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Co-ordination Chemistry

Simple salt

② Molecular addition Compound

- Double salt
- Complex

Complex → perfect complex
Complex → Imperfect Complex

Perfect Complex Compound :→ Complex Compound which do not give test of it's all constituent ions in their aq. solution due to their negligible degree of dissociation

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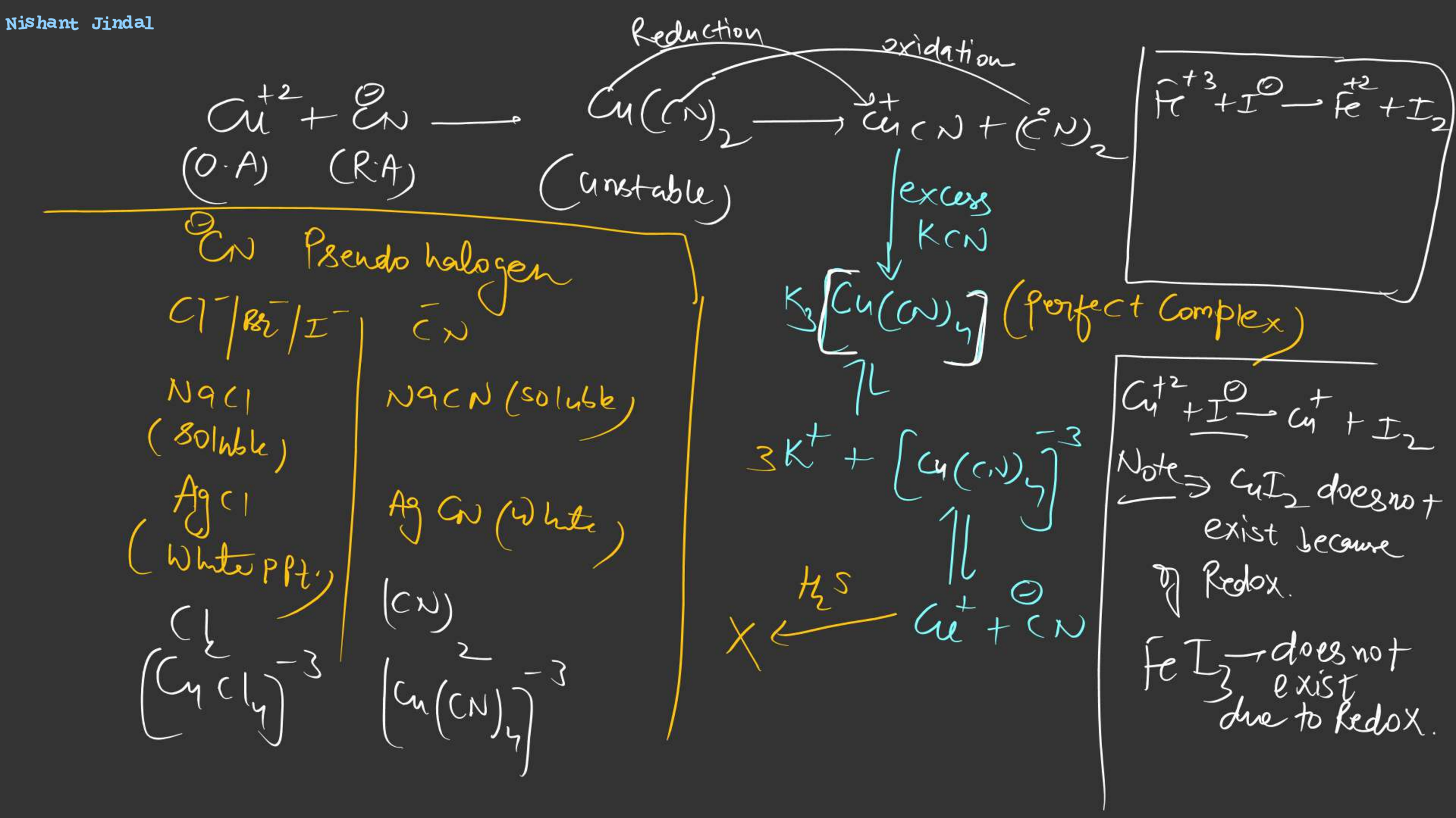

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Imperfect Complex

Complex compound which may give test of it's all constituent ions in their aq. solution due to their high degree of dissociation.

$$Cd^{+2} + \bar{C}N \longrightarrow Cd(CN)_2 \xrightarrow[KCN]{\text{excess}} K_2[Cd(CN)_4]$$

