Coordination Compound

Coordinate chemistry — A branch of chemistry which deals with coordinate compounds. That is called coordinate ~~de~~ chemistry, they are also called complex ion or compound

Double Salt — A compound which have more than one cation after ionisation

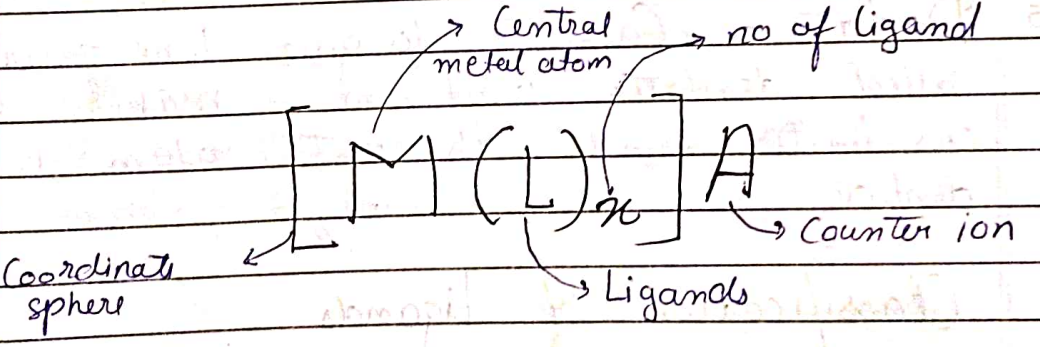
$K_2SO_4\ Al_2(SO_4)_3 \cdot 24H_2O \xrightarrow{Aq} 2K^+ + 2Al^{+3} + 4SO_4^{-2} + 24H_2O$

potash Alum

~~Coordinate Compound~~

Coordinate Compound — A compound which cannot dissociate after ionisation but they have more than one cation

$K_4[Fe(CN)_6] \xrightarrow{Aq} 4K^+ + [Fe(CN)_6]^{-4}$



Defination -

1 Central Metal Atom - They are lewis acid Mostly they are d block elements which have vacent d orbit and it makes coordinate bond with ligands. It is also called nuclear atom. They maybe +ve or neutral

2 Ligands - Ligands are lewis base, they maybe cation, anion or neutral. They make coordinate bond with central atom. They are capable to give lone pair

3 Coordinate Sphere - It is represented by big square bracket, it contain coordinate bond ~~formu~~ carrying compound.

4 Counter ion - They maybe cation or anion which is only available to create neutral balance in coordinate sphere

5 Dentate - Capacity to give lone pair is called dentate and the making of ~~ligand~~ coordinate bond with central atom is called denticity

Classification of Ligands

On the basis of giving lone pair

1. ~~Negativ~~ Monodentati - Capacity to give one lone pair

i) -ve ligand

X^- — halo	S^{-2} — Sulphido
OH^- — hydroxo	O_2^{-2} — Peroxo
CN^- — cyno	CH_3COO^- — aceto
O^{-2} — oxo	NO_3^- — Nitrito
NH_2^- — amido	NO_2^- — Nitro
CNS^- — Thiocyanto	CO_3^- — Carbonato
	SO_4^- — Sulphato

ii) Neutral ligand

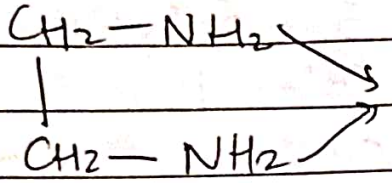
CO — Carboxyl
NH_3 — Ammine
PH_3 — Phosphine
H_2O — Aqua
NO — Nitrosyl
C_2H_5N — Pyridine

iii) Positive ligand

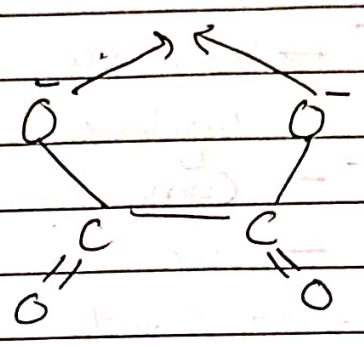
NO_2^+ — Nitrosonium
NO^+ — Nitrosonium
$H_2N_2H_3^+$ — Hydrazinium

2 Bidentate

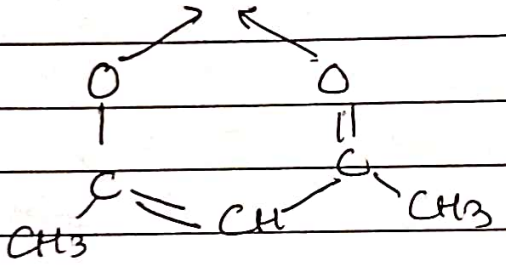
A ligand have capacity to give two lone pair is called bidentate ligand.



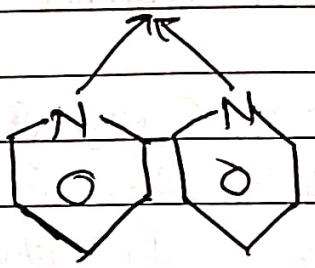
Ethylene diamine
(en



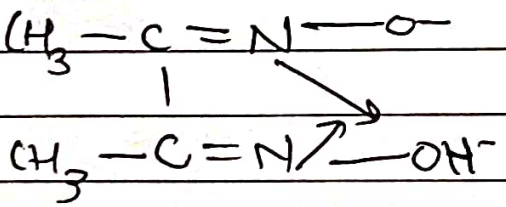
Oxalato
(Ox^{-2})



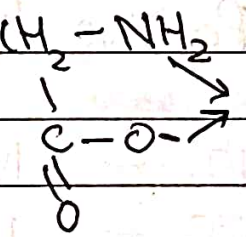
Acetyl acetato
(acac)



2,2-Dipyridye
(dipy)



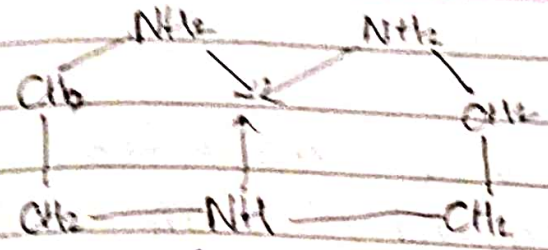
(DMG) - dimethyl
glyoximinato



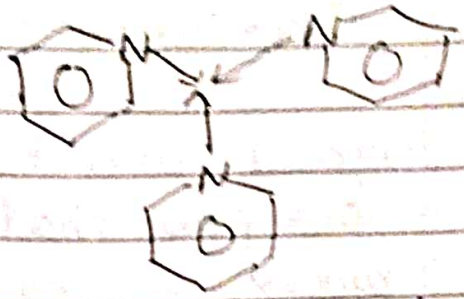
Glycinato (Gly⁻)

3- Tridentate ligand -

6- A ligand which have capacity to given three lone pair is called tridentate ligand.



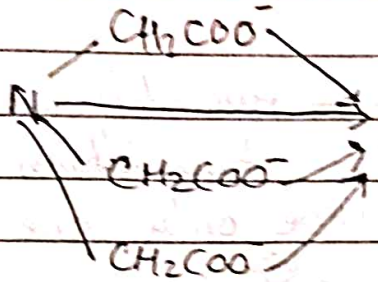
Diethylene Triamine
(dien)



2,2',2'' Terpyridine
(Tpy)

Tetradentate ligand :-

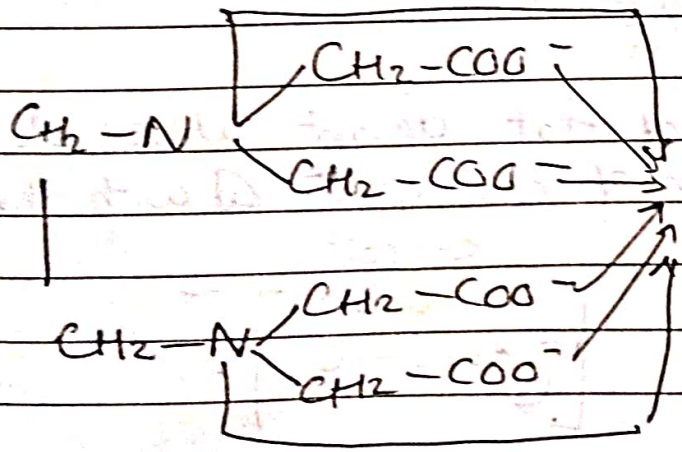
A ligand which have capacity to gives four lone pair is called tetradentate legand



Nitroplaaletato
$(nta)^{-3}$

Hexadentate ligand

A ligand which have capacity to given six lone pair is called Hexadentate ligand



Ethylenediamine
tetra Acetate $(EDTA)^{-4}$

Chelation :-

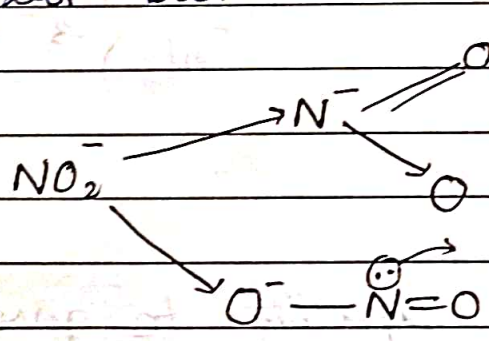
ligand which can give more than one lone pair that is called Chelate and the process is called chelation

- → bidentate
- → Tridentate
- → Tetradentate
- → Hexadentate

} Chelate

Ambidentate ligands

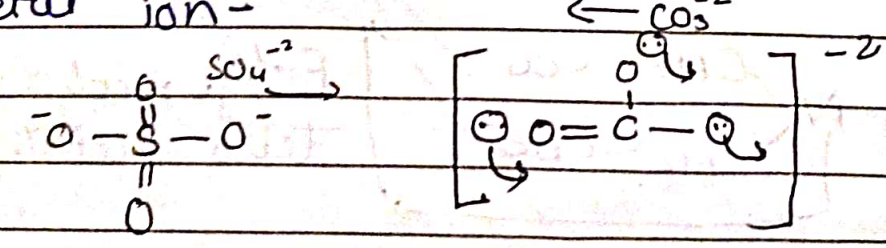
ligands which has two different donar atoms and either of the two atom can give lone pair but at a time only one can give.



