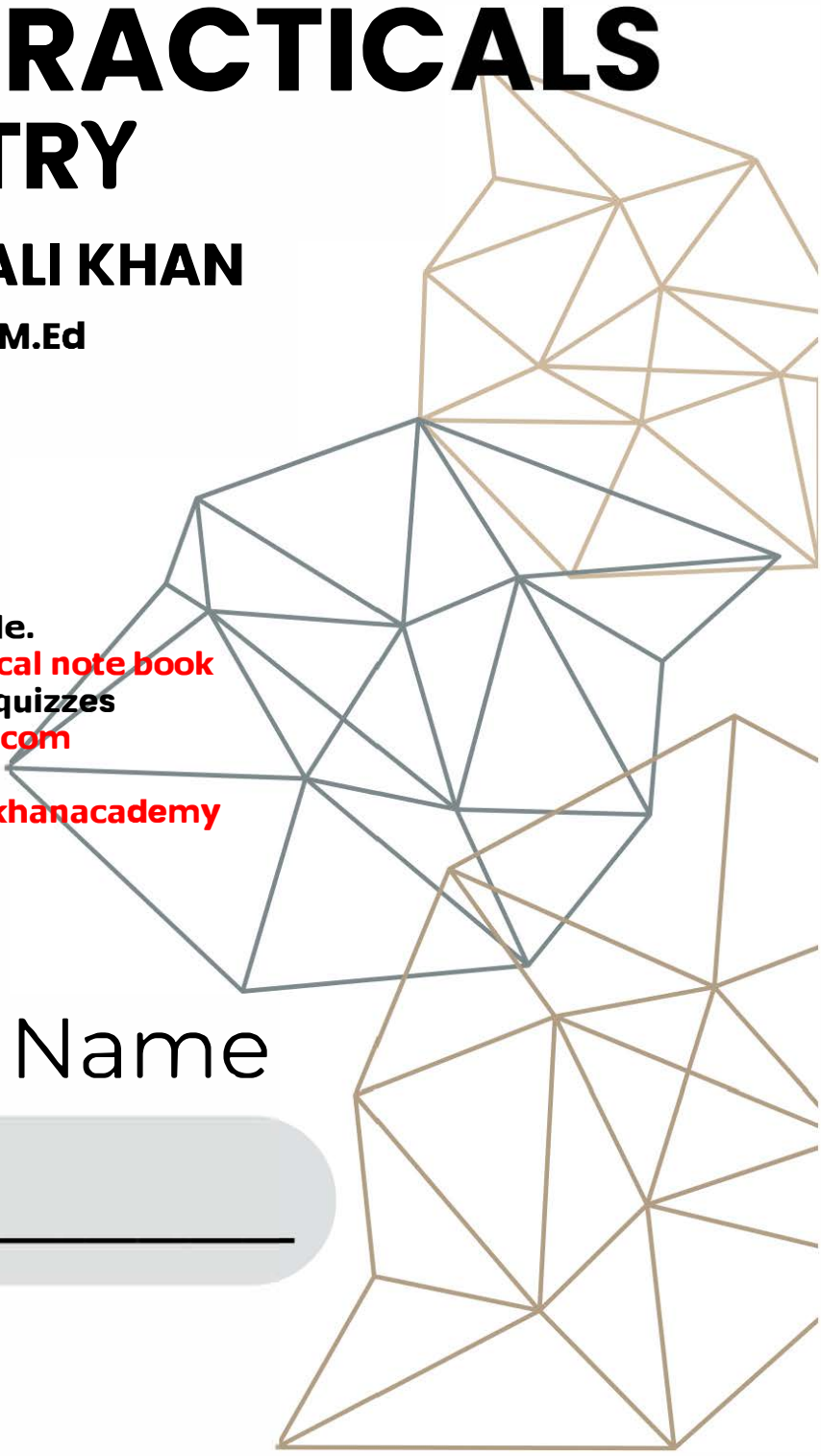
F.SC. PRACTICALS
CHEMISTRY

Lect. UMAIR ALI KHAN

M.phil (Chemistry) M.Ed



Useful Links
Click to watch lecture guide.
How to prepare your practical note book
Visit on Web for notes and quizzes
www.UmairKhanAcademy.com
Visit Youtube for lectures.
www.youtube.com/umairkhanacademy

Student Name

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F.Sc. Practical Syllabus

1. **Short experiments**
    a. Crystallization of Benzoic acid from water.
    b. Purify commercial preparation of NaCl by passing HCl gas.
    c. Separate the mixture of various inks by paper chromatography
    d. Separation and identification of lead and cadmium ions from the mixture by paper chromatography.
    e. Determine the heat of neutralization of NaOH and HCl.
2. **Titration (volumetric analysis)**
    a. Acid base titration
    b. Redox titration
        i. $KMnO_4$ titration
        ii. Iodimetry
3. **Detections**
    a. Detection of elements C, H, N, S and halogens in organic compounds.
    b. Detection of functional group. (Carboxylic acid, phenol and aldehyde are in notes)
4. **Preparations**
    a. Preparation of aspirin (acetyl salicylic acid)
    b. Preparation of iodoform
    c. Preparation of phenyl glucasazone.
    d. Preparation of copper ammine complex.
5. **Inorganic analysis (qualitative analysis or salt analysis)**
    a. Detection of Acid radical
    b. Detection of Basic radical
6. **Estimation of barium in the given sample solution, gravimetrically as chromate**

INSTRUCTION NOTE

1. In first 20 mints you have to write two experiments. Titration is of much importance. There are many experiments in practical notebook. Few important examples are included in notes. You have to write, same as mentioned in notes with supposed observations and calculation in exams, even writing in you practical notebook.
2. 2nd most important experiment is salt analysis (qualitative analysis), they can be performed with the help of scheme included in the notes.
3. Short experiments can be consulted in initial experiments from notebook.
4. If you want to learn more about experiments, such as
    a. How to perform basic experiment.
    b. How to make solutions.
    c. What are the basic concepts of titration
    d. How to perform salt analysis and how to write in exam.
    e. Basic definitions and concepts.
    f. Online help

    Then consult **UMAIR KHAN ACADEMY (Channel) At YouTube**
    Or Facebook page
    https://www.facebook.com/umairkhanacademy/

    Some links are given below

1. **Prepare 1 molar, 1000 ml solution of NaOH.**

https://youtu.be/_q7Q4md-ZCY

2. **Prepare 1 molar, 100 ml solution of NaOH.**

https://youtu.be/5jfpd-4w9tI

3. **Prepare 0.05 molar, 1000 ml solution of NaOH.**

https://youtu.be/-pX3jhG7tbg

4. **Prepare 1 molar, 1000 ml solution of oxalic Acid.**

https://youtu.be/oyXtSfhAmPU

5. **Prepare 1 molar, 50 ml solution of H2SO4 from stock molarity (18M)**

https://youtu.be/vQPOtyjuZxk

6. **Prepare 1 molar, 1000 ml solution of HCl from stock molarity (12M)**

https://youtu.be/xXOtRmtB4Wc

7. **Prepare 1 molar, 1000 ml solution of HCl from stock solution which is 37% of HCl having density 1.18 g/cm3.**

https://youtu.be/Cnx4gt3wUZ0

8. **A complete guide to titration (Very much informative)**

https://youtu.be/cD_GMCQd7UE

Quick Points to Learn

Some important acid base reactions

1. $HCl + NaOH \rightarrow NaCl + H_2O$ molar ratio 1:1
2. $2HCl + Na_2CO_3 \rightarrow H_2CO_3 + 2NaCl$ molar ratio 2:1
3. $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$ Molar ratio 1:2
4. $H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$ Molar ratio 1:2
5. $(COOH)_2 + 2NaOH \rightarrow (COONa)_2 + 2H_2O$ Molar ratio 1:2
6. $H_2SO_4 + Na_2CO_3 \rightarrow Na_2SO_4 + H_2CO_3$ Molar ratio 1:1
7. $H_2SO_4 + 2NaHCO_3 \rightarrow Na_2SO_4 + H_2CO_3$ Molar ratio 1:2
8. $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$ Molar ratio 1:**1**

Indicator

1. Phenolphthalein is used in case of strong bases such as NaOH, KOH.
2. Methyl orange is used in case of weak bases such as Na_2CO_3, Soap(NaOH)
3. **$KMnO_4$ Titration ($KMnO_4$ is used as oxidizing agent with following reducing reagents)**

i. $FeSO_4$ Molar Wt. 152 g/mol
ii. $FeSO_4.7H_2O$ Molar Wt. 278 g/mol
iii. $FeSO_4.(NH_4)_2SO_4.6H_2O$ Molar Wt. 392 g/mol (Mohar's salt)
iv. $(COOH)_2$ Molar Wt. 90 g/mol (Oxalic Acid)
v. $(COOH)_2.2H_2O$ Molar Wt. 126 g/mol
vi. $(COONa)_2$ Molar Wt. 134 g/mol (Sod. oxalate)
vii. $(COOK)_2$ Molar Wt. 166 g/mol (Pot. oxalate)
viii. $(COONH_4)_2$ Molar Wt. 124 g/mol (Amm. oxalate)

Important redox reactions

1. $2KMnO_4 + 8H_2SO_4 + 10FeSO_4.7H_2O \rightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 78H_2O$
2. $2KMnO_4 + 10FeSO_4.(NH_4)_2SO_4.6H_2O + 8H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 10(NH_4)_2SO_4 + 68H_2O$
3. $2KMnO_4 + 3H_2SO_4 + 5(COOH)_2.2H_2O \rightarrow K_2SO_4 + 2MnSO_4 + 10CO_2 + 18H_2O$
4. $2KMnO_4 + 8H_2SO_4 + 5(COONa)_2 \rightarrow K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O + 5\ Na_2SO_4$
5. $2KMnO_4 + 8H_2SO_4 + 5(COONH_4)_2 \rightarrow K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O + 5\ (NH4)_2SO_4$
6. $2KMnO_4 + 8H_2SO_4 + 5(COOK)_2 \rightarrow 6\ K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O$
7. $2Na_2S_2O_3 + I_2 \rightarrow Na_2S_2O_6 + 2NaI$ (Iodimetry, redox reaction)

Standard Solution

The solution with known concentration (molarity) is called standard solution.

Molar Ratio

Molar ratio is indicated by balanced chemical equation.

