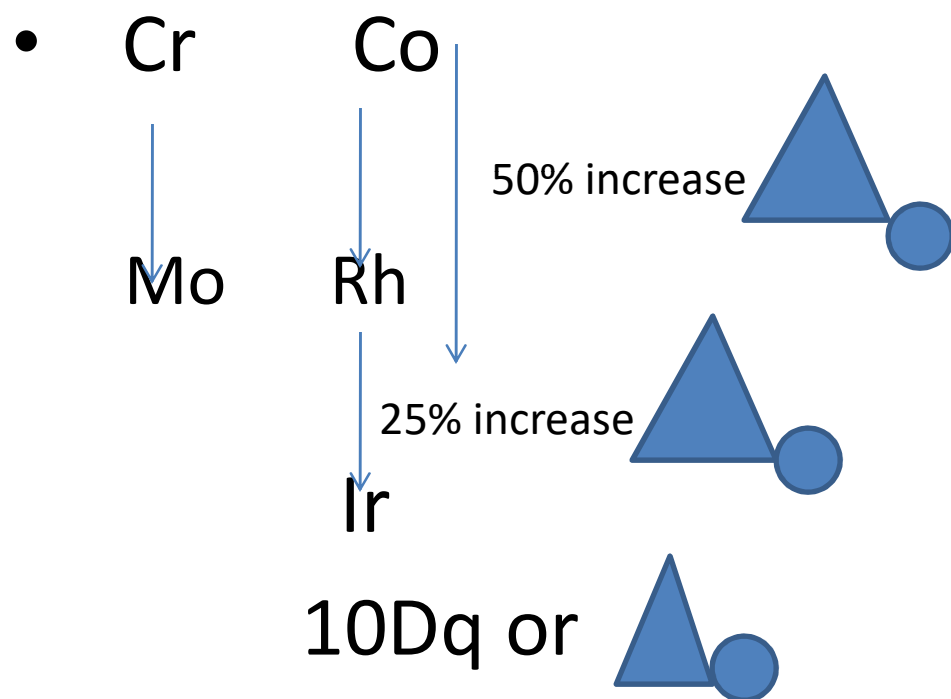
CHEMISTRY DEPARTMENT

- Name of the teacher : *Dr. Nandini Kumari*
- Subject: *Chemistry (Inorganic)*
- Course: B.Sc(Hon's)
- Year : Second year
- Semester : IV (CC-408)
- College :Patna Women's College,Patna University,Patna
- Topic: *Co-ordination Chemistry (PartI)*

Factors affecting $10Dq$ value

- *Nature of the metal ion*
- *Oxidation state*
- *Geometry of the Complexes*
- *Strength of the ligand*
- *Nature of the metal ion* : The magnitude of d-orbital splitting depends upon principal qt no. of the d-orbital involves. Magnitude of d-orbital splitting increases with the increase of principal qt. no. d-orbital splitting in 3d orbital is less than 4d and 5d orbital.

- As we move down in group d-orbital splitting increases. For EXample:



- The reason behind this observation is that ligands around the metal ion experience steric hindrance. Increase in size of metal ion giving rise to steric crowding therefore can approach closer to metal ion thus cause greater splitting.
- Oxidation state(O.S): Magnitude of d-orbital splitting increases with increase o.s of metal ion. Higher oxidation state higher the orbital splitting.

- Complex Oxidation State

- $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ +2 14000 cm^{-1}

- $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ +3 17400 cm^{-1}

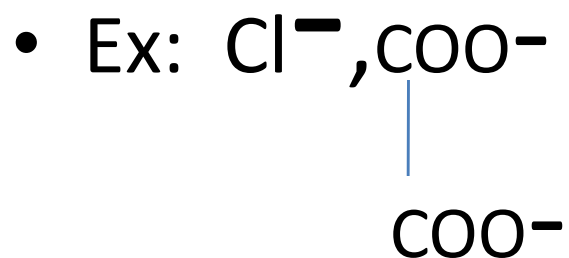
- Radius of ligand: Smaller the radius of ligand

- Greater the value of $10Dq$ i.e stronger the ligand greater the value of $10Dq$.

- $\text{I}^- < \text{Br}^- < \text{Cl}^- < \text{F}^- < \text{OH}^- < \text{H}_2\text{O} < \text{NH}_3 < \text{CN}^-$



- Charge of ligand : Greater is the charge greater is the value of $10Dq$.



Geometry of the complex:- $10Dq$ value also depends upon geometry of complexes.

- $10Dq_{Oh} > 10Dq_{Td}$.
- Splitting energy of Td complexes is smaller than that of pairing energy.
- Spectrochemical series: It has been found that by experimental study of spectra of a large numbers of complexes containing i.e. possible to arrange metal ions and ligands group into series. A/c the ligand field experience. Thus the series which results by arranging metal ion or ligand group in increasing order of $10 Dq$ is called spectrochemical series. It can be arranged either of two ways.

- By increasing metal ion in increasing order of $10Dq$
- $Mn^{2+} < Ni^{2+} < Fe^{2+} < V^{2+} < Fe^{3+} < Cr^{3+} < V^{3+} < Co^{3+} < Mn^{4+}$
- By increasing ligand in increasing order of $10Dq$
- $I^- < Br^- < Cl^- < F^- < OH^- < H_2O < NCS^- < NH_3 < NH_2OH < NO_2^-$
- $NH_2 < CN^- < CO$.

Jahn –Teller Theorm

- Jahn –teller theorm states that “ Any non –linear molecular system in a degenerate electronic state will be unstable and will undergo some sort of distortion to lower its symmetry and lower energy and remove the degeneracy.”
- A/c this theorm when degenerate orbitals are unsymmetrically occupied the degenracy is destroyed and as a result distortion in octahedral structure. Example : $\text{Cu}(\text{NH}_3)_4 \cdot 2\text{H}_2\text{O}$

