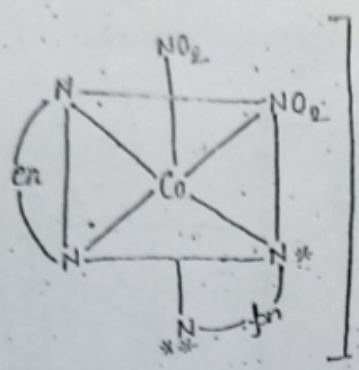
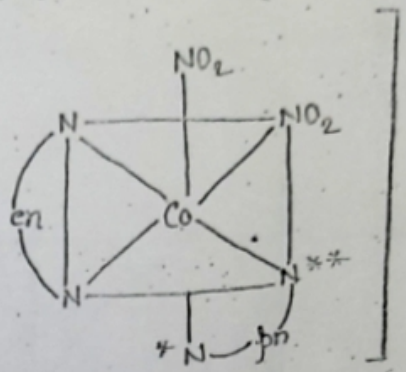
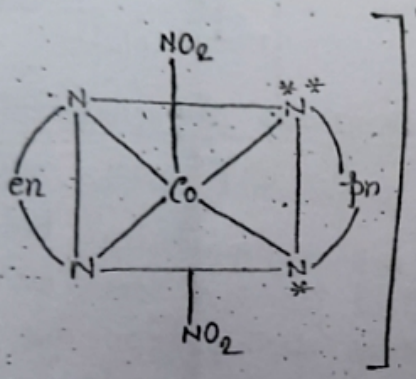
This type of complexes exhibit four geom isomers; two are cis and other two are trans.



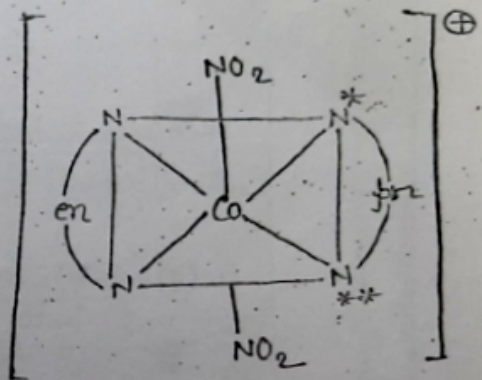
cis



cis



Trans



Trans

iii) Optical isomerism :≈

Optical isomerism in four co-ordinated tetrahedral complexes :≈

a) [Ma4], [Ma2b2], [Ma3b] type complexes :≈

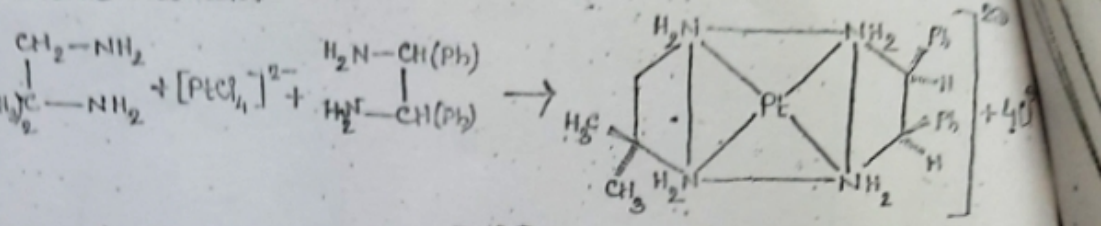
Tetrahedral complexes of [Ma4], [Ma2b2] and [Ma3b] type are not able to show optical isomerism. Because all the possible arrangements of the ligands around the central metal ion are exactly equivalent.

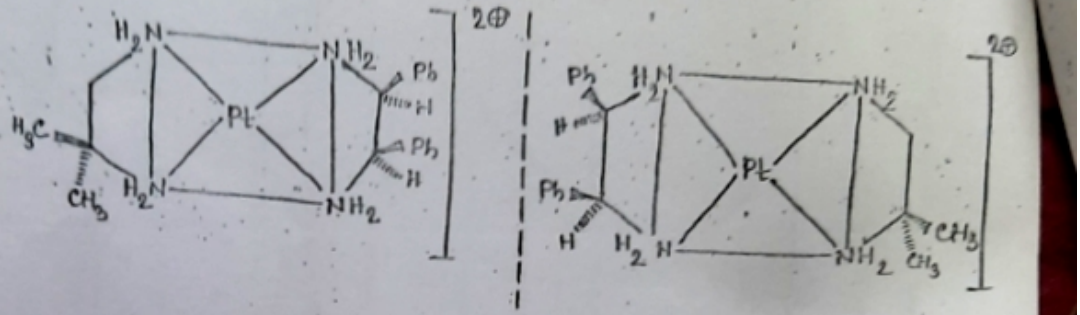
b) [Mabcd] type complexes :≈

Since the central metal atom in tetrahedral complex of [Mabcd] type is surrounded by four different ligands, the tetrahedral complex of this type

∅ Optical isomerism in square planar complexes :≈

Isobutylene diammine and mesodiphenyl ethylenediammine react with $[PtCl_4]^{2-}$ and forms a square planar complex which exist in two optically active isomers.





