TOPIC : QUALITATIVE ANALYSIS EXERCISE # 1

SECTION (A)

1. $CuSO_4.5H_2O \xrightarrow{\Delta} CuSO_4$ (due to no crystal field splitting) Blue White

2. $2NaNO_3(s) \xrightarrow{800 \circ C} Na_2O(s) + N_2(g) + \frac{5}{2}O_2(g)$

$$\begin{split} & \mathsf{MgCO}_3(\mathsf{s}) \xrightarrow{\Delta} \mathsf{MgO}(\mathsf{s}) + \mathsf{CO}_2(\mathsf{g}) \\ & 2\mathsf{FeSO}_4(\mathsf{s}) \xrightarrow{\Delta} \mathsf{Fe}_2\mathsf{O}_3(\mathsf{s}) + \mathsf{SO}_2(\mathsf{g}) + \mathsf{SO}_3(\mathsf{g}) \\ & (\mathsf{NH}_4)_2\mathsf{Cr}_2\mathsf{O}_7(\mathsf{s}) \xrightarrow{\Delta} \mathsf{N}_2(\mathsf{g}) + 2\mathsf{H}_2\mathsf{O}(\mathsf{g}) + \mathsf{Cr}_2\mathsf{O}_3(\mathsf{s}) \end{split}$$

- 3. $ZnCO_3 \xrightarrow{} ZnO + CO_2^{\uparrow}$. ZnO is becomes yellow when hot on cooling, turns white.
- 4. $Ag_2CO_3 \longrightarrow Ag_2O + CO_2^{\uparrow}$ \therefore Carbonates of Na, K, Rb, Cs do not decompose on heating.

SECTION (B)

- 1. Chlorides of metals are more volatile at compared to other salts.
- **3.** Li \rightarrow crimson red colour
 - $Ca \rightarrow Brick red colour$
 - $\mbox{Sr} \rightarrow \mbox{crimson}$ red colour but its halide is not deliquescent

 $Ba \rightarrow Apple green$

4. Example : $CuO + B_2O_3 \longrightarrow Cu(BO_2)_2$

 $BO_2^- \rightarrow$ metaborate ion

 $6. \qquad \text{CoO} + \text{B}_2\text{O}_3 \longrightarrow \text{Co(BO}_2)_2$

SECTION (C)

- 1. Carbonates of alkali metals and ammonium are soluble in water. All other carbonates are insoluble in water.
- 2. $SO_3^{2-} + Ba(OH)_2 \longrightarrow BaSO_3 \downarrow \text{ (white)} + 2OH^-.$ $3SO_2 + Cr_2O_7^{2-} + 2H^+ \longrightarrow 2Cr^{3+} \text{ (green colour solution)} + 3SO_4^{2-} + H_2O.$
- 3. $CH_{3}COO^{-} + H^{+} \longrightarrow CH_{3}COOH \uparrow (smells like vinegar)$

- 4. SO_3^{2-} reduces KMnO₄ to colourless Mn⁺² $5SO_3^{2-} + 2MnO_4^{-} + 6H^+ 2Mn^{2+} + 5SO_4^{2-} + 3H_2O$
- **5.** $X^{-2} = S^{-2}$

SECTION (D)

