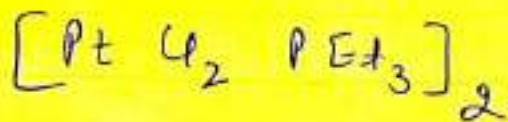
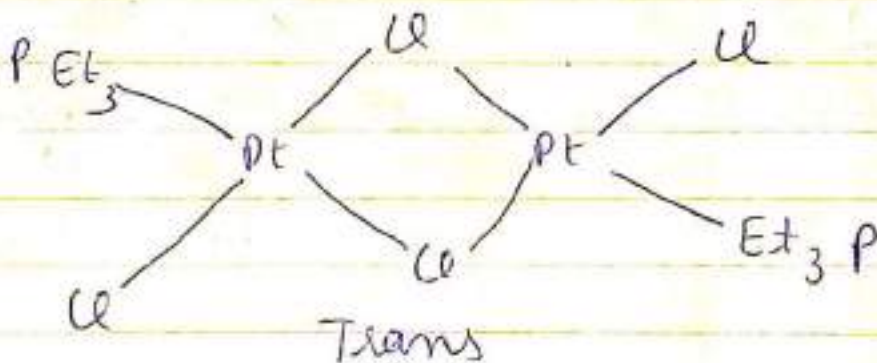
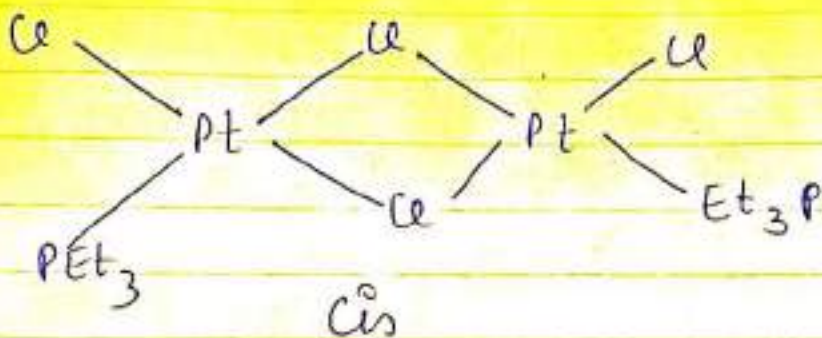


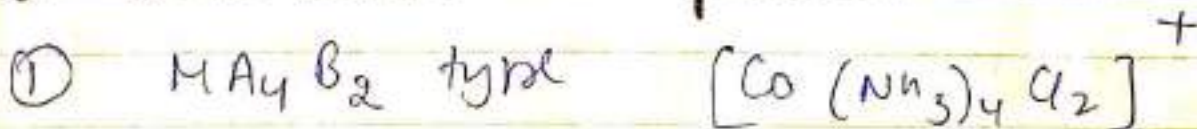
f)  $M_2 A_4 X_4$  type



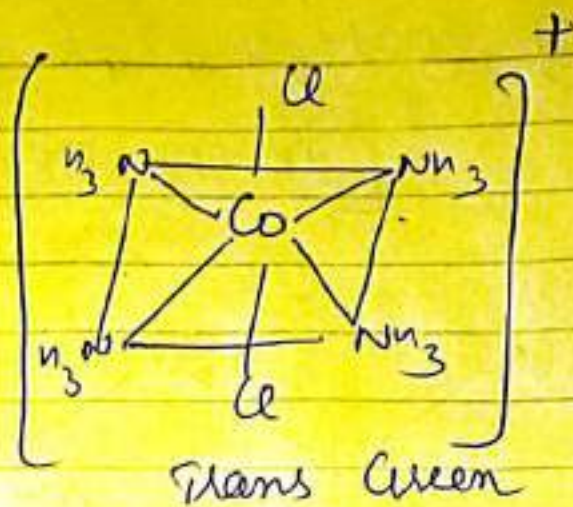
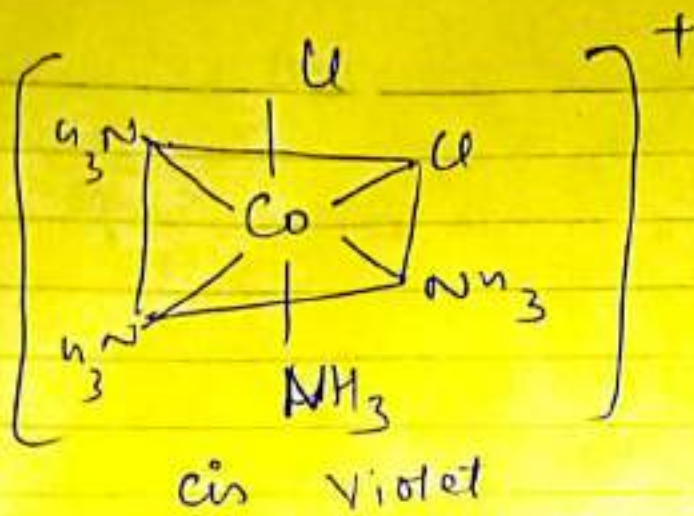
Et = ethyl



