

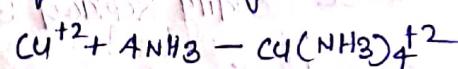
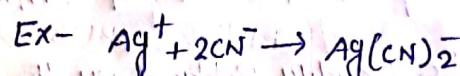
[COMPLEXOMETRY]

INTRODUCTION:

- Werner first observed that each atom is surrounded by the maximum number of small which is collectively called as complex.
- The technique involves the titrating the metal ions with complexing agent which is commonly known as the ligands. The formed coloured complex is used to detect the end point of the titration.

Principle:-

The main principle is the reaction between the ligand and the metal ion to form a complex. The metal ions acts as Lewis acid and the ligand acts as Lewis base which is the complex agents.



Metal Ion + Chelating Agent or Complexing Agent \rightarrow

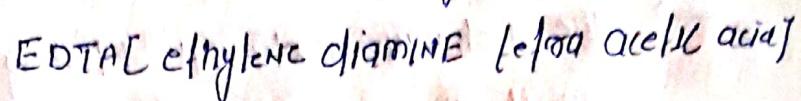
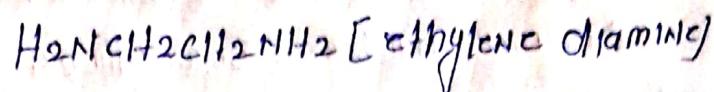
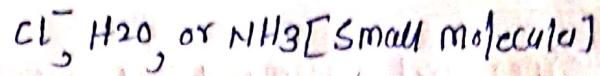
Metal Ligand, or, Complex, or, Ligand.

THEORY:-

Initially, the metal ions are solvated, that is they are dissolved in the appropriate solvent and then these solvent ions are replaced by the ions or other solvent molecule to form the complex.

- The replacing solvent or ions are known as ligands. The ligands are defined as the charged or, neutral species with lone pair of electrons form the coordinate bond with metal ions to form complexes.

Examples -



* → THE FOLLOWING steps play an important role in the
Complexometric titration -

- (1) Selection of the complexing agent.
- (2) Detection Method employed for the detection of the end point.
- (3) Maintaining of the experimental conditions.

LIGANDS: →

A ligand is the charged particle or neutral particles which can be readily replaced by the other groups by complex formation (MLn). n is the coordination number of the metal ion and give the maximum number of ligand groups bound.

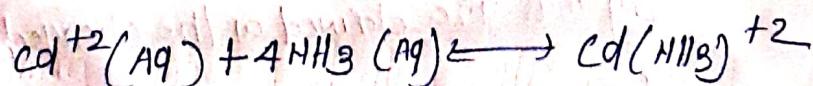
→ There are two main classes of ligands.

(A) UNIDENTATE LIGANDS: →

Ligands that are bound to a metal ions at one place are called unidentate ligands.



The following are the steps involved - with ammonia ligand



(B) Bidentate or Multidentate ligand.

⇒ These ligands contain more than one group which is capable of binding with the metal ions.

Ex - ethylenediamine,

EDTA, etc.

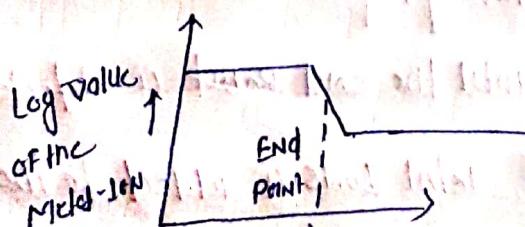
* CHELATING Agents →

→ Ligands with more than one electron donating group are called chelating agents.

Ex = EDTA.

* DETERMINATION OF THE END POINT:

⇒ In complexometric titration, the free metal ions are converted to the complex ions. The end point is determined by plotting the P^M value which is the negative logarithm of the metal ion concentration versus volume of the titrant. The end point is detected by using an indicator or, by applying an instrumental method.



→ Volume of the titrant (ml)

(Complexometric titration (c.v.r.))

* END POINT Detection Methods: →

→ The end point is detected by using visual indicators or by applying instrumental methods.

→ INDICATORS: - Indicator is a dye which is capable of forming dye-Metal complex.

→ These indicator should possess the following Requirements.

[1] It should be chemically stable.

[2] The Dye-Metal complex formed should be in equal ratio.

[3] The colour of the Indicator should differ from colour of the metal ions.

[4] It should be selective.

[5] It should not compete with the EDTA.

* Types of complexometric titration: →

1) DIRECT TITRATION: →

→ It is simplest and the most convenient method. The standard chelating agent solution is added to the metal ion solution until the end point is detected.

→ In this method, metal ions are added to the suitable buffer solution and appropriate indicator solution and the resulting solution is titrated with the EDTA solution.

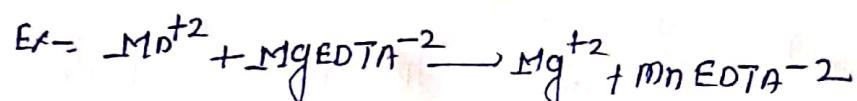
① Back-titration:

→ In this Method, excess of complexing Agent is back titrated with the standard solution of the second metal ions. In this Method excess of standard EDTA solution is added to the sample solutions and the pH is adjusted. Then the resulting solution is back titrated with the appropriate titrant.

Ex - Mn determination and ZnO determination.

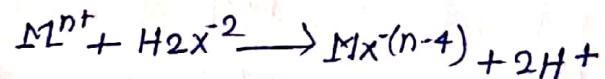
② Replacement titration:

By name itself it indicate the displacement of the metal ion with other metal ions take place in the method. But it does not give the sharp end point.



③ Indirect titration:

⇒ Here positions from the complexing agent are displaced by the heavy metal and titrated with sodium alkali -



Example - This method is used in the analysis of Na, K, Ag, etc.

* CONCEPT OF MASKING AND DEMASKING AGENTS:

⇒ Masking and demasking agent used for the masking of the reactions of the interfering other metal ions which are called as masking agent and the retaining the ability of the reactants to react are known as the demasking agents.