[CLASS XII CHEMISTRY PRACTICALS]

Evaluation Scheme for Examination Marks

Volumetric Analysis	08
Salt Analysis	08
Content Based Experiment	06
Project Work	04
Class record and viva	04
	Total 30

Note:-
1. **Chemical Equations of Experiment 3 to 11 are to be written on blank pages.**
2. **Observation table of experiment 13 to 16 are to be drawn on blank pages.**
3. **Investigatory Project work (4 marks) is also included in the practical syllabus. For project work, contact the teacher for the topic.**
4. **Project report should be hand written.**
5. **Start each experiment from a new page.**

EXPERIMENT – 1

Classification of Anions

Group	Group Reagent	Observation	Inference
A	Dilute H_2SO_4	a) Colourless, odourless gas with brisk effervescence (CO_2) which turn lime water milky. b) Colourless gas with rotten egg like smell (H_2S) which turns lead acetate paper black. c) Colourless gas with smell of burning sulphur (SO_2) which turns acidified dichromate paper green. d) Brown coloured gas (NO_2) which turns ferrous sulphate solution black or brown. e) Colourless gas with vinegar like smell.	CO_3^{2-} (Carbonate) S^{2-} (sulphide) SO_3^{2-} (Sulphite) NO_2^- (Nitrite) CH_3COO^-(Acetate)
B	Conc. H_2SO_4	a) Colourless pungent smelling gas (HCl) which gives white dense fumes with glass rod dipped in NH_4OH. b) Violet coloured vapours (I_2) which turns starch paper blue. c) Reddish brown gas (NO_2) having pungent smell (On adding copper turning, fumes becomes intense) d) Brown colour gas with pungent smell (Br_2) which turns starch paper yellow. e) Colourless, odourless gas with brisk effervescence ($CO + CO_2$) which turns lime water milky and burns on the mouth of test tube with blue flame.	Cl^- (Chloride) I^- (Iodide) NO_3^- (Nitrate) Br^- (Bromide) $C_2O_4^{2-}$ (Oxalate)
C	$BaCl_2$	White ppt. of $BaSO_4$ is formed.	SO_4^{2-} (sulphate)
D	Ammonium molybdate $3(NH_3)_4MoO_4$	Cannary yellow ppt. of phospho ammonium molybdate $(NH_4)_3PO_4.12\ MoO_3 . 6H_2O$	PO_4^{3-} (phosphate)

EXPERIMENT – 2

Classification of Cations

Group	Group Reagent	Radical	PPt/Smell	Colour
Zero	NaOH	NH_4^+	Smell of NH_3	-
I	Dil. HCl	Pb^{+2}	$PbCl_2$	White
II	H_2S gas in acidic	Pb^{+2}	PbS	Black
	Medium	As^{3+}	As_2S_3	Yellow
		Cu^{+2}	CuS	Black
		Cd^{+2}	CdS	Yellow
III	NH_4Cl (s) in presence of	Fe^{2+}	$Fe(OH)_2$	Light green
	NH_4OH	Fe^{3+}	$Fe(OH)_3$	Reddish brown
		Al^{3+}	$Al(OH)_3$	Gelatinous white
IV	H_2S gas in basic medium	Ni^{2+}	NiS	Black

		Co^{2+}	CoS	Black
		Mn^{2+}	MnS	Flesh colour
		Zn^{2+}	ZnS	Dirty white
V	$(NH_4)_2\ CO_3$ in presence of NH_4OH	Ba^{2+}	$BaCO_3$	White
		Ca^{2+}	$CaCO_3$	White
		Sr^{2+}	$SrCO_3$	White
VI	Na_2HPO_4 in presence of NH_4OH	Mg^{2+}	$MgNH_4PO_4$	White

EXPERIMENT – 3

Aim :- To analyse the given inorganic salt for acidic and basic radicals [$(NH_4)_2\ CO_3$]

Preliminary Investigation

Physical State	Solid
Colour	White (Cu^{2+}, Fe^{2+}, Fe^{3+} , Ni^{2+}, Mn^{2+},Co^{2+}absent)
Odour	Ammonium smell (may be NH_4^+)
Solubility	Soluble in water
Flame Test	No Characteristic flame (Pb^{2+}, Cu^{2+}, Ca^{2+}, Sr^{2+} , Ba^{2+}, Zn^{2+} absent)

(A) Identification of Acidic Radical

(a) Preliminary test :

Experiment	Observation	Inference
1. Salt solution + dil H_2SO_4	Colourless, colourless gas with brisk effervescence which turn lime water milky	Group A anion (CO_3^{2-} may be present)
Confirmative test :		
1. $BaCl_2$ Test : Salt solution + $BaCl_2$	White ppt of $BaCO_3$	CO_3^{2-} Confirmed
2. $MgSO_4$ Test : Salt solution + $MgSO_4$	White ppt of $MgCO_3$	CO_3^{2-} Confirmed

(B) Identification of Basic Radical

a) Preliminary Test

Experiment	Observation	Inference
1. Salt Solution + NaOH+ Heat	Smell of NH_3	
2. Place a red litmus on the mouth of test tube.	Red litmus turns blue	Zero group present $(NH_4^+\ may\ be)$

Confirmative test

Experiment	Observation	Inference
1. Nessler's reagent test : Salt + Solution + NaOH + Nessler's Reagent	Reddish brown ppt. is formed	NH_4^+ confirmed.
2. NaOH test : Salt Solution + NaOH + Heat. Bring a glass rod dipped in conc. HCl	Smell of NH_3 Dense white fumes of NH_4Cl are formed.	NH_4^+ Confirmed.

Chemical Reactions : -

Acidic Radical

Preliminary Test :-

1. $(NH_4)_2CO_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4 + CO_2 \uparrow + H_2O$
2. $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

Confirmative Test

1. $BaCl_2$ Test :

$$(NH_4)_2CO_3 + BaCl_2 \rightarrow BaCO_3 \downarrow + 2NH_4Cl$$

2- $MgSO_4$

$$(NH_4)_2CO_3 + MgSO_4 \longrightarrow MgCO_3 \downarrow + (NH_4)_2SO_4$$

2. Basic Radical

(a) Preliminary Test :-

1. $(NH_4)_2CO_3 + 2NaOH \longrightarrow Na_2CO_3 + 2H_2O + 2NH_3 \uparrow$

NH_3+ Red litmus -----→ Litmus turns blue

(b) Confirmative test :-

1. Nessler's Test :

$K_2HgI_4 \longrightarrow 2KI + Hg\ I_2$

(Nessler's Reagent)

$HgI_2 + NH_3 \longrightarrow NH_2HgI + HI$

$2NH_2HgI + H_2O \longrightarrow$

NH_2
/
Hg
\
O + NH_4I
/
Hg
\
I

2. NaOH Test

$(NH_4)_2CO_3 + 2NaOH \longrightarrow Na_2CO_3 + 2H_2O + 2NH_3 \uparrow$

$NH_3 \uparrow + HCl \longrightarrow NH_4Cl$ $(Dense\ white\ fumes)$

Result : The given inorganic salt contains following

Acidic Radical : - CO_3^{2-}

Basic Radical : NH_4^+

EXPERIMENT – 4

Aim : To analyse the given salt of acidic and basic radical (NH_4Cl)

Preliminary Investigation

Physical state : Solid

Colour : white (Cu^{2+}, Fe^{2+}, Fe^{3+},Ni^{2+}, Mn^{2+}, Co^{2+} absent)

Odour : Ammonium smell (NH_4^+ may be present)

Solubility : Soluble in water

Flame Test : No characteristic flame (Cu^{2+}, Ca^{2+}, Ba^{2+},Sr^{2+},Pb^{+2} , Zn^{2+}absent)

(A) Identification of Acidic Radical

a- Preliminary test:

	Experiment	**Observation**	**Inference**
1	Salt solution + dil H_2SO_4 solution	No gas is evolved	Group A anion $\left(CO_3^{2-}, CH_3COO^-, NO^-{}_2, SO_3^{2-}, S^{2-}, absent\right)$
2	Salt + Conc H_2SO_4 + Heat Bring a glass rod dipped in NH_4OH	Colourless gas with pungent smell which gives dense white fumes of NH_4Cl	Group B anion (Cl^- may be)

(b) Confirmative Test:

	Experiment	**Observation**	**Inference**
1	**$AgNO_3$ test :** Salt Solution + $AgNO_3$. Dissolve the ppt in NH_4OH	Curdy white ppt White ppt soluble in NH_4OH	Cl^- confirmed
2	**Chromyl chloride Test:** a) Salt + Solid $K_2Cr_2O_7$ (1:2) + conc. H_2SO_4 + Heat b) Pass these vapour through NaOH c) Add acetic acid and lead acetate to yellow solution	Reddish orange gas is evolved Solution be comes yellow Yellow ppt of lead chromate is formed.	Cl^- confirmed

Identification of Basic Radical

Preliminary Test:

	Experiment	Observation	Inference
1	Salt solution + NaOH + Heat	Smell of Ammonia	Zero group (NH_4^+) May be
2	Place a red litmus on the mouth of test tube	Red litmus turns blue	

Confirmative Test:

	Experiment	Observation	Inference
1	Nessler Test: Salt solution + NaOH + Nessler's reagent	Reddish brown ppt is formed	NH_4^+ Confirmed
2	NaOH Test : Salt Solution + NaOH + Heat Bring a glass rod dipped in dil HC*l*	Smell of NH_3 white dense fumes of NH_4Cl are formed	NH_4^+ Confirmed

