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Important Instructions

1) Read instructions of do's and dont's carefully.
2) Record your observations and calculations on sapce provided in the notebook.
3) Take signature of the batch incharge after completion of experiment on same day.
4) Read carefully the begining of each section, a concise explanatory account of theoretical experiments has been given.
5) Solve exercise of each experiment after completion of experiment on same day.
6) Use given space provided after each experiment for notes, rough work and rough calculations and then fair it to main experiment.
7) A Scheme of marking for practical examination is given on **page no. 143** for accurate working.
8) A format of question paper for annual practical examination is given for your information on **page no. 145.**
9) At the end, tables of logarithums is given for calculation.
10) At the end, tables for preparation of different concentration solutions and reagents are given in **appendix I to V.**

Observations:

1. Solution in a burette : $KMnO_4$
2. Solution by a pipette : oxalic acid
3. Solution in conical flask : 10ml oxalic acid + dil. H_2SO_4 (1 test tube)
4. Indicator : $KMnO_4$
5. End point : Colourless to light pink
6. Chemical Equation : $2KMnO_4 + 5H_2C_2O_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 10CO_2\uparrow$

Observation Table:

Burette level	Pilot reading	Burette reading in mL			C.B.R.
		I	II	III	
Final	9	9.5	9.5	9.5	9.5 (x) mL
Initial	to 10 mL	0.0	0.0	0.0	
Difference		9.5	9.5	9.5	

Calculation: From above chemical equation

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

2 moles 5 moles

2×158 g (316 g) ≡ 1000 mL 5 M (molar mass of $KMnO_4$ = 158 g/mol)

∴ 1000 mL 5 M oxalic acid ≡ 316 g of $KMnO_4$

∴ 10 mL 0.1 M oxalic acid $= \frac{316 \times 10 \times 0.1}{1000 \times 5}$

$= 0.0632$ g of $KMnO_4$

∴ Hence 9.5 (x) C.B.R. mL of $KMnO_4$ solution contains = 0.0632 g of $KMnO_4$

∴ 1000 mL of $KMnO_4$ contains $= \frac{0.0632 \times 1000}{9.5 \text{(x) CBR}}$

Hence molarity of $KMnO_4$ in the solution is $= \frac{0.0632 \times 1000}{9.5 \text{(x) CBR} \times 158}$

$= \frac{0.4}{9.5 \text{(x) CBR}}$

= 0.0421 M

Space for log calculation

Number	log

Result: The molarity of $KMnO_4$ solution is 0.0421 M

Remark and sign of teacher: .....

MCQ

Select [✓] the most appropriate answer from given alternatives of each sub question.

1. The molar mass of oxalic acid is
   a. 126 u ✓b. 126 g/mol
   c. 12.6 u d. 12.6 g/mol
2. To prepare 1 M solution of oxalic acid
   ✓a. 126 g of oxalic acid dissolve in distilled water and diluted to 1 L
   b. 12.6 g of oxalic acid dissolve in distilled water and diluted to 1 L
   c. 1.26 g of oxalic acid dissolve in distilled water and diluted to 1 L
   d. 0.126 g of oxalic acid dissolve in distilled water and diluted to 1 L
3. Water of crystallization present in oxalic acid is/are.....
   a. 1 ✓b. 2 c. 3 d. 5
4. Oxalic acid is used to prepare standard solution because it is a.....
   a. substance ✓b. primary standard substance
   c. secondary standard substance d. tertiary standard substance
5. The quantity of oxalic acid required to prepare 0.1 M 100 mL standard solution of oxalic acid is
   a. 126 g b. 12.6 g ✓c. 1.26 d. 0.126 g

Short answer questions

1. Calculate the molar mass of oxalic acid. (H = 1, C = 12, O = 16)

Ans. Molar mass of oxalic acid is 126 g/mol.

2. Why heating is required in oxalic acid and potassium permanganate titration?

Ans. The heating is required in oxalic acid & potassium permagnate titration because reaction is very slow at room tempeature.

3. Why one test tube of 2M sulphuric acid is required in permanganate titration?

Ans. one test of dilute H_2SO_4 is required in permagnate solution because is prevent oxidate of magnese dioxide.

4. What is the oxidation state of carbon atom in oxalic acid after completion of redox titration?

Ans. The oxidation state of carbon atom in oxalic acid after completion redox titration is +4.

5. Why primary standard substances are used to make standard solutions?

Ans. primary standard is a substance which is very pure representative of no. of moles of substance & easily weighted used to determine as unknown conc^n of $KMnO_4$.

Remark and sign of teacher: .....

Observations:

1. Solution in a burette : $KMnO_4$
2. Solution by a pipette : 0.1 M F.A.S.
3. Solution in conical flask : 10 ml 0.1M F.A.S + 1 test tube dil. H_2SO_4
4. Indicator : $KMnO_4$
5. End point : Colourless to light Pink
6. Chemical Equation : $2KMnO_4 + 10FeSO_4(NH_4)_2SO_4 + 8H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 10(NH_4)_2SO_4 + 8H_2O$

Observation Table:

Burette level	Pilot reading	Burette reading in mL			C.B.R.
		I	II	III	
Final	10	10.5	10.5	10.5	10.5 (x) mL
Initial	to	0.0	0.0	0.0	
Difference	11 mL	10.5	10.5	10.5	

Calculation: From above chemical equation

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

2 moles 10 moles

$2 \times 158 = 10$ moles of mohr's salt (molar mass of $KMnO_4 = 158$ g)

$\therefore$ 1000 mL 10M Mohr's salt $\equiv$ 316 g of $KMnO_4$

$\therefore$ 10 mL 0.1M Mohr's salt $= \dfrac{316 \times 10 \times 0.1}{1000 \times 10}$

$= 0.0316$ g of $KMnO_4$

$\therefore$ Hence 10.5 (x) CBR mL of $KMnO_4$ solution contains = 0.0316 g of $KMnO_4$

$\therefore$ 1000 mL of $KMnO_4$ contains $= \dfrac{0.0316 \times 1000}{10.5(x)\ CBR \times 158}$

Hence molarity of $KMnO_4$ in the solution is $= \dfrac{0.0316 \times 1000}{10.5(x)\ CBR \times 158}$

$= \dfrac{0.2}{10.5(x)\ CBR}$

$= 0.019$ M

Result: The molarity of $KMnO_4$ solution is 0.019 M

Space for log calculation

Number	log

Remark and sign of teacher: .....

MCQ

Select [✓] the most appropriate answer from given alternatives of each sub question.

1. The indicator used in Redox titration is-----
   a. phenolphthalein b. methyl orange
   c. methylene blue ✓d. potassium permanganate
2. Select the titrant used in redox titration
   a. oxalic acid b. F.A.S ✓c. $KMnO_4$ d. H_2SO_4
3. The oxidation state of Mn in $KMnO_4$ in redox titration before titration is +7, the oxidation state of Mn after completion of titration is-----
   ✓a. +2 b. +3 c. +4 d. +7
4. The oxidation state of Iron in Mohr's salt is +2, the oxidation state of Iron after completion of titration is-----
   a. +1 b. +2 ✓c. +3 d. +4
5. The role of Mn^{2+} ion during oxidation-reduction titration of $KMnO_4$ by oxalic acid is-----
   ✓a. catalyst b. reductant c. oxidant d. reactant

Short answer questions

1. What specific name is given to the permanganate titrations?

Ans. Redox titration is given to the permaganate solutions.

2. Why heating is not required in F.A.S. and potassium parmanganate titration?

Ans. In this titration heating is not required in FAS & potassium permaganate titration because the the reaction rate is very high at Room temperature.

3. Why is dilute sulphuric acid added while preparing a standard solution of Mohr's salt?

Ans. Simplest reason for using dil. H_2SO_4 added while preparing a standard solution of mohr's salt to get clear solution & prevent hydrolysis of ferrous Sulpnate.

4. Calculate the molar mass of Mohr's salt (Fe = 56, S = 32, N = 14, H = 1, O = 16)

Ans. Mohr's salt $(FeSO_4.(NH_4)_2SO_4.6H_2O$

$= 56+32+64+28+8+32+64+12+96$

$= 392$ g.mol

5. Calculate the amount of F.A.S. required to prepare M/20 standard solution of F.A.S.

Ans. M/20 Standard of F.A.S means 0.05 soln.

1M FAS = 392 gm

0.1M FAS = 39.2 gm

0.05 M FAS = 19.6 gm.

Remark and sign of teacher: .....

