

Co-ordination

Salts

Compounds

Acidic

e.g. NaHCO_3

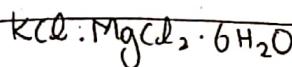
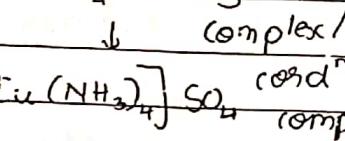
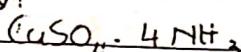
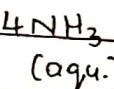
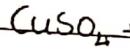
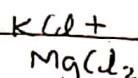
Basic

e.g. $\text{Mg}(\text{OH})\text{Cl}$

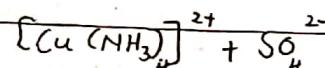
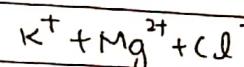
Mixed

 NaKCO_3 Two more metal cations
other than H^+ .Addⁿ / Molecular→ comp. formed by the
crystallisation of twoor more than one salt solⁿ.

SIGN HERE

salt solⁿ.

Double Salt



Double Salt

First is solid only
(\because dissociates into ions).Coordⁿ comp.→ First both in solid & solⁿ.

Completely ionised

→ Partially.

good conductor

→ Poor

gives test of all
ions.

→ X

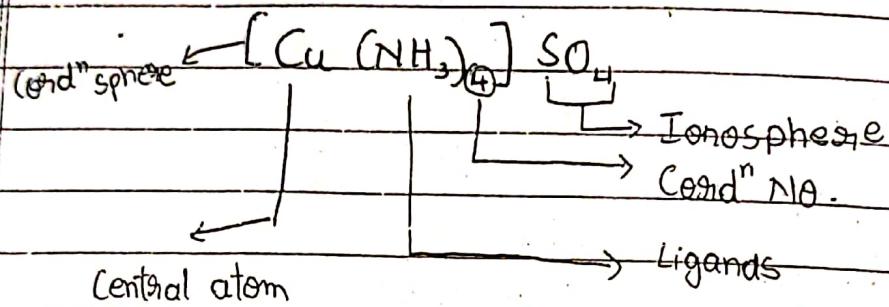
* Double Salt

$K_2Cl \cdot MgCl_2 \cdot 6H_2O$ - Pot. chloride - Mag. Chloride - hydrate (1)

$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$ - Pot. sulphate - Alu. sulphate - hydrate (1)

$(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$ - Amm. Sulphate - Fe2+ sulphate - hydrate (1)

Introduction:



- Central atom
- Mostly d-block elements.
- * Should have vacant d-orbitals.
- Also called Lewis acid / Electrophile.

- Coordⁿ No.
- No. ofative bonds formed b/w central atom and ligands.
- Highly specific
- upto 16
- Common 4 & 6.
- Coordⁿ Sphere
- Represented by [].

contains C.A. & lig only
never loses its identity.

Ionosphere
Present either side of c.s.
responsible for ionisation & conductivity.

Ligands
L.P. donors
Should be e⁻ rich
Also called Nucleophiles / lewis base.

Classification of ligands

On the basis of charges

Anionic: X^- , CN^- , NC^- , SCN^- , NCS^- , NO_2^- , ONO^- , $C_2O_4^{2-}$, SO_4^{2-} ,
 OH^- , O^- , H^- , NH_2^- , $NH_2CH_2COO^-$, etc.

Neutral: CO , NO , H_2O , NH_3 , $NH_2CH_2CH_2NH_3$, $(C_6H_5)_3P$ etc.

Cationic: NO^+ , $NH_2NN_3^+$

On the basis of denticity \rightarrow L.P. donor capacity

Monodentate: X^- , CN^- , NC^- , NH_2^- , H^- , OH^- , NO_2^- , ONO^- , CNS^- ,
 NCS^- , CO , NH_3 , H_2O , NO^+ , O^{2-} , S^{2-} etc.

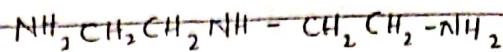
Bidentate: $C_2O_4^{2-}$, CO_3^{2-} , $NH_2CH_2COO^-$, $NH_2CH_2CH_2NH_2$ etc.

Denticity is charge supportive
One atom can donate only one lone pair

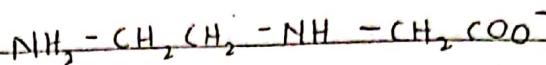
Ethylenediamine ↑

* Polydentate

T Tridentate

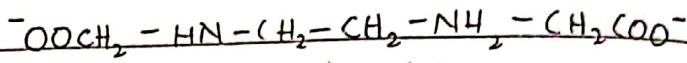


Diethylene triamine



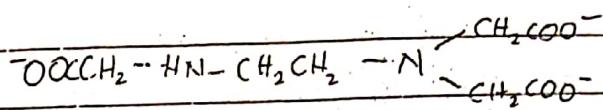
Ethylene diamine acetate ion

Tetradentate



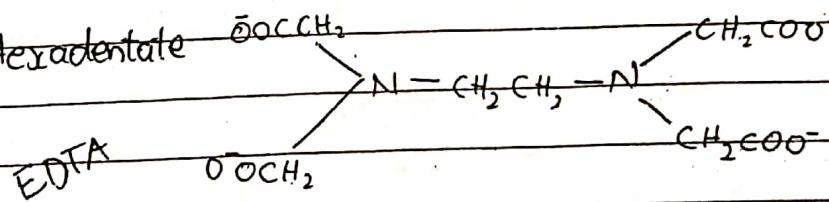
Ethylene diamine dicarboxylate ion

Pentadentate



Ethylene diamine triacetate ion

Hexadentate



Ethylene diamine tetraacetate ion

* Special types

→ Ambidentate - ligands having more than one donor site but can donate by one at a time

- CN & -NC

- CNS & -NCS

- UNO & -UNO

- * All peroxides are diamagnetic
 * Pt superoxides are paramagnetic/less paramagnetic

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Flexidentate - Bi to polydentate lig. shows flexibility
 in denticity

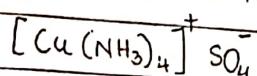
ex EDTA Hexa
 Penta
 Tetra ...

Chelating lig. - Bi to polydentate lig. shows tend
 to form ring like structure * increases stability

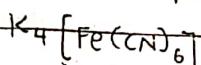
Classification of coordination comp.

on the basis of charges

- Cation complex / Simple Anionic salt $[]^{n+}$



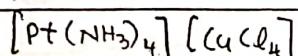
- Anion complex / simple cationic salt $[]^{n-}$



Non-ionic $[]^0$

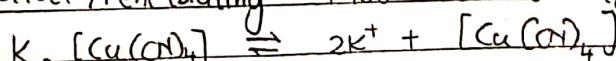


- Cation-Anion-complex $[]^{n+} []^{n-}$

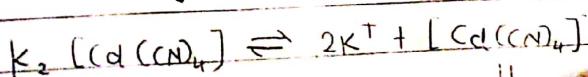


→ On the basis of stability

- Perfect / Penetrating - Most common type

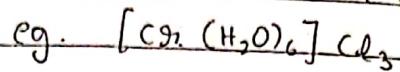


Imperfect (Rarely):

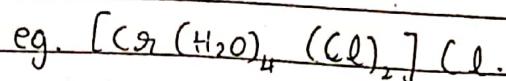


→ On the basis of types of lig.

Homoleptic Complex - Only one type of lig. in C.S.



Heteroleptic Complex - More than one lig. in C.S.



Werner's - Theory

1) C.A. of C.C. shows 2 types of valency.
(Primary & Secondary).

2)

Primary

Secondary

- Main valency

x

- Ionizable

x

- Represented by
dotted lines

- Dark lines

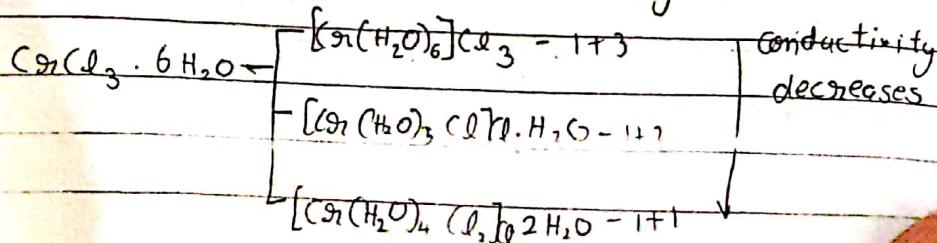
- Satisfied by O.N.
of C.A.

- Satisfied by C.N.

