

University of Tikrit
College Of Pharmacy



General Inorganic and Analytical Chemistry

First Year Students
Practical Part 1 And 2

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And
Dr. Sermed B. Dikram

EXP. 1

Demonstration of Some Laboratory Equipments.

EXP. 2

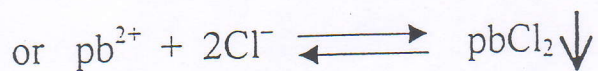
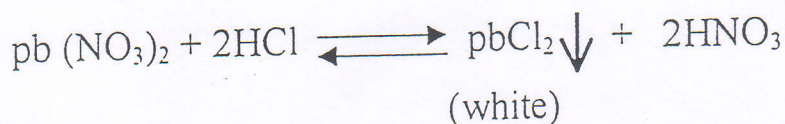
Group Separation and Identification of the Cations

Group I Cations (The Silver Group) Ag^+ , pb^{2+} and Hg_2^{2+} ions

Reactions of the lead ion, pb^{2+} :

1. With dilute HCl

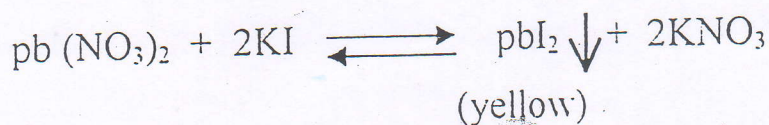
White precipitate of pbCl_2 is formed.



pbCl_2 is soluble in hot water, but separates out again in needles when the solution is cooled.

2. With KI solution

Yellow precipitate of pbI_2 is formed.

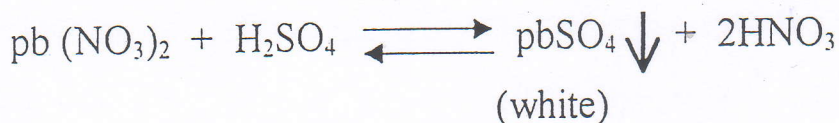


pbI_2 is soluble in excess of KI solution forming a complex ion.

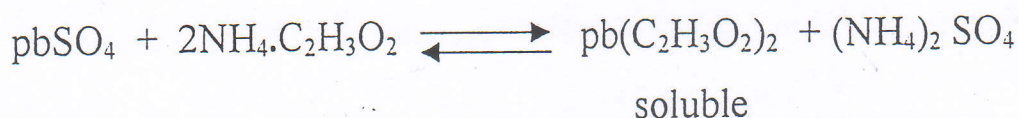


3. With dilute H₂SO₄

White precipitate of PbSO₄ is formed.

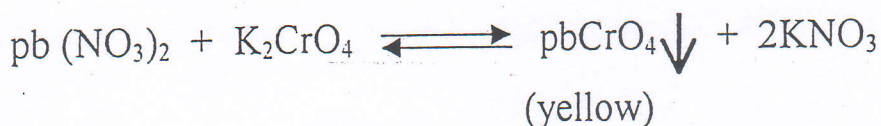


PbSO₄ is soluble in a concentrated solution of ammonium acetate.

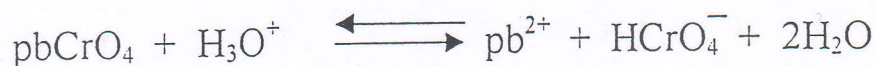
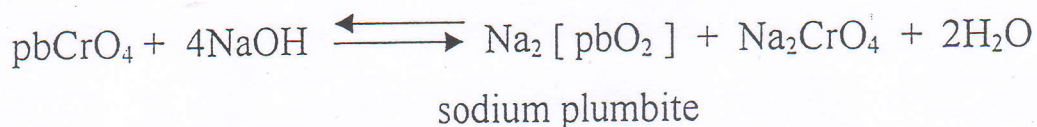


4. With K₂CrO₄ solution

Yellow precipitate of PbCrO₄ is formed.

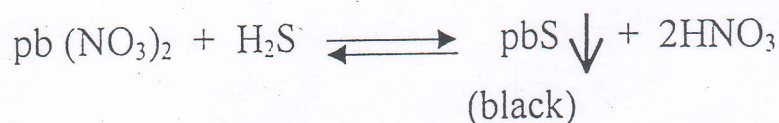


PbCrO₄ is soluble in acetic acid and in ammonia solution, but soluble in alkali hydroxides and in nitric acid.