Question No. 1: Separate and identify the mixture of various inks by paper chromatography.

Apparatus and Chemicals

Whatman filter paper strip, chromatographic tank, beaker, given mixture of inks, solvent (Ethanol, water), capillary tube jet, scale, lead pencil

Procedure

1. Take a strip of Whatman filter paper, 20cm long.
2. Draw a line 2.5cm apart from one end of this strip with the help of lead pencil and mark 'X' in middle.
3. Put a small drop of ink mixture on the mark.
4. Now hang down the strip in chromatographic tank or beaker to dip one end (having mixture spot) in the solvent in a way, mixture spot remains outside from solvent.
5. Allow to stand the strip, till solvent travels ¾ part of it and different ink colour spots are visible.
6. Now, remove the strip, stand to dry.
7. Note the distance covered by solvent and different inks.
8. Calculate Rf value for each component by the given formula.

$$R_f = \frac{Distance\ (cm)\ travelled\ by\ spot\ from\ original\ ilne}{Distance\ (cm)\ travelled\ by\ solvent\ front\ from\ original\ ilne}$$

Result: I separated the colours of different inks from given inks mixture and shown to the examiner.

Question No. 2: Separate and identify the mixture of Pb^{2+} and Cd^{2+} ions from their solutions by paper chromatography.

Apparatus and Chemicals

Whatman filter paper strip, chromatographic tank, beaker, given mixture of Pb^{2+} and Cd^{2+} ions, solvent (Acetone 2volume, *ter*-Butyl alcohol 2 volume, dil HNO_3 1 volume), H_2S solution, capillary tube jet, scale, lead pencil.

Procedure

1. Take a strip of Whatman filter paper, 20cm long.
2. Draw a line 2.5cm apart from one end of this strip with the help of lead pencil and mark 'X' in middle.
3. Put a small drop of Pb^{2+} and Cd^{2+} mixture on the mark.
4. Now hang down the strip in chromatographic tank or beaker to dip one end (having mixture spot) in the solvent in a way, mixture spot remains outside from solvent.
5. Allow to stand the strip, till solvent travels ¾ part of it.
6. Now, remove the strip, stand to dry.
7. Use locating agent (H_2S solution or ammonium sulphide soulution) to locate the spots of Pb^{2+} and Cd^{2+} ions.
8. Note the distance covered by solvent and Pb^{2+} and Cd^{2+} ions.
9. Calculate Rf value for each ion by the given formula.

$$R_f = \frac{Distance\ (cm)\ travelled\ by\ spot\ from\ original\ ilne}{Distance\ (cm)\ travelled\ by\ solvent\ front\ from\ original\ ilne}$$

Result: **I separated the Pb^{2+} and Cd^{2+} ions from given mixture and shown to the examiner.**

Question No. 3: Purify the given sample of benzoic acid by crystallization method.

Apparatus and Chemicals

Benzoic acid, water, spirit lamp, filters paper, glass rod, beaker, funnel, tripod stand.

Procedure

1. Take 50 ml water in 250 ml beaker and boil the water on tripod stand.
2. Add given sample of benzoic acid in small fractions with constant stirring till appropriate amount is added. (Do not make saturated or super saturated solutions)
3. Filter the hot solution through filter paper and funnel and filtrate is obtained in china dish.
4. Cool the filtrate, pure colourless, odourless crystalline needles of benzoic acid are obtained.
5. Dry the crystals between two folds of filter paper.

Result: I purified the given sample of benzoic acid by crystallization and shown to examiner.

Question No. 4: Purify the given sample of common salt by passing HCl gas.

Apparatus and Chemicals

Beaker, funnel, round bottom flask, gas burner or spirit lamp, glass tubing, NaCl, H_2SO_4

Procedure

1. Dissolve some quantity of impure salt in a beaker. Filter it in another beaker with filtering apparatus.
2. In a round bottom flask NaCl is reacted with Conc. H_2SO_4, dropped from thistle funnel, as a result HCl gas is formed which is passed through rubber tubing joined to the inverted funnel onto impure solution (filtrate of point 1) of sodium chloride.

$$2NaCl + H_2SO_4 \longrightarrow Na_2SO_4 + 2HCl$$

3. White, pure crystals of sodium chloride are separated out due to common ion effect.
4. Dry them in folding of filter paper.

Result: I purified the given sample of NaCl and shown to examiner.

Question No. 5: Determine the heat of neutralization of strong acid (HCl) and strong Base (NaOH).

Apparatus and Chemicals

Calorimeter with stirrer, thermometer, balance, beaker, glass rod, 0.1M HCl and 0.1M NaOH

Procedure

1. Take 50ml 0.1M NaOH solution in calorimeter and note the initial temperature (T1) by thermometer.
2. Now, add 50ml 0.1M HCl solution in calorimeter, neutralization reaction get started and heat is evolved.
3. Note the increasing temperature after each 10 seconds interval.
4. When temperature becomes uniform, it is noted as final temperature (T2)
5. Note the weight of calorimeter before adding solutions (M1) and after adding both solutions (M2).
6. Calculate the heat of neutralization as follows.

Volume of HCl or NaOH = **V** = **50ml**

Molarity of HCl and NaOH = **M** = **0.1M**

Specific Heat of Calorimeter = **S1** = **0.380 J/gK**

Specific Heat of Solution = **S2** = **4.18 J/gK**

Rise in temperature = **θ** = **T2- T1**

= **35.72-35**

= **0.72 °C**

Heat of neutralization

$$= \frac{(M1\,S1 + M2\,S2)}{1000} \times \frac{1000}{V \times M}$$

$$= \frac{(50.5 \times 0.38 + 91.5 \times 4.18)}{1000} \times \frac{1000}{50 \times 0.1}$$

= **57.4 kJ/mole**

Result: I determined heat of neutralization of strong acid (HCl) and strong base (NaOH) by calorimeter and I found it as -57.4 kJ/mole. (exothermic)

Question: 01

The given solution contains 6g of a mixture of HCl and NaCl dissolve per litre. Determine the percentage composition of the mixture. You are provided with 0.1M NaOH.

Principle It is an acid base titration.
Standard Solution 0.1M NaOH
Chemical Equation $NaOH + HCl \rightarrow NaCl + H_2O$
Molar ratio $n_1 = 1, \quad n_2 = 1$
Indicator Phenolphthalein
End point Light pink
Procedure

The given solution of HCl mixture is taken in burette and run down drop wise in the conical flask, having 10ml NaOH solution with few drops of phenolphthalein, till the end point is reached which is light pink. Three concordant readings are taken for volume of acid used.

Observations

Sr. NO	Initial reading	Final reading	Volume of Acid used
1	0	10	10 ml
2	10	20	10 ml
3	20	30	10 ml

Concordant Reading (V_1) = 10 ml

Calculations

Acid = Base

$$\frac{M_1V_1}{n_1} = \frac{M_2V_2}{n_2}$$

$$\frac{M_1\ 10}{1} = \frac{0.1\ X\ 10}{1}$$

$$M_1 = \frac{0.1\ X\ 10\ X\ 1}{1\ X\ 10}$$

Molarity of HCl = 0.1 M

Amount dissolve per litre of HCl = Molarity x Molecular. Wt.

= 0.1 x 36.5

= 3.65g

Amount dissolve per litre of NaCl = 6- 3.65

= 2.35g

% age composition of HCl = $\frac{3.65}{6} X\ 100$

= **60.83%**

% age composition of NaCl = $\frac{2.35}{6} X\ 100$

= **39.17%**

Question: 02

The given solution contains 8g of a mixture of Oxalic acid and sodium oxalate dissolve in 1000ml. Determine the percentage composition of sodium oxalate the mixture.

Principle It is an acid base titration.
Standard Solution 0.1M NaOH
Chemical Equation
$(COOH)_2 + 2NaOH \rightarrow (COONa)_2 + 2H_2O$
Molar ratio (Acid) $n_1 = 1, \quad n_2 = 2$
Indicator Phenolphthalein
End point Light pink
Procedure

The given solution of oxalic acid mixture is taken in burette and run down drop wise in the conical flask, having 10ml NaOH solution with few drops of phenolphthalein, till the end point is reached which is light pink. Three concordant readings are taken for volume of acid used.

Observations

Sr. NO	Initial reading	Final reading	Volume of Acid used
1	0	10	10 ml
2	10	20	10 ml
3	20	30	10 ml

Concordant Reading (V_1) = 10 ml

Calculations

Acid = Base

$$\frac{M_1V_1}{n_1} = \frac{M_2V_2}{n_2}$$

$$\frac{M_1\ 10}{1} = \frac{0.1\ X\ 10}{2}$$

$$M_1 = \frac{0.1\ X\ 10\ X\ 1}{2\ X\ 10}$$

Molarity of oxalic acid = 0.05 M

Amount dissolve per litre of oxalic acid = Molarity x Molecular. Wt.

= 0.05 x 126

= 6.3 g

Amount dissolve per litre of sodium oxalate = 8- 6.3

= 1.7g

% age composition of oxalic acid = $\frac{6.3}{8} X\ 100$

= **78.75%**

% age composition of sodium oxalate = $\frac{1.7}{8} X\ 100$

= **21.25%**

Question: 03

The given solution contains 6.3g of $(COOH)_2$. xH_2O dissolve in litre (1000ml). Find out the value of "x". You are provided with 0.1M NaOH.

Principle It is an acid base titration.

Standard Solution 0.1M NaOH

Chemical Equation

$(COOH)_2.xH_2O + 2NaOH \rightarrow (COONa)_2 + (2+x)H_2O$

Molar ratio (Acid) $n_1 = 1$, $n_2 = 2$

Indicator Phenolphthalein

End point Light pink

Procedure

The given solution of oxalic acid is taken in burette and run down drop wise in the conical flask, having 10ml NaOH solution with few drops of phenolphthalein, till the end point is reached which is light pink. Three concordant readings are taken for volume of acid used.