White ppt

(Imperfect)

$$\Downarrow$$

$$2K^+ + [Cd(CN)_4]^{-2}$$

$$\Downarrow$$

$$Cd^{+2} + \bar{C}N \xrightarrow{H_2S} CdS$$

Yellow ppt

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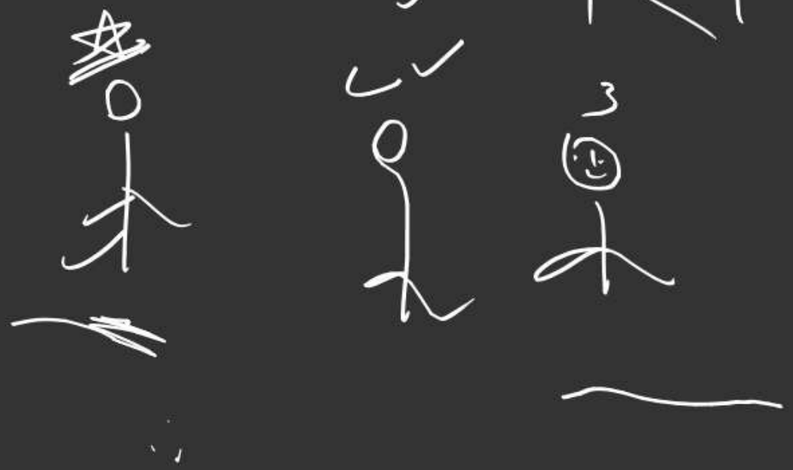
$K_{sp} = [A^+][B^\ominus]$ (Sat - solution)

$K_{sp} > [A^+][B^\ominus]$ (unsat solution)

$K_{sp} < [A^+][B^\ominus]$ (Super Sat - Solution)