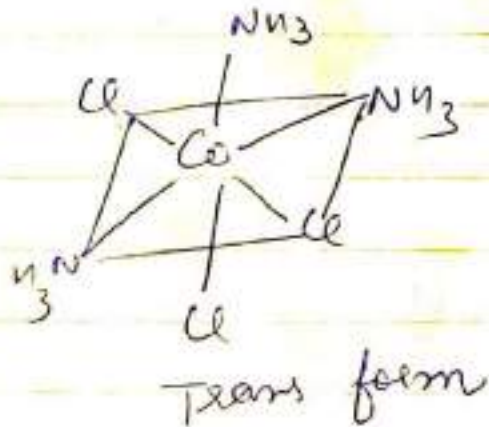
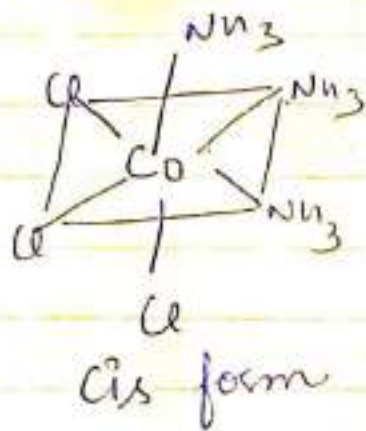
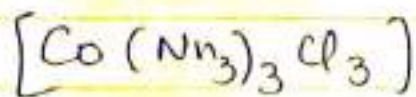
## 2) Octahedral complexes



exists in cis and trans



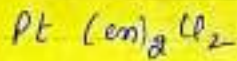
(ii)  $MA_3B_3$  type



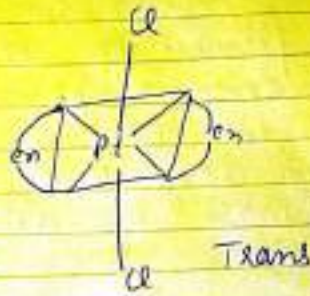
(iii)  $M(AA)_2B_2$  type

AA is any symmetrical bidentate ligand like ethylene diamine (en)

B = anionic ligand  $\text{Cl}^-$ ,  $\text{en}^-$ ,  $\text{NO}_2^-$



cis form



Trans

## Isomerism in Transition Metal Complexes

D-block elements are known as transition elements. In d-block elements, the last electron enters in the d-shell.

Complex formation by transition elements

Transition metals form a large number of complexes. Here a metal cation

binds a number of anions or neutral molecules

### Reason for making Complexes

- 1) The presence of vacant  $(n-1)d$  orbitals which can accept one or more electron pairs from ligands
- 2) High charge density due to small size
- 3) Variation in oxidation states

### Isomerism in Transition Metal Complexes

- A) Structural Isomerism
- B) Stereo Isomerism or space Isomerism

#### A) Structural Isomerism

It is of 7 types

- 1) Ionisation Isomerism:- Having same composition but yield different ions in the solution

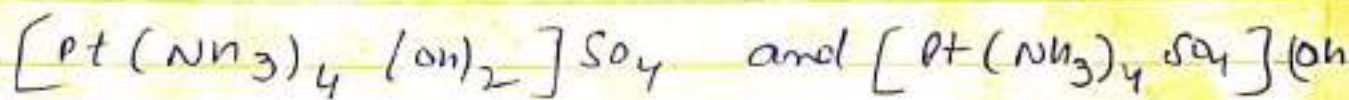
for example  $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$  is

Red violet and in solution gives

precipitate with  $\text{BaCl}_2$  confirming the presence of  $\text{SO}_4^{2-}$  ion