Procedure:

1. Take four conical flasks (250 mL), wash with water and label them as A, B, C, D respectively.
2. Using 50 mL burette take exactly 20, 30, 40 and 50 mL 0.1 M $Na_2S_2O_3$ in the flasks A, B, C, D respectively.
3. Using another 50 mL burette add 28, 18 and 8 distilled water to flasks A, B and C respectively. (There is no addition of distilled water in flask D)
4. With the help of 10 mL measuring cylinder, add 2 mL 1 M HCl to the flask A containing 20 mL 0.1 M $Na_2S_2O_3$ and 28 mL distilled water. Start the stop watch immediately.
5. Shake and keep the conical flask on a paper having cross mark and view the cross mark through reaction mixture from top of the conical flask.
6. When the cross mark on the paper just become invisible stop the stop watch immediately and record the time required in seconds.
7. Repeat the experiment by adding 2 mL 1 M HCl to flasks B, C and D, simultaneously. By using stop watch record the time required, when cross mark on the paper just becomes invisible. (Use same paper having cross mark for flasks B, C and D)

Observation Table:

Conical Flasks	0.1 M $Na_2S_2O_3$ in mL	H_2O mL	1M HCl mL	Time required to become cross mark invisible (t) sec	$1/t\ s^{-1}$	Concentration of $Na_2S_2O_3$
A	20	28	2	414(s)	0·0024	0.04
B	30	18	2	233(s)	0·0043	0.06
C	40	8	2	146(s)	0·0068	0.08
D	50	-	2	138(s)	0·0072	0.1

Graph: Plot a graph of 1/t against concentration of sodium thiosulphate solution.

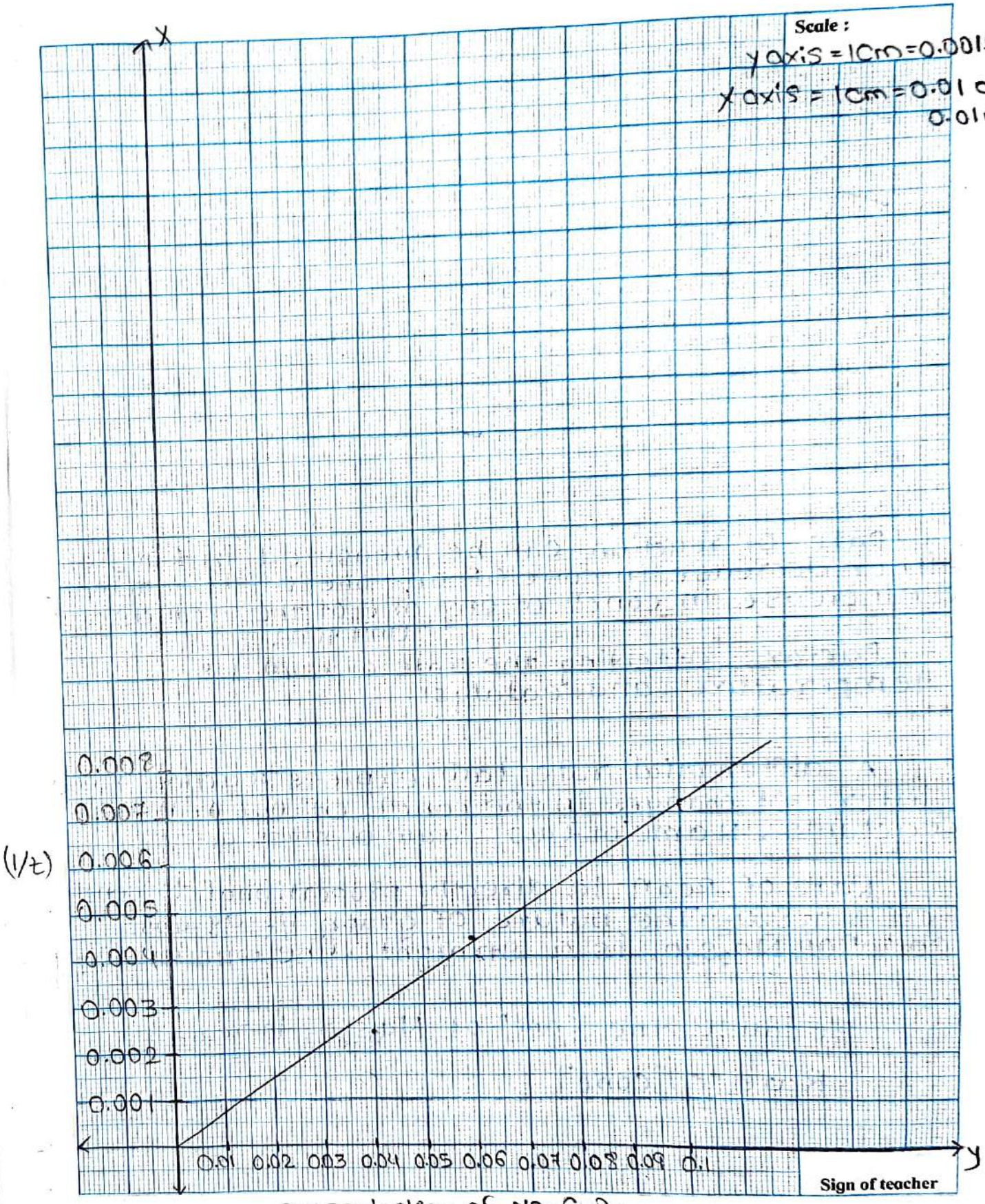
Result:

Rate of reaction (1/t) is ..directly proportional to conc. of $Na_2S_2O_3$

Remark and sign of teacher: .....

.....

.....


Scale :
y axis = 1cm = 0.001 S^{-1}
x axis = 1cm = 0.01 cm = 0.01 mol/dm³
X
y
(1/t)
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.1
Sign of teacher
concentration of $Na_2S_2O_3$

MCQ

Select [✓] the most appropriate answer from given alternatives of each sub question.

1. The rate of reaction between 0.1 M $Na_2S_2O_3$ and 1 M HCl does NOT depends on
   a. temperature ✓ b. concentration
   c. pressure d. catalyst
2. Sodium thiosulphate solution reacts with hydrochloric acid solution to produce .....
   a. a colloidal solution of sulphur ✓ b. transparent solution of sulphur
   c. black solution of sulphur d. white precipitate of NaCl
3. The time required for completion of the reaction, when we add 2 mL of 1M HCl to the flasks A, B, C and D containing increasing order of concentration of 0.1 M $Na_2S_2O_3$ .....
   a. increases b. decreases ✓
   c. first decreases and then increases d. first increases and then decreases
4. The nature of graph for effect of concentration on rate of reaction between 0.1 M $Na_2S_2O_3$ and 1 M HCl is a straight line with .....
   a. decreasing slope b. increasing slope ✓
   c. increasing slope intersecting to y-axis d. decreasing slope intersecting to x-axis

Short answer questions

1. Define rate of reaction.

Ans. Rate of reaction can be measured in terms of either decrease in conc of any one of the reactants or increase in concⁿ of any one of the products per unit time.

2. Mention the factors affecting the rate of reaction.

Ans. Factors affecting the rate of reaction is temperature and catalyst.

3. Write the name of law for the study of effect of concentration on the rate of reaction.

Ans. A differential rate law express reaction rate inter of changes in the concn of one or more reactants. Name of law – law of mass action.

4. Explain the nature of graph of 1/t against concentration of $Na_2S_2O_3$ solution.

Ans. Rate of Rean is directly proportional to concⁿ of $Na_2S_2O_3$. The nature of graph 1/t against concⁿ of $Na_2S_2O_3$ is a straight line with increasing slope.

5. Why rate of reaction is fastest, if distilled water is not added to 50 mL (i.e D flask) 0.1 M $Na_2S_2O_3$?

Ans. Because the concⁿ of $Na_2S_2O_3$ increases

Rate ∝ [Conc]

Remark and sign of teacher: .....

Observation Table:

1	Mass of 0.2 M $CuSO_4$ solution	-	25 g
2	Mass of zinc metal	-	1 g
3	Total mass of solution	m	26 g
4	Initial temperature of $CuSO_4$ solution	t_1	27 °C
5	Final temperature of mixture	t_2	37 °C
6	Rise in temperature	Δt = 37 °C (t_2) 27 °C (t_1)	10 °C
7	Specific heat capacity of water	S	4.184 J/g °C

Calculation:

Heat evolved in displacement reaction is given by

$Q = m\ S\ \Delta t$

$Q = 26 \times 4.184\ J/g\ ^{0}C \times 10.\ \Delta t$

Q = 1087.8 J.