Preliminary Test :

$$2NH_4Cl + H_2SO_4 \xrightarrow{Heat} (NH_4)_2SO_4 + 2HCl$$

$$NH_4OH + HCl \longrightarrow NH_4Cl + H_2O$$

(White dense fumes)

Confirmative Test :

$AgNO_3$ test $\quad NH_4Cl + 2AgNO_3 \longrightarrow 2AgCl \downarrow + NH_4NO_3$

(Curdy white ppt)

$$AgCl + NH_4OH \longrightarrow [Ag(NH_3)_2]Cl + 2H_2O$$

(Diammine silver (I) Chloride)

Chromyl Chloride Test :

$K_2Cr_2O_7 + H_2SO_4 \longrightarrow K_2SO_4 + 2Cr_2O_3 + H_2O$

$2NH_4 + H_2SO_4 \longrightarrow (NH_4)_2SO_4 + 2HCl$

$$CrO_3 + 2HCl \longrightarrow Cr_2O_2Cl_2 \uparrow + H_2O$$

(*Vapour*)

$$CrO_2Cl_2 + 4NaOH \longrightarrow Na_2CrO_4 + 2NaCl + H_2O$$

(Sodium Chromate (Yellow Solution)

$$Na_2CrO_4 + Pb(CH_3COO)_2 \xrightarrow[CH_3COOH]{dil.} PbCrO_4 + CH_3COONa$$

(Lead Chromate)

Chemical Reaction for Basic Radical

Preliminary Test :

$$NH_4Cl + NaOH \xrightarrow{\Delta} NaCl + H_2O + NH_3 \uparrow$$

NH_3+ Red litmus -----→ Litmus turns blue

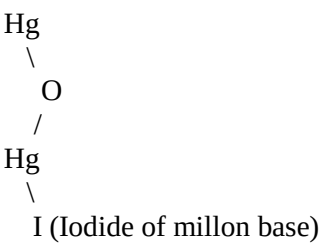
Confirmative Test :

Nessler's Test :

$K_2HgI_4 \longrightarrow 2KI + HgI_2$

$HgI_2 + NH_4 \longrightarrow NH_2HgI + HI$

$2NH_2HgI + H_2O \longrightarrow NH_2 + NH_4I$



I (Iodide of millon base)

NaOH Test :

$NH_4Cl + NaOH \longrightarrow NaCl + H_2O + NH_3(g)$

$NH_3 + HCl \longrightarrow NH_4Cl$
(Dense white fumes)

Result : The given inorganic salt contains
Acidic Radical Cl^-
Basic Radical NH_4^+

EXPERIMENT – 5

Aim : To analyze the given inorganic salt for acidic and basic radical. $Pb(NO_3)_2$

Preliminary Investigation

Physical state	:	Solid
Colour	:	Creamish white (Cu^{2+}, Co^{2+},Ni^{2+} Fe^{2+}, Mn^{2+} Fe^{3+}absent)
Odour	:	No characteristic odour (NH_4^+ , S^{2-} , CH_3COO^- absent)
Solubility	:	Soluble in water
Flame Test	:	Dull Bluish white flame is obtained (Pb^{2+}may be)

(A) Identification of Acidic Radical
a- Preliminary test:

	Experiment	Observation	Inference
1	Salt solution + dil H_2SO_4 solution	No gas is evolved	Group A $\left(CO_3^{2-}, CH_3COO^-, NO^-_2, SO_3^{2-}, S^{2-}, absent\right)$
2	Salt + Conc^n H_2SO_4 + Heat	Brown Colourled gas (NO_2) is evolved	Group B (NO_3^- may be present)

(b) Confirmative test:

	Experiment	Observation	Inference
1	Diphenyl amine test : salt + Conc^n H_2SO_4 + diphenyl amine	Deep blue coloured solution	NO_3^- - confirmed
2	Ring Test : Salt + Freshly prepared $FeSO_4$ + Conc^n H_2SO_4 along the side of the test tube	Brown ring is formed at the junction of two liquids	NO_3^- - confirmed

Identification of Basic Radical
a- Preliminary test :

	Experiment	Observation	Inference
1	Salt solution + NaOH	No Smell of ammonia	Zero group [NH_4^+] absent
2	Salt Solution + dil HCl Filter the above ppt and boil it with water and divide into parts.	White ppt of $PbCl_2$ is formed	I group [Pb^{2+} may be]

Identification of Basic Radical
a- Confirmative test :

	Experiment	Observation	Inference
1	KI test : 1st part + KI	Pb I_2 (Yellow Ppt)	Pb^{2+} Confirmed
2	K_2CrO_4 Test : 2nd part + K_2CrO_4	Yellow ppt of $PbCrO_4$ is formed	Pb^{2+} Confirmed

Chemical reaction for Acidic Radical

Preliminary Test : $Pb(NO_3)_2 + H_2SO_4 \longrightarrow PbSO_4 + 2HNO_3$

$Cu + HNO_3 \longrightarrow Cu(NO_3)_2 + 2\,NO_2 + H_2O$

Confirmative Test :

i) Ring Test $Pb(NO_3)_2 + H_2SO_4 \longrightarrow PbSO_4 + 2HNO_3$

$6FeSO_4 + 3H_2SO_4 + 2HNO_3 \longrightarrow 3Fe_2(SO_4)_3 + 4H_2O + 2NO$

$FeSO_4 + NO \longrightarrow FeSO_4 . NO$
(Nitroso ferrous sulphate)

ii) Diphenyl amine Test

$2(C_6H_5)_2 NH + [O] \longrightarrow (C_6H_5)_2 N – N (C_6H_5)_2 + H_2O$
(Diphenyl amine hydrazine)

(B) Identification of Basic Radical

Preliminary Test : $Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2 \downarrow + 2HNO_3$
(White)

Confirmative Test :

i) KI Test : $PbCl_2 + 2KI \longrightarrow PbI_2 \downarrow + 2KCI$

ii) K_2CrO_4 Test : $PbCl_2 + K_2CrO_4 \longrightarrow PbCrO_4 \downarrow + 2KCl$
(Yellow ppt.)

Result : The given inorganic salt contains

Acidic Radical NO_3^- Basic Radical Pb^{+2}

EXPERIMENT – 6

Aim : To analyze the given inorganic salt for acidic and basic radical.[$CuSO_4$]

Preliminary Investigation

Physical state	:	Solid
Colour	:	Blue (Cu^{2+} may be)
Qdour	:	No characteristic odour (absence of NH_4^+ , S^{2-} , CH_3COO^-)
Solubility	:	Soluble in water.
Flame Test	:	Bluish green flame (Cu^{2+} may be)

(A) Identification of Acidic Radical

a- Preliminary test :

	Experiment	Observation	Inference
1	Salt solution + dil H_2SO_4 solution	No gas is evolved	Group A $\left(CO_3^{2-}, S^{2-}, SO_3^{2-}\ NO_2^-\ CH_3COO^-\ absent\right)$
2	Salt + Conc^n H_2SO_4 + Heat	No gas evolved	Group B anions $\left(Cl^-, Br^-, I^-, NO_3^-, C_2O_4^{2-}\ are absent\right)$

(b) Confirmative test :

	Experiment	Observation	Inference
1	$BaCl_2$ test : Salt Solution + $BaCl_2$ Solution Add dil. HCl or dil HNO_3	White Ppt formed Ppt remains insoluble	SO_4^{2-} confirmed
2	Lead Acetate Test : - Salt Solution + lead acetate solution Add ammonium acetate Solution ($CH_3COO\,NH_4$) to above ppt.	White ppt. formed Ppt becomes soluble	SO_4^{2-} confirmed

Identification of basic Radical

a- Preliminary test :

	Experiment	Observation	Inference
1	Salt solution + NaOH + heat	No smell of ammonia	Zero Group, $\left(NH_4^+\ absent\right)$
2	Salt solution + dil . HCl	No white Ppt	Group I, (Pb^{2+} absent)
3	Above solution + H_2S gas	Black Ppt is formed	Group II, (Cu^{2+} / Pb^{2+} may be present)
4	Dissolve above ppt in HNO_3	Solution turms bluish green	
5	Divide the above solution in 2 parts .		

