

Chemistry chart

For

Standard XI Science



Name _____

Class _____

Div _____

Roll No _____

Batch No _____

INORGANIC VOLUMETRIC ANALYSIS**Acid-Base titration****Experiment No-1**

Date: _____

Aim: You are provided with two solutions as follows

Flask X - HCl

Flask Y - (0.1050N) NaOH

Titrating these solutions determine Normality and strength in terms of g/litre. of HCl solution.

Requirements:

- (i). Apparatus: Burette. Stand Pipette. Conical flask. White tile
 (ii) Chemicals: NaOH (0.1050 N). HCl and Phenolphthalein

Theory: This is a titration of strong acid HCl and strong base NaOH, where they react with each other and form salt and water. The process is called neutralization. Using the normality of NaOH. The strength of HCl can be calculated in terms of normality and grams/litre

Procedure: (i) Wash all the apparatus with water.

(ii) Rinse the pipette with HCl solution. Pipette out 10 ml of HCl solution in conical flask. Add a drop of phenolphthalein indicator.

(iii) Rinse the burette with NaOH solution and fill it with NaOH.

Remove the air bubble if any. Adjust zero mark with lower meniscus.

(iv) Titrate HCl solution against NaOH by adding NaOH from burette one ml at a time till the solution becomes light pink by constant stirring. Note this reading as pilot reading.

(v) Repeat the titration to get constant reading.

Result:

Solution	Normality	g/Litre.
HCl	-----N	.....
NaOH	0.1050 N	

Observations and Calculations.

Given: 0.1050N NaOH solution

To find : Normality & strength of HCl solution in terms of grams/litre

- (i) **Solution in Burette:** NaOH (0. 1050N)
- (ii) **Solution in Pipette:** HCl Solution
- (iii) **Solution in conical flask:** 10 ml of HCl + two drops of indicator
- (iv) **Indicator:** Phenolphthalein
- (v) **End point:** Colourless to light pink



Observation Table:

Pilot Reading -----ml to -----ml

Burette Reading	I	II	III	Constant Burette Reading (C.B.R.)
Final	... mL	.... mL	..... mL	..... mL
Initial	0mL	0mL	0mL	
Difference	.... mL	..... mL	..... mL	

Calculations:

1. To calculate Normality of HCl Solution
- $$N_1 V_1 = N_2 V_2$$
- N_1 = Normality of NaOH
 V_1 = Volume of NaOH (i.e. C.B.R)
 N_2 = Normality of HCl
 V_2 = Volume of HCl

$$0.1050 \times \text{C.B.R} = N_2 \times 10$$

$$N_2 = \frac{0.1050 \times \text{C.B.R.}}{10}$$

$$= \text{-----}'N$$

$$\text{Normality of HCl} = \text{-----} N$$

2. To calculate g/L of HCl

$$= \text{Normality of HCl} \times \text{Eq.wt. Of HCl}$$

$$\text{-----}N \times 36.5$$

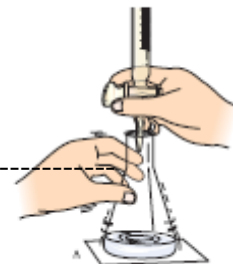
$$= \text{-----} g/L$$

Note:-(Show log calculations in pencil)

INORGANIC VOLUMETRIC ANALYSIS

REDOX TITRATIONS

Date:-----

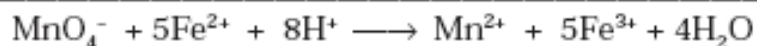
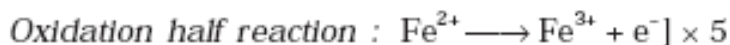
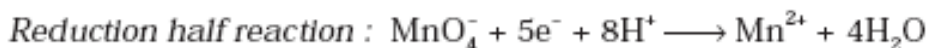
**Experiment No:-****Aim:-** You are provided with two solutions as follows.**Container A:** ----- N Solution of Hydrated Mohr's Salt.**Container B:** - KMnO₄ Solution.