∅ Optical isomerism in octahedral complexes :≈

a) $[Ma_4b_2]$, $[Ma_3b_3]$ type complexes :≈

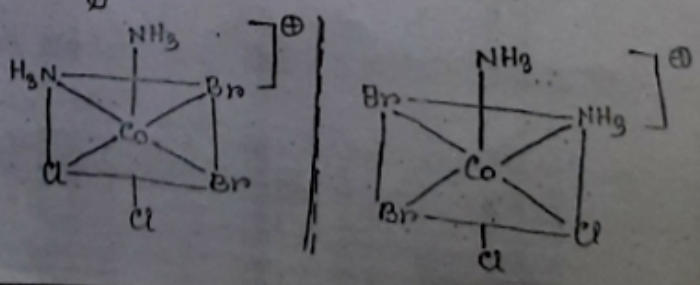
The octahedral complex $[Ma_4b_2]$ type exist in cis and trans isomers. Both the isomers are optically inactive due to the present of plane of symmetry and do not show optical isomerism.

The octahedral complexes of $[Ma_3b_3]$ type exist in 'fac' and 'mer' isomers. Both these isomers are optically inactive and hence do not show optical isomerism.

ii) $[Ma_2b_2C_2]$ type complexes :≈

This type of complexes can exist in five geometrical isomers. The cis isomers exist in two optical isomers. The other four isomers are symmetrical and hence are optically inactive:

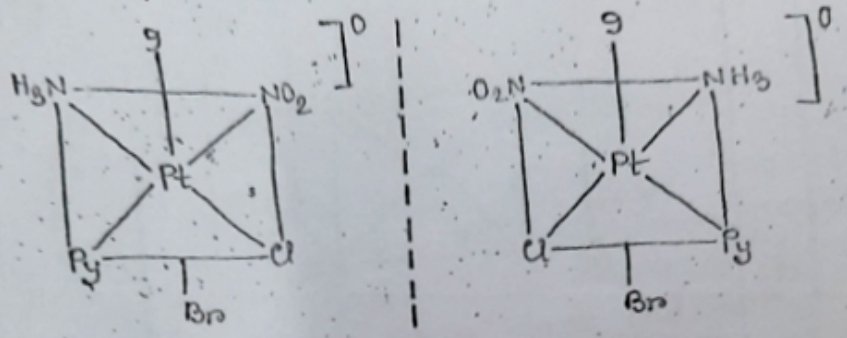
e.g: $[Co(NH_3)_2Br_2Cl_2]^+$



c) [Mabcdef] type complexes :-

This type of complexes can exist in 15 geometrical isomers. Each of these 15 isomers exist in optically active 'd' and 'l' forms giving a total 30 optically active isomers. The two optically active isomers of one of the 15 isomers are shown below:

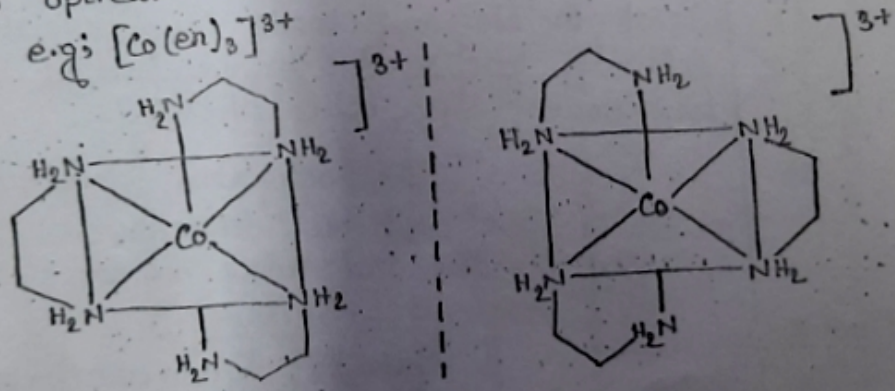
e.g: $[Pt(NH_3)(Py)(NO_2)(Cl)(Br)(I)]^0$



d) [M(AA)$_3$] type complexes :-

Due to the absence of plane of symmetry, the octahedral complexes of this type exist in two optical isomers.