(b) Confirmative test :

	Experiment	Observation	Inference
1	NH_4OH test : 1st part + NH_4 OH	Deep bule colour	Cu^{2+} confirmed
2	Potassium ferrocynide test : IInd part + $K_4[Fe(CN)_6]$	Chocolate brown ppt of Copper ferrocyanide is formed	Cu^{2+} confirmed

Acidic Radical

1- $BaCl_2$ Test:

$CuSO_4 + BaCl_2 \rightarrow BaSO_4 \downarrow + CuCl_2$
(White Ppt)

2- $(CH_3COO)_2$ Pb Test :

$CuSO_4 + (CH_3COO)_2 Pb \rightarrow PbSO_4 \downarrow + 2(CH_3COO)_2 Cu$
(White Ppt)

$PbSO_4 \downarrow + 2CH_3COONH_4 \rightarrow (CH_3COO)_2 Pb + (NH_4)_2SO_4$

(b) Basic radical

$Cu^{2+} + H_2S \rightarrow CuS + 2H^+$
Black ppt

$$3CuS + 8HNO_3 \longrightarrow Cu(OH)_2 + 2NO + 4H_2O + 3S$$

1. NH_4OH test

$$Cu(NO_3)_2 + 4NH_4OH \longrightarrow [Cu(NH_3)_4](NO_3)_4 + 4H_2O$$

Deep blue ppt

2. $K_4[Fe(CN)_6$ test

$$2Cu(NO_3)_2 + K_4[Fe(CN)_6] \rightarrow Cu_2[Fe(CN)_6] + 4KNO_3$$

Result : The given inorganic salt contains. **Acidic Radical –** SO_4^{2-}

Basic Radical Cu^{2+}

EXPERIMENT – 7

Aim : To analyze the given inorganic salt for acidic and basic radical.$Al_2(SO_4)_3$

Preliminary Investigation

Physical state	:	Solid
Colour	:	White (Cu^{2+}, Fe^{2+}, Fe^{3+},Ni^{2+}, Mn^{2+} , Co^{2+}absent)
Qdour	:	No characteristic odour (absence of NH_4^+ , S^{2-} , CH_3COO^-)
Solubility	:	Soluble in water.
Flame Test	:	No characteristics flame (Pb^{+2}, Sr^{+2}, Cu^{2+}, Ca^{+2}, Ba^{+2},Ni^{+2}, Zn^{2+}absent)

(A) Identification of Acidic Radical

a- Preliminary test:

	Experiment	Observation	Inference
1	Salt solution + dil H_2SO_4	No gas is evolved	Group A $\left(CO_3^{2-}, S^{2-}, SO_3^{2-}\ NO_2^-\ CH_3COO^-\right)$ Absent
2	Salt + Conc^n H_2SO_4 + Heat	No gas evolved	Group B anions $\left(Cl^-, Br^-, I^-, NO_3^-, C_2O_4^2\ absent\right)$
3.	Salt + $BaCl_2$	White ppt is formed	Group C anion (SO_4^{2-} may be)

(b) Confirmative test :

	Experiment	Observation	Inference
1	$BaCl_2$ test :Salt Solution + $BaCl_2$ Add dil HCl to above ppt	White Ppt Ppt remains insoluble	SO_4^{2-} confirmed
2	Lead Acetate Test : - Salt Solution + $(CH_3COO)_2$ Pb. solution Add $CH_3COO\ NH_4$ to above ppt.	White ppt. Ppt dissolves in ammonium acetate.	SO_4^{2-} confirmed

B- Identification of Basic Radical

(a) Preliminary test :

	Experiment	Observation	Inference
1	Salt solution + NaOH + heat	No smell of NH_3	Zero Group, $\left(NH_4^+\ absent\right)$
2	Salt solution + dil . HCl	No Ppt	Group I, (Pb^{2+} absent)
3	To the above solution pass H_2S gas	No ppt.	Group II (Cd^{2+} , Pb^{2+} , As^{2+} Cu^{2+} absent)
4	Boil H_2S gas and add NH_4Cl + NH_4OH & divide the Solution in two parts.	White gelatinous ppt.	Group III (Al^{3+} may be)

(b) Confirmative test:

	Experiment	Observation	Inference
1	Take test : 1st part + dil + HCl + 2 drops of blue litmus + NH_4OH	Blue ppt.floats over colourless solution	Al^{3+} confirmed
2	Ammonium chloride Test : IInd part + NH_4Cl + Boil the solution	Formation of white gelatinous ppt.	Al^{3+} confirmed

Acidic Radical

1. $BaCl_2$ test :

$$Al_2(SO_4)_3 + BaCl_2 \longrightarrow BaSO_4 \downarrow +2AlCl_3$$

White ppt

2. $(CH_3COO)_2$ Pb test :

$$Al_2(SO_4)_3 + (CH_3COO)_2Pb \longrightarrow PbSO_4 \downarrow +Al(CH_3COO)_3$$

White ppt

$$PbSO_4 \downarrow +2CH_3COONH_4 \longrightarrow (CH_3COO)_2Pb + (NH_4)_2SO_4$$

Basic Radical

$$Al_2(SO_4)_3 + NH_4OH \longrightarrow Al(OH)_3 \downarrow +(NH_4)_2SO_4$$

$$Al(OH)_3 + 3HCl \rightarrow AlCl_3 + 3H_2O$$

$$AlCl_3 + 3NH_4OH \longrightarrow Al(OH)_3 \downarrow +3NH_4Cl$$

White ppt

Result : The given inorganic salt contains. Acidic Radical – SO_4^{2-}

Basic Radical Al^{+3}

EXPERIMENT – 8

Aim : To analyze the given inorganic salt for acidic and basic radical. ($ZnCl_2$)

Preliminary Investigation

Physical state	:	Solid
Colour	:	White (Cu^{2+}, Fe^{+2}, Fe^{+3},Ni^{+2}, Mn^{+2} , Co^{+2} are absent)
Qdour	:	No characteristic above $(S^{2-},\ NH_4^+,\ CH_3COO^-)absent$
Solubility	:	Soluble in water.
Flame Test	:	Green flashes (Zn^{2+} may be)

(A) Identification of Acidic Radical

a- Preliminary test :

	Experiment	Observation	Inference
1	Salt solution + dil H_2SO_4	No gas is evolved	Group A $\left(CO_3^{2-}\ , S^{2-}, SO_3^{2-}\ \ NO_2^-\ \ CH_3COO^-\ absent\right)$
2	Salt + Conc^n H_2SO_4 + Heat	Colourless gas having pungent smell which gives white dense fumes with glass rod dipped in NH_4OH	Group B anions (Cl^- may be)

(b) Confirmative test :

	Experiment	Observation	Inference
1	Chromyl chloride test : Salt + $K_2Cr_2O_7$ (1 : 2) + conc. H_2SO_4 + heat Pass the vapour in a test tube containing NaOH solution Add (CH_3COOH + $(CH_3COO)_2$ Pb into above solution	Orangish red or reddish orange vapour of chromyl chloride are evolved Yellow solution of Na_2CrO_4 is obtained Yellow ppt of lead chromate is formed	Cl^- Confirmed
2	$AgNO_3$ Test : Salt Solution + $AgNO_3$ Dissolve ppt. in NH_4OH	White ppt. ppt becomes soluble.	Cl^- confirmed

B- Identification of Basic Radical

(a) Preliminary test :

	Experiment	Observation	Inference
1	Salt solution + NaOH + heat	No smell of NH_3	Zero Group, $\left(NH_4^+\ absent\right)$
2	Salt solution + dil . HCl	No white Ppt	Group I (Pb^{2+} absent)
3	To the above solution pass H_2S gas	No ppt.	Group II, (Cu^{2+} , As^{+3}, Cd^{+2}, Pb^{+2} absent)
4	Boil above solution to remove H_2S and add NH_4Cl (s) + NH_4OH in exess.	No ppt.	Group III [Fe^{2+}, Fe^{3+},Al^{3+} absent]
5	To above test tube pass H_2S gas Dissolve the white ppt in HCl and divide it into 2 parts.	White ppt is obtained	Group IV [Zn^{2+} may be]

(b) **Confirmative test :**

	Experiment	Observation	Inference
1	$K_4[Fe(CN)_6]$ Test : 1st part + $K_4[Fe(CN)_6]$	White ppt of zinc ferrocyanide	Zn^{+2} conformed
2	NaOH Test : 2nd part + NaOH	Bluish white ppt.	Zn^{+2} confirmed

Chemical reaction for Acidic Radical

Preliminary Test :

$$ZnCl_2 + H_2SO_4 \longrightarrow ZnSO_4 + 3HCl \uparrow$$

$$HCl + NH_4OH \longrightarrow NH_4Cl + H_2O$$

(White dense fumes)

Confirmative Test :

i) Chromyl chloride test : $K_2Cr_2O_7 + H_2SO_4 \xrightarrow{\Delta} K_2SO_4 + 2Cr_2O_3 + H_2O$

$$ZnCl_2 + H_2SO_4 \xrightarrow{\Delta} ZnSO_4 + 2HCl$$

$$CrO_3 + 2HCl \xrightarrow{\Theta} CrO_2Cl_2 \uparrow + H_2$$

(red vapours of chromyl chloride)

$$CrO_2Cl_2 + 4NaOH \longrightarrow Na_2CrO_4 + 2NaCl + H_2O$$

$$Na_2CrO_4 + Pb(CH_3COO)_2 \xrightarrow[CH_3COOH]{Dil.} PbCrO_4 + CH_3COONa$$

ii) Silver Nitrate Test

$$ZnCl_2 + 2AgNO_3 \longrightarrow 2AgCl \downarrow + Zn(NO_3)_2$$

(Curdy white ppt.)

$$AgCl + 2NH_4OH \longrightarrow [Ag(NH_3)_2]Cl + 2H_2O$$

[Diammine silver (I) chloride) {Soluble complex]

Chemical reaction for Basic Radical

(a) Preliminary Test :

$$ZnCl_2 + H_2S \rightarrow ZnS \downarrow + 2HCl$$

$$ZnS + 2HCl \rightarrow ZnCl_2 + H_2S \uparrow$$

(b) Confirmative Test :

1 $K_4[Fe(CN)_6] Test: ZnCl_2 + K_4[Fe(CN)_6] \rightarrow Zn_2[Fe(CN)_6] \downarrow + 4KCl$

2. NaOH test :

$$ZnCl_2 + NaOH \longrightarrow Zn(OH)_2 + 2NaCl$$

$$Zn(OH)_2 + 2NaOH \rightarrow Na_2ZnO_2 + 2H_2O$$

Result : The given inorganic salt contains. Acidic Radical Cl^-
Basic Radical Zn^{+2}

EXPERIMENT – 9

Aim : To analyze the given inorganic salt for acidic and basic radical. ($BaBr_2$)

Preliminary Investigation

Physical state : Solid

Colour : White (Cu^{2+}, Fe^{+2}, Fe^{+3},Ni^{+2}, Mn^{+2} , CO^{+2} are absent)

Qdour : No characteristic adour (NH_4^+, CH_3COO^-, S^{2-})*absent*

Solubility : Soluble in water.