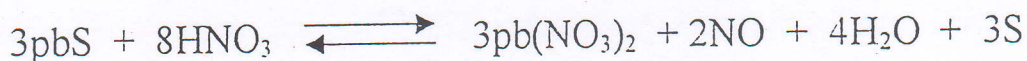


5. With sulphide ion solution (use H₂S)

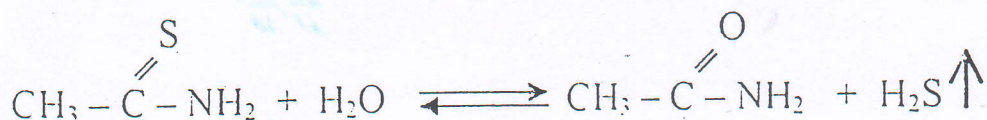
Black precipitate of PbS is formed.



PbS is soluble in hot dilute HNO₃.

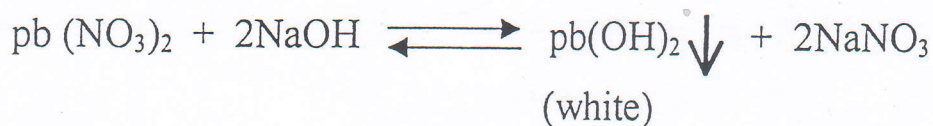


Note : H₂S is evolved from thioamide. Which is hydrolyzed rapidly in acidified aqueous solution (dil HCl) and liberate H₂S after heating the mixture in a water bath.

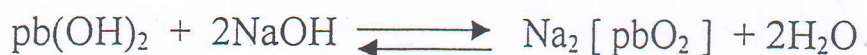


6. With NaOH solution

White precipitate of $\text{pb}(\text{OH})_2$ is formed.



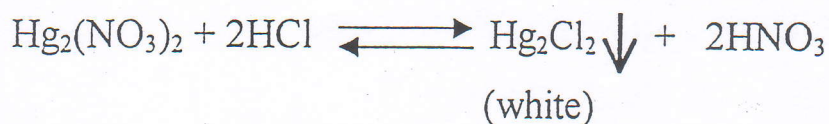
$\text{pb}(\text{OH})_2$ is soluble in excess of the reagent.



Reactions of the mercurous ion, Hg_2^{2+} :

1. With dilute HCl

White precipitate of Hg_2Cl_2 (Calomel) is formed.

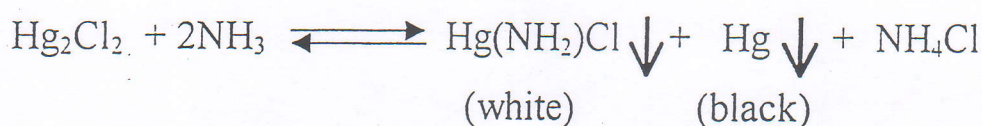


Hg_2Cl_2 is insoluble in hot water, but soluble in aqua regia (1ml of concentration HNO_3 + 3ml of concentration HCl).



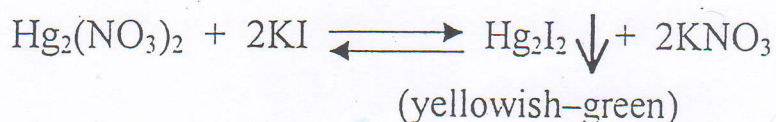
soluble

Hg_2Cl_2 turns to a black mixture when treated with aqueous ammonia.

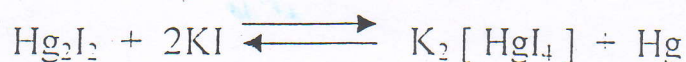


2. With KI solution

Yellowish-green precipitate of Hg_2I_2 is formed.



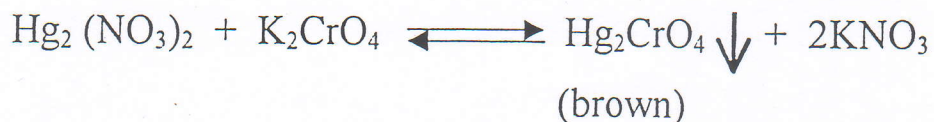
Hg_2I_2 is soluble in excess of KI solution.



Potassium mercuri-iodide

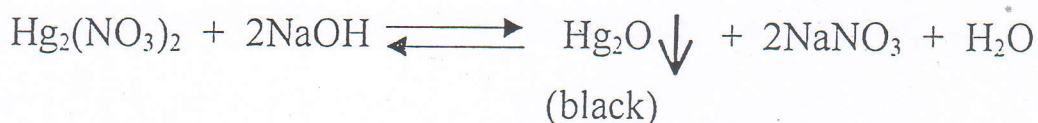
3. With K_2CrO_4 solution

Brown a morpous precipitate of Hg_2CrO_4 is formed, which is converted into a red crystalline form on boiling.



