**INTRODUCTION**

Coordination compounds are a special class of compounds in which the central metal atom is surrounded by ions or molecules beyond their normal valency. These compounds are also referred to as complex compounds or simply complexes. In the modem terminology, these compounds are called coordination compounds. These compounds are widely present in the minerals, plants and animals, and play many important functions. Many biologically important compounds are coordination compounds in which complicated organic species are bound to the metal ions. The common examples are: hemoglobin, which is a coordination compound of iron, chlorophyll, which is a coordination compound of magnesium, Vitamin B12 which is a coordination compound of cobalt etc. The coordination compounds are finding extensive applications in metallurgical processes, analytical chemistry and medicinal chemistry. Many complex metal oxides and sulphides which constitute minerals are solid-state coordination compounds

**Molecular or Addition Compounds:**

When solutions containing two or more simple stable compounds in stiochiometric proportions are allowed to evaporate, crystals of new substances are obtained. These substances are termed molecular or addition compounds.

Some common examples are as follows.

 Simple stable compounds Addition or molecular compound

 

The molecular or addition compounds are of two types.(1) Double salts or lattice compounds and (2)coordination or complex compound.

**(A) Double salts or lattice compounds:** The addition compounds which are stable in solid state only but are broken down into individual constituents, when dissolved in water are called double salts or lattice compounds. Their solution has the same properties as the mixture of individual compounds. For example when carnallite (KCl. MgCl2. 6H2O) is dissolved in water it exhibit the properties of KCl and MgCl2. Mohr’s salt [FeSO4.(NH4)2 SO4.6H2O] when dissolved in water gives Fe+2, NH4+1 and SO42- ions in the solution, which gives the tests of all these ions.

**(B) Coordination or complex compounds:** The addition compounds in which some of the constituent ions or molecules lose their identity and when dissolved in water they do not break up completely into individual ions are called coordination compounds.The properties of their solutions are different than those of their constituents. In such compounds there is complex ion which is a central metal ion with lewis bases attached to it through coordinate covalent bonds. On the basis of stability of complex ion, complex ions are further divided as follows.

**(a) Perfect complexes:** Those in which complex ion is fairly stable and is either not dissociated or feebly dissociated in solution state, **Ex.** K4 [Fe(CN)6] → 4K+1+ [Fe(CN)6]4- [Fe(CN)6]4- → Fe+2 + 6CN-1 (feebly dissociated

The ferrocyanide ion [Fe(CN)6]4- is so in significantly dissociated that it can be considered as practically undissociated and does not give the test of Fe2+or CN¯ ions.

**(b) Imperfect complexes:** Those in which complex ion is less stable and is reversibly dissociated to give enough simple ions and thus imparts their tests, Ex.

K2 [Cd(CN)4] → 2K1+ + [Cd(CN)4]2-

[Cd(CN)4]2-  → Cd + 4CN1- (appreciably dissociated)

An imperfect complex may be too unstable to exist and may be completely dissociated in solution; it then becomes a double salt.

Let us consider the following two compounds to differentiate between the two types of molecular compounds-

1. 2KCl(aq.) + HgCl2(aq.) 🡪 2 KCl HgCl2 (solid)
2. 2KCl(aq.) + MgCl2(aq.) 🡪 2 KCl MgCl2,6H2O (solid)

The compound (2) gives a total 7 ions in aqueous solution and gives +ve qualitative tests for K+, Mg+2, Cl- ions. On the other hand, the compound (1) gives a total of 3 ions in aqueous solution and gives no +ve tests for Hg+2 and Cl- ions. Thus, it may be concluded that compound (2) is a double salt and compound (1) is a complex compound.

 **Difference between coordination compound and double salt:**

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| Coordination compound  | Double salt  |
| A coordination compound contains a central metal atom or ion surrounded by number of oppositely charged ions or neutral molecules. These ions or molecules are bonded to the metal atom or ion by a coordinate bond.  | When two salts in stoichiometric ratio are crystallised together from their saturated solution they are called double salts  |
| Example: K4[Fe(CN)6]  | Example:FeSO4.(NH4)2SO4.6H2O (Mohr’s salt)  |
| They do not dissociate into simple ions when dissolved in water.  | They dissociate into simple ions when dissolved in water.  |