- 1. $4\text{Cl}^- + \text{Cr}_2\text{O}_7^{2-} + 6\text{H}^+ \longrightarrow 2\text{Cr}\text{O}_2\text{Cl}_2^{\uparrow} \text{(deep red)} + 3\text{H}_2\text{O}.$
- **2.** AgCl + 2NH₃ \longrightarrow [Ag(NH₃)₂]⁺ Cl⁻ (soluble complex).
- 3. $2\text{NaI} + \text{H}_2\text{SO}_4 \longrightarrow \text{Na}_2\text{SO}_4 + 2\text{HI}$ $2\text{HI} + \text{H}_2\text{SO}_4 \longrightarrow \text{I}_2^{\uparrow} (\text{dark violet}) + 2\text{H}_2\text{O} + \text{SO}_2$ The free iodine may than be identified by deep blue colouration produced with starch paste solution.
- 4. $2NO_{3}^{-} + 4H_{2}SO_{4} + 6Fe^{2+} \longrightarrow 6Fe^{3+} + 2NO^{\uparrow} + 4SO_{4}^{2-} + 4H_{2}O.$ $Fe^{2+} + NO^{\uparrow} + SO_{4}^{2-} \longrightarrow [Fe(NO)]^{2+}SO_{4}^{2-}.$
- 5. $CI^{-} + H_2SO_4 \longrightarrow HCI^{+} (colourless) + HSO_4^{-}$ $MnO(OH)_2 + 2H_2SO_4 + 2CI^{-} \longrightarrow Mn^{2+} + CI_2^{+} (yellowish green) + 2SO_4^{2-} + 3H_2O$ $CI_2 + H_2O \longrightarrow 2HCI + [O]$ Litmus + $[O] \longrightarrow$ colourless oxidised form CI_2 is a yellowish green gas which bleaches litmus paper by oxidation.
- 6. $CrO_2Cl_2 + 2H_2O \longrightarrow H_2CrO_4 + 2HCl$ $H_2CrO_4 + (CH_3COO)_2Ba \longrightarrow BaCrO_4 \downarrow (Yellow) + 2CH_3COOH$
- 7. $5Cl_2 + l_2 + 6H_2O \longrightarrow 2HIO_3 \text{ (colourless)} + 10HCI$ Br₂ + Cl₂ \implies 2BrCl (pale yellow)

SECTION (E)

- 1. $SO_4^{2-} + Ba^{2+} \longrightarrow BaSO_4 \downarrow \text{ (white)}$
- 2. AgNO₃ + PO₄³⁻ \longrightarrow Ag₃PO₄ \downarrow (yellow ppt.) Ag₃PO₄ \downarrow + 6NH₃ \longrightarrow 3[Ag(NH₃)₂]⁺ (soluble) + PO₄³⁻ Ag₃PO₄ \downarrow + H⁺ \longrightarrow H₂PO₄⁻ (soluble) + 3Ag⁺

SECTION (F)

- **1.** It is alkaline solution of $K_2[Hgl_4]$.
- 2. $NH_4^+ + 2[Hgl_4]^{2-} + 4OH^- \longrightarrow HgO.Hg(NH_2)I \downarrow (brown) + 7I^- + 3H_2O$
- **3.** $NH_4^+ + OH^- \xrightarrow{\Delta} NH_3^+ + H_2O.$
 - (1) NH₃, alkaline in nature turns red litmus blue;

 $NH_3 + HCI \longrightarrow NH_4CI$ (white fumes) (2) 2Hg NO₃ + 2NH₃ \longrightarrow Hg (NH₂) NO₃ + Hg + NH₄NO₃ (3) $2K_2$ (HgI₄) + NH₃ + 3KOH \longrightarrow HgOHgNH₂I \downarrow (brown) + 7KI + 2H₂O (4) $CuSO_4 + 4NH_3 \rightarrow [Cu(NH_3)_4] SO_4$ (intense blue) SECTION (G) 1. Dilute HCI (2M) is the group reagent for Ist group radicals. Ag⁺ + HCl \longrightarrow AgCl \downarrow (white) + H⁺ ; Cu²⁺ + 2HCl \longrightarrow CuCl₂ (soluble) + 2H⁺. 2. $Pb^{2+} + 2Cl^{-} \longrightarrow PbCl_{2} \downarrow$ (soluble in hot water); $PbCl_{2} + CrO_{4}^{2-} \longrightarrow PbCrO_{4} \downarrow$ (yellow) + 2Cl⁻. 3. $Hg_2CI_2 + 2NH_3 \longrightarrow Hg < \stackrel{CI}{\underset{NH_4}{\leftarrow}} (white) + Hg \downarrow (black) + NH_4CI$ 4. Black 5. $Pb(NO_3)_2 + 2NH_4OH \longrightarrow Pb(OH)_2 \downarrow \text{ (white)} + 2NH_4NO_3$ $Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2 \downarrow (white) + 2NaNO_3$ $Pb(NO_3)_2 + H_2S \longrightarrow PbS\downarrow (black) + 2NaNO_3$ $Ag^+ + 2CI^- \longrightarrow [AgCI_2]^-$ (soluble complex); $Aq^+ + Cl^-$ (dilute HCl) $\longrightarrow AqCl\downarrow$ (white) 6. $Ag_{2}CrO_{4}\downarrow + NH_{2} \longrightarrow 2[Ag(NH_{2})_{2}]^{+} + CrO_{4}^{2-}$ $2Ag^{+} + CrO_{4}^{2-} \longrightarrow Ag_{2}CrO_{4} \downarrow (red);$ $3Ag^{+} + HPO_4^{2-} \longrightarrow Ag_3PO_4^{\downarrow}$ (yellow) + H⁺; $Ag_3PO_4^{\downarrow} + 6NH_3^{} \longrightarrow [Ag(NH_3)_2]^{+} + PO_4^{3-}$ SECTION (H) $H_{2}S \Longrightarrow 2H^{+} + S^{2-}$; $HCI \Longrightarrow H_{2}^{+} + CI^{-}$. 1. Due to common ion effect, the ionisation of H₂S is suppressed and thus low concentration of S²⁻ ions is obtained. This much of S²⁻ ions concentration is enough to precipitate only IInd group cations (because