Titrating these solutions determine the

1. Normality of the solution in container B.
2. Strength of less /more concentrated solution in container B/C in terms of gms/_____ ml.

Apparatus & Chemicals Required:-Burette, Pipette conical flask Burette stand white tile, KMnO₄ Solution , Hydrated Mohr's Salt and Dil. sulphuric acid**Theory:-**

This is a Redox titration where Neutralization point is due to Reduction and Oxidation reaction occurring simultaneously. In this titration - KMnO₄ undergoes reduction with change in oxidation number of manganese ion from +7 to +2 and Mohr's Salt undergoes oxidation with change in oxidation number of iron+2(Ferrous) to +3(Ferric) Thus acts as a - KMnO₄ Oxidizing agent and Mohr's Salt acts as reducing agent and at the end point colour change is from colourless to light pink

(b) Ionic equation**Procedure:**

1. Rinse the pipette with the given _____ N Mohr's Salt solution and pipette out 10 ml of it in a washed titration flask.
2. Rinse and fill the burette with the given KMnO₄ solution.
3. Add one test-tube (15 ml) or One and half (if test tube size is small) test tube of dilute sulphuric acid (2 N) to the solution in the titration flask.
4. Note the initial reading of the burette.
5. Add KMnO₄ solution from the burette till a permanent light pink colour is imparted to the solution in the titration flask on addition of the last single drop of KMnO₄ solution.
6. Note the final reading of the burette.
7. Repeat the above steps to get three concordant readings.

Result:

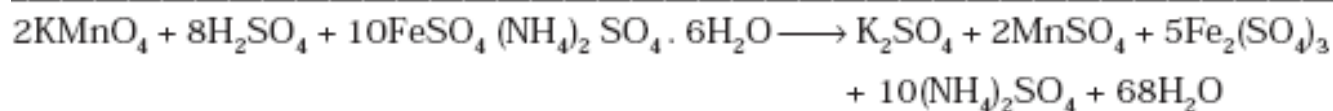
Solution	Normality	Grams/-----ml
<u>KMnO₄</u>		
Mohr's Salt		

_____Solution is Less/More Concentrated in terms of Normality/ gms per -----ml

1. Given:-
2. To find:

Observations:

1. Solution in Burette : KMnO_4 solution.
2. Pipette Solution: Mohr's Salt Solution
3. Solution in Flask: 10 ml of ----- N /M Mohr's Salt+ 1 test tube dil. H_2SO_4 ,
4. Indicator: KMnO_4 acts as self indicator.
5. End point: Colourless to light pink.

Chemical equations:**Observation Table:**

Pilot Reading _____ ml To _____ ml.

Burette Reading	I	II	III	Constant Burette Reading (C.B.R.)
Final	... mL	.... mL	..... mL	..... mL
Initial	0mL	0mL	0mL	
Difference	.... mL	..... mL	..... mL	

Calculations:

1. To calculate Normality of : KMnO_4 solution = $N_1V_1=N_2V_2$
2. To calculate Grams per -----ml = $N \times \text{Eq. Wt} \times \text{-----} / 1000$

Physical Experiments

Determination of pH values

Aim: To determine the pH value of the given solutions namely washing soda, lemon juice, vinegar, milk, tomato juice, tap water, etc

Apparatus required: 5 droppers, test tubes, test-tube stand, and glazed tile.

Chemicals required: Universal indicator paper, distilled water, washing soda, vinegar, lemon juice, milk, tomato juice, tap water.

Theory: The pH value of a solution is defined as the negative logarithm of hydronium ion concentration in mol/L.

$$\text{pH} = -\log [\text{H}^+]$$

If the hydronium ion concentration is 1×10^{-7} mol/L, it may be stated that its pH is 7 and the solution is neutral solution.

$$\text{Pure water } [\text{H}_3\text{O}^+] = 1 \times 10^{-7} \text{ mol/L}$$

Therefore, the $\text{pH} = 7$

The pH of an acidic solution is below 7

The pH of a basic solution is above 7

$$\text{Since } [\text{OH}^-] = 1 \times 10^{-14}$$

Therefore, Hydroxide ion concentration can vary from 1×10^{-7} to 1×10^{-14} and Hydronium ion concentration can vary from 1×10^{-1} to 1×10^{-7} .