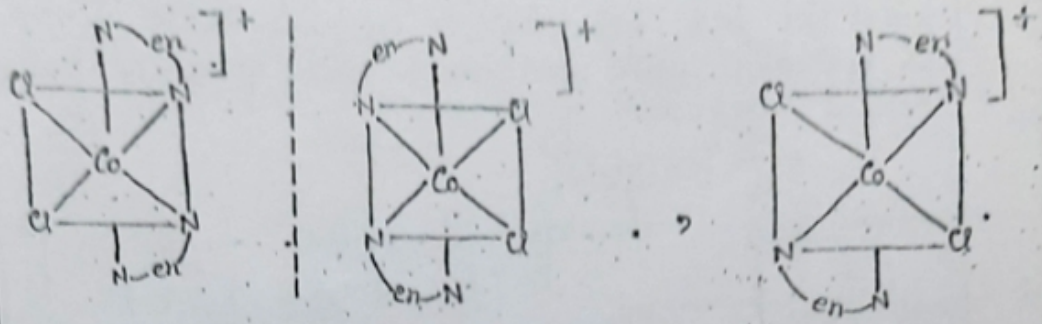
e.g: $[Co(en)_3]^{3+}$



e) [M(AA)$_2$Cl$_2$] type complexes :-

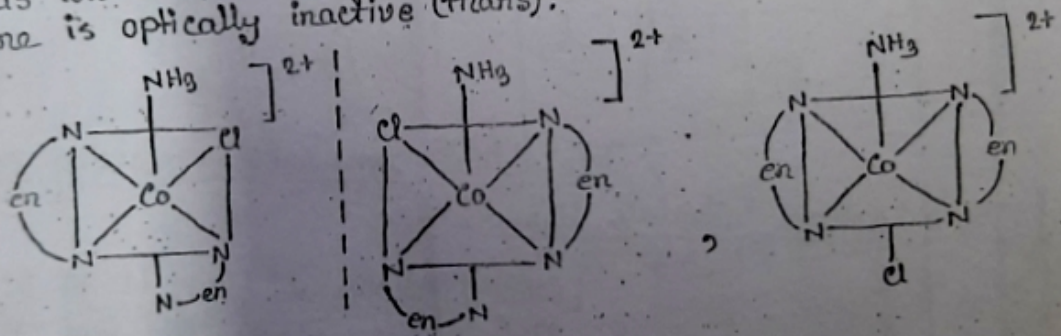
$[Co(en)_2Cl_2]^+$ ion is an example of this type of complexes. This ion shows two geometrical isomers — one is cis form and another is trans form. This cis isomer does not have any plane and hence is optically active. On the otherhand the trans

isomer has plane of symmetry and hence is optically inactive. Consequently this ion has 3 isomers, two are optically active (cis) and one is optically inactive (trans).



f) $[M(AA)_2ab]$ type complexes :-

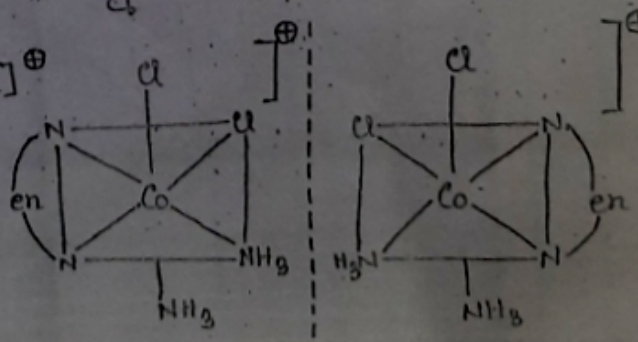
$[Co(en)_2NH_3Cl]^{2+}$ ion is an example of this type of complexes. This ion shows two geometrical isomers — one is cis form and another is trans form. This cis isomer does not have any plane and hence is optically active. On the other hand the trans isomer has plane of symmetry and hence is optically inactive. Consequently this ion has 3 isomers, two are optically active (cis) and one is optically inactive (trans).



g) $[M(AA)a_2b_2]$ type complexes :-

This type of complexes exist in 3 geometrical isomers. The cis isomer is optically active. On the otherhand the other two geometrical isomers are optically inactive.