2. $2Bi^{3+} + 3H_2S \longrightarrow Bi_2S_3$ (black) $\downarrow + 6H^+$

of the low K_{SP} of IInd group sulphides).

- **3.** HgS dissolves in aqua regia 3HgS \downarrow + 6HCl + 2HNO₃ \longrightarrow 3HgCl₂ + 3S \downarrow + 2NO + 4H₂O.
- 4. $Pb^{2+} + CrO_4^{2-} \longrightarrow PbCrO_4 \downarrow (yellow); PbCrO_4 \downarrow + 4OH^- \longrightarrow [Pb(OH)_4]^{2-} + CrO_4^{2-}$
- 5. $2Hg^{2+} + SnCl_2 \rightarrow Hg_2Cl_2 \downarrow \text{(silky white)} + Sn^{4+}.$
- 6. $Cu^{2+} + 4NH_4OH \rightarrow [Cu(NH_3)_4]^{2+} + 4H_2O.$
- 7. $H_2S \rightleftharpoons 2H^+ + S^{2-}$; $H_2S \rightleftharpoons 2H^+ + S^{2-}$

On account of common ion effect the ionization of H_2S is suppressed Ksp of 2nd group sulphides are lower, so, only those basic radicals get precipitated.

- 8. Both Cd^{2+} and Sn^{2+} are precipitated as yellow sulphides in the presence of dilute HCI.
- 9. $2Cu^{2+} + 4l^- \longrightarrow Cu_2l_2\downarrow + l_2$ $Cu^{2+} + 3CN^- \longrightarrow CuCN \downarrow + (CN)_2$
- $\begin{array}{ll} \textbf{10.} & (I) \ Cu^{2+} \ (aq) + 2OH^{-} \ (aq) \longrightarrow Cu(OH)_2 \downarrow (blue). \\ & (II) \ Cu^{2+} \ (aq) + [Fe(CN)_6]^{4-} \ (aq) \longrightarrow Cu_2[Fe(CN)_6] \downarrow \ (brown). \\ & (III) \ 2Cu^{2+} \ (aq) + 5I^{-} \ (aq) \longrightarrow 2CuI \downarrow \ (white) + I_3^{-} \ (intense \ brown \ solution). \end{array}$

SECTION (I) : IIIRD GROUP

- **1.** $NH_4CI \implies NH_4^+ + CI^-$; $NH_4OH \implies NH_4^+ + OH^-$. Because of common ion effect, the ionisation of NH_4OH is suppressed.
- 2. $[AI(OH)_4]^- + NH_4^+ \xrightarrow{\Delta} AI(OH)_3 \downarrow + NH_3^+ + H_2O$ Hydroxide ion concentration is reduced owing to the formation of ammonia (a weak base) which escapes on boiling.
- **3.** $Fe(OH)_3 + OH^- \longrightarrow$ No reaction.
- 5. To oxidise ferrous ion into ferric ion otherwise Fe²⁺ is not completely precipitated as Fe(OH)₂.
- 6. $Cr^{3+} + 3OH^- \longrightarrow Cr(OH)_3 \downarrow (green) + OH^- \longrightarrow [Cr(OH)_4]$ (soluble green complex) $Fe^{3+} + 3OH^- \longrightarrow Fe(OH)_3 \downarrow (brown)$ $Fe(OH)_3$ is not affected by concentrated NaOH.
- 7. (1) $[Fe(H_2O)_5SCN]^{2+}$ red solution
- 8. $Fe^{2+} + 2K^+ + [Fe(CN)_6]^{4-} \longrightarrow K_2Fe[Fe(CN)_6] \downarrow (white).$
- 9. $\operatorname{Fe}^{3+} + [\operatorname{Fe}(\operatorname{CN})_6]^{3-} \longrightarrow \operatorname{Fe}[\operatorname{Fe}(\operatorname{CN})_6]$ brown colouration $3\operatorname{Fe}^{3+} + 6\operatorname{CH}_3\operatorname{COO}^- + 2\operatorname{H}_2\operatorname{O} \rightleftharpoons [\operatorname{Fe}_3(\operatorname{OH})_2(\operatorname{CH}_3\operatorname{COO})_6]^+ + 2\operatorname{H}^+.$
- **10.** (1) $2Fe^{3+} + H_2S \longrightarrow 2Fe^{2+} + 2H^+ + S\downarrow$ (white)
 - (2) $2Fe^{3+} + 3S^{2-} \longrightarrow 2FeS^{\downarrow}(black) + S^{\downarrow}$
 - (3) $Fe^{3+} + 3SCN^{-} \longrightarrow Fe(SCN)_{3}$ deep red colouration