Eg- CN^- & NC^-
NO^- & ONO^-
SCN & CNS^-
CNO^- & NCO^-
$S_2O_3^{-2}$ & $OSOeS^{-2}$

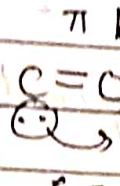
Flexeedentate ligand

Polydentate ligands that do not utilise all of their donar atom of coordinate with the metal ion-



π-acid ligands-

They are characterised by their ability to ~~donate~~ donate a pair of e^- from a p_π-bonded atom to a metal metal center in a coordination complex



IUPAC

+ve cation + -ve Anion

[ ]

no of ligands + Name of ligand + central atom name + O N of central atom

Di
tri
tetra
Penta
Hexa

Name latin if it is -ve part then ate suffix

raman no. ( )

Fe → ferrati	Au → Aurrati	(I)
Ag → Argentati	Pd → Plumbati	(II)
Sn → Stannati		(III)
Cu → cuprati		(IV)
		(V)

if already Di, tri

2 Bis
3 Tris
4 Tetrakis
5 Pentakis

$K_4[Fe(CN)_6]$

$4K^+ + [Fe(CN)_6]^{-4}$

$x \quad -1 \times 6 = -4$

$x = +2$

Potassium hexa cyno ferrati (II)

$[Co(NH_3)_6]Cl_3$

$[Co(NH_3)_6]^{3+} + 3Cl^-$

$x + 0 = +3$

Hexa ammine cobalt (III) Chloride

1) $K_2[Pt(Cl)_6]$ Potassium hexa chloro platinati (IV)

$2K^+ \quad [Pt(Cl)_6]^{2-} \quad x - 6 = -2, \; x = 4$

2) $[Pt(NH_3)_4]Cl_2$

$[Pt(NH_3)_4]^{+2}$

$Pt = +2$ Tetra ammine platinium (II) Chloride

3) $[Co(NH_3)_3Cl_3]$

$Co = +3$ Triammine trichloro cobalt (III)

4) $K_3[Fe(CN)_6]$ $[Fe(CN)_6]^{-3}$

$Fe = +3$

Potassium hexa cyno ferrati (III)

5) $[Cr(H_2O)_4Cl_2]$

$Cr = +2$ Tetraaqua dichloro chromium (II)

6) $[Ag(NH_3)_2]Cl$

$Ag = +1$ Diammine Silver (I) Chloride

7) $[Pt(Cl_6)]^{-2}$

$Pt = +4$ Hexachloro platinate (IV) ion

8) $Fe_4[Fe(CN)_6]_3$

$4Fe^{3+}$ $[Fe(CN)_6]^{-4}$ $= Fe = +2$

Iron hexa cyno ferrate (II)

9) $[Cr(en)_2Cl_2]$ $Cr = +6$

Dichloro bis ethylene diamine Chromium (III)

10) $[Cr(CO)_6]$

Hexa carboxyl Chromium (0)

11) $K_3[Co(NO_2)_6]$ K^{+3} $[Co(NO_2)_6]^{-3}$ $Co = +3$

Potassium hexanitrocobaltate (III)

12) $[Cr(NH_3)_3Cl_3]$ $Cr = +3$

Triammine trichloro chromium (III)

13 $Na_3[Fe(CN)_5NO]$

Na^{+3} $[Fe(CN)_5NO]^{-3}$. Fe = +2

Sodium penta cyanonitrosyl ferrate (II)

14 $[NiCl_4]^{-2}$ Ni = +2

Tetrachloridonicklate (II) ion

15 $[Ru(NH_3)_5Cl]^{+2}$

x 0 −1 = +2

Pentaammine chloro Ruthium (III)

16 $[Ni(Gly)_2]$

−2

Diglycineto Nickel (IV)

Bis ✗ O

17 $[Ni(CO)_4]$

Tetracarboxyl Nickel (0)

18 $K_3[Al(C_2O_4)_3]$ $[Al(C_2O_4)_3]^{+3}$ n = 3.

−6

Potassium Trioxalato aluminate (III)

19 $[Ag(CN)_2]^-$

Dicynoargentate (I) ion.

20 $Li^{+1}[AlH_4]^{-1}$

Lithium Tetrahydroaluminate (III)

21) $[Co(NH_3)_4(H_2O)Cl]Cl$ (Co = +1)

Tetraammine aqua chloro cobalt (III) Chloride

22 $K_2[Zn(OH)_4]^{2-}$ Zn

Potassium Tetra hydroxo zincate (II)

23 $[Co(NH_3)_6]^{+3}[Cr(CN)_6]^{-3}$

Hexaammine cobalt (III) Hexacyno chromate (III)

Sadwick Rule

This theory is consider as calculation of EAN. (Effective atomic number).

Werner's Theory

This theory is based on primary and secondary valency

According to Werner primary valency are the real valency or oxidation number of central atom but secondary valency are the valency which is related to the coordinate sphere.

According to him secondary valency are the valency or no of coordinate bond formed by any central atom.

$K_4[Fe(CN)_6]$ → SV → Ox = +6

PV Ox = +2

PV : +2

SV : +6 denticity × no of ligand

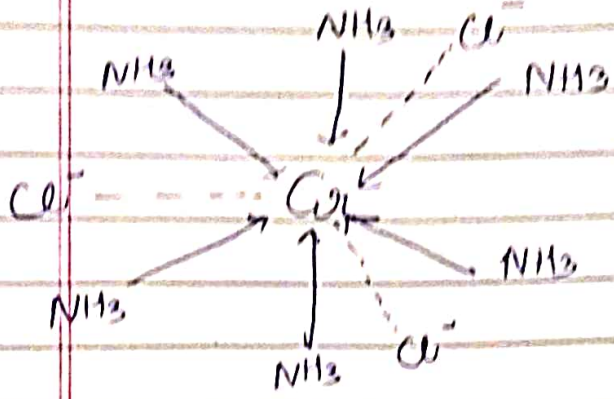
	PV	SV	EAN
$[Cu(NH_3)_4]^{+2}SO_4^{-2}$	2	4	
$[Co(NH_3)_6]^{+3}Cl_3^{-3}$	3	6	
$[Ni(CO)_4]$	0	4	
$K_2^{+2}[Ni(CN)_4]^{-2}$	2	4	
$K_3^{+3}[Cr(C_2O_4)_3]^{-3}$	3	6	
$K_3^{+3}[Fe(CN)_6]^{-3}$	3	6	
$[Ag(NH_3)_2]^{+1}Cl^{-1}$	1	2	

Verner Theary.

	PV	SV
$K_2^{+2}[Fe(EDTA)]^{-3}$	$x-4=-2$	6×1
	$x=2$	6

Werner Theory

$[Cr(NH_3)_6]Cl_3$



PV : - - - - -
SV : ——→

Homoleptic
होमोलेप्टिक (एक ही तरह के)

Same type of ligand in one coordinate sphere.

$[Cr(NH_3)_6]Cl_3$

Hetroleptic
हेटरोलेप्टिक (एक से ज्यादा तरह के)

different type of ligands attached in one coordinate sphere

$[Cr(NH_3)_2(CO_2)_2Cl_2]Cl$

Sadwick Rule

EAN → effective atomic number

$EAN = [\text{atom no of central atom} - PV + 2 \times SV]$

If EAN are equal to noble gas then it is stable otherwise unstable.

2
8
18
36
54
86

$K_4[Fe(CN)_6]$

$4K^+ + [Fe(CN)_6]^{-4}$

$x - 1 \times 6 = -4$

$x = +2$

PV = 2

SV = $1 \times 6 = 6$

EAN = $(26-2) + 2 \times 6$

$24 + 12 = 36$ noble gas stable.

Coordination Compound	PV	SV	EAN	
$[Cu(NH_3)_4]SO_4$	2	4	29-2+2+4 = 35	Unstable
$[Co(NH_3)_6]Cl_3$	3	6	27-3+12 = 36	Stable
$[Ni(CO_4)$	0	4	28-0+8 = 36	Stable
$K_2[Ni(CN)_4]$	2	4	28-2+8 = 34	Unstable
$K_3[Cr(C_2O_4)_3]$	3	6	24-3+12 = 33	Unstable
$K_3[Fe(CN)_6]$	3	6	26-3+12 = 35	Unstable
$[Ag(NH_3)_2]Cl$	1	2	47-1+4 = 50	Unstable

Hybridisation

→ In this theory we study about hybridization in hybridization only valance shell electron participate

→ Hybridisation is a process in which orbits participate not e^-

→ So in hybridisation full filled, half filled or vacent any type of Obrit participate (It is outermost)

→ After hybridisation all the energy are equally distributed in orbits

In the availibility of ligand-ligand are of two types

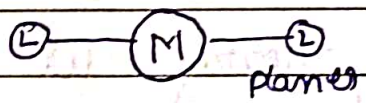
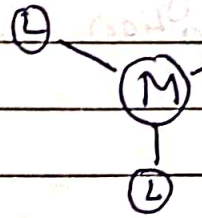
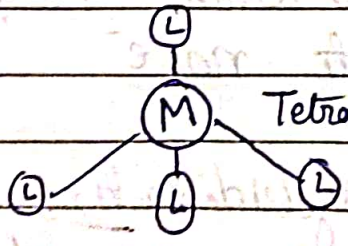
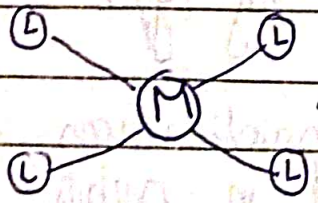
1) Weak field ligand

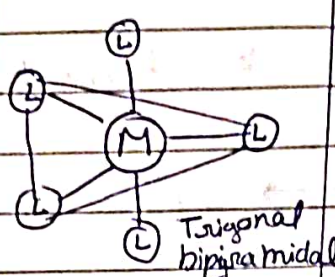
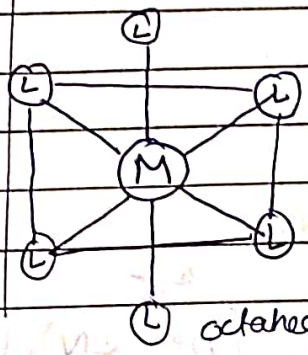
$I^- < Br^- < SCN^- < Cl^- < S^{-2} < F^- < OH^- < C_2O_4^{-2} < H_2O$

2) Strong field ligand

$NSC^- < EDTA^{-4} < NH_3 < en < CN^- < CO$

Of the availibility of strong field ligand structure can be change because pairing of electron can be possible to make spdex for strong field ligand

Coordination no	Hybridisation	Shape of orbit	Angle	Example
2	SP	 planes	180°	$K[Ag(CN)]$
3	Sp_2	 Trigand planes	120°	$K[Hg(I)_3]$
4	Sp_3	 Tetrahedral	109.5°	$[Cu(NH_3)_4]$
	dsp_2 Sp_2d	 square planar	90°	$[Ni(NH_3)_4]$

Coordination no	& Hybridization	Shape	Angle	Example
5	dsp_3 sp^3d		120° 90°	$[Fe(CO)_5]$
6	d^2sp^3 sp^3d^2		90°	$K_4[Fe(CN)_6]$ $[Co(NH_3)_6]Cl_3$

