3.) Naming of BRIDGING LIGAND coordination compound:

- **Rule:**
- Use 'μ' as prefix to name bridging ligands.

Eg: $[(H_2O)_4Co-OH-Co(NH_3)_4]Cl_3$: $x+y=4$

$+2 -1 +2 = +3$; $-1(3) = -3$

⇒ tetraaquacobalt(II)-μ-hydroxo tetraamminecobalt(II) chloride

Ref: 1.) $[(CO)_4Ni(CN)(Cl)Ni(NH_3)_4]SO_4$: $x+y=4$

⇒ tetracarbonylnickle(II)-μ-chloro-μ-cyano-tetraamminenickle (II) sulphate

2.) $[(CO)_4Fe(NH_2)(NH_2)Fe(NH_3)_4]CO_3$: $x+y=4$

⇒ tetracarbonyl iron(II)-μ-diamido-tetraammine iron(II) carbonate

3.) $[(CO)_4Fe(NH_2)(NH_2)Fe(NH_3)_4](CO_3)_2$: $x+y=6$

$-2(2) \Rightarrow -4$

⇒ tetracarbonyl iron(III)-μ-diamido-tetraammine iron(III) carbonate

imp 4.) $[(H_2O)_4Ni-OH-Ni(H_2O)_4]I_3$: $x+y=4$

⇒ μ-hydroxo bis(tetraaquanickle(II)) iodide.

5.) $\left[(H_2O)_4Cr\begin{matrix}NH_2^{(-1)}\\NO_2^{(-1)}\end{matrix}Cr(H_2O)_4\right](SO_4)_2^{-2(2)=(-4)}$: $x+y=6$

⇒ μ-amido-μ-nitrito-bis(tetraaqua chromium)(III) sulphate.

*Effective Atomic Number (EAN):

EAN = Total no. of electron in central atom/ion $^{\mp z}$ + (2 × No. of coordination Bond)

Q:01. Find out the Effective Atomic Number in:

(A) $[Ni^0(CO)_4]$:
→ $28+(2\times4) \longrightarrow \underline{36}$ Highly stable coordin^n comp.

(B) $[Cr^{+3}(NH_3)_6]Cl_3^{-3}$: $Cr = 24-3 = 21$
→ $21+(2\times6) \longrightarrow \underline{33}$ Oxidising agent (e ले आएगा)

(C) $[V(CO)_6]$:
→ $23+(2\times6) \longrightarrow \underline{35}$ OA.

(D) $[Mn(CO)_6]$:
→ $25+(2\times6) \longrightarrow \underline{37}$ Reducing agent (e छोड़ेगा)

(E) $K_4^{+4}[Fe^{+2}(CN)_6^{-6}]$: EAN: $Fe = 26-2 = 24$
→ $24+(2\times6) \longrightarrow \underline{36}$ stable.

(F) $K_2[Zn(OH)_2]$:
→

(G) $Hg[Co(SCN)_4]$:
→

⟹ Significance of EAN:

- If EAN of central metal atom or ion is equal to the noble gas configuration then, it is a highly stable compound.

⟶ 1.) To predict if a complex acts as an oxidising agent or reducing agent.

eg: $[V(CO)_6] + e^- \xrightarrow{\text{reduction}} [V(CO)_6]^-$

EAN = 35 (acts as OA) EAN = 36

- $[V(CO)_6]$ will reduce itself to stabilize itself. Hence, it is an oxidising agent.

eg: $[Mn(CO)_6] \xrightarrow{\text{oxidation}} [Mn(CO)_6]^+ + e^-$

EAN = 37 (acts as RA) EAN = 36

- $[Mn(CO)_6]$ will oxidise itself to stabilise itself. Hence it is a reducing agent.

⟶ 2.) To predict if a complex is mononuclear, binuclear or polynuclear.

eg: $[Co(CO)_4]$ (EAN = 35)

↳ this complex combines with an another tetracarbonyl-cobalt(0) and forms a binuclear coordination complex which is highly stable. Hence, we can say that $[Co(CO)_4]$ exists as $[Co_2(CO)_8]$ or $[Co(CO)_4]_2$ or $[Co(CO)_4][Co(CO)_4]$ or $(CO)_4Co—Co(CO)_4$.

3.) To predict, if a Metal-Metal (M-M) bond exists or not.

eg: $[Co_2(CO)_8]$:-

(27×2) (2×8)

↳ EAN of 2 Co = 54+16 ⟹ 70.

EAN of 1 Co = $\frac{70}{2}$ ⟹ 35

Hence, this compound is possible.

- to attain EAN = 36, binuclear compound should be formed. Hence, in above compound M-M bond do exist.

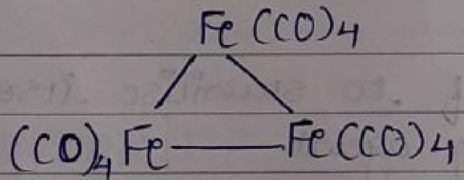
eg: $[Fe_3(CO)_{12}]$:-

(26×3) (2×12)

↳ EAN of 3 Fe = 78+24 ⟹ 102.

EAN of 1 Fe = $\frac{102}{3}$ ⟹ 34.

Hence, this compound is possible.



NEET Q: Is Pentacarbonyliron coordination compound mono, di or trinuclear?