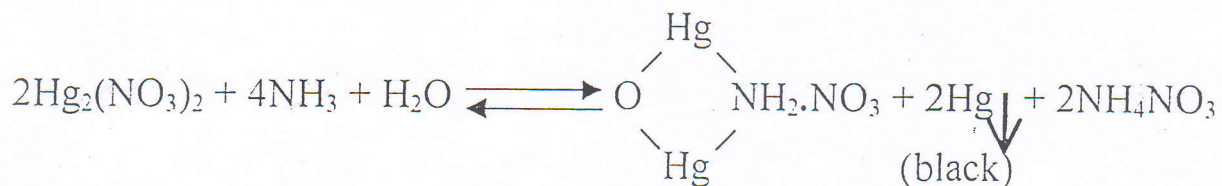
4. With NaOH solution

Black precipitate of Hg_2O is formed.



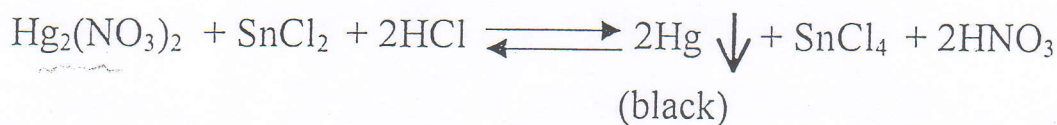
5. With ammonia solution

Finely-divided black precipitate of Hg is formed.



6. With $SnCl_2$ solution

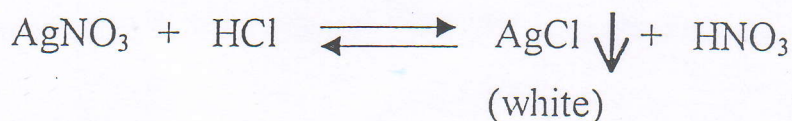
Finely-divided black precipitate of Hg is formed with excess of the reagent.



Reactions of the Silver ion, Ag^+ :

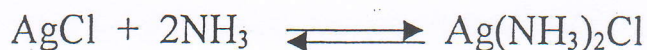
1. With dilute HCl

White precipitate of $AgCl$ is formed.

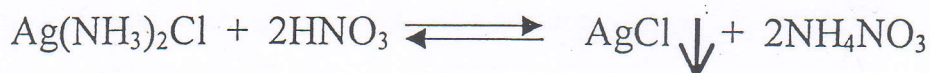


$AgCl$ is insoluble in dilute HNO_3 , but is soluble in aqueous ammonia owing to the formation of the silver diammino complex

ion, $\text{Ag}(\text{NH}_3)_2^+$

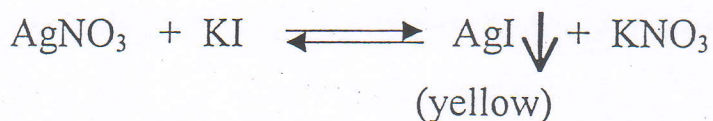


AgCl is precipitated again from the ammoniacal solution by the addition of dilute HNO_3



2. With KI solution

Yellow precipitate of AgI is formed.



AgI is insoluble in concentrated ammonia solution, but is soluble in solutions of KCN or $\text{Na}_2\text{S}_2\text{O}_3$

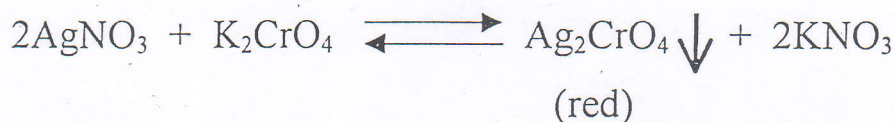


Sodium thiosulphate

Toxic
عظيمة

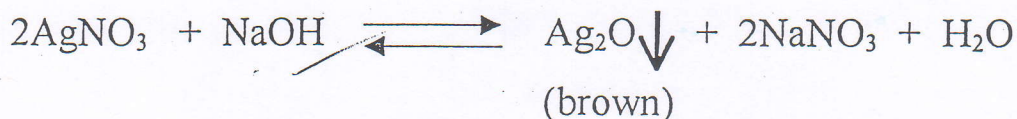
3. With K_2CrO_4 solution

Red precipitate of Ag_2CrO_4 is formed.



