8 Optical Isomerism :-

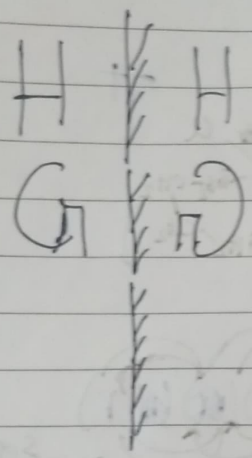
For a compound to be optically active :-

(i) It should not be superimposable on its mirror image
(ii) It should not contain any element of symmetry

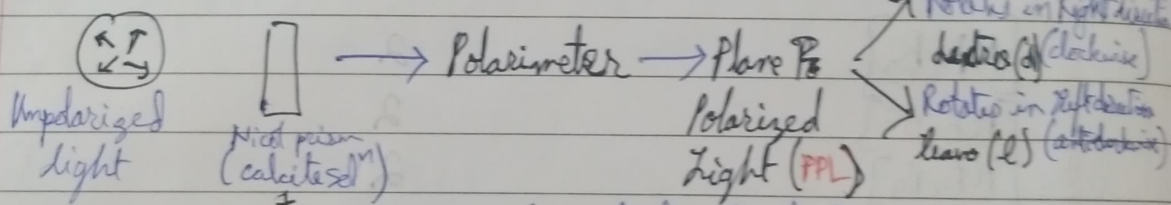
Case 1 :- Super imposable mirror image
Optically inactive

Case 2 :- Non-super imposable mirror image
Optically active

Case 3 :-



Polarized light :-



∴ To check if compound is optically active / not

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Plane Polarized Light (PPL) :-

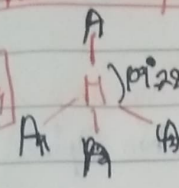
1) If the compound rotates PPL in clockwise / Right direction
Then it is dextro [denoted by d/+]

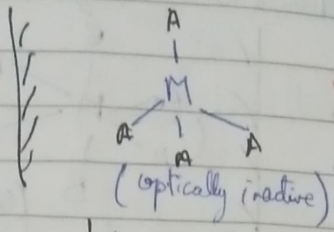
2) If the compound rotates PPL in anti-clockwise / Left direction
Then it is laevo [denoted by l/-]

CN = 4

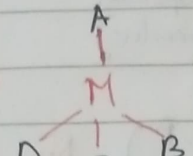
(A) Tetrahedral complexes

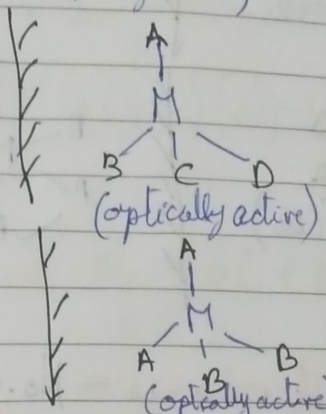
Case 1:- $[MA_4]$



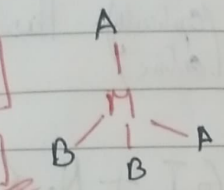


Case 2:- $[MABCD]$

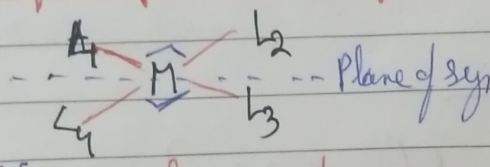




Case 3:- $[MA_2B_2]$ (or) $[MA_2BC]$



(B) Square planner complexes



$\left[\because \angle bet^{n} :- \begin{matrix} L_1, L_2 \\ L_2, L_3 \\ L_3, L_4 \\ L_4, L_1 \end{matrix} \right\} 90^{\circ} \quad \begin{matrix} L_1, L_3 \\ L_4, L_2 \end{matrix} \Big\} 180^{\circ}$

Hence, Square planner complexes never show Optical Isomerism
(due to presence of plane of symmetry → P.O.S)