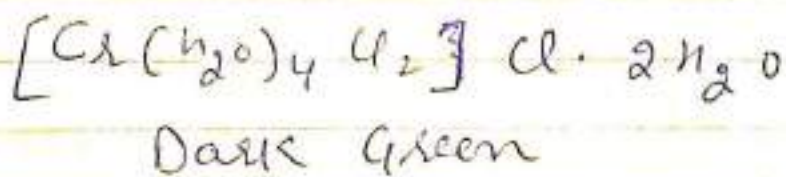
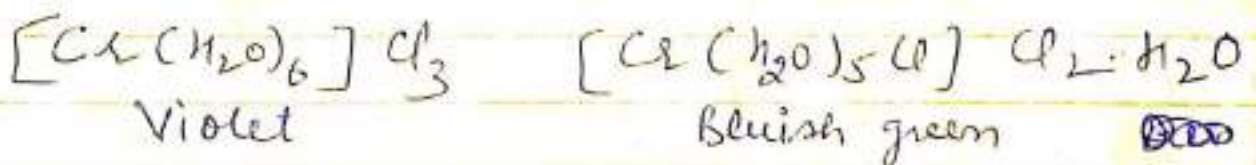
On the other hand  $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$  is red and does not give test for sulphate ion but gives precipitate of  $\text{AgBr}$  with  $\text{AgNO}_3$ .

Other examples

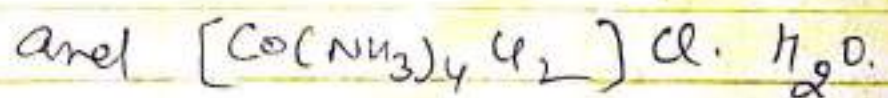


## 2) Hydrate Isomerism:-

which vary in the number of water molecules.

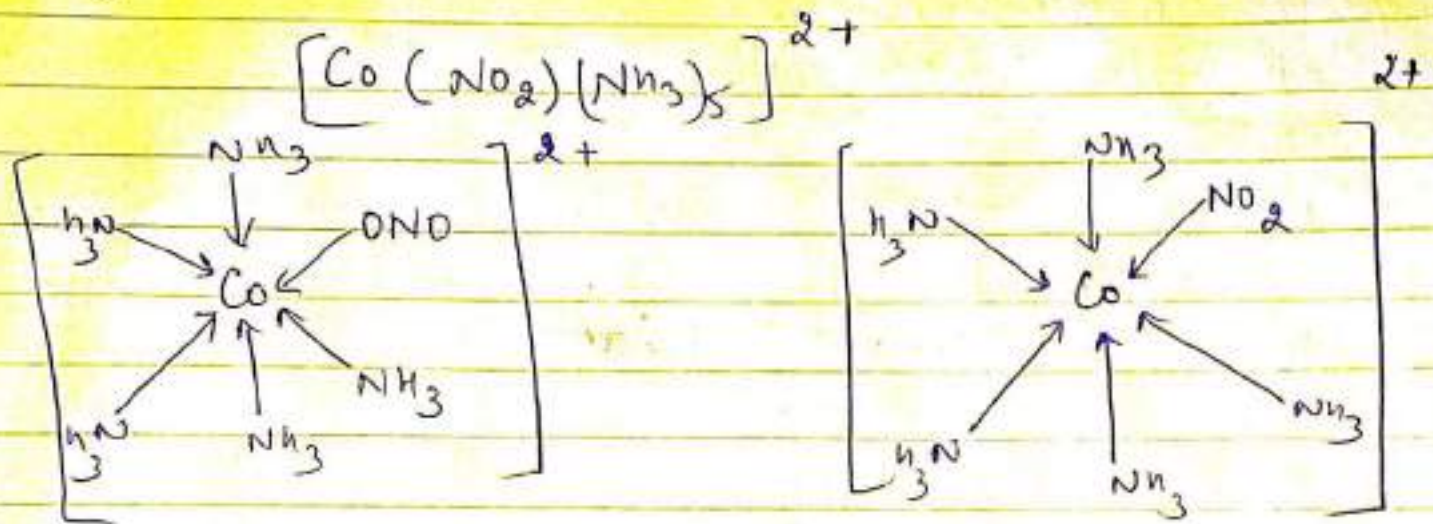


Other example :-  $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})\text{Cl}]\text{Cl}_2$