4. With NaOH solution

Brown precipitate of Ag_2O is formed.



5. With ammonia solution

White precipitate at first, which quickly passes into brown Ag_2O

Ag_2O is soluble in excess of the reagent.

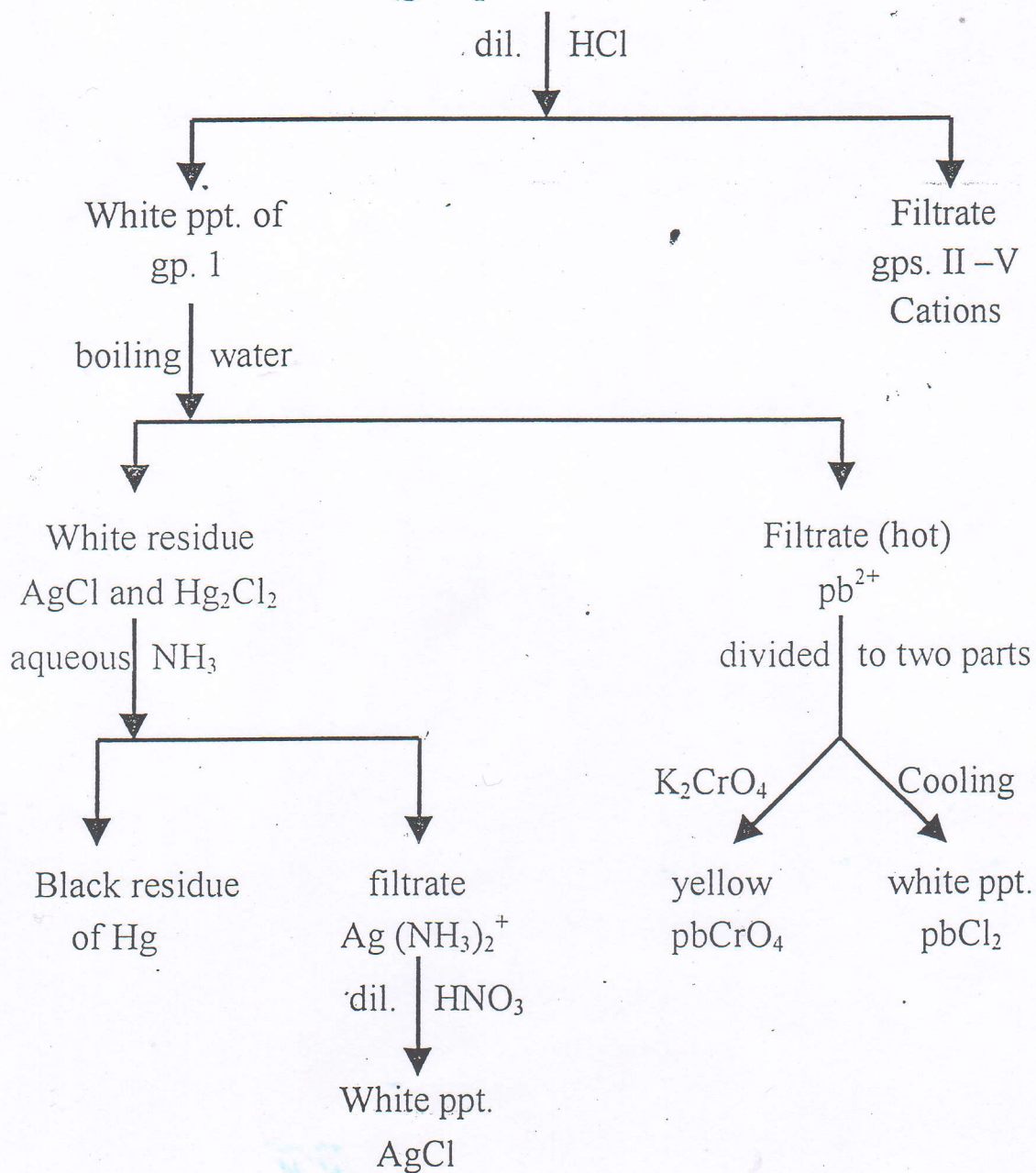


EXP. 3

Analysis of the silver group (group 1)