Observations

Sr. NO	Initial reading	Final reading	Volume of Acid used
1	0	10	10 ml
2	10	20	10 ml
3	20	30	10 ml

Concordant Reading (V_1) = 10 ml

Calculations

Acid		Base
$\frac{M_1V_1}{n_1}$	=	$\frac{M_2V_2}{n_2}$
$\frac{M_1\ 10}{1}$	=	$\frac{0.1\ X\ 10}{2}$
M_1	=	$\frac{0.1\ X\ 10\ X\ 1}{2\ X\ 10}$
Molarity of oxalic acid	=	0.05 M
Amount dissolve per litre of oxalic acid	=	Molarity x Molecular. Wt.
6.3g/l	=	0.05 X (90 + 18x)
$\frac{6.3}{0.05}$	=	90 + 18x
126	=	90 + 18x
126 -90	=	18x
36		18x
$\frac{36}{18}$	=	x
2	=	x

Result

Water molecules of crystallization in oxalic acid are two

Question: 04

Determine the solubility of oxalic acid at room temperature. You are provided with 0.1M NaOH.

Principle It is an acid base titration.

Standard Solution 0.1M NaOH

Chemical Equation

$(COOH)_2. + 2NaOH \rightarrow (COONa)_2 + 2H_2O$

Molar ratio (Acid) $n_1 = 1$, $n_2 = 2$

Indicator Phenolphthalein

End point Light pink

Procedure

Clear saturated solution of oxalic acid at room temperature is prepared and 5ml of this solution is taken to make it 100 ml by diluting. This solution of oxalic acid is taken in burette and run down drop wise in the conical flask, having 10ml NaOH solution with few drops of phenolphthalein, till the end point is reached which is light pink. Three concordant readings are taken for volume of acid used.

Observations

Sr. NO	Initial reading	Final reading	Volume of Acid used
1	0	10	10 ml
2	10	20	10 ml
3	20	30	10 ml

Concordant Reading (V_1) = 10 ml

Calculations

Acid		Base
$\frac{M_1V_1}{n_1}$	=	$\frac{M_2V_2}{n_2}$
$\frac{M_1\ 10}{1}$	=	$\frac{0.1\ X\ 10}{2}$
M_1	=	$\frac{0.1\ X\ 10\ X\ 1}{2\ X\ 10}$
Molarity of oxalic acid	=	0.05 M
Amount dissolve per litre of oxalic acid	=	Molarity x Molecular. Wt.
	=	0.05 x 126
	=	6.3 g/l
1000ml of dilute oxalic acid contains	=	6.3g
1ml of dilute oxalic acid contains	=	$\frac{6.3}{1000}$
100ml of dilute oxalic acid contains	=	$\frac{6.3}{1000}\ X\ 100$

	=	0.63g
5ml of oxalic acid saturated solution	=	100 ml of dilute solution
100 ml of dilute solution contains	=	0.63g
5ml of oxalic acid solution contains	=	0.63g
1ml of oxalic acid solution	=	$\frac{0.63}{5}$
100ml of oxalic acid solution contains	=	$\frac{0.63}{5} X\ 100$
	=	12.6g

Result

Solubility of oxalic acid at room temperature is 12.6g

Question: 05

Determine the weight of monovalent metal M. When 4g of its hydroxide (MOH) are dissolve per litre in the given solution. You are provided with 0.1M HCl.

Principle It is an acid base titration.

Standard Solution 0.1M HCl

Chemical Equation $MOH + HCl \rightarrow MCl + H_2O$

Molar ratio $n_1 = 1, \quad n_2 = 1$

Indicator Phenolphthalein

End point Light pink

Procedure

The given solution of HCl is taken in burette and run down drop wise in the conical flask, having 10ml MOH solution with few drops of phenolphthalein, till the end point is reached which is light pink. Three concordant readings are taken for volume of acid used.

Observations

Sr. NO	Initial reading	Final reading	Volume of Acid used
1	0	10	10 ml
2	10	20	10 ml
3	20	30	10 ml

Concordant Reading (V_2) = 10 ml

Calculations

Base		Acid
$\frac{M_1V_1}{n_1}$	=	$\frac{M_2V_2}{n_2}$
$\frac{M_1\ 10}{1}$	=	$\frac{0.1\ X\ 10}{1}$
M_1	=	$\frac{0.1\ X\ 10\ X\ 1}{1\ X\ 10}$
Molarity of MOH	=	0.1 M
Amount dissolve per litre of MOH	=	Molarity x Molecular. Wt.
4	=	0.1 x (M+16+1)
$\frac{4}{0.1}$	=	M+ 17
40	=	M+ 17
40 - 17	=	M
23g/mol	=	M

Result **The atomic weight of M is 23 g/mol. Which is considers as wt. of Na.**

Question: 06

The given solution contains 6g of a impure NaOH dissolve per litre. Determine the % age purity of the sample. You are provided with 0.1M HCl solution.

Principle It is an acid base titration.

Standard Solution 0.1M HCl

Chemical Equation $NaOH + HCl \rightarrow NaCl + H_2O$

Molar ratio $n_1 = 1, \quad n_2 = 1$

Indicator Phenolphthalein

End point Light pink

Procedure

The given solution of HCl is taken in burette and run down drop wise in the conical flask, having 10ml impure NaOH solution with few drops of phenolphthalein, till the end point is reached which is light pink. Three concordant readings are taken for volume of acid used.

Observations

Sr. NO	Initial reading	Final reading	Volume of Acid used
1	0	10	10 ml
2	10	20	10 ml
3	20	30	10 ml

Concordant Reading (V_2) = 10 ml

Calculations

Base		Acid
$\frac{M_1V_1}{n_1}$	=	$\frac{M_2V_2}{n_2}$
$\frac{M_1\ 10}{1}$	=	$\frac{0.1\ X\ 10}{1}$
M_1	=	$\frac{0.1\ X\ 10\ X\ 1}{1\ X\ 10}$
Molarity of NaOH	=	0.1 M
Amount dissolve per litre of NaOH	=	Molarity x Molecular. Wt.
	=	0.1 x 40
	=	4g
6g of impure sample contains	=	4g of pure NaOH
1g of impure sample contains	=	$\frac{4}{6}$
100g of impure sample contains	=	$\frac{4}{6} X\ 100$
		66.6%

Result: % age purity of NaOH is 66.6%

Question: 07

6.5 grams of an impure sample of $KMnO_4$ is dissolves per litre. Determine the percentage of Mn present in the given solution. 0.1M Mohar's satl solution is given.

Principle It is a Redox titration.

Standard Solution 0.1M Mohar's salt solution

Chemical Equation

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

Molar ratio

($KMnO_4$) $n_1 = 2$, ($FeSO_4.(NH_4)_2SO_4.6H_2O$) $n_2 = 10$

Indicator $KMnO_4$ Itself

End point Light pink

Procedure

The given solution of $KMnO_4$ is taken in burette and run down drop wise in the conical flask, having 10ml Mohar's salt solution and half test tube of dil. H_2SO_4, till the end point is reached which is light pink. Three concordant readings are taken for volume of $KMnO_4$ used.

Observations

Sr. NO	Initial reading	Final reading	Volume of $KMnO_4$ used
1	0	10	10 ml
2	10	20	10 ml
3	20	30	10 ml

Concordant Reading (V_1) = 10 ml

Calculations

$KMnO_4$		Mohar's Salt
$\frac{M_1V_1}{n_1}$	=	$\frac{M_2V_2}{n_2}$
$\frac{M_1\ 10}{2}$	=	$\frac{0.1\ X\ 10}{10}$
M_1	=	$\frac{0.1\ X\ 10\ X\ 2}{10\ X\ 10}$
Molarity of KMnO4	=	0.02 M
Amount of Mn dissolve per litre	=	Molarity x Atomic weight of Mn^{+2}
	=	0.02 x 55
	=	1.1g
% age of Mn in the given solution	=	$\frac{1.1}{6.5} X\ 100$
	=	**16.92%**

Question: 08

The given solution contains 10 grams of mixture of ammonium oxalate and ammonium sulphate dissolved per litre. Find out the %age composition of the mixture, you are provided with 0.02M $KMnO_4$.

Principle It is a Redox titration.

Standard Solution 0.02M KMnO4 solution

Chemical Equation

$2KMnO_4 + 8H_2SO_4 + 5(NH_4)_2C_2O_4.H_2O \rightarrow$
$K_2SO_4 + 2MnSO_4 + 5(NH_4)_2SO_4 + 10CO_2 + 13H_2O$

Molar ratio

$(KMnO_4)\ n_2 = 2$, $(NH_4)_2C_2O_4.H_2O\ n_1 = 05$

Indicator $KMnO_4$ Itself

End point Light pink

Procedure

The given solution of $KMnO_4$ is taken in burette and run down drop wise in the conical flask, having 10ml of mixture solution and half test tube of dil. H_2SO_4+ heat to 60 ^{0}C, till the end point is reached which is light pink. Three concordant readings are taken for volume of $KMnO_4$ used.

Observations

Sr. NO	Initial reading	Final reading	Volume of $KMnO_4$ used
1	0	10	10 ml
2	10	20	10 ml
3	20	30	10 ml

Concordant Reading (V_2) = 10 ml

Calculations

$(NH_4)_2C_2O_4.H_2O$ $KMnO_4$

$$\frac{M_1V_1}{n_1} = \frac{M_2V_2}{n_2}$$

$$\frac{M_1\ 10}{5} = \frac{0.02\ X\ 10}{2}$$

$$M_1 = \frac{0.02\ X\ 10\ X\ 5}{2\ X\ 10}$$

Molarity of Amm.Oxalate = 0.05 M

Amount of Amm.Oxalate dissolve per litre = Molarity x Mol. weight

= 0.05 x 142

= 7.1g

10g of mixture contains Amm.Oxalate = 7.1g

1g of mixture contains Amm.Oxalate = 7.1/10

100g of mixture contains Amm.Oxalate = $\frac{7.1}{10}\ X\ 100$

= **71 g or 71%**

%age of Amm.Oxalate in the mixture = **71%**

%age of Amm.sulphate in the mixture = 100-71= **29%**

Question: 09

Determine the no. of molecules of water of crystallization in a given sample of oxalic acid by $KMnO_4$ titration. The amount of oxalic acid dissolved per litre is 6.3g.

Principle It is a Redox titration.

Standard Solution 0.02M KMnO4 solution

Chemical Equation

$2KMnO_4 + 3H_2SO_4 + 5(COOH)_2.xH_2O \rightarrow$
$K_2SO_4 + 2MnSO_4 + 10CO_2 + (5x+8)H_2O$

Molar ratio

$(KMnO_4)\ n_2 = 2$, $[(COOH)_2.xH_2O]\ n_1 = 05$

Indicator $KMnO_4$ Itself

End point Light pink

Procedure

The given solution of $KMnO_4$ is taken in burette and run down drop wise in the conical flask, having 10ml of oxalic acid solution and half test tube of dil. H_2SO_4+ heat to 60 ^{0}C, till the end point is reached which is light pink. Three concordant readings are taken for volume of $KMnO_4$ used.