Physical Test : Solid

(A) Identification of Acidic Radical
a- Preliminary test:

	Experiment	Observation	Inference
1	Salt solution + dil H_2SO_4	No gas is evolved	Group A $\left(CO_3^{2}\ ,S^{2-},SO_3^{2-}\ \ NO_2^{-}\ \ CH_3COO^{-}\ absent\right)$
2	Salt + Conc H_2SO_4 + Heat	Reddish orange vapours which turns starch paper yellow	Group B anion (Br^- may be)

(b) Confirmative test:

	Experiment	Observation	Inference
1	$AgNO_3$ Test : Salt Solution +$AgNO_3$ Dissolve ppt. in NH_4OH	Yellow ppt. Ppt. remains partially soluble	Br^- confirmed
2	MnO_2 Test : Salt Solution + MnO_2 + Conc. H_2SO_4+ Heat	Orange red vapour of Br_2	Br^- confirmed

B- Identification of Basic Radical

(a) Preliminary test:

	Experiment	Observation	Inference
1	Salt solution + NaOH + heat	No smell of NH_3	Zero Group, $\left(NH_4^{+}\ absent\right)$
2	Salt solution + dil . HCl	No white Ppt	Group I (Pb^{2+} absent)
3	To the above solution pass H_2S gas	No ppt.	Group II (Cu^{2+} , As^{+3}, Cd^{+2}, Pb^{+2} absent)
4	Boil above solution to remove H_2S and add NH_4Cl (s) + NH_4OH in exess.	No ppt.	Group III [Fe^{2+}, Fe^{3+},Al^{3+} absent]
5	To above test tube pass H_2S gas	No ppt	Group IV [Zn^{2+} , Co^{+2}, Ni^{+2}, Mn^{+2} absent]
6	Remove H_2S gas by boiling. Add $[NH_4]_2\ CO_3$ to it.	White ppt	V group (Ca^{2+}, Ba^{2+}, Sr^{2+}may be)

(b) Confirmative test:

	Experiment	Observation	Inference
1	Potassium chromate test : 1st part + K_2CrO_4	Yellow ppt	Ba^{2+} confirmed
2	Ammonium sulphate Test : IInd part + $(NH_4)_2SO_4$	No ppt	Sr^{2+} absent
3	Ammonium oxalate Test: IIIrd part + ammonium oxalate test $(NH_4)_2C_2O_4$	No ppt	Ca^{2+} absent
4.	Flame test : Perform flame test with salt.	Apple green flame	Ba^{2+} confirmed

Chemical reaction for Acidic Radical
Preliminary Test:

$$BaBr_2 + H_2SO_4 \longrightarrow BaSO_4 + 2HBr$$

$$H_2SO_4 + 2HBr \longrightarrow SO_2 + Br_2 \uparrow + 2HCl$$

$$Starch + Br_2 \longrightarrow Yellow\ Colour$$

Confirmative Test:

i) Silver Nitrate test

$BaBr_2 + 2AgNO_3 \longrightarrow Ba(NO_3)_2 + 2AgBr \downarrow$

(Yellow ppt)

ii) MnO_2 Test :- $BaBr_2 + MnO_2 + 2H_2SO_4 \longrightarrow BaSO_4 + MnSO_4 + 2H_2O + Br_2 \uparrow$

Chemical reaction for Basic Radical

Preliminary Test :

$BaBr_2 + (NH_4)_2CO_3 \longrightarrow BaCO_3 \downarrow + 2NH_4Br$

Confirmative Test :

$BaCO_3 + 2CH_3COOH \longrightarrow (CH_3COO)_2Ba + CO_2 \uparrow + H_2O$

$(CH_3COO)_2Ba + K_2CrO_4 \longrightarrow 2CH_3COOK + BaCrO_4 \downarrow$

$1K_2CrO_4$ Test : (Yellow ppt)

Result : The given inorganic salt contains. Acidic Radical Br^-

Basic Radical Ba^{2+}

EXPERIMENT – 10

Aim : To analyze the given inorganic salt for acidic and basic radical. $(NH_4)_2C_2O_4$

Preliminary Investigation

Physical state	:	Solid
Colour	:	White (Cu^{2+}, Fe^{+2}, Fe^{+3},Ni^{+2}, Mn^{+2}, Co^{+2} are absent)
Qdour	:	No characteristic adour
		$(NH_4^+, S^{2-}, CH_3COO^- absent)$
Solubility	:	Soluble in water.
Flame Test	:	No characteristic flame $(Ca^{+2}, Sr^{+2}, Ba^{+2}, Pb^{+2}, Cu^{+2}, Zn^{+2}$ absent)

(A) Identification of Acidic Radical

a- Preliminary test :

	Experiment	Observation	Inference
1	Salt solution + dil H_2SO_4 + heat	No gas is evolved	Group A $(CO_3^{2-}, S^{2-}, SO_3^{2-}\ NO_2^-\ CH_3COO^-$ absent)
2	Salt + Conc^n H_2SO_4 + Heat	Colourless, odourless, mixture of gas which turns time water milky & burns on the mouth of test tube water with blue flame	Group B $(C_2O_4^{2-}$, may be)

(b) Confirmative test :

	Experiment	Observation	Inference
1	Calcium Chloride Test : Salt Solution + $CaCl_2$	White ppt. of calcium oxalate is formed	$(C_2O_4^{2-})$ confirmed
2	$KMnO_4$ Test : Above ppt + dil H_2SO_4+ Heat Add very dil solution of $KMnO_4$	Pink colour of $KMnO_4$ is discharged with evolution of CO_2 gas.	$(C_2O_4^{2-})$ Confirmed

B- Identification of Basic Radical

(a) Preliminary test:

	Experiment	Observation	Inference
1	Salt solution + NaOH + heat Place red litmus paper on mouth to test tube	Smell of NH_3 Red litmus turns blue	Zero Group, $(NH_4^+ \ present)$

(b) **Confirmative test:**

	Experiment	Observation	Inference
1	To above solution, bring on glass rod dipped in conc. HCl near mouth of test tube.	White dense of NH_4Cl are formed	(NH_4^+) confirmed
2	Nessler's Test : Solution + NaOH + Nessler's reagent	Reddish brown ppt is formed	(NH_4^+) confirmed

Chemical reaction for Acidic Radical

Preliminary Test :

$$(NH_4)_2C_2O_4 + H_2SO_4 \rightarrow H_2C_2O_4 + (NH_4)_2SO_4$$

$$H_2C_2O_4 \rightarrow CO_2 \uparrow + CO + H_2O$$

Confirmative Test :

i) $CaCl_2$ test

$$(NH_4)_2C_2O_4 + CaCl_2 \longrightarrow CaC_2O_4 \downarrow + 2NH_4Cl$$

Calcum oxalate (White ppt)

ii) $KMnO_4$ Test :-

$$CaC_2O_4 + H_2SO_4 \longrightarrow H_2C_2O_4 + CaSO_4$$

$$2KMnO_4 + 3H_2SO_4 \longrightarrow 2MnSO_4 + H_2SO_4 + 3H_2O + 5[O]$$

$$H_2C_2O_4 + [O] \xrightarrow[sol^n]{hot} 2CO_2 + H_2O$$

Basic Radical

a) Preliminary test

$$(NH_4)_2C_2O_4 + 2NaOH \longrightarrow Na_2C_2O_4 + 2NH_3 \uparrow + 3H_2O$$

$$NH_3 \uparrow \text{Red litmus} \longrightarrow \text{Blue litmus}$$

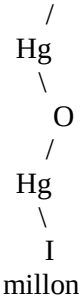
Confirmative Test :

Nessler's Test :

$$K_2HgI_4 \longrightarrow 2KI + HgI_2$$

$$HgI_2 + NH_3 \longrightarrow NH_2HgI + HI$$

$$2NH_2HgI + H_2O \longrightarrow NH_2 + NH_4I$$



(Iodide of millon base)

NaOH Test :

$NH_4Cl + NaOH \longrightarrow NaCl + H_2O + NH_3(g)$

$NH_3 + HCl \longrightarrow NH_4Cl$ (Dense white fumes)

Result : The given inorganic salt contains.

Acidic Radical – $C_2O_4^{2-}$

Basic Radical (NH_4^+)

EXPERIMENT – 11

Aim : To analyze the given inorganic salt for acidic and basic radical.