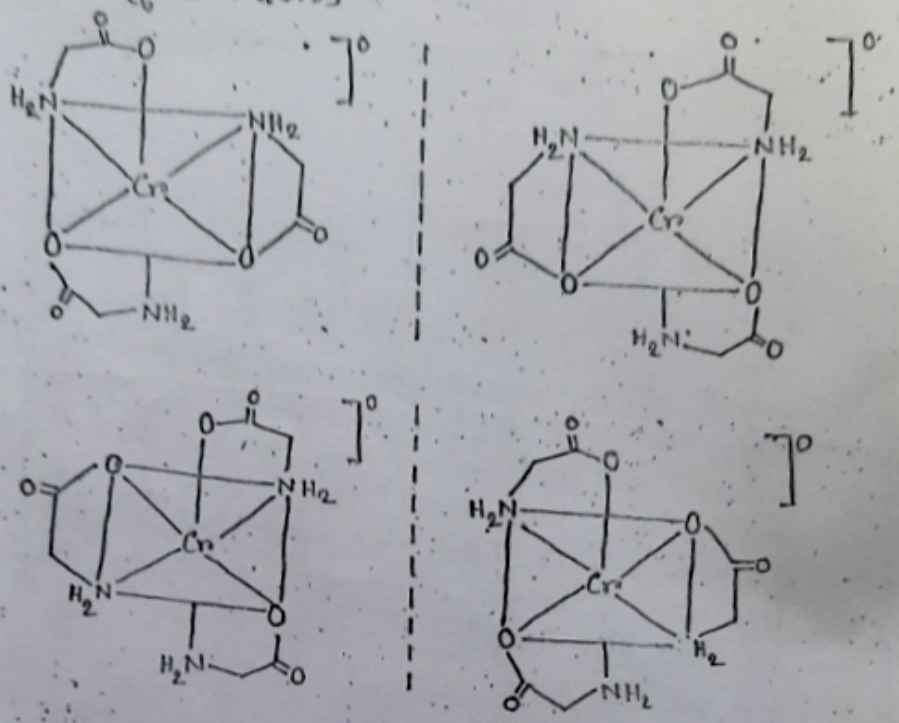
e.g: $[Co(en)(NH_3)_2Cl_2]^{\oplus}$



iv) $[M(AB)_3]$ type complexes :-

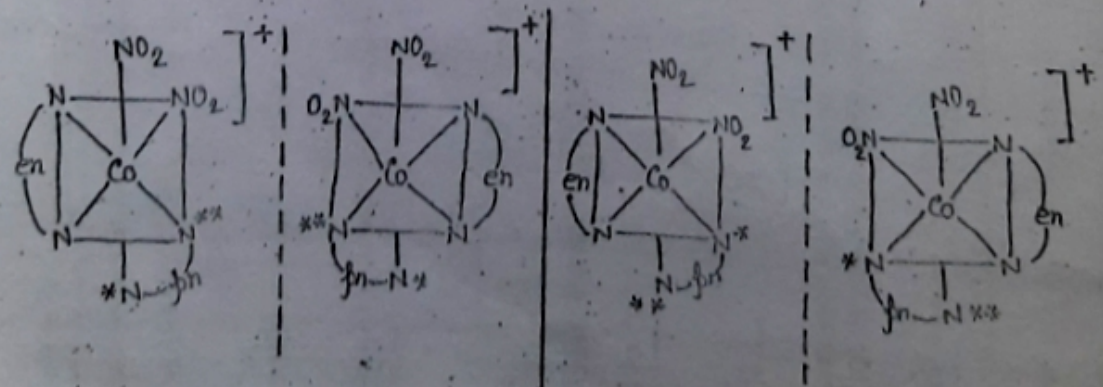
The octahedral complexes of this type exist in two geometrical isomers. Each of these form is optically active and hence each gives a pair of optical isomers.