1000 mL 0.2 M $CuSO_4$ solution contain 0.2 mol of 'Cu'

25 mL 0.2 M $CuSO_4$ solution contain

$= \dfrac{25 \times 0.2}{1000}$

$= 5 \times 10^{-3}$ mol of 'Cu'

..... (Q) is the heat evolved, when 5×10^{-3} mol of 'Cu' is displaced it

Therefore enthalpy of displacement is

$\Delta H = \dfrac{1087.8 (Q)}{5 \times 10^{-3}}$

ΔH = 217.56 × 10^3 J/mol

ΔH = 217.56 kJ/mol

Space for log calculation

Number	log

Result:

The enthalpy of displacement of 'Cu' from copper sulphate by zinc dust ΔH = −217.56 kJ/mol

(Negative sign is because reaction is exothermic in nature)

Remark and sign of teacher: .....

.....

.....

MCQ

Select [✓] the most appropriate answer from given alternatives of each sub question.

1. The number of water molecules present in hydrated $CuSO_4$ is/are

   a. 1 b. 2

   c. 3 ✓ d. 5

2. The metal used for connection of railway tracks after a particular distance

   a. Zn ✓ b. Al

   c. K d. Fe

3. A thermodynamic state function is a quantity

   a. used to determine heat changes ✓ b. whose value is independent of path

   c. used to determine pressure volume work d. whose value depends on temperature only

4. The enthalpies of all elements in their standard state are

   a. unity ✓ b. zero

   c. < O d. different for each element

Short answer questions

1. Why does Zinc displace copper from $CuSO_4$ solution?

Ans. zinc displaces copper from $cuso_4$ soln because zinc is having large value of standard oxidation potential. [E oxidation = +0.763 V] than copper E^o oxidn = 0.33]

2. What is enthalpy of displacement?

Ans. The enthalpy change that occurs when one mole of substance is completly displaced from it's aqueous soln is called enthalpy of displacement.

3. What is specific heat of a substance?

Ans. The specific heat of substance is the amount of energy required to raise the temp of 1 gram of the substance by 1°C unit J/g°c or cal/g°c.

4. Write balanced chemical equation, when Iron filings are we kept in blue coloured solution of copper sulphate.

Ans. When Iron filing are kept in blue coloured soln of $CuSO_4$ then blue colour slowly becomes colourless due to formation of $FeSO_4$

$3CuSO_4(aq) + 2Fe(s) \longrightarrow Fe_2(SO_4)_3 + 3Cu + \Delta H = -150\ KJmol^{-1}$

colourless Red Brown ppt

Remark and sign of teacher: .....

Compound No.1

Test	Observation	Inference
1. Test for Carboxylic acid group Substance + 10% $NaHCO_3$ solution.	Substance soluble with brisk effervenses of CO_2 gas.	Carboxylic group present ($-\overset{O}{\overset{\|\|}{C}}-OH$)

Result: The given organic compound no.1 contains following functional group.

Name of the functional group	Structure of functional group
Carboxylic	$-\overset{O}{\overset{\|\|}{C}}-OH$

Compound No.2

Test	Observation	Inference
1. Test for Carboxylic acid group Substance + 10% $NaHCO_3$ solution.	No brisk effervenses of CO_2 gas.	Carboxylic group absent.
2. Test for Phenolic group Substance + little water + neutral $FeCl_3$ solution	Green colouration.	Phenolic (Ar-OH) group present

Result: The given organic compound no.2 contains following functional group.

Name of the functional group	Structure of functional group
Phenolic	Ar-OH.

Compound No.3

Test	Observation	Inference
1. Test for Carboxylic acid group Substance + 10% $NaHCO_3$ solution.	No brisk effervescence of CO_2 gas.	Carboxylic group absent
2. Test for Phenolic group Substance + little water + neutral $FeCl_3$ solution	No colouration	Phenolic group absent.
3. Test for Aldehyde group (liquid) Substance + 2-3 mL Schiff's reagent/ Tollen's reagent and heat	Pink colour appears.	Aldehyde ($-\overset{H}{\overset{\|}{C}}=O$) group present.

Result: The given organic compound no.3 contains following functional group.

Name of the functional group	Structure of functional group
Aldehyde	$-\overset{H}{\overset{\|}{C}}=O$

Compound No.4

Test	Observation	Inference
1. Test for Carboxylic acid group Substance + 10% $NaHCO_3$ solution.	No brisk effervescence of CO_2 gas	carboxylic group absent.

2. Test for Phenolic group Substance + little water + neutral $FeCl_3$ solution	No colouration	phenolic group absent.
3. Test for Aldehyde group (liquid) Substance + 2-3 mL Schiff's reagent/ Tollen's reagent and heat	No pink colouration	Aldehyde group absent
4. Test for Ketonic group (liquid) Substance + few drops of NaOH + few drops of sodium nitroprusside soln	Red colour.	Ketonic group. Present (>C=O)

Result: The given organic compound no.4 contains following functional group.

Name of the functional group	Structure of functional group
Ketonic	>C=O.

Compound No.5

Test	Observation	Inference
1. Test for Carboxylic acid group Substance + 10% $NaHCO_3$ solution.		
2. Test for Phenolic group Substance + little water + neutral $FeCl_3$ soln		
3. Test for Aldehyde group (liquid) Substance + 2-3 mL Schiff's reagent/ Tollen's reagent and heat		
4. Test for Ketonic group (liquid) Substance + few drops of NaOH + few drops of sodium nitroprusside soln		
5. Test for Amino group Substance + conc. HCl and shake to dissolve. Cool under tap water, add excess of $NaNO_2$. + β-naphthol in NaOH		

Result: The given organic compound no.5 contains following functional group.

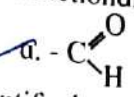
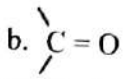
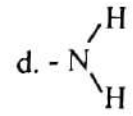
Name of the functional group	Structure of functional group
.....	

Remark and sign of teacher: .....

MCQ

Select [✓] the most appropriate answer from given alternatives of each sub question.

1. The functional group present in Methanal is .....

a.  b. c.  d. 

2. Identify the functional group of primary amine

a. $-NH_2$ b. $-\underset{|}{N}-$ c. $\diagdown N-H$ d. NH_3

3. The distinguishing test between alcohol and phenol is -

a. bicarbonate test
b. neutral $FeCl_3$ test
c. sodium nitroprusside test
d. tollen's reagent test

4. Primary amines on treatment with excess of $NaNO_2$, concentrated HCl and β-naphthol in alkaline medium gives.....

a. green colour
b. orange colour
c. violet colour
d. red colour

5. Acetaldehyde when heated with ammonical silver nitrate solution gives .....

a. red ppt b. silver mirror c. red colour d. grey mirror

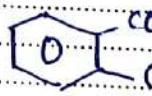
Short answer questions

1. Define: Functional group.

Ans. Functional group is defined as an atom or group of atoms present in a molecule which represents it's properties & responsible for characteristic reaction.

2. Draw structure of an organic compound having two functional group in molecule.

Ans.



3. Give distinguishing test for carboxylic acid and phenol.

Ans. Sodium bicarbonate $NaHCO_3$ readily reacts with carboxylic acid but does not reacts with phenol.

4. If alkaline $KMnO_4$ solution is added to an organic compound, it decolorises. Identify the functional group present in the compound?

Ans. If alkaline $KMnO_4$ soln is added to an organic compound it decolorises it indicates that such compound contain unsaturation $>C=C<$ or $-C\equiv C-$

5. Write a chemical reaction for Tollen's reagent test with ethanal.

Ans.

$$CH_3CHO + 2Ag(NH_3)_2OH \xrightarrow{\Delta} CH_3COOH + 2Ag + 4NH_3$$

Tollen's Reagent — Silver mirror

Remark and sign of teacher: .....

Aim: To detect the presence of carbohydrates or proteins or fats and oils in the given food stuff.

Food stuff for carbohydrates (Perform any two tests)

Sr. No.	Test	Observation	Inference
1	**Solubility:** Substance + Water	Soluble in water	Glucose present
2	**Fehling Test:** Little substance + 1 mL Fehling solution 'A' and 'B'. Heat the test tube on a water bath	Red ppt. is formed	Glucose Present
3	**Benedict's Test:** Little substance + add 2 mL Benedict's reagent. Heat gently.	Red ppt is obtained	Carbohydrate is Present.