Observations

Sr. NO	Initial reading	Final reading	Volume of $KMnO_4$ used
1	0	10	10 ml
2	10	20	10 ml
3	20	30	10 ml

Concordant Reading (V_2) = 10 ml

Calculations

$(COOH)_2$ $KMnO_4$

$$\frac{M_1V_1}{n_1} = \frac{M_2V_2}{n_2}$$

$$\frac{M_1\ 10}{5} = \frac{0.02\ X\ 10}{2}$$

$$M_1 = \frac{0.02\ X\ 10\ X\ 5}{2\ X\ 10}$$

Molarity of Oxalic Acid = 0.05 M

Amount of $(COOH)_2$ dissolve per litre = Molarity x Mol. weight

6.3 = 0.05 x (90+18x)

126/0.05 = 90+18x

126 = 90+18x

126-90 = 18x

36/18 = x

x = **2**

Result: No. of molecules of crystallization in oxalic acid are two

Question: 10

The given solution contains 30g of partially oxidized $FeSO_4.7H_2O$ dissolve per litre. Determine the %age oxidation of given Sample.

Principle It is a Redox titration.

Standard Solution 0.02M KMnO4 solution

Chemical Equation

$2KMnO_4 + 8H_2SO_4 + 10FeSO_4.7H_2O \rightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 78H_2O$

Molar ratio

$(KMnO_4)\ n_2 = 2$, $(FeSO_4.7H_2O)\ n_1 = 10$

Indicator $KMnO_4$ Itself

End point Light pink

Procedure

The given solution of $KMnO_4$ is taken in burette and run down drop wise in the conical flask, having 10ml of partially oxidized ferrous sulphate solution and equal volume of dil. H_2SO_4, till the end point is reached which is light pink. Three concordant readings are taken for volume of $KMnO_4$ used.

Observations

Sr. NO	Initial reading	Final reading	Volume of $KMnO_4$ used
1	0	10	10 ml
2	10	20	10 ml
3	20	30	10 ml

Concordant Reading (V_2) = 10 ml

Calculations

Ferrous sulphate		$KMnO_4$
$\frac{M_1V_1}{n_1}$	=	$\frac{M_2V_2}{n_2}$
$\frac{M_1\ 10}{10}$	=	$\frac{0.02\ X\ 10}{2}$
M_1	=	$\frac{0.02\ X\ 10\ X\ 10}{2\ X\ 10}$
Molarity of Oxalic Acid	=	0.1 M
Amount of $FeSO_4$ dissolve per litre	=	Molarity x Mol. weight
	=	0.1 x 278
	=	**27.8g**
Amount of already oxidized $FeSO_4.7H_2O$ to $Fe_2(SO4)_3$	=	30 - 27.8= **2.2**
%age of $Fe_2(SO_4)_3$	=	$\frac{2.2}{30} X\ 100$
	=	**7.333%**

Result: Percentage of oxidation is 7.333%

Question: 11

Determine the amount of iodine per litre in the given sample solution. You are provided with 0.1M $Na_2S_2O_3$ (hypo) solution.

Principle It is a Redox titration (Iodimetry)

Standard Solution 0.1M $Na_2S_2O_3$ solution

Chemical Equation

$2Na_2S_2O_3 + I_2 \rightarrow Na_2S_2O_6 + 2NaI$

Molar ratio

(Iodine) $n_1 = 1$, $(Na_2S_2O_3)\ n_2 = 2$

Indicator

Freshly prepared Starch Solution

End point just colourless

Procedure

10ml of iodine solution is taken in conical flask and diluted it with a test tube full of water. Hypo ($Na_2S_2O_3$) solution is taken in burette and run drop wise in iodine solution until dark brownish colour of iodine changed to pale yellow colour and then about 2ml of freshly prepared starch solution as indicator is added which turned the solution colour into intensely blue. Now more hypo is run down drop wise until the solution changed to just colourless. Three concordant readings are taken for volume of hypo used

Observations

Sr. NO	Initial reading	Final reading	Volume of Hypo used
1	0	25	25 ml
2	10	35	25 ml
3	20	45	25 ml

Concordant Reading (V_2) = 25 ml

Calculations

Iodine		Hypo ($Na_2S_2O_3$)
$\frac{M_1V_1}{n_1}$	=	$\frac{M_2V_2}{n_2}$
$\frac{M_1\ 10}{1}$	=	$\frac{0.1\ X\ 25}{2}$
M_1	=	$\frac{0.1\ X\ 25\ X\ 1}{2\ X\ 10}$
Molarity of iodine	=	0.125 M
Amount of Iodine dissolve per litre	=	Molarity x Mol. weight
	=	0.125 x 254

= **31.75g**

Result: A/L of iodine is 31.75g

Question: 12

Calculate the percentage purity of the given impure sample of hypo, 80g of which are dissolved per litre of the solution. You are provided with 0.05M iodine solution.

Principle It is a Redox titration (Iodimetry)

Standard Solution 0.05M iodine solution

Chemical Equation

$2Na_2S_2O_3 + I_2 \rightarrow Na_2S_2O_6 + 2NaI$

Molar ratio

$(Na_2S_2O_3)\ n_1 = 2$, (Iodine) $n_2 = 1$

Indicator

Freshly prepared Starch Solution

End point just colourless

Procedure

10ml of iodine solution is taken in conical flask and diluted it with a test tube full of water. Hypo ($Na_2S_2O_3$) solution is taken in burette and run drop wise in iodine solution until dark brownish colour of iodine changed to pale yellow colour and then about 2ml of freshly prepared starch solution as indicator is added which turned the solution colour into intensely blue. Now more hypo is run down drop wise until the solution changed to just colourless. Three concordant readings are taken for volume of hypo used

Observations

Sr. NO	Initial reading	Final reading	Volume of Hypo used
1	0	25	25 ml
2	10	35	25 ml
3	20	45	25 ml

Concordant Reading (V_1) = 25 ml

Calculations

Hypo ($Na_2S_2O_3$) **Iodine**

$$\frac{M_1V_1}{n_1} = \frac{M_2V_2}{n_2}$$

$$\frac{M_1\ 25}{2} = \frac{0.05\ X\ 10}{1}$$

$$M_1 = \frac{0.05\ X\ 10\ X\ 2}{1\ X\ 25}$$

Molarity of hypo = **0.25 M**

Amount of hypo dissolve per litre = **Molarity x Mol. weight**

= **0. 25 x 248**

= **62g**

%age purity of hypo = $\frac{62}{80} X\ 100$

= **77.5%**

Result: Percentage purity of Hypo is 77.5 %

Experiment 1

Estimation of Barium ions as Barium chromate

Material Required

Ba^{2+} ions solution, K_2CrO_4 solution

Apparatus

Beakerm funnel tripod stand, burner wire gauze, oven, measuring cylinder, filter paper. etc.

Chemical Equation

$$Ba^{2+} K_2CrO_4 \longrightarrow BaCrO_4 + 2K^+$$

Procedure

i) Take 20 cm^3 of Ba^{2+} ions solution in a beaker.
ii) Now add K_2CrO_4 in excess in order to precipitate Ba^{2+} ions as $BaCrO_4$.
iii) Boil this solution for 2–3 minutes to increase precipitate.
iv) Filter the solution through a pre-weighed filter paper to get ppt.
v) Wash the ppt. with hot water.
vi) Dry the crystals and weigh them.

Observation & Calculation

Volume of Ba^{2+} solution taken = $20cm^3$
Mass of filter paper = 0.5g
Mass of filter paper + ppt. = 1.25g
Mass of $BaCrO_4$ ppt. = 1.25 – 0.5 = 0.75g
Molecular mass of $BaCr_4$ = 253.33 g/mol
Atomic mass of Ba^{2+} = 137.33 g/mol

Thus

253.33g $BaCrO_4$ contains Ba^{2+} ions = 137.33g

0.75 g $BaCrO_4$ contains Ba^{2+} ions $= \frac{137.33 \times 0.75}{253.33} = 0.406g$

$20cm^3$ of the given solution contains Ba^{2+} ion = 0.406g

$100cm^3$ of the given solution contains Ba^{2+} ions $= \frac{0.406 \times 100}{20} = 2.03$

Results

The given solution contains 2.03 g of Ba^{2+} ions in 100 cm^3 of solution.

Experiment 2

Detection of Elements in an Organic compound (N,S,Hologen)

Preparation of Lassaigne's solution (L.S.)

i) Take a small piece of freshly cut sodium metal in a dry fusion tube.
ii) Heat the fusion tube in the flame until sodium metal melts.
iii) Add a small quantity of given organic compound in it.
iv) Heat the mixture carefully till red hot.
v) Put the fusion tube in a china dish containing about 10 cm^3 of distilled water.
vi) Break the fusion tube and boil the solution for 5 minutes.
vii) This solution is used for detection of elements (N,S & Halogens)
viii) Filter the solutions. The filtrate called as Lassgne's solution or extract.

Test for nitrogen

Experiment	Observation	Inference
Sodium extract + few drops of NaOH + freshly prepared $FeSO_4$ + boiled + cooled + few drops of H_2SO_4	i) Prussian blue colour or ppt. formed. ii) Blood red colour appeared.	Nitrogen is present. Both Nitrogen & sulphur are present.

Test for Sulphur

Experiment	Observation	Inference
Sodium extract + Dil. CH_3COOH+ $(CH_3COO)_2Pb$ solution.	Black ppt. of lead sulphate are formed.	Sulphur is present.

Test for Halogens

Experiment	Observation	Inference
Sodium extract + few drops of Conc. HNO_3 + boiled + cooled + $AgNO_3$ solution.	i) White ppt. soluble in excess of NH_4OH. ii) Pale yellow ppt. sparingly soluble in NH_4OH solution. iii) Yellow ppt in insoluble in NH_4OH solution.	Chlorine is present. Bromine is present. Iodine is present.