SECTION (J)

- 1. Zn, Mn, Co and Ni are placed in IV group. Their group reagent is H_2S in presence of NH_4OH and NH_4CI .
- 2. $Mn^{2+} + H_2S \longrightarrow MnS \downarrow (buff colour) + 2H^+$
- (1) MnS buff coloured (i.e. light pink coloured) (2) ZnS white
 (3) HgS black (4) CdS yellow
- 4. ZnS + 2HCl \longrightarrow ZnCl₂ + H₂S \uparrow ZnCl₂ is soluble while HgS is insoluble in HCl.
- 5. $Ni^{2+} + 2CN^{-} \longrightarrow Ni(CN)_2 \downarrow (green)$
- **7.** The filter paper ash test is substitute for cobalt nitrate charcoal cavity test. Double oxide ZnO.CoO formed is green in colour. It is called Rinmann's green.

- 8. (1) $Zn(OH)_2 \downarrow + 2OH^- \rightleftharpoons [Zn(OH)_4]^{2-}$ (2) and (3) $Zn(OH)_2 \downarrow + 4NH_3 \rightleftharpoons [Zn(NH_3)_4]^{2+} + 2OH^$ or NH_4^+
- 9. $5PbO_2 + 2Mn^{2+} + 4H^+ \longrightarrow 2MnO_4^-$ (violet red or purple red) + $5Pb^{2+} + 2H_2O$.
- 11. $Ni^{2+} + 2OH^- \longrightarrow Ni(OH)_2 \downarrow (green)$ $Ni(OH)_2 \downarrow is insoluble in excess of NaOH solution$ $Pb^{2+} + 2OH^- \longrightarrow Pb(OH)_2 \downarrow (white) ; Pb(OH)_2 \downarrow + 2OH^- \longrightarrow [Pb(OH)_4]^{2-} colourless solution.$

12. NiCl₂ + KCN (excess) K₂[Ni(CN)₄]
K₂[Ni(CN)₄]
$$\xrightarrow{\text{NaOH+Br}_2 \text{ water}}$$
 Ni₂O₃ \downarrow + 4NaCNO+NaBr + KCNO + H₂O
black

SECTION (K)

6.

 $\begin{array}{lll} \textbf{2.} & \operatorname{Fe}^{2+} + [\operatorname{Fe}(\operatorname{CN})_6]^{4-} \to \text{white precipitate} & ; & \operatorname{Fe}^{3+} + [\operatorname{Fe}(\operatorname{CN})_6]^{4-} \to \text{prussian blue precipitate}. \\ & \operatorname{Zn}^{2+} + [\operatorname{Fe}(\operatorname{CN})_6]^{4-} \to \operatorname{Bluish white/white precipitate} & ; & \operatorname{Cu}^{2+} + [\operatorname{Fe}(\operatorname{CN})_6]^{4-} \to \operatorname{chocolate brown} \\ & \operatorname{precipitate} & \\ & \operatorname{Ag}^+ + [\operatorname{Fe}(\operatorname{CN})_6]^{4-} \to \text{white precipitate} & ; & \operatorname{Ca}^{2+} + \operatorname{K_4}[\operatorname{Fe}(\operatorname{CN})_6]^{4-} \to \text{white precipitate}. \end{array}$