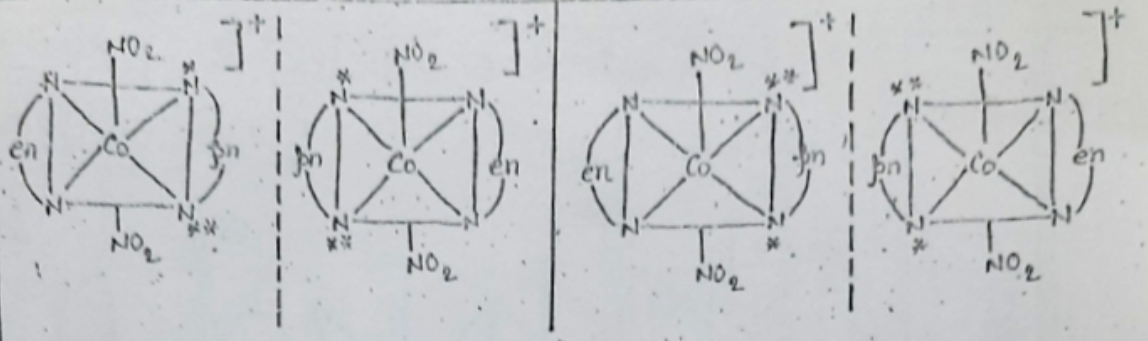
e.g: $[Cr(gly)_3]^0$



v) Octahedral complexes containing optically active bidentate ligand :-

$[Co(en)(pn)(NO_2)_2]^+$ ion is an example of such type of octahedral complexes. This ion exist in four geometrical isomers. Out of these four isomers, two are cis isomers and two are trans isomers. Both cis and trans isomers are optically active.

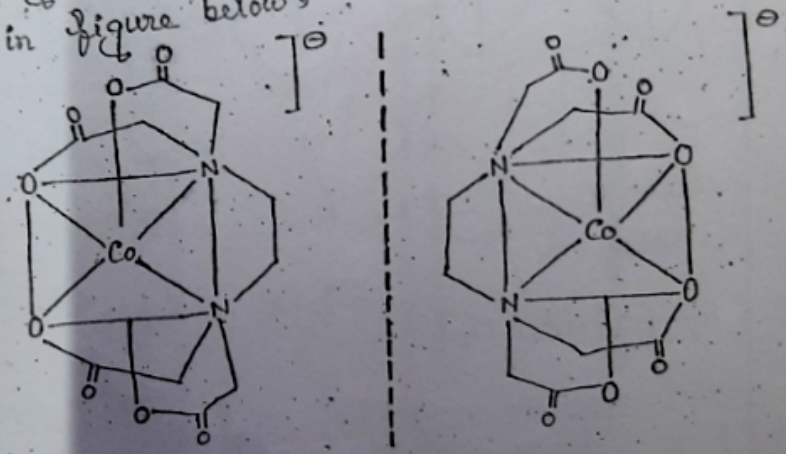




j) Octahedral complexes containing polydentate ligand :≈

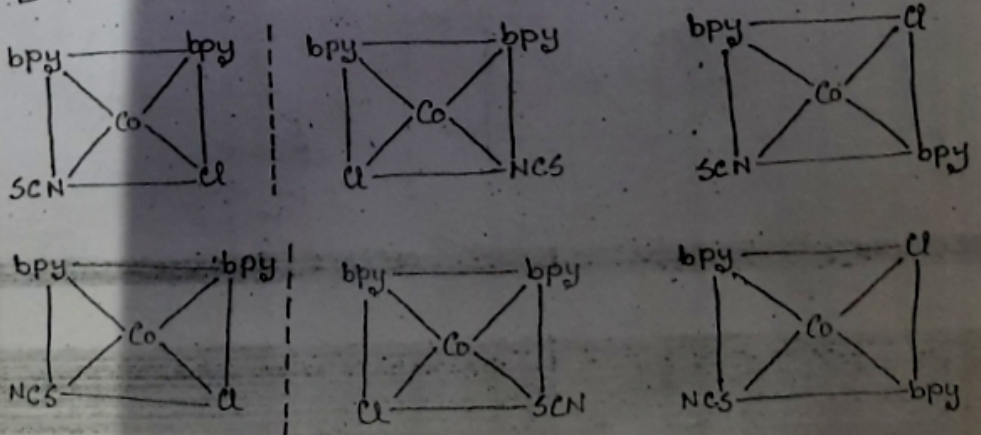
Complexes containing hexadentate ligand like $EDTA^{4-}$ exist in two optical isomers.

e.g: $[Co^{III}(EDTA)]^{\ominus}$ ion exist in two optical isomers, shown in figure below:



