

Application of the formation of chelate complex:

Some applications of the formation of chelated complexes are given below:

i) Formation of chelate in analytical chemistry.

Gravimetric estimation and identification of Ni^{2+} ion by dimethylglyoxime.

Estimation of Mg^{2+} and Ca^{2+} ion by EDTA.

ii) Formation of chelate in softening water and estimation of hardness of water.

iii) Formation of chelate for removing poisonous metal from the body.

e.g. Poisonous lead (Pb) can be removed from the body by this process. Injection of $[\text{Ca}(\text{Na}_2\text{EDTA})]$ is given to the patient. This complex reacts with 'Pb' in the body and forms $\text{Pb}[\text{Na}_2\text{EDTA}]$ chelate which is more stable than $[\text{Ca}(\text{Na}_2\text{EDTA})]$ and goes out from the body through urine.

iv) Separation of ions by solvent extraction method.

e.g. Cu^{2+} and Fe^{3+} ion can be separated from other ion by this method. When Cu^{2+} ion is treated with acetylacetonone, the chelate of Cu^{2+} is formed. This chelate $[\text{Cu}(\text{acac})]^\circ$ is extracted with some suitable organic solvents and thus Cu^{2+} ion can be separated from other ions.

v) Role of metal chelates in living system.

e.g. Role of hemoglobin, role of chlorophyll in plants etc.

vi) In food preservation,
 e.g. fruit, fruit juices, etc. now preserves with
 the help of chelating compound.

vii) Estimation of trace amount of transitional
 metal ion.

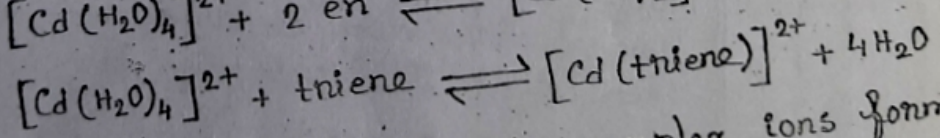
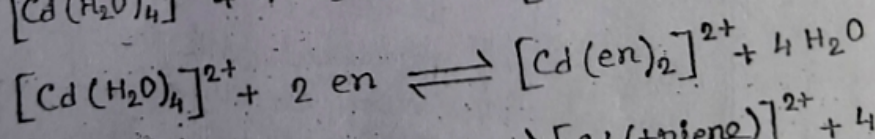
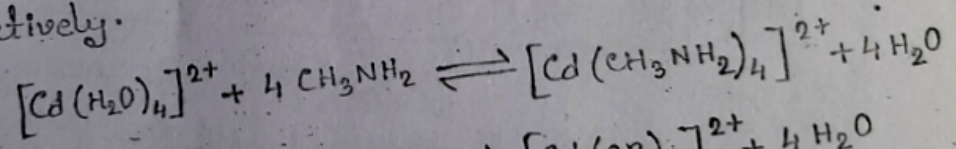
e.g. Trace amount of Fe^{3+} can be estimated by
 forming the intensely colour chelate $[Fe(o-phen)_3]^{3+}$.

Chelate effect: \approx (20/12/100)

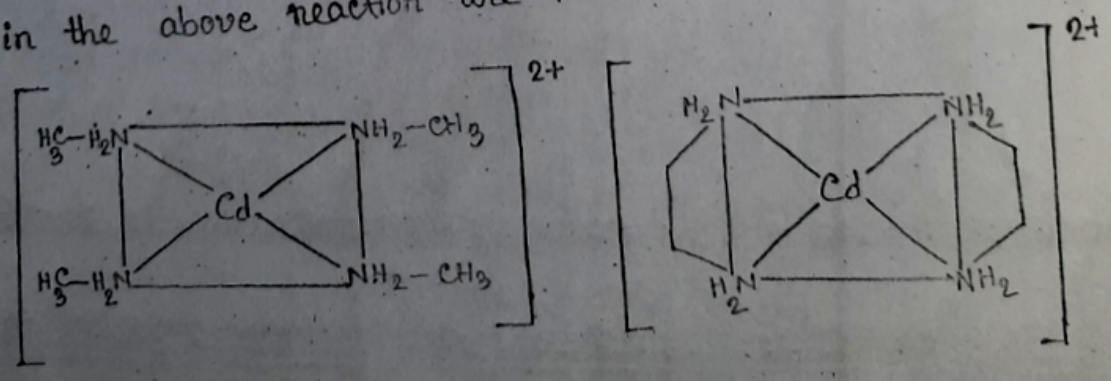
The chelated complexes are known to be
 more stable than the non chelated complexes. This effect
 is known as chelate effect.

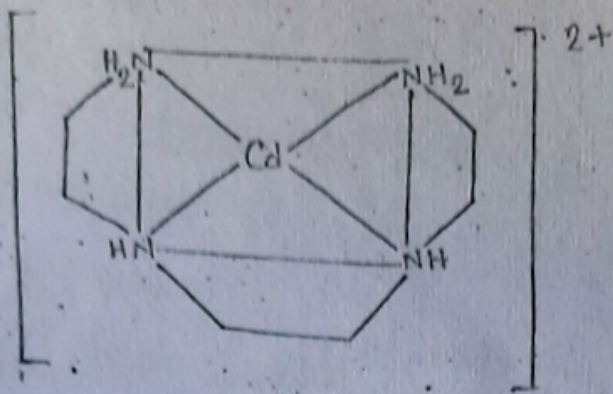
Explanation: \approx v.u

Chelate effect can be explained by considering
 the formation of some non-chelated and chelated complex
 ions of same metal. $[Cd(H_2O)_4]^{2+}$ forms three co-ordinate
 complex ions with CH_3NH_2 , 'en', and triene which are
 formulated as $[Cd(CH_3NH_2)_4]^{2+}$, $[Cd(en)_2]^{2+}$, $[Cd(triene)]^{2+}$
 respectively.

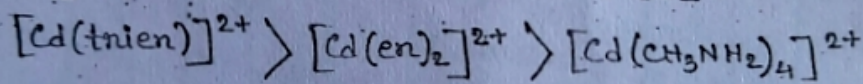


The structures of the complex ions form
 in the above reaction are shown in figure below:





These above structures shows that $[Cd(CH_3NH_2)_4]^{2+}$ has no ring where $[Cd(en)_2]^{2+}$ and $[Cd(triene)]^{2+}$ ions have two and three 5 membered rings respectively, including Cd^{2+} ions. In such complex ions the co-ordination number of Cd^{2+} ion is equal to 4, since CH_3NH_2 , en and $trien$ are the monodentate, bidentate and tetradentate ligand respectively. Since $[Cd(en)_2]^{2+}$ and $[Cd(trien)]^{2+}$ are chelated ions, each of these is more stable than $[Cd(CH_3NH_2)_4]^{2+}$ ion which is a non-chelated ion. It has been found that the stability of these ions are in the order —



Q $[Co(en)_3]^{3+}$ ion is more stable than $[Co(NH_3)_6]^{3+}$ ion?

⇒ $[Co(en)_3]^{3+}$ ion is more stable than $[Co(NH_3)_6]^{3+}$ ion. It is explained with the help of chelate effect. Two factors may be considered to be responsible for such effect. These are given below:

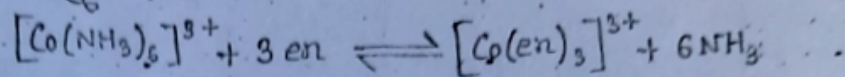
a) Probability factor : ~

The first one is to considered the difference in dissociation between $[Co(en)_3]^{3+}$ and $[Co(NH_3)_6]^{3+}$. If one NH_3 molecule dissociates it has little probability for returning to its former site. But if one of the $-NH_2$ group of 'en' dissociates, the ligand is retained by the other end still attached to the metal. The dissociated 'N' atom can move only a few picometers away and can swing back and attached to the

metal ion. Thus the chelate has a smaller probability of dissociation than the non chelate complex.

b) Thermodynamic factor %

The second one is to consider the following equation:



Since the bonding of NH_3 and 'en' is very similar, ΔH for this reaction should be approximately zero. The change in entropy of this reaction will be proportional to the difference in the no. of particles present in the system. The reaction proceeds to the right with an increase in no. of particles. Hence entropy factor favours the production of chelate complex. Hence $[\text{Co}(\text{en})_3]^{3+}$ is more stable than $[\text{Co}(\text{NH}_3)_6]^{3+}$ ion.

① Inner-metallic complexes %

Def ✓ (There are some chelating ligands which contain a neutral donor group and an acidic donor group in their structure and they satisfy both the primary and secondary valency of the metal ion and form neutral chelate. Such chelates are known as inner metallic complexes or simply inner complexes of first order.)

These chelate compounds are non-electrolyte with very low solubility in water and with high solubility in organic solvent.

Examples of ligands which form inner metallic complexes are acetylacetonate (acac), glycine (gly-H), dimethylglyoxime (DMG-H) and the complexes are $[\text{Pt}(\text{gly})_2]^\ominus$, $[\text{Ni}(\text{DMG})_2]^\ominus$, $[\text{Co}(\text{acac})_2]$, $[\text{Co}(\text{gly})_3]$, $[\text{Co}(\text{acac})_3]$ etc.

When the chelating ligand containing both neutral and acidic donor group, can not satisfy the primary valency of the metal ion, the resulting complex itself becomes an ion and requires other ion

for charge neutralisation. The complex formed is known as inner complex of second order.

e.g. $[\text{Si}(\text{acac})_3] \text{Cl}$, $[\text{B}(\text{acac})_2][\text{FeCl}_4]$, $\text{K}[\text{Pt}(\text{acac})\text{Cl}_2]$ etc.

① Properties of innermetallic complexes:

The properties of inner metallic complexes are given below:

i) Many of them are insoluble in water but may be extracted into organic solvents.

ii) There is sometimes pronounced colour changes during the formation of inner complexes. This permit colourimetric measurements.

iii) Most of the inner complexes have no melting point and are volatile.

① Application of inner metallic complexes:

Some application of inner metallic complexes are given below:

i) Formation of inner metallic complexes in analytical chemistry.

a) Gravimetric estimation and identification of Ni^{2+} by dimethylglyoxime.

b) Estimation of Mg^{2+} and Ca^{2+} ion by EDTA.

ii) Formation of inner-metallic complexes in softening water and estimation of hardness of water.

iii) Formation of inner-metallic complexes for removing poisonous metal from the body.

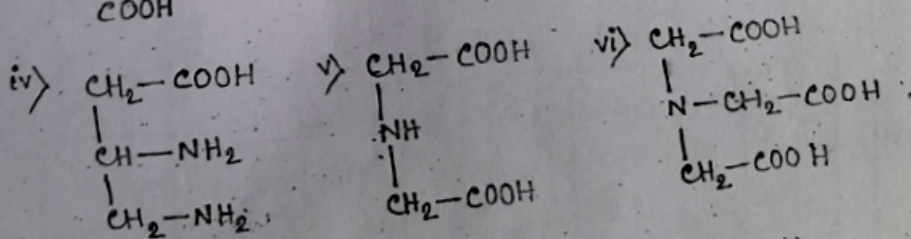
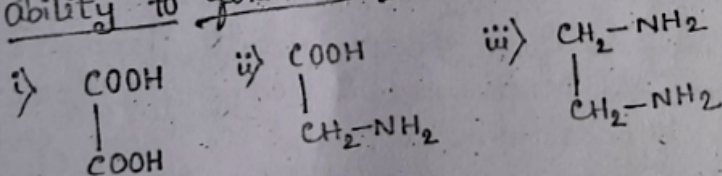
e.g. Poisonous Pb can be removed from the body by this process. Injection of $\text{Ca}[\text{Na}_2\text{EDTA}]$ is given to the patient. This complex reacts with

'Pb' in the body and formed $Pb[Na_2EDTA]$ inner metallic complex which is more stable than $Ca[Na_2EDTA]$ inner metallic complex and goes out from the body through urine.

