WERNER'S THEORY

B.Sc Part-II

INORGANIC CHEMISTRY

By

DR. SANJAY KUMAR YADAV

Deptt of Chemistry

G.D. College Begusarai

[Lecture Notes]

WERNER'S THEORY

In 1893, Werner put forward his famous theory of coordination to explain the formation and structure of complex compound. In recognition of his work in this field, he was awarded the Nobel Prize in chemistry. Werner is rightly called the father of coordination chemistry.

The important postulates of Werner's coordination theory are as follows.

1. In coordination compounds, the metal atom exhibit two types of valency, viz the primary valency and secondary valency. The primary valency is ionisable and is non directional whereas the secondary valency is non-ionizable and is directional. In modern terminology the primary valency corresponds to oxidation

State and the Secondary valency corresponds to the coordination number.

2. Every metal atom has a fixed no of secondary valency ie It has a fixed coordination number.

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

4. The secondary valencies are always directed towards fixed position in space and this leads to definite geometry of the coordination compounds. For example, if a metal ion has six secondary valencies, these are arranged octahedrally around the central metal ion. If the metal ion has four secondary valencies, these are arranged in either tetrahedral or square planar arrangement around the central metal ion. The secondary valencies, thus determine the stereochemistry of the complex. On the other hand the

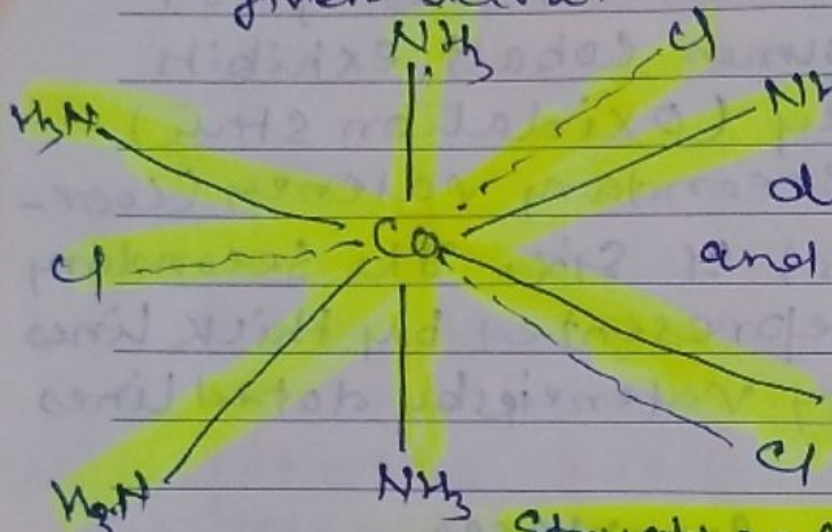
Primary valency is non directional.

Let us try to explain the structure of various cobalt ammines on the basis of Werner's theory. In all these compounds cobalt exhibits primary valency (oxidation state) of three and secondary valency (coordination number) of six. The secondary valencies are represented by thick lines and the primary valencies by dotted lines

1. $CoCl_3 . 6NH_3$ complexes.

In this compound the coordination no of cobalt is 6 and all the 6 secondary valencies are occupied by NH_3 molecules. The chloride ions are bonded to Co by three primary valencies. These chloride ions are instantaneously precipitated on the addition of silver nitrate. The total no of ions in this case is 4, three chloride ions and one complex ion. The central ion and the neutral molecules or ion (ligands) satisfying secondary valency are written in a square brackets while writting the formula

of the complex compound. Thus the complex may be formulated as $[Co(NH_3)_6]Cl_3$ and may be represented by figure which is given below.



The Primary valency as already discussed, are ionizable and therefore all the chloride ions would get precipitated on the addition of silver nitrate

Structure of $CoCl_3 \cdot 6NH_3$ complex

no of Cl^- ion precipitated = 03

REST PART NEXT PdF