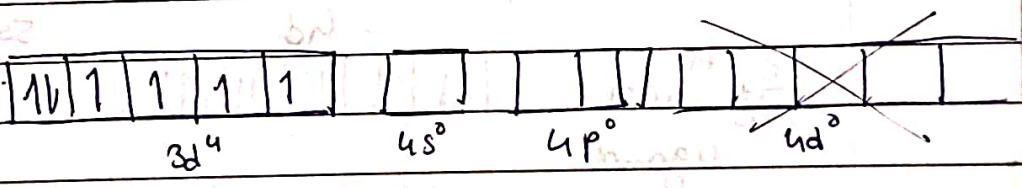
eg $K_4[Fe(CN)_6]$

① Step I $\quad 4K^+ + [Fe(CN)_6]^{-4}$

$x - 1\times6 = -4 \qquad x = +2$

$Fe_{26} :- [Ar]_{18}\ 3d^6\ 4s^2$

$Fe^{2+} :- 3d^6\ 4s^0\ 4p^0\ 4d^0$



Fe^{2+} with SF ligand

d^2SP_3

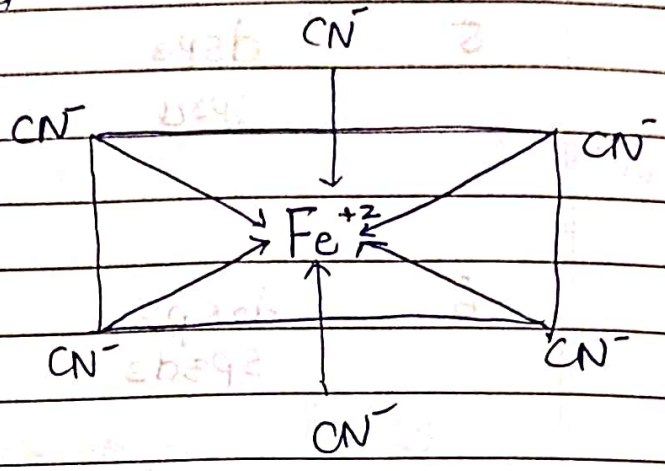
① hyb ⟶ d^2sp^3

② Shape ⟶ octahydral

③ Angle ⟶ 90°

④ Diamagnetic

⑤ Colourless



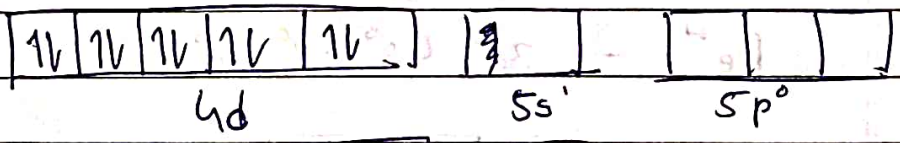
Q1. $K[Ag(CN)_2]$

$K^+ \quad [Ag(CN)_2]^-$

$n = 1$

$Ag_{47} = [Kr]\ 4d^{10}\ 5s^{1}\ 5p^0$

$Ag^{+1}_{46} = [Kr]\ 4d^{10}\ 5s^0\ 5p^0$



Ag^{+1} with ligand

SP

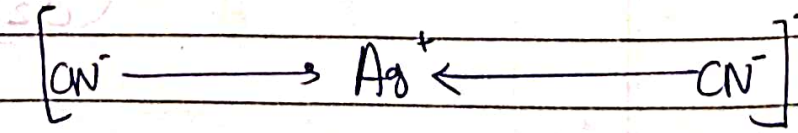
hyb ⟶ SP

Shape ⟶ linear

Angle ⟶ 180°

Diamagnetic

Colourless

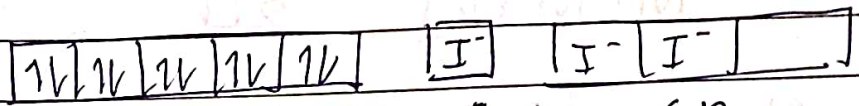


Q2. $K[Hg(I)_3]$ $\quad K^+ [HgI_3]^-$, $n = 2$

Hg $[Xe]\ 5d^{10}\ 6s^2\ 6p^0$

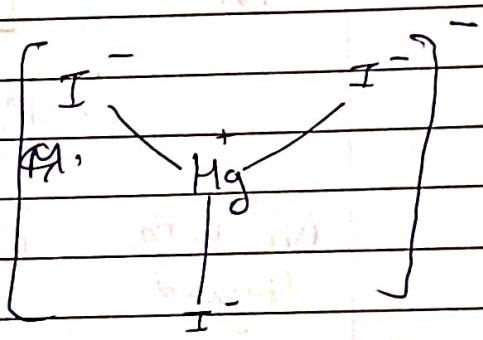
Hg^{2+} $[Xe]\ 5d^{10}\ 6s^0$

Hg^{2+} with ligand.



SP^2

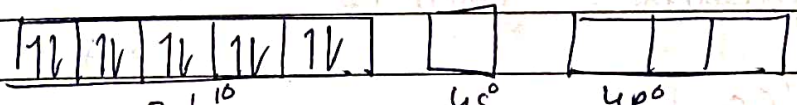
hyb → sp^2
shape → Trigonal
Angle → 120°
Paraganmehic
Coloured



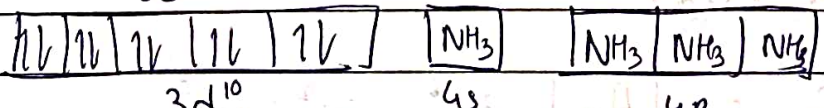
Q3) $[Cu(NH_3)_4]Cl$ $\quad [Cu(NH_3)_4]^{+1}\ Cl^-$, $n = +1$

$Cu = [Ar]_{18}\ 3d^{10}\ 4s^1\ 4p^0$

Cu^{+1} $[Ar]\ 3d^{10}\ 4s^0\ 4p^0$

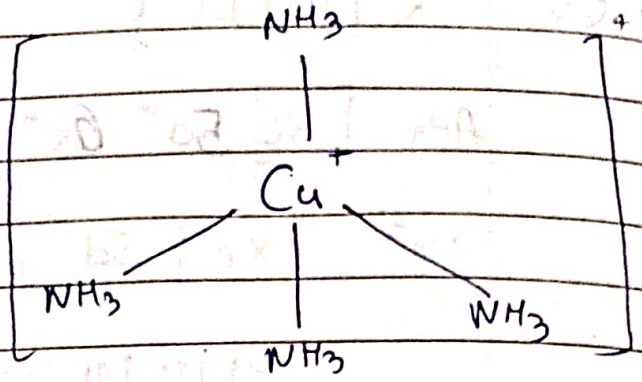


Cu^{+1} with ligand



SP^3

hyb → sp^3
Shape → Tetrahedral
Angle → 109.5°
Diamagnetic
colourless



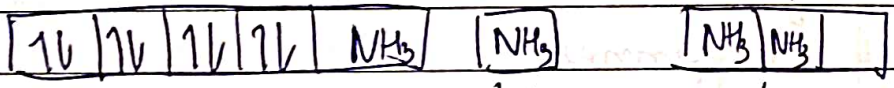
Q4 $[Ni(NH_3)_4]Cl_2$

$[Ni(NH_3)_4]^{2+}$ $2Cl^-$

$Ni_{28} = [Ar]\ 3d^8\ 4s^2$ ~~$4p^2$~~

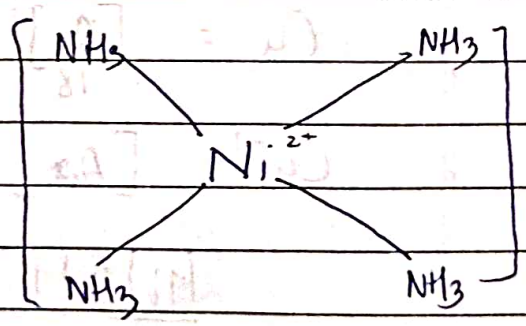
$Ni^{2+} = [Ar]\ 3d^8\ 4s^0$

Ni^{2+} with ligand



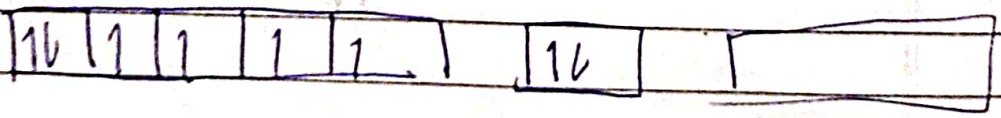
dsp^2

hyb → dsp^2
Shape → square planar
Angle → 90
Paramagnetic Diamagnetic
Colourful colourless



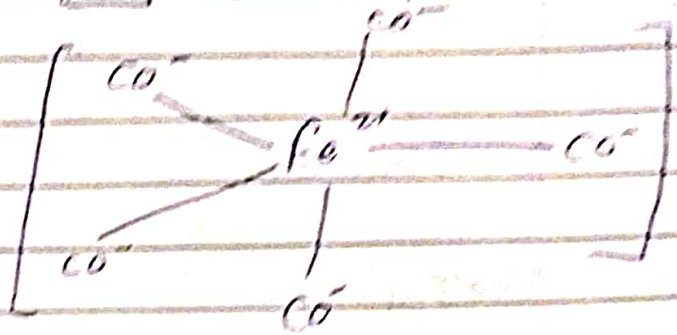
Q5 $[Fe(CO)_5]$

$Fe = [Ar]\ 3d^6\ 4s^2\ 4p^0$



Q5 with | ↑↓ | ↑↓ | ↑↓ | ↑↓ | ↑↓ | | ↑↓ | ↑↓ | ↑↓ |

hyb → d^2sp^3
Shape
Angle
Paramagnetic Diamagnetic
Colourless,



Q6 $[Cr(NH_3)_6]Cl_3$

$[Cr(NH_3)_6]^{3+}$ $3Cl^-$

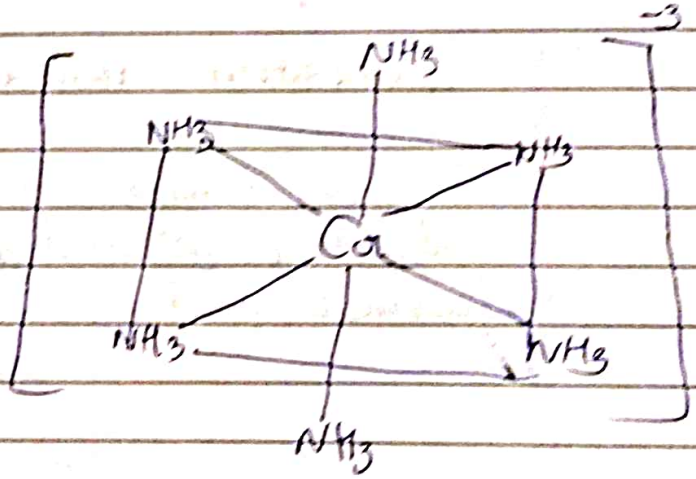
$Cr_{24} = [Ar]\ 3d^5\ 4s^1\ 4p^0$

$Cr^{3+} = [Ar]\ 3d^3\ 4s^0\ 4p^0$

Cr^{3+} with ligand | 1 | 1 | 1 | | | | | |
3d 4s 4p

Cr^{3+} with ligand | 1 | 1 | 1 | NH_3 | NH_3 | NH_3 | NH_3 | NH_3 | NH_3

hyb → d^2sp^3
Shape → Octahedral
Angle → 90
Paramagnetic
Colourful.



Isomerism

- Structural
  - Ionisation
  - Hydrate
  - Coordination
  - linkage
  - Ligand
- Stereo
  - Geometrical
    - Cis / trans
    - FEC / mer
  - Optical
    - Enantiomers
      - d form
      - l form

Isomerism

The compound have same chemical formula but different physical and chemical property and also the account of different structure

Chemical formula = same
Molecular mass : same

Ionisation isomers

Type of isomers which is due to the group which are differentiate between ligands and coordinate sphere

$Co(NH_3)_4Br_2SO_4$

$[Co(NH_3)_4SO_4]Br_2$
→ (1) 3 ions
→ Rxn with $BaCl_2$
→ $BaBr_2$
Colourless

$[Co(NH_3)_4Br]SO_4$
→ 2 ions
→ Rxn with $BaCl_2$
→ $BaSO_4$
with ppt

Hydrate isomers

The isomer in which no of water no. or molecule are present inside the coordinate sphere

$Cr(H_2O)_6Cl_3$ $AgNO_3$.

(1) $[Cr(H_2O)_6]Cl_3 \xrightarrow{H_2O\ aq} [Cr(H_2O)_6]^{+3} + 3Cl^-$
4 ions.