Result : The given .....Sample.....**food stuff contains carbohydrates**

Food stuff for protein (Perform any two tests)

Sr. No.	Test	Observation	Inference
1	**Biuret Test:** Substance + 10% NaOH + few drops of 1% $CuSO_4$ solution, shake well	Bluish Violet colour	Protein is Present
2	**Xanthoprotic Test:** Substance + few drops of conc. HNO_3. Shake a little and leave undisturbed for some time	Yellow colouration	Protein is Present
3	**Ninhydrin Test:** Substance + NaOH solution + few drop of Ninhydrin reagent. Heat.	Intense blue colour	Protein is Present

Result: The given.....Sample.....**food stuff contains protein.**

Food stuff for fats and oils (Perform any two tests)

Sr. No.	Test	Observation	Inference
1	**Solubility:** a. Substance + Water	immiscible	Oil is Present
	b. Substance + chloroform	miscible	Oil is Present
2	**Spot Test:** Put a drop of substance on filter paper	translucent spot increases on drying filter paper	Oil is Present
3	**Acrolein Test:** Substance + few crystals of potassium bisulphate. Heat	Pungent irritating smell of formation of acrolein	Oil Present

Result: The given .....Sample..... **food stuff contains fats or oils.**

Remark and sign of teacher: .....

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MCQ

Select [✓] the most appropriate answer from given alternatives of each sub question.

1. Fats and oils are -------

✓a. triesters of glycerol and fatty acids b. diesters of glycerol and fatty acids

c. glycerol and fatty acids d. glycol and fatty acids

2. ------- are insoluble in water but soluble in acidic or alkaline solutions

✓a. fats b. oils c. proteins d. carbohydrates

3. Proteins contain ------- linkage.

✓a. polypeptide b. polyester c. polypropylene d. polystyrene

4. Glucose powder when heated with Fehling solution gives-------

a. blue ppt ✓b. red ppt c. green ppt. d. black ppt

Short answer questions

1. What are Carbohydrates?

Ans. Optically active polyhydroxy aldehyde or polyhydroxy ketones are called carbohydrates.

2. Write the name of chemical test, when protein in food stuff is treated with concentrated HNO_3.

Ans. When protein is food stuff is treated with conc. HNO_3 it gives Yellow colour or ppt. This called Xanthopro test

3. Write structure of peptide linkage present in proteins.

Ans. —CO—NH— or —C(=O)—N(H)—

4. Mention Biuret test for proteins in short.

Ans. Substance containing protein is treated with 10% NaOH & few drops of 1% $CuSO_4$ soln on shaking it gives Violet colour.

5. Write an important difference between oils and fats.

Ans. At ordinary temp. oils are liquids while fats are solid. oils ar triesters of unsaturated fatty acids while fats are triesters of saturated fatty acids.

Remark and sign of teacher: .....

MCQ

Select [✓] the most appropriate answer from given alternatives of each sub question.

1. The anion does NOT gives positive test with dil. H_2SO_4 and conc. H_2SO_4
   a. Cl^- b. CO_3^- c. CH_3COO^- ✓d. SO_4^-
2. When moisten oxalic acid is taken between the fingers, it smells like vinegar, indicates the presence of following anion
   a. sulphate b. nitrate ✓c. acetate d. nitrite
3. Canary yellow ppt. of ammonium phosphomolybdate indicates the presence of ..... radical
   a. Cl^- b. SO_4^{2-} ✓c. PO_4^{3-} d. NO_3^-
4. Smell of rotton eggs of a substance with dil. H_2SO_4 indicates the presence of ..... radical
   a. SO_3^{2-} b. SO_4^{2-} ✓c. S^{2-} d. $C_2O_4^-$

Short answer questions

1. **Write the formula of the compound formed in brown ring test.**

Ans. The compound formed in brown ring test is $[Fe(NO)(H_2O)_5]SO_4$

2. **Write the name of the complex formed, when sodium nitroprusside is added to O.S. of mixture in the confirmatory test of sulphide ion.**

Ans. When Sodium Nitroprusside is added to O.S of mixture in the confirmatory test of S^- ion, then Sodium pentacyano nitrosyl (II) sulphide $Na_4[Fe(CN)_5NO]$ is forms.

3. **Write the names of anion detected with the help of dil. H_2SO_4.**

Ans. CO_3^{2-} (carbonate ion), NO_2^- Nitrite, S^{2-} (Sulphide ion) SO_3^{2-} (Sulphite ion)

4. **Write the names of anion detected with the help of conc. H_2SO_4.**

Ans. Cl^- (chloride), Br^- (Bromide), I^- (Iodide), NO_3^- (Nitrate) oxalate & CH_3COO^- (Acetate ion)

5. **What is lime water and what happens on passing CO_2 gas through it?**

Ans. Lime water is solution of calcium hydroxide in H_2O which is alkaline & turns milky as passing CO_2 gas through it.

6. **Describe the layer test for iodide ions?**

Ans. Take Soln containing iodine ions & Cl_2 water & chloroform Shake well chloroform layer aquires Violet layer.

7. **How do you test the presence of sulphide ion in dry test.**

Ans. Mixture of salts is treated with dil. H_2SO_4 which evolves colourless gas with smell of rotton eggs (H_2S) which is turns lead acetate paper black indicates process of

Remark and sign of teacher: .....

Experiment No. 20 (Mixture No. 1)

Date: / /

Aim : Analyse two acidic (anion) radicals qualitatively from given inorganic mixture.

Apparatus : Test tubes, test tube holder, test tube stand, filter paper etc.

A. Preliminary tests:

Test	Observation	Inference
Color	White	Chloride, Nitrates, Sulphates, carbonates of Ca^{2+}, Ba^{2+}, Sr^{2+} or Mg^{2+} may be present
Nature	Crystalline	chloride, Br^-, I^-, NO_2^-, SO_4^{2-} CO_3^{2-}, CH_3COO^- or compounds of NH_4^+ or K^+ may be present

B. Dry Tests for Acidic radicals (Test tube must be dry for following tests)

Test	Observations	Inference
1. Heating in a dry test tube:- Take a small quantity of the mixture in a clean and dry test tube and heat it strongly	colourless, odourless gas, which turns lime water milky.	CO_3^{2-}, $C_2O_4^{2-}$ may be Present
2. Action of dil. H_2SO_4 : Take a small quantity of mixture + dilute H_2SO_4	Evolution of colourless odourless gas with brisk effervescence of CO_2 gas	CO_3^{2-} may be present
3. Action of conc. H_2SO_4 : Take a small quantity of mixture + conc. H_2SO_4	colourless gas having Pungent smell	Cl^- may be Present
4. Action of Cu foils and conc. H_2SO_4 Mixture + Cu filings and conc. H_2SO_4, heat it strongly	No brown fumes	NO_3^- is absent
5. Action of MnO_2 and conc. H_2SO_4 Mixture + MnO_2 powder + conc. H_2SO_4	colourless gas	Cl^- may be Present.

Individual dry tests for SO_4^{2-} & PO_4^{3-} (if required)

1. Test for sulphate Mixture + dil. HCl, boil the solution + $BaCl_2$ solution	No white ppt	SO_4^{2-} is absent
2. Test for phosphate Mixture + conc. HNO_3 boil + excess of ammonium molybdate solution	No canary Yellow ppt	PO_4^{3-} is absent.

C. Preparation of original solution (O.S) : Mixture is dissolved in 20 mL quantity of distilled water in a beaker, stir with glass rod to dissolve the mixture. Clear solution is obtained. Use this O.S. for further tests of acidic radicals.

D. Wet Tests for Anion (Acidic Radicals)

1. O.S. + $AgNO_3$	White ppt insoluble in dil. HNO_3	Halides may be Cl^-, Br^-, I^- Present.
If white ppt obtained in above test, perform following distinction test		
Distinction between Cl^-, Br^- and I^- : O.S. + dil. H_2SO_4 (till acidic) + chloroform + Cl_2 water (fresh) in excess, shake vigorously and observe the colour of chloroform layer carefully.	chloroform layer colourless.	Cl^- Present
2. O.S. + $Ba(NO_3)_2$ solution	White ppt. Soluble in dil. HCl or H_2SO_4 with effervesence	CO_3^{2-} Present
3. O.S. + dil. acetic acid + (Freshly prepared) $FeSO_4$ solution	No brown colouration	NO_3^- absent
4. O.S. + diphenyl amine + conc. H_2SO_4	No evolution of NO_2 gas	NO_3^- absent
5. O.S. + $FeCl_3$ solution	No. ppt	PO_4^{3-} & CH_3COO^- absent
6. O.S. + dil. acetic acid + $CaCl_2$	No. White ppt.	$C_2O_4^{2-}$ absent
7. O.S. + dil. H_2SO_4 + 2-3 drops of $KMnO_4$	Pink colour of $KMnO_4$ remains as it is.	SO_3^{2-} absent.