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$[A^+][B^\ominus]$

1×7

$K_{sp(AB)} = 10$

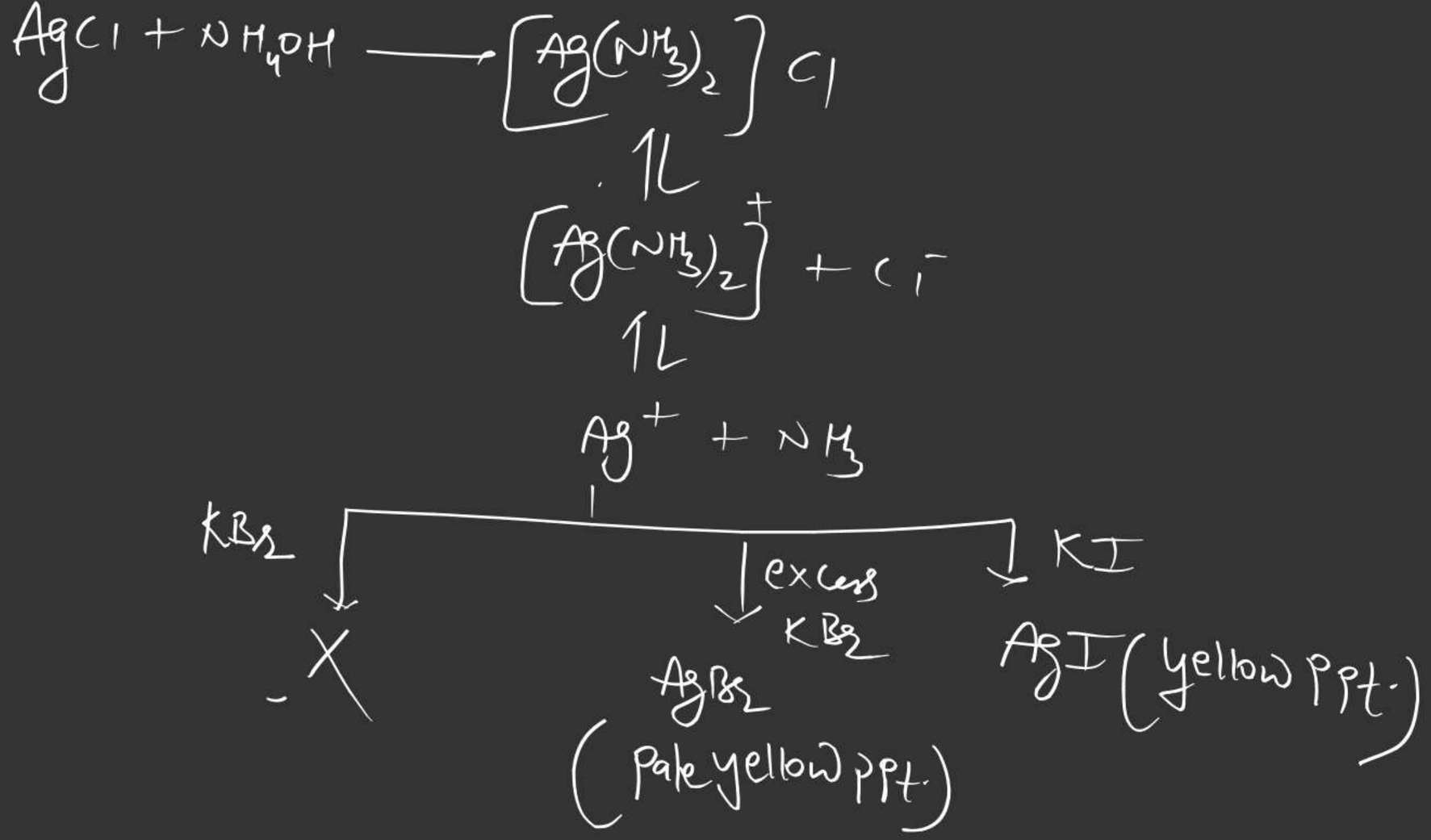
$[A^+][B^\ominus]$

1×12

$[A^+][C^-]$

1×7

$K_{sp(AC)} = 6$



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Representation of Complex

$$[ML_x]^{\pm n}$$

Ionisation sphere — Co-ordination sphere — Ionisation sphere

M = Metal Cation/atom

L = ligand

x = no of ligands

n = Charge on complex

type of Complex

1. Simple cation Complex anion
   $K_4[Fe(CN)_6]$
2. Complex Cation Simple anion
   $[Cu(NH_3)_4]SO_4$
3. Complex Cation Complex anion
   $[Cu(NH_3)_4][CuCl_4]$
4. Neutral complex
   $[Ni(CO)_4]$

$K_4[Fe(CN)_6]$

total ion = 5

Counter ion / PPt ion = 4

Metal Cation = Fe^{+2}

ligand = CN^-

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

(5)

find the number of Counter ion in $[Co(NH_3)_6]Cl_3$

Ans = PPt ion / Counter ion = 3

total ion = 4

Werner's theory

Werner was first scient who tried to explain bonding in complex compound.

Note →

(1) every metal has two type of valency
   (a) primary val. (2) secondary val.

(2) primary val. ionisable while sec. val. nonionisable

(3) PV satisfied with neg ligand while SV is satisfied with either by neg. ligand or by neutral ligand

Note ⇒ positive ligand were not discover.

Note :→ In modern terminology

PV → oxidation state of metal cation

SV = Co-ordination number of metal cation.

Note ⇒ every metal cation have fix SV

So Complex have certain geometry

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$CoCl_3 \cdot 6NH_3$ + excess $AgNO_3$ ⟶ 3 mol of AgCl

$[Co(NH_3)_6]Cl_3$

$CoCl_3 \cdot 5NH_3$ + excess of $AgNO_3$ ⟶ 2 mol of AgCl

$[Co(NH_3)_5Cl]Cl_2$

$CoCl_3 \cdot 4NH_3$ + excess of $AgNO_3$ ⟶ 1 mol of AgCl

$[Co(NH_3)_4Cl_2]Cl$

$CoCl_3 \cdot 3NH_3$ + excess of $AgNO_3$ ⟶ no ppt.

$[Co(NH_3)_3Cl_3]$

Co^{+3} C.N $= 6$

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PV = ...

SV = _____

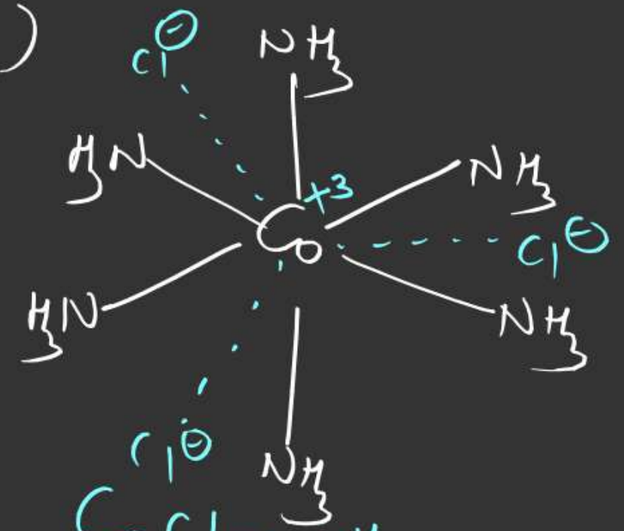
(SV/PV) = ...