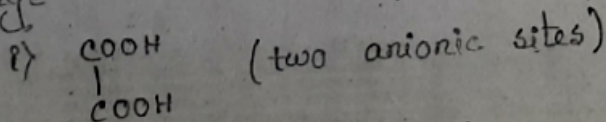
iv) Separation of ions by solvent extraction method, e.g.; Cu^{2+} and Fe^{3+} ion can be separated from other ion by this method. When Cu^{2+} ion is treated with acetylacetonone, Cu^{2+} ion is a inner metallic complex is formed. This inner-metallic complex $[Cu(acac)]^0$ is extracted with some suitable organic solvents and thus Cu^{2+} ion can be separated from other ions.

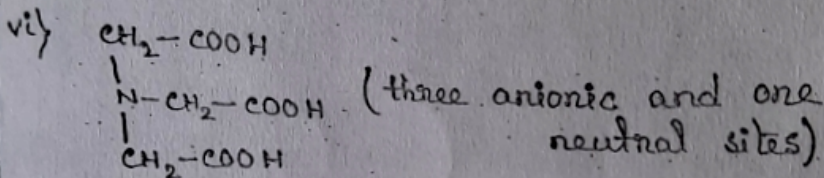
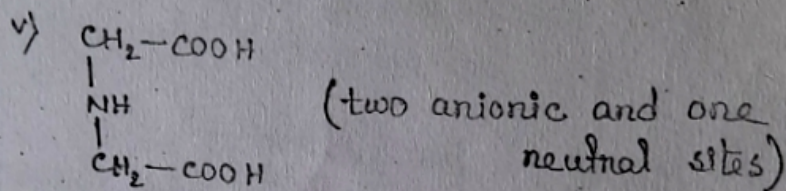
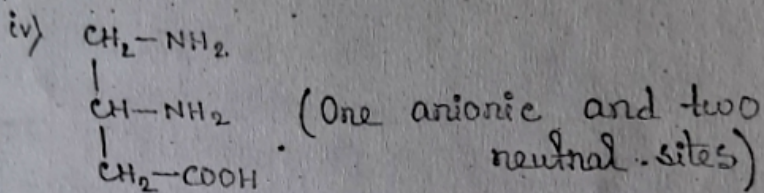
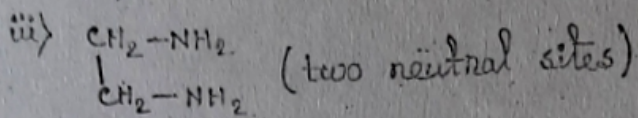
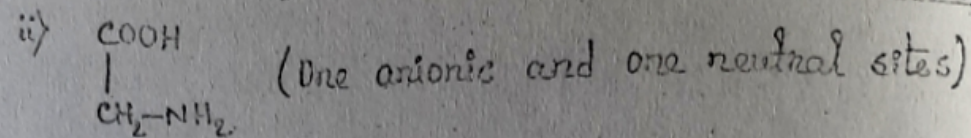
v) In food preservation —
e.g.; fruit, fruit juices etc. now preserves with the help of inner-metallic complexes.

Q Which of the following chelating ligands have the ability to form inner-metallic complex with Co^{2+} & Co^{3+} ion?



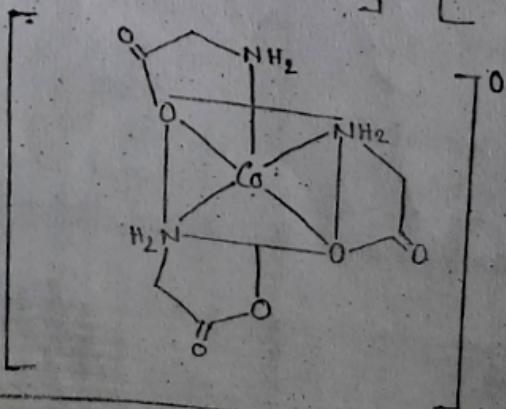
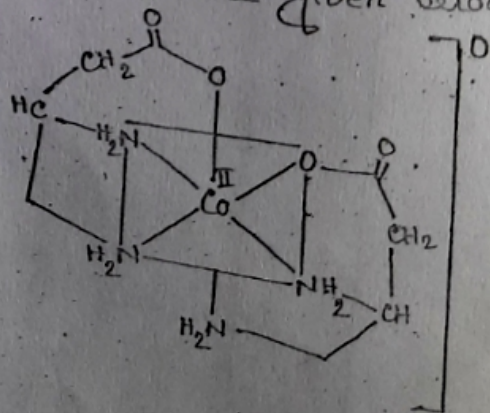
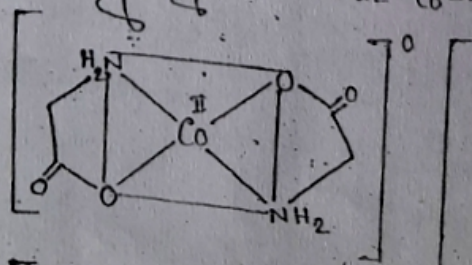
⇒ According to Werner's co-ordination theory the co-ordination no. of Co^{2+} is 4 and 6 but Co^{3+} is only 6. He we shall considered the inner complexes of first order only, i.e.; in each of the complexes the co-ordination no. of the metal ion and the balance of charge must be considered. The given ligands are —





Therefore to maintain the charge and co-ordination number, the ligand ii) and iv) have the ability to form the inner metallic complex with Co^{2+} ion.

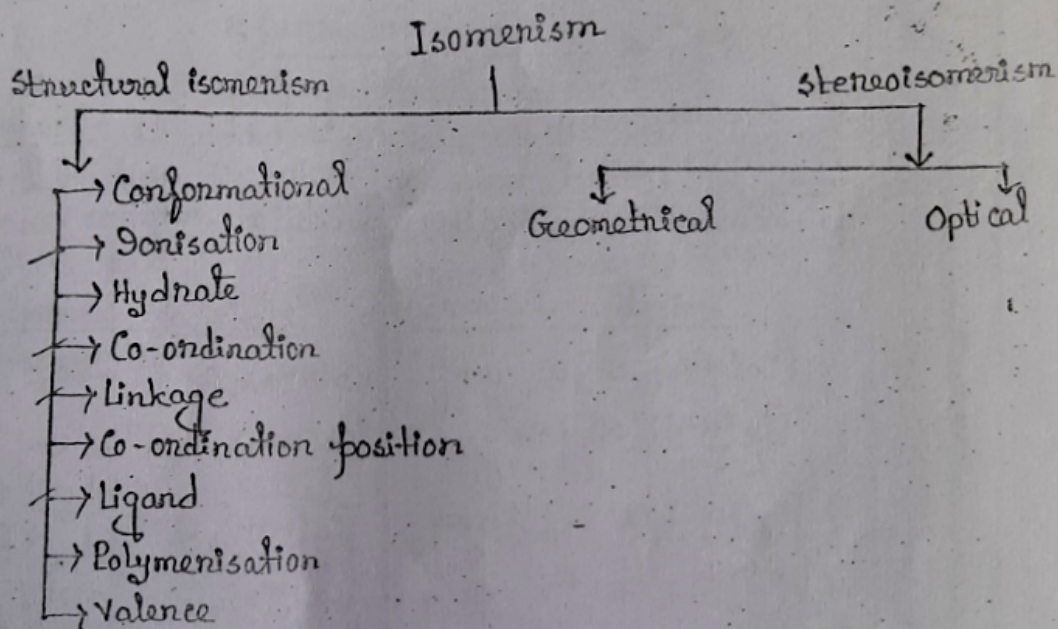
On the same reason, the ligand ii) has the ability to form inner metallic complex with Co^{3+} ion. Hence the inner metallic complexes formed by the chelating ligands with Co^{2+} and Co^{3+} are given below:



Isomerism of co-ordination compound

The co-ordination compounds which have the same molecular formula but have their ligand attached to the central metal atom in different ways, are called isomer. Isomers have different properties. The phenomenon that gives rise to different isomer is called isomerism.

Different types of isomerism in complex compound may be classified as follows:



A. Structural isomerism

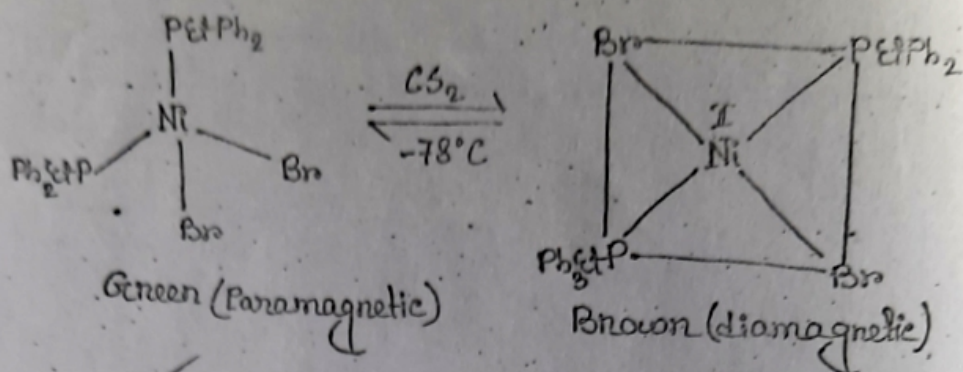
These isomerism arises due to the difference in the structures of complex compounds. This isomerism is of the following types:

a) Conformational isomerism

In this isomerism, the two isomers have different geometries:

e.g. $[\text{Ni}(\text{P}(\text{C}_6\text{H}_5)_2)_2\text{Br}_2]$ complex gives two conformational isomer. One of these is green and paramagnetic while the other is brown and diamagnetic. The green form is tetrahedral while the brown form is

square planar. Thus these have different geometries, but the co-ordination no. of Ni^{2+} in both the isomer is 4. This type of isomerism is also called polytopal isomerism.



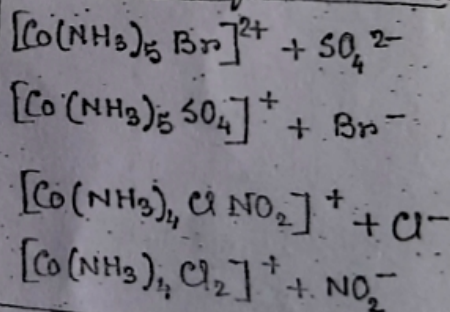
b) Ionisation isomerism :

Compounds having the same molecular formula but dissociates in solution to produce different ion are called ionisation isomers and the phenomenon is known as ionisation isomerism.