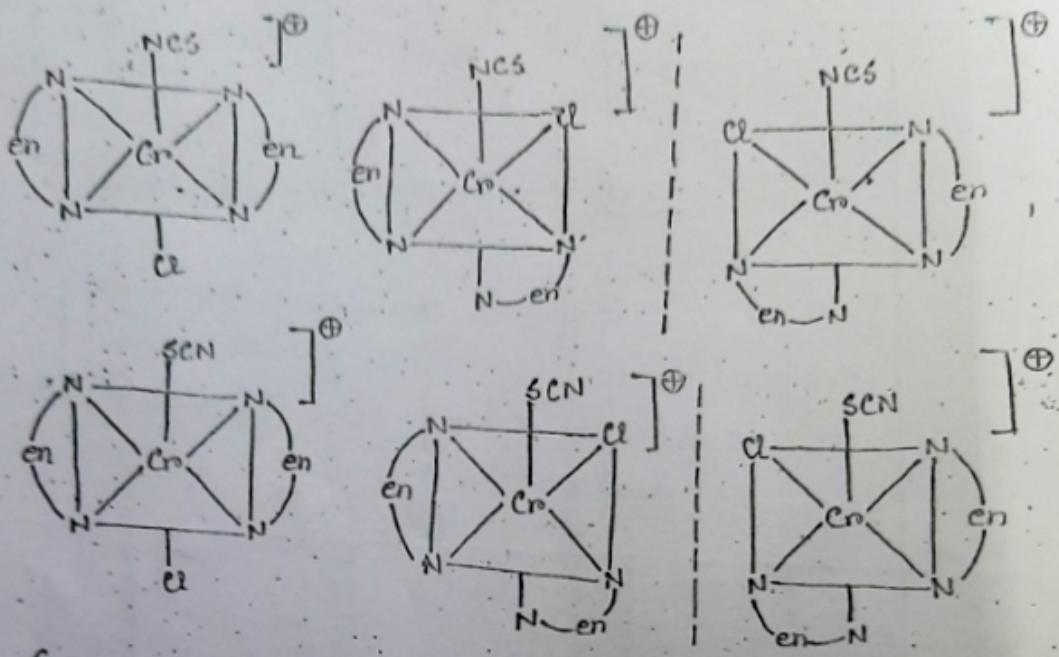
Ø Draw the structures of all the possible isomers of the following species :≈

i) $[Co^{III}(bpy)_2(NCS).(Cl)]$



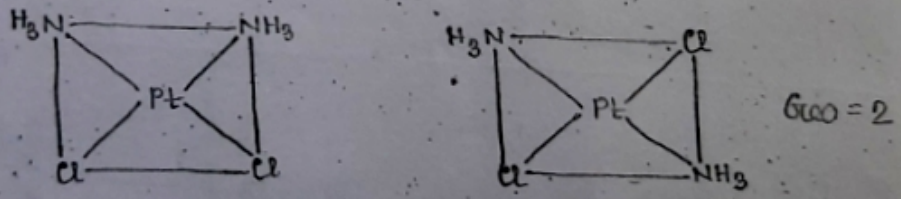
Geo - 2, optical - 1, Co-ordination - 3, Total = 6

ii) $[Cr^{III}(en)_2(NCS)(Cl)]^{\oplus}$



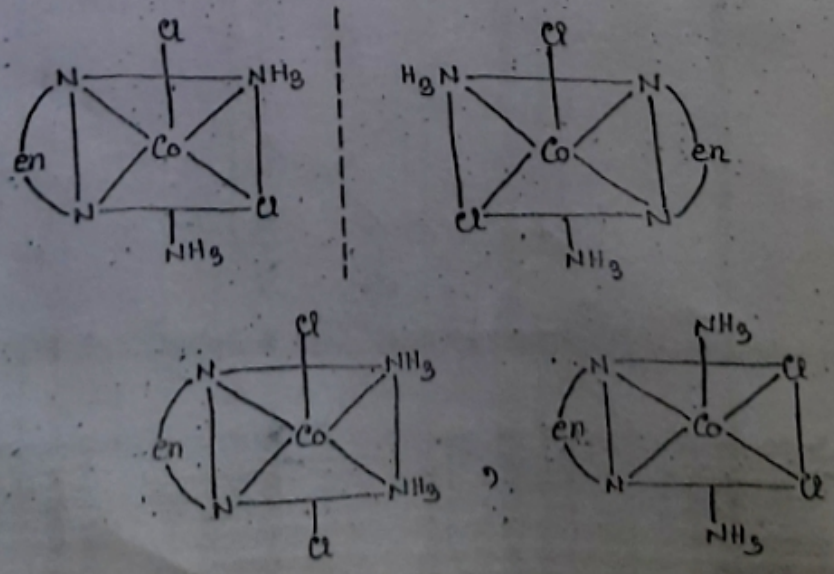
Geo - 2, optical = 1, for co-ordination position = 3, Total = 6.