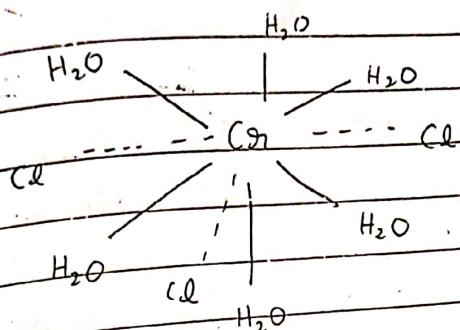
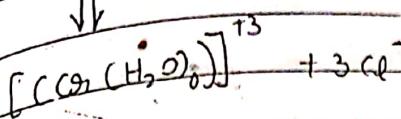
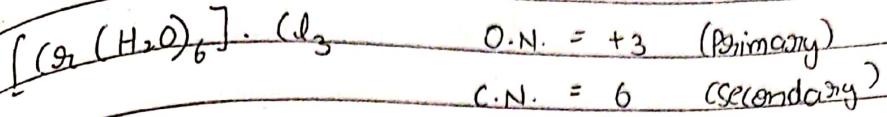
x

- Explain about the
structure

3) Also, explains about the conductivity.



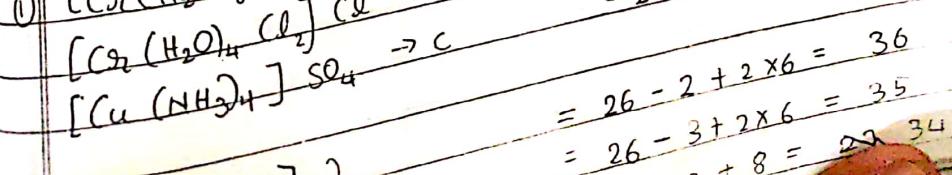
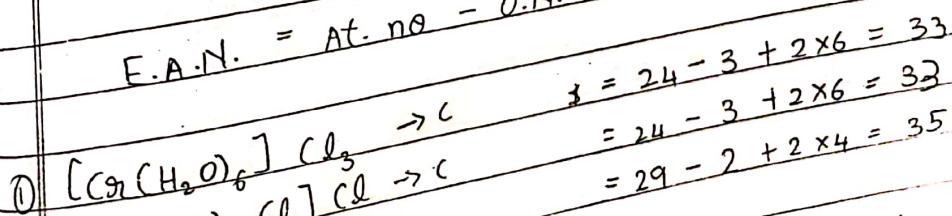
Expt



- * Effective Atomic No. / Sidgwick No.
- "Actual no. of e⁻ present in C.A. after the formation of complex."
- Explain abt the stability of complex.

For stab comp - FAN should be equal to the At. no. of zero group - 18, 36, 54

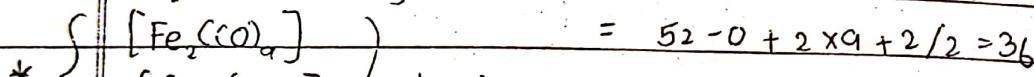
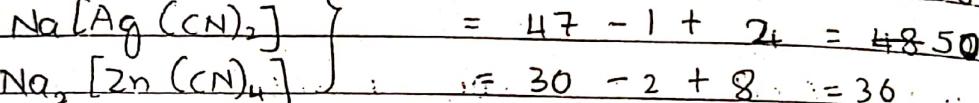
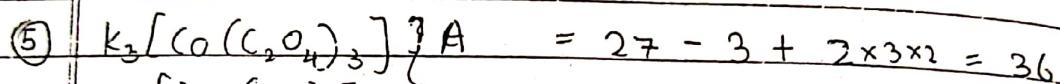
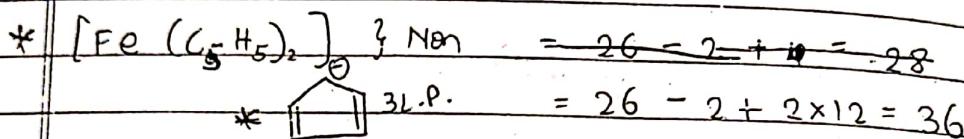
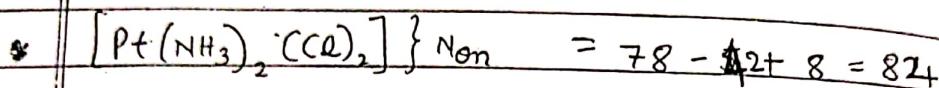
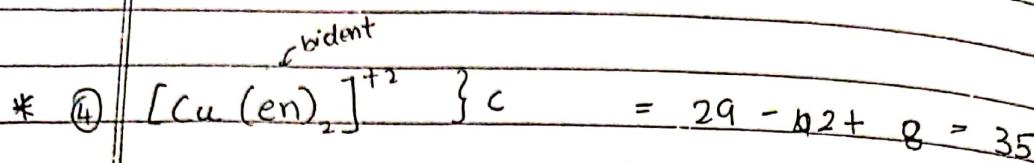
$$\text{F.A.N.} = \text{At. no} - \text{O.N.} + 2 \times \text{C.N.}$$



oxidation state of NO_3^-
" $\text{NO}_3^- = -1$

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$$\begin{array}{lcl} \textcircled{3} & \left. \begin{array}{l} \text{K}_2[\text{Hg I}_4] \\ \text{K}_2[\text{Pt Cl}_6] \\ [\text{Ni (CO)}_4] \\ [\text{Fe (CO)}_5] \end{array} \right\} \text{A} & = 80 - 2 + 8 = 86 \\ & & = 78 - 4 + 12 = 86 \\ & & = 28 - 4 + 8 = 30 + 2 = 32 \\ & & = 26 - 5 + 10 = 36 \end{array}$$

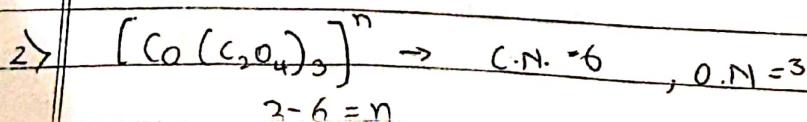
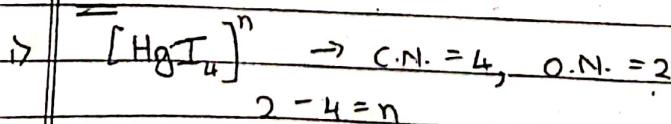


Double central atom for each atom.

$$M - M \rightarrow E.A.N = \frac{\text{At. No.} - \text{O.N.} + 2 \times \text{C.N.} + 2}{2}$$

$$M - M - M \rightarrow E.A.N = \frac{\text{At. No.} - \text{O.N.} + 2 \times \text{C.N.} + 4}{3}$$

ex



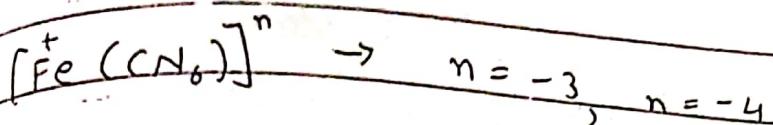
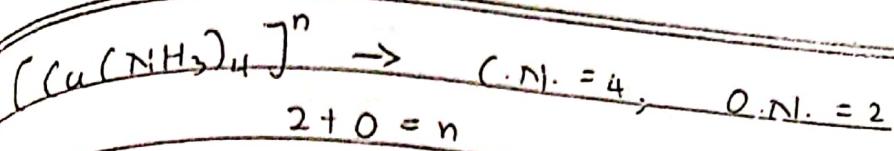
nr

• J DOKS

bond-order classmate

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Shortcut for carbonyl

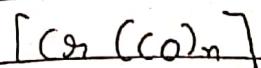
$$36 = 26 - 0 + 2n$$

$$n = 5$$

$$3d \rightarrow 36$$

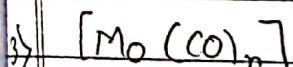
$$4d \rightarrow 54$$

$$5d \rightarrow 86$$



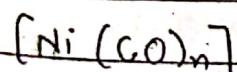
$$36 = 24 + 0 + 2n$$

$$n = 6$$



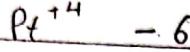
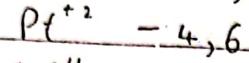
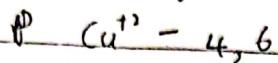
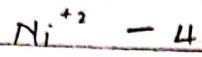
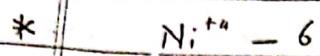
~~$$36 = n$$~~
$$54 = 42 + 0 + 2n$$

$$n = 6$$



$$36 = 28 + 0 + 2n$$

$$n = 4$$



The one where

C.N. = $2 \times O.N$

is more stable

Q Find if Oxid or Red:

1) $[\text{Fe}(\text{CO})_6] = 26 - 0 + 12 = 38$



hypothetical
comp.

↓

will lose $2 e^-$, so
reducing agent.

