Kaur XI Sci A and B E: Pasta 30/9/13

ANALYSIS OF CATION

Prepare a clear transparent solution by dissolving the given salt in

i. Distilled water (hot or cold) or
ii. Dil. HCl (hot or cold)

Group separation

1. **Salt solution + dil. HCl**
   If precipitate is formed – I group is present. (Pb^{2+})
   If the precipitate is not formed, I group is absent.
   $Pb^{2+} + Cl^- \rightarrow PbCl_2$
2. **Pass H_2S.**
   If precipitate is formed II group is present. (Cu^{2+} or As^{3+})
   If precipitate is **black**, it is Cu^{2+}
   If precipitate is **yellow**, It is As^{3+}.
   If precipitate is not formed, II group is absent.
   $Cu^{2+} + H_2S \rightarrow CuS + H^+$
3. Boil it to remove H_2S. Add 3 drops of ~~Con. HNO_3~~ and boil. Add solid NH_4Cl and NH_4OH (more).
   If precipitate is formed, II group is present.
   If precipitate is **reddish brown**, it is Fe^{3+}.
   If precipitate is not formed, III group is absent
   $Fe^{3+} + NH_4OH \rightarrow Fe(OH)_3$
4. Add more NH_4OH and pass H_2S.
   If precipitate is formed IV group is present.
   If the precipitate is **black**, it is Ni^{2+} or Co^{2+}
   If it is **flesh coloured**, it is Mn^{2+}
   If precipitate is **dirty white**, it is Zn^{2+}.
   If precipitate is not formed, IV group is absent.
   $Zn^{2+} + H_2S \rightarrow ZnS + H^+$ $\quad Co^{2+} + H_2S \rightarrow CoS + H^+$

   $Mn^{2+} + H_2S \rightarrow MnS + H^+$ $\quad Ni^{2+} + H_2S \rightarrow NiS + H^+$

5. Boil the mixture to remove H_2S. Add NH_4Cl, NH_4OH and $(NH_4)_2CO_3$
   If **white precipitate** is formed, V group is present.
   Ba^{2+}, Sr^{2+} or Ca^{2+}

If precipitate is not formed, V group is absent.

$BaCl_2 + (NH_4)_2CO_3 \rightarrow BaCO_3 + NH_4Cl$

$SrCl_2 + (NH_4)_2CO_3 \rightarrow SrCO_3 + NH_4Cl$

6. If there is no precipitate, it would be NH_4^+ or Mg^{2+}.

Confirmatory tests:

I group

Wash the precipitate with cold water and add 2ml of **water** and boil. Divide it into 2 parts.

S.No.	Experiment	Observation	Inference
1	To one part add K_2CrO_4	Yellow precipitate	Pb^{2+} is confirmed
2	To the other part add KI	Yellow precipitate	Pb^{2+} is confirmed

$PbCl_2 + K_2CrO_4 \rightarrow PbCrO_4 + KCl$

$PbCl_2 + KI \rightarrow PbI_2 + KCl$

II group:

Wash the precipitate with hot water.

If the precipitate is black, treat with 3ml of HNO_3 and boil. Add NH_4OH. **Blue colour** solution is obtained. Divide the blue solution into 2 parts.

S.No.	Experiment	Observation	Inference
1	To one part, add acetic acid + KI	White precipitate is formed in brown solution	Cu^{2+} is confirmed
2.	To the other part add $K_4[Fe(CN)_6$	Chocolate brown colour	Cu^{2+} is confirmed

$Cu^{2+} + HNO_3 + NH_4OH \rightarrow$ Deep blue colour solution

$Cu^{2+} + K_4[Fe(CN)_6] \rightarrow Cu_2[Fe(CN)_6 + KNO_3$

If the precipitate is yellow, dissolve the precipitate in **Con.HNO_3** and divide into 2 parts.

S.NO.	Experiment	Observation	Inference
1.	Ammonium molybdate	Yellow precipitate	As^{3+} is confirmed
2.	Magnesia mixture	White precipitate	As^{3+} is confirmed

III grp: Al^{3+} (white ppt). / Pg-196. (Prac. book)

C.T: 1) Lake test: Dissolve white ppt + dil HCl. Add 2 drops of blue litmus soln. + NH_4OH dropwise till blue colour develops. — Blue ppt.

2) Cobal Nitrate Test

Perform charcoal cavity / Cobalt nitrate test with salt — Blue mass

III group:

If the precipitate is **reddish brown**, it is Fe^{3+}

Dissolve the precipitate in **dil.HCl** and divide the solution into 2 parts.