iii) $[Pt(NH_3)_2Cl_2]$



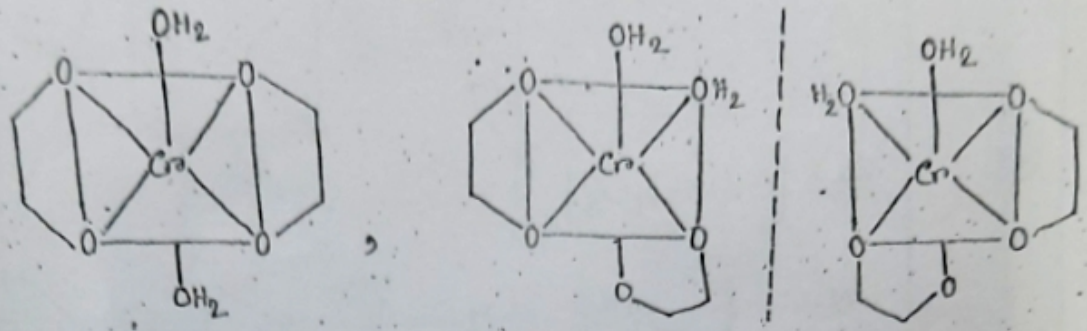
Geo = 2

iv) $[Co^{II}(en)(NH_3)_2Cl_2]$



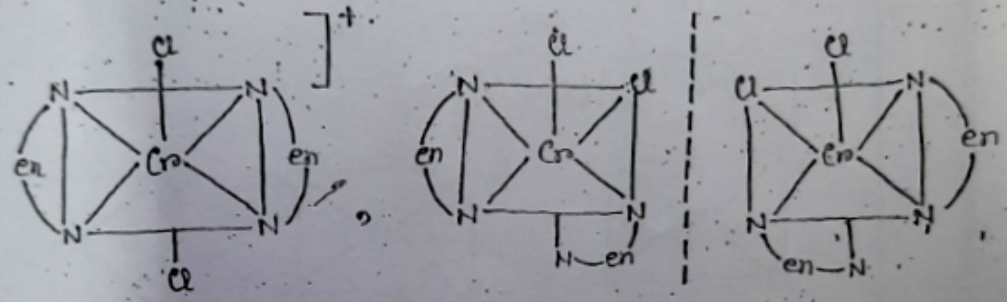
Geo - 3, optical - 1, Total - 4.