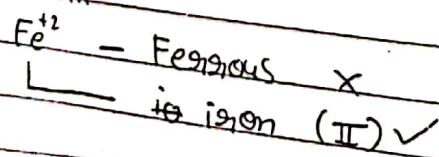
2) $[\text{Cr}(\text{CO})_6] = 24 - 0 + 10 = 34$



will gain $2 e^-$, so
oxidising agent.

T.U.P.A.C:

- 1) All letters are in lower case and no spacing
- 2) write the common name of metals with O.N. in Roman.



- 3) Write the no. of lig. as bi, tri, -

- 4) In heteroleptic comp, write the names in alphabetical order,

No. is also the part of name of ligand.

bi - bis

tri - triis

tetra - tetraakis

$(\text{en})_3^-$ - triethylenediamine X

↳ triis(Ethylenediamine) V.

→ more correct
to write organic IUPAC es well.

Name of lig [e → o]

Anionic : X - halo / halide

CN⁻ - cyano / cyanide

NC⁻ - isocyano / isocyanide

CNS⁻ - thiocyanato / thiocyanide

NCS⁻ - isothiocyanato / isothiocyanide

NO₂⁻ - nitro

ONO⁻ - nitrito (O-nitro)

H⁻ - hydrido

NH₂⁻ - Amido

SO₄²⁻ - Sulphato

OH⁻ - hydroxo / hydroxido

CO₃²⁻ - Carbonato

O²⁻ - oxo / oxido

NH₂CH₂COO⁻ (gly) - glycinate

N⁻³ - Azide

C₂O₄²⁻ - oxalato

Si²⁻ - Sulphido

N₃ -

(C₆H₅)₃P - Triphenyl phosphine

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CO - carbonyl

NO - Nitrosyl

$\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$ - Ethylenediamine
(en)

* NH_3 - Ammine

* Cationic (+ium)

NO^+ - Nitrosylum

NH_2NH_3^+ - Hydrazinium

* NH_4^+ not a cationic ligand.

Cationic Complex $[\text{ }]^n+$

→ No. of ligands → Name of ligands (Alphabetical) →
(C.A., O.N.) gap → free ion

Eg:

1) $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$ - tetraammine copper(II) sulphate

2) $[\text{Cr}(\text{H}_2\text{O})_6\text{Cl}_2]\text{Cl}$ - tetraqua dichloro chromium(III) chloride

3) $[\text{Fe}(\text{NH}_3)_6]\text{SO}_4$ - hexammine iron(II) sulphate

* 4) $[\text{Cu}(\text{en})_2]^{+2}$ - bis(ethylenediamine)copper(II) ion

5) $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3$ - hexaqua cobalt(III) chloride

6) $[\text{Ni}(\text{NH}_3)_6]\text{SO}_4$ - hexaammine nickel(II) sulphate

Anionic Complex $[\text{ }]^{n-}$

→ Free ion gap → No. of ligands → Name of ligand (Alphabetical)
C.A. + ate (O.N.).

Eg:

1) $\text{K}_4[\text{Cr}(\text{C}_2\text{O}_4)_6]$ - potassium hexaoxochromate(IV) ferrato(II)

2) $\text{K}_2[\text{Ni}(\text{Cl})_6]$ - potassium tetrachloronickelate(II)

- $K_2[PtCl_6]$ - potassium hexachloroplatinate (IV)
 $K_2[Ni(CN)_4]$ - potassium tetracyanonickelate (II)
 $K_3[Co(NO_2)_6]$ - potassium hexanitrocobaltate (III) ~~(IV)~~
 $K_3[Co(C_2O_4)_3]$ - potassium tetr oxalate cobaltate (III)
 $Na[Ag(CN)_2]$ - sodium bicyanoargentate (I)
 $Na_2[Zn(CN)_4]$ - sodium tetracyanozincate (II)
 $K_3[Fe(CN)_6]$ - potassium hexacyanoferrate (III)

Non-ionic complex $[]^0$

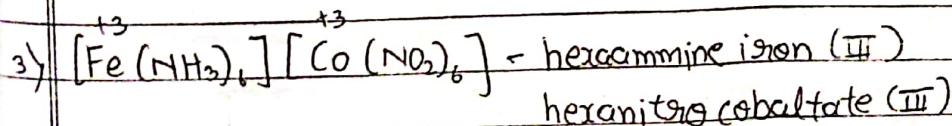
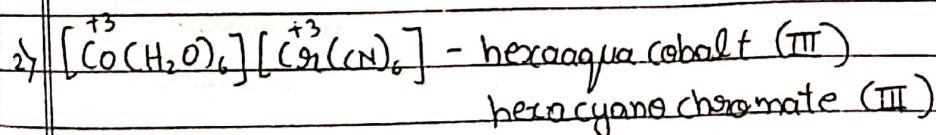
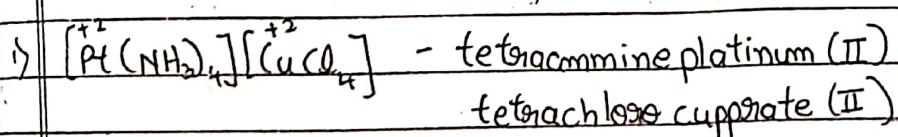
→ No. of ligands → Name of ligands (alphabetical) → C.A. (O. N.)
 ex:

- $[Ni(CO)_4]$ - tetra carbonyl nickel (0)
 $[Cu(gly)_2]$ - ~~di~~glycinate copper (II)
 $[Pt(NH_3)_2Cl_2]$ - diammine dichloroplatinum (II)
 $[Fe(CO)_5]$ - pentacarbonyl iron (0)

Cationic Anionic complex $[]^{n+} []^{n-}$

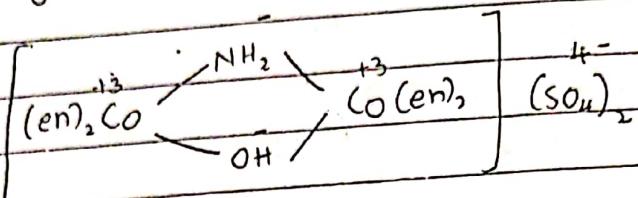
Rules of cation $\xrightarrow{\text{gap}}$ rules of anion

ex.



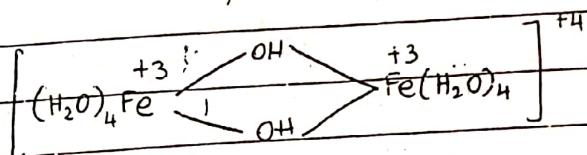
4) $[\text{Cu}(\text{en})_2]^{+2} [\text{Cu}(\text{Cl}_4)]^{-}$ - bis(ethylenediamine)copper(II)
tetrachlorocuprate(II)

* Bridge complex:



→ bis(ethylenediamine)- μ -amido- μ -hydroxo bis(ethylenediamine) cobalt(III) sulphate.

→ tetrakis(ethylenediamine)- μ -amido- μ -hydroxo dicobalt(III) sulphate.



→ tetra-aqua iron(III) - μ -hydroxo - μ -hydroxo tetra-aqua iron(II) ion

→ octaqua - μ -dihydroxo diiron(III) ion

V.B.T.:

Ex:

5) $K_2[\text{Cu}(\text{Cl}_4)]$

Cu - $3d^{10} 4s^1$

$\text{Cu}^{+2} - 3d^9 4s^0$

4 L.P.

$3d^{10}$

$4s^0$

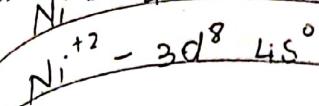
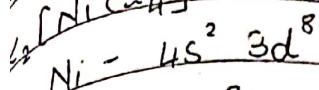
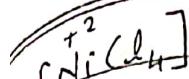
$4p^0$

| n | n | n | n | n |

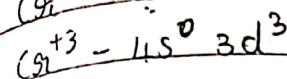
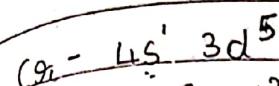
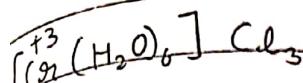
sp^3

1 unpaired e^- pair.

classmate

Date _____
Page _____ $3d^8$ $4s^0$ $4p^0$

1↑	1↓	1↑	1	1
----	----	----	---	---

 sp^3 2 unpaired e^- pairs.

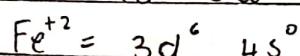
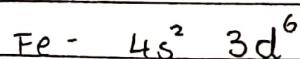
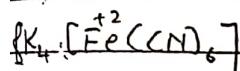
1	1	1							
---	---	---	--	--	--	--	--	--	--

 $* d^2 sp^3$ 3 unpaired e^- pairs.

drawbacks:

Not explanation about the spectra of complexes.

Not explained abt strength of lig.

Not explained abt filling of e^- against hund's rule.