(2) $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O \xrightarrow{H_2O\ aq} [Cr(H_2O)_5Cl]^{+2}$
3 ion

(3) $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O \xrightarrow{H_2O\ aq} [Cr(H_2O)_4Cl_2]^{+}$
2 ion.

(4) $[Cr(H_2O)_3Cl_3]3H_2O \xrightarrow{H_2O\ aq} [Cr(H_2O)_3Cl_3]$
1 ion.

if excess of $AgNO_3$

2 mol AgCl → $[Cr(H_2O)_5Cl]Cl_2$
3 mol AgCl → $[Cr(H_2O)_6]Cl_3$
1 mol AgCl → $[Cr(H_2O)_4Cl_2]Cl$
0 mol AgCl → $[Cr(H_2O)_3Cl_3]$

Co(NH3)6Cl3 → [Co(NH3)6]Cl3 → 3 mol AgCl
Co(NH3)5Cl3 → 2 mol AgCl
Co(NH3)4Cl3 → 1 mol AgCl

Coordinate Isomers

The type of isomers which are differentiate between cation or anion complex or the linkage are interchange in both cation or anion.

$[Co(NH_3)_6][Cr(CN)_6]$

Co → Neutral ligand
cobalt
cation → Co

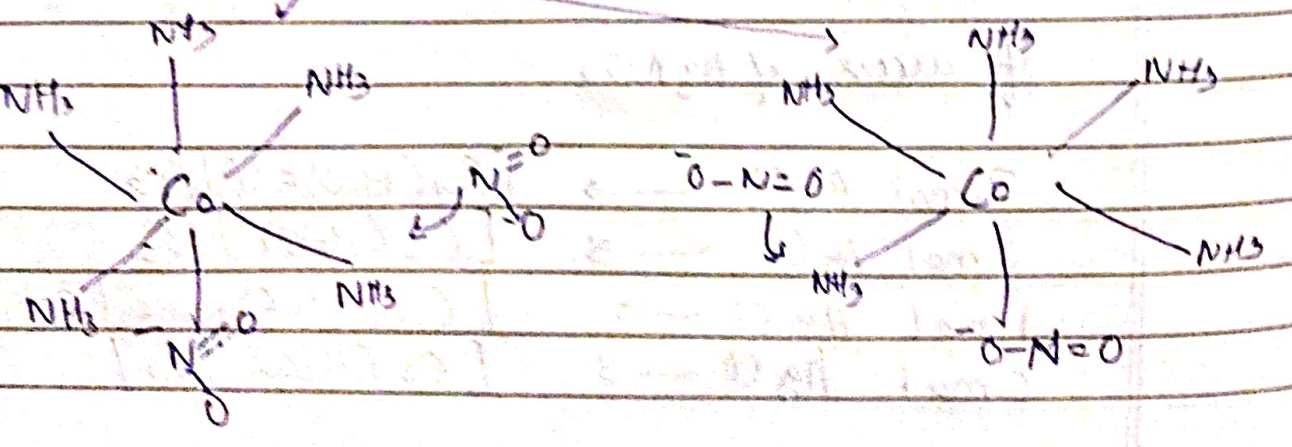
Cr → negative by
chromate
Anion → Cr

Linkage Isomers

The type of isomer occure in complex compound which contain ambident ligand. The ligand have two donar donar atom but at a time only one is directly linked to the central atom of complex. This type of isomer is differentiate R-O or UV light

→ Ambidentate ligand

$[Co(NH_3)_5NO_2]Cl_2$



Ligand isomers:

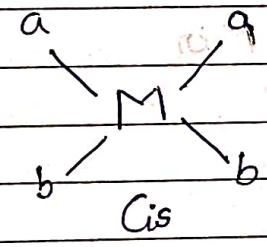
The type of isomers which have same molecular formula but different with respect to their ligand is called ligand isomer

$[Fe(H_2O)_2 C_3H_6(NH_2)_2 Cl_2]$

$[Fe(H_2O)_2 \underset{①NH_2}{C_3H_6}-CH_2-\underset{②NH_2}{CH_2} Cl_2]$ $[Fe(H_2O)_2 \underset{①NH_2}{CH_3}-\underset{②NH_2}{CH}-CH_2Cl_2]$

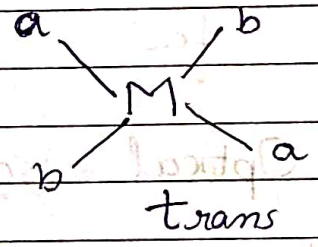
Geometrical Isomer

Cis / Trans

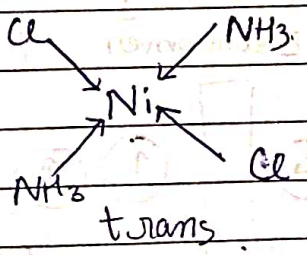


Cis

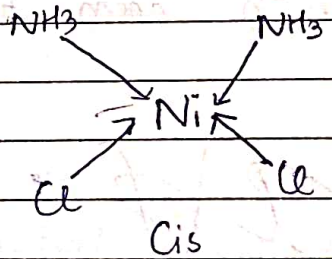
Atomation



trans

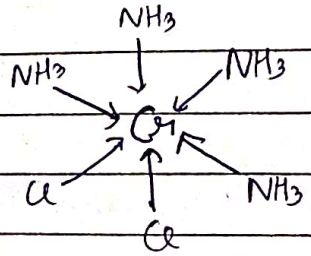


trans

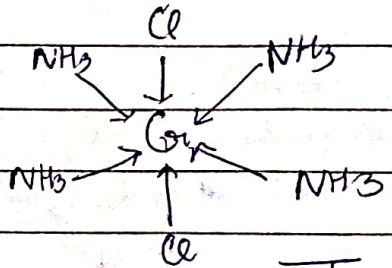


Cis

CN = 6 Ma_4b_2

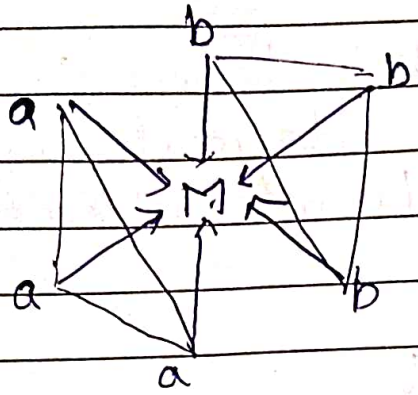


Cis

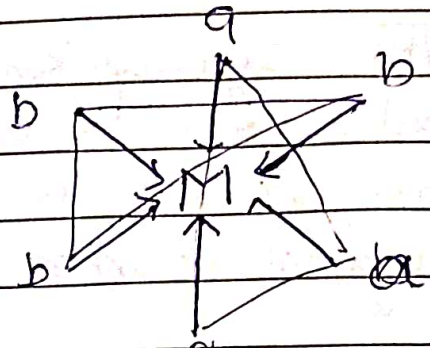


Trans

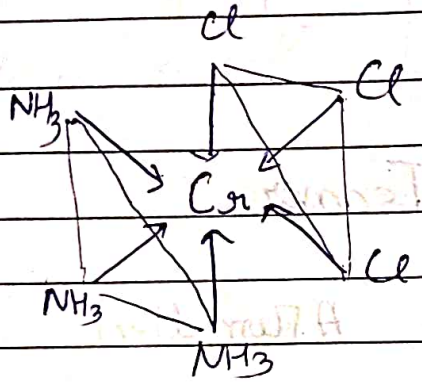
CN = 6 Ma_3b_3



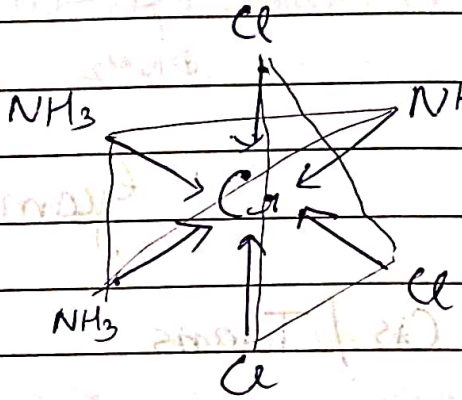
facial



Meridonial.



fac

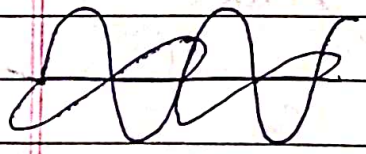


Mer

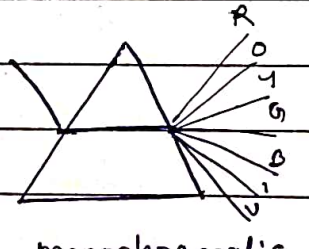
Optical isomer

Which can rotate PPL → optically active.

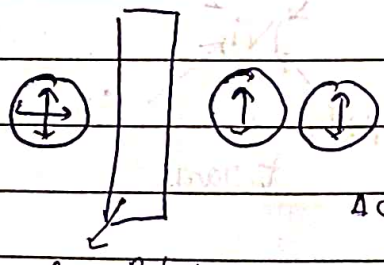
Enantiomer



EM wave



monochromatic light



liq Polariser

CW

Dextrorotatory
d form
+ve

ACW

Levorotatory
l form
-ve

PPL → rotate → optically active (Enantiomer)

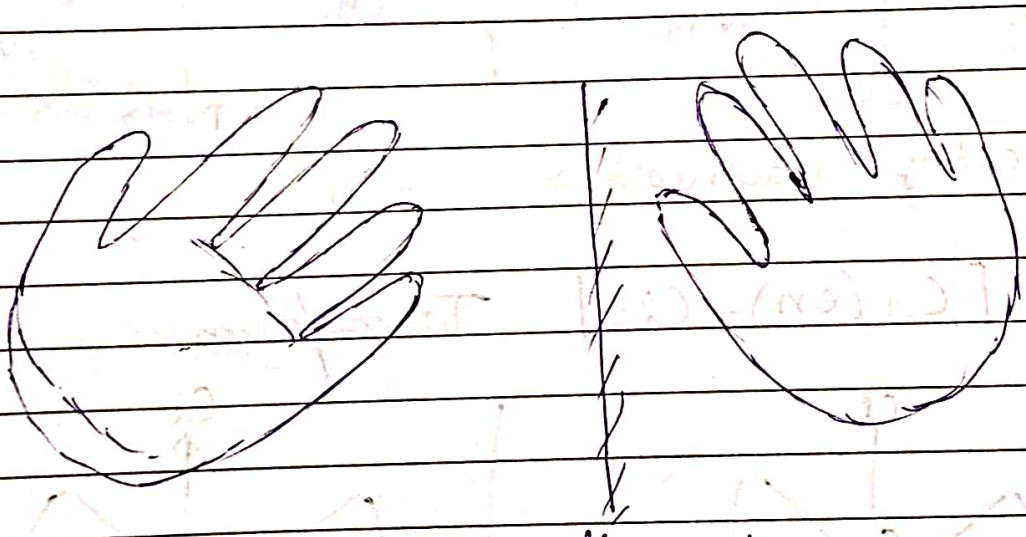
d form l form

PPL Not rotate → Meso compound
optically inactive

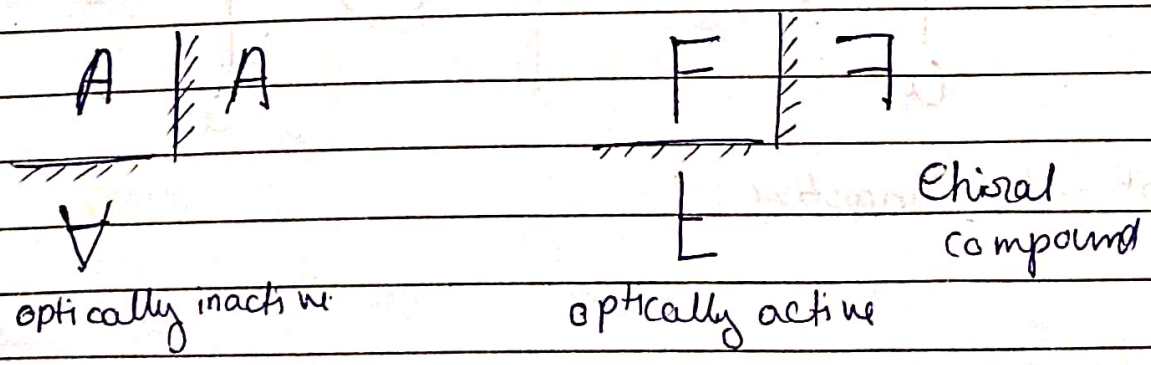
50 % rotation → d form
l form
] racemic mixture

Trick.