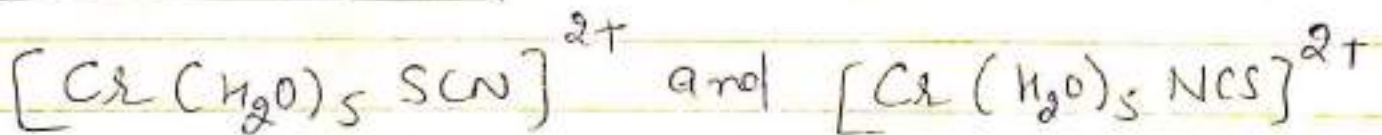
### 3.) Linkage Isomerism:-

Linkage Isomerism occurs when more than a single atom in a mono-dentate ligand may function as a donor. For Example  $\text{NO}_2^-$  ion either can act as donor from N and O.



Nitropentamminecobalt (Red)  
Other examples

Nitroperitammium Cobalt  
Yellow

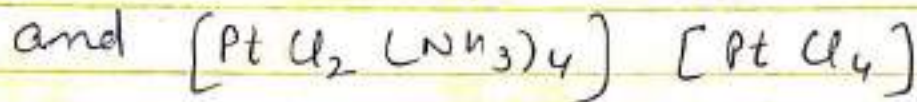
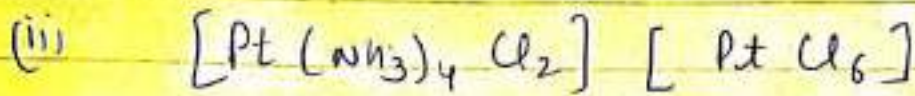
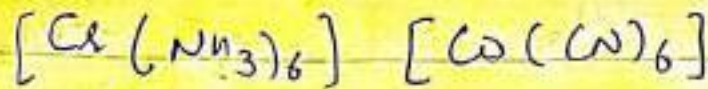
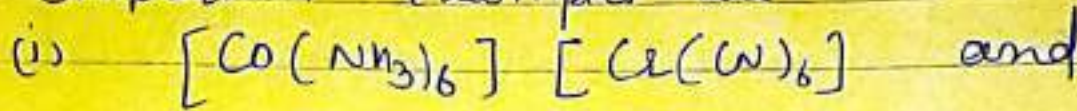


### 4.) Co-ordination Isomerism:-

The isomer differ in the distribution of ligands in the ~~cation~~ cation (+ve) and

Anion (-).

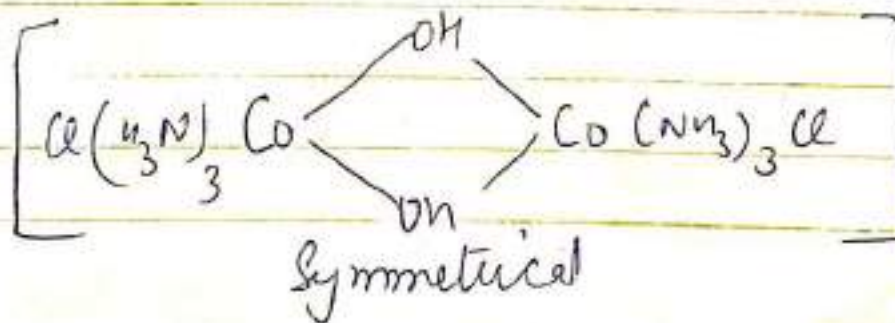
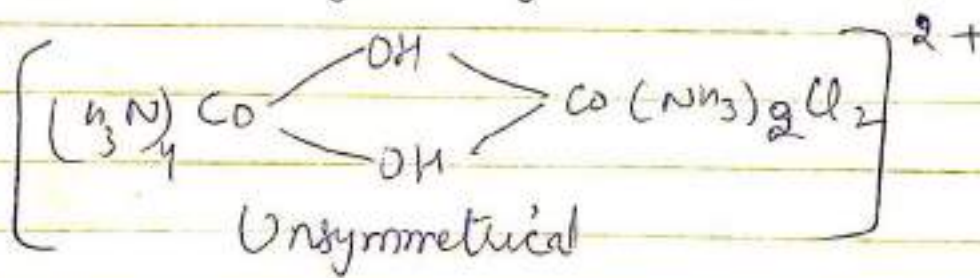
Important examples are