1↑	1	1	1	1	1
----	---	---	---	---	---

 $sp^3 d^2$

X wrong

4 unpaired e^- pairs.Was observed to be $d^2 sp^3$ diamagnetic.

classmate
Date _____
Page _____

(M)agnetic & dipole
Ligand

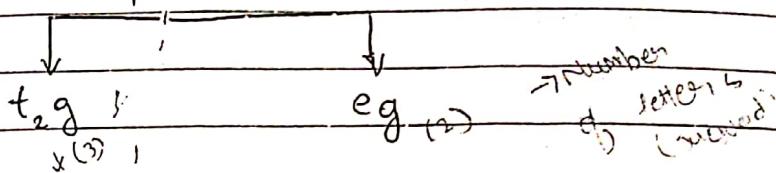
Crystal Field Theory

- 1) "Coord" complex is pure electrostatic in nature & always behaves like dipole
- 2) C.A. & lig. shows 2 types of interaction.

(a) Force of attraction arises b/w (+) charged C.A. & (-ve) charged lig.

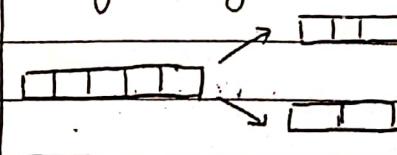
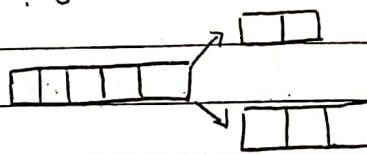
(b) Force of repulsion arises b/w 'd' e⁻ of C.A. and lone pair of ligand
* most considerable effect

- 3) Because of repulsion, d-orbital lost its degeneracy and split into 2 sets



	C.N.-6 (Octahedral)	C.N.-4 (Tetrahedral)
Energy ↑	eg > t _{2g}	eg < t _{2g}

eg > t_{2g}



$$\Delta t = 4, \Delta_o$$

Tetrahedral's 9
energy ↓ for
Octahedral complex (energy)

Crystal field splitting / stabilizing energy

$$= (-0.4 t_{2g} + 0.6 eg) \Delta_o$$

↑ CFSE C.N.

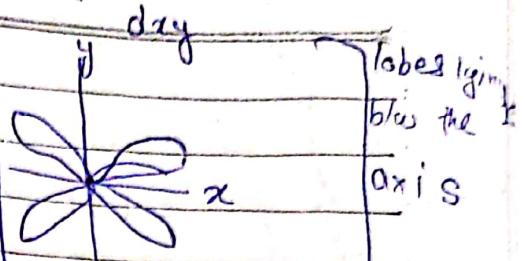
CFSE & ON

CN. ④ $\text{C}(\text{NH}_3)_4$ sp^3 square planar
 $\text{C}(\text{Cl})_4$ sp^3 tetrahedral

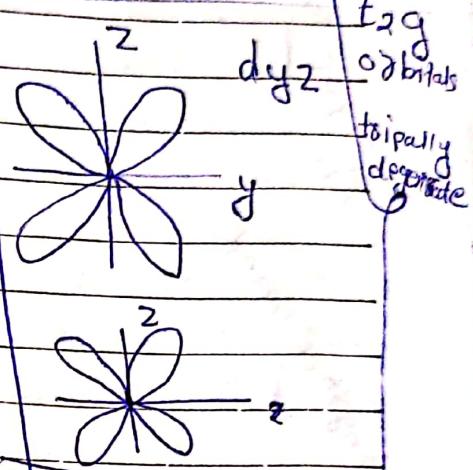
classmate

Date _____
Page _____

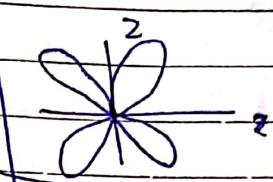
CN. ⑤ N_5 dsp^2 (square planar)



CN. ⑥ N_5O dsp^3
 CN. ⑦ N_5O_2 sp^3d trigonal bipyramidal



CN. ⑧ N_5O_3 sp^3d^2
 CN. ⑨ N_5O_4 d^2sp^3 octahedral

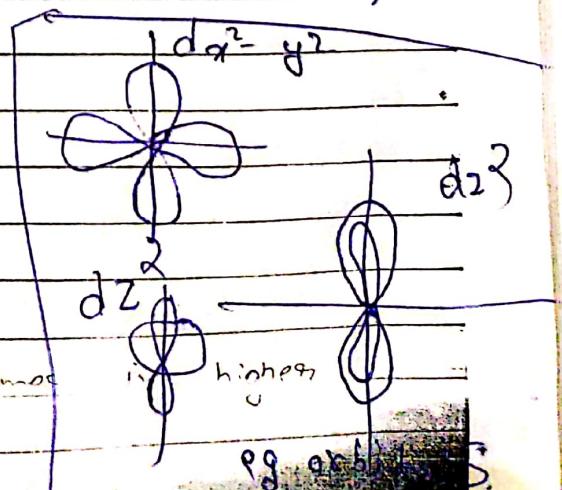


spin of e^- Less unpaired e^- if ≤ 3 , low spin.
 High More unpaired e^- if ≥ 3 , high spin.

orbital Inner $\text{dsp}^2, \text{dsp}^3, \text{d}^2\text{sp}^3$ etc. (Jugaad)
 Outer $\text{sp}^3\text{d}, \text{sp}^3\text{d}^2$ etc. if d inside \rightarrow inner $\text{d}^2 \text{sp}^3$
 d out \rightarrow outer sp^3d^2

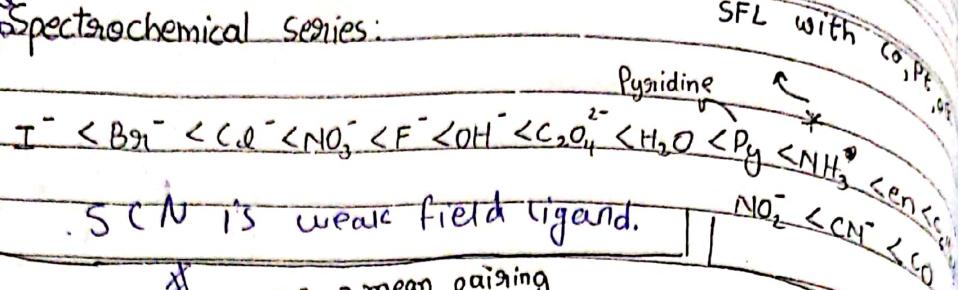
filling of e^- Low to high
 Left to right

In pair of ligand atoms come
 energy level



P (mean pairing Energy) : The energy required to pair 16 or two electron in an orbital.

Spectrochemical series:



. SCN is weak field ligand.

- $\Delta_o < p \rightarrow$ mean pairing energy
- Weak field ligand
- filling by Hund's rule.
- Strong field ligand
- Pushing of e^- / against Hund's rule

* $\text{C}_2\text{O}_4^{2-}$ & H_2O act as SFL for Co^{+3}

* F^- act as S.F.L. for Ni^{+4}

* NH_3 act as W.F.L. for Fe^{+2} & Mn^{+2}

Do \rightarrow For $\text{K}_4[\text{Fe}(\text{CN})_6]$

- $\text{Fe}^{+2} - 3d^6 4s^2$

lig - SFL

coord. no. - 6

eg $> t_{2g}$

1t	1t	1t			
----	----	----	--	--	--

filling against
Hund's rule

: $d_2 \text{sp}^3$ / low spin

dia / Inner.

①

2) $\text{K}_3[\text{Fe}^{+3}(\text{CN})_6]$ - $\text{Fe}^{+3} - 3d^5 4s^0$, CN - 6.

1t					
----	--	--	--	--	--

SFL.

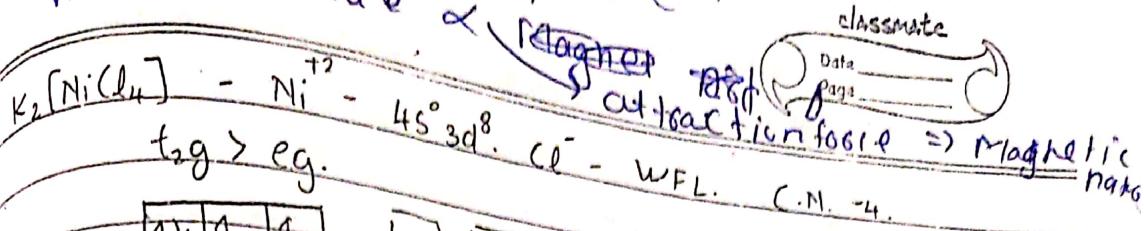
eg $> t_{2g}$

$d_2 \text{sp}^3 \rightarrow$ low spin

para/ inner.