Preliminary Investigation

Physical state	:	Solid
Colour	:	Green (Ni^{2+} may be)
Qdour	:	No characteristic odour
		(absence of CH_3COO^- , NH_4^+ S^{2-})
Solubility	:	Soluble in water.
Flame Test	:	No Characteristic flame
		[absence of Cu^{2+}, Pb^{+2}, Zn^{2+},Cu^{2+},Br^{+2})

(a) Identification of Acidic Radical

a- Preliminary test :

	Experiment	Observation	Inference
1	Salt solution + dil HCl	No gas is evolved	Group A $(CO_3^{2-}, S^2, SO_3^{2-}\ NO_2^-\ CH_3COO^-$ abser
2	Salt + Conc^n H_2SO_4 + Heat	Colourless pungent smelling gas (HCl) is evolved which gives white dense fumes of NH_4Cl.	Group B anions Cl^- may be present

(b) Confirmative test :

	Experiment	Observation	Inference
1	$AgNO_3$ Test : Salt Solution + $AgNO_3$ Dissolve ppt. in NH_4OH	Curdy white ppt Ppt become soluble	Cl^- confirmed
2	Chromyl chloride test : Salt + $Kr_2Cr_2O_7$(s) (1:2) + conc. H_2SO_4 + heat Pass the vapour in a test tube containing NH_4OH Add (CH_3COOH + $Pb(CH_3COO)_2$	Reddish orange vapours of chromyl chloride are evolved Solution becomes Yellow Yellow ppt of lead chromate is formed	Cl^- confirmed

B- Identification of Basic Radical

Preliminary test :

	Experiment	Observation	Inference
1	Salt solution + NaOH +Heat	No smell of NH_3	Zero Group, $(NH_4^+$ *absent*$)$
2	Salt solution + dil . HCl	No white Ppt	Group I, Pb^{2+} absent
3	Pass H_2S gas through above NH_4Cl	No ppt.	Group II, (Cu^{2+} , As^{+3}, Cd^{+2} , Pb^{+2}) absent
4	Remove H_2S gas by boiling & add NH_4Cl (s) + NH_4OH in excess.	No ppt.	Group III [Fe^{2+}, Fe^{3+},Al^{3+} absent]
5	Pass H_2S gas through above solution Dissolve the ppt by boiling with aqua regia [Conc HCl + Conc. HNO_3] evaporate to dryness & add water & divide in 2 parts .	Black ppt.	Group IV [Ni^{+2} or Co^{+2} May be present]

(b) **Confirmative test :**

	Experiment	Observation	Inference
1	DMG test : I part + DMG	Rose pink ppt.	Ni^{+2} conformed
2	NaOH Test : 2nd part + NaOH	Apple green ppt	Ni+ confirmed

Chemical reaction for Acidic Radical

Preliminary Test :

$$NiCl_2 + H_2SO_4 + heat \longrightarrow NiSO_4 + 2HCl \uparrow$$

$$NH_4OH + HCl \longrightarrow NH_4Cl + H_2O$$

(White dense fumes)

Confirmative Test :

i) $AgNO_3$ test $NiCl_2 + 2AgNO_3 \longrightarrow 2AgCl \downarrow + Ni(NO_3)_2$

Curdy white ppt

$$AgCl + 2NH_4OH \longrightarrow [Ag(NH_3)_2]Cl + H_2O$$

(Diammine Silver (I) Chloride)

2) Chromyl chloride test (*i*) $4NiCl_2 + K_2Cr_2O_7 + 7H_2SO_4 \xrightarrow{\Delta} 2KHSO_4 + 2CrO_2Cl_2 + 3H_2O + 2NiHSO_4$

$$Cr_2O_2Cl_2 + 4NaOH \xrightarrow{\Delta} Na_2CrO_4 + 2NaCl + H_2O$$

(Sodium Chromate)

$$Pb(CH_3COO)_2 + Na_2CrO_4 \longrightarrow PbCrO_4 + 2CH_3COONa$$

Yellow Ppt

Identification of Basic Radical

Preliminary Test : $NiCl_2 + H_2S \longrightarrow NiS \downarrow + 2HCl$

(black ppt.)

$$3NiS + 2HNO_3 + 6HCl \longrightarrow 3NiCl_2 + 2NO + 3S + H_2O$$

Confirmative Test :

i) DMG test

$$\begin{array}{l} CH_3 - C = N - OH \\ \qquad\quad | \\ CH_3 - C = N - OH \end{array} + NiCl_2 + 2NH_4OH \longrightarrow 2NH_4Cl + H_2O + DMG - NiComplex$$

(ii) NaOH Test :

$$NiCl_2 + 2NaOH \longrightarrow Ni(OH)_2 + 2NaCl$$

Result : The given inorganic salt contains. Acidic Radical Cl^-

Basic Radical Ni^{+2}

EXPERIMENT – 12

Aim : To prepare 250 ml of 0.02 M (M/50) Mohr's Salt solution.

Apparatus Required : Chemical balance, weight box, beaker (250 ml), watch glass, volumetric flask (250 ml) glass rod, funnel, test tube.

Chemical required :- Mohr's salt, conc. H_2SO_4, Distilled water.

Theory : Molecular formula of Mohr's salt – $FeSO_4[NH_4]_2SO_4.6H_2O$

It is primary standard, hence is solution can be prepared by direct weighing.

Molecular weight of Mohr's salt : 56+32+4×16+2(14+4)+32+4×16+6×18 = 392 g.

Thus to prepare 1000 ml of 1M Mohr's salt solution, 392 g of Mohr's salt is needed. To prepare 250ml of 1 M Mohr's salt $\frac{392}{1000} \times 250$ *ie* $\frac{392}{4}$ *g* of mohr's salt is need.

To prepare 250 ml of 0.02 of Mohr's salt solution $\left(\frac{392}{4} \times 0.02\right) g$ of salt is needed. Mohr's salt required = 1.9600 g of mohr's salt.

Observation :

1- Weight of empty watch galss (W_1) = 21.7200 g

2- Weight of empty watch glass + mohrs salt (W_2) = 21.7200 + 1.9600 = 23.6800 g
3- Weight of Mohr's Salt [$W_2 - W_1$] = 23.6800 – 21.7200 = 1.9600 g
4- Volume of solution = 250 ml.
6. Morality of solution = M/50
Result : 250 ml of M/50 solution of Mohr's salt is prepared.
Precautions :
1- Add 2-3 ml of conc. H_2SO_4 to prevent hydrolysis of $FeSO_4$ before making solution of 250 ml.
2- Weighing should be done accurately.
3. Apparatus should be clean.

EXPERIMENT – 13

Aim : To prepare a standard solution of M/50 Mohr's salt solution. With its help, determine molarity and strength of $KMnO_4$ Solution.
Apparatus Required : Burette, comical flask, pipette, burette stand, test tube, white tile, watch glass, volumetric flask (250ml) beaker, funnel glass rod, weight box, wash bottle.
Chemical Required :
Mohr's Salt, $KMnO_4$ solution, dil H_2SO_4, conc. H_2SO_4 and water.
Theory :
(a) Preparation of standard or known solution of M/50 Mohr's salt solution - Mohr's salt is a primary standard solution. Hence its can be prepared by direct weighting.
Molecular weight of mohr's salt : 392 g/mol
Thus to prepare 1000 ml of 1M Mohr's salt solution,
392 g of Mohr's salt is needed.
To prepare 250ml of 1 M Mohr's salt $\frac{392}{100} \times 250$ *ie* $\frac{392}{4}$ *g* of mohr's salt is need.
To prepare 250 ml of 0.02 of Mohr's salt solution $\left(\frac{392}{4} \times 0.02\right) g$ of salt is needed. Mohr's salt required = 1.9600 g of mohr's salt.

(b) Titration of Mohr's salt Sol (standard solution) with $KMnO_4$ (unknown solution) - $KMnO_4$ is strong and versatile oxidizing agent. When its treated with Mohr's salt solution in sufficiently acidic medium Fe^{2+} ion are oxidised to Fe^{3+} in cold according to reaction :
Ionic equation :

$$MnO_4^- + 5Fe^{+2} + 8H^+ \longrightarrow Mn^{2+} + 5Fe^{+3} + 4H_2O$$

Molecular equation

$$2KMnO_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5[O]$$

$$5[[2FeSO_4.(NH_4)_2SO_4.6H_20] + H_2SO_4 + [O] \longrightarrow Fe_2(SO_4)_3 + 2(NH_4)_2SO_4 + 13H_2O)]$$

Adding both equation

$$2KMnO_4 + 8H_2SO_4 + 10FeSO_4.(NH_4)_2SO_4 \longrightarrow 2K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 10(NH_4)_2SO_4 + 68H_2O$$

Indicator $\longrightarrow$ $KMnO_4$ is a self indicator
End point $\longrightarrow$ colourless to pink

Observations:-
1. Preparation of standard solution :-
Weight of empty water glass (W_1) 21.7200 g
Weight of watch glass + Mohr's salt (W_2) = 23.6800 g
Weight of Mohr's salt = $W_2 - W_1$ = (23.6800 – 21.7200) g = 1.9600 g
Volume of mohr's salt = 250 ml
Volume of mohr's salt taken for each titration (V_2) = 20 ml
2. Titration of standard solution with $KMnO_4$ Solution :-

S.no.	Volume of Mohr's salt used (V_1) ml	Burette initial	Reading final	Volume of $KMnO_4$ used	Concordant Reading
1	20ml	0.0	14.8	14.8	
2	20 ml	0.0	14.6	14.6	14.6

3	20 ml	0.0	14.6	14.6	

Calculation :

$$M_1V_1 = \frac{1}{5}M_2V_2$$

$$M_1 \times 14.6 = \frac{1}{5} \times \frac{M}{50} \times 20$$

M_1=0.0068 M

Strength = 158 × M = 158 × 0.0068 M = 1.0744 g/*l*

M_1 = Molarity of $KMnO_4$ Sol^n = ?
V_1 = Volume of $KMnO_4$ Sol^n = 14.6 ml
M_2 = Molarity of Mohr's Salt Sol^n = M/50
V_2 = Volume of Mohr's Salt Sol^n = 20 ml

Result

1. Molarity of the given solution = 0.0068 M
2. Strength of the given solution = 1.0744 g/l

Precaution :

1. Weighting should be accurate.
2. Add 2 – 3 ml of conc H_2SO_4 to prevent hydrolysis of Mohr's Salt solution.
3. While titrating, the funnel should not be placed at the top of the burette.