Experiment 3

Identification of functional groups in a simple organic compounds

i) Identification of Carboxylic acids

r.No	Experiment	Observation	Inference
1	**Litmus Test** Aq. Solution + blue litmus solution.	Blue litmus turned red.	May be an acidic compound (carboxylic acids).
2	**$NaHCO_3$ Test** Aq. Solution + 5% $NaHCO_3$ solution	A coloureless odourless gas evolved with effervescence, turned lime water milky (CO_2 gas)	May be carboxylic acids.
3	**Ester Formation Test** Organic compound + Ethanol + few drops of Conc. H_2SO_4	Fruity smell evolved due to ester formation	Carboxylic acid is confirmed.
4	**$FeCl_3$ Test** Organic compound + few drops of neutral $FeCl_3$ solution.	Red dish brown	Carboxylic acid is confirmed.

Result: The given organic compound is a carboxylic acid.

ii) Identification of Phenols

Sr.No	Experiment	Observation	Inference
1	**Litmus Test** Aq. Solution + blue litmus solution.	Blue litmus becomes red.	May be an acidic compound (carboxylic acids, phenols).
2	**$NaHCO_3$ Test** Organic compound +5% $NaHCO_3$	No effervescences	Carboxylic acids are absent.
3	**NaOH Test** Organic compound +5% NaOH. Solution.	Organic compound is soluble.	Phenols are indicated.
4	**$FeCl_3$ Test** Organic compound + few drops of neutral $FeCl_3$.	Blue/purple colouration formed.	Phenol is confirmed.
5	**Bromine Water Test** Organic compound + Bromine water	White ppt. formed	Phenol is confirmed.

Result: The given organic compound is a phenol.

iii) Identification of Aldehyde

Sr.No	Experiment	Observation	Inference
	Litmus Test Aq. Solution + blue litmus solution.	No change	Acidic compound absent.
1	**$NaHCO_3$ Test** Organic compound +5% $NaHCO_3$ solution	Insoluble	Carboxylic acids are absent.
2	**NaOH Test** Organic compound +5% NaOH. Solution.	No reaction occurred.	Phenols are absent.
3	**2,4 Dinitrophenyl hydrazine test** Organic compound + 2,4–DNPH	Yellow ppt. formed	Aldehyde or ketone is present.
4	**Silver Mirror Test** Organic compound + $AgNO_3$ solution + 2–3 drops NH_4OH + warm on a water bath.	Silver mirror formed on the walls of the test tube.	Aldehyde is confirmed.
4	**Fehling's solution test** Organic compound + Fehling's solution + heat	Brick red ppt. of Cu_2O formed.	Aldehyde is confirmed.

Result: The given organic compound is an aldehyde.

PREPARATIONS OF

a) Aspirin

b) Iodoform

c) Glucosazone

d) Copper Ammine Complex

a) PREPARATION OF ASPIRIN

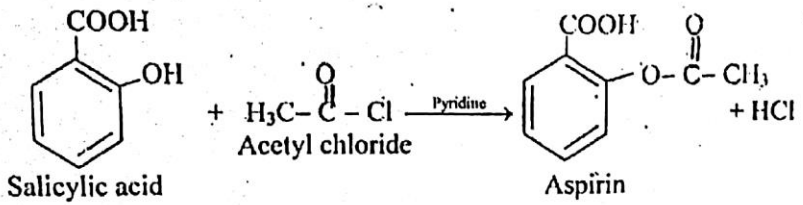
Material required

Salicylic acid 5g, Acetyl chloride 4cm^3, Pyridine 1cm^3, Acetic acid 10cm^3.

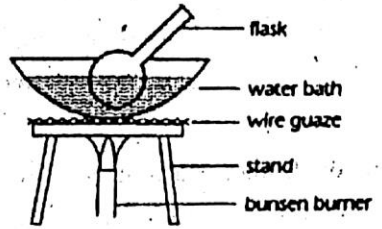
Apparatus

Conical flask, measuring cylinder, beaker, water bath, funnel, filter paper etc.

Chemical equation



Diagram



Procedure

i) Take a round bottom flask. Add 5g of salicylic acid and 1 cm^3 of pyridine in it.
ii) Then add 4 cm^3 of acetyl chloride slowly with constant stirring.
iii) Maintain the temperature of mixture between 50–60°C.
iv) Now heat the flask in water bath for few minutes.
v) Pour this mixture solution in about 200 cm^3 of ice cold water & shake well.
vi) White crystals of aspirin will be formed.
vii) Separate the crystals by filtration and wash them with cold water.
viii) Recrystallize crystals from equal volumes of water and acetic acid.
ix) Dry the crystals between folds of filter paper.

Result

I prepared the pure crystals of aspirin and shown to the examiner.

b) PREPARATION OF IODOFORM

Material required

Ethyl alcohol 20cm^3, sodium carbonate 20g, iodine 10g,

Apparatus

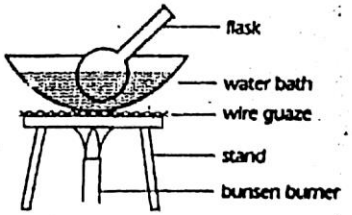
Round bottom flask, funnel tripod stand, measuring cylinder, water bath, filter paper, wire gauze.

Chemical equation

$$CH_3CH_2OH + 4I_2 + 3Na_2CO_3 \longrightarrow CHI_3 + 5NaI + 3CO_2 + 2H_2O + HCOONa$$

(Ethyl alcohol) (sodium carbonate) (Iodoform)

Diagram



Procedure

i) Take 100cm^3 of distilled water in a round bottom flask. Add 20g of Na_2CO_3 in it & shake well.
ii) Heat this solution on water bath upto 60°Cand add 20cm^3 ethyl alcohol in it.
iii) Add few crystals of solid iodine in above solution and shake well until the brown colour of iodine persist.
iv) At this stage yewllow crystals of iodoform begins to separate out from the solution.
v) Keep this solution for sometime .
vi) Separate these crystals by filtration.
vii) Recrystallize iodoform by dissolving in alcohol.
viii) Dry the crystals between folds of filter paper.

Result

I prepared the pure crystals of iodoform and shown to the examiner.

c) PREPARATION OF GLUCOSAZONE

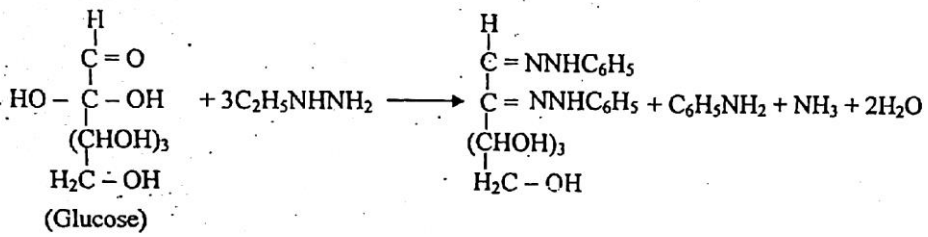
Material required

Phenyl hydrazine 2g, glucose 1g, sodium acetate 3g, dilute acetic acid.

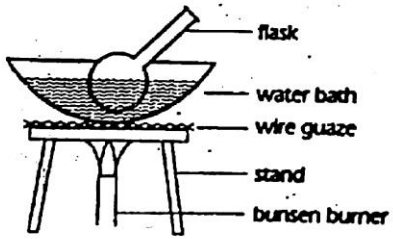
Apparatus

Round bottom flask, water bath, funnel, filter paper, tripod stand, wire gauze etc.

Chemical equation



Diagram



Procedure

i) Dissolve 1 g of glucose in 5cm^3 water to form a solution.
ii) Take a round bottom flask and add 3g sodium acetate in 20cm^3 of water. Add 2g of phenyl hydrazine into it to prepare a solution and shake well.
iii) Now add the glucose solution to the round bottom flask with constant shaking.
iv) Heat the flask on a water bath. After about 20 to 30 minutes crystals of glucosazone start appearing.
v) Cool the solution to get maximum crystals.
vi) Filter the crystals and wash with dil. acetic acid.
vii) Recrystallize the glucosazone with hot alcohol.
viii) Dry the crystals between folds of filter paper.

Result

I prepared the pure crystals of glucosazone and shown to the examiner.

d) PREPARATION OF COPPER AMMINE COMPLEX

Material required

Copper sulphate 5g, liquid ammonia 15cm^3, Ethanol 40cm^3.

Apparatus

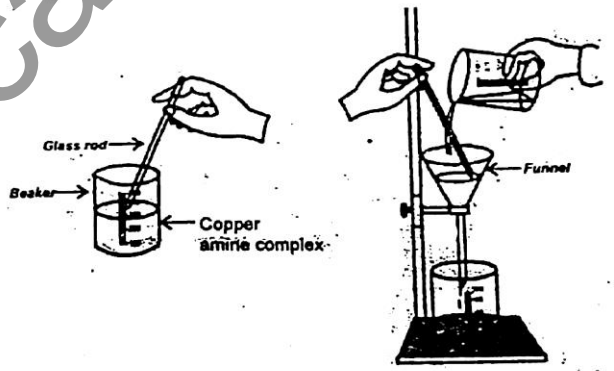
Beaker, Measuring cylinder, stirrer, funnel, filter paper, watch glass etc.