☐ Diamagnetic (no poles) Paramagnetic + Attracted by magnetic field
 ☐ Paramagnetic (one pole) Diamagnetic - Repelled by " "
 ↳ no. of unpaired e⁻

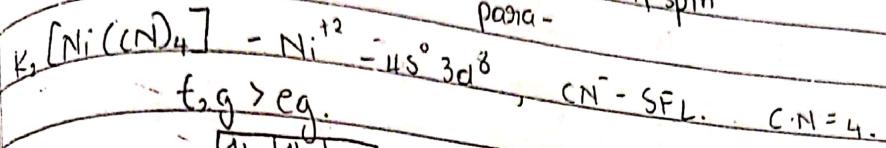
no. of unpaired e⁻ \propto



1V	1V	1V
1V	1V	

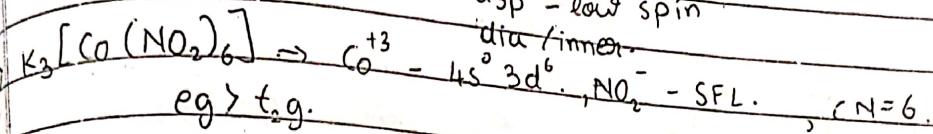


sp³ - low spin
paga-



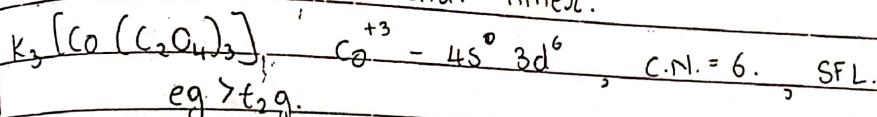
1V	1V	
1V	1V	

dsp² - low spin



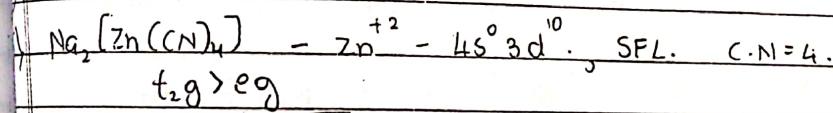
1V	1V	1V
1V	1V	

d₂sp³ - low spin
dia. inner.



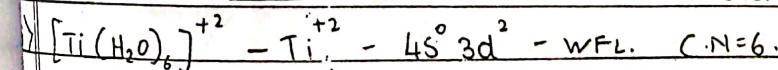
1V	1V
1V	1V

d₂sp³ - low spin
dia. inner.



1V	1V	1V
1V	1V	

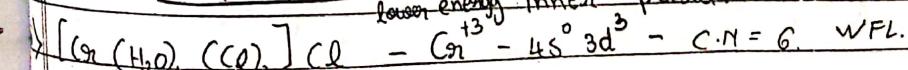
sp³ - low spin
dia



eg > t_{2g}.

1	1		

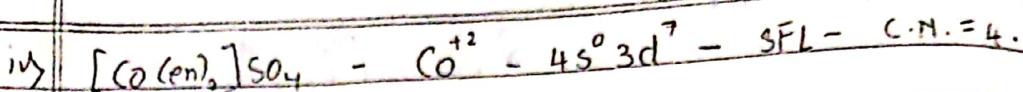
won't occupy d₂sp³ - low spin
lower energy inner - paga.



eg > t_{2g}.

1	1	1
1	1	

d₂sp³ - high spin
paga - inner.

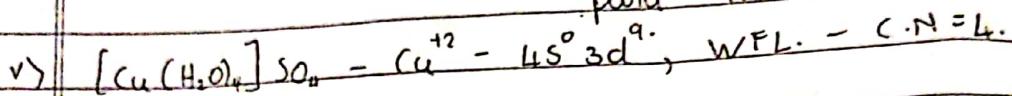


$t_{2g} > eg.$

1V	1V	1
1V	1V	

dsp^2 - low spin

para - inner.



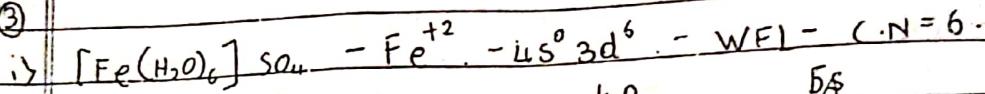
$t_{2g} > eg.$

1V	1V	1
1V	1V	

sp^3 - low spin

para

②

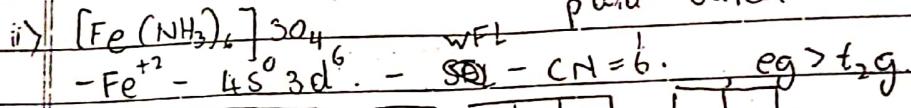


$eg > t_{2g}$	$3d$	$4s$	$4p$	$5s$	$4d$

1	1
1V	1V

sp^{3d^2} - o low spin

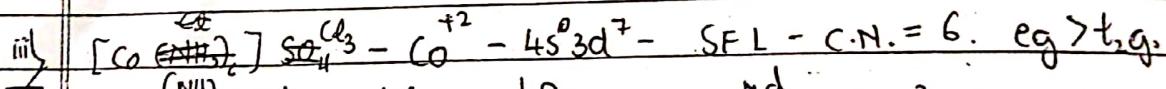
p dia - outer.



1	1					
1V	1B	1B				

sp^{3d^2} low spin

dia - inner outer.

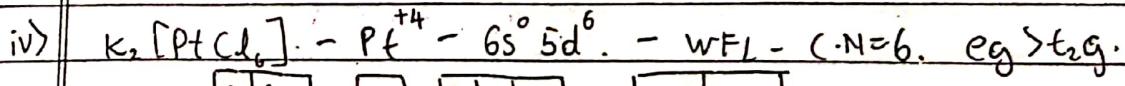


$(\text{NH}_3)_6$	$3d$	$4s$	$4p$	$4d$

1	1				
1V	1V	1V			

d_2sp^3 low spin

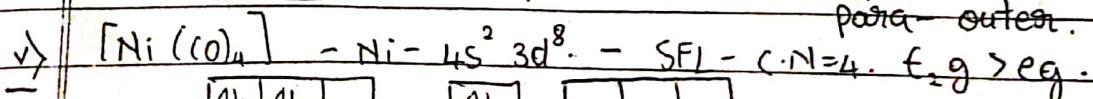
dia inner



1	1				
1V	1V	1	4s	4p	4d.

sp^3d_2 high spin

para - outer.



1V	1V		1V		
1V	1V				

pushed

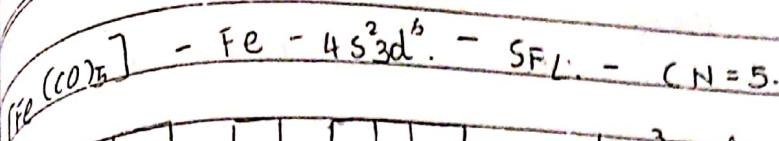
cn^3 - low spin

C.N. = 5 \rightarrow Rules of C.N. = 4
 C.N. = 6 \rightarrow Rules of C.N. = 6

classmate

Date _____

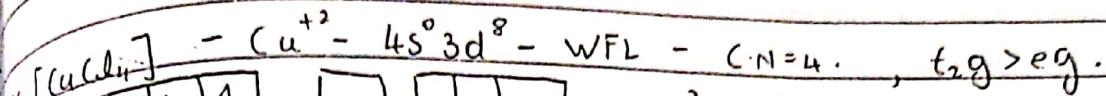
Page _____



1v	1v				
1v	1v				

dsp^3 - low spin

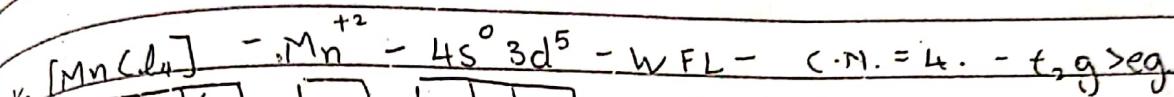
dia - inner.



1v	1	1
1v	1v	

sp^3 - low spin

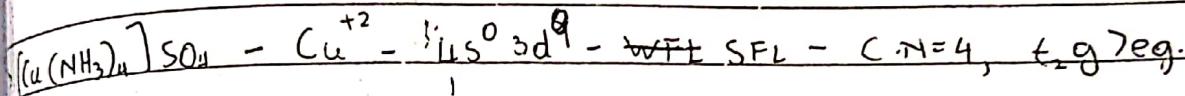
para - ~~inner~~



1	1	1
1	1	

sp^3 - high spin

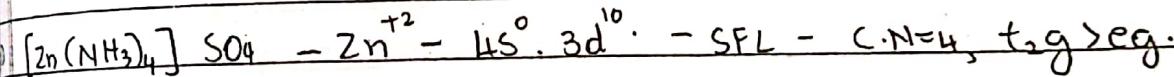
para.