EXPERIMENT – 14

Aim : To prepare solution of M/30 (250 m*l*) Mohr's salt solution. With its help, determine molarity and strength of $KMnO_4$ solution.

Apparatus Required : Burette, conical flask, pipette, burette stand, test tube, white tile, watch glass, volumetric flask (250ml) beaker, funnel glass rod, weight box, wash bottle.

Chemical Required :

Mohr's Salt, [$FeSO_4.(NH_4)_2SO_4.6H_2O$] ,$KMnO_4$, dil H_2SO_4, conc. H_2SO_4

Indicator : $KMnO_4$ is a self indicator

End point : Colourless to pink

Theory :

(a) Preparation of standard solution of M/30 mohr's salt

Molecular formula of mohr's salt : $FeSO_4.(NH_4)_2SO_4.6H_2O$. mohr's salt is a primary standard . Hence its solution can be prepared by direct weighing.

Thus to prepare 1000 ml of 1M Mohr's salt solution,
392 g of Mohr's salt is needed.

To prepare 250ml of 1 M Mohr's salt $\frac{392}{1000} \times 250$ *ie* $\frac{392}{4}$ *g* of mohr's salt is need.

Thus to prepare 250 ml of M/30 mohr's salt solution, 392/4 × 1/30 i.e, 3.2670 g of mohr's salt is needed.

(b) Titration of Mohr's salt Sol (standard solution) with $KMnO_4$ (unknown solution), $KMnO_4$ is strong and versatile oxidising agent . When its treated with mohr's salt solution in sufficiently acidic medium, Fe^{2+} ion are oxidise to Fe^{3+} according to reaction.

Ionic equation : $MnO_4^- + 5Fe^{+2} + 8H^+ \longrightarrow Mn^{2+} + 5Fe^{+3} + 4H_2O$

Molecular equation : $2KMnO_4 + 3H_2SO_4 + \longrightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5(O)$

$[2FeSO_4(NH_4)_2SO_4.6H_2O + H_2SO_4 + [O] \longrightarrow Fe_2(SO_4)_3 + 2(NH_4)_2SO_4 + 13H_2O] \times 5$ **Adding both the Eqn.**

$2KMnO_4 + 8H_2SO_4 + 10FeSO_4.(NH_4)_2SO_4.6H_2O \longrightarrow K_2SO_4 + 2MnSO_4$
$+ 5Fe_2(SO_4)_3 + 10(NH_4)_2SO_4 + 68H_2O$

Observation Table:-

1. Preparation of standard solution:-

Weight of empty watch glass (W_1) 21.7200 g
Weight of watch glass + Mohr's salt (W_2) = 21.7200+3.2670 = 24.9870g
Weight of Mohr's salt = $W_2 - W_1$= 24.9870-217200 = 3.2670 g
Volume of mohr's salt = 250 ml
Molarity of mohr's salt = M/30

2. Titration of standard solution with $KMnO_4$ Solution :-

S.no.	Volume of Mohr's salt used (V_1) ml	Burette Reading		Volume of $KMnO_4$ used	Concordant Reading
		Initial	Final		
1	*20ml*	0.0 *ml*	14.4 *ml*	14.4 *ml*	
2	*20 ml*	0.0 *ml*	14.2 *ml*	14.2 *ml*	14.2 *ml*
3	*20 ml*	0.0 *ml*	14.2 *ml*	14.2 *ml*	

Calculation : According to ionic eq.

$$MnO_4^- + 5\ Fe^{2+} + 8H^+ \longrightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$$

5 moles of mohr's salt = 1 mole of $KMnO_4$ $\quad M_1V_1 = \frac{1}{5}M_2V_2$

M_1 = Molarity of $KMnO_4$ = ?
V_1 = Volume of $KMnO_4$ = 14.2 ml
M_2 = Molarity of Mohr's salt solution = M/30
V_2 = Volume of Mohr's salt solution = 20 m*l*

$$M_1 \times 14.2 = \frac{1}{5} \times \frac{M}{30} \times 20$$

$$M_1 = \frac{1}{5} \times \frac{M}{30} \times \frac{20}{14.2} = 0.00938M$$

Strength of $KMnO_4$ = molarity × mol.wt. of $KMnO_4$.
= 0.00938 ×158
= 1.48209 g/L

Result

1. Morality of the given $KMnO_4$ solution = 0.00938 M
2. Strength of the given $KMnO_4$ solution = 1.48204 g/L

Precaution :

1. Weighting should be accurate.
2. Add 2 – 3 ml of conc. H_2SO_4 to prevent hydrolysis of Mohr's Salt solution during preparation of standard solution.
3. In case of coloured solution ($KMnO_4$) upper meniscus is read.

EXPERIMENT – 15

Aim : To prepare solution of M/40 oxalic acid. With its help determine the molarity and strength of given $KMnO_4$ solution.

Apparatus Required : Burette, conical flask, pipette, beaker (250 ml), test tube, white tiles, volumetric flask, beaker, funnel, glass rod, weight box, wash bottle.

Chemical Required : Oxalic acid, crystal, dil H_2SO_4, $KMnO_4$ solution

Indicator : $KMnO_4$ act as a self indicator.

End point : Colourless to Pink

Theory :

(a) Preparation of standard or known solution :-

Molecular formula of oxalic acid is $H_2C_2O_4.2H_2O$. It is a primary standard solution. thus its solution can be prepared by direct weighing.

Molecular weight of oxalic acid = 126 g

To prepare 250 ml of 1M oxalic acid solution, 126 of oxalic acid is required. Thus to prepare 250 ml of 1M oxalic acid solution (126/4)g is oxalic acid is required.

To prepare 250 ml of M/40 oxalic acid solution.

$\frac{126}{4} \times \frac{M}{40} = 0.7876g$ of oxalic acid is needed

(b) Titration of standard solution with $KMnO_4$ (unknown solution), $KMnO_4$ is strong and versatile oxidising agent. In sufficiently acidic medium, at about 60°C $KMnO_4$ oxidises oxalic acid to CO_2 and itself is reduced into colourless Mn^{2+} ion.

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

Molecular equation :-

$$2KMnO_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5[O]$$

$$H_2C_2O_4 + [O] \longrightarrow 2CO_2 + H_2O] \times 5$$

Adding both the eqn.

$$2KMnO_4 + 3H_2SO_4 + 5H_2C_2O_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 10CO_2$$

Observation Table :-

1. Preparation of M/40 standard solution :-
   Weight of empty watch glass (W_1) 21.7260 g
   Weight of watch glass + Mohr's salt (W_2)
   = 21.7200+ 0.7876 = 22.5076 g
   Weight of oxalic acid = $W_2 - W_1$ = 0.7876 g
   Volume of oxalic acid = 250 ml
   Molarity of oxalic acid = M/40

2. Titration of standard solution with $KMnO_4$ Solution :-

S.no.	Volume of Mohr's salt used (V_1) ml	Burette Reading		Volume of $KMnO_4$ used	Concordant Reading
		Initial	final		
1	*20ml*	0.0 *ml*	15.0 *ml*	15.0 *ml*	
2	*20 ml*	0.0 *ml*	14.9 *ml*	14.9 *ml*	14.9 *ml*
3	*20 ml*	0.0 *ml*	14.9 *ml*	14.9 *ml*	

Calculation : According to ionic equation .

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

$\therefore$ 1 mole of oxalic acid required 2/5 mole of $KMnO_4$.

$\therefore M_1V_1 = 2/5\ M_2V_2$

M_1 = molarity of $KMnO_4$ solution = ?

V_1 = molarity of $KMnO_4$ solution = 14.9 ml

M_2 = molarity of oxalic acid solution = M/40

V_2 = volume of oxalic acid solution. = 20 ml

$$M_1 \times 14.9 = \frac{2}{5} \times \frac{1}{40} \times 20 \Rightarrow M_1 = 0.0135M$$

Strength of $KMnO_4$ = Molarity × Mol.wt.= 0.0135 M × 158 = 2.1345 g/L

Result

1. Molarity of the given $KMnO_4$ solution = 0.0135 M
2. Strength of the given $KMnO_4$ solution = 2.1345 g/L

Precaution:

1. Oxalic acid should not be heated about 60^oC.
2. weighing should be accurate.

EXPERIMENT – 16

Aim : To prepare solution of M/20 oxalic acid with its help determine the morality and strength of given $KMnO_4$ solution.

Apparatus Required : Burette, conical flask, pipette, beaker, test tube, weight box, white tiles, volumetric flask beaker, funnel glass rod, weight box, wash bottle.

Chemical Required : Oxalic acid, crystal, dill H_2SO_4, $KMnO_4$ solution

Indicator : $KMnO_4$ act as a self indicator.

End point : Colourless to Pink

Theory :

(a) Preparation of standard or known solution :-

Molecular formula of oxalic acid is $H_2C_2O_4.2H_2O$. It is a primary standard solution. Thus its solution can be prepared by direct weighting.

Molecular weight of oxalic acid = 126 g

$\therefore$ molar mass = 126 g/*l*

To prepare 1000 ml of 1M oxalic acid solution, 126 of oxalic acid is required

To prepare 250 ml of 2M oxalic acid solution (126/4)g is oxalic acid is required.
∴ To prepare 250 m*l* of M/20 oxalic acid solution.