- **3.** Strontium chloride gives crimson colour flame in Bunsen burner. BaCl₂ -apple green, CaCl₂ -brick red, KCl - lilac(violet).
- 4. Ca salts impart brick red colour to the flame.
- 5. (1) titan yellow is absorbed by magnesium hydroxide producing a deep-red colour or precipitate. (2) $Mg^{2+} + NH_3 + HPO_4^{2-} \longrightarrow Mg(NH_4)PO_4 \downarrow$ (white).
 - (3) Blue lake is formed by the adsorption of reagent on Mg(OH)₂.
 - (1) $Pb(NO_3)_2 + 2NaCI \longrightarrow PbCl_2 \downarrow (white) + 2NaNO_3$
 - $Ba(NO_3)_2 + 2NaCI \longrightarrow BaCl_2 + 2NaNO_3$; $BaCl_2$ is soluble in water
 - (2) $Pb^{2+} + SO_4^{2-} \longrightarrow PbSO_4 \downarrow$ (white) ; $Ba^{2+} + SO_4^{2-} \longrightarrow BaSO_4 \downarrow$ (white)
 - (3) $2KI + Pb^{2+} \longrightarrow PbI_2 \downarrow (yellow) + 2K^+$; No precipitation with Ba²⁺.
- 7. $BaCl_2 + 2AgNO_3 \longrightarrow 2AgCl\downarrow (white) + BaNO_3$ $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 \downarrow (white) + 2HCl$
- **8.** (1) No precipitate with $K_2 CrO_4$ in acetic acid as its k_{sp} is high.

- (2) $Ca^{2+} + 2K^{+} + [Fe(CN)_6]^{4-} \longrightarrow K_2Ca[Fe(CN)_6] \downarrow$ (white)
- (3) $Ca(OH)_2$ formed is water soluble.
- (4) $Ca(HCO_3)_2$ is formed which is water soluble.
- **9.** Ba²⁺ salts gives yellow precipitate with K_2CrO_4 solution and this precipitate is not soluble in CH₃COOH. Ba²⁺ ions gives apple green colour in the flame test.

EXERCISE # 2

- **1.** Anion is SO_3^{2-} which has trigonal pyramidal structure.
- **2.** (i) substance $I^{-}(aq.) + Hg^{2+}$ ions $\longrightarrow HgI_{2}$ (red precipitate)
 - (ii) substance $I^{-}(aq.) + Pb^{2+}$ ions $\longrightarrow PbI_{2}$ (yellow precipitate)
 - (iii) substance I⁻(aq.) + Bi³⁺ ions \rightarrow BiI₃ (black precipitate)
 - (iv) substance I⁻(aq.) + Cu²⁺ ions \longrightarrow Cu₂I₂+ I₂ (white precipitate in brown solution)
- **3.** (1) Both gives yellow precipitate.
 - (2) $Pb^{2+} + 2I^- \longrightarrow PbI_2 \downarrow (yellow)$ $Pb^{2+} + 2Br^- \longrightarrow PbBr_2 \downarrow (white)$
 - (3) $Ag^+ + Br^- \longrightarrow AgBr \downarrow (yellow)$; $AgBr + Na_3AsO_3 \longrightarrow No$ effect $Ag^+ + I^- \longrightarrow AgI \downarrow (yellow)$; $AgI + Na_3AsO_3 \longrightarrow No$ effect
 - (4) No reaction is observed with Br^- and I^- .

6.
$$Na_2B_4O_7.10H_2O \xrightarrow{\Delta} Na_2B_4O_7 + 10H_2O$$
; $Na_2B_4O_7 \xrightarrow{\Delta} 2NaBO_2 + B_2O_3$

- $CuO + B_2O_3 \longrightarrow Cu(BO_2)_2$ (copper (II) metaborate) red and opaque bead in oxidising flame.
- 7. $SO_3^{2-} + 2H^+ \longrightarrow SO_2^{-} + H_2O$ $SO_2 + 2IO_3^{-} + 4H_2O \longrightarrow I_2 + 5SO_4^{-2} + 8H^+$ Thus the gas B and compound A are SO₂ and Na₂SO₃ respectively.
- 8. Fe³⁺ + 3SCN⁻ \longrightarrow Fe(SCN)₃ (deep red colouration).
- 9. $2I^- + Cl_2 \longrightarrow I_2 + 2Cl^-$. I_2 being covalent dissolves in chloroform giving purple or violet solution. Ba²⁺ + SO₄²⁻ \longrightarrow BaSO₄ \downarrow (white).
- **10.** Both belong to same group i.e. IInd group and their K_{SP} values are low ; so both are precipitated according to the following reactions.
 - $2Bi^{3+} + 3S^{2-} \longrightarrow Bi_2S_3 \downarrow (black).$

 $Sn^{4+} + 2S^{2-} \longrightarrow SnS_2 \downarrow$ (yellow).