⟶ $[Fe(CO)_5]$ ∴, EAN = 26+(2×5) ⟹ 36.

∴, it is mononuclear compound, as its EAN = 36 which indicates that it is highly stable compound and no M-M bond is formed.

✱ NOTE:

I.) if EAN = 36 : Mononuclear (No M-M Bond)

II.) if EAN = 35 : Binuclear (1 M-M Bond)

III.) if EAN = 34 : Trinuclear (2 M-M Bonds)

* Bonding in coordination compounds:

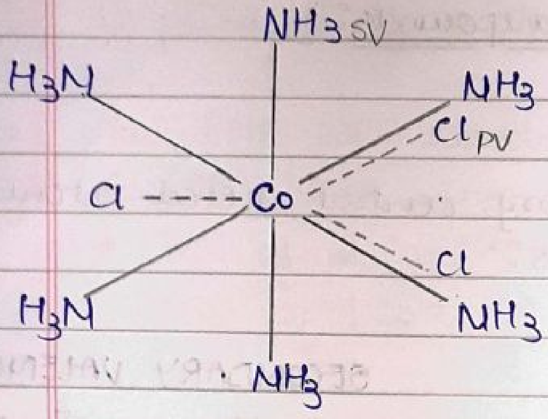
⇛ Werner's Theory: Alfred Werner (1866-1919) (Swiss Chemist)

- according to Werner's Theory, central metal atom has two types of valencies:

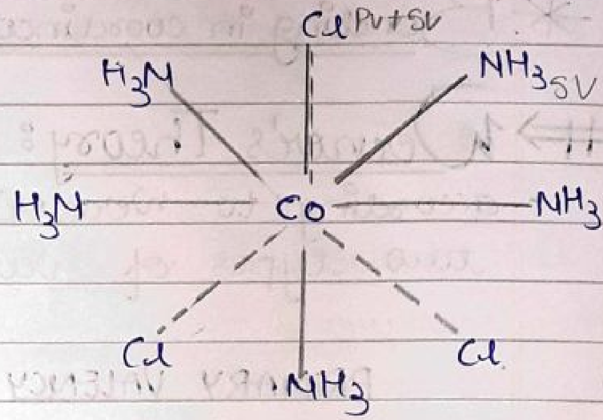
PRIMARY VALENCY (PV)	SECONDARY VALENCY (SV)
• equals to oxidation state of central metal atom.	• equals to the coordination no. of central metal atom.
• can be satisfied by anion.	• can be satisfied by ligands
• Non-directional	• Directional
• Ionisable	• Non-ionisable
• Is not helpful to predict the geometry of compound.	• Helpful to predict the geometry of compound.
• Represented by dotted or dash lines (---)	• represented by bold or dark lines (—)

*** NOTE:**
- according to Werner, all secondary valencies have shape or geometry arrangement according to their coordination number.

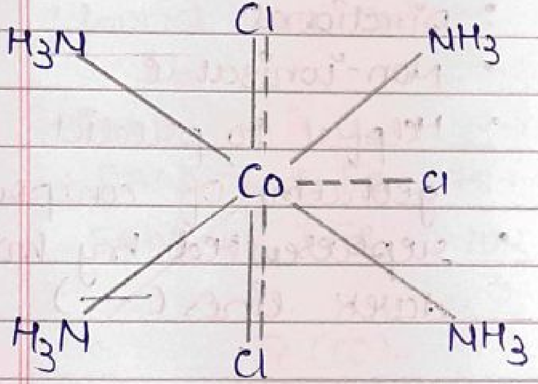
	Original Formula	Colour	Ions per unit formula	Free Cl^- ions per. for. unit	Modern Formula
1.	$CoCl_3 \cdot 6NH_3$	Orange	4	3	$[Co(NH_3)_6]Cl_3$
2.	$CoCl_3 \cdot 5NH_3$	Purple	3	2	$[Co(NH_3)_5Cl]Cl_2$
3.	$CoCl_3 \cdot 4NH_3$	Green	2	1	trans-$[Co(NH_3)_4Cl_2]Cl$
4.	$CoCl_3 \cdot 4NH_3$	Violet	2	1	cis-$[Co(NH_3)_4Cl_2]Cl$
5.	$CoCl_3 \cdot 3NH_3$		0	0	$[Co(NH_3)_3Cl_3]$



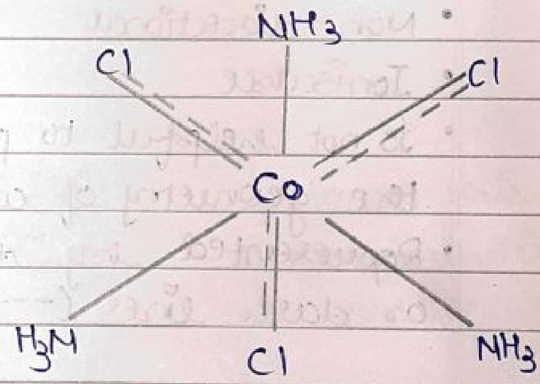
$[Co(NH_3)_6]Cl_3$



$[Co(NH_3)_5Cl]Cl_2$



$[Co(NH_3)_4Cl_2]Cl$



$[Co(NH_3)_3Cl_3]$

- in above coordination compounds, conductivi order is $1 > 2 > 3 = 4 > 5$