$Fe(OH)_3 + HCl \rightarrow FeCl_3 + H_2O$

S.NO	Experiment	Observation	Observation
1.	Add NH_4OH	Dark brown colour	Fe^{3+} is confirmed
2.	$K_4[Fe(CN)_6$	Deep blue	Fe^{3+} is confirmed
3.	Add KSCN	Deep red colour	Fe^{3+} is confirmed

$FeCl_3 + K_4[Fe(CN)_6 \rightarrow K_3\,Fe[Fe(CN)_6] + KCl$

$FeCl_3 + KSCN \rightarrow K_3Fe[Fe(SCN)_6$

Group: IV

Case I

If the precipitate is black, it is Co^{2+} or Ni^{2+}

Dissolve the precipitate in **aqua regia** (3 parts of con.HNO_3 and 1 part of HCl)

Blue residue – Co^{2+}. Yellow precipitate – Ni^{2+}. Evaporate the solution in a china dish. Dissolve in water. Pink colour solution is obtained. Divide into 2 parts.

S.No.	Experiment	Observation	Inference
1.	To one part add KSCN. Allow to settle	Blue colour	Co^{2+} is confirmed
2.	Add NH_4OH, CH_3COOH and crystal KNO_3 and warm	Yellow precipitate	Co^{2+} is confirmed

Dissolve the yellow precipitate in water. Green solution is obtained. Divide the green solution into 2 parts.

S.No.	Experiment	Observation	Inference
1.	Add NH_4OH and few drops of DMG	Bright red precipitate	Ni^{2+} is confirmed
2.	Add NaOH in excess and bromine water and boil	Black precipitate	Ni^{2+} is confirmed

se: II

the precipitate is of buff colour, dissolve the precipitate in dil.HCl. Boil off H_2S

$MnS + HCl \rightarrow MnCl_2 + H_2S$

S.No.	Experiment	Observation	Inference
1.	Add NaOH solution	White precipitate	Mn^{2+} is confirmed
2.	To the white precipitate add bromine water	Black or brown colour	Mn^{2+} is confirmed
3.	To the black precipitate add Con. HNO_3 and lead peroxide. Boil and cool	Pink colour solution	Mn^{2+} is confirmed

$MnCl_2 + NaOH \rightarrow Mn(OH)_2$

$Mn(OH)_2 + O \rightarrow MnO(OH)_2$

$PbO_2 + H+ + Mn^{2+} \rightarrow MnO_4^- + Pb^{2+} + H_2O$

Case: III

If the precipitate is dirty white, dissolve in dil.HCl, boil off H_2S and divide into 2 parts.

$ZnS + HCl \rightarrow ZnCl_2 + H_2S$

S.No	Experiment	Observation	Inference
1	Add NaOH dropwise	White precipitate	Zn^{2+} is confirmed
2	To the white precipitate, add more NaOH	White precipitate dissolves	Zn^{2+} is confirmed
3	To the other part add $K_4[Fe(CN)_6]$ Potassium ferro-cyanate	White precipitate or bluish	Zn^{2+} is confirmed

$ZnCl_2 + NaOH \rightarrow Zn(OH)_2$

$Zn(OH)_2 + NaOH \rightarrow Na_2ZnO_4$

$Zn^{2+} + K_4[Fe(CN)_6] \rightarrow Zn_2[Fe(CN)_6]$

Group: V

Dissolve the part of the white precipitate in hot dil acetic acid and divide the solution into 3 parts $BaCO_3 + CH_3COOH \rightarrow (CH_3COO)_2Ba + H_2O + CO_2$

S.No	Experiment	Observation	Inference
1.	Add few drops of potassium chromate	Yellow precipitate	Barium is confirmed
2.	Flame test	Green flame	Barium is confirmed

$(CH_3COO)_2Ba + K_2CrO_4 \rightarrow BaCrO_4$

If Ba^{2+} is absent

S.No	Experiment	Observation	Inference
1.	Add ammonium sulphate solution and warm	White precipitate	Sr^{2+} is confirmed
2.	Flame test	Crimson red	Sr^{2+} is confirmed

$(CH_3COO)_2Sr + (NH_4)_2SO_4 \rightarrow SrSO_4$

If Ba^{2+} and Sr^{2+} are absent, then

S.No	Experiment	Observation	Inference
1.	Add ammonium oxalate and little ammonium hydroxide	White precipitate	Calcium is confirmed
2.	Flame test	Brick red	Calcium is confirmed

$(CH_3COO)_2Ca + (NH_4)_2C_2O_4 \rightarrow CaC_2O_4$

Group VI

Concentrate the filtrate and divide into 2 parts

S.No	Experiment	Observation	Inference
1.	To one part of the solution add solid ammonium chloride ammonium hydroxide in slight excess. Then add ammonium phosphate solution	White precipitate	Mg^{2+} is confirmed
2.	Add NaOH solution and then add freshly prepared cobalt nitrate	Yellow precipitate	Mg^{2+} is confirmed

S.No	Experiment	Experiment	Inference
1.	Solid mixture is heated with con.NaOH	Ammonia gas is evolved. The gas gives white fumes when a rod dipped in dil.HCl is brought near the mouth of the test tube	NH_4^+ is confirmed
2.	Salt + nesslers reagent	Brick red precipitate	NH^+_4 is confirmed

Result: The given salt is _____

The anion present in the salt is _____

The cation present in the salt is _____