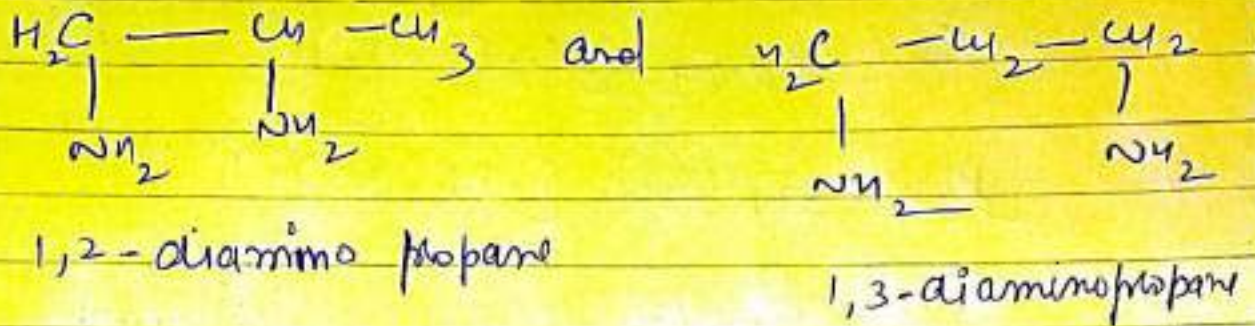
Interchange of ligand between the complex ions

### 5) Co-ordination Position Isomerism:-

It occurs due to the difference in the distribution of ligands in two co-ordination centres. It generally occurs in bridged complexes.



6) **Ligand Isomerism**: - It occurs in those complexes where two ligands are isomers.



7.) **Polymerisation Isomerism**: -

It occurs in b/w compounds having the same empirical formula but different molecular weight.  $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$  and  $[\text{Pt}(\text{NH}_3)_4]$   $[\text{Pt}(\text{Cl})_4]$

(B) **Stereoisomerism or Space Isomerism**

- 1) Geometrical
- 2) Optical Isomer

1) **Geometrical Isomerism**  
Already Discussed



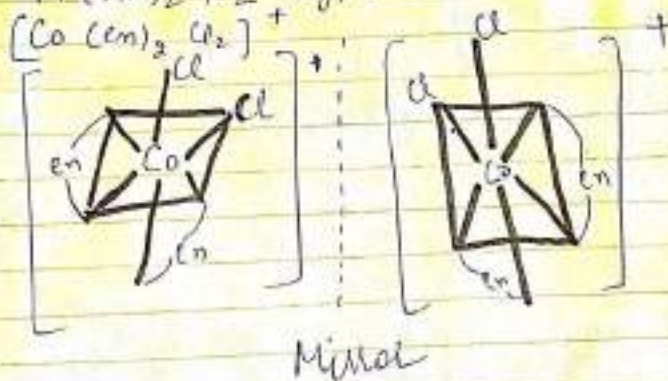
## 2) Optical Isomerism

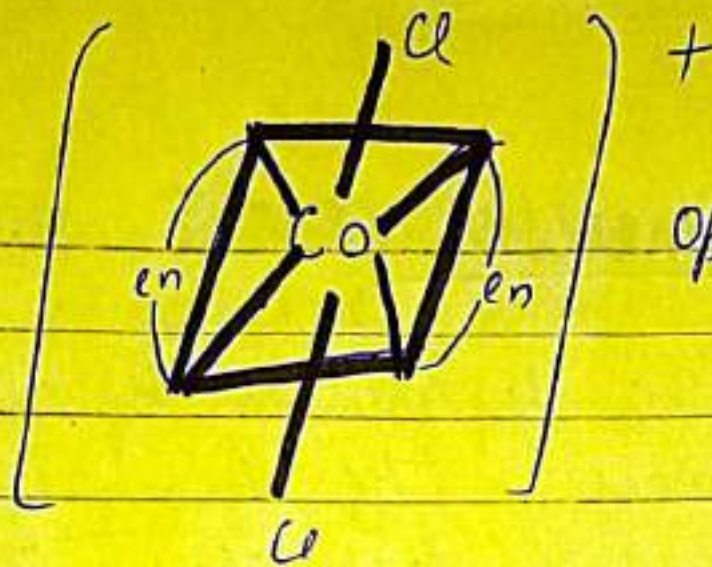
Optical isomers are represented by two structures or enantiomers. The two enantiomers are mirror images of each other and are non-superimposable on each other. The optical isomers are dextro (d) and laevo (l).

