Theories of Coordination Compounds

DATE

Blomstrand Theory | Werner theory | Sidgwick Theory | Pauling's Electroneutrality principle | VBT | CFT | MOT

VBT, CFT, MOT → Modern theories.

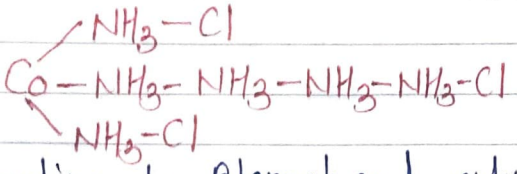
1. Blomstrand Theory :

→ First proposed by C.W. Blomstrand (1826-1894).

→ Further modified by S.M. Jørgensen (1837-1914).

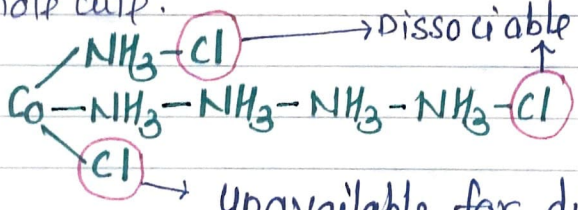
According to this theory nitrogen form a chain like structure (like carbon atom).

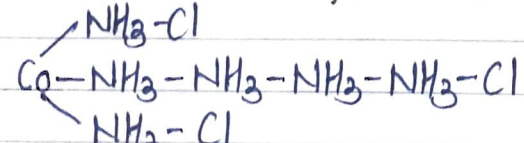
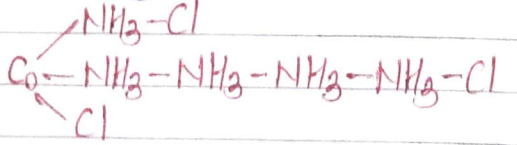
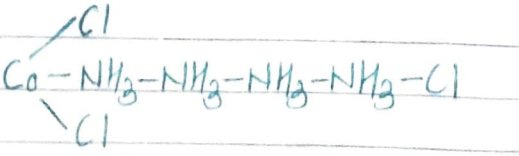
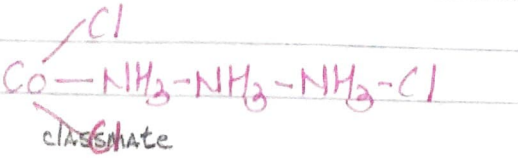
e.g.



According to Blomstrand only those Cl^- ions will be dissociate which is directly attached to the NH_3 molecule.

e.g.



Blomstrand Chain formula	No. of Ions Predicted
	04
	03
	02
	02

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PAGE

DATE

2. Werner's Theory of Coordination Compounds:

→ Given by Alfred Werner in 1893

→ Werner was the first Inorganic chemist to awarded Noble prize for chemistry in 1913

→ Werner theory of coordination compounds was based on a group of compounds that is relatively slow to react in solution and thus easier to study.

→ For this reason, many of his examples were compounds of Co(III), Rh(III), Cr(III), Pt(II) and Pt(IV) which are kinetically inert or slow to react.

→ Werner isolated different complex compounds from the reaction of $CoCl_3$ and NH_3.

→ These compounds are called cobalt ammines.

Compound	Colour	Name on the Basis of colour
$CoCl_3 \cdot 6NH_3$	Yellow	Luteo complex
$CoCl_3 \cdot 5NH_3$	Purple	Purpureo complex
$CoCl_3 \cdot 4NH_3$	Violet	Violeo complex
$CoCl_3 \cdot 4NH_3$	Green	Praseo complex
$CoCl_3 \cdot 3NH_3$	Blue green.	

Postulates of Werner's Theory:

1. Metal possess two types of valencies.

Valencies

Primary Valency

→ Also called as ionizable valency

→ Corresponds to oxidation state.

→ Non-directional

Secondary Valency

→ Also called as non-ionizable valency

→ Corresponds to coordination number.

→ Directional

→ Determine stereochemistry of the complex.