Ionisation isomers

- i) $[Co(NH_3)_5 Br] SO_4$ and $[Co(NH_3)_5 SO_4] Br$
- ii) $[Co(NH_3)_4 Cl NO_2] Cl$ and $[Co(NH_3)_4 Cl_2] NO_2$

Mode of ionisation

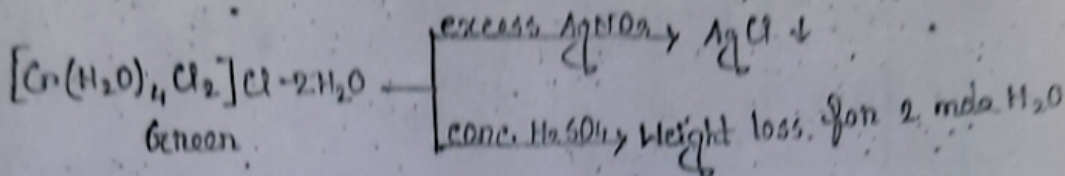
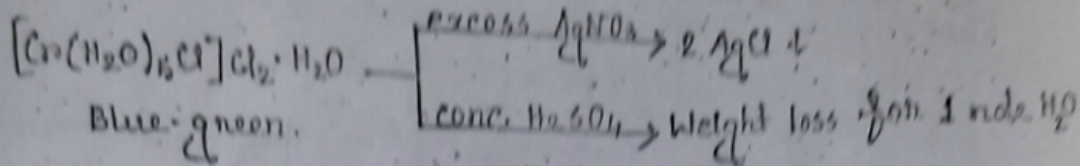
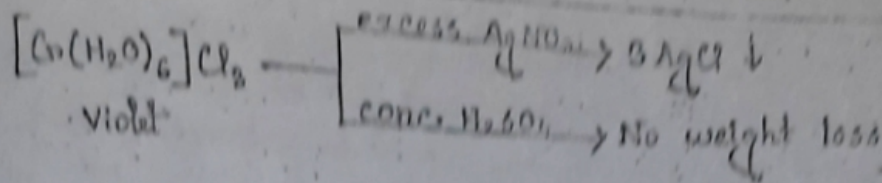


c) Hydrate isomerism :

The compounds having same molecular formula but different no. of water molecule in the first and second co-ordination sphere, are called hydrate isomers and the phenomenon is known as hydrate isomerism.

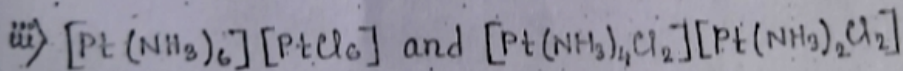
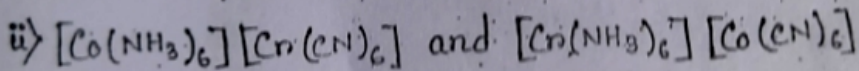
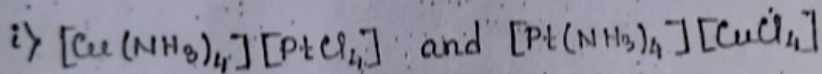
$CrCl_3 \cdot 6H_2O$ exists in three hydrate isomers which are $[Cr(H_2O)_6] Cl_3$, $[Cr(H_2O)_5 Cl] Cl_2 \cdot H_2O$ and $[Cr(H_2O)_4 Cl_2] Cl \cdot 2H_2O$.

These have different physical and chemical properties —



d) Co-ordination isomerism :-

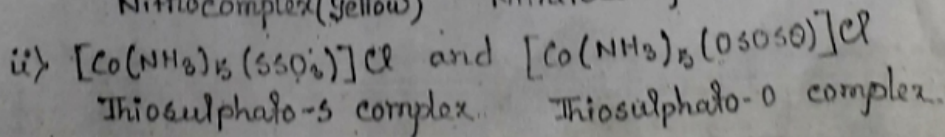
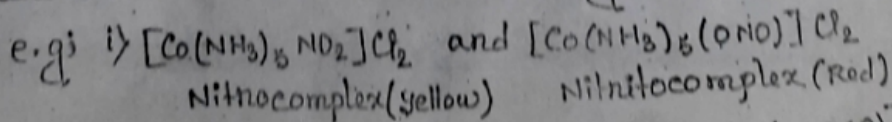
This type of isomerism is shown by those complex compounds which are composed of complex cations and complex anions. Ligands may be interchange between the complex cationic and anionic part of a compound to



e) Linkage isomerism :-

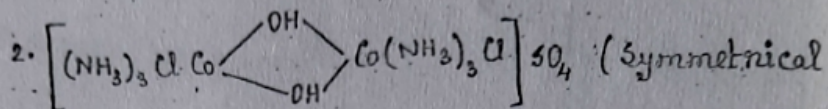
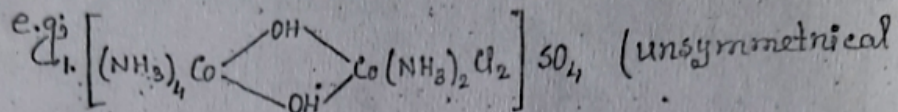
The ligands which have two or more donor atoms but in forming complexes only one donor atom is attached to the metal ion at a given time, such ligand are called ambidentate ligands.

Different modes of co-ordination of this ligand to the same metal ion produce linkage isomers and the phenomenon is known as linkage isomerism.

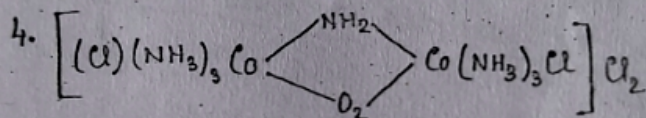
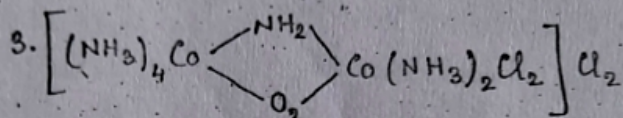


⤷ Co-ordination position isomerism ∴

This type of isomerism is shown by those complex compound which contain bridging ligand. This type of isomerism arises when the non-bridging ligand are differently placed around the metal ion.



Thus the compounds (1) and (2) are the co-ordination position isomers to each other.

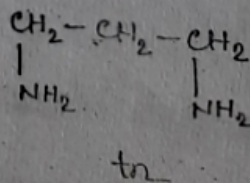
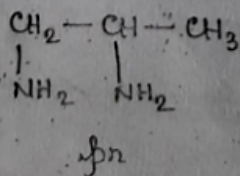


Compounds (3) and (4) are also the co-ordination position isomers to each other.

⤷ Ligand isomerism ∴

There are certain ligand which exist as isomers.

e.g. Diammine derivatives of propane exists in two isomeric forms which are called 1,2-diammine propane or propylene diammine (pn) and 1,3-diammine propane or trimethylene diammine (tn). The structures of 'pn' and 'tn' are given above —



'pn' and 'tn': both are bidentate ligand. When these ligand get co-ordinated to the metal atom, two isomers are obtained. These are called ligand isomers and the phenomenon is called ligand isomerism.

$[Co(pn)_2Cl_2]Cl$ and $[Co(tn)_2Cl_2]Cl$ are ligand isomers.

ii) Polymerisation isomerism°

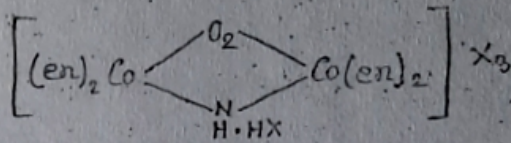
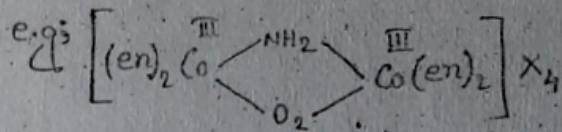
This type of isomerism is found in those complex compounds whose formula appear to be polymers of some simple complex compound. All these complex compounds have the same ratio of different metal atoms and ligand in them.

e.g: The following complex compounds are polymerisation isomers to each other, since (2) and (3) compounds appeared to be dimer of (1) and compound (4) appears to be the pentamer of comp. (1). The ratio $Co^{3+} : NH_3 : NO_2^-$ in all the compounds is 1:3:3.

<u>Complex</u>	<u>Number of ligands</u>		
	<u>Co^{3+}</u>	<u>NH_3</u>	<u>NO_2^-</u>
1. $[Co(NH_3)_3(NO_2)_3]$	1	3	3
2. $[Co(NH_3)_6][Co(NO_2)_6]$	2	6	6
3. $[Co(NH_3)_4(NO_2)_2][Co(NH_3)_2(NO_2)_4]$	2	6	6
4. $[Co(NH_3)_5(NO_2)_3]_5[Co(NO_2)_6]_2$	5	15	15

ix) Valence isomerism°

The term was used by Werner to complex species in which the same group is held in one compound by primary valency and in another compound by secondary valency.



B. Stereoisomerism

When the compounds contain the same ligands co-ordinated to the same central metal ion but the arrangement of ^{ligand} in space is different, then the compounds are said to be stereoisomers and the phenomenon is known as stereoisomerism.

Stereoisomerism is two types. These are —

- Geometrical isomerism or cis-trans isomerism
- Optical isomerism or mirror image isomerism.

Geometrical isomerism

The complex compounds which have the same ligands in co-ordination sphere but the relative position of the ligand around the central metal ion is different, are called geometrical isomers and the phenomenon is called geometrical isomerism.

In a given complex compound the two ligands may occupy the positions either adjacent to each other or opposite to each other. The complex compounds having the two ligands occupying the adjacent position to each other is called cis isomer while that in which the two ligands occupy the opposite positions, is called trans isomer. Thus geometrical isomerism is called cis-trans isomerism.

Geometrical isomerism is not found in the complex compound with co-ordination no. two and three, since in this cases all the positions

occupied by the ligands around the central metal atom are adjacent to one another. Geometrical isomerism is not most common with the complexes having co-ordination no. 4 and 6.

① Geometrical isomerism in four co-ordinated complexes \approx Complexes having central atom with co-ordination no. 4, may have either tetrahedral or square planar geometry. Geometrical isomerism can not be shown by tetrahedral complex since all the four ligands in this geometry have adjacent position to one another and all the four bond angles are the same.

② Geometrical isomerism in square planar complexes \approx

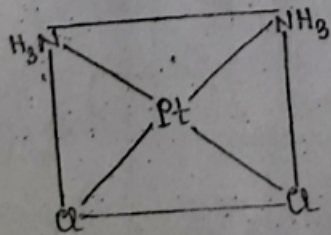
a) $[Ma_4]$, $[Ma_3b]$, $[Ma_2b_2]$ type complexes \approx

square planar complexes of this type do not show geometrical isomerism, since all the possible arrangements of four ligands around the central metal atom is the same.

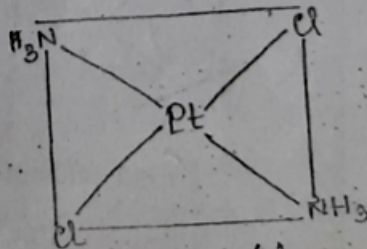
b) $[Ma_2b_2]$ type complexes \approx

Here M = metal ion, 'a' and 'b' are monodentate ligands. Complexes of this type can exist in cis and trans isomers.

e.g. $[Pt(NH_3)_2Cl_2]$, $[Pt(Py)_2Cl_2]$ etc.



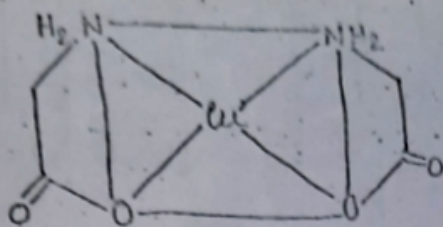
Cis (a)



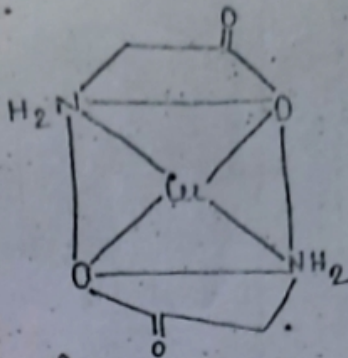
Trans (b)

Fig: Cis and trans isomers of $[Pt(NH_3)_2Cl_2]$.

e.g. $[Pt(gly)_2]^0$, $[Cu(gly)_2]^0$ etc.



