Stereoisomerism:

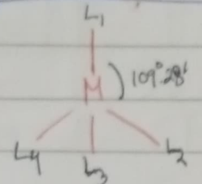
Compounds having same molecular formula, structural formula, chemical bonds but different spatial arrangement of atoms/molecules.

Such compounds are stereoisomers.

1. Geometrical Isomerism:-

CN = 4

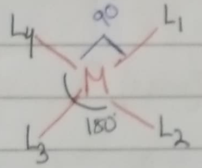
(A) Tetrahedral complexes



Here in this structure, the angle bet^n ligands & C.M.A is 109°28' for all L_1, L_2, L_3, L_4

Hence, (A) does not show G.I (Geometrical isomerism)

(B) Square Planner complexes



Here, in this structure,

$\angle$ bet^n :- $\left.\begin{matrix} L_1, L_2 \\ L_2, L_3 \\ L_3, L_4 \\ L_4, L_1 \end{matrix}\right\}$ 90° & $\left.\begin{matrix} L_1, L_3 \\ L_2, L_4 \end{matrix}\right\}$ 180°

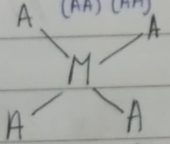
∵ This type complexes show 2 types of angles

Hence, (B) can show G.I

Case 1:- $[MA_4]$

M (AA) (AA)

(AA) (AA)

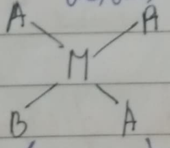


(no. G.I)

Case 2:- $[MA_3B]$

M (AA) (AB)

(AB) (AA)

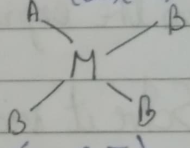


(no G.I)

Case 3:- $[MAB_3]$

M (AB) (BB)

(BB) (AB)

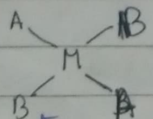


(no. G.I)

Case 4:- $[MA_2B_2]$ → M(AA)(BB) ≠ M (AB)(AB)

(I) (II)

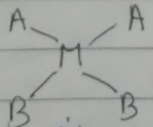
(I)



trans

[when same ligand is at 180, it is trans]

(II)



cis

[when same ligand is at 90°, ~~then~~ it is cis]

∴ $[MA_2B_2]$ has 2 G.I Eg:- $[Pt(NH_3)_2Cl_2]^{+2}$

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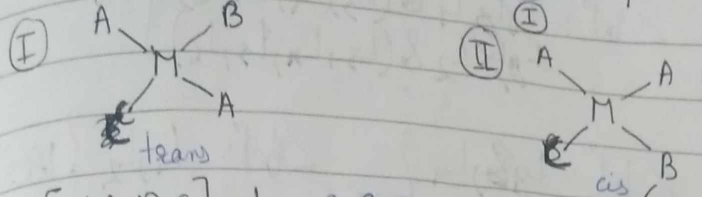
Case 5 :- $[MA_2BC] \rightarrow M(AA)(BC) \neq M(AB)(AC)$

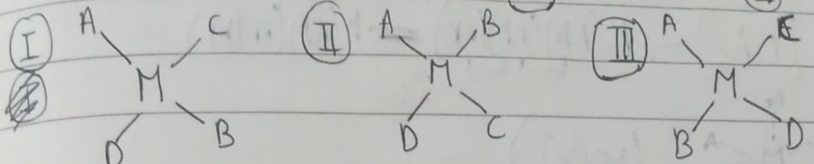
(I) (II)



$\therefore [MA_2BC]$ has 2 G.I. Eg:- $[Cu(NH_3)_2(H_2O)Cl]^+$

Case 6 :- $[MABCD] \rightarrow M(AB)(CD) \neq M(AC)(BD) \neq M(AD)(CB)$

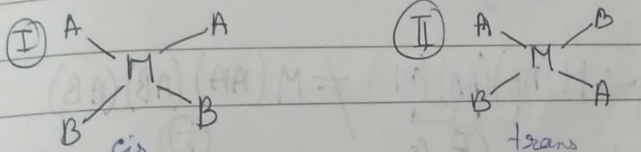
(I) (II) (III)



$\therefore [MABCD]$ has 3 G.I. Eg:- $[Cu(NH_3)(H_2O)(CN)Cl]^{+2}$

Case 7 :- $[M(AB)_2] \rightarrow M(AB)(AB) \neq M(AA)(BB)$

(I) (II)

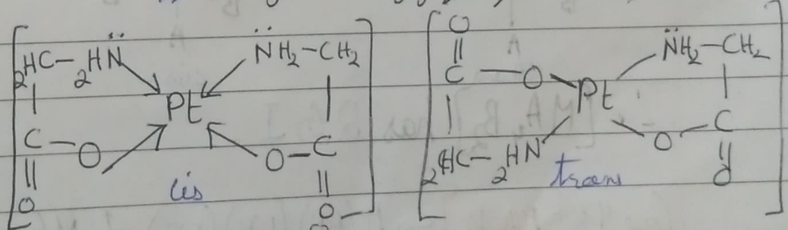


* $(AB)_2$ - unsymmetrical bidentate ligands

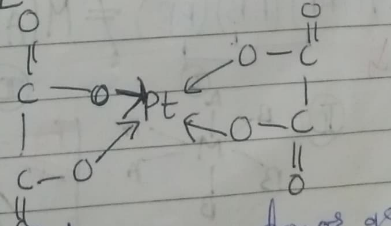
$\therefore [M(AB)_2]$ has 2 G.I. Eg:- $[Pt(gly)_2]^{+2}$, ~~$[Pt(ox)_2]^{+4}$~~

$[Pt(gly)_2]^{+2}$:-

glycinato



$[Pt(ox)_2]^{+4}$:-



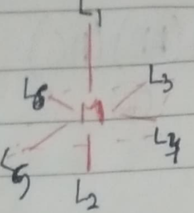
Since, $[Pt(ox)_2]$ has same donor group (O)

It is a symmetrical bidentate ligand

Hence, only unsymmetrical bidentate ligand complex shows G.I.