$\frac{126}{4}\times\frac{1}{20}=1.5750g$ of oxalic acid is needed

(b) Titration of standard solution with $KMnO_4$ (unknown solution): $KMnO_4$ is strong and versatile Oxidizing agent. When it is titrated against standard oxalic acid solution (reducing agent) in sufficiently acidic medium at above 60°C, $KMnO_4$ oxidizes acid into CO_2 and itself gets reduced to colourless Mn^{+2}ions.

Molecular Equation :

$$2KMnO_4+3H_2SO_4\longrightarrow K_2SO_4+2MnSO_4+3H_2O+5[O]$$

$$H_2C_2O_4+[O]\longrightarrow 2CO_2+H_2O]\times 5$$

Adding both equation : $2KMnO_4 + 3H_2SO_4 + 5\ COOH\ .\ 2H_2O \rightarrow K_2SO_4 + 2MnSO_4 + 8\ H_2O + 10CO_2$

Ionic equation : $MnO_4^- + 8H^+ + 5e^{(-)} \longrightarrow Mn^{2+} + [4H_2O]\times 2$

$$C_2O_4^{2-}\longrightarrow 2CO_2+2e^-]\times 5$$

$$2KMnO_4^- + 16H^+ + 5C_2O_4^{2-}\longrightarrow 2Mn^{2+}+8H_2O+10CO_2$$

Observation Table :

a) Preparation of M/20 oxalic acid solution :

Weight of water glass (W_1) = 21.7200g
Weight of watch glass + weight of oxalic acid (W_2) = 23.2950 g
∴ weight of oxalic acid ($w_2 - w_1$) = 1.5750g
Volume of oxalic acid used for each titration = 250 m*l*.

3. Titration of standard solution with unknown Solution :-

S.no.	Volume of Mohr's salt used (V_1) *ml*	Burette	Reading	Volume of $KMnO_4$ used	Concordant Reading
1	2.0 *ml*	0.0 *ml*	15.1 *ml*	15.1 *ml*	
2	2.0 *ml*	0.0 *ml*	14.8 *ml*	14.8 *ml*	14.8 *ml*
3	2.0 *ml*	0.0 *ml*	14.8 *ml*	14.8 *ml*	

Calculation : According to the ionic eq.

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

∴1 mole of oxalic acid required 2/5 mole of $KMnO_4$.

$\therefore M_1V_1 = 2/5\ M_2V_2$

$$\frac{2}{5}\times\frac{M}{20}\times\frac{20}{14.8}=0.027M$$

M_1 = Molarity of $KMnO_4$ Sol^n = ?
V_1 = Volume of $KMnO_4$ Sol^n = 14.8 ml
M_2 = Molarity of Oxalic acid Sol^n = M/20
V_2 = Volume of Oxalic acid Sol^n = 20 ml

Strength of $KMnO_4$ used = Molarity × molar mass = 0.027 × 158 = 4.2702 g/*l*

Result

1. Molarity = 0.0270 M
2. Strength = 4.2702 g/L

Precaution :

1. Weighting should be accurate .
2. Always remove funnel from burette while titrating the solution.

EXPERIMENT – 17

Aim : To identify the functional group in the given organic compound.

Apparatus Required : Test tube, test tube stand, test tube holder, dropper, litmus (blue), $NaHCO_3$, conc. H_2SO_4, NH_4OH, $FeCl_3$.

Physical Properties:

State: Solid
Colour: White
Odour: Vinegar Like
Flammability: Burn with non sooty flame (Aliphatic)

Preliminary test :

S.no.	Experiment	Observation	Inference
1	Litmus test : Organic compound + 2 drops of litmus solution.	Litmus solution turns from blue to red.	-COOH or – OH may be present
2	Organic compound + $NaHCO_3$ solution.	Colourless, odorless gas with brisk effervescence.	-COOH group may be or – OH (phenol group present.

Confirmatory test :

S.no.	Experiment	Observation	Inference
1	Ester test : Organic compound + C_2H_5OH + conc. H_2SO_4 + Heat	Fruity smell of ester	$-\overset{\overset{O}{\|}}{C}-OH$ grp confirmed.
2	$FeCl_3$ Test : Organic compound + dil $FeCl_3$ solution .	Red colour appear	$-\overset{\overset{O}{\|}}{C}-OH$ confirmed

Chemical Reaction : **$NaHCO_3$ Test :** $RCOOH + NaHCO_3 \longrightarrow RCOONa + CO_2 \uparrow + H_2O$

Easter Test : $RCOOH + R-OH \xrightarrow[H_2SO_4]{conc.} RCOOR' + H_2O$

(Fruity smell ester)

$FeCl_3$ Test : $RCOOH + NH_4OH \longrightarrow RCOONa$

$RCOONa + H_2O \longrightarrow$ Ammoniac salt (Soluble)

$RCOONH_4 + FeCl_3 \longrightarrow (RCOO)_3 Fe + 3NH_4Cl$

$(RCOO_3)Fe + H_2O \longrightarrow Fe(OH)(R\,COO)_2 + RCOOH$

Basic ferric acetate.

Result :

The functional group present in the given organic compound is carboxylic acid

$$\cdot \left(-\overset{\overset{O}{\|}}{C}-OH \right)$$

EXPERIMENT – 18

Aim : To identify the functional group in the given organic compound.

Apparatus Required : Test tube, test tube stand, test tube holder, dropper litmus (blue) solution, dil HCl, NaOH, Na metal, dil H_2SO_4, CH_3COOH.

Physical Properties:

State: Liquid
Colour: Colourless
Odour: Spirit Like
Water Solubility: Soluble in Water
Flammability: Burn with non-sooty flame (Aliphatic)

Preliminary test :

S.no.	Experiment	Observation	Inference
1	Organic compound + blue litmus solution.	No change	-COOH or – OH(Phenol)

			group absent
2	Organic compound + dil HCl + NaOH	No ppt. or oily layer	- NH_2 grp. Absent
3	Organic comp + Na metal	H_2 gas evolved	- OH (alcohol) Group may be

Confirmatory test :

S.no.	Experiment	Observation	Inference
1	Cerric ammonium nitrate Test : Organic compound + cerric ammonium nitrate	Red colour	- OH group. confirmed
2	Ester Test : Organic compound + CH_3COOH + Conc. H_2SO_4 (1 – 2 drops) + Heat.	Fruity smell of ester.	- OH grp. confirmed

Chemical reaction :

1- Na Metal test : -

$$2ROH + 2Na - OH \longrightarrow 2RONa + H_2 \uparrow$$

2- CERRIC AMMONIUM NITRATE TEST :

$$2ROH + (NH_4)_2 Ce(NO_3)_6 \longrightarrow (ROH)_2 Ce(NO_3)_4 + 2NH_4NO_3$$

(Red Colour)

3- Easter Test :

$$ROH + R'COOH \xrightarrow[H_2SO_4]{conc.} R'COOR + H_2O$$

Alcohol acid ester

Result : The functional group present in organic compound is alcohol group (-OH).

EXPERIMENT – 19

Aim : To identify the functional group in the given organic compound.

Apparatus Required : Test tube, test tube stand, test tube holder, dropper litmus (blue) $NaHCO_3$, $FeCl_3$ Solution, Phthalic anhydride, Con. H_2SO_4, NaOH.

Physical Properties:

State: Solid
Colour: White
Odour: Phenolic Smell
Water Solubility: Water insoluble
Flammability: Burn with non-sooty flame (Aromatic)

Preliminary test :

S.no.	Experiment	Observation	Inference
1	Organic compound + blue litmus solution.	Blue litmus turn Red	-COOH or phenolic – (OH) may be
2	$NaHCO_3$ test : Organic compound + $NaHCO_3$ solution.	No effervescence	- COOH absent Phenolic group may be

Confirmatory test :

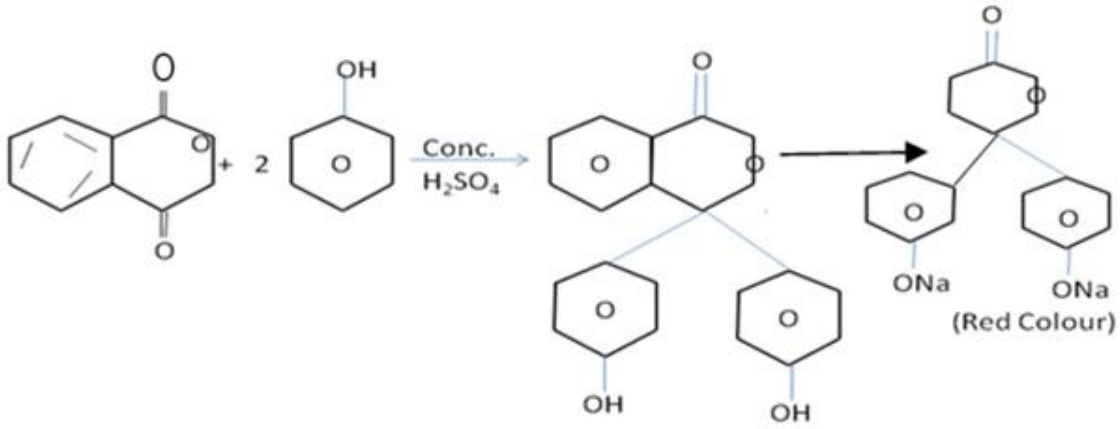
S.no.	Experiment	Observation	Inference
1	$FeCl_3$ Test : Organic compound + $FeCl_3$	Green blue or violet colouration	Phenolic (- OH) group. confirmed
2	Phthalic test :	Intense green	Phenol (- OH) grp.