Cis



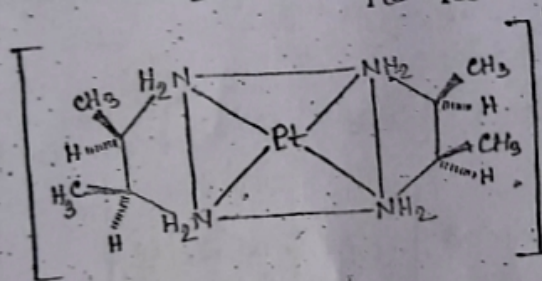
Trans

Fig: - Cis & trans isomers of $[Cu(gly)_2]^0$.

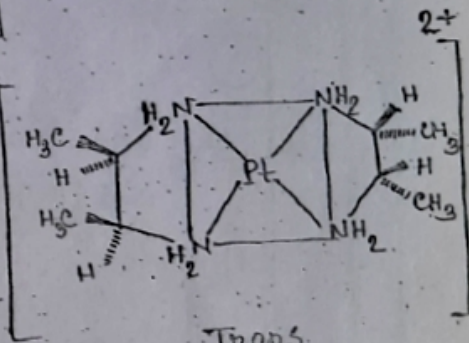
→ $[M(AA)_2]$ type complexes $^{\circ} \approx$

Such type of complexes also have cis and trans isomers. Here 'AA' represents the bidentate ligand containing chiral centres.

e.g. $[Pt(NH_2-CH(Me)-CH(Me)-NH_2)_2]^{2+}$

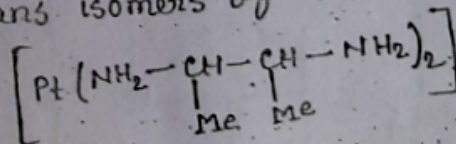


Cis



Trans

Fig: - Cis and trans isomers of



→ $[M_2a_2b_4]$ type complexes $^{\circ} \approx$

Here M is the metal ion, A and B are monodentate ligands, B also acts as a bridging ligand. This type of bridged binuclear square planar complexes exist in cis and trans isomers as well as the unsymmetrical isomer.

e.g. $[Pt_2(PET)_2Cl_4]^0$

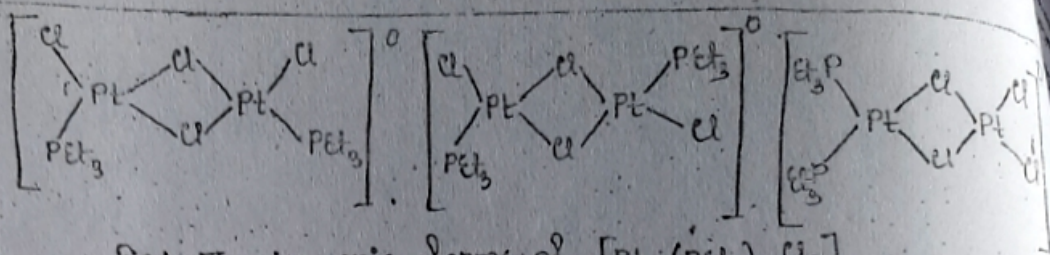


Fig:- The isomeric forms of $[Pt_2(PEt_3)_2Cl_2]$.

Geometrical isomerism in octahedral complexes:

a) $[Ma_6]$, $[Ma_5b]$, $[M(AA)_3]$ type complexes:

These type of complexes do not exhibit geometrical isomerism.

b) $[Ma_4b_2]$ type complexes:

(A)

This type of complexes exist in cis and trans isomers.

e.g. $[Co(NH_3)_4Cl_2]^+$, $[Co(NH_3)_4(NO_2)_2]^+$ etc.

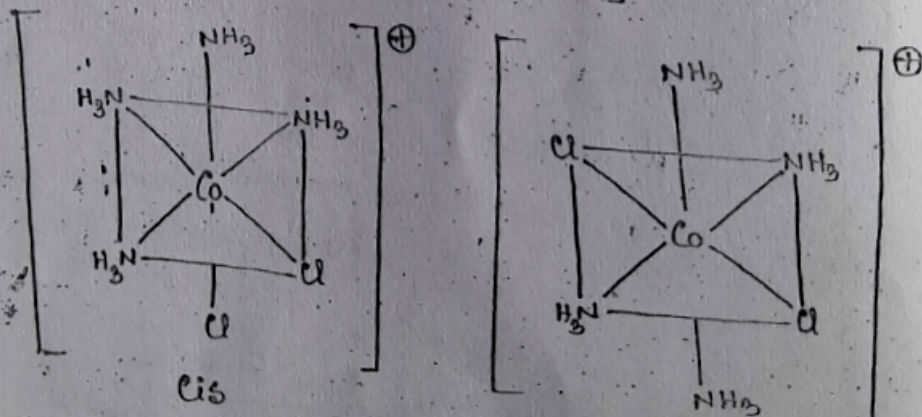


Fig:- Cis & trans isomers of $[Co(NH_3)_4Cl_2]^+$

c) $[Ma_4bc]$ type complexes:

This type of complexes also exist in cis and trans isomers.

e.g. $[Co(NH_3)_4(H_2O)(Cl)]^{2+}$

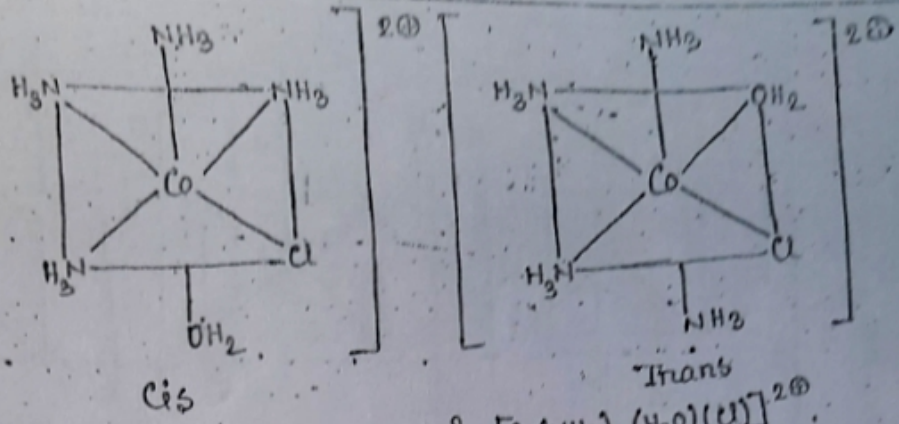


Fig:- Cis and trans isomers of $[Co(NH_3)_4(H_2O)Cl]^{2+}$.

d) $[Ma_3b_3]$ type complexes:

This type of complexes exhibits two geometrical isomers;

- i) The ligands of one type may form an equatorial triangle on one of the faces, called facial or 'Fac' isomer.
- ii) The ligands of one type may occupy three positions such that two are trans to each other, is called meridional or 'Mer' isomer.

e.g. $[Cr(NH_3)_3Cl_3]^0$, $[Co(NH_3)_3Cl_3]^0$ etc.

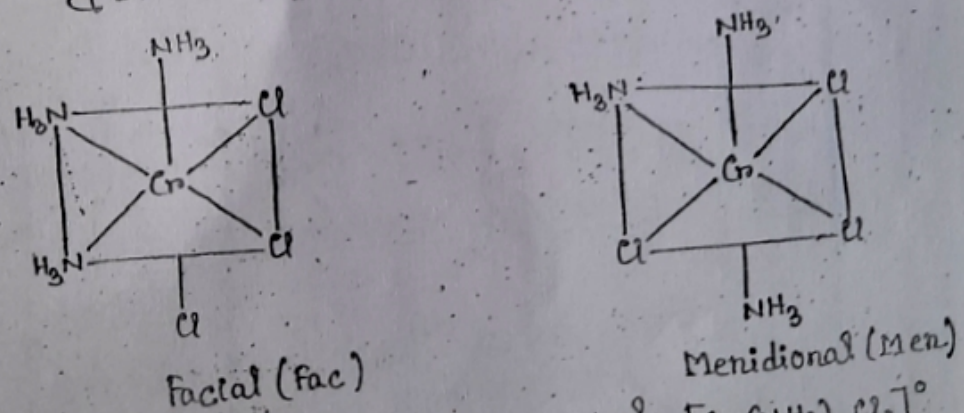


Fig:- Facial and Meridional isomers of $[Cr(NH_3)_3Cl_3]^0$.

e) $[Ma_2b_2c_2]$ type complexes:

This type of complexes exhibits five geometrical isomers.

e.g. $[Co(NH_3)_2Cl_2Br_2]^\ominus$, $[Pt(NH_3)_2(Py)_2Cl_2]^{2\oplus}$ etc.

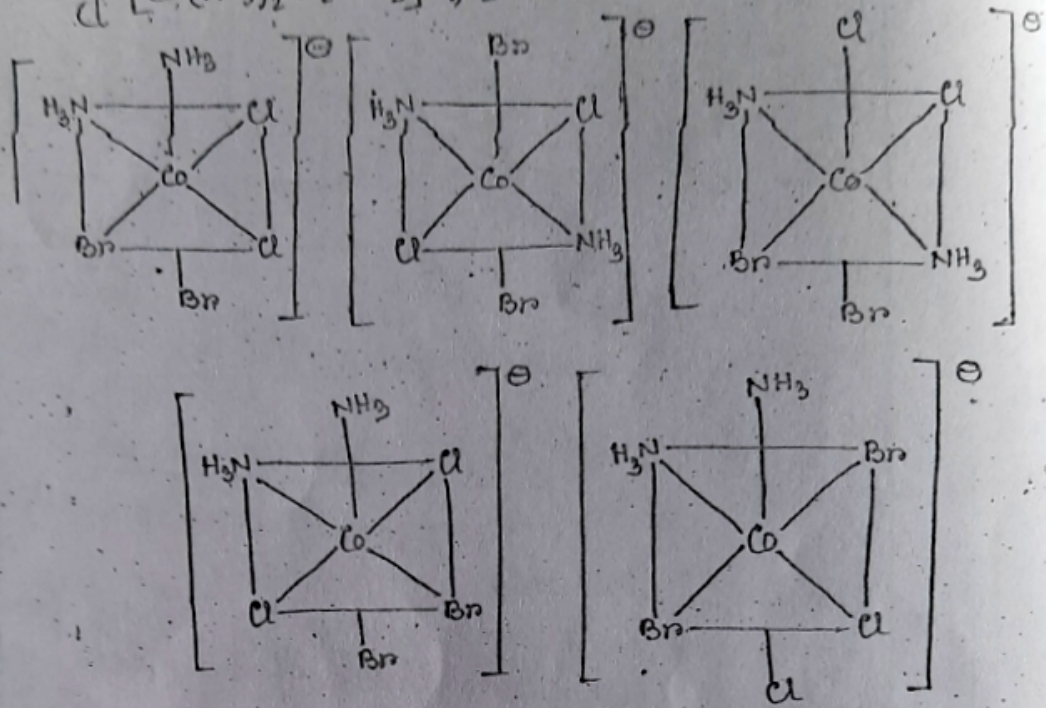
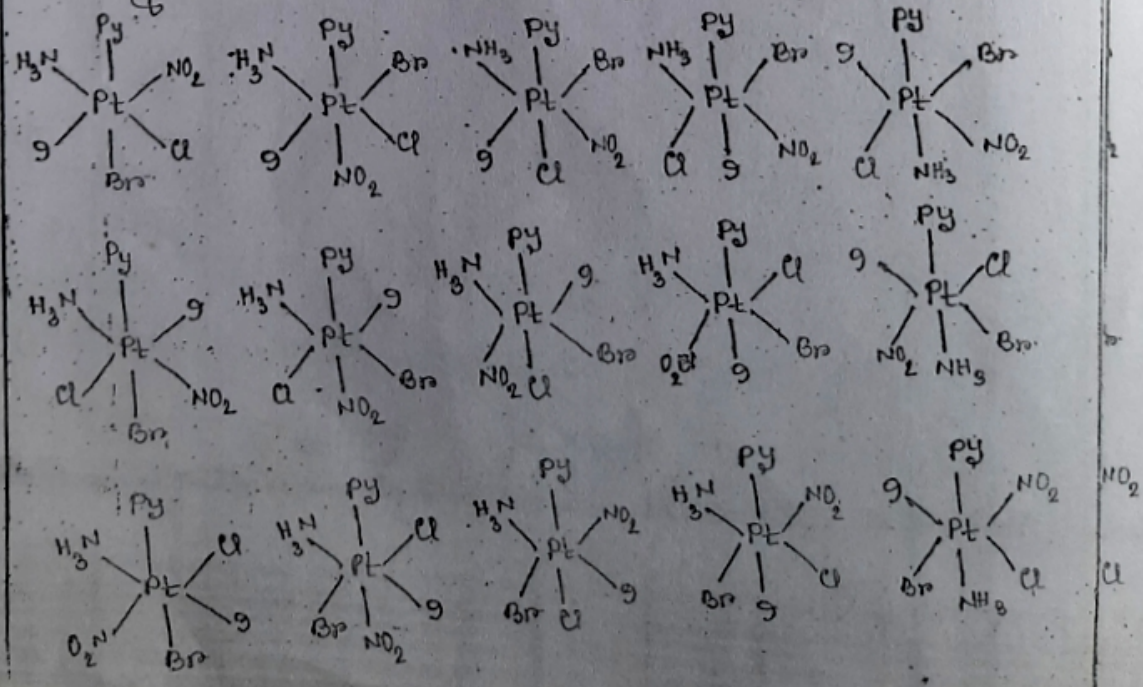