Chemical equation

$CuSO_4 + 4NH_4OH \longrightarrow [Cu(NH_3)_4]SO_4 + 4H_2O$

Copper sulphate (Tetraammine copper (II) sulphat)
(Copper ammine complex)

Diagram

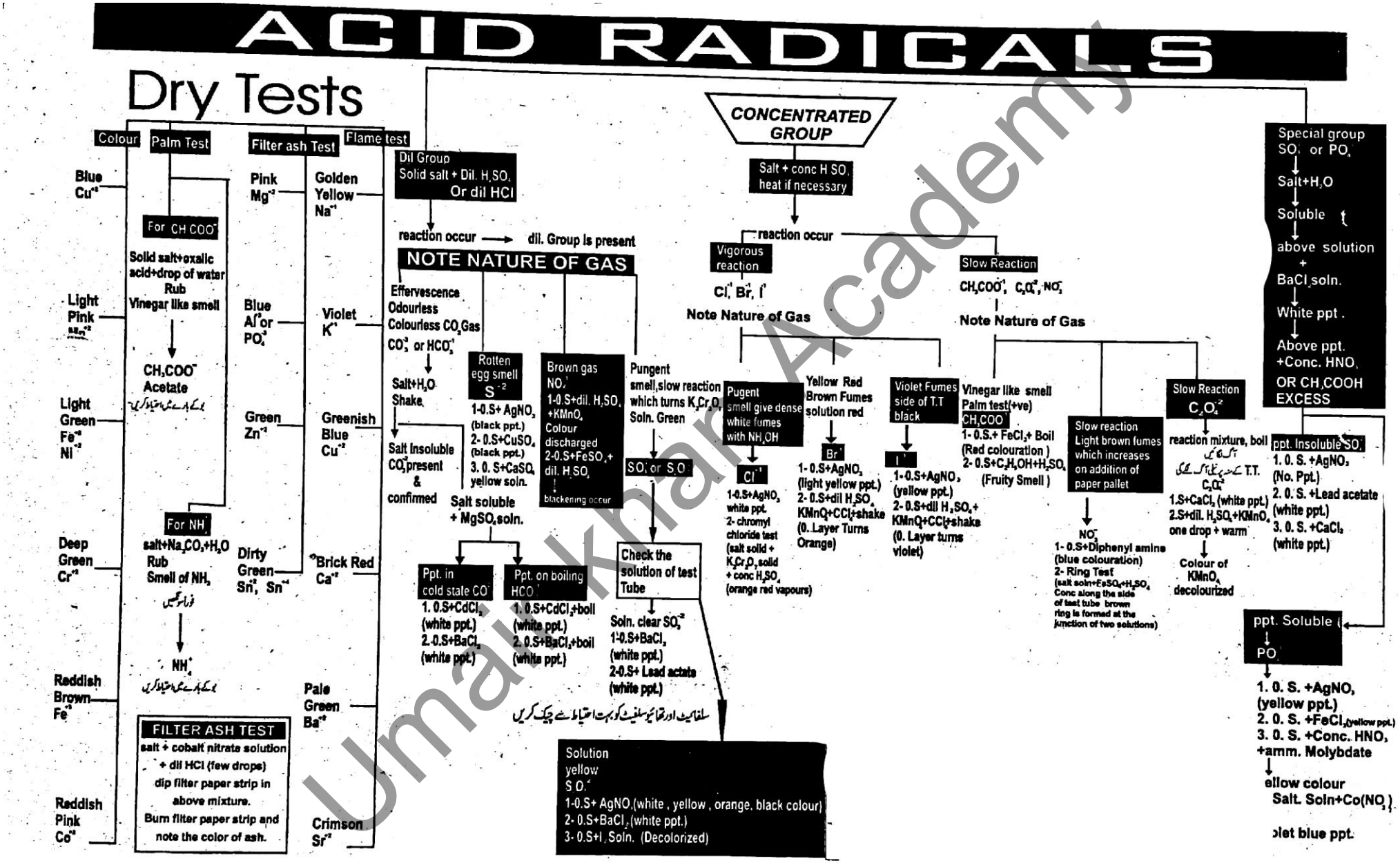


Procedure

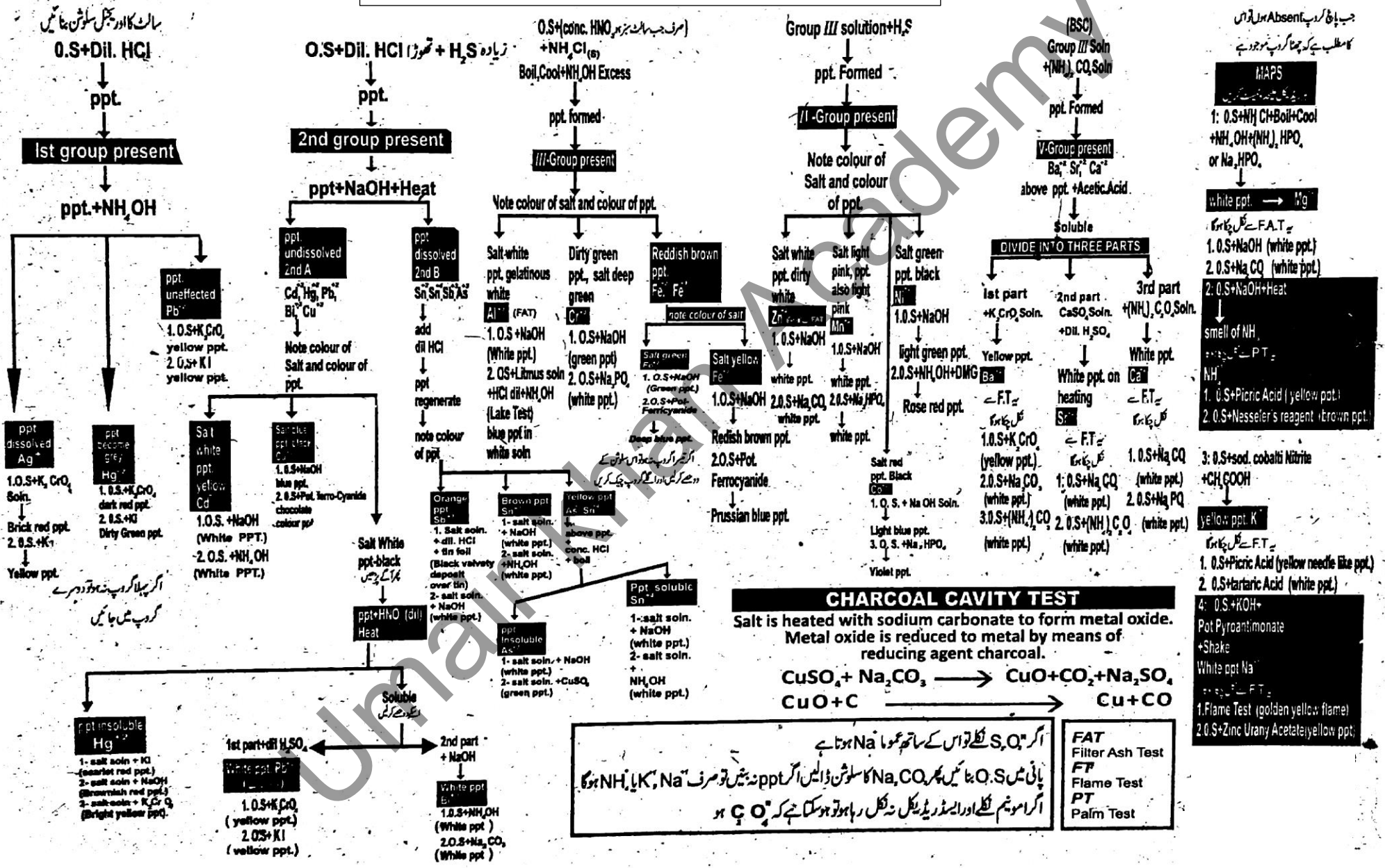
i) Take 20cm^3 of water in a beaker and dissolve 5g $CuSO_4$ in it.
ii) Add few drops of Conc. H_2SO_4 in above solution to make it clear.
iii) Then add liquid ammonia drop wise with constant stirring till an intense blue colour solution.
iv) Now add 50 cm^3 of alcohol with constant stirring.
v) Allow it to stand for sometime.
vi) Long, thin blue needle shape crystals of copper ammine complex are formed.
vii) Filter the crystal and wash with alcohol.
viii) Dry the crystals between folds of filter paper.

Result

I prepared the pure crystals of copper ammine complex and shown to the examiner.



Basic Radicals



Selective Short questions

Q.1 What is salt?

Ans: Salt

Salt is a compound which is formed by complete neutralization of an acid with a base. $NaOH + HCl \longrightarrow NaCl + H_2O$

e.g. NaCl, $NaHCO_3$, KNO_3 etc.

Q.2 What is acidic and basic radical?

Ans: Acidic radicals

That part of the salt which is derived from the acid is called acid radical. It is negatively charged portion of the salt. It is usually composed of a non-metals e.g. $CO_3^{2-}, SO_4^{2-}, B\bar{r}, C\bar{l}$ etc.

Basic Radical

That part of the salt which is derived from the base. It has positive charge. It is usually a metallic ion e.g. Na^+, K^+, Ca^{2+}, Al^{3+} etc. or NH_4^+.

Q.3 What is the difference between the detection of basic radicals and acid radicals?

Ans: The basic radicals are detected and confirmed by the formation of colour or precipitate, while the acid radicals are generally detected by the confirmation of their volatile product.

Q.4 What do you mean by an "ion".

Ans: An ion is an atom or a group of atoms having positive or negative charge.

e.g. $CO_3^{2-}, NO_3^{1-}, Cl^-, SO_4^{2-}, Na^+, K^+$ etc.

Q.5 What is chemical test?

Ans: A chemical reaction performed on the salt or on its solution, to check presence or absence of some radical is called chemical test.

Q6 How would you perform charcoal cavity test?

Ans: Dip up a shallow cavity in a charcoal block. Mix a little salt with anhydrous Na_2CO_3 and fill the charcoal cavity with it. Put a drop of water on the salt to make a paste. Heat it strongly in reducing flame of Bunsen burner with the help of blow pipe. Examine the bead and colour of the incrustation or scales.

	Observations		Inference
	Bead or Scales	Incrustation	
1	White grey bead, marks paper.	Yellow incrustation.	Pb
2	White malleable bead, does not mark paper.	No incrustation	Ag

Q.7 Explain chemistry of Charcoal Cavity Test?

Ans: Na_2CO_3 converts a metallic salt into a carbonate which decomposes to its oxide on heating. The oxide in certain cases is further reduced with the carbon of charcoal block to metal which appears in the form of bead or scales.

$Pb(NO_3)_2 + Na_2CO_3 \longrightarrow 2NaNO_3 + PbCO_3$

$PbCO_3 \longrightarrow PbO + CO_2$ (Yellow incurstation)

(Bead)

$PbO + C \longrightarrow CO + Pb$

In certain cases metal oxides are not reduced to the metal or only partially reduced. In such cases we get incrustation only of metal oxide.

$CdCl_2 + Na_2CO_3 \longrightarrow CdCO_3 + 2NaCl$

$CdCO_3 \longrightarrow CO_2 + CdO$ (Brown incrustation).

Q.8 What is the difference between a bead and an incrustation?

Ans: Bead is a spherical shaped metallic mass. Incrustation is a layer of metallic oxides formed around the cavity.