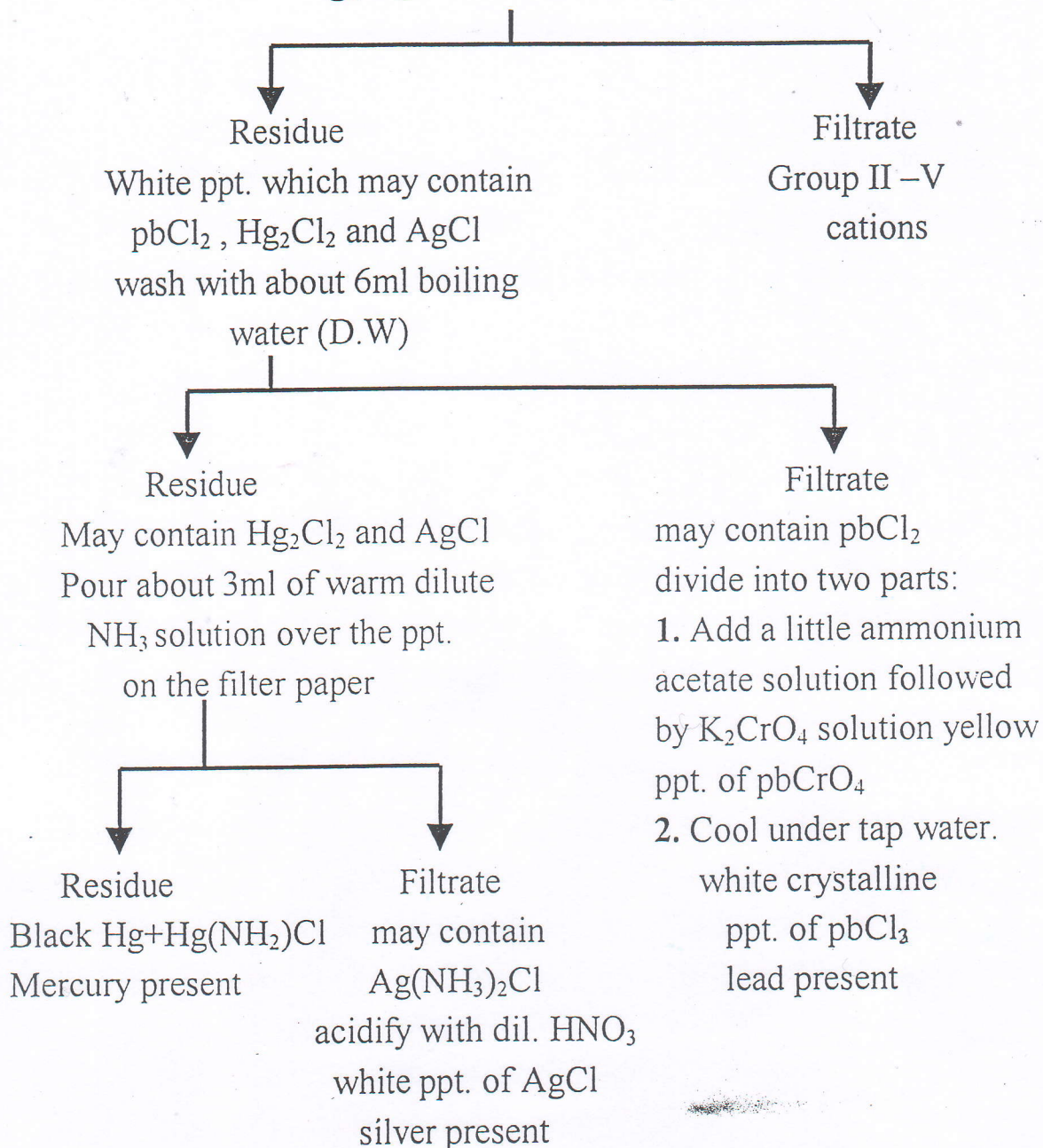
Schematic diagram for the analysis of group 1

(groups I–V cations)



Separation and identification of Group I cations

To the given solution in a test tube add dilute HCl in excess and filter. Wash the ppt., which may contain PbCl_2 , AgCl and Hg_2Cl_2 with a little very dilute HCl.



EXP. 4

Group II cations

1. The copper group (group II A)

Hg^{2+} , Bi^{3+} , Cu^{2+} and Cd^{2+} ions.

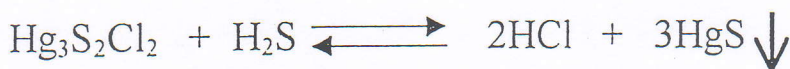
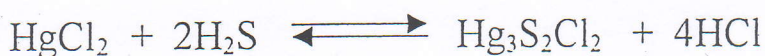
2. The Arsenic group (group II B)

The Copper Group II A

Reactions of the mercuric ion, Hg^{2+}

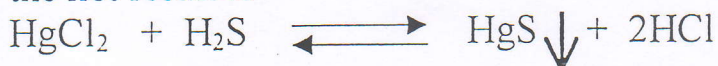
1. With sulphide ion (use H_2S)

Black precipitate of HgS is formed.

