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METAL LIGAND EQUILIBRIUM IN SOLUTION:

The formation of metal complexes in solution, two types of stability of complexes have been distinguished. These are –
1. Thermal stability and
(ii) Kinetic stability.

① Thermal stability – This kind of stability of complexes deals with the properties like bond energies, stability constants and redox potentials that affect the equilibrium conditions. Biltz (1927) has classified the complex compounds into stable and unstable complexes, on the basis of thermodynamic stability of complexes in solution. stable complexes are those which possess sufficient stability to retain their identity in solution. Unstable complexes are those which are

reversibly dissociated in solution into their components. Stable and unstable complexes have also been called penetration and normal complexes respectively.

(II) Kinetic stability — This kind of stability deals with the rate of reaction of complexes in solution, the mechanism of chemical reactions, formation of intermediate complexes, activation energies of the process. Taube (1950) has classified the complexes into labile and inert complexes, on the basis of kinetic stability of complexes in solution.

A complex ion dissociates in aqueous solution to a very small extent. Stronger is the metal-ligand bond in complex ion, lesser is the dissociation of the complex ion in solution greater is the stability of the complex ion. So, the stability the complex ion in solution is a measure of the resistance of the replacement of a ligand by another ligand.

Dissociation of a complex ion in solution — In aqueous solution, a complex ion dissociate to a very small extent. When a complex ion dissociates, there lies an equilibrium between the undissociated complex ion and the species obtained by the dissociation of the complex ion. Hence the stability of the complex ion in solution is expressed in terms of equilibrium constant of the dissociation equilibrium. Example — the dissociation of $[Cu(NH_3)_4]^{2+}$ ion in solution is represented by the equilibrium:

$$[Cu(NH_3)_4]^{2+} \rightleftharpoons Cu^{2+} + 4NH_3$$

The dissociation of above equilibrium is given by —

Dissociation (Instability) Constant

$$K_{dis} = \frac{[Cu^{2+}][NH_3]^{4+}}{[Cu(NH_3)_4]^{2+}}$$