Enantiomers of Enantiomers

### Optical Activity in octahedral complexes

①  $M(AA)_2X_2$  type

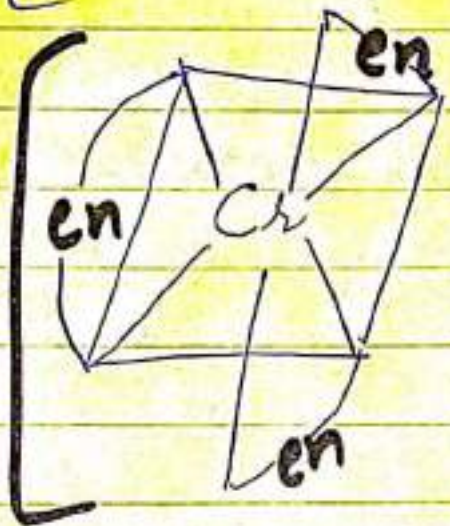
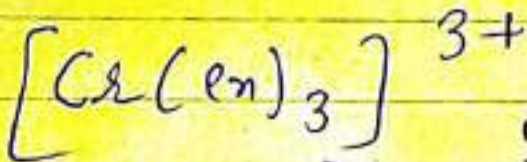




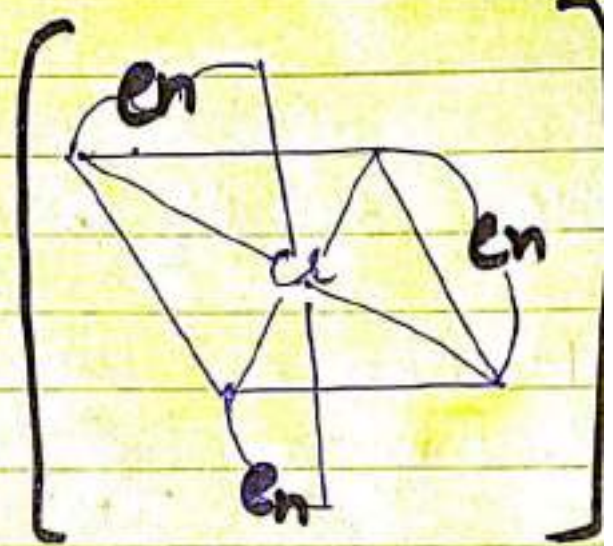
Optically inactive

(ii)