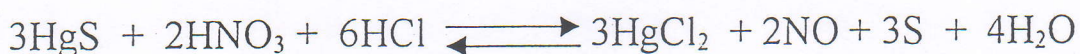


(black)

the net result is

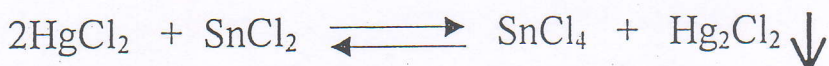


HgS is soluble in aqua regia.



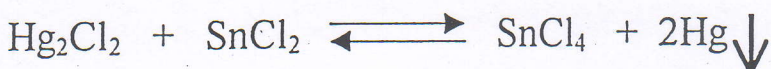
2. With SnCl_2 solution

White precipitate of Hg_2Cl_2 is formed.



(white)

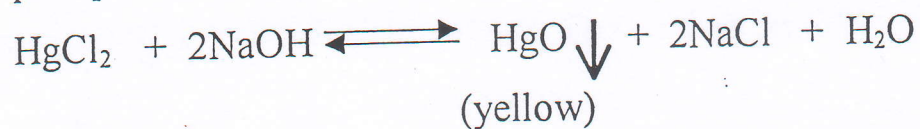
Hg_2Cl_2 is reduced by the excess of the reagent to grey-black metallic mercury (after 5 minutes).



(black)

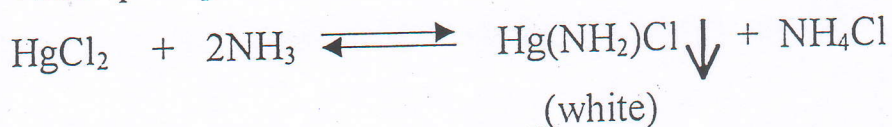
3. With NaOH solution

Reddish-brown precipitate is formed initially converted to yellow precipitate of HgO.



4. With ammonia solution

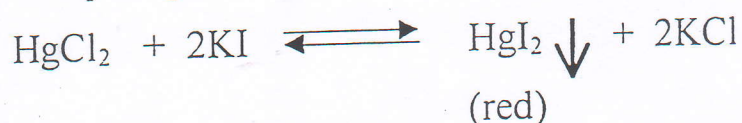
White precipitate of Hg(NH₂)Cl is formed.



Hg(NH₂)Cl is soluble in a large excess of the reagent.

5. With KI solution

Red precipitate of HgI₂ is formed.



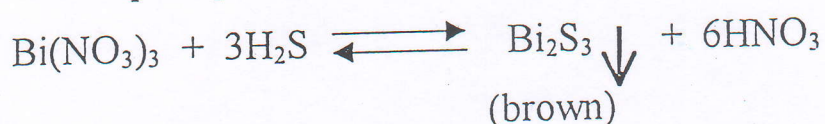
HgI₂ is soluble in excess of the reagent.



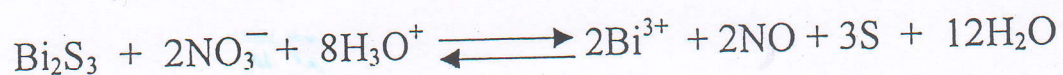
Reactions of the Bismuth ion, Bi³⁺

1. With sulphide ion (use H₂S)

Brown precipitate of Bi₂S₃ is formed.

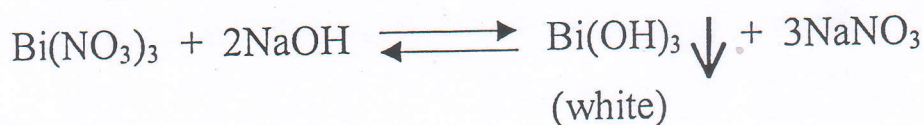


Bi₂S₃ is insoluble in cold dilute acids, but soluble in hot dilute HNO₃ and in boiling concentrated HCl

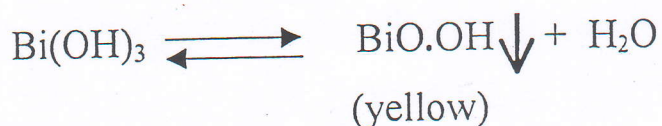


2. With NaOH solution

White precipitate of $\text{Bi}(\text{OH})_3$ is formed.

