# CH-COORDINATION COMPOUNDS

(1) Addition Compounds :- When two or more than two simple salt is added in a particular stoichiometric ratio then a compound formed is known as Addition Compound.

- Types of Addition Compound :-
  - (A) Double Salt or Lattice Compound
  - (B) Coordination compound or Complex.

■ Double Salt Or Lattice Compound :-

↳ Double Salt is a part of addition compound which is formed on adding more than one simple salt having Common anion.

↳ Double Salt exists in Solid form

Eg :-

$$KCl(s) + MgCl_2(s) + 6H_2O \longrightarrow \underbrace{KCl \cdot MgCl_2 \cdot 6H_2O}_{\text{(Solid)}}$$

(Carnalite)

KCl, $MgCl_2$ : simple salts

(Addition compound)

↳ Double Salt on addition of water ionise completely i.e. each ion of double salt give positive test, through qualitative analysis.

NOTE :- Qualitative Analysis is a systematic approach to find out prescence of cation and anion.

Cation test using standard anion and they give a observation based on colour / specific test.

Anion test using standard cation and they give a observation based on colour / specific test.

↳ Other examples of Double Salt :-

✱ $(NH_4)_2SO_4 + FeSO_4 + 6H_2O \rightarrow (NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$ (s.)
(Mohr's Salt)

✱ $CaCO_3 + MgCO_3 \longrightarrow CaCO_3 \cdot MgCO_3$ (Dolomite)

$\xrightarrow[H_2O]{\text{excess}} Ca^{2+} + Mg^{2+} + CO_3^{2-}$

Q. Select correct statement about double salt :-

(A) Each ion in double salt retain their identity

(B) Each ion of double salt gives positive confirmation of cation and anion

(C) Both A and B are correct

(D) None of Above

✱ $M^{I}_2SO_4 \cdot M^{III}_2(SO_4)_3 \cdot 24H_2O$

↳ Trivalent ion ($Al^{3+}$, $Cr^{3+}$, $Fe^{3+}$, ....)

↳ Univalent ion except $Li^+$ (due to small size).
($K^+$, $NH_4^+$, $G^+$, ....)

Empirical Formula ⇒

$M^{I}_2 \cdot M^{III}_2(SO_4)_2 \cdot 24H_2O \longrightarrow M^{I}M^{III}(SO_4)_2 \cdot 24H_2O$

Examples of Alum :-

$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O \rightarrow$ Potash Alum.

T.I.P. :- If Aluminium is present in double salt then use monovalent ion's name in Alum naming, if not present use trivalent ion name.

$(NH_4)_2 \cdot SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$ → Ammonium Alum
$K_2SO_4 \cdot Fe_2(SO_4)_3 \cdot 24H_2O$ → Ferric Alum
$(NH_4)_2SO_4 \cdot Cr_2^{3+}(SO_4)_3 \cdot 24H_2O$ → Chrome Alum
$Na_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$ → Soda Alum.

Q. In $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$ (Potash Alum) how many ions can give positive test in qualitative analysis?

(A) 2 (B) 3 (C) 1 (D) 4

NOTE :- Alum swell on heating due to removal of $H_2O$ and it converts into ~~amph~~ amorphous solid. (not a true solid or pseudo solid or arrangement of particle is irregular).

NOTE :- Uses of Alum :-
↳ as a blood coagulant.
↳

✱ Pseudo Alum :-
↳ All alums have same crystalline structures, i.e. they are isomorphous.

↳ Pseudo Alums have different crystalline structures :- $M^{II}SO_4 \cdot M^{III}_2(SO_4)_3 \cdot 24H_2O$
Eg :- $(Mn)SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$
↳ Manganese

$Na_3PO_4$ and $Na_3AsO_4$ → Isomorphous

Q How many of the given compound posses true alum property?

(i) $(NH_4)_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$
(ii) $K_2SO_4 \cdot Cr_2(SO_4)_3 \cdot 24H_2O$
(iii) $CrSO_4 \cdot Fe_2(SO_4)_3 \cdot 24H_2O$
(iv) $MgSO_4 \cdot Fe_2(SO_4)_3 \cdot 24H_2O$
(v) $CuCO_3 \cdot Cu(OH)_2$
(vi) $PbCO_3 \cdot Pb(OH)_2$

→ (A) 1 (B) 4 (C) 5 (D) None

(2) Co-Ordination Compound or Complexes :-

$Fe(CN)_2 + 4KCN \longrightarrow 4K^+[Fe(CN)_6]$

(Brown) (Soluble) (Pale Yellow)

Lewis Acid ($e^-$ acceptor) — Lewis Base ($e^-$ donor) — $K_4[Fe(CN)_6]$ (or) — complex

NOTE :- In complex / co-ordinate compound doesn't ionise completely in aq. so as lewis base interacts with lewis acid through co-ordinate bond, which doesn't dissociate in aqueous sol$^n$.

↳ Complex / Perfect complex doesn't give positive test of all ions present in compound i.e. negative test of few ions is observed.

Eg. :- $K_4[Fe(CN)_6] + H_2O \longrightarrow \underset{\text{+ve test}}{4K^+} + \underset{\text{↳ -ve test}}{[Fe(CN)_6]^{4-}}$