$Pb(NO_3)_2 + Na_2CO_3 \longrightarrow 2NaNO_3 + PbCO_3$

$PbCO_3 \longrightarrow PbO + CO_2$ (Yellow incurstation)

(White grey bead)

Q.9 What is Filter Ash Test

Ans: Crystals of salt are dissolved in equal amount of cobalt nitrate solution. A filter paper strip is dipped in this solution. Dry it, burn on flame and colour of ash is noted.

Observation	Result
1) Pink ash	Mg Salt
2) Green ash	Zn salts
3) Blue ash	Al^{3+} + Or PO_4^{-3}
4) Dirty green ash or Bluish green	Sn salts

Q.10 How would you perform flame Test?

Ans: Make thick paste of salt with drops of Conc. HCl in China dish (salt is converted to chlorides which are more volatile compound). With the help of platinium wire or scapula, this paste is placed in oxidizing flame

Observation	Result
1) Bluish green	Copper Cu^{2+}
2) Yellowish green or grass green	Barium Ba^{2+}
3) Crimson	Strontium Sr^{2+}
4) Brick red	Calcium Ca^{2+}
5) Violet	Potassium K^{+}
6) Golden yellow	Sodium Na^{+}

Q.11 What is the purpose of using blue glass in the flame test?

Ans: Blue glass absorbs a part of light. Therefore, blue glass produces a characteristic change in the colour of the flame of basic radicals having similar flames. For example Ca and Sr have brick red and crimson colour and they appear green and purple through blue glass.

Q.12 Explain Chemistry of Borax Bead Test?

Ans: $Na_2B_4O_7 \xrightarrow{\Delta} 2NaBO_2 + B_2O_3$

(Volatile)

$CuSO_4 \xrightarrow{\Delta} CuO + SO_3$

$B_2O_3 + CuO \longrightarrow Cu(BO_2)_2$

(blue bead)

$2Cu(BO_2)_2 + C \xrightarrow{\Delta} 2CuBO_2 + B_2O_3 + CO$

(Colourless)

$2CuBO_2 + C \xrightarrow{\Delta} 2Cu + B_2O_3 + CO$

(Reddish brown)

Q.13 Can you perform borax bead test for colourless salts?

Ans: No, this test is only performed for coloured salts because none of the colourless salt gives a characteristic bead with borax beat test.

Q.14 Why is platinum wire used in the borax bead test?

Ans: Only platinum wire is used in the borax bead test because it has high melting point and imparts no colour to the flame.

Q.15 Can we make a paste of the salt in Conc. H_2SO_4 instead of Conc. HCl?

Ans: No, if a paste of the given salt is prepared with Conc. H_2SO_4, it will change to sulphate which are not as volatile as chlorides. Therefore characteristic colour will not be imparted to the flame easily.

Q.16 What do you mean by a wet test?

Ans: It is attest which is applied to the salt after forming its solution. e.g. confirmatory tests of acid & basic radicals.

Q.17 Explain preparation of Neutral Solution (N.S.)?

Ans: Few gram of solid salt + Double quantity of solid Na_2CO_3 + 5cm^3 H_2O + Boil for 10–15 minutes then centrifugate it, discard the residue. Centrifugate is basic due to addition of Na_2CO_3. Then cool the centrifugate + CH_3COOH with stirring until evolution of CO_2 gas ceases (slightly acidic) + NH_4OH with stirring. Boil the soln. to expel the excess of NH_3 gas, then neutral solution is obtained which is used for confirmatory test.

Q.18 Why do we heat the salt with strong solution of Na_2CO_3 for the preparation of solution of acid radicals?

Ans: We heat the salt with strong solution of Na_2CO_3 so that double decomposition reaction may take place. The anion remain in the solution while cations of heavy metals are replaced by sodium and are precipitated as neutral or basic carbonates and in some cases hydroxides. For example,

i) $BaSO_3 + Na_2CO_3 \longrightarrow BaCO_3\downarrow + Na_2SO_3$

ii) $2CuSO_4 + 2Na_2CO_3 + H_2O \longrightarrow (CuOH)_2CO_3\downarrow + 2Na_2SO_4 + CO_2\uparrow$

iii) $2AlCl_3 + 3Na_2CO_3 + 3H_2O \longrightarrow 2Al(OH)_3\downarrow + 6NaCl + 3CO_2\uparrow$

Q.19 Name the acid radicals of dilute acid group.

Ans: (i) Carbonate $\left(CO_3^{2-}\right)$ (ii) Bicarbonate $\left(HCO_3^{1-}\right)$

(iii) Sulphide (S^{2-}) (iv) Sulphite $\left(SO_3^{2-}\right)$

(v) Thiosulphate $\left(S_2O_3^{2-}\right)$ (vi) Nitrite $\left(NO_2^{1-}\right)$

Q.20 Name some insoluble carbonates.

Ans: All carbonates are insoluble in water except those of sodium, potassium and ammonium. For example, $CaCO_3$, $SrCO_3$, $BaCO_3$ etc.

Q.21 Why lime water turns milky on passing CO_2 through it?

Ans: When CO_2 is passed through lime water $Ca(OH)_2$, insoluble $CaCO_3$ is produced as white milky suspensions.

$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$

Q.22 If an excess of CO_2 gas is passed through the above milky precipitate, the milky precipitate disappears and a clear solution is formed why?

Ans: On passing excess of CO_2, the precipitate gets dissolved due to the formation of $Ca(HCO_3)_2$

$CaCO_3 + H_2O + CO_2 \longrightarrow Ca(HCO_3)_2$

Q.23 Is there any gas like CO_2, which turns lime water milky?

Ans: Yes, SO_2, turns lime water milky due to the formation of insoluble $CaSO_3$.

$Ca(OH)_2 + SO_2 \longrightarrow CaSO_3 + H_2O$

Q.24 How will you distinguish between a carbonate and a bicarbonate?

Ans: When $MgSO_4$ is added to O.S. formation of a white ppt. in the cold state indicates carbonate. But the formation of a white ppt. on heating indicates the presence of bicarbonate.

$CO_3^{2-} + MgSO_4 \xrightarrow[\text{State}]{\text{In cold}} MgCO_3$

(White ppt.)

$HCO_3^{1-} + MgSO_4 \longrightarrow Mg(HCO_2)_2 \xrightarrow{\Delta} MgCO_3 + CO_2 + H_2O$

(White ppt.)

Q.25 Why a bicarbonate forms white ppt. on heating with $MgSO_4$?

Ans: Because all bicarbonates are soluble in water and on heating they are changed to insoluble carbonates.

$MgSO_4 + 2NaHCO_3 \longrightarrow Na_2SO_4 + Mg(HCO_3)_2$

$Mg(HCO_3) \longrightarrow MgCO_3 + CO_2 + H_2O$

White ppt.

Q.26 How will differentiate between SO_3^{2-} and $S_2O_3^{2-}$?

Ans: Add dil. H_2SO_4 to the salt. A colourless gas with burning sulphur smell which turns $K_2Cr_2O_7$ solution green indicates both sulphite and thiosulphate. Note the colour of the contents of the tube.

Yellow contents = Thiosulphate

Transparent = Sulphite

Q.27 What is palm test?

Ans: When solid salt containing acetate radical is mixed with solid oxalic acid in the presence of a drop of water, smell of acetic acid or vinegar comes out. This test usually performed on palm of the hand. So it is called palm test.

Q.28 What is the fruity smell test?

Ans: When the solution of an acetate salt is heated in the presence of ethyl alcohol and Conc. sulphuric acid, fruity smell comes out.

$CH_3COO^{1-} + C_2H_5OH + \text{Conc. } H_2SO_4 \xrightarrow{\Delta} CH_3COOC_2H_5 + H_2O$

(Fruity smell)

Q.29 Does nitrite gives "ring test"?

Ans: Nitrite also gives ring test similar to that of nitrates but the acid used should be dil. acetic acid or dil. H_2SO_4 instead of Conc. H_2SO_4.

$2NaNO_2 + 2CH_3COOH \longrightarrow 2CH_3COONa + 2HNO_2$

$3HNO_2 \longrightarrow H_2O + HNO_3 + NO$

$FeSO_4 + NO \longrightarrow [Fe(NO)]SO_4$

Nitroso-ferrous sulphate (ring)

Q.30 Can we use Conc. HCl in place of Conc. H_2SO_4 in concentrated acid group.

Ans: No, we cannot use Conc. HCl in Conc. acid group because this group contains Cl^- ion so it will create confusion because we are introducing Cl^- ions ourself in the form of Conc. HCl.

Q.31 What is chromyl chloride test?

Ans: It is confirmatory test for Cl^- and is performed as. Take small quantity of solid salt and solid $K_2Cr_2O_7$ in a test tube. Add Conc. H_2SO_4 in the test tube and heat the mixture. Pass the gas through NaOH solution and then add acetic acid and lead acetate. Yellow ppt. of $PbCrO_4$ is obtained.

$K_2Cr_2O_7 + 4NaCl + 6H_2SO_4 \xrightarrow[Heat]{\Delta} KHSO_4 + 4NaHSO_4 + 5H_2O + 2CrO_2Cl_2 \uparrow$

(Chromyl chloride)

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

$Na_2CrO_4 + (CH_3OO)_2Pb \longrightarrow PbCrO_4 + 2CH_3COONa$

(Yellow ppt.)

Q.32 How the reddish brown vapours of Br_2 and NO_2 are distinguished?

Ans: Bromides give the brown vapour of bromine while nitrate gives brown vapours of NO_2. If the addition of Cu-turnings, increases the intensity of brown fumes, then nitrate is indicated and if there is no change in vapour's intensity on the addition of Cu-turnings, then bromide is present.

Q.33 By what methods SO_4^{2-} and PO_4^{3-} are confirmed?

Ans: The confirmation of these two radicals differs from others in the fact that they are confirmed by the method of precipitation and not by volatile products.

Q.34 What happens when silver nitrate solution is added to a thiosulphate?

Ans: A white precipitate of silver thiosulphate is formed which immediately changes its colour to yellow, organs, brown and finally black.

$S_2O_3^{2-} + AgNO_3 \longrightarrow Ag_2S_2O_3$

(White coloured)

$Ag_2S_2O_3 + S_2O_3^{2-} \longrightarrow [Ag(S_2O_3)]^{-3} \longrightarrow Ag_2S$

(Black coloured ppt.)

Q.35 Name the acid radicals of Conc. Sulphuric acid group.

Ans: $Cl^{1-}, Br^{1-}, I^{1-}, NO_3^{1-}, CH_3COO^{1-}, C_2O_4^{2-}$

Q.36 How will you distinguish between a thiosulphate and sulphite by the help of dil. H_2SO_4 only?