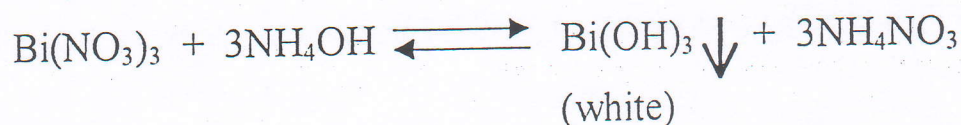


$\text{Bi}(\text{OH})_3$ becomes yellow on boiling, due to dehydration.



3. With ammonia solution

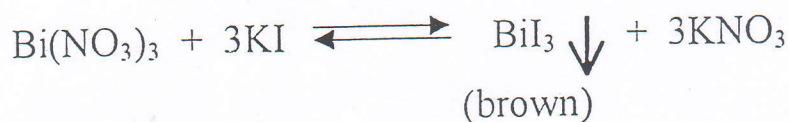
Deep blue solution of $(\text{OH})_3$ is formed.



$\text{Bi}(\text{OH})_3$ is insoluble in excess of the reagent.

4. With KI solution

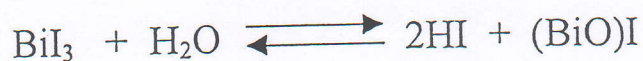
Dark brown precipitate of BiI_3 is formed.



BiI_3 is soluble in excess of the reagent to give a yellow solution of $\text{K}[\text{BiI}_4]$.



$\text{K}[\text{BiI}_4]$ is decomposed upon dilution giving an orange-coloured precipitate of $(\text{BiO})\text{I}$.

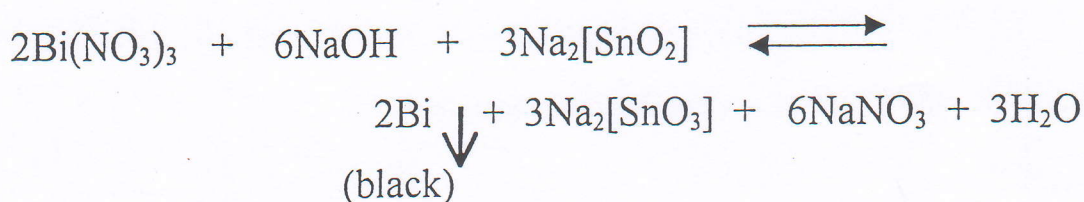


5. With sodium stannite solution

Black precipitate of finely divided Bi is formed.

Sodium stannite $\text{Na}_2[\text{SnO}_2]$ is freshly prepared by adding 3M NaOH solution drop by drop to a solution of stannous chloride

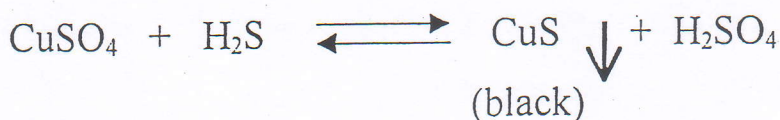
until the initial white precipitate of $\text{Sn}(\text{OH})_2$ just dissolves.



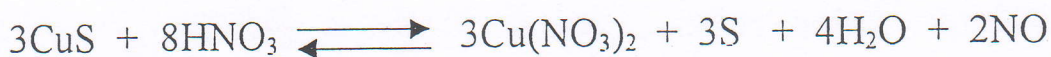
Reactions of the Cupric ion, Cu^{2+}

1. With sulphide ion (use H_2S)

Black precipitate of CuS is formed.

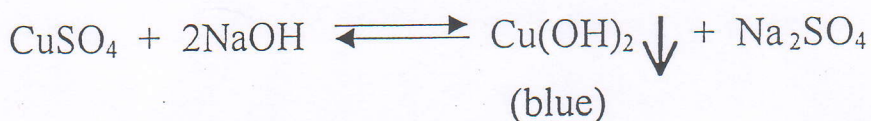


CuS is insoluble in NaOH solution, but is soluble in hot dilute HNO_3 and in KCN solution.

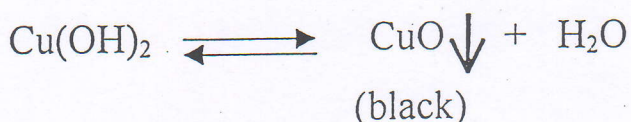


2. With NaOH solution

Blue precipitate of $\text{Cu}(\text{OH})_2$ is formed.