→ Case 4, Case 5, Case 6, Case 7 :- Shows Geometrical Isomerism

CN = 6

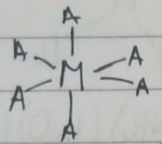


Here, in this structure,
$\angle$ betⁿ :- L_1 & (L_3, L_4, L_5, L_6) } $90°$
L_2 & (L_3, L_4, L_5, L_6)

$\angle$ betⁿ :- L_3, L_5 ; L_4, L_6 } $180°$ $\angle$ betⁿ :- L_3, L_4 ; L_4, L_5 ; L_5, L_6 ; L_6, L_3 } $90°$ $\angle$ betⁿ :- L_1, L_2 } $180°$

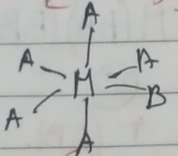
∴ It shows 4 diff bonds :-
Hence, in this structure shows G.I

Case 1 :- $[MA_6]$ → $M(AA)(AA)(AA)$ $\xRightarrow{\text{equal}}$ $M(AA)(AA)(AA)$



(no G.I)

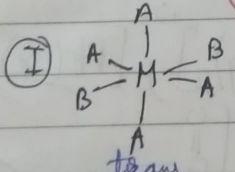
Case 2 :- $[MAB_5]$ → $M(AA)(AA)(AB)$ = $M(AA)(AB)(AA)$



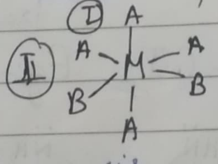
(no G.I)

Case 3 :- $[MA_4B_2]$ → $M(AA)(AA)(BB)$ ≠ $M(AA)(AB)(AB)$
I II

or BC



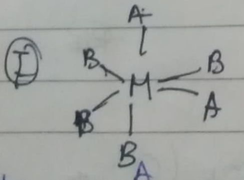
trans

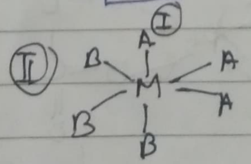


cis

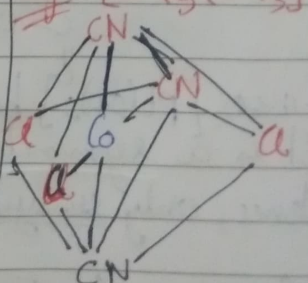
∴ $[MA_4B_2]$ has 2 G.I

Case 4 :- $[MA_3B_3]$ → $M(AA)(AB)(BB)$ ≠ $M(AB)(BA)(AB)$
I II

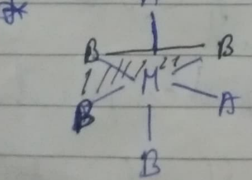




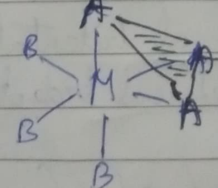
Eg :- $[Co\,Cl_3(CN)_3]^{3-}$



mer isomer



meridonal (mer)

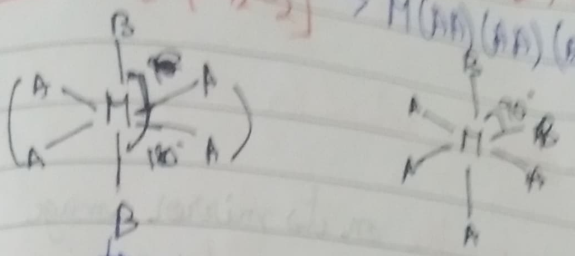


facial (fac)

∴ $[MA_3B_3]$ has 2 G.I

Case 5:- $[M(AA)_2B_2]$ → $M(AA)(AA)(BB)$

symmetrical bidentate ligand ; $(en)_2$, $(ox)_2$

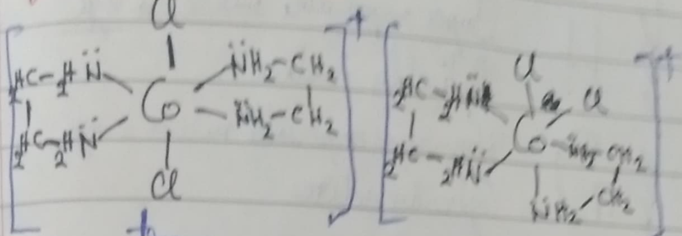


trans

cis

∴ $[M(AA)_2B_2]$ has 2 GI

Eg:- $[Co(en)_2Cl_2]^+$



trans

cis

Case 6:- [MABCDEF] → M(AB)(CD)(EF) ∴ [MABCDEF] has 15 GI

....so on

<u>Complex</u>	<u>No. of Geometrical isomers</u>
$[MA_4B_2]$	2
$[MA_4BC]$	2
$[MA_3B_3]$	2
$[MA_2B_2C]$	3
$[MA_2BCD]$	4
$[MA_2B_2C_2]$	5
$[MA_2B_2CD]$	6
$[MA_2BCDE]$	9
$[MABCDEF]$	15
$[M(AA)_2B_2]$	2
$[M(AA)_2BC]$	2
$[M(AB)_3]$	2
$[M(AA)_3]$	2

→ Except for Case 1 & Case 2 others show Geometrical Isomerism