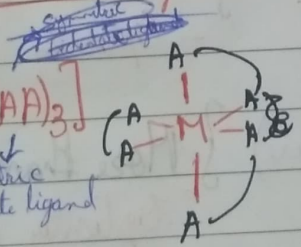
———— × ————

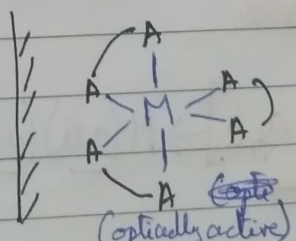
CN = 6

Octahedral complexes

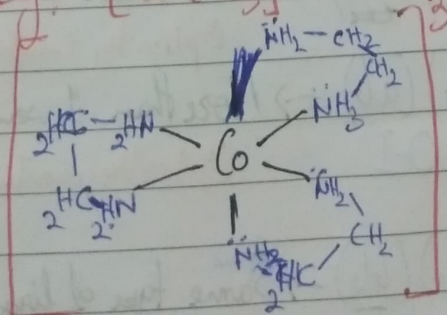
Case 1:- $[M(AA)_3]$

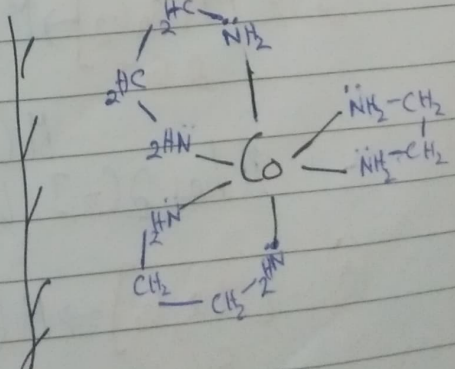
↓ symmetric bidentate ligand



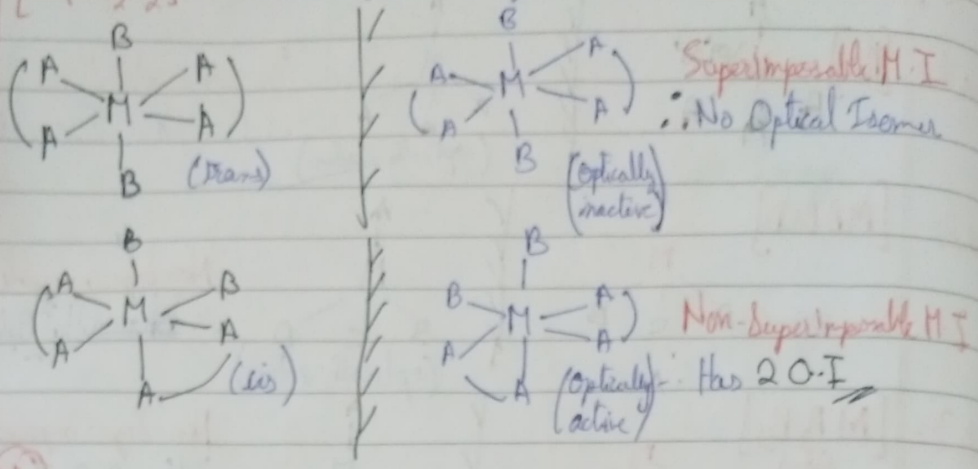


Eg:- $[Co(en)_3]^{3+}$





Case 2:- $[M(AA)_2B_2] \rightarrow 2$ G.I (cis & trans)



(*) Total no of stereoisomers = No. of G.I + No. of O.I
= 2 + 2 = 4

(*) Trick to check Optical Isomerism :-

If the pairs have same type of ligand [eg. (aa) type]
(or)
more than one same pair [eg. (ab)(ab) type]
Then, the compound is Optically inactive

Cases:-

① :- $[Ma_4] \rightarrow M(aa)(aa)(aa)$ } More than 1 same pair
∴ Optically inactive

② :- $[Ma_3b] \rightarrow M(ab)(aa)(ab)$ } More than 1 same pair
∴ Optically inactive

③ :- $[Ma_2b_2]$ 2 G.I $\rightarrow M(aa)(aa)(bb)$ & $M(aa)(ab)(ab)$ → More than 1 same pair
∴ Optically inactive
It has 2 G.I but no O.I

④ :- $[Ma_2b_2]$ 2 G.I $\rightarrow M(aa)(ab)(bb)$ & $M(ab)(ab)(ab)$ → Same type of ligand [(aa), (bb)]
∴ Optically inactive
→ More than 1 same pair
∴ Optically inactive

⑤ :- $[Ma_3bcd]$ → M(aa)(ab)(cd) → Same type of ligand (aa)

4 G.I

&

M(aa)(ac)(bd) → Same type of ligand (aa)

&

M(aa)(ad)(bc) → " " " (aa)

Optically inactive

&

M(ab)(ac)(ad) → Different ligands

∴ Optically active

O.I $< \begin{matrix} d \\ l \end{matrix} \}^2$

∴ Total no. of stereoisomers = No. of GI + No. of O.I

= 4 + 2

= 6

Complex	No. of Optical Isomers
$[MA_4B_2]$	0
$[MA_4BC]$	0
$[MA_3B_3]$	0
$[MA_3B_3]$	0
$[MA_3BCD]$	2
$[MA_2B_2C_2]$	2
$[MA_2B_2CD]$	4
$[MA_2BCDE]$	12
⑥ $[MABCDEF]$	30
$[M(AA)_2B_2]$	2
$[M(AA)_2BC]$	2
$[M(AB)_3]$	4
$[M(AA)_3]$	2