1v	1v	1
1v	1v	

dsp^3 - low spin

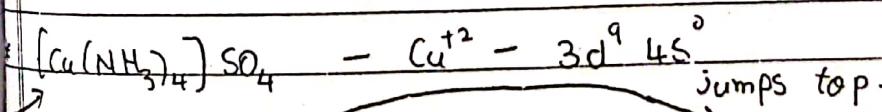
dia - inner. para



1v	1v	1v
1v	1v	

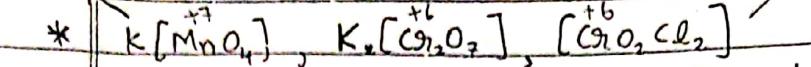
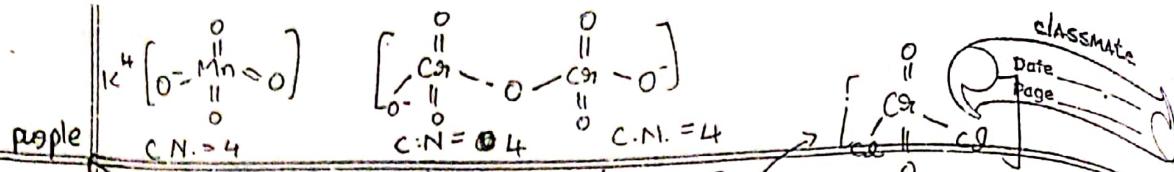
sp^3 - low spin

sp^3 dia.



water	1v	1v	1			
solvent						
(color)	1v	1v				

dsp^2 - 1 unpaired.

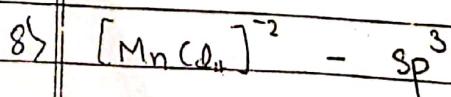
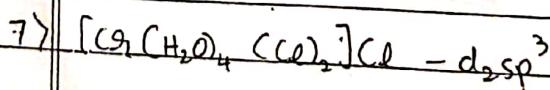
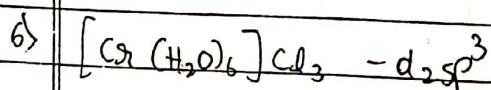
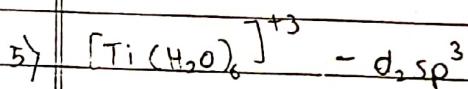
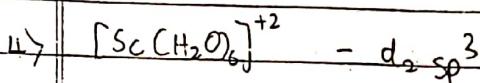
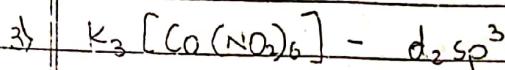
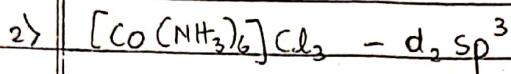
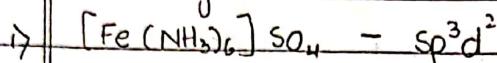


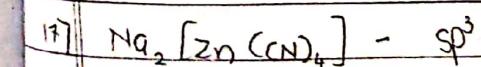
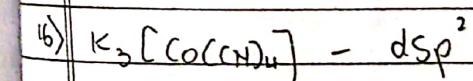
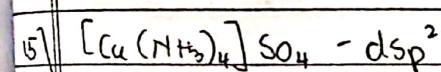
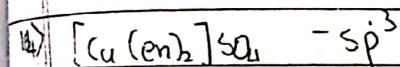
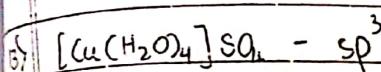
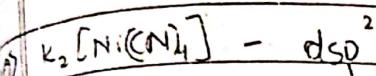
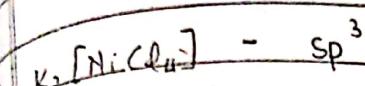
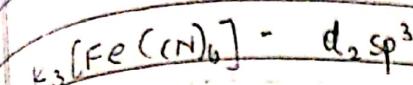
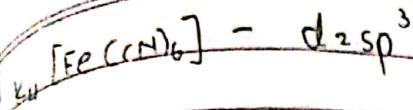
\rightarrow It - O strong, \downarrow orange \rightarrow green

\rightarrow All hybridisations come out to be $d_3\text{s} \approx \text{sp}^3$
 [Tetrahedral]

\rightarrow Zero unpaired e.s. Diamagnetic.

Q. Find hybridisation:





* Limitation of C.F.T

1) It considers ligand molecules as point charges but it is not appropriate bcz in case of neutral ligands like H_2O and NH_3 , H_2O should be stronger ligand as it is more polar but it is not.

2) It does not state anything about π bonding in complexes

3) It considers metal atom as positively charged particle but there are some complex in which the oxidation state of metal is zero

*

→

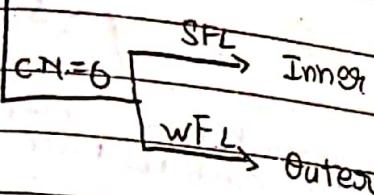
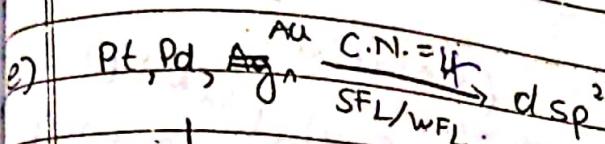
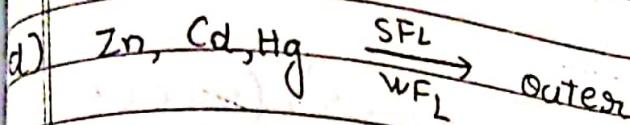
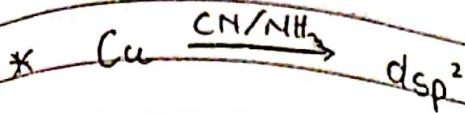
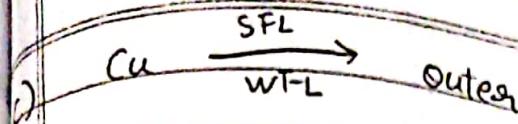
a)

b)

Shortcut:

Only for ionic compounds:
Sc, Ti, V, Cr $\frac{\text{SFL}}{\text{WFL}} \rightarrow$ Inner

Mn, Fe, Co, Ni $\frac{\text{SFL}}{\text{WFL}} \rightarrow$ Outer



Colour Theory: (Most of complex compounds are coloured)

a) In paramagnetic (unpaired e⁻)

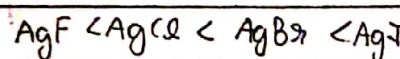
- due to transition
 $(d-d / f-f)$ presence of unpaired e⁻ is mind

b) In diamagnetic (paired e⁻)

→ Due to charge transfer b/w O²⁻ and M_r

eg: KMnO₄, K₂S₂O₈, Cr₂O₇Cl₂ etc. {Check resonance}

→ Due to covalent nature.



X M^{+2} L^{-1} O²⁻

Aqueous solution
is coloured

classmate
Date _____
Page _____

Almost all the complexes
zinc is white or colourless

*

VIB/GYOR

VIB
GYOR

R

O

V

B

G

Y

Isomerism: (Same molecular formula but diff properties) (same CN & ON)

H₂O molecule in m⁺
poorly coordinated

[Inside the coordination sphere]

~~X O.N > C.N
and nature
of compound
should
not be
altered.~~

Structural (the compounds have different bonding pattern)

→ Ionisation SI

→ Hydrate

→ Linkage / Salt

→ Coordⁿ SI

→ Coordⁿ posⁿ SI

→ Polymerisation

Stereo (Relative

arrangement of group is different)

→ Geometric

e.g. $[\text{Co}(\text{NH}_3)_6]^{2+}$
 $\{ \text{Fe}_6(\text{NH}_3)_6 \}^{2+}$

It is observed in complexes containing bidentate ligands
They differ in number and type of ions present
in solution.

1) Ionisation SI :- "Isomers formed by the exchange of ions b/w c.s. & I.S."

cond: Complex should be cationic $[\text{J}]^{n+}$.