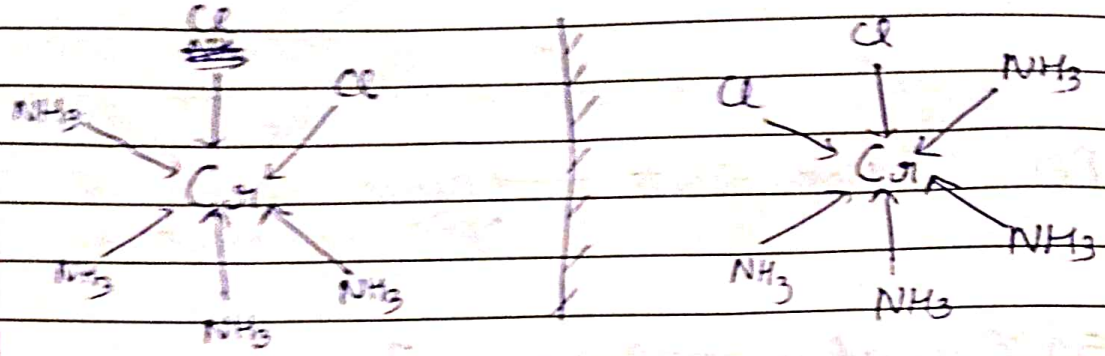
A compound whose mirror image do not superimpose with each other → optically active.



optically active.

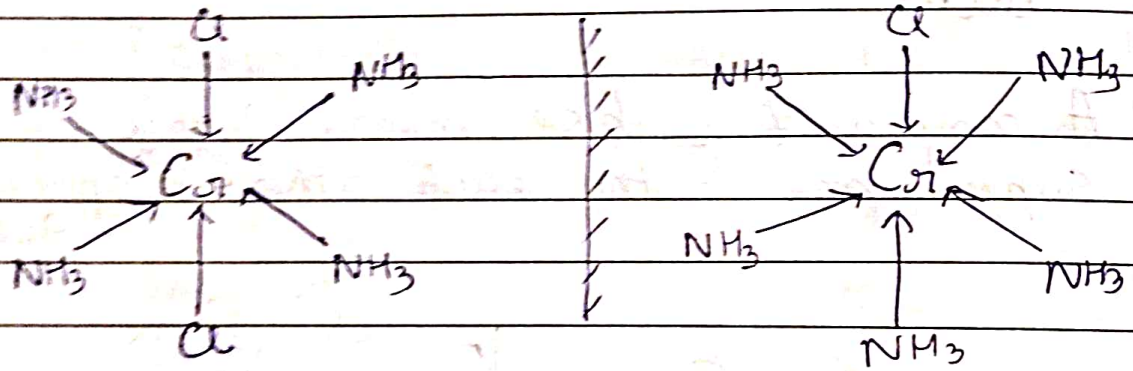


$[Cr(NH_3)_4Cl_2]$ Cis form.



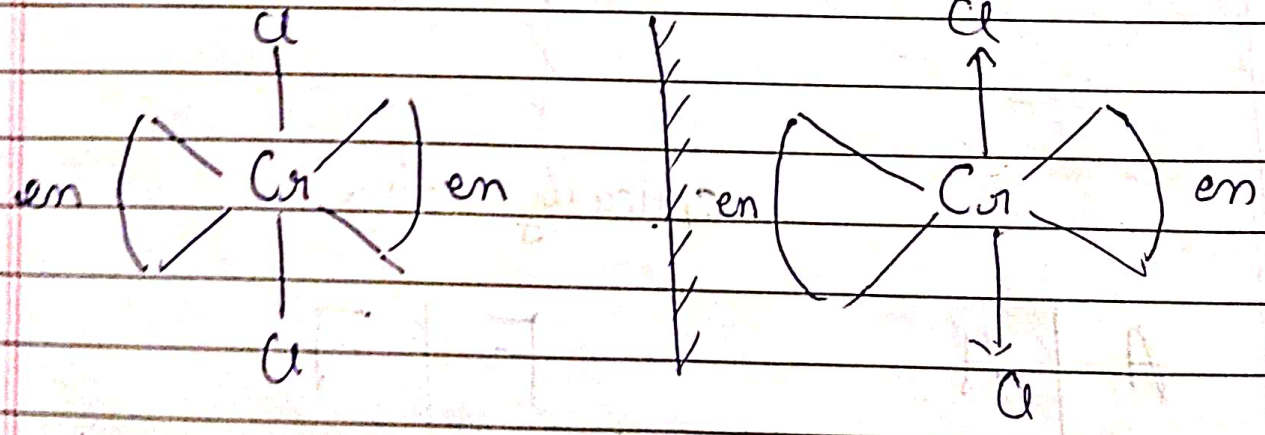
Optically active.

$[Cr(NH_3)_4Cl_2]$ trans form



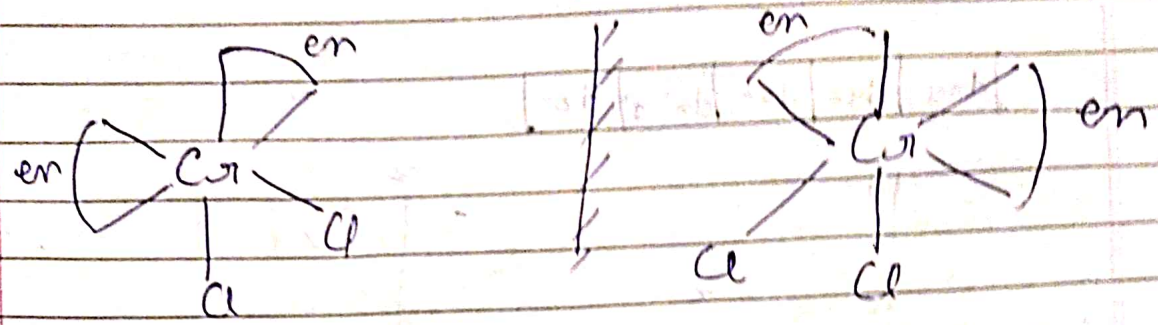
optically inactive

$[Cr(en)_2Cl_2]$ Trans form



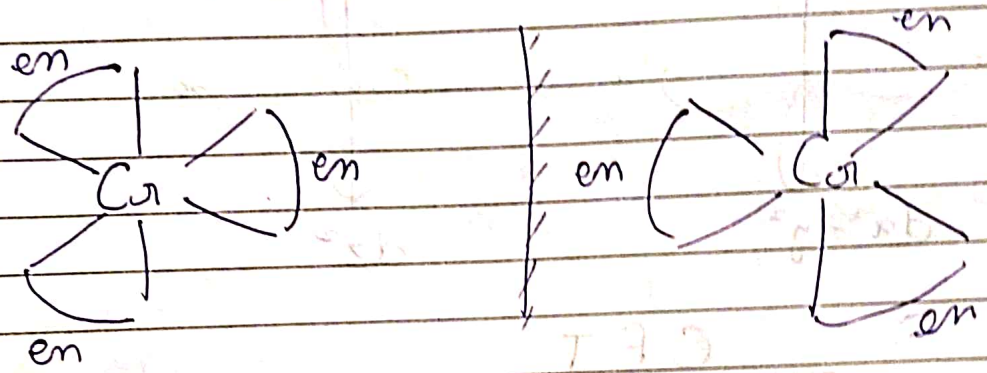
optically inactive.

$[Cr(en)_2Cl_2]$ as form



optically active.