Fig.:- Five isomers of $[Co(NH_3)_2Cl_2Br_2]$.

[Mabcdef] type complexes

Octahedral complexes which have different monodentate ligands exhibit 15 isomers. (geometrical).

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



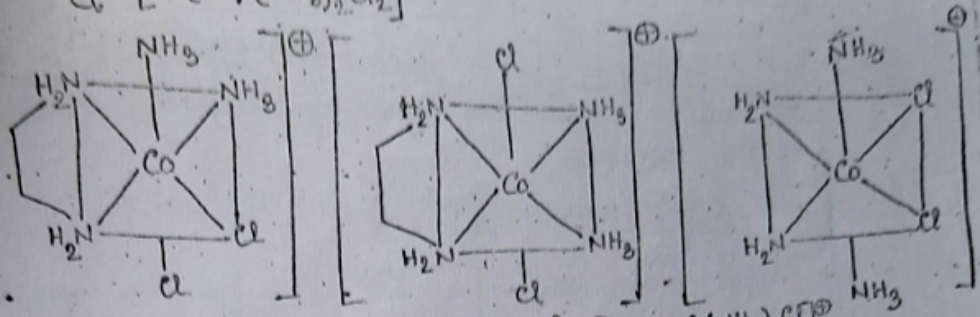
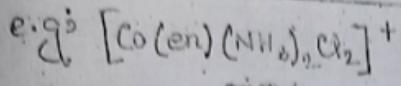


Fig.:- Three geometrical isomers of $[Co(en)(NH_3)_2Cl_2]^+$.

(i) $[M(AB)_3]$ type complexes

Here 'AB' represents an unsymmetrical bidentate ligand in which 'A' and 'B' are two different co-ordinating atoms. Complexes of this type exist in two geometrical isomers.

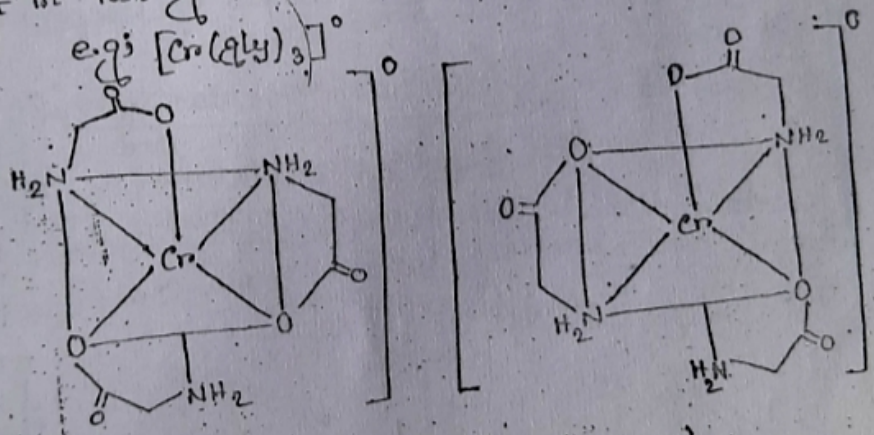
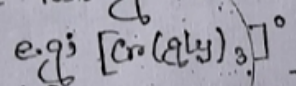
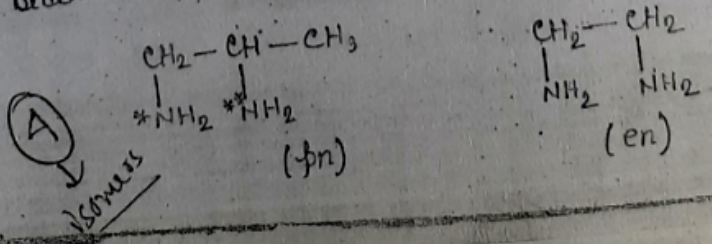


Fig.:- Two isomers of $[Cr(gly)_3]^0$ complex.

(ii) Octahedral complexes containing optically active bidentate ligand

e.g. $[Co(en)(pn)(NO_2)_2]^0$ is an important example of such type of complexes. Here 'en' and 'pn' are ethylene diamine and 1,2-diaminopropane respectively. Both of these ligands are bidentate and their structures are given below:



g) $[M(AA)_2a_2]$ type complexes: ~

Here 'AA' represents a symmetrical bidentate ligand. This type of complexes exist in cis and trans isomers.

e.g. $[Co(en)_2(NH_3)_2]^{3+}$, $[Cr(en)_2Cl_2]^+$ etc.

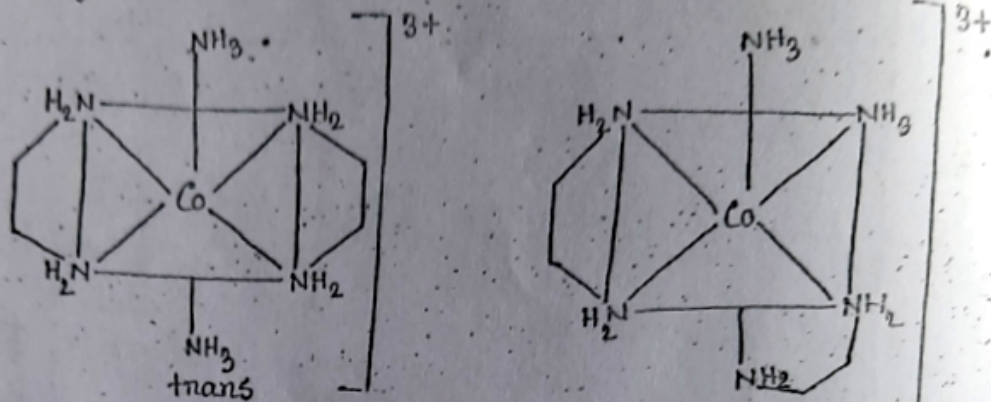


Fig:- Two geometrical isomers of $[Co(en)_2(NH_3)_2]^{3+}$ complex.

h) $[M(AA)_2ab]$ type complexes: ~

Here 'AA' represents a symmetrical bidentate ligand. This type of complexes exist in cis and trans isomers.

e.g. $[Co(en)_2(NH_3)Cl]^{2+}$

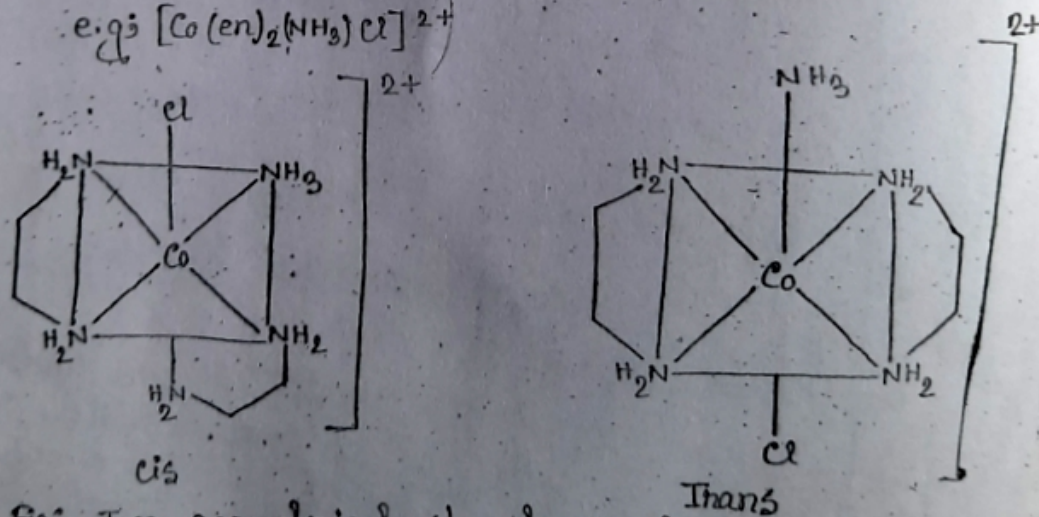


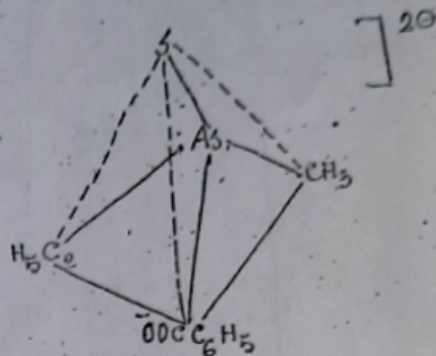
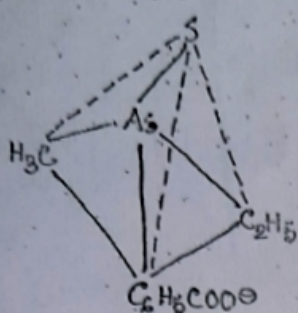
Fig:- Two geometrical structures of $[Co(en)_2(NH_3)Cl]^{2+}$

i) $[M(AA)_2a_2b_2]$ type complexes: ~

Complexes of this type exist in three geometrical isomers.

is expected to produce a pair of enantiomers.