- **11.** Oxidation by MnO_4^- , $Cr_2O_7^{2-}$ or NO_3^- produces turbidity due to the formation of sulphur. $2MnO_4^- + 5H_2S + 6H^+ \longrightarrow 2Mn^{2+} + 5S \downarrow + 8H_2O.$
- **12.** The K_{sp} of Al(OH)₃ is low as compared to that of the hydroxides of other metals. The OH⁻ concentration provided by ammonium hydroxide in presence of NH₄Cl is just sufficient to precipitate Al³⁺ as Al(OH)₃. Al³⁺ + NH₃ + H₂O $\xrightarrow{NH_4Cl}$ Al(OH)₃ \downarrow (gelatinous white) + NH₄⁺.
- **13.** $Ag_2S + 2HCI \longrightarrow AgCI \downarrow + 2H_2S$; HgS is also insoluble in 2N HCI so silver and mercury do not pass into filtrate while ZnS, MnS and FeS dissolves in 2N HCI forming their soluble chlorides and thus pass into filtrate.

- **14.** $Ba^{2+} + CrO_4^{2-} \longrightarrow BaCrO_4 \downarrow$ (yelllow) ; $Ba^{2+} + SO_4 \longrightarrow BaSO_4$ (white). $Ba^{2+} + 2Cl^- \longrightarrow BaCl_2$ (soluble in water). K_{sp} of SrCrO₄ is high in acetic acid, so no precipitate is formed. Lead carbonate and basic lead carbonate both gives precipitate with K_2CrO_4 and NaCl.
- **15.** As the concentration of CO_3^{2-} ions provided by $(NH_4)_2CO_3$ in presence of NH_4CI and ammonia is not just sufficient to precipitate the Mg as $MgCO_3$ because of its high K_{sp} value.

EXERCISE # 3 PART - I

- 1. $Cu(NO_3)_2 \xrightarrow{Ammonia} [Cu(NH_3)_4]^{+2} \xrightarrow{KCN} [Cu(CN)_4]^{3-} \xrightarrow{H_2S} No \text{ ppt of } CuS$ $Cd(NO_3) \xrightarrow{Ammonia} [Cd(NH_3)_4]^{+2} \xrightarrow{KCN} [Cd(CN)_4]^{3-} \xrightarrow{H_2S} Yellow \text{ ppt of } CdS$
- **2.** H₂S is presence of HCl is a group reagent of IInd group and among the following Cd⁺² is a IInd group ion which forms yellow precipitabe of CdS.

3. Borax Bead test

 $\begin{array}{ccc} Na_{2}B_{4}O_{7} & 10H_{2}O & \stackrel{\Delta}{\longrightarrow} Na_{2}B_{4}O_{7} & \stackrel{\Delta}{\longrightarrow} 2NaBO_{2} + B_{2}O_{3} \\ CuO + B_{2}O_{3} & \longrightarrow & Cu(BO_{2})_{2} \\ & copper & metaborate \end{array} (blue bead)$

- **4.** H_2S in presence of NH_4OH is a group reagent for IVth group, and Zn^{+2} is the ion of IVth group which forms white precipitate of ZnS.
- 5. In qualitative analysis of cation of second group H_2S gas is passed in presence of HCI, of sulphide ions is obtained which is sufficient for the precipitation of second group cations in form of their sulphides due to lower value of their solubility product (K_{sp}). Here, fourth group cations are not precipitated becasue they require for exceeding their ionic product to their solubility products and higher sulphide ions concentration due to their higher K_{sp} which is not obtained here due to common ion effect.