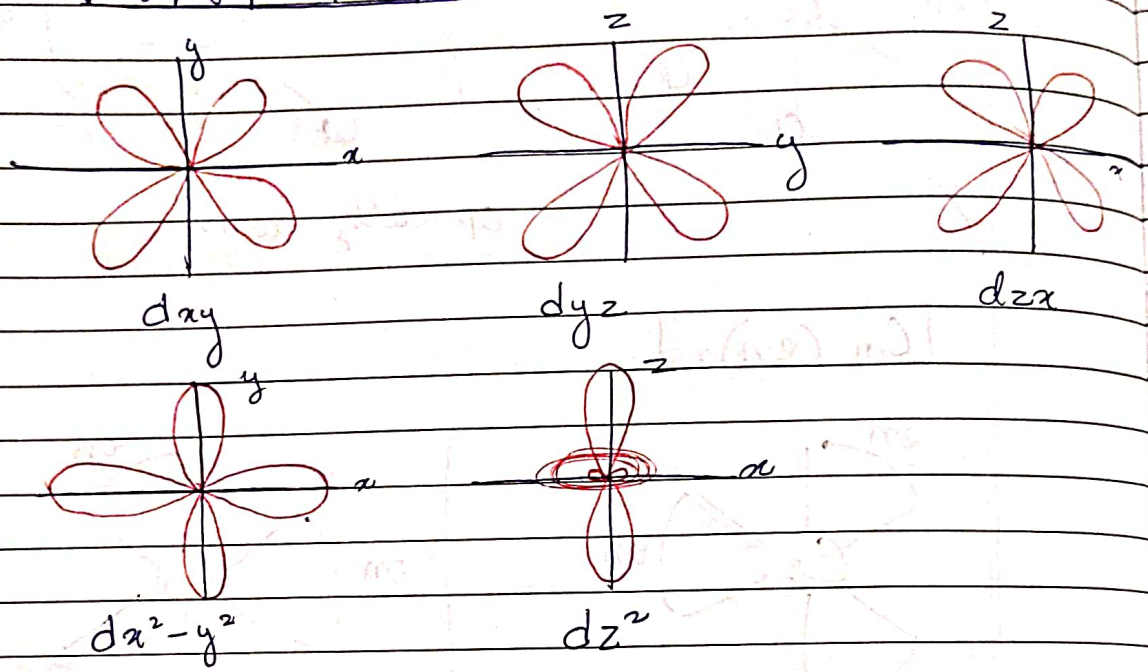
$[Cr(en)_3]$



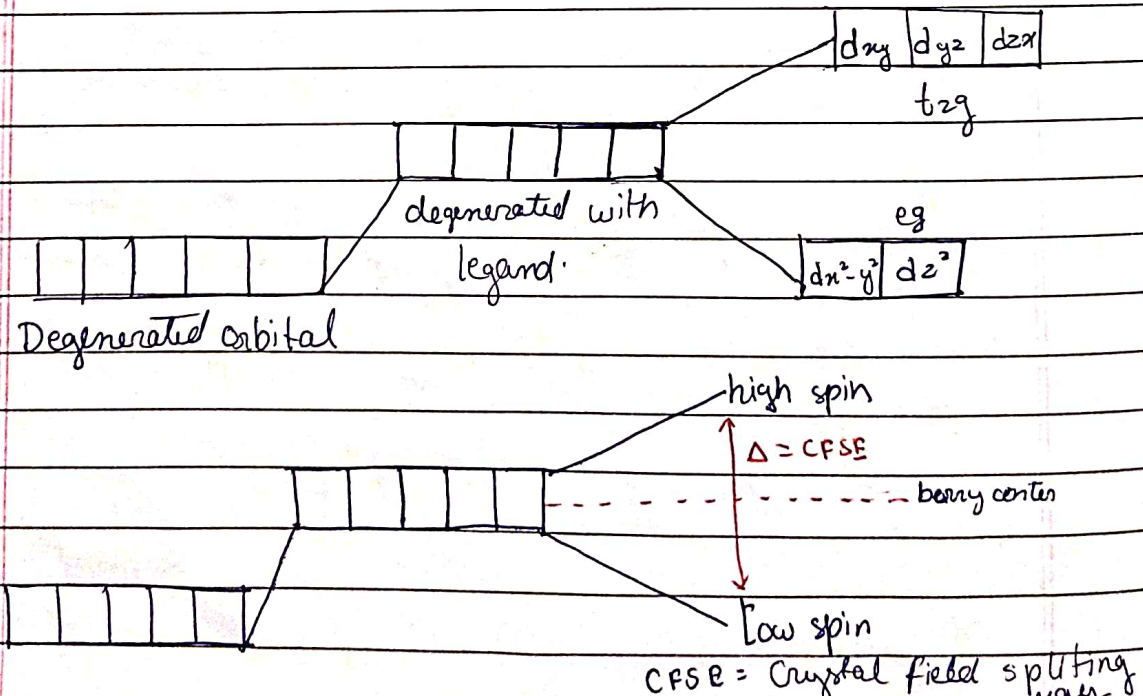
optically active.

Shape of Orbital

d_{xy}	d_{yz}	d_{zx}	$d_{x^2-y^2}$	d_{z^2}



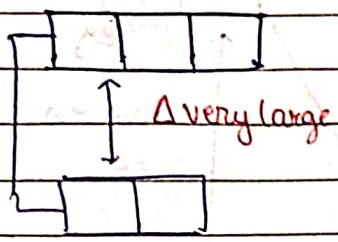
CFT
Crystal Field Theary



CFSE = Crystal field splitting energy

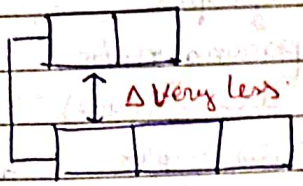
ligan-1

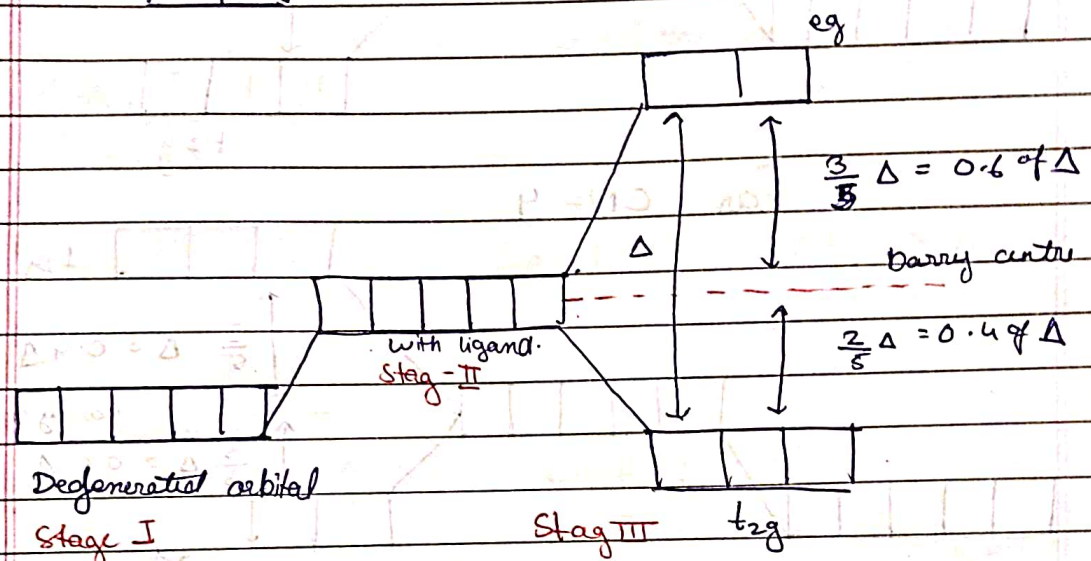
$\frac{CN^-}{SFL}$



ligand-2

$\frac{Cl^-}{WFL}$





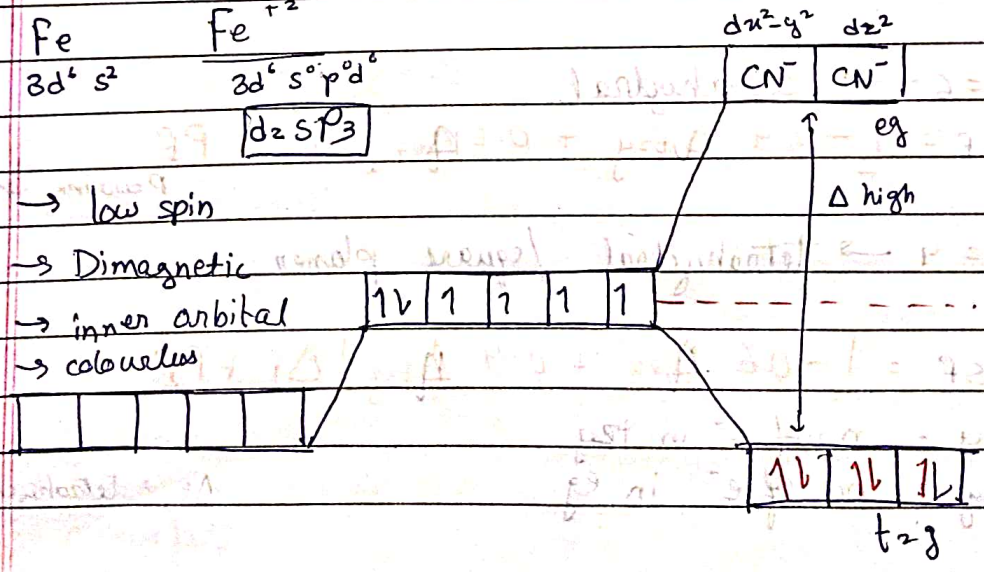
$K_4[Fe(CN)_6]$

Fe
$3d^6 s^2$

Fe^{+2}
$3d^6 s^0 p^0 d^0$

d_2sp_3

→ low spin
→ Dimagnetic
→ inner orbital
→ colourless



$K_4[Fe(CC)_6]$ CN = 6

Fe : Fe^{2+} d^6

26 d^6s^2

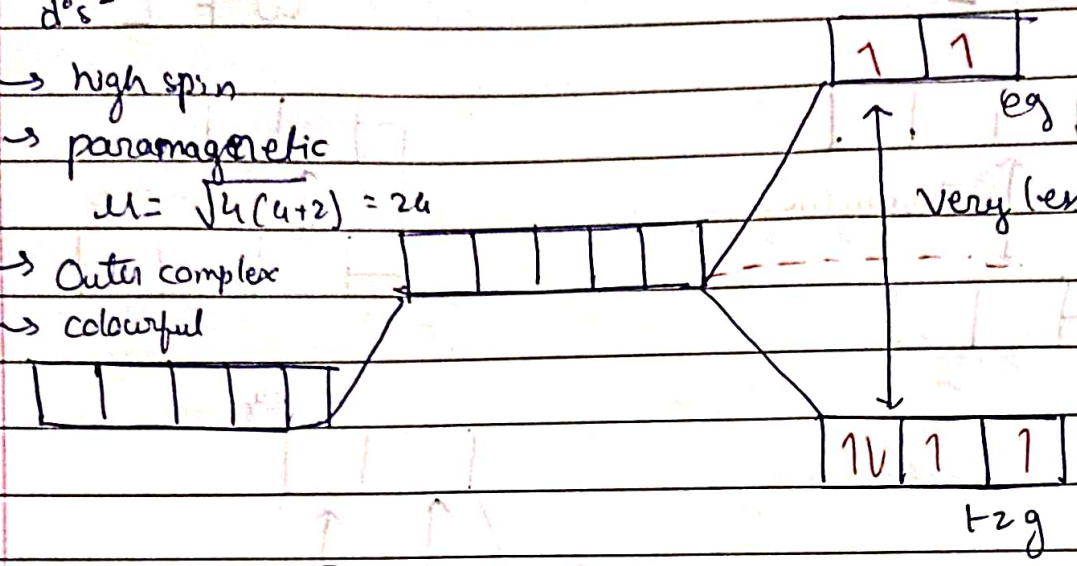
→ high spin

→ paramagnetic

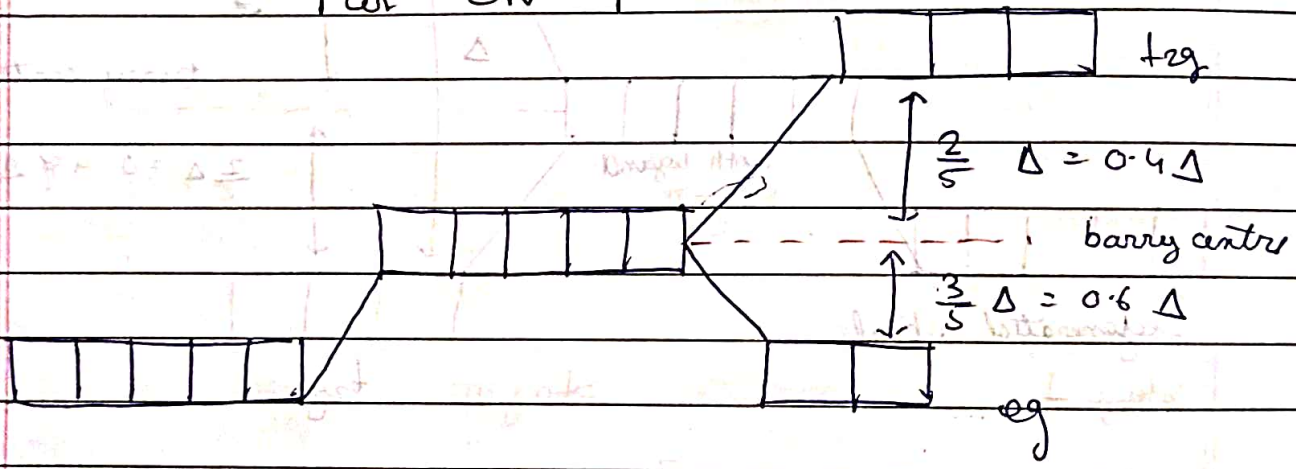
$\mu = \sqrt{4(4+2)} = 24$

→ Outer complex

→ colourful



For CN = 4



CFSE = ?