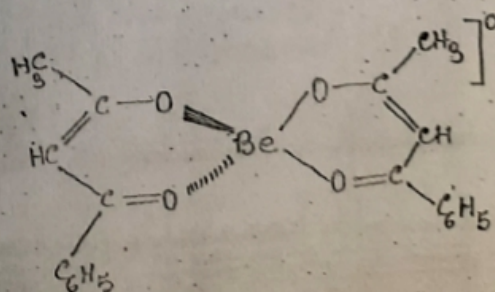
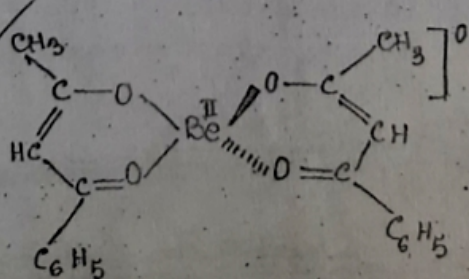
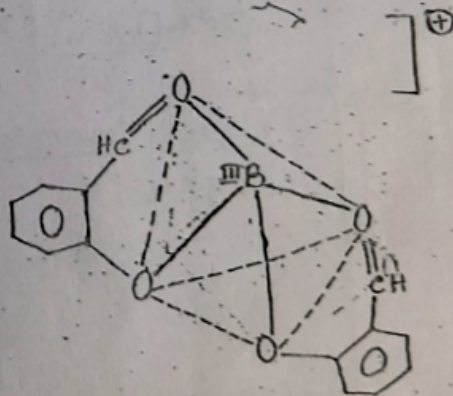
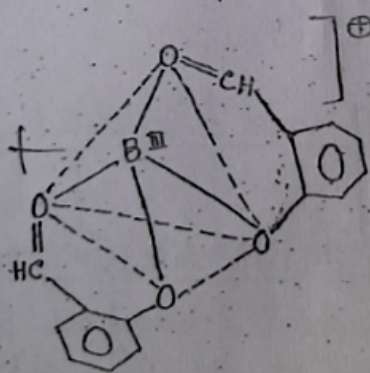
e.g. $[As^{III}(Me)(Et)(S)(C_6H_5COO^-)]^{2-}$ exist in two optical isomers as shown in figure below:



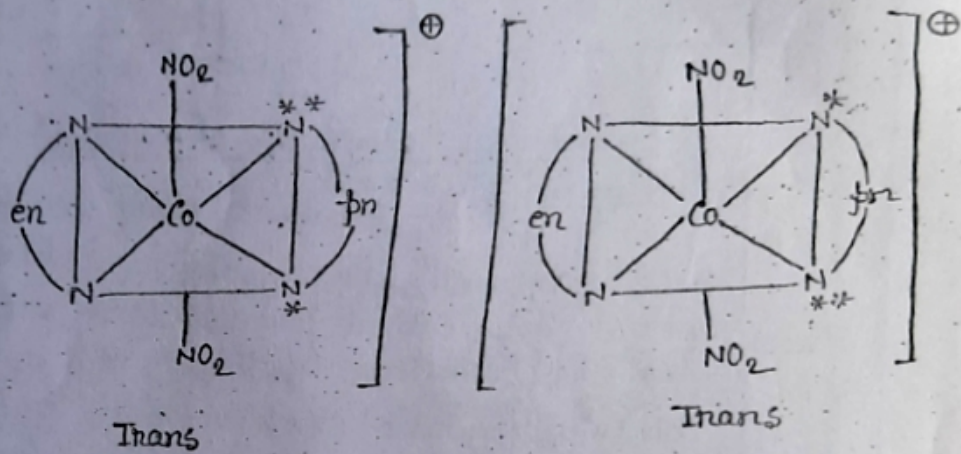
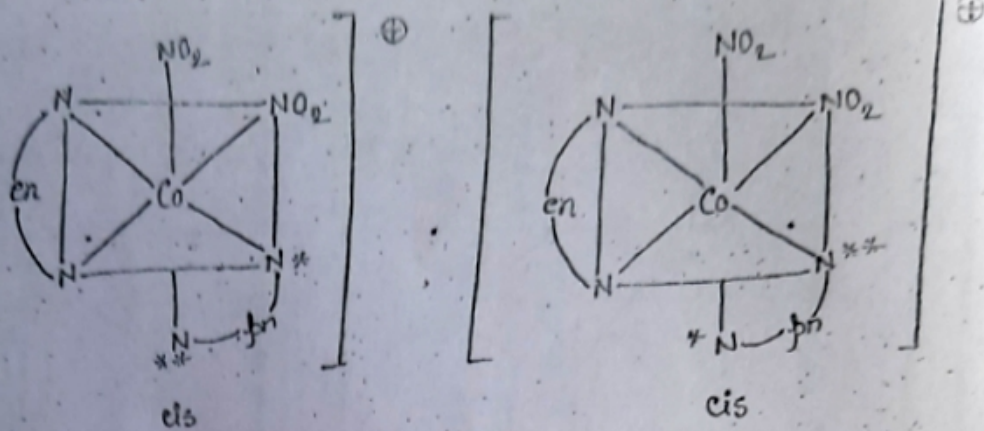
Mirror plane

Tetrahedral complexes of symmetrical bidentate ligand:

$Be(II)$, $B(III)$, $Zn(II)$ with symmetrical bidentate ligand resolves into optical isomers. Some examples of tetrahedral complexes of this type are —
 bis(salicylaldolato) $B(III)$ ion and bis(benzoylacetonato) $Be(II)$ ion whose optical isomers are given below;



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



ii) Optical isomerism \approx

1) Optical isomerism in four co-ordinated tetrahedral complexes \approx

a) $[Ma_4]$, $[Ma_2b_2]$, $[Ma_3b]$ type complexes \approx

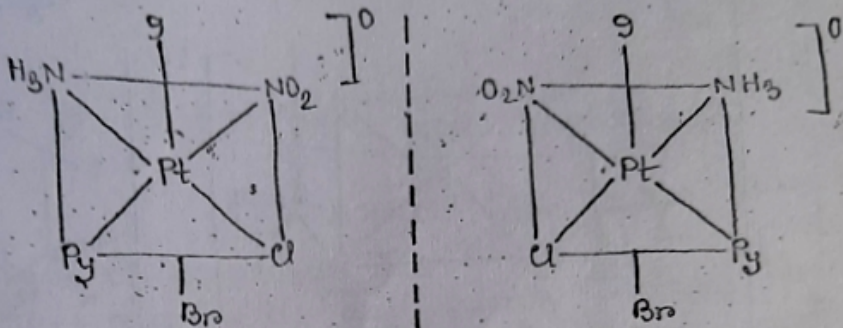
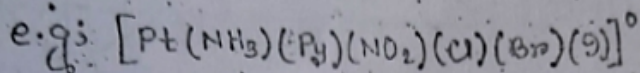
Tetrahedral complexes of $[Ma_4]$, $[Ma_2b_2]$ and $[Ma_3b]$ type are not able to show optical isomerism. Because all the possible arrangements of the ligands around the central metal ion are exactly equivalent.

b) $[Mabcd]$ type complexes \approx

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

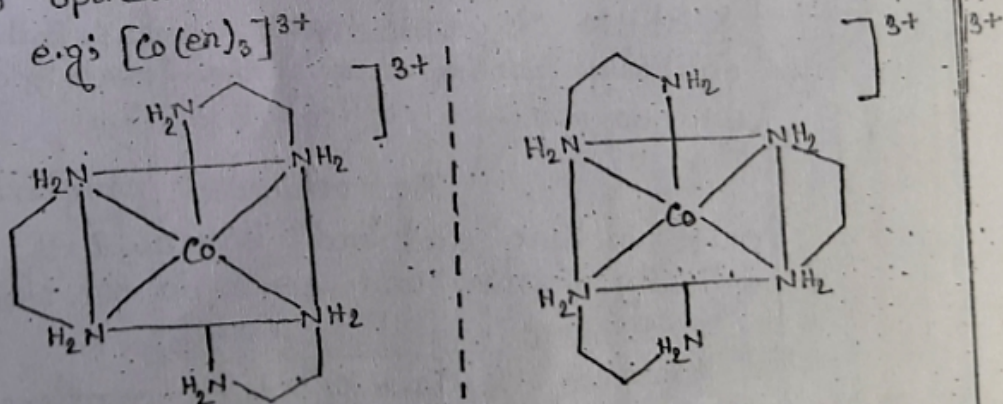
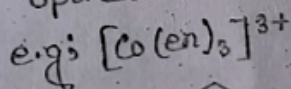
c) $[Mabcdef]$ type complexes: \approx

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:



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

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

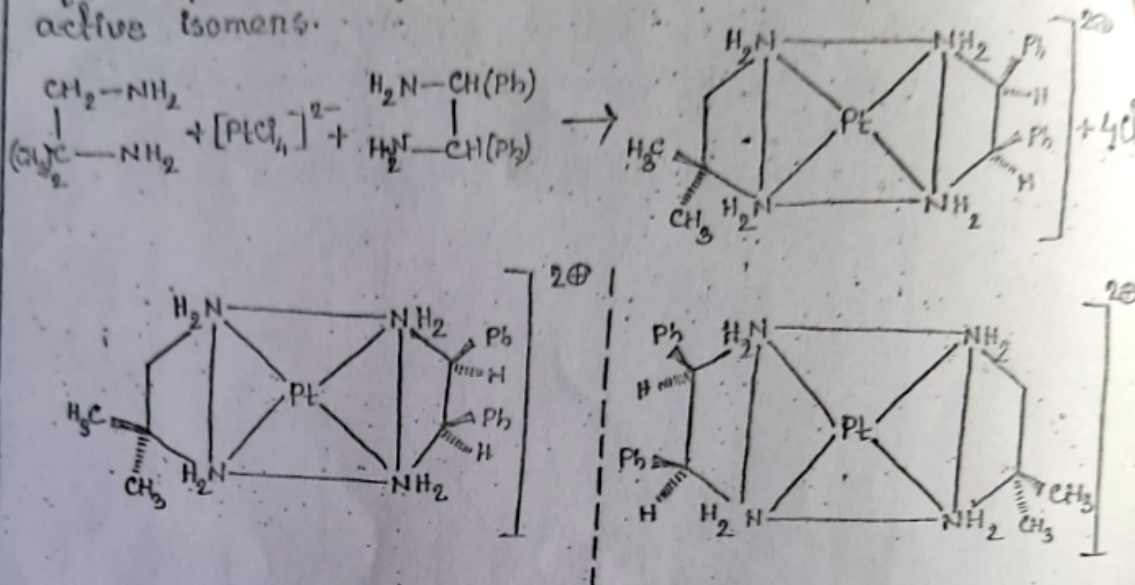


e) $[M(AA)_2(a_2)]$ type complexes: \approx

$[Co(en)_2Cl_2]^+$ 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

① Optical isomerism in square planar complexes:

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



② Optical isomerism in octahedral complexes:

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

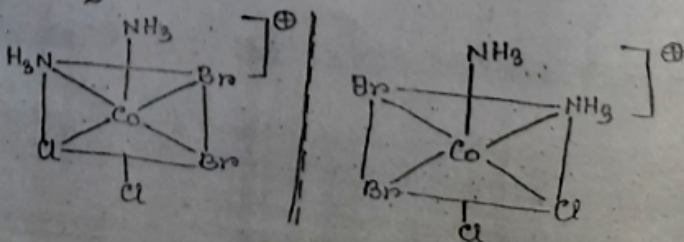
The octahedral complexes of $[Ma_4b_2]$ type exist in cis and trans isomers. Both the isomers are optically inactive due to the presence of a plane of symmetry and do not show optical isomerism.

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.