Thus pH values vary from 1 to 14. This is known as pH scale.

Procedure:

1. Prepare solutions in small quantities of lemon juice, milk, tomato juice etc.
2. Take the solution of the sample and arrange them on a test tube stand.
3. Place a drop of the test solution on the indicator paper with the help of a dropper.
4. Observe the colour produced and compare it with the colour on the chart.
5. Read the pH value from the chart given against the colour obtained on the indicator paper.
6. Repeat the experiment with other solutions.

Result:

The sample of solution _____, _____ are acidic, sample _____ and _____ are basic, and the _____ sample is neutral.

pH Scale

[H ₃ O ⁺] Mol/L	10 ⁰	10 ⁻¹	10 ⁻²	10 ⁻³	10 ⁻⁴	10 ⁻⁵	10 ⁻⁶	10 ⁻⁷	10 ⁻⁸	10 ⁻⁹	10 ⁻¹⁰	10 ⁻¹¹	10 ⁻¹²	10 ⁻¹³	10 ⁻¹⁴
pH	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
								Neutral							
	Acidic							Basic							

Observation Table**With pH paper**

Sr. No.	Sample of Solution	Shade of Colour	pH	Acidic, Basic or Neutral
1	Vinegar			
2	Tomato Juice			
3	Lemon Juice			
4	Milk			
5	Tap water			
6	Washing soda			

Observation Table**With universal indicator**

Sr. No.	Sample of Solution	Shade of Colour	pH	Acidic, Basic or Neutral
1	Vinegar			
2	Tomato Juice			
3	Lemon Juice			
4	Milk			
5	Tap water			
6	Washing soda			

Crystallization

Aim: To obtain pure crystals of copper sulphate from an impure sample.

Apparatus: Pestle and mortar, beaker, evaporating dish, sand bath and filter papers.

Chemicals: Impure sample of copper sulphate.

Theory:

Crystallization is the (natural or artificial) process of formation of solid crystals precipitating from a solution, melt or more rarely deposited directly from a gas. Crystallization is also a chemical solid–liquid separation technique, in which mass transfer of a solute from the liquid solution to a pure solid crystalline phase occurs. In chemical engineering crystallization occurs in a crystallizer. Crystallization is therefore an aspect of precipitation, obtained through a variation of the solubility conditions of the solute in the solvent, as compared to precipitation due to chemical reaction.

Procedure:

- (i) Grind some of the impure sample of copper sulphate in a pestle and weigh out roughly 5 g. Take 50 ml of distilled water in a beaker and add the weighed sample of impure copper sulphate. Warm gently and stir it with a glass rod. The copper sulphate will dissolve leaving the insoluble impurities in suspension. Filter the solution into an evaporating dish.
- (ii) Heat the solution gently on a sand bath and concentrate it to the saturation point. Test the attainment of the saturation point. If it has been reached, stop heating the solution and keep it aside for crystallization.
- (iii) After some time the crystals will appear. Remove the mother liquor by decantation and wash the crystals to remove the mother liquor sticking to the crystals. Dry the crystals by pressing them between filter papers.

Result :

- i. Colour of the crystals: _____
- ii. Shape: _____
- iii. Yield: _____ Grams
- iv. Percentage yield: _____%

Diagram :