$[\text{ion} \rightleftharpoons \text{ion}]$

ex: ① $[\text{Co}(\text{NH}_3)_6\text{Br}_4]\text{SO}_4 \rightarrow [\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}_4$

acts as flexidentate

so here: ② $[\text{Pt}(\text{OH})_2(\text{NH}_3)_4]\text{SO}_4 \rightarrow [\text{Pt}(\text{SO}_4)(\text{NH}_3)_4](\text{OH})_2$

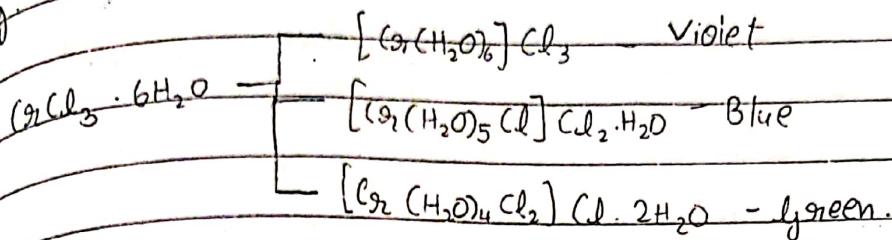
2) Hydrate SI :- "Isomers formed by the exchange of ion with H₂O b/w c.s. & I.S."

cond: Complex should be cationic $[\text{J}]^{n+}$ with H₂O.

$[\text{ion} \rightleftharpoons \text{H}_2\text{O}]$

It occurs in complexes having both complex cation and complex anion.

Eg:

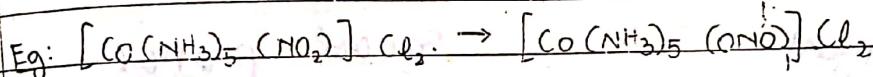


→ won't form $[\text{Cr}(\text{H}_2\text{O})\text{Cl}_3] \cdot 3\text{H}_2\text{O}$ as non-ionic

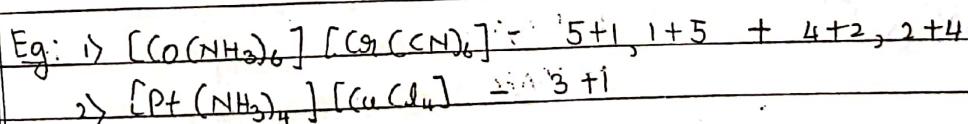
Linkage S.I.: Shown by exchange of linkage in ambidentate lig:

- CN & - NC
- CNS & - NCS
- NO₂ & - ONO

→ Detected by infrared spectroscopy

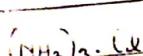
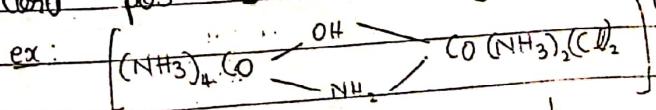


→ Coordⁿ S.I. - Shown by cationic anionic complex
- Formed by interchange of lig in 2 CS.



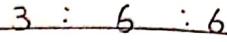
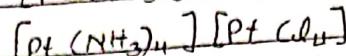
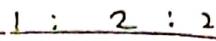
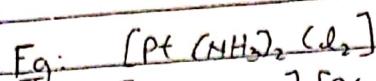
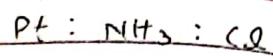
→ No. of neutral ligand should be more in first part. [otherwise first CS non-ionic].

→ Coordⁿ pos SI - Shown by bridge lig: comp.



ii) no identical.

b) Polymerisation: - Same stoichiometric composition by diff molec. composition.

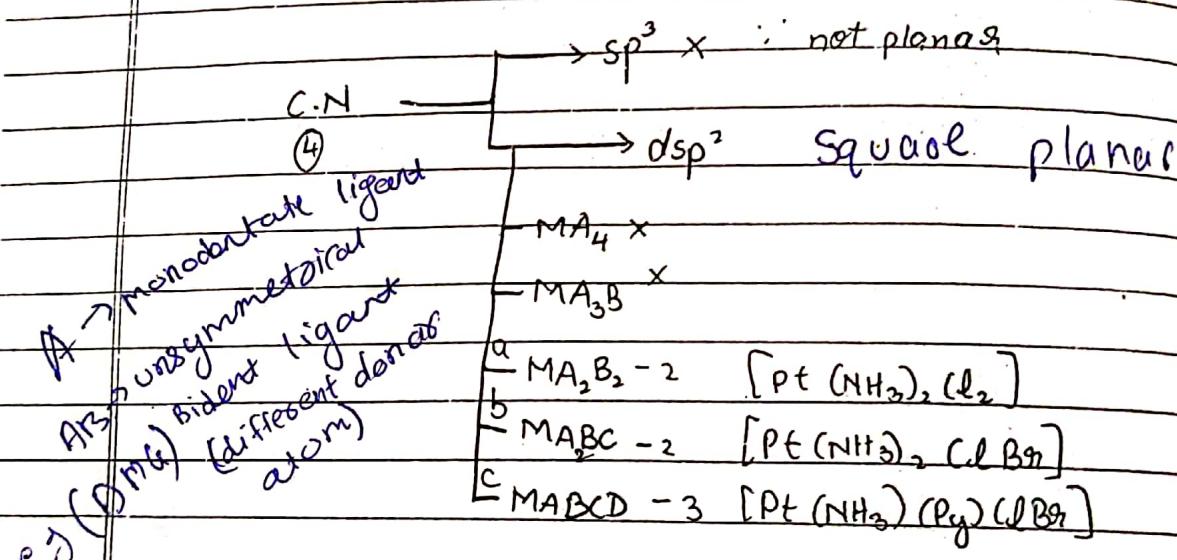


* Geometrical: Isomers formed by the change in relative posⁿ of ligands around C.A.

cis - same at 90°

trans - same at 180°.

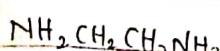
$\text{AP}_4 \rightarrow$ geometric
 $\text{P}_2\text{d}_2\text{O}_2$ ligand



→ Bidentate

Sym
(AA)

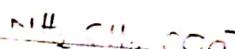
ex. (E_n)

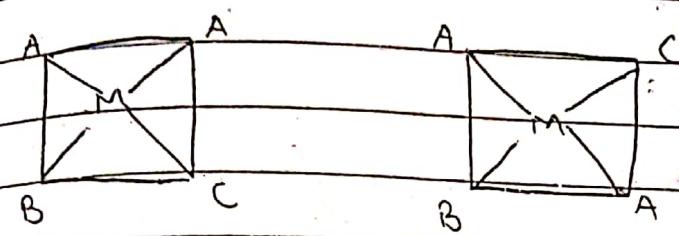
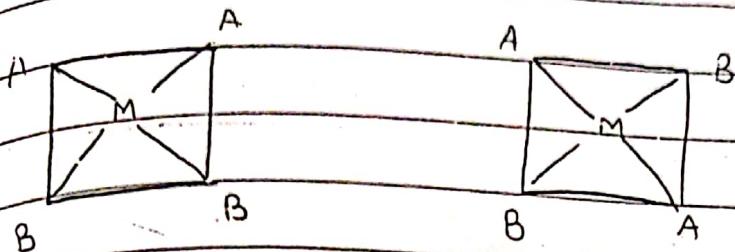
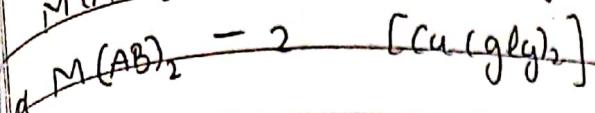
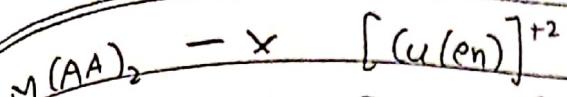


Unsym.

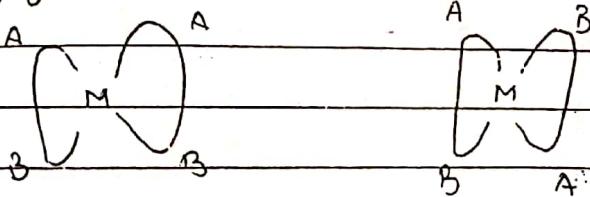
(AB)

ex. g^ty





$\rightarrow Cu(gly)_2$

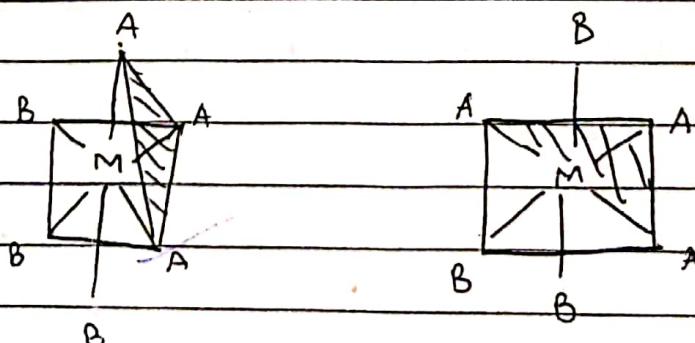


\rightarrow If $C.N = 4$, all compounds can show 2 geom isomers. except ABCD type. [check eligibility first]

$(N = 6)$ $\rightarrow \begin{cases} \text{sp}^3\text{d}^2 \\ \text{d}^2\text{sp}^3 \end{cases}$

- MA_6 - X
- MA_5B - X
- MA_4B_2 - 2
- MA_4BC - 2
- MA_3B_3 - 2 (Fac-Mer)
- +1
one sub.
- $\text{MA}_3\text{B}_2\text{C}$ - 3
- MA_3BCD - 4
- $\text{MA}_2\text{B}_2\text{C}_2$ - 5
- $\text{MA}_2\text{B}_2\text{CD}$ - 6
- $\text{MA}_2\text{B}_2\text{CDE}$ - 9
- MABCDEF - 15
- M(AA)_3 - X
- M(AB)_3 - 2

$\rightarrow \text{MA}_3\text{B}_3$ -



Facial

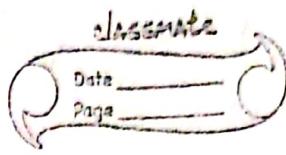
\rightarrow Two in plane

\rightarrow 1 1

Meridional

\rightarrow Three in plane.