CN = 6 ⟶ octahydral

$CFSF = [-0.4\ \Delta_{t2g} + 0.6\ \Delta_{eg}]\Delta_o + Pf$

Pairing energy

CN = 4 → tetrahydral / square planer

$CFSF = [-0.6\ \Delta_{eg} + 0.4\ \Delta_{t2g}]\Delta_t + Pf$

Δ_{t2g} = no. of e^- in t_{2g}

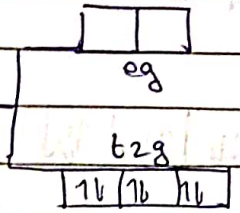
Δ_{eg} = no of e^- in eg

Δ_t = tetrahydral

Q $K_4[Fe(CN)_6]$ $\Delta_0 = 1.2\,eV$ $PE = 2.0\,eV$

Sol

Fe d^6s^2 Fe^{2+} d^6



$CFSE = [-0.4 \times 6 + 0.6 \times 0]\,1.2 = 2.0$

$= -2.4 \times 12 + 2.0$

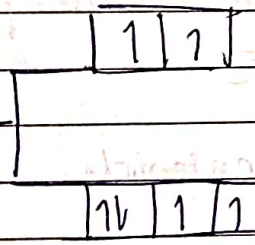
$= 0.88\,eV$

$\eta_{eg} = 0$

$\eta_{t_{2g}} = 6$

Q $K_4[Fe(Cl)_6]$ $\Delta_0 = 1.2$ $PE = 2.0$

$Fe^{+2} \rightarrow d^6$



$\eta_{eg} = 2$

$\eta_{t_{2g}} = 4$

$CFSE = [-0.4 \times 4 + 0.6 \times 2]\,1.2 + 2.0$

$= (-1.6 + 1.2)\,1.2 + 2.0$

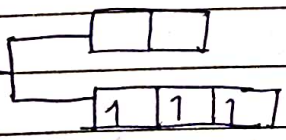
$= -0.48 + 2.0$

$\boxed{CFSE = 1.52\,eV}$

$[Cr(CNH_3)_6]Cl_3$

$[Cr(CH_2O)_6]Cl_3$ wfl

$_{24}Cr$ $d^5s^1 \rightarrow d^5$

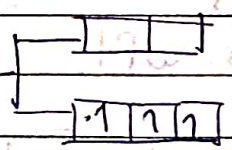


→ low spin → inner orbit

→ Para $\mu = \sqrt{15}$ BM

→ colourfull

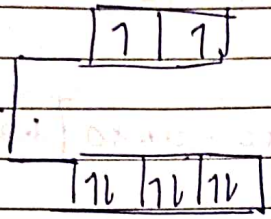
$Cr^{+3} \rightarrow d^3$



same

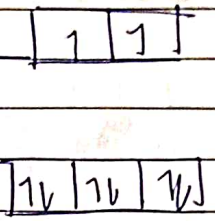
d^8

with SFL



d^3

WFL



50* SFL / WFL → same.

→ low spin
paramagnetic $\sqrt{15}$ BM
colourful
inner

d^8

n=2

high spin n=2
paramagnetic $\sqrt{8}$ BM
colorful
outer

Q As per IUPAC nomenclature the name of the complex $[Co(H_2O)_4(NH_3)_2]Cl_3$ is

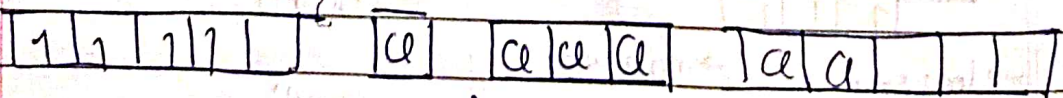
d) Diamminetetraaquacobalt(III) chloride.

Q The type of hybridisation and magnetic property of the complex $[MnCl_6]^{3-}$, respectively, are.

Mn d^5s^2
25

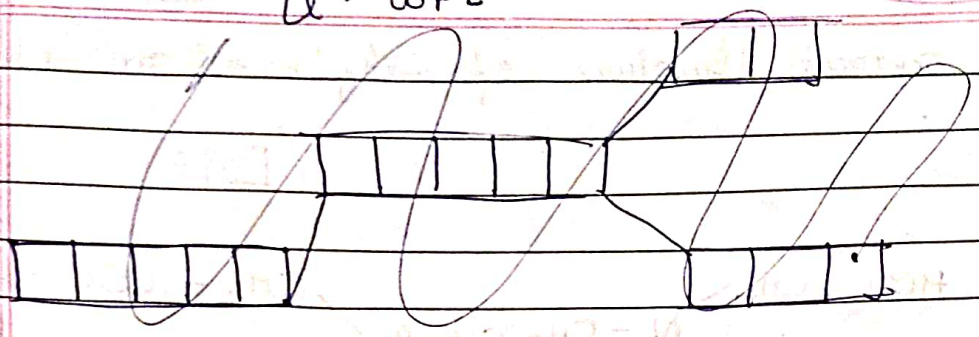
Mn^{3+} d^4

Cl → WFL



para. sp^3d^2

d → WFL

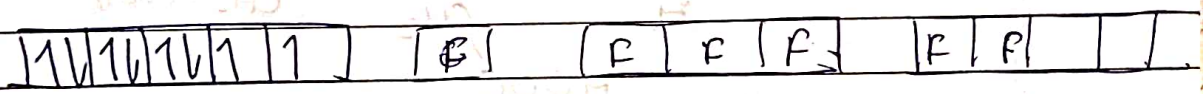


Q The calculated spin only magnetic moment of $[Cr(NH_3)_6]^{3+}$ and $[CuF_6]^{3-}$ in BM, respectively are (Atomic number of Cr and Cu are 24 and 29, respectively)

Cr^{3+} d^3

BM = $\sqrt{3\times5} = \sqrt{15}$ 3.

Cu^{+3} d^8



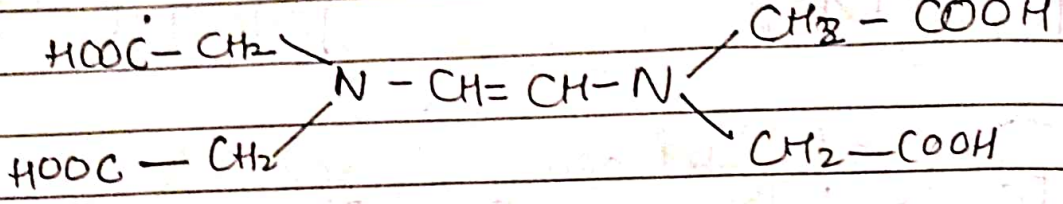
~~$\sqrt{2\times5} = \sqrt{6} =$ a)~~

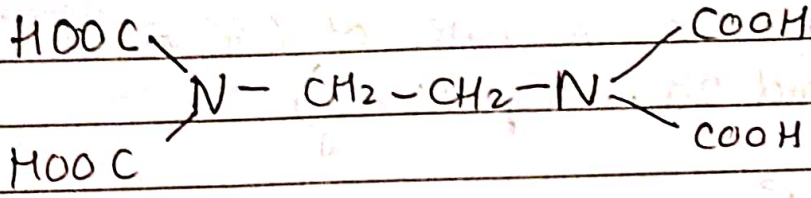
BM: $\sqrt{2\times4} = \sqrt{8} =$

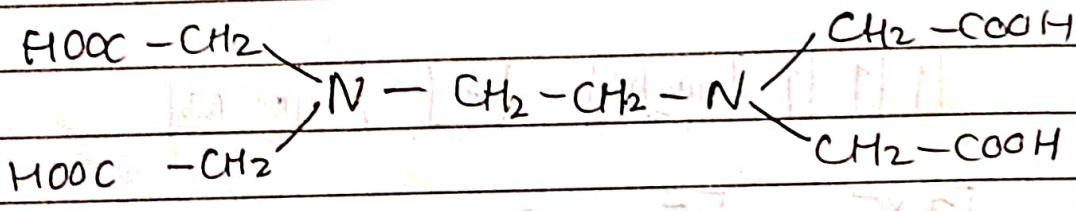
Q Transition metal complex with highest value of crystal field spliting (Δ_B) will be

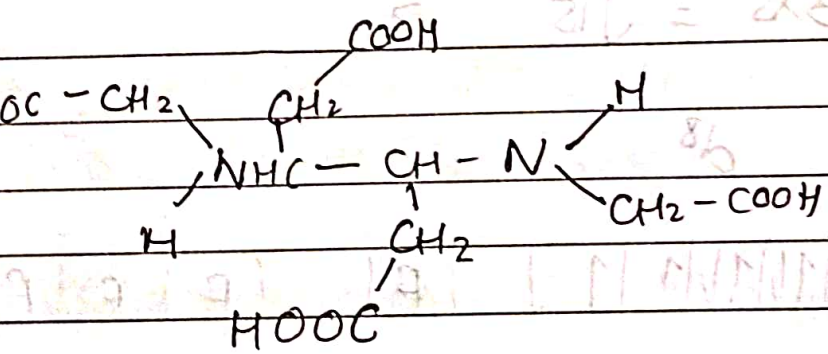
d) $[Os(H_2O)_6]^{3+}$ potential energy more d orbital ~~in~~ se me sabse shresht

Q The correct structure of ethylenediaminetetraacetic acid (EDTA) is

a) 

b) 

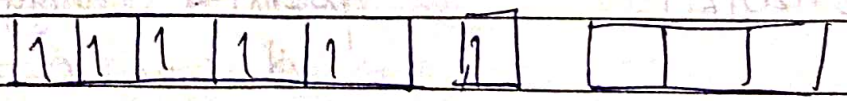
c) 

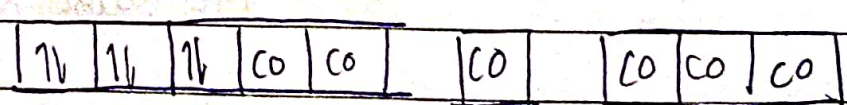
d) 

Q The spin only magnetic moment value (in Bohr magneton units) of $Cr(CO)_6$ is

a) 0

$Cr \quad d^5 s^1$



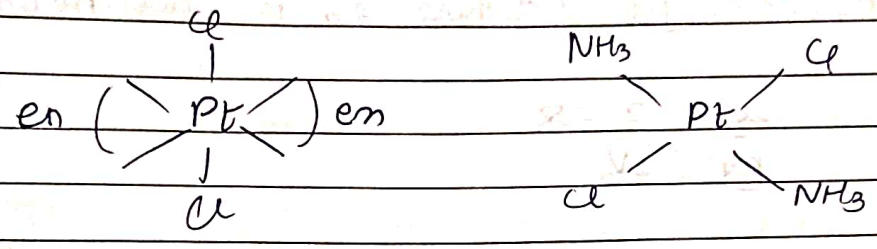


reacetic acid

Q The compound that exhibit geometrical isomerism is

a) $[Pt(en)Cl_2]$ b) $[Pt(en)_2]Cl_2$

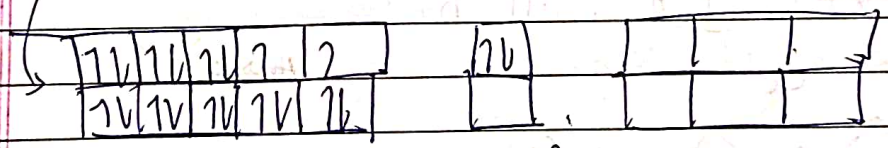
c) $[Pt(en)_2Cl_2]Cl_2$ d) $[Pt(NH_3)_2Cl_2]$



Q Both $[Ni(CO)_4]$ and $[Ni(CN)_4]^{2-}$ are diamagnetic The hybridization of nickel in these complexes, respectively

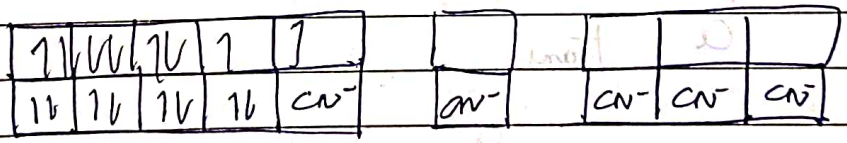
$[Ni(CO)_4]$ $[Ni(CN)_4]^{2-}$

28 $d^8 s^2$ 28 d^8



sp^3

magneton



dsp^2

Q The complexes $[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6]$ are the examples of which type of isomerism?