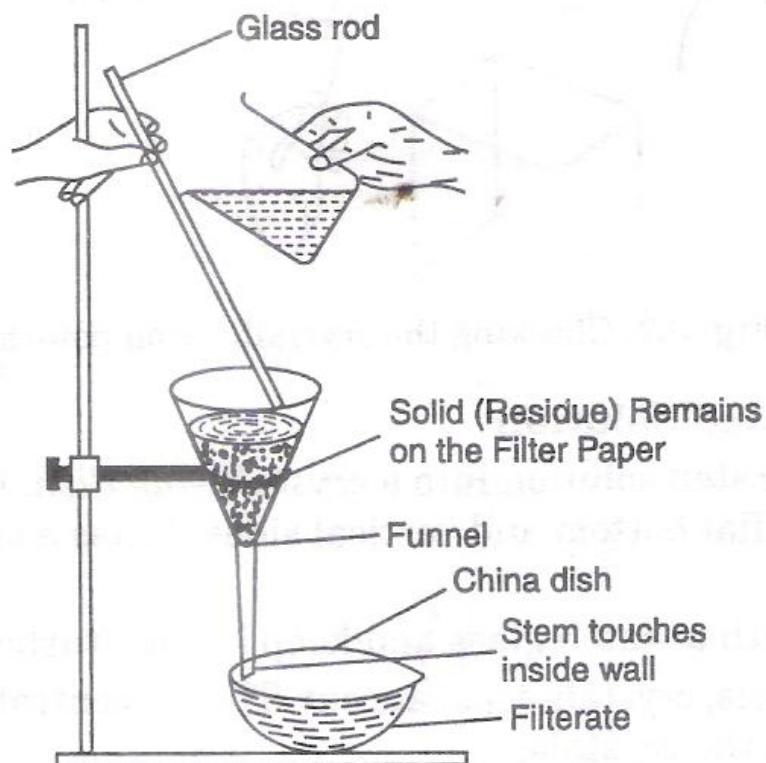


Fig. Removing insoluble impurities by filtration.

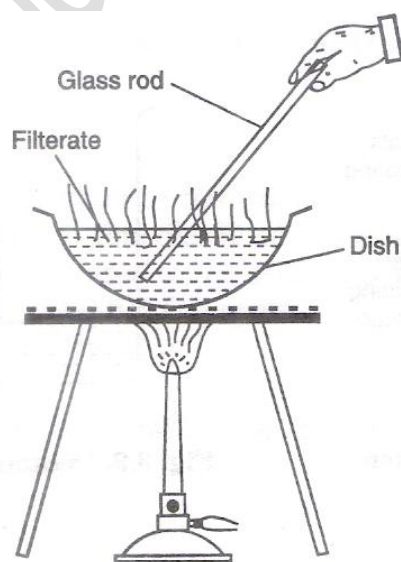


Fig. Evaporation of solution.

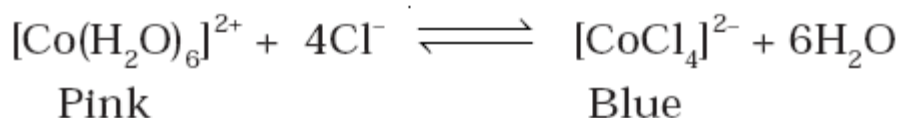
CHEMICAL EQUILIBRIUM

Aim

Study of the shift in equilibrium in the reaction between $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ and Cl^- ions, by changing the concentration of any one of these ions.

Theory

In the reaction between $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ and Cl^- ions, the following displacement reaction takes place.



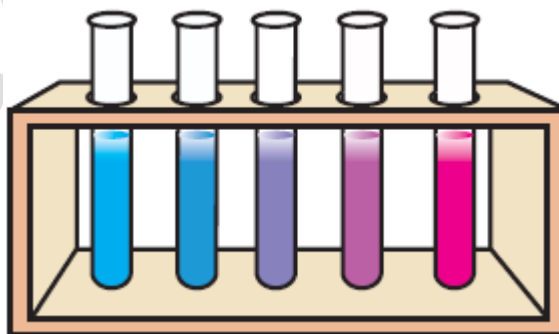
This reaction is known as ligand displacement reaction and the equilibrium constant, K , for this is written as follows:

$$K = \frac{[[\text{CoCl}_4]^{2-}]}{[[\text{Co}(\text{H}_2\text{O})_6]^{2+}][\text{Cl}^-]^4}$$

Since the reaction occurs in the aqueous medium, it is believed that concentration of H_2O is almost constant and is included in the value of K itself and is not shown separately in the expression for equilibrium constant. Now if at equilibrium the concentration of either $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ ion or Cl^- ions is increased, then this would result in an increase in $[\text{CoCl}_4]^{2-}$ ion concentration thus, maintaining the value of K as constant. In other words we can say that equilibrium will shift in the forward direction and will result in a corresponding change in colour.