6. NiCl₂ + DMG
$$\longrightarrow$$
 [Ni(dmg)₂] ; It is not tetrahydral square planer

7. Mass of organic comp. = 0.25 g

$$V_1 = 40 \text{ ml}$$

 $T_1 = 300 \text{ k}$
 $P_1 = 725 - 25 = 700 \text{ mm of Hg}$
 $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$
 $V_2 = \frac{700 \times 40 \times 273}{300 \times 760} = 33.52 \text{ ml}$
% of N = $\frac{28 \times V \times 100}{22400 \times \text{mass of org. com.}} = \frac{28 \times 33.52 \times 100}{22400 \times 0.25} = 16.76$

8. I_2 reacts with I^- and maintains the following equilibrium.

 $I_{2} + I^{-} \rightleftharpoons I_{3}^{-}$ Hg²⁺ gives ppt of Hgl, on reaction with but Hgl, I is soluble in solution of I $Hg^{2+} + 2I^{-}$? Hgl_{2} $Hgl_{a} + 2l^{-} \rightleftharpoons [Hgl_{4}]^{2-}$ PART - II 1. Compound which has higher value of K_{sn} will be more soluble. Among of following FeS has higher K_{sp} =10⁻²⁰ value 2. Because CoS has K_{sn} > lonic product so it is soluble while other have K_{sn} < lonic product so these are precipitate out. 3. With $K_{a}[Fe(CN)_{e}]$, Cu^{2+} ions gives reddish brown ppt. $2CuSO_4 + K_4[Fe(CN)_6] \longrightarrow Cu_2[Fe(CN)_6] + 2K_2SO_4$ reddish brown ppt. 4. $S^{2-} + (CH_3COO)_2Pb \longrightarrow PbS\downarrow + 2CH_3COO^$ black ppt. $S^{2-} + Na_{2}[Fe(CN)_{5}NO] \longrightarrow [Fe(CN)_{5}NOS]^{4-} + 2Na^{+}$ violet ppt. Hence, they are distinguished by both the reagents as only S²⁻ gives precipitate with these reagents. 6. $CuS \longrightarrow black$ SnS → Brown $Cds \longrightarrow Yellow$ $Sb_2S_3 \longrightarrow orange$ Zns \longrightarrow white Nis —→ Black

- 7. In Brown ring test, Fe^{2+} oxidizes to Fe^{3+} , and $NO_{3^{-}}$ reduces to NO.
- 8. In basic medium

 $\begin{array}{ccc} \text{KMn}\,\text{O}_4^- & \xrightarrow{\text{OH}^-} & \text{Mn}\,\text{O}_4^{2-} \\ \text{purple} & \text{green} \end{array}$

- 9. PbSO₄ belong to Ist group so insoluble in HCI

PART - III

1. $NH_4OH \Longrightarrow NH_4^+ + OH^-$

 $NH_4CI \longrightarrow NH_4^+ + CI^-$

Common ion effect of NH_4^+ supresses the dissociation of NH_4OH . Thus low concentration of OH^- is obtained which is just sufficient to exceed the K_{sp} of $Fe(OH)_3$ (as K_{sp} of $Fe(OH)_3$) is less than $Cr(OH)_3$.

- 2. (1) AgCl + 2NH₃ \rightarrow [Ag(NH₃)₂]Cl (colourless soluble complex); Agl + 2NH₃ \rightarrow No reaction
 - (2) $Fe^{3+} + [Fe(CN)_6]^{4-} \longrightarrow Fe_4[Fe(CN)_6]_3$ (prussian blue colouration or ppt.)
 - (3) 2KHCO₃ $\xrightarrow{\Delta}$ K₂CO₃ + H₂O + CO₂ ; Ca(HCO₃)₂ $\xrightarrow{\Delta}$ CaCO₃ + H₂O + CO₂
 - (4) In reducing flame the bead is colourless. It is violet in oxidising flame.

- 3. $\operatorname{Hgl}_{2} \downarrow + 2I^{-} \longrightarrow [\operatorname{Hgl}_{4}]^{2^{-}}$ (colourless soluble complex) $\operatorname{Hgl}_{2} \xrightarrow{\Delta} \operatorname{Hg} + \operatorname{I}_{2}^{\uparrow}$ (violet colour)
- 4. $Zn_2[Fe(CN)_6]$ is white.
- 5. $Na_2C_2O_4 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO + CO_2$ $Na_2C_2O_4 + CaCl_2 \longrightarrow CaC_2O_4 \downarrow + 2NaCl$ $8H_2SO_4 + 5CaC_2O_4 + 2KMnO_4 \longrightarrow 5CaSO_4 + K_2SO_4 + 2MnSO_4 + 8H_2O + 10CO_2$