v) $[Cr(Ox)_2(H_2O)_2]$



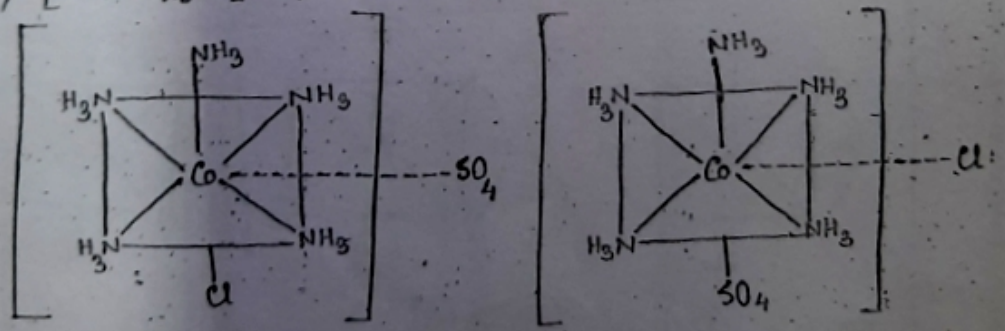
Geo - 2, optical - 1, Total - 3

vi) $[Cr(en)_2Cl_2]^+$

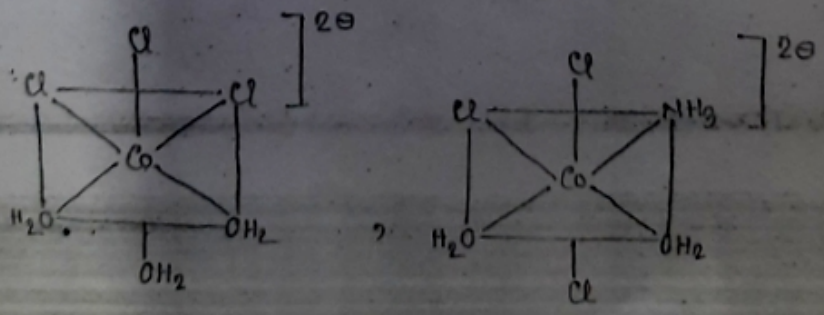


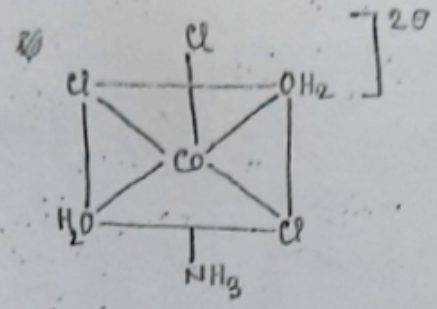
Geo - 2, Optical - 1, Total - 3

vii) $[Co(NH_3)_5Cl]SO_4$

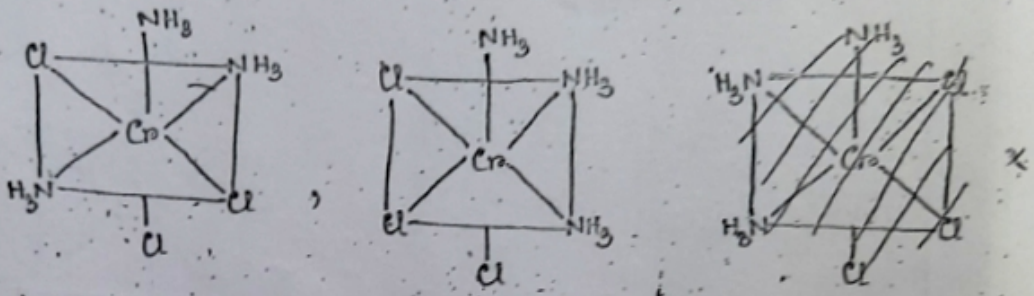


viii) $[CoCl_3(OH)_2NH_3]^{2\ominus}$

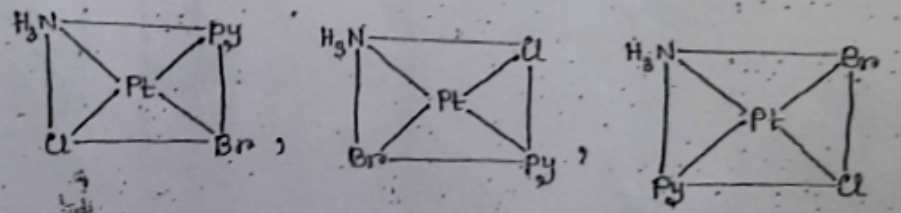




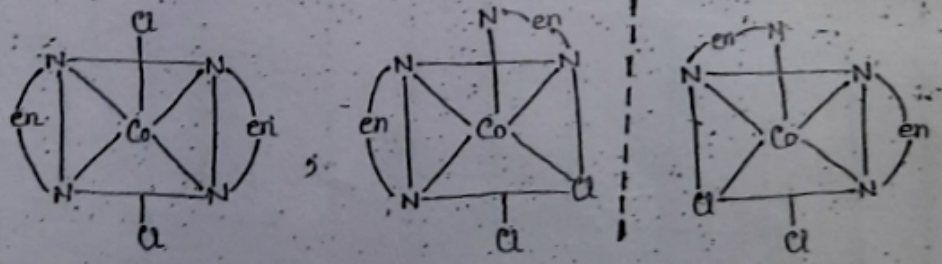
ix) $[Cr(NH_3)_3Cl_3]$



x) $[Pt(NH_3)(Py)(Br)(Cl)]$

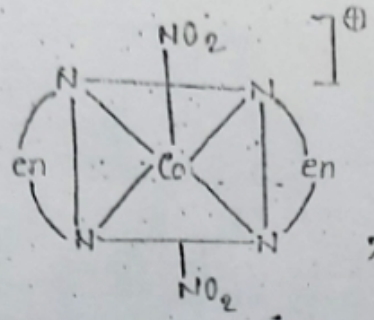


xi) $[Co(en)_2Cl_2]Cl$



Geo - 2 , Optical - 1 , Total - 3

xii) $[Co(en)_2(NO_2)_2]^{\oplus}$



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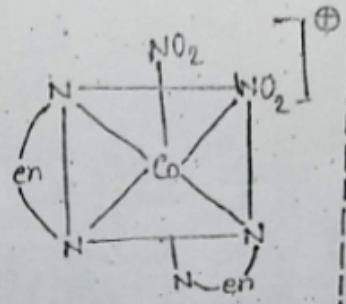

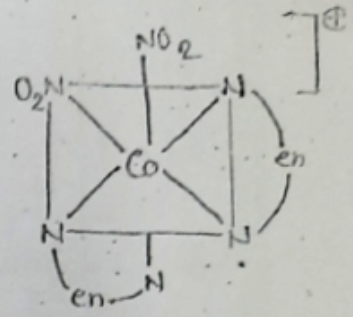

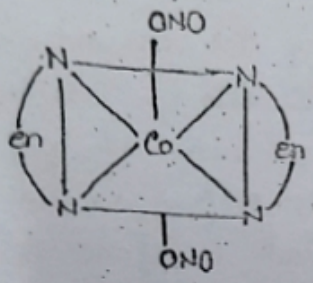

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