Chemicals and Material Required

- Conical flask (100 mL) : One
- Beakers (100 mL) : Three
- Burettes : Three
- Test tubes : Six
- Test tube stand : One
- Glass rod : One
- Acetone/alcohol : 60 mL
- Concentrated hydrochloric acid : 30 mL
- Cobalt chloride : 0.6000 g



Procedure

- Take 60 mL of acetone in a 100 mL conical flask and dissolve 0.6000 g CoCl_2 in it to get a blue solution.
- Take 5 test tubes of same size and mark them as A, B, C, D and E. Add 3.0 mL of cobalt chloride solution in each of the test tubes from 'A' to 'E' respectively. Now add 1.0 mL, 0.8 mL, 0.6 mL, 0.4 mL and 0.2 mL of acetone respectively in these test tubes. Add 0.2 mL, 0.4 mL, 0.6 mL and 0.8 mL of water to test tubes B, C, D and E respectively, so that the total volume of solution in each of the test tubes is 4.0 mL.
- Note the gradual change in colour of the mixture from blue to pink with an increase in the amount of water. Record your observations in tabular form (Tables 4.3).
- Take 10 mL cobalt chloride solution in acetone prepared above and add 5 mL distilled water to it. A solution of pink colour will be obtained.
- Take 1.5 mL of pink solution from step (iv) in five different test tubes labeled as A', B', C', D' and E'. Add 2.0 mL, 1.5 mL, 1.0 mL and 0.5 mL of water to the test tubes labeled from A' to D' and 0.5 mL, 1.0 mL, 1.5 mL, 2.0 mL and 2.5 mL concentrated HCl respectively in the test tubes A' to E' so that total volume of solution in the test tubes is 4 mL.
- Note the gradual change in colour of pink solution to light blue with increasing amounts of hydrochloric acid. Record your observations in tabular form (Tables 4.4).

Table 4.3 : Shift in equilibrium on adding water

Sl. No.	Test tube	Volume of acetone added in mL	Volume of CoCl_2 solution added in mL	Volume of water added in mL	Colour of mixture
1.	A	1.0	3.0	0.0	
2.	B	0.8	3.0	0.2	
3.	C	0.6	3.0	0.4	
4.	D	0.4	3.0	0.6	
5.	E	0.2	3.0	0.8	

Table 4.4 : Shift in equilibrium on adding Cl^- ions

Sl. No.	Test tube	Volume of conc. HCl added in mL	Volume of aquo complex solution added in mL	Volume of water added in mL	Colour of mixture
1.	A'	0.5	1.5	2.0	
2.	B'	1.0	1.5	1.5	
3.	C'	1.5	1.5	1.0	
4.	D'	2.0	1.5	0.5	
5.	E'	2.5	1.5	0.0	

Note : • In the first set of experiments concentration of chloro complex is constant and concentration of water is changing.
 • In the second set concentration of aquo complex is constant and concentration of chloride ions is increasing.

Result:- At equilibrium when the concentration of Cl^- ions is increased, then this results in an increase in $[\text{CoCl}_4]^{2-}$ ion concentration thus, maintaining the value of K as constant and equilibrium shifts in the forward direction and results in a change in colour from pink to blue. Similarly when the concentration of H_2O is increased, then this results in an increase in $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ ion concentration thus, maintaining the value of K as constant and equilibrium shifts in the backward direction and results in a change in colour from blue to pink.

Determination of Boiling Point (B.P):

Aim :- To determine the boiling point of an organic compound (liquid)

Apparatus :- Thiele's tube , capillary tube , Stand ,thread, Bunsen burner.

Chemicals :- Pure given organic compound, liquid paraffin.

Theory :- The boiling point of a liquid compound is the temperature at which the vapour pressure of the liquid becomes equal to the atmospheric pressure. The presence of impurities raises its B.P. The B.P. of the given organic liquid is generally determined by using Thiele's tube or open oil bath.