E. Confirmatory tests for Acidic Radicals

1. C.T. for first detected acidic radical ...CO_3^{2-}

Test	Observation	Inference
1. O.S + 2-3 drops Phenolphthalein indicator	Pink colour	CO_3^{2-} confirmed
2. O.S + dil HCl	Effervescence of CO_2 which turns lime water milky.	CO_3^{2-} confirmed

2. C.T. for second detected acidic radical ...Cl^-.....

Test	Observation	Inference
1. O.S + Lead acetate soln	White ppt.	Cl^- confirmed.
2. O.S + $AgNO_3$	White ppt soluble in NH_4OH	Cl^- confirmed

Result :

The given inorganic mixture no. 1 contains following two anions (Acidic radicals)

i) ...CO_3^{2-}... (Carbonate)

ii) ...Cl^-.... (Chloride)

Remark and sign of teacher: .....

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Experiment No. 21 (Mixture No. 2)

Date: / /

Aim : Analyse two acidic (anion) radicals qualitatively from given inorganic mixture.

Apparatus : Test tubes, test tube holder, test tube stand, filter paper etc.

A. Preliminary tests:

Test	Observation	Inference
Color	Blue	chlorides, Nitrates, Sulphates, carbonates of Cu^{2+}, Cr^{2+}, Ni^{2+} may be present
Nature	crystalline	Cl^-, Br^-, I^-, NO_2^-, SO_4^{2-}, CO_3^{2-} CH_3COO^- or compounds of NH_4^+ or K^+ may be present.

B. Dry Tests for Acidic radicals (Test tube must be dry for following tests)

Test	Observations	Inference
1. Heating in a dry test tube:- Take a small quantity of the mixture in a clean and dry test tube and heat it strongly	Greenish Yellow gas which turns starch iodide Paper blue.	Cl^- may be Present
2. Action of dil. H_2SO_4 : Take a small quantity of mixture + dilute H_2SO_4	No colour gas.	CO_3^{2-}, S^{2-}, NO_2^- SO_3^{2-}, CH_3COO^- absent.
3. Action of conc. H_2SO_4 : Take a small quantity of mixture + conc. H_2SO_4	Colourless gas having Pungent smell	Cl^- may be Present
4. Action of Cu foils and conc. H_2SO_4 Mixture + Cu filings and conc. H_2SO_4, heat it strongly	No brown fumes	NO_3^- is absent
5. Action of MnO_2 and conc. H_2SO_4 Mixture + MnO_2 powder + conc. H_2SO_4	greenish Yellow gas turning moist blue litmus paper red & then bleaches	Cl^- may be Present.

Individual dry tests for SO_4^{2-} & PO_4^{3-} (if required)

1. Test for sulphate Mixture + dil. HCl, boil the solution + $BaCl_2$ solution	White PPt. insoluble in conc. HCl	SO_4^{2-} may be Present
2. Test for phosphate Mixture + conc. HNO_3 boil + excess of ammonium molybdate solution	No canary Yellow ppt.	PO_4^{3-} is absent.

C. Preparation of original solution (O.S) : Mixture is dissolved in 20 mL quantity of distilled water in a beaker, stir with glass rod to dissolve the mixture. Clear solution is obtained. Use this O.S. for further tests of acidic radicals.

D. Wet Tests for Anion (Acidic Radicals)

1. O.S. + $AgNO_3$	White ppt insoluble in dil. HNO_3	Halides may be (Cl^-, Br^-, I^-) Present
If white ppt obtained in above test, perform following distinction test		
Distinction between Cl^-, Br^- and I^- : O.S. + dil. H_2SO_4 (till acidic) + chloroform + Cl_2 water (fresh) in excess, shake vigorously and observe the colour of chloroform layer carefully.	Chloroform layer colourless	Cl^- present.
2. O.S. + $Ba(NO_3)_2$ solution	White ppt insoluble in dil. HNO_3	SO_4^{2-} Present
3. O.S. + dil. acetic acid + (Freshly prepared) $FeSO_4$ solution	No brown colouration	NO_2^- absent
4. O.S. + diphenyl amine + conc. H_2SO_4	No evolution of NO_2 gas	NO_3^- absent
5. O.S. + $FeCl_3$ solution	No ppt	PO_4^{3-} & CH_3COO^- absent
6. O.S. + dil. acetic acid + $CaCl_2$	No white ppt	$C_2O_4^{2-}$ absent
7. O.S. + dil. H_2SO_4 + 2-3 drops of $KMnO_4$	Pink colour of $KMnO_4$ remains as it is.	SO_3^{2-} absent

E. Confirmatory tests for Acidic Radicals

1. C.T. for first detected acidic radical ..Cl^-....

Test	Observation	Inference
1. O.S + Lead acetate Soln.	White ppt.	Cl^- confirmed
2. O.S + $AgNO_3$	White ppt Soluble in NH_4OH	Cl^- confirmed

2. C.T. for second detected acidic radical ....SO_4^{2-} (Sulphate)

Test	Observation	Inference
1. O.S + Lead acetate Soln.	White ppt. Insoluble in dil HNO_3 but soluble in hot ammonium acetate soln.	SO_4^{2-} confirmed.
2. O.S + $BaCl_2$	White ppt of $BaSO_4$	SO_4^{2-} confirmed

Result :

The given inorganic mixture no.2 contains following two anions (Acidic radicals)

i) ..Cl^-.... (Chloride)

ii) ..SO_4^{2-}... (Sulphate)

Remark and sign of teacher: .....

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Experiment No. 22 (Mixture No. 3)

Date: / /

Aim : Analyse two acidic (anion) radicals qualitatively from given inorganic mixture.

Apparatus : Test tubes, test tube holder, test tube stand, filter paper etc.

A. Preliminary tests:

Test	Observation	Inference
Color	White	Chlorides, Nitrates, Sulphates, Carbonates of Ca^{2+}, Ba^{2+}, Sr^{2+}, or Mg^{2+} maybe present
Nature	crystalline	Cl^-, Br^-, I^-, NO_2^-, SO_4^{2-}, BO_3^{3-} CH_3COO^- or compounds of NH_4^+ or K^+ may be present.

B. Dry Tests for Acidic radicals (Test tube must be dry for following tests)

Test	Observations	Inference
1. Heating in a dry test tube:- Take a small quantity of the mixture in a clean and dry test tube and heat it strongly	Colourless, odourless gas which turns lime water milky.	CO_3^{2-}, $C_2O_4^{2-}$ may be present.
2. Action of dil. H_2SO_4: Take a small quantity of mixture + dilute H_2SO_4	Evolution of colourless, odourless gas with brisk effervences of CO_2	CO_3^{2-} maybe Present.
3. Action of conc. H_2SO_4 : Take a small quantity of mixture + conc. H_2SO_4	Yellowish brown gas having pungent smell turns starch paper yellow.	Br^- maybe Present.
4. Action of Cu foils and conc. H_2SO_4 Mixture + Cu filings and conc. H_2SO_4, heat it strongly	NO Brown fumes	NO_3^- is absent
5. Action of MnO_2 and conc. H_2SO_4 Mixture + MnO_2 powder + conc. H_2SO_4	Reddish brown gas turning starch Paper Yellowish brown	Br^- may be Present.

Individual dry tests for SO_4^{2-} & PO_4^{3-} (if required)

1. Test for sulphate Mixture + dil. HCl, boil the solution + $BaCl_2$ solution	NO white PPt	SO_4^{2-} is absent.
2. Test for phosphate Mixture + conc. HNO_3 boil + excess of ammonium molybdate solution	No Canary Yellow PPt.	PO_4^{3-} is absent.

C. Preparation of original solution (O.S) : Mixture is dissolved in 20 mL quantity of distilled water in a beaker, stir with glass rod to dissolve the mixture. Clear solution is obtained. Use this O.S. for further tests of acidic radicals.