Bpst forms - non-planar



Optical: "Ability of complex to rotate the plane of polarised light"

clockwise - dextro/d +ve

Anticlockwise - leavo/l -ve

Racemic Mixture - ±

optically active compound
(d) - right
(l) - left
enantiomer

C.N=11 \rightarrow d^{sp^2} X] Geometric plane of symmetry,
 sp^3 ✓ then no opticals.

C.N=6 \rightarrow sp^3d^2 ✓
 d^2sp^3 ✓

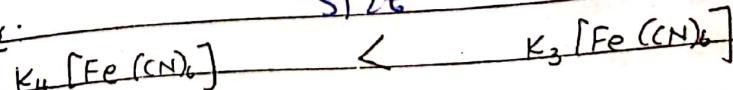
M_{A_6} , MA_5B , MA_4BC , MA_3B_3 , trans-X (won't show)
sym. bidentate ✓
MABCDEF - 30

Stab \propto C.R.I.A

→ Stability factor:

a) Stab \propto charge density of C.A.

ex:

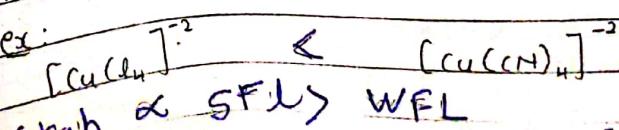


Stab \propto O.N of C.A.

Stab \propto $F^- > Cl^- > Br^-$

b) Stab \propto Lewis basic nature of lig.

ex:



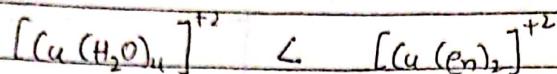
which \propto SFLS > WFL

classmate
Date _____
Page _____

first consider this
Stab . Smallest ring = 6 member ring

c) Stab \propto chelating lig.

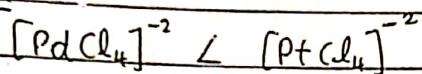
ex



Stab \propto Mono < bi < tri < tetra

d) Stab \propto CFSE

ex



3d < 4d < 5d

e) Stab \propto 1

dissociation const

f) Increasing william order of stab

	Mn^{+2}	Fe^{+2}	Co^{+2}	Ni^{+2}
Size	Decreases \rightarrow			
Stab	Increases \rightarrow			[Compare charge density]

USES -

i) Biological

- Haemoglobin - Fe^{+2} , C.N = 6
- Chlorophyll - Mg^{+2} , C.N = 6
- vit B₁₂ - Co^{+2} , C.N = 6

Medicinal

- Anticancer $\rightarrow [Pt(NH_3)_2Cl_2] \rightarrow$ cis platin

- Anticoagulant $\rightarrow Na^+$ salt of E.D.T.A (captures calcium which is responsible for clotting)

- Water softener

} EDTA

Treatment of lead softener poisoning

Extraction of Ag, Au etc.

Purification of Ni, Fe etc.

Organometallic Comp (Metal-carbon link)

Sigma bonded
OMC

Pi-bonded
OMC

Sigma-Pi
bonded OMC

$R Mg X$

$R_2 Zn$

$(C_2H_5)_4Pb$
etc

Ferrrocene $[Fe(\eta^5-C_5H_5)_2]$

Zeise's salt $K[PtCl_3(\eta^2-C_2H_4)]$

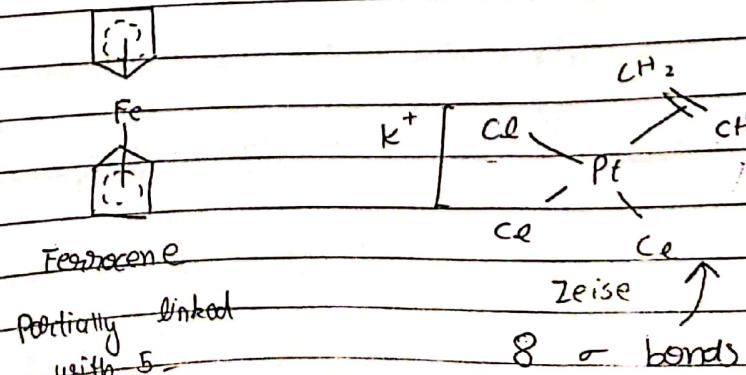
+ η (eta) - No. of carbon linked

$Fe_2(CO)_9$

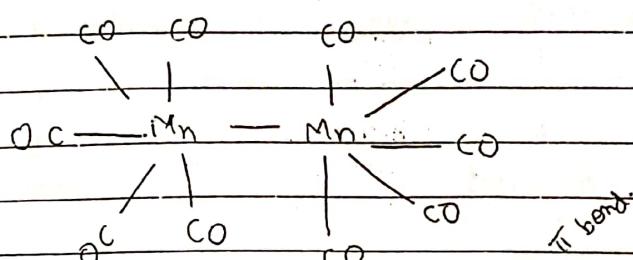
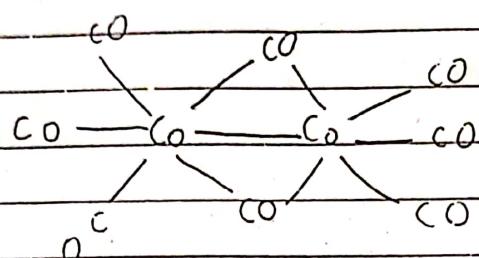
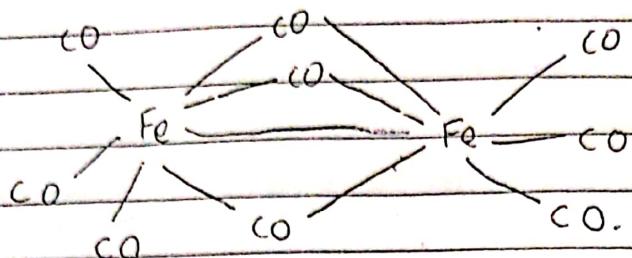
$CO_2(CO)_8$

$Mn_3(O)_6$

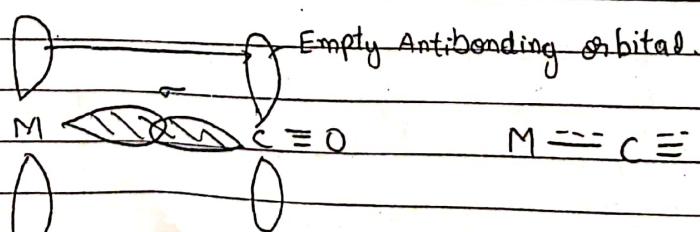
wid C.A.



*



* Non classical lig.

 \rightarrow SFV π acidic lig. $\text{CO}, \text{CN}^-, \text{C}_5\text{H}_5^-$ etc. e^- acceptor lig. \rightarrow tendency of back bonding $\rightarrow \text{CO} \rightarrow \text{B.O} \downarrow, \text{B.L} \uparrow$

(USPS:

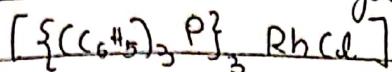
not used
now

Anti Knocking Agent - T.E.L, B.T.X.

 \downarrow tetraethyl lead \downarrow Benzene + toluene + xylyne

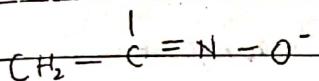
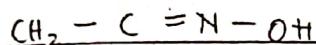
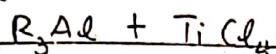
Homogenous catalyst - Hydrogenation

eg. Wilkinson's Catalyst.



Heterogeneous catalyst - Polymerisation.

eg. Zeigler Natta Catalyst.



(dmg) - dimethylglyoxime

sod-Nitroprusside - $\text{Na}_3[\text{Fe}(\text{CN})_5\text{NO}]$ 