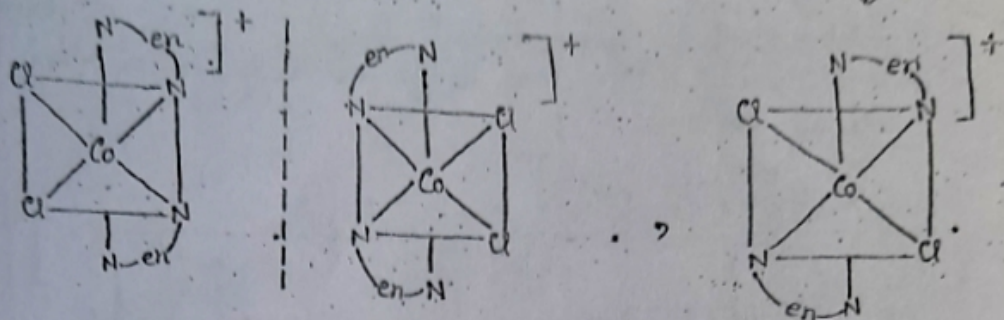
ii) $[Ma_2b_2c_2]$ type complexes:

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. $[Co(NH_3)_2Br_2Cl_2]^+$

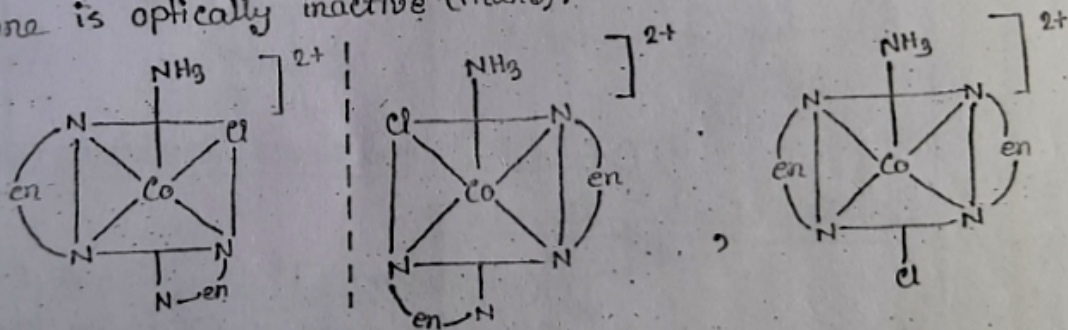


isomer has plane of symmetry and hence is optically inactive. Consequently this ion has 3 isomers, two are optically active (cis) and one is optically inactive (trans).



8) $[M(AA)_2ab]$ type complexes

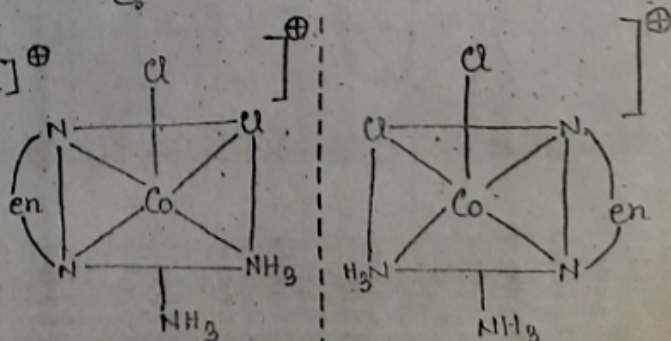
$[Co(en)_2NH_3Cl]^{2+}$ ion is an example of this type of complexes. This ion shows two geometrical isomers — one is cis and another is trans form. This cis isomer does not have any plane of symmetry and hence is optically active. On the other hand the trans isomer has plane of symmetry and hence is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



9) $[M(AA)_2a_2b_2]$ type complexes

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

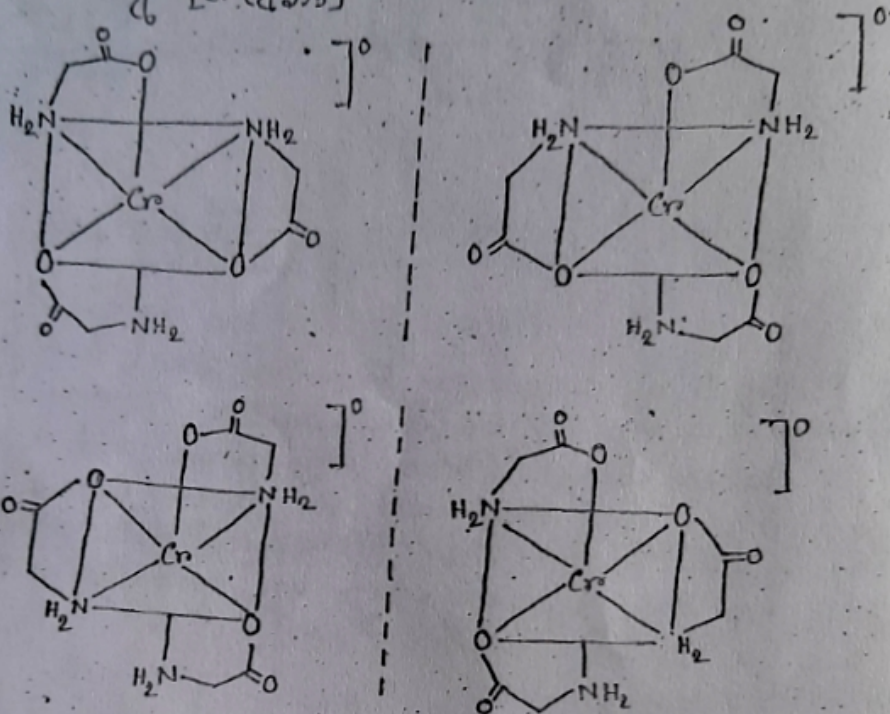
e.g. $[Co(en)(NH_3)_2Cl_2]^+$



h) $[M(AB)_3]$ type complexes \approx

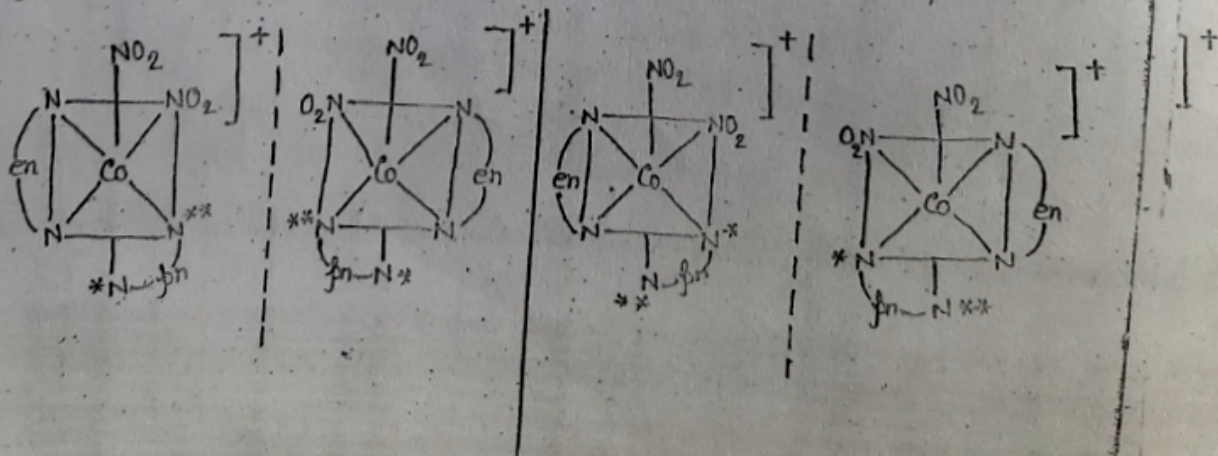
The octahedral complexes of this type exist in two geometrical isomers. Each of these forms is optically active and hence each gives a pair of optical isomers.

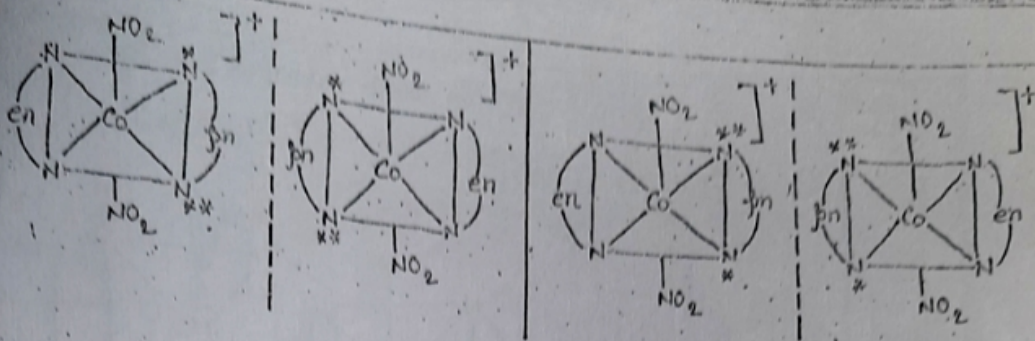
e.g. $[Cr(gly)_3]^0$



i) Octahedral complexes containing optically active bidentate ligand \approx

$[Co(en)(fn)(NO_2)_2]^+$ 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.

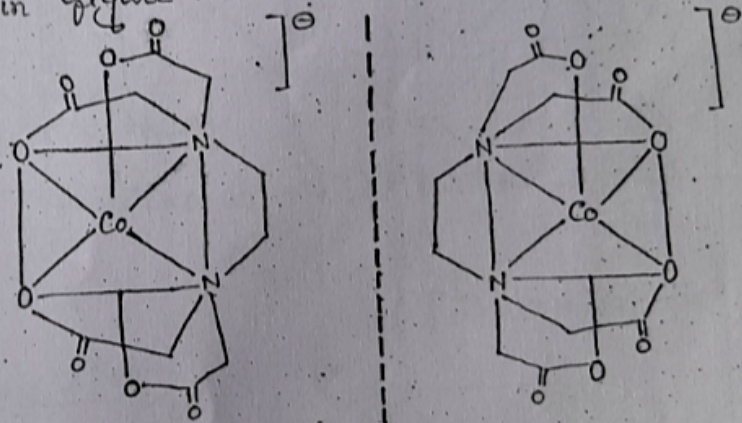




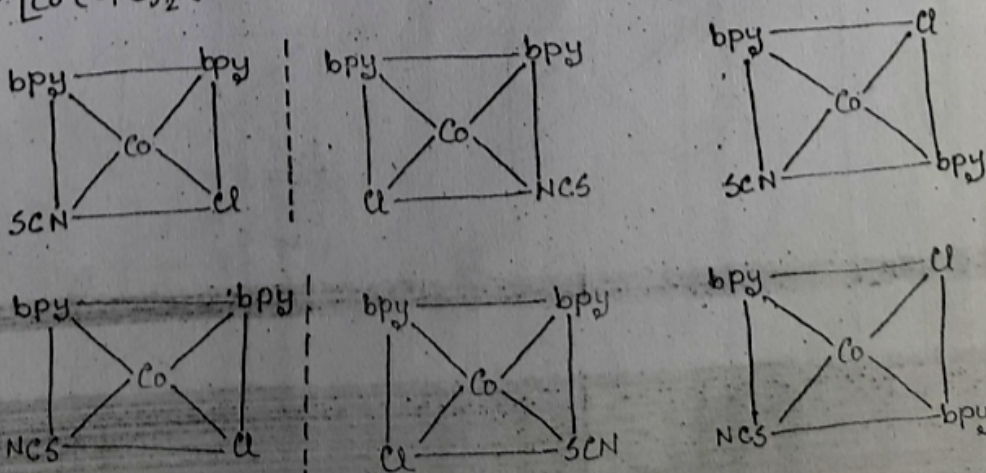
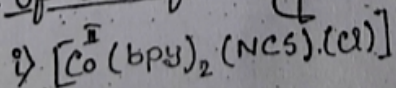
j) Octahedral complexes containing polydentate ligand : \approx