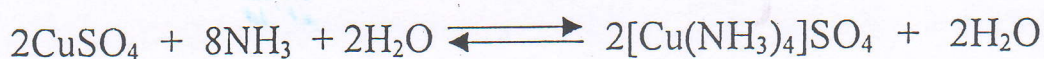


$\text{Cu}(\text{OH})_2$ is converted on boiling into black precipitate of CuO .



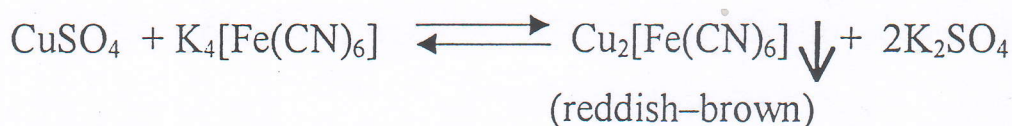
3. With ammonia solution

Deep blue solution of $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$ is formed.



4. With potassium ferrocyanide $K_4[Fe(CN)_6]$ solution

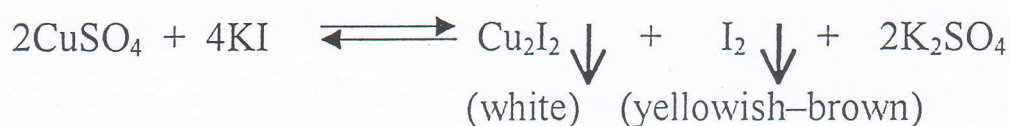
Reddish-brown precipitate of $Cu_2[Fe(CN)_6]$ is formed.



$Cu_2[Fe(CN)_6]$ is insoluble in dilute acids, but dissolves in aqueous ammonia forming a blue solution.

5. With KI solution

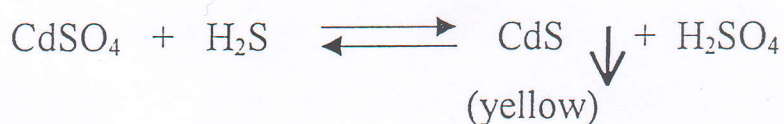
Yellowish-brown mixture of Cu_2I_2 (white) and I_2 (yellowish-brown) precipitate is formed.



Reactions of the Cadmium ion, Cd^{2+}

1. With sulphide ion (use H_2S)

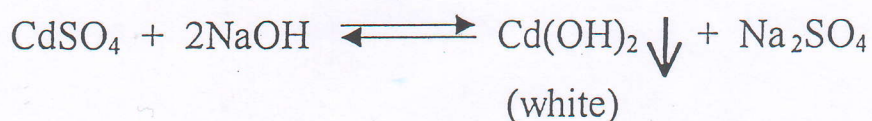
Yellow precipitate of CdS is formed in a neutral or a slightly acidic solution.



CdS is insoluble in KCN solution, but is soluble in hot dilute nitric acid.

2. With NaOH solution

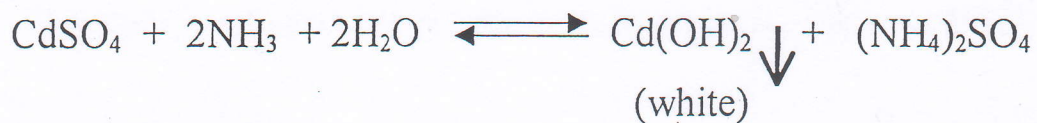
White precipitate of $Cd(OH)_2$ is formed.



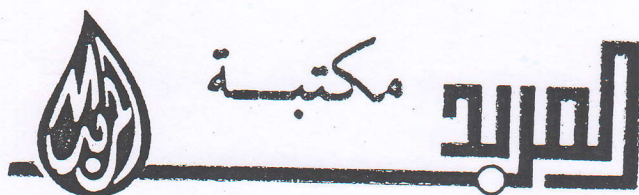
$Cd(OH)_2$ is insoluble in excess of the reagent.

3. With ammonia solution

White precipitate of $\text{Cd}(\text{OH})_2$ is formed.



$\text{Cd}(\text{OH})_2$ is soluble in excess of the reagent due to the formation of $[\text{Cd}(\text{NH}_3)_4]\text{SO}_4$.



احمد الحاج ماجد العبدربه

قرطاسية - طباعة - استنساخ - رونيو

سبهاء - القاطول - ٧٢٠٧٢٦