$M(AA)_3$  type



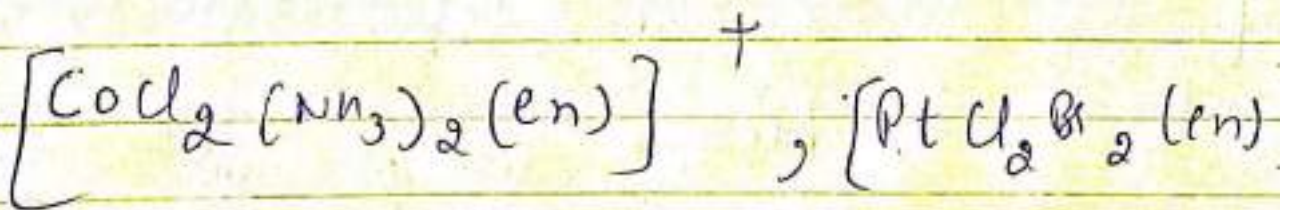
3+

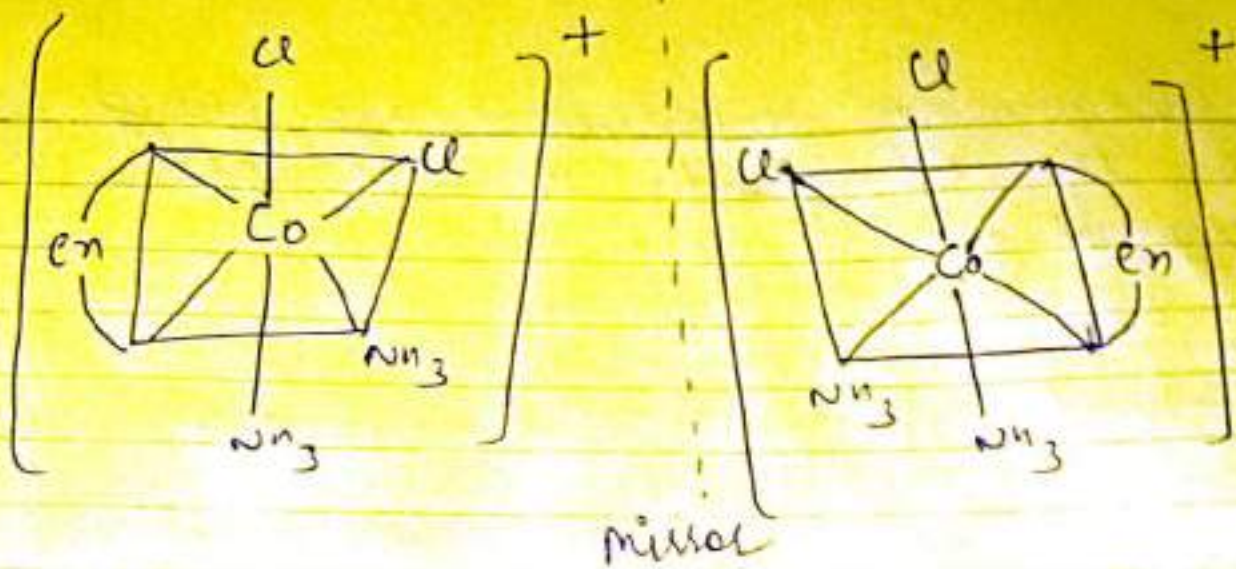


mirror

(iii)

$M(AA)B_2X_2$  type





Non Superimposable mirror images

### Important Questions

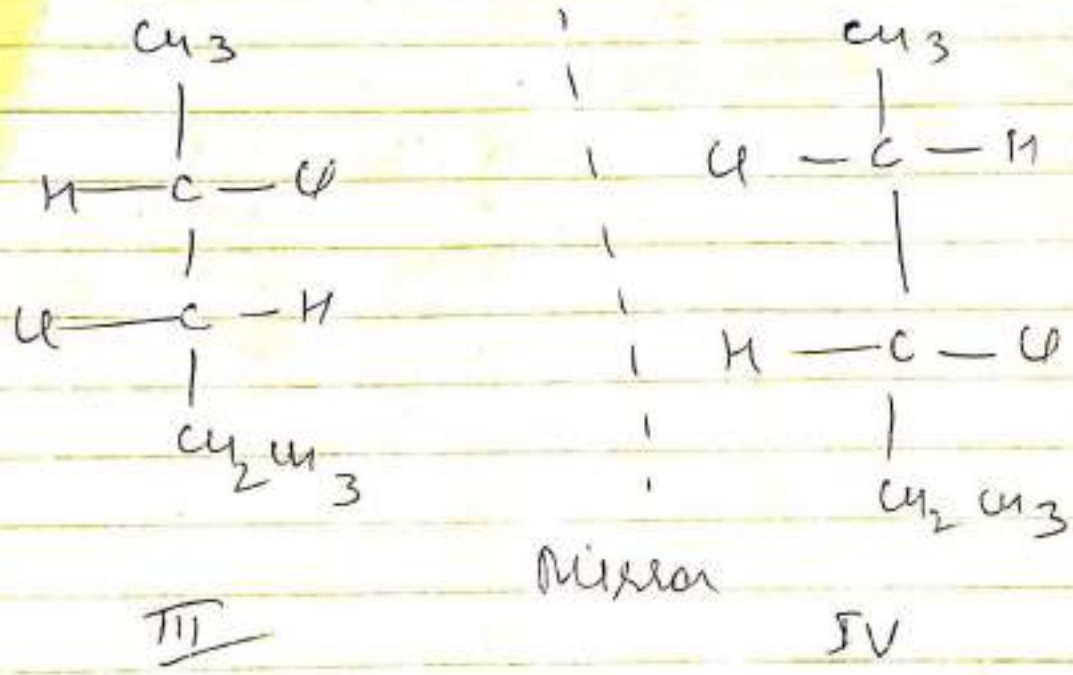
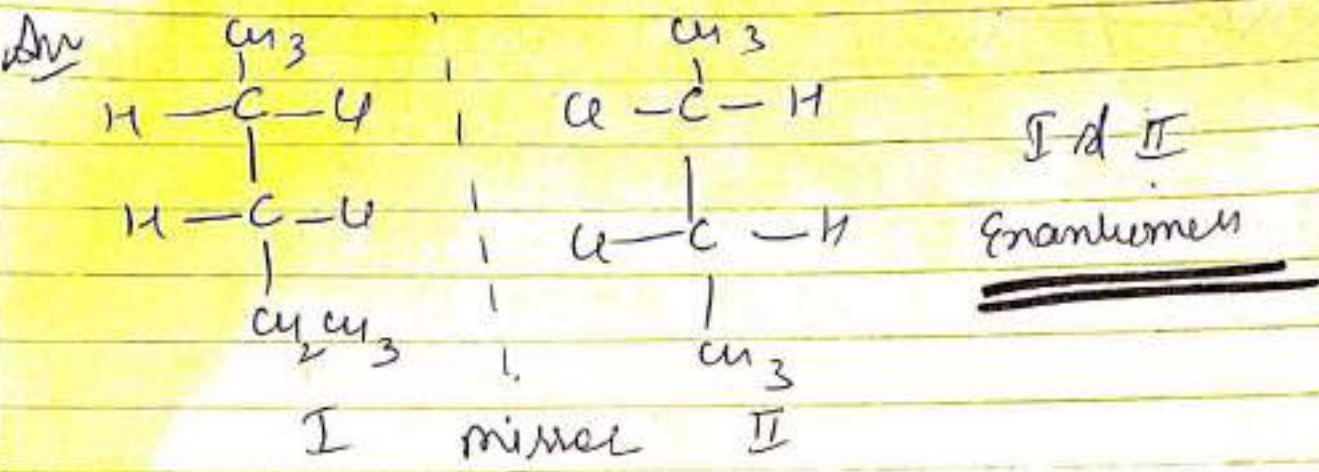
Q1 What is the necessary and sufficient condition for a molecule to be optically active?  
Ans molecule should be optically active only when it is having a chiral centre. mirror images are always non superimposable.