Coordination isomerism

Q The name of complex ion $[Fe(CN)_6]^{3-}$ is

Hexacyanidoferrate(III) ion

Q The sum of coordination number and oxidation number of the metal M in the complex $[M(en)_2(C_2O_4)]Cl$ (where, en is ethylenediamine) is

~~5 + 3 = 8~~

PV SV

PV $= n + 0 - 2 = +1$

$n = 3$

SV $= 2 \times 2 = 4$

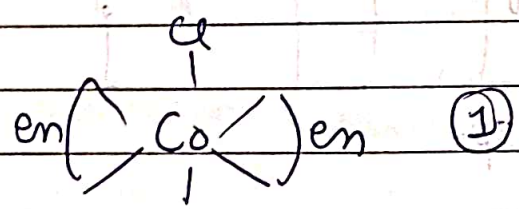
$2 = 2$

6

$3 + 6 = 9$.

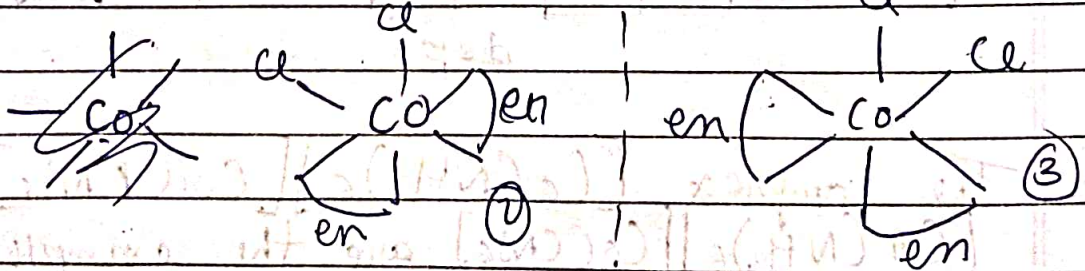
Q Number of possible isomers for the complex $[Co(en)_2Cl_2]Cl$ will be.

Ans (3)



(1)

trans



Q3 Cobalt (III) chloride forms several octahedral complexes with ammonia. Which of the following will not give test for chloride ions with silver nitrate at 25°C

✓ $CoCl_3 \cdot 3NH_3$ $[CoCl_3(NH_3)_3]$
$CoCl_3\ 4NH_3$
$CoCl_3\ 5NH_3$
$CoCl_3 \cdot 6NH_3$

Q5 The correct order of the stoichiometries of AgCl formed when $AgNO_3$ in excess is treated with the complexes.

$CoCl_3 \cdot 6NH_3$ $CoCl_3 \cdot 5NH_3$ $CoCl_3\ 4NH_3$

$[Co(NH_3)_6]Cl_3$ $[Co(NH_3)_5Cl]Cl$ $[Co(NH_3)_4Cl_2]$

3 AgCl 2 AgCl 1 AgCl

Q4 The geometry and magnetic behaviour of the complex $[Ni(CO)_4]$ are.

$Ni : d^8 s^2$

↑↓	↑↓	↑↓	1	1		↑↓

↑↓	↑↓	↑↓	↑↓	↑↓	CO	CO	CO	CO

sp^3

tetrahydral diamagnetic

Q The type of isomerism shown by the complex $[CoCl_2(e$
is

a) ionisation b) coordination c) geometrical
d) linkage

Q Ethylene diaminetetraacetate (EDTA) ion is

a) hexadentate ligand with four O and two N donor atoms
b) Unidentate ligand
c) bidentate ligand with two N donor atoms
d) tridentate ligand with three N donor atoms.

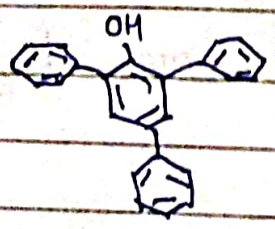
Q. The IUPAC name of the complex $[Ag(H_2O)_2][Ag(CN)_2]$ is.

a) diaquasilver (II) dicyanidoargentate (I)
b) dicyanidosilver (I) diaquaargentate (I)
c) diaquasilver (I) dicyanidoargentate (I)
d) dicyanidosilver (II) diaquaargentate (II)

NOTE:- Spectro Chemical Series.

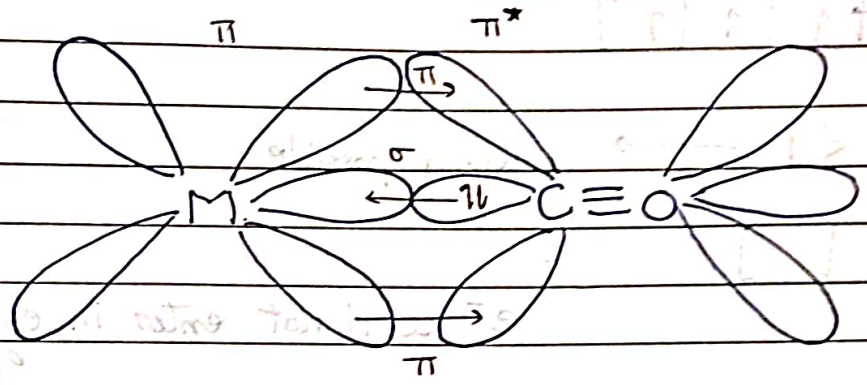
The list of ligand based on strength of their interaction with metal ion

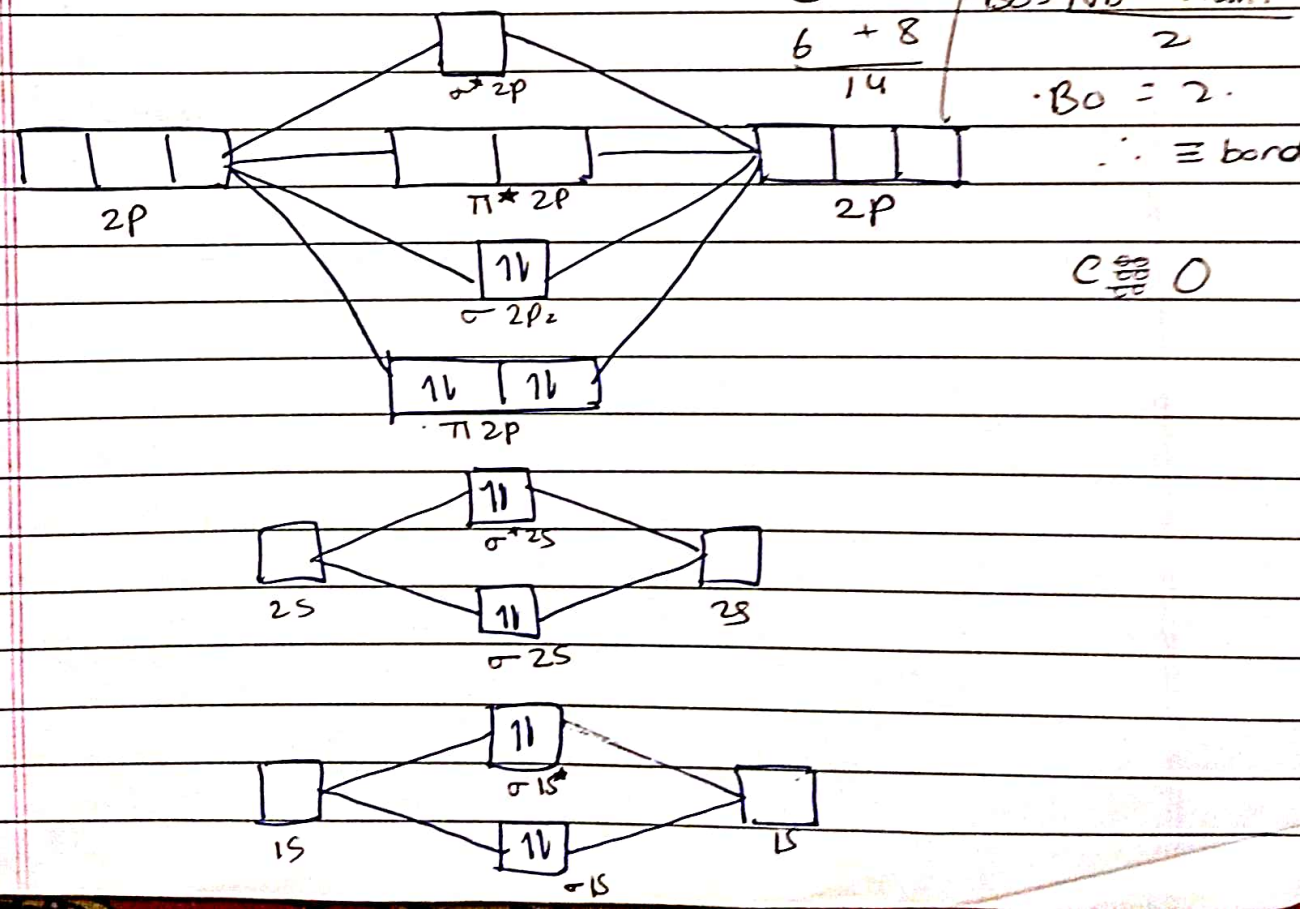
$I^- < Br^- < S^{2-} < SCN^- < Cl^- < NO_3^- < N_3^- < F^- < OH < C_2O_4^{-2} < H_2O < NS^-C < CH_3CN < Py < NH_3 < en < bipy < phen < NO_2^- < PPh_3 < CN^- < CO$



Synergic bonding

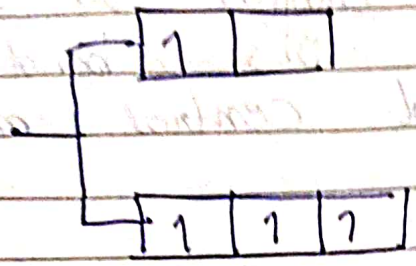
Synergic bond envolve transfer of electron from ligand to metal and the transfer of e⁻ from field metal orbital to antibonding orbital of ligands. It's a bond between carbonyl group and central metal atom





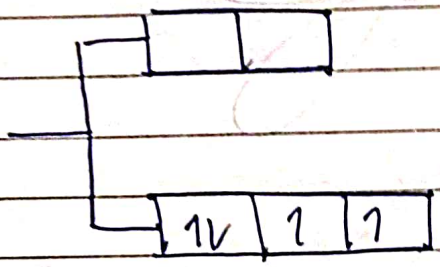
d^4

1) $\Delta_o > P$ ⟶ pairing not possible



e^- will be enter in eg

2) $\Delta_o < P$ ⟶ pairing possible



e^- will not enter in eg