D. Wet Tests for Anion (Acidic Radicals)

1. O.S. + $AgNO_3$	Pale Yellow ppt Partly soluble in NH_4OH	Br^- maybe present
If white ppt obtained in above test, perform following distinction test		
Distinction between Cl^-, Br^- and I^- : O.S. + dil. H_2SO_4 (till acidic) + chloroform + Cl_2 water (fresh) in excess, shake vigorously and observe the colour of chloroform layer carefully.	Chloroform layer Yellowish brown.	Br^- present
2. O.S. + $Ba(NO_3)_2$ solution	White ppt soluble in dil HCl.	CO_3^{2-} present.
3.O.S. + dil. acetic acid + (Freshly prepared) $FeSO_4$ solution	NO brown colouration	NO_2^- absent.
4. O.S. + diphenyl amine + conc. H_2SO_4	NO Evolution of NO_2 gas.	NO_3^- absent
5. O.S. + $FeCl_3$ solution	NO PPt	PO_4^{3-} & CH_3COO^- absent.
6. O.S. + dil. acetic acid + $CaCl_2$	No white ppt.	$C_2O_4^{2-}$ absent
7. O.S. + dil. H_2SO_4 + 2-3 drops of $KMnO_4$	Pink colour of $KMnO_4$ remains same as it	SO_3^{2-} absent.

E. Confirmatory tests for Acidic Radicals

1. C.T. For first detected acidic radical ...CO_3^{2-}...

Test	Observation	Inference
1. O.S + 2-3 drops of Phenolphthalein indicator.	Pink colour	CO_3^{2-} confirmed
2. O.S + dil. HCl	Effervescence of CO_2 which turns lime water milky	CO_3^{2-} confirmed.

2. C.T. For second detected acidic radical ...Br^- (Bromide)

Test	Observation	Inference
1. O.S + MnO_2 + conc. H_2SO_4 Heat.	Raddish brown gas turning starch paper Yellowish brown.	Br^- confirmed.
2. O.S + Cl_2 water + $CHCl_3$	chloroform layer aquires Yellow colour.	Br^- confirmed.

Result :

The given inorganic mixture no. 3 contains following two anions (Acidic radicals)

i) ...CO_3^{2-} (Carbonate)

ii) ...Br^-... (Bromide)

Remark and sign of teacher: .....

MCQ

Select [✓] the most appropriate answer from given alternatives of each sub question.

1. A colourless solid 'A' produces black spots on the skin. It's aqueous solution gives brown ring test and also gives yellow ppt. with KI solution 'A' could be
   a. copper nitrate b. zinc nitrate
   c. silver nitrate d. lead nitrate
2. Which of the following sulphide is completely precipitated in acidic medium
   a. HgS b. PbS c. CdS d. CuS
3. The colour of precipitate observed, when potassium iodide is added to water soluble lead salts is
   a. black b. white c. yellow d. red
4. Which of the following is NOT a preliminary test
   a. charcoal cavity test b. flame test
   c. NaOH test d. brown ring test
5. The colour of carbonate cation precipitate of group V is.....
   a. black b. green
   c. white d. yellow

Short answer questions

1. **The removal of H_2S gas from filtrate is must before doing analysis of group III and V. Why?**

Ans. If H_2S gas isn't boiled off then group IV cations also get precipiated. It would react with HNO_3 & would be oxeidised to colloidal sulphur which would interfere with further analysis

2. **Write the name of brown ppt. obtained, when Nessler's reagent is added in O.S. for confirmatory test of ammonium ion.**

Ans. Brown ppt - Basic mercury (II) amido-iodine

3. **During the detection of groups, if Group-I is detected then for next Group test what care should be taken?**

Ans. If group-I is detected then reagent must be added in bulk O.S for complete ppt formation of group I cation then filter it & filtrate is taken for further tests.

4. **Why cracking noise/decrepitation is observed during dry test in qualitative analysis of cations?**

Ans. Lead Nitrate, Barium Nitrate, Potassium bromide, Sodium Chloride etc make cracking noise due to decomposition on heating in a dry test tube. Also due to heating bigger crystal breaks up into smaller ones

5. **Name a cation, which is not obtained from metal.**

Ans. cation Ammonium ion NH_4^+ is not obtained from metal

Remark and sign of teacher: .....

Experiment No. 23 (Mixture No. 1)

Date: / /

Aim : Analyse two basic (cation) radicals qualitatively from given inorganic mixture.

Apparatus : Test tubes, test tube holder, test tube stand, filter paper etc.

A. Preliminary tests:

Test	Observation	Inference
Color	Blue	Cu^{2+} may be Present
Nature	Crystalline	Water soluble salts like Nitrates, sulphates & halides Of NH_4^+, Al^{3+}, etc may be Present

B. Dry Tests for Basic radicals (Test tube must be dry for this test)

Test	Observation	Inference
1. Heating in a dry test tube:- Take a small quantity of the mixture a clean and in dry test tube and heat it strongly.	Formation of White Sublimate	NH_4^+ may be Present
2. Charcoal Cavity Test: Mixture + Na_2CO_3 solid in 1:2 proportion placed in fresh charcoal cavity, moisten with a drop of water. Heat it with blow pipe in a reducing (yellow) flame	Substance fuses & sinks in the cavity	NH_4^+ or Ca^{2+} salts may be Present
3. NaOH Test: Mixture + NaOH solution & heat. Hold moist turmeric paper near the mouth of the test tube	Moist turmeric Paper turns brown.	NH_4^+ may be Present.
4. Flame Test: Prepare a paste of the given mixture with conc. HCl on a watch glass. Make a small loop at the end of the platinum wire & dip it in the mixture or use glass rod. Heat it on oxidising flame (Blue) observe the colour change of the flame.	Bluish White	Cu^{2+} may be Present

C. Preparation of original solution (O.S)

Take a small quantity of mixture in a beaker add 20 mL of distilled water, stir with glass rod to dissolve the mixture. If mixture does not dissolve completely then warm it to dissolve. Clear solution is obtained, which is used as a O.S for further tests.

1. Analysis of Group zero (NH_4^+)

Test	Observation	Inference
1. O.S. + NaOH solution + Heat, test with moist turmeric paper.	Evolution of NH_3 gas which turns moist turmeric Paper brown	Group zero Present (NH_4^+)

2. O.S. + NaOH solution + Heat, Bring a glass rod dipped in conc. HCl. near the mouth of the test tube.	Dense white fumes of NH_4Cl.	NH_4^+ Present.
C.T. for NH_4^+ : i. O.S. + Nessler's reagent in excess	Brown ppt	NH_4^+ confirmed.
ii. O.S + Picric Acid (2, 4, 6 trinitro phenol)	Yellow ppt of ammoniumpicrate	NH_4^+ confirmed.

Detection of group (if group zero is absent, two groups must be detected following test)

Test	Observation	Inference
1. O.S. + dil. HCl	No ppt.	Group I Absent
2. O.S./Filtrate + dil HCl (heat) + H_2S gas or water	Black ppt.	Group II (Cu^{2+}, As^{3+}) present.
3. O.S./Filtrate (Remove H_2S) + NH_4Cl (equal) + NH_4OH (till alkaline to litmus)	No ppt	Group III Absent
4. O.S./Filtrate + NH_4Cl (equal) + NH_4OH (till alkaline to litmus) + H_2S gas or water	No ppt	Group IV Absent
5. O.S./Filtrate (Remove H_2S) + NH_4Cl (equal) + NH_4OH (till alkaline to litmus) +$(NH_4)_2CO_3$	No ppt	Group V absent
6. O.S./Filtrate + NH_4Cl (equal) + NH_4OH (till alkaline to litmus) + Na_2HPO_4	No ppt	Group VI absent

2.Analysis of first detected group Analysis of II group.

Test	Observations	Inference
O.S + dil. HCl + H_2S gas or water.	Black ppt	Pb^{2+} or Cu^{2+} may be present.
Group II Black ppt + 1:1 HNO_3 ppt dissolves + dil. H_2SO_4	No ppt.	Cu^{2+} present.
Above Soln + NH_4OH in excess)	Blue colour.	Cu^{2+} Present.

3. C.T. for first detected radical C.T. For Cu^{2+}.

Test	Observations	Inference
1. Above soln + acetic acid + $K_4Fe(CN)_6$	chocolate brown ppt	Cu^{2+} confirmed.
2. Above soln + KI.	White ppt in brown coloured solution.	Cu^{2+} confirmed.

2. Analysis of second detected group

Test	Observations	Inference
1.		
2.		
3.		

3. C.T. for second detected radical

Test	Observations	Inference
1.		
2.		

Result:-

The given inorganic mixture no. 1 contains following two cations (Basic Radicals)

i) ...Cu^{2+} (Copper)

ii) ...NH_4^+ (Ammonium.

Remark and sign of teacher: .....

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.....

