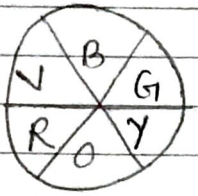
Colour of Transition Metal Complexes:



A compound looks blue if it absorbs radiations of all colours but reflects blue colour i.e. it absorbs of white light minus blue colour.
A compound also looks blue if it reflects all colours except orange, the complementary colour of blue.

→ A compound appears black, if it ~~appears~~ absorbs all the radiations of white light in visible region.

→ If a compound absorbs no visible light, it appears white or colourless.

Reason for colour in TMCs:

Two reason.

- d-d Transition
- Charge transfer.

Rules for Electronic Transitions:

Two rule.

1. Laporte Selection Rule: $\Delta \ell = \pm 1$

$s \rightarrow s$ ✗
$p \rightarrow p$ ✗
$s \rightarrow p$ ✓
$p \rightarrow s$ ✓
$p \rightarrow d$ ✓
$s \rightarrow d$ ✗

2. Spin Selection Rule:

$\Delta S = 0$

Factors on which Colour Depends:

Nature of metal ion

$[Cu(H_2O)_5]SO_4$ Blue
$[Ti(H_2O)_6]^{3+}$ Purple
$[Co(H_2O)_6]^{2+}$ Red

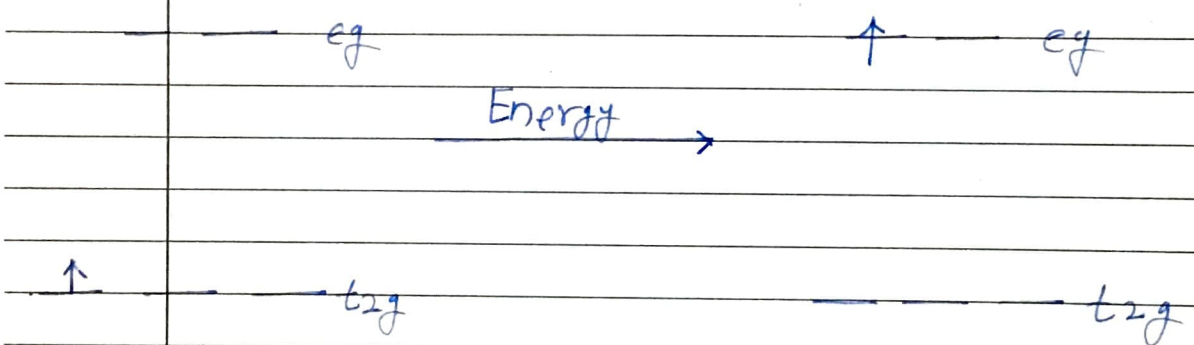
Nature of Ligands

$[Co(H_2O)_6]^{3+}$ Blue
$[Co(NH_3)_6]^{3+}$ Yellowish Orange
$[Co(CN)_6]^{3-}$ Yellow

$[Ni(NH_3)_6]^{2+}$ Blue
$[Ni(H_2O)_6]^{2+}$ Green
$[Ni(NO_2)_6]^{4-}$ Brown-red

$E = h\nu$ or $E = \frac{hc}{\lambda}$

1: d-d Transition:



e.g. $[Ti(H_2O)_6]^{3+}$
$[Cu(H_2O)_5]SO_4$
$[Co(H_2O)_6]^{2+}$

2. Charge transfer spectra: Internal redox process.

LMCT | MLCT | Intervalence CT | Intraligand CT

(A) Ligand to Metal Charge Transfer (LMCT):
If the transfer of $\bar{e}$ takes place from ligand to metal then it is called as LMCT

Conditions for LMCT:

(i) Metal should be in high O.S. high ionization energy small size and vacant orbitals at low energies.

(ii) Ligands should have lone pair of electrons of relatively high energy and low electron affinity.

e.g. MnO_4^- $Cr_2O_7^{2-}$, CdS HgS
V_2O_5 CrO_3 $PbCrO_4$ $Fe(SCN)_3$
$FeBr_3$

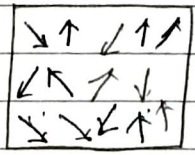
Magnetic Substance

Diamagnetic | Paramagnetic | Ferromagnetic | Ferrimagnetic | Anti-ferromagnetic

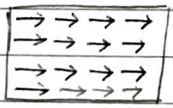
1. Diamagnetic substance:
   - → All ēons are paired.
   - → Substances which are weakly repelled by the external magnetic field are called diamagnetic field.
   - → Magnetic susceptibility is -ve.
   - → Mass is lesser than expected.

2. Paramagnetic substance:

One or more unpaired ēns are present.
Magnetic susceptibity is positive ($\neq 0$)
→ Attracted towards magnetic field.
→ Mass is higher than expected.
→ Magnetic susceptibility varies inversely with temp.
e.g. Al, Pt, Pd, Cr, $CuSO_4 5H_2O$, O_2 etc.

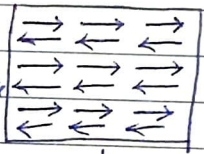


3. Ferromagnetic substance:



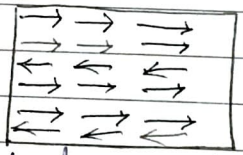
→ Special case of paramagnetism.
→ Below a particular temprature called curie temp. all the ēns are aligned in same direction like ↑↑↑↑
→ Magnetic susceptibility is positive.
→ χ decreases with ↑se in tem ($\chi \propto \frac{1}{T}$)
e.g. Fe, Co, Ni CrO_2 etc.

4. Antiferromagnetic substance.



→ Below a particular temprature (Neel's temprature) alignment of half ē in one direction and other half is in opposite direction. e.g. MnO, FeO, CoO, NiO and Cr_2O_3 etc.
$Cu_2(CH_3COO)_4 \cdot 2H_2O$

5. Ferrimagnetic substance:



If some of the magnetic momepts are systematically aligned opposite to the others to give a resultant magnetic moment, the substance is said to be ferrimagnetic and the critical temp. is called as curie temp. e.g.
Fe_3O_4 $Fe^{III}[Fe^{II}Fe^{III}]O_4$
↓ ↓
Td Oh