2. Every metal has a fixed number of secondary valency (i.e. C.N.)

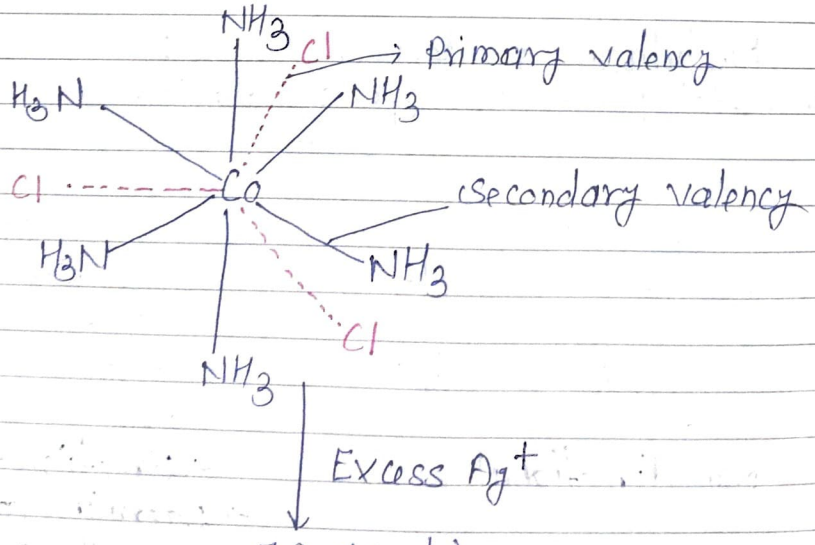
DATE

3. The metal atom tends to satisfy both its primary and secondary valencies.
→ Primary valencies are satisfied by negative ions whereas secondary valencies are satisfied by either by negative ions or by neutral molecules.
→ In certain cases, a negative ion may satisfy both types of valencies.

4 The secondary valencies are always directed towards fixed positions in space and this leads to definite geometry of the coordination compound.
→ Secondary valency determine the stereochemistry of the complex.

Note: ····· Primary valency
——— Secondary valency
═══ Primary as well as secondary valency

eg. $CoCl_3 \cdot 6NH_3$

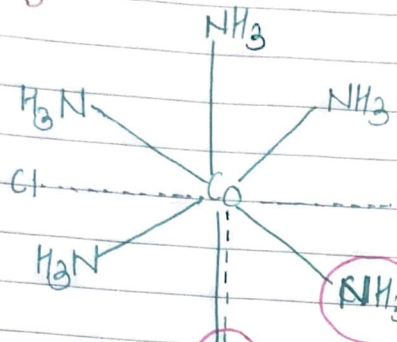


No. of Cl^- precipitated = 03
No. of cation present = 01
Total no. of ions = 04
Nature = Ionic molecule

PAGE

DATE

$CoCl_3 \cdot 5NH_3$:



Cl → Primary valency

NH_3 → Secondary valency

Cl → Satisfy both primary and secondary valency

Excess Ag^+

$2AgCl$ (ppt.)

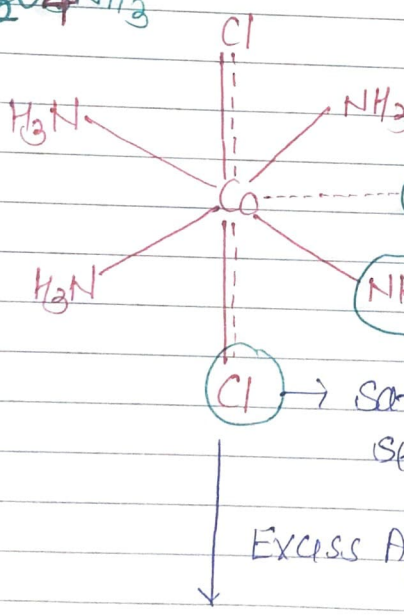
No. of Cl^- (anion) precipitated = 2

No. of cation = 1

Total number of ions = 3

Nature → Ionic molecule

$CoCl_3 \cdot 4NH_3$



Primary valency

Secondary valency

Cl → Satisfy both primary and secondary valency

Excess Ag^+

$AgCl$ (ppt.)

No. of Cl^- (anion) precipitated = 1

No. of cation = 1

Total no. of ions = 2

Nature → ionic complex