Experiment No. 24 (Mixture No. 2)

Date: / /

Aim : Analyse two basic (cation) radicals qualitatively from given inorganic mixture.

Apparatus : Test tubes, test tube holder, test tube stand, filter paper etc.

A. Preliminary tests:

Test	Observation	Inference
Color	Green.	Ni^{2+} may be Present
Nature	crystalline	Water soluble salts like Nitrates

B. Dry Tests for Basic radicals (Test tube must be dry for this test)

Test	Observation	Inference
1. Heating in a dry test tube:- Take a small quantity of the mixture a clean and in dry test tube and heat it strongly.	Formation of white sublimate	NH_4^+ may be Present
2. Charcoal Cavity Test: Mixture + Na_2CO_3 solid in 1:2 proportion placed in fresh charcoal cavity, moisten with a drop of water. Heat it with blow pipe in a reducing (yellow) flame	Substance fuses & sinks in the cavity	NH_4^+ or Ca^{+2} Salts may be Present.
3. NaOH Test: Mixture + NaOH solution & heat. Hold moist turmeric paper near the mouth of the test tube	Moist turmeric Paper turns brown.	NH_4^+ may be Present
4. Flame Test: Prepare a paste of the given mixture with conc. HCl on a watch glass. Make a small loop at the end of the platinum wire & dip it in the mixture or use glass rod. Heat it on oxidising flame (Blue) observe the colour change of the flame.	Bluish green	Zn^{2+} & Mn^{2+} Salts may be Present.

C. Preparation of original solution (O.S)

Take a small quantity of mixture in a beaker add 20 mL of distilled water, stir with glass rod to dissolve the mixture. If mixture does not dissolve completely then warm it to dissolve. Clear solution is obtained, which is used as a O.S for further tests.

1. Analysis of Group zero (NH_4^+)

Test	Observation	Inference
1. O.S. + NaOH solution + Heat, test with moist turmeric paper.	Evolution of NH_3 gas which turns moist turmeric Paper brown	Group zero Present (NH_4^+).

2. O.S. + NaOH solution + Heat, Bring a glass rod dipped in conc. HCl. near the mouth of the test tube.	Dense white fumes of NH_4Cl	NH_4^+ Present
C.T. for NH_4^+ : i. O.S. + Nessler's reagent in excess	Brown ppt	NH_4^+ confirmed.
ii. O.S + Picric Acid (2, 4, 6 trinitro phenol)	Yellow ppt of ammonium picrate	NH_4^+ confirmed.

Detection of group (if group zero is absent, two groups must be detected following test)

Test	Observation	Inference
1. O.S. + dil. HCl	No white ppt	Group I absent
2. O.S./Filtrate + dil HCl (heat) + H_2S gas or water	No Black ppt	Group II absent
3. O.S./Filtrate (Remove H_2S) + NH_4Cl (equal) + NH_4OH (till alkaline to litmus)	No ppt	Group III absent
4. O.S./Filtrate + NH_4Cl (equal) + NH_4OH (till alkaline to litmus) + H_2S gas or water	Black ppt	Group IV Present
5. O.S./Filtrate (Remove H_2S) + NH_4Cl (equal) + NH_4OH (till alkaline to litmus) +$(NH_4)_2CO_3$	No ppt	Group V absent
6. O.S./Filtrate + NH_4Cl (equal) + NH_4OH (till alkaline to litmus) + Na_2HPO_4	No ppt	Group VI absent

2. Analysis of first detected group Analysis of Group IV

Test	Observations	Inference
O.S + NH_4Cl + NH_4OH + H_2S gas	Black ppt	Ni^{2+}, Co^{2+} Present
Colour of original soln	Greenish	Ni^{2+} Present.
Dissolve the Black ppt of IV in aqua regia (conc. HCl + HNO_3) 3:1 proportion dilute with water. Use this soln for C.T. Ni^{2+}		

3. C.T. for first detected radical C.T. for Ni^{2+}.

Test	Observations	Inference
1. Above soln + NH_4OH + dimethyl glyoxime	Scarlet Red ppt	Ni^{2+} confirmed.
2. Above soln + NaOH	Light green ppt	Ni^{2+} confirmed.

2. Analysis of second detected group

Test	Observations	Inference
1.		
2.		
3.		

3. C.T. for second detected radical

Test	Observations	Inference
1.		
2.		

Result:-

The given inorganic mixture no. 2 contains following two cations (Basic Radicals)

i) Ni^{2+} (Nickel)

ii) NH_4^+ (Ammonium)

Remark and sign of teacher: .....

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Experiment No. 25 (Mixture No. 3)

Date: / /

Aim : Analyse two basic (cation) radicals qualitatively from given inorganic mixture.

Apparatus : Test tubes, test tube holder, test tube stand, filter paper etc.

A. Preliminary tests:

Test	Observation	Inference
Color	White	Sr^{2+}, Ba^{+} may be Present
Nature	Crystalline	Water soluble salts like Nitrates, Sulphates & halides of NH_4^+, Al^{3+} etc may be present

B. Dry Tests for Basic radicals (Test tube must be dry for this test)

Test	Observation	Inference
1. Heating in a dry test tube:- Take a small quantity of the mixture a clean and in dry test tube and heat it strongly.	Formation of white sublimate	NH_4^+ may be Present
2. Charcoal Cavity Test: Mixture + Na_2CO_3 solid in 1:2 proportion placed in fresh charcoal cavity, moisten with a drop of water. Heat it with blow pipe in a reducing (yellow) flame	Substance fuses & sinks in the cavity	NH_4^+ or Ca^{2+} salt may be Present
3. NaOH Test: Mixture + NaOH solution & heat. Hold moist turmeric paper near the mouth of the test tube	Moist turmeric Paper turns brown	NH_4^+ may be Present
4. Flame Test: Prepare a paste of the given mixture with conc. HCl on a watch glass. Make a small loop at the end of the platinum wire & dip it in the mixture or use glass rod. Heat it on oxidising flame (Blue) observe the colour change of the flame.	Bluish green	Zn^{2+} & Mn^{2+} salt may be Present

C. Preparation of original solution (O.S)

Take a small quantity of mixture in a beaker add 20 mL of distilled water, stir with glass rod to dissolve the mixture. If mixture does not dissolve completely then warm it to dissolve. Clear solution is obtained, which is used as a O.S for further tests.

1. Analysis of Group zero (NH_4^+)

Test	Observation	Inference
1. O.S. + NaOH solution + Heat, test with moist turmeric paper.	Evolution of NH_3 gas which turns moist turmeric Paper brown	Group zero Present (NH_4^+)

2. O.S. + NaOH solution + Heat, Bring a glass rod dipped in conc. HCl. near the mouth of the test tube.	Dense white fumes of NH_4Cl	NH_4^+ Present
C.T. for NH_4^+ : i. O.S. + Nessler's reagent in excess	Brown ppt	NH_4^+ confirmed
ii. O.S + Picric Acid (2, 4, 6 trinitro phenol)	Yellow ppt of ammonium picrate	NH_4^+ confirmed

Detection of group (if group zero is absent, two groups must be detected following test)

Test	Observation	Inference
1. O.S. + dil. HCl	No ppt	Group Ist absent
2. O.S./Filtrate + dil HCl (heat) + H_2S gas or water	No Black ppt	Group IInd absent
3. O.S./Filtrate (Remove H_2S) + NH_4Cl (equal) + NH_4OH (till alkaline to litmus)	No ppt.	Group III absent
4. O.S./Filtrate + NH_4Cl (equal) + NH_4OH (till alkaline to litmus) + H_2S gas or water	White ppt	Group IV Present
5. O.S./Filtrate (Remove H_2S) + NH_4Cl (equal) + NH_4OH (till alkaline to litmus) +$(NH_4)_2CO_3$	No ppt	Group V absent
6. O.S./Filtrate + NH_4Cl (equal) + NH_4OH (till alkaline to litmus) + Na_2HPO_4	No ppt	Group VI absent

2. Analysis of first detected group (IV group)

Test	Observations	Inference
O.S + NH_4Cl + NH_4OH + H_2S gas	White ppt	Zn^{2+} Present.
Dissolve the white ppt in dil HCl & remove H_2S gas by boiling. Use this soln for C.T of Zn^{2+}.		

3. C.T. for first detected radical C.T. for Zn^{2+}

Test	Observations	Inference
1. O.S + NaOH	white ppt soluble in excess of NaOH but reprecipitated by H_2S	Zn^{2+} confirmed.
2. O.S + $K_4[Fe(CN)_6]$	white ppt	Zn^{2+} confirmed.