Ans: Dilute sulphuric acid will produce SO_2 gas only and the solution in the test tube will remain transparent . But in case of thiosulphate the contents of the test tube will become yellow due to formation of a ppt. of sulphur along with evolution of SO_2 gas.

$SO_3^{2-} + H_2SO_{4\,(dil.)} \longrightarrow SO_4^{2-} + SO_2\uparrow + H_2O$

$S_2O_3^{2-} + H_2SO_{4(dil.)} \longrightarrow SO_4^{2-} + SO_2\uparrow + S\downarrow + H_2O$

Q.37 What is common ion effect?

Ans: Common ion effect is a phenomenon in which the degree of dissociation of a weak electrolyte is suppressed by the addition of another electrolyte having common ion.

$H_2S \rightleftharpoons 2H + S^{2-}$

$HCl \rightleftharpoons H^+ + Cl^-$

18 **What is Original solution (O.S.)**

Ans: A transparent, homogeneous solution of salt in a suitable solvent. This is used for analysis of acid and basic radicals by wet tests. If dissolved in water, also called aqueous solution (Aq.S.)

Q.39 Sometimes we get a white precipitate on diluting a salt solution prepared in Conc. HCl. Explain why?

Ans: If the salt is soluble in Conc. HCl but forms white ppt. on dilution, it may be due to formation of oxychlorides of Bi^{3+} or Sb^{3+} e.g.

$$BiCl_3 + H_2O \longrightarrow \underset{\text{White ppt.}}{BiOCl} + 2HCl$$

The white ppt. can be redissolved by adding few drops of Conc. HCl.

$$BiOCl + 2HCl \longrightarrow BiCl_3 + H_2O$$

Q.40 Why is $AgNO_3$ solution kept in coloured bottles?

Ans: Since $AgNO_3$ decomposes into its oxides in direct sunlight, therefore, it is kept in coloured bottles to prevent its decomposition.

Q.41 How will you perform the lake test for Al?

Ans: To O.S. solution, add few drops of litmus solution and acidify it with dil. HCl. Then add NH_4OH. Allow it to stand for a while. A blue ppt. floats in a colourless solution.

Q.42 How will you differentiate between Fe^{2+} and Fe^{3+}?

Ans:

Fe^{2+}	(i)	O.S. + NaOH soln.	Yellowish green ppt.	Fe^{2+} is confirmed
	(ii)	O.S. + potassium ferricyanide $K_3[Fe(CN)_6]$.	Dark blue ppt.	Fe^{2+} is confirmed
Fe^{3+}	(i)	O.S. + NaOH soln.	Blue ppt.	Fe^{3+} is confirmed
	(ii)	O.S.+Pot.ferricyanide + $K_3[Fe(CN)_6]$.	Deep blue ppt.	Fe^{3+} is confirmed

Q.43 Are the basic radicals metals only?

Ans: The majority of the basic radicals are metals but non-metallic radicals like Ammonium, are also basic radicals.

Q.44 Why some radicals are coloured and some are not?

Ans: Metal of the d-block series, which have unpaired electrons in their valence shell, show colour due to transition of these electron in the d-orbitals. Anions of transition metal complexes like permanganate ion or the chromate ion show colour due to the movement of odd electron in the molecule.

Q.45 What are deliquescent substances?

Ans: These are the substances which absorb moisture from the air.
For example, NaOH, P_2O_5 etc.

Q.46 Name the basic radicals of Group 1" ? How the basic radicals of group 1st are precipitated?

Ans: Basic radicals of group I are Pb^{2+}, Hg^{1+}, Ag^{1+}. The basic radicals of group 1st are precipitated by dilute HCl.
Basic radicals of group I are precipitated as their chlorides, e.g. AgCl, HgCl, $PbCl_2$.

Q.47 Can we use Dil. H_2SO_4 in place of Dil. HCl as group reagent in first group of basic radicals?

Ans: No, because in that case basic radicals of other groups will also be precipitated as sulphates in the first group, e.g. $BaSO_4$, $SrSO_4$ etc.

Q.48 Name basic radicals of group 2nd. What is the group reagent for 2nd group?

Ans: 2^{nd} A Pb^{4+}, Hg^{2+}, Bi^{3+}, Cd^{2+}, Cu^{2+}.
2^{nd} B Sn^{2+}, Sn^{4+}, As^{3+}, Sb^{3+}.
H_2S in the presence of Dil. HCl.

Q.49 Why yellow ammonium Sulphide is used?

Ans: It is used in the 2nd group of basic radicals to distinguish between basic radicals of IIA and IIB groups.

Q.50 Why do we add dil. HCl before passing H_2S gas in the 2nd group?

Ans: H_2S is a weak electrolyte and cannot ionize completely in the presence of common H^+ ions from HCl which is a strong electrolyte.

$$H_2S \rightleftharpoons 2H + S^{2-}$$

$$HCl \rightleftharpoons H^+ + Cl^-$$

This low concentration of sulphide ions would precipitate basic radicals of 2nd group only, whereas it would be insufficient to precipitate radicals of other groups because their sulphides are comparatively soluble.

Q.51 Sometime a turbid solution is obtained when the mixture is dissolved in water, what is that due to?

Ans: Due to Bi and Sb salts which hydrolyse to form BiOCl and SbOCl. It may be avoided by adding few drops of dil. HNO_3, which will prevent hydrolysis.

Q.52 Name basic radicals of 3rd group. What is group reagent of 3rd group.

Ans: Fe^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+}.
$NH_4Cl_{(s)}$ + boil + cool + NH_4OH.

Q.53 Why NH_4Cl is added along with NH_4OH?

Ans: The cations of 3rd group are precipitated as insoluble hydroxides, if NH_4Cl is not added other cations may also precipitate as hydroxides. In the presence of NH_4Cl, the ionization of NH_4OH is suppressed so that the $-OH^-$ ions in the solution are just sufficient to precipitate the radicals of the 3rd group only and not others.

$$NH_4Cl \rightleftharpoons NH_4^+ + Cl^-$$

$$NH_4OH \rightleftharpoons NH_4^+ + OH^-$$

Q.54 What is green vitriole?

Ans: $FeSO_4.7H_2O$ is called green vitriole.

Q.55 What is alum?

Ans: It is a double salt of potassium an aluminium having the formula $K_2SO_4\ Al_2(SO_4)_3.24H_2O$.

Q.56 Why is it necessary to boil off H_2S from the filtrate of 2nd group before the addition of Conc. HNO_3?

Ans: It is essential to boil off H_2S gas, otherwise it will be oxidized, at least partly, to H_2SO_4.

$$H_2S + 8HNO_3 \longrightarrow H_2SO_4 + 4H_2O + 8NO_2$$

If the mixture contains Ba and Sr, they will form insoluble sulphates and get precipitated in the 3rd group.

Q.57 Name the basic radicals of 4th group. What is the group reagent for 4th group?

Ans: 4th group of basic radical contains Co^{2+}, Ni^{2+}, Zn^{2+} and Mn^{2+}.
The group reagent is NH_4Cl + boil + cool + NH_4OH + H_2S.

Q.58 How the basic radicals of 4th group are precipitated?

Ans: They are precipitated as their sulphides.

For example

NiS = Black ppt. MnS = Pink or flesh colour ppt.
CoS = Black ppt. ZnS = Grayish white ppt.

Q.59 What are the colour of Cu, Fe, Co, Ni, Cr and Mn beads?

Ans: i) Cu = blue bead (ii) Fe = reddish brown bead
iii) Co = blue bead (iv) Ni = Brown bead
(v) Mn = violet bead (vi) Cr = Deep green bead.

Q.60 What are the basic radicals of group 5th? What is the group reagent of 5th group?

Ans: Ba^{2+}, Ca^{2+} and Sr^{2+}.
$(NH_4)_2\ CO_3$ in the presence of NH_4Cl and NH_4OH.

Q.61 How the basic radicals of 5th group are precipitated?

Ans: Basic radicals of 5th group are precipitated as their carbonates.
$CaCO_3$, $SrCO_3$, $BaCO_3$.

Q.62 Why is it necessary to add NH_4OH before the addition of $(NH_4)_2CO_3$ for the precipitation of group 5th radicals?

Ans: $(NH_4)_2CO_3$ reagent used in the laboratories usually contains a high percentage of NH_4HCO_3 which will give a little precipitate with the metals of group 5th if NH_4OH is not added.

$$NH_4HCO_3 + NH_4OH \longrightarrow (NH_4)_2CO_3 + H_2O$$

Q.63 Sometimes it is expected that calcium does not get precipitated in group 5th. What is the reason?

Ans: This happens because Ca forms $Ca(HCO_3)_2$ instead of $CaCO_3$ on the addition of $(NH_4)_2CO_3$ solution. $Ca(HCO_3)_2$ is soluble and passes into the filtrate of V group.

Q.64 Name the basic radicals of 6th group. What is the group reagent of 6th group?

Ans: Mg^{2+}, Na^+, K^+ and NH_4^+

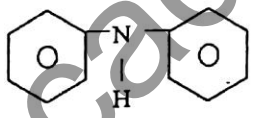
There is no common group reagent for the basic radicals of 6th group. Hence they are confirmed individually except Mg^{2+}. Mg^{2+} is precipitated by the above solution of 5th group + $(NH_4)_3PO_4$

Q.65 Name some colour salts of Na and K.

Ans: Na_2CrO_4 = Yellow K_2CrO_4 = Yellow
$KMnO_4$ = Pink $K_2Cr_2O_7$ = Orange red.

Q.66 What is the formula of diphenyl amine & dimethylglyoxime.

Ans: $(C_6H_5)_2NH$ or

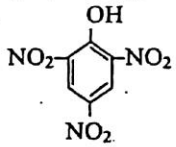
(i) 

(ii) $CH_3 - C = NOH$
$CH_3 - C = NOH$

Q.67 What is the formula of (i) Nessler's reagent (ii) Picric acid, (iii) sodium cobaltinitrite, (iv) Potassium pyroantimonate?

Ans: i) Nessler's reagent: K_2HgI_4

ii) Picric acid.



iiii) Sodium cabltintrite $Na_3[Co(NO_2)_6]$

iv) $K_2H_2Sb_2O_7$ is potassium pyroantimonate.