SUBJECT - CHEMISTRY
CLASS - BSc (Hons) PART-II
PAPER - III
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TOPIC Co-ordination chemistry

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Double Salt or Lattice Compounds: These are the addition Compounds, which exist only in crystal lattices but break down into their Constituent Compounds when these are dissolved in water or any other Solevent. The physical and chemical properties of double salts are essentially the same as those of the individual compounds. for example, potashalum is a double salt. This salt is obtained when potassium Sulphate and aluminium Sulphate are mixed in Stoichiometric amounts in Solution and the Solution is crystallised.

$$K_2SO_4 + Al_2(SO_4)_3 + 24H_2O \xrightarrow{\text{crystallisation}} K_2SO_4Al_2(SO_4)_3\,24H_2O$$

Double salt (Potash alum)

Potash alum is stable only in the crystalline state. But when dissolved in H_2O, it loses its identity and breaks up in to its Constituent Simple ions, K^+ Al^{3+} and SO_4^{2-} Thus potash alum is a example of double salt. other examples of double salts are, Carnallite ($KCl.MgCl_2\,6H_2O$), Mohr's salt ($FeSO_4(NH_4)_2SO_4\,6H_2O$. It aqueous Solution shows the properties of its Contituent ion ie

(I) $K_2SO_4 \cdot Al_2(SO_4)_3\,24H_2O(s) \longrightarrow 2K^+(aq) + 2Al^{3+}(aq) + 4SO_4^{2-}(aq)$
(Potash alum)

(II) $KCl \cdot MgCl_2 \cdot 6H_2O(s) \longrightarrow K^+(aq) + Mg^{2+}(aq) + 3Cl^-(aq)$
(Carnallite)

(III) $FeSO_4(NH_4)_2SO_4 \cdot 6H_2O(s) \rightarrow Fe^{2+}(aq) + 2NH_4^+(aq) + 2SO_4^{-2}(aq)$

Co.ordination Compound (Complex Compound): Molecular or addition Compounds which retain their identity even in Solution and the properties of which different from those of their Constituents are Called Complex Compound or Co-ordination Compounds.

For example: When a solution of ferrous cyanide is mixed with potassium cyanide, potassium ferrocyanide is formed which in aqueous solution does not give test for Fe^{2+} and CN^- ions but gives the test of ferrocyanide ion $[Fe(CN)_6]^{4-}$

$$Fe(CN)_2 + 4KCN \rightarrow K_4[Fe(CN)_6]$$

(Potassium ferrocyanide Complex Compound)

$$K_4[Fe(CN)_6] \rightleftharpoons 4K^+ + [Fe(CN)_6]^{4-}$$

(Complex ion)

Another example is that when NH_3 is added to $CuSO_4$ solution, a deep blue colour due to the formation of tetra ammine cupric sulphate is obtained

$$CuSO_4 + 4NH_4OH \longrightarrow [Cu(NH_3)_4]SO_4 + 4H_2O$$

(Tetra ammine cupric sulphate Complex Compound)

Tetra ammine cupric sulphate when dissolved in water does not give the test of Cu^{++} ions but instead gives $[Cu(NH_3)_4]^{2+}$ ions.

$$[Cu(NH_3)_4SO_4 \rightleftharpoons [Cu(NH_3)_4]^{2+} + SO_4$$

(Complex ion)

from the above example. It is evident that $K_4[Fe(CN)_6]$ and $[Cu(NH_3)_4]SO_4$ are Co-ordination Compounds.

Co-ordination Compounds are known by various names such as Complex Compounds, werner Complexes and additive Compounds.

Difference between double Salt and Complex Compounds.

Double Salt	Complex Compound
1 The usually two Simple Salts in equimolar proportions.	The Simple Salt from which they are formed may or may not be equimolar proportions.
2 They dissociates Completely in ions in the aqueous Solution	The Complex ions does not dissociated into ions
3 They are ionic Compounds and do not Contain any Co-ordinate bond.	They may or may not be ionic but the Complex part always Contains Co-ordinate bonds.