2. Analysis of second detected group

Test	Observations	Inference
1.		
2.		
3.		

3. C.T. for second detected radical

Test	Observations	Inference
1.		
2.		

Result:-

The given inorganic mixture no. 3 contains following two cations (Basic Radicals)

i) Zn^{2+} (Zinc cation)

ii) NH_4^+ (Ammonium)

Remark and sign of teacher: .....

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Activity No.5

Date: / /

Aim: Identify Resin Identification Code (RIC) / Recycle Symbols of plastics on different plastic materials.

Theory: The Resin Identification Code (RIC) was developed in 1988 by the plastics Industry association. It was created for workers in the plastic and recycling industry to be able to sort and recycle plastics more efficiently. Each RIC corresponds to a specific type of resin used in a plastic product.

Chronological order of when that plastic become recyclable :

'1' signifies that the product is made out of **polyethylene terephthalate** (PET) (beverage bottles, cups, water bottles, soft drink, etc.)

'2' signifies **high-density polythylene** (HDPE) For example (shampoo bottles, water bottles, milk bottles and jugs, etc.)

'3' signifies **polyvinyl chloride** (PVC) For example (PVC pipes, vinyl siding, flooring, window frames, etc.)

'4' signifies **low-density polyethylene** (LDPE) For example (plastic bags, shopping bags, soft bottles, tubing, squeezable bottles, etc.)

'5' signifies **polypropylene** (PP) For example (auto parts, industrial fibre , food containers, microwaveable wares, etc.)

'6' signifies **polystyrene** (PS) For example (plastic utensils, CD cases, styrofoam, toys, hard packings, cafeteria trays etc.)

'7' signifies other plastics, such as **acrylic, nylon, polycarbonate** and **polylactic acid** (PLA) for example. Baby feeding bottle, CD production etc.

* As per **United State Army Garrison-Hawaii** (USAG-HI) and **United State Environmental Protection Agency** (USEPA) the plastic material having number 6, 7 or with no number are not recyclable.

Apparatus: Various types of plastic materials, like mineral water bottle, transparent cell phone's back cover, PVC pipe, soft drink bottles, plastic milk bags, etc.

Procedure:

1. Take one by one given plastic material.
2. Observe the bottom or lower side or all sides of plastic material and find the triangle with number.
3. Mention your remark in observation table whether material is recyclable or not

Observation and Result Table:

Sr. No.	Name of Plastic Materials	RIC Code	Remark (Recyclable or Not)
1	Mineral Water bottle	1	Recyclable
2	Cell phone's transparent plastic back cover	6	Not Recyclable
3	PVC pipe	3	Recyclable
4	Plastic beaker	6	Not Recyclable
5	Baby's feeding bottle	7	Not Recyclable
6	Soft drink bottle	1	Recyclable
7	Plastic container (empty)	5	Recyclable

Remark and sign of teacher: .....

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MCQ

Select [✓] the most appropriate answer from given alternatives of each sub question.

1. The following symbol ♺ indicate

   ✓a. universal recycling b. universal decomposition
   c. universal reuse d. use and throw

2. The RIC code on cafeteria tray is .....

   a. 1 b. 3 c. 4 ✓d. 6

3. If RIC code on plastic material is 7 then which type of material will be there

   ✓a. polylactic acid b. polyethylene trephthalate
   c. high density polyethylene d. low density polyethylene

4. The RIC on auto vehicle part is .....

   a. 2 b. 4 ✓c. 5 d. 7

5. The code used for recycle symbols on diffrent plastic material is .....

   ✓a. RIC b. MIC c. TLC d. PPC

Short answer questions

1. What it indicates if there is no ♺ such symbol on plastic material?

Ans. The plastic material are not recyclable

2. Write RIC for beverage bottles?

Ans. The RIC for beverage bottle is 1.

3. ♺5 signifies which type of plastic material?

Ans. Polypropylene

4. Write RIC for food containers.

Ans. RIC for food container is 5

5. What was the purpose for development of RIC in 1988?

Ans. It was created for workers in plastic & recycling industry to be able for plastic more efficiency.

Remark and sign of teacher: .....

Activity No.6

Date: / /

Aim: To prepare 100 mL of 0.1 M standard solution of ferrous ammonium sulphate (Mohr's salt)

Theory: The molecular formula of ferrous ammoniun sulphate is $FeSO_4.(NH_4)_2SO_4.6H_2O$.

It molar mass is 392 g/mol.

1000 mL of 1 M solution of F.A.S. solution contains 392 g of $FeSO_4.(NH_4)_2SO_4.6H_2O$

Hence 100 mL of 0.1 M solution of F.A.S. will contains $= \frac{100 \times 0.1 \times 392}{1000 \times 1} = 3.92$ g of F.A.S.

Apparatus: 100 mL volumetric flask, beaker, glass rod, balance watch glass, etc.

Chemicals: F.A.S. (Mohr's salt), distilled water, dilute H_2SO_4

Procedure:

1. Weigh accurately 3.92 g Ferrous ammonium sulphate on watch glass.
2. Transfer the weighed F.A.S. to a beaker and wash the watch glass with distilled water and transfer washing to the beaker.
3. Add little distilled water to dissolve it by stirring.
4. Transfer the solution of F.A.S. from beaker to 100 mL standard flask.
5. Wash the beaker twice with distilled water and transfer washing to the standard flask.
6. Dilute the solution up to the mark on standard flask to make volume 100 mL.
7. Add few drops of H_2SO_4 to get clear solution.

Result/Conclusion: 0.1 M Standard Soln of Ferrous ammonium Sulphate is prepared.

Remark and sign of teacher: .....

MCQ

Select [✓] the most appropriate answer from given alternatives of each sub question.

1. The molar mass of F.A.S. is-----
   a. 392 u ✓b. 392 g/mol c. 39.2 u d. 39.2 g/mol
2. To prepare standard 1 M solution of F.A.S.....
   a. 0.392 g of F.A.S. of dissolved in distilled water and diluted to 1 L of solution
   b. 3.92 g of F.A.S. is dissolved in distilled water and diluted to 1 L of solution
   c. 39.2 g of F.A.S. is dissolved in distilled water and diluted to 1 L of solution
   ✓d. 392 g of F.A.S. is dissolved in distilled water and diluted to 1 L of solution
3. The second name for ferrous ammonium sulphate (F.A.S.) is .....
   a. Rochelle salt ✓b. Mohr's salt c. common salt d. sea salt
4. To prepare 100 mL of standard 0.1 M solution of F.A.S. .....
   a. 0.392 g of F.A.S. is dissolved in distilled water and diluted to 100 cm^3
   ✓b. 3.92 g of F.A.S. is dissolved in distilled water and diluted to 100 cm^3
   c. 39.2 g of F.A.S. is dissolved in distilled water and diluted to 100 cm^3
   d. 392 g of F.A.S. is dissolved in distilled water and diluted to 100 cm^3
5. The green colour of 0.1 M F.A.S. solution turns to which colour if we keep that solution open in an air for a long time?
   a. red b. blue ✓e. yellowish brown d. violet

Short answer questions

1. Calculate the amount of F.A.S. required to prepare 1000 mL of 0.1 M standard solution of F.A.S..

Ans. 392 gm of FAS is required to prepare 1000 ml of 1M soln. Hence 39.2 gm of FAS is required to prepare 1000 ml of 0.1 M. F.A.S. soln.

2. Calculate the molar mass of F.A.S. (Fe = 56, S = 32, N = 14, O = 16, H = 1)

Ans. $FeSO_4(NH_4)_2SO_4 \cdot 6H_2O$.

$(56+32+64)+(14+4)\times 2+32+16\times 4+12+96$

$= 392$ g/mol

3. Why the 0.1 M F.A.S. solution becomes yellowish brown on keeping open for a long time?

Ans. The 0.1 M F.A.S soln becomes Yellowish brown colour on keeping open for a long time because Fe^{+2} (green) ions undergoes oxidn to Fe^{3+} (Yellow brown ions)

4. Why it is necessary to add few drops of conc. H_2SO_4 in the preparation of F.A.S. solution?

Ans. It is necessary to add few drop of conc. H_2SO_4 in the preparation of F.A.S soln because of to get the clear soln & to prevent hydrolysis of Fe^{2+} ions or to prevent oxidn.

5. How many water of crystallisation are present in Mohr's salt?

Ans. In Mohr's Salt 6 number of H_2O molecule are present.

Remark and sign of teacher: .....