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

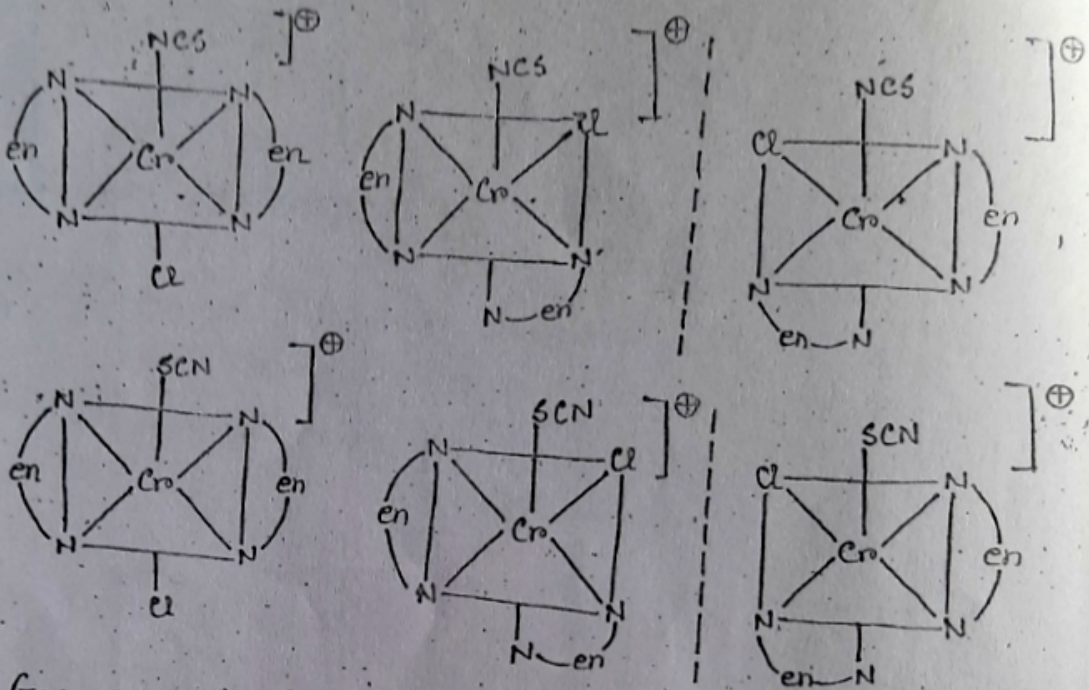
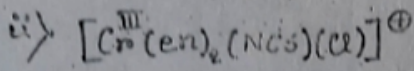
e.g. $[\text{Co}(\text{EDTA})]^{-}$ ion exist in two optical isomers, shown in figure below :



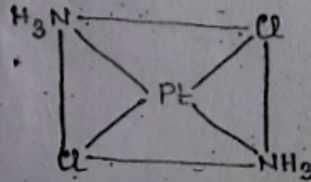
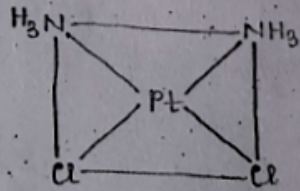
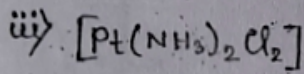
o) Draw the structures of all the possible isomers of the following species : \approx



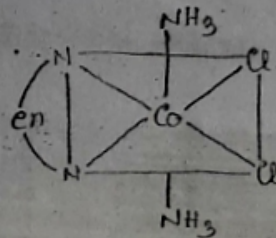
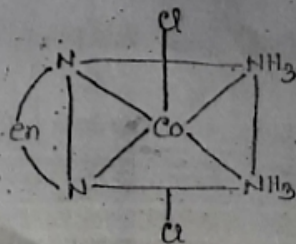
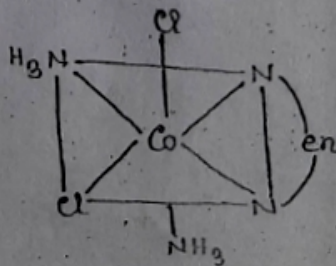
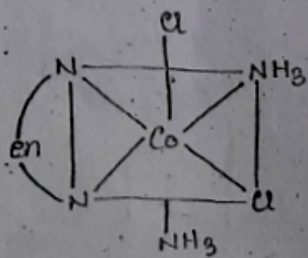
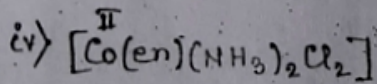
Geo - 2, optical - 1, Co-ordination - 3, Total = 6



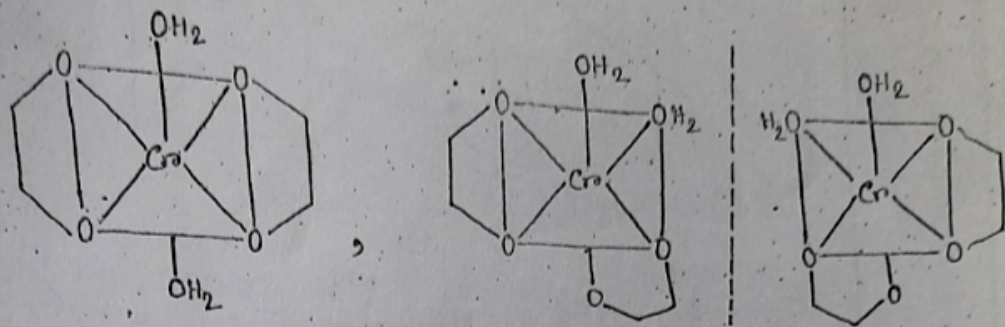
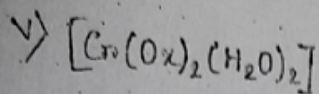
Geo - 2, optical = 1, for co-ordination position = 3, Total = 6.



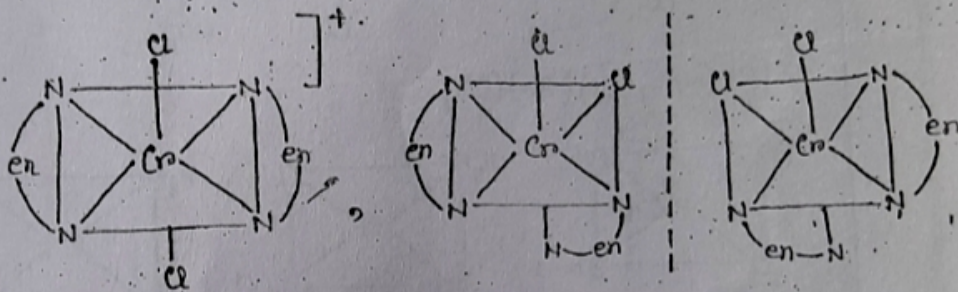
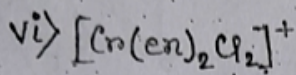
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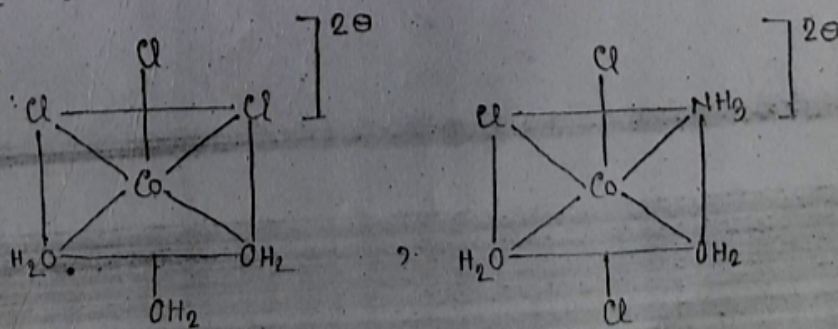
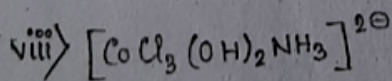
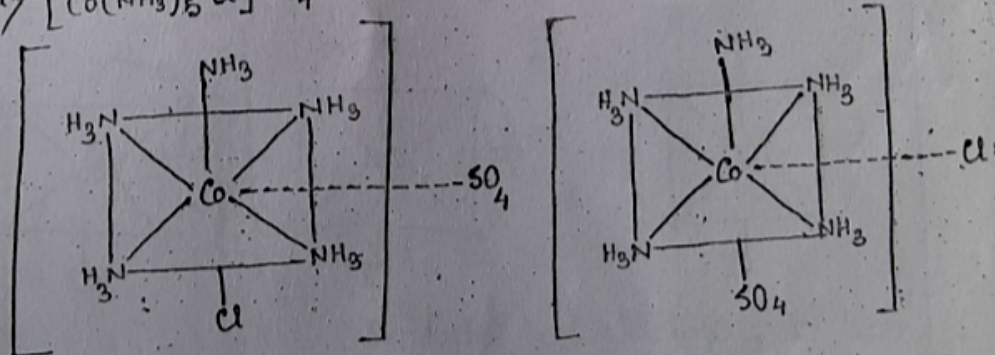
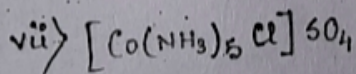
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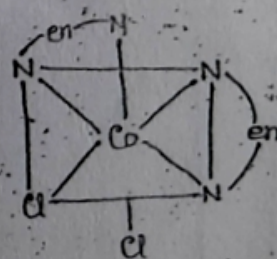
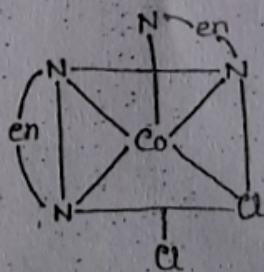
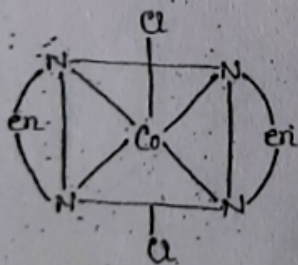
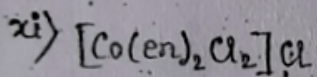
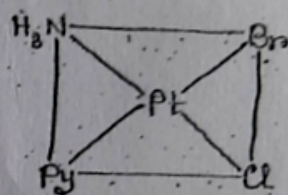
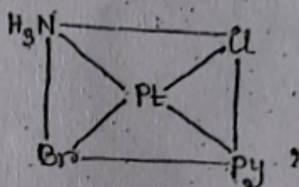
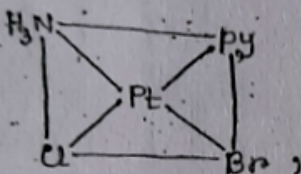
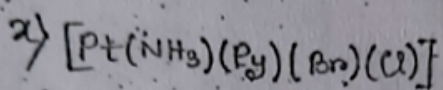
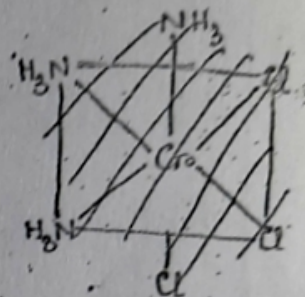
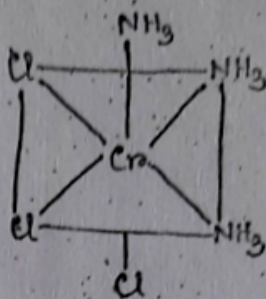
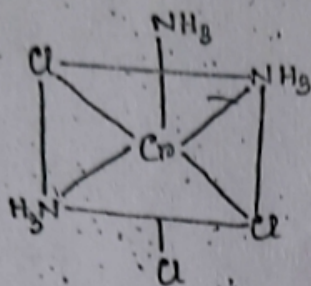
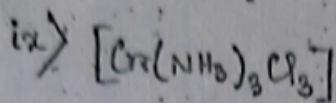
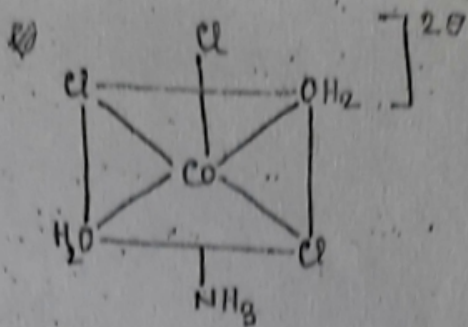


Geo - 2, optical - 1, Total - 3.



Geo - 2, Optical - 1, Total - 3.





Geo - 2, Optical - 1, Total - 3