Order of Conductance

I > II > III > IV

number of ions ↑ conductance ↑

(I)



$CoCl_3 \cdot 6NH_3$

total ion = 4

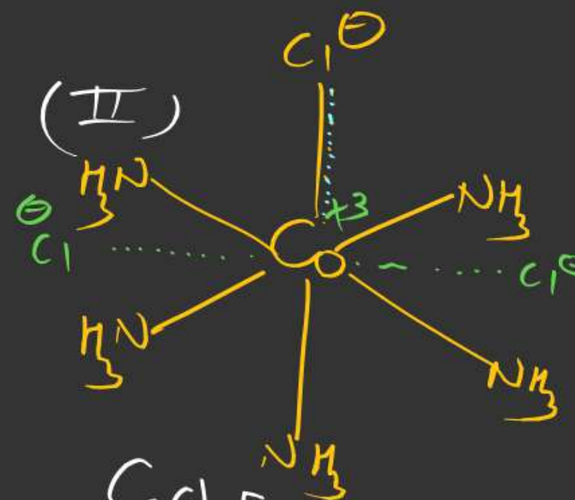
PPt ion = 3

PV = 3

SV = 6

PV/SV = 0

(II)



$CoCl_3 \cdot 5NH_3$

total ion = 3

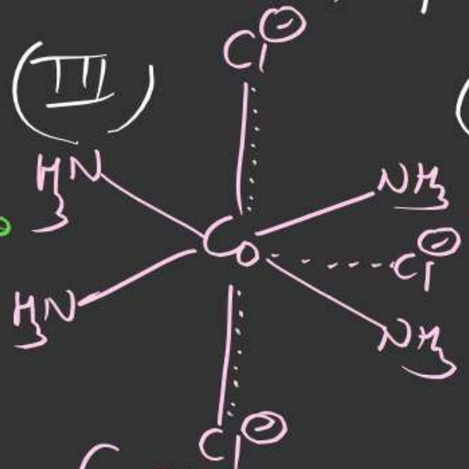
ppt ion = 2

PV = 3

SV = 6

SV/PV = 1

(III)



$CoCl_3 \cdot 4NH_3$

total ion =

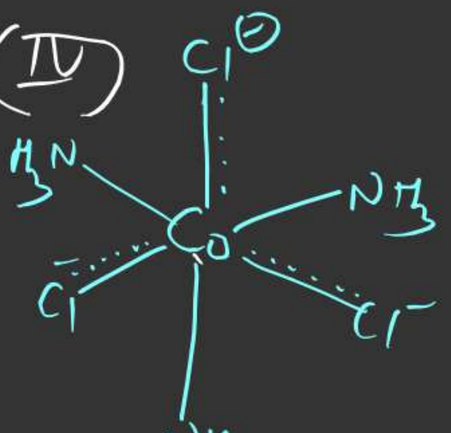
PPt ion =

PV = 3

SV = 6

PV/SV = 2

(IV)



$CoCl_3 \cdot 3NH_3$

PV = 3

SV = 6

PV/SV = 3

$$[Co(NH_3)_5SO_4]Br \rightleftharpoons [Co(NH_3)_5(Br_2)]SO_4^{-2}$$

When number of ions same then

Charge ↑ conductance ↑

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Order of Conductance

		total ions
$PtCl_4 \cdot 6NH_3$	(I) $[Pt(NH_3)_6]Cl_4$	5
$PtCl_4 \cdot 5NH_3$	(II) $[Pt(NH_3)_5Cl]Cl_3$	4
$PtCl_4 \cdot 3NH_3$	(III) $[Pt(NH_3)_3Cl_3]Cl$	2
$2HCl \cdot PtCl_4$	(IV) $H_2[PtCl_6]$	3
$PtCl_4 \cdot 2NH_3$	(V) $[Pt(NH_3)_2Cl_4]$	

I > II > IV > III > V

Ans

+4	C.N
Pt	= 6

Note ⇒ there is not sharp line between perfect and imperfect.

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Imperfect Complex