Q2 Which of the following compound will exhibit optical isomerism.

- Ans
- (a)  $\text{CH}_3\text{CH}(\text{OH})\text{Cl}$       (b)  $\text{C}_2\text{H}_6\text{O}$
- (c)  $\text{CH}_3\text{CH}(\text{OH})\text{Cl}$

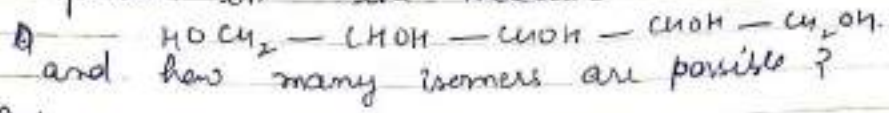
Ans only (c) is optically active because of chiral carbon.

Q3 How many Enantiomers are possible for the Compound 2,3-Dichloropentane? Explain.

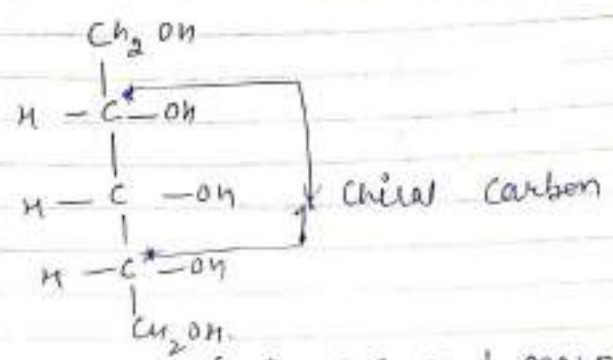


III and IV.  
Enantiomers

Q4 How many chiral carbon atoms are present in the molecule



Ans



Three isomers (+), (-) and meso

Q5 Does the absence of chiral carbon atom always make the molecule optically inactive?

Ans NOT necessary. A molecule is active if it is non-superimposable on its mirror image. Ex. Pent-2,3-diene is optically active

Q6. Differential b/w Enantiomers and Diastereoisomers.

Q7. Draw all the stereoisomers of 3-chloro-2-pentanol

Q8. Assign R and S Configuration to the molecules

Q9. What are meso Compounds?

Q10. Why Anti Conformation is more stable than the eclipsed Conformation of Butane? ~~and~~ Explain with the help of P.E diagram

Q11. Differentiate b/w functional and positional isomerism with example

Q12. What are Tautomers?

Q13. Define angle of rotation. How to Calculate Specific Rotation?

Q14. Show Geometrical isomers of Square planar complexes.

Q15. Draw cis-trans isomers of  $MA_2B_2$

Q16. What are linkage isomers? type