	Organic compound + pthalic acid + 2-3 drops H_2SO_4 + Δ .then cool and dil. NaOH	blue or red colouration	Confirmed

Chemical Reaction :
Confirmative test :
$FeCl_3$ test

$$3C_6H_5OH + FeCl_3 \longrightarrow Fe(OC_6H_5)_3 + 3HCl$$

(Ferric peroxide)



(Violet)
Result : The given organic comp. contains phenolic (-OH) grp.

EXPERIMENT – 20

Aim : To identify the functional group in present in the given organic compound.
Apparatus Required : Test tube, test tube stand, test tube holder, dropper, litmus solution, 2,4 DNP, dil HCl, NaOH, reagent, Fehling solution, Schiff reagent.
Physical Properties:

State:	Liquid
Colour:	Colourless
Odour:	Pungent
Water Solubility:	Soluble in Water
Flammability:	Burn with non-sooty flame (Aliphatic)

Preliminary test :

S.no.	Experiment	Observation	Inference
1	Organic compound + blue litmus solution.	No change	-COOH or phenolic group absent
2	Organic compound + NaOH+ dil HCl	No ppt or oily layer	- NH_2 gup. Absent
3	Organic comp + 2 ml of 2, 4 DNP shake & allow it to stand.	Orange – red ppt.	- CHO or ketonic - group present.

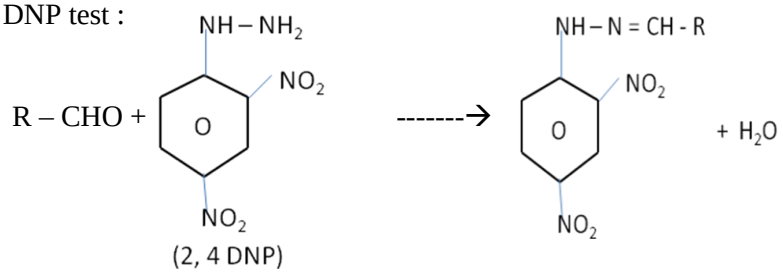
Confirmatory test :

S.no.	Experiment	Observation	Inference
1	**Schiff's solution test :** Organic compound + 2 ml of Schiff's reagent.	Pink colour Obtained	-CHO group present
2	**Fehling's solution test** : Organic compound + Fehling's solution (A + B) + boil in a water bath	Red ppt.	- CHO grp present.

Chemical reaction :

1- Preliminary test :

(i) 2, 4 DNP test :



(aldchyde – 2, 4 dil nitro phenyl hydrazone) (Orange – red ppt)

b) **Confirmatory Test :**

(i) Fehling's test : -

$$Cu(OH)_2 \xrightarrow[salt]{Rochell's} CuO + H_2O$$

$$R-CHO + 2CuO \longrightarrow Cu_2O + R-COOH$$

(Red ppt)

$$R-CHO + 2Cu^{2+} + 5OH^{(-)} \longrightarrow RCOO^{(-)} + Cu_2O + 3H_2O$$

Result : Given organic compound contains aldehydic grp. (- CHO)

EXPERIMENT – 21

Aim : To identify the functional group in present in the given organic compound.

Apparatus Required : Test tube, test tube stand, test tube holder, dropper, litmus solution, 2,4 DNP, dil HCl, NaOH, sodium, nitro pruside, meta dinitro benzene

Physical Properties:

State: Liquid
Colour: Colourless
Odour: Nail paint remover like
Water Solubility: Water soluble
Flammability: Burn with non-sooty flame (Aliphatic)

Preliminary test :

S.no.	Experiment	Observation	Inference
1	Organic compound + blue litmus solution.	No change	-COOH or phenolic group absent
2	Organic compound + NaOH+ dil HCl	No ppt or oily layer	- NH_2 gup. Absent
3	Organic comp + 2 ml of 2, 4 DNP shake & allow it to stand.	Orange – red ppt.	- CHO or ketonic - group present.

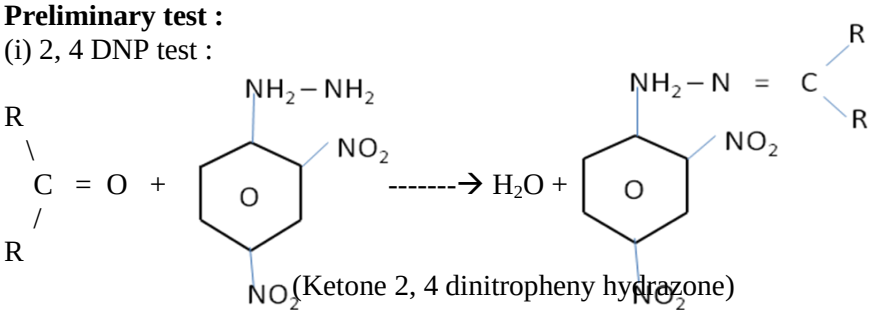
Confirmatory test :

S.no.	Experiment	Observation	Inference
1	Organic compound + sodium nitro prusside + 2 – 3 drops of NaOH and shake.	Red colour or wine red colour	-CHO group present
2	Organic compound + Meta dinitrobenzene + NaOH	Violet colour which fades on standing.	Ketonic grp confirmed.

Chemical reaction :

1- **Preliminary test :**

(i) 2, 4 DNP test :



(Ketone 2, 4 dinitropheny hydrazone)

b- Confirmatory test :

(i) Sodium Nitroprousside Test :

$$CH_3 - \overset{\overset{O}{\|}}{C} - CH_3 + OH^{(-)} \longrightarrow CH_3COCH_2^{(-)} + H_2O$$

$$\left[Fe(CN)_5NO\right]^{2-} + CH_3\overset{\overset{O}{\|}}{C} - C\overset{\Theta}{H}_2 \dashrightarrow \left[Fe(CN)_5NO\ CH_3 - \overset{\overset{O}{\|}}{C} - CH_2\right]^{-3}$$

Result : Given organic compound contains Ketonic group (>C = 0)

EXPERIMENT – 22

Aim : To study carbohydrates in pure form of detect its presence in food.

Appeartus required : Test tube, test tube stand, test tube holder, burner etc.

Theory : Carbohydrates are Polyhydroxy aldehydes or polyhydroxy ketones, their derivatives and the substance which yield them on hydrolysis carbohydrates are classified as sugars and non sugars. Sugars like glucose, fructose and cane sugar are crystalline. Among sugars, glucose, fructose and lactose are reducing while sucrose is non reducing sugar.

Test :

	Experiment	Observation	Inference
1	**Conc. H_2SO_4 test:** **Sample +** Conc. H_2SO_4 + Heat	Charring with burnt sugar smell.	Carbohydrates present.
2	**Molisch test :** Aq. Solution of sample + 2 drops of 1% α naphthol + conc. H_2SO_4.	Reddish purple ring in formed at the junction of 2 layers	Carbohydrates present.
3	**Fehling solution test :** **Sample s**olution + 1 m*l* of fehling A + 1 m*l* of Fehling B + Δ	Red ppt	Reading Sugar persent
4	**Tollens reagent :** Aq. Solution of sample + 2 m*l* of Tollens eagent + Δ	Silver mirror is formed along the surface of test tube.	Reducing sugar present.
5	**Benedit's Solution test:** Aq solution of sample + Benedict's reagent + Heat	Red ppt	Reducing sugar present
6	**Iodine test :** Sample Solution + few drops of iodine solution	Violet colour	Starch is present.

Result : Carbohydrates is present.

EXPERIMENT – 23

Aim : To study fat in pure form and to detect into presence in given food sample.

Apparatus required : Test tube stand, test tube holder, burner etc.

Theory : Fats and oil are esters of long chain fatty acids and glycerol and thus also called glycerides. Fats contains saturated fatty acids while oil contain unsaturated fatty acids.

Test :

S.no.	Experiment	Observation	Inference
1	**Spot Test :** Put a small amount of	Translucent spot	Fat is present.

	sample on a filter paper and press with another filter paper .	appears on the filter paper	
2	**Acrolein test :** Take a few drops of sample in a test tube. Add few drops of potassium bisulphite to it and Heat.	Irritating smell appears due to the form of acrolein vapours.	Fat is present
3	**Solubility test :** Take a small amount of sample in 3 test tubes. Add water, alcohol and chloroform in 1, 2, 3 test tube respectively.	Sample does not dissolve in H_2O but is soluble in alcohol on heating and soluble in chloroform.	Fat is present

Result : Fat is present.

EXPERIMENT – 24

Aim : To study proteins from sample and detect their presence in food sample.

Apparatus required : Test tube stand, test tube holder, glass rod, burner etc.

Theory : Proteins are high molecular mass, long chain polymers composed of α amino acid. Amino acids are molecule that have both $-NH_2$ and –COOH group.

Test :

S.no.	Experiment	Observation	Inference
1.	**Biuret test :** Sample + NaOH + Dil $CuSO_4$ solution	Bluish violet colour appears	Protein is present
2.	**Xanthoprotein test :** Sample + few drops of conc.HNO_3 + Δ	Yellow ppt.	Protein is present
3.	**Million's test :** Sample + 2 drops of millions reagent + Δ	White ppt which changes to brick red on boiling	Protein is present
4.	**Ninhydrin test :** Protein sample + Few drops of ninhydrin solution + Boil the contents for 1 minute	Blue colour appear	Protein is present

Result : Protein is present.