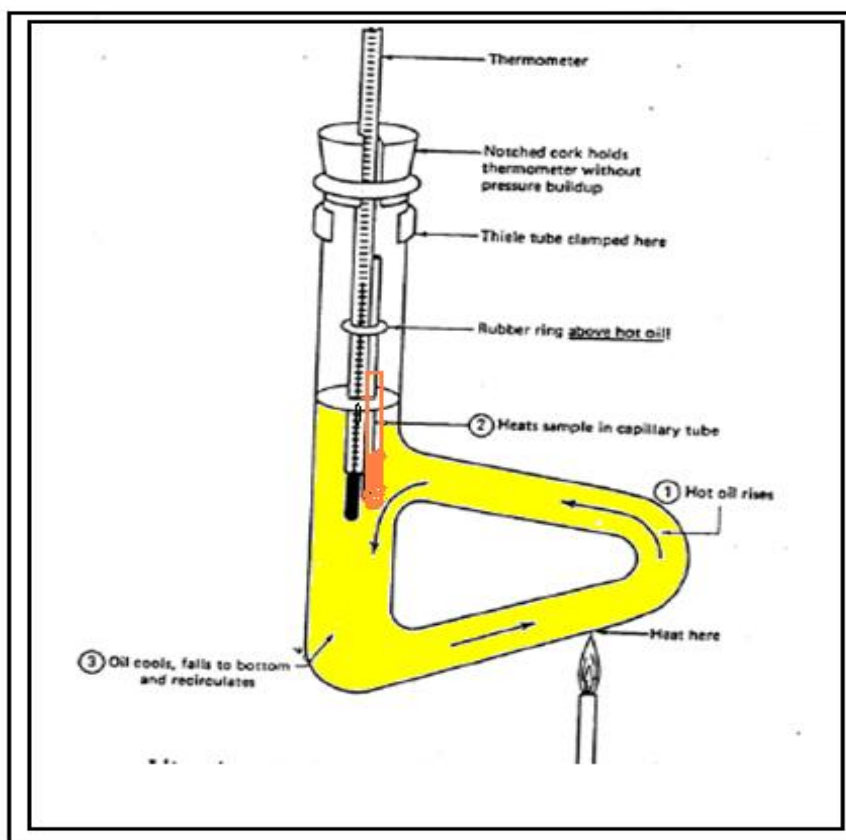
Procedure :-

- 1) Take a small tube (usually sodium fusion tube) and fill it by pure organic liquid whose boiling point is to be determined.
- 2) Seal a capillary tube at one end and place it in the liquid with the sealed end above the surface of the liquid.
- 3) Fasten the glass tube to the thermometer using a thread or a rubber band.
- 4) Immerse partly the thermometer in the paraffin liquid taken in a small beaker or Thiele's tube taking care to see that thread is above the level of the liquid bath i.e. it is not coming in contact with liquid bath.
- 5) Heat the Thiele's tube gently at the lower bent arm and no stirring is required as convection currents maintain uniform temperature. As rapid and continuous stream of air bubbles start coming out from the lower end of the capillary tube, remove the burner but continue stirring note down the temperature at which the air bubble stop and the liquid rushes into the capillary tube. This is the boiling point of the liquid.

Result:- 1) The Boiling point of given organic Liquid _____ is _____ °C

2) The Boiling point of given Unknown organic Liquid is _____ °C

3) The Unknown organic liquid is _____

Diagram**Observation Table**

Sr.No	Name of the compound	Boiling point in Degree Celsius	Boiling point in Kelvin
1	Acetic acid	118	
2	Unknown compound		

Boiling point of some common organic compounds

Sr.No	Name of the compound	Boiling point in Degree Celsius	Boiling point in Kelvin
1	Nitrobenzene	210	
2	Benzene	80	
3	Benzaldehyde	179	
4	Acetone	56	

Determination of Melting Point (M.P):

Aim :- To determine the Melting point of an organic compound (Solid)

Apparatus :- Thiele's tube , capillary tube , sodium fusion tube ,Stand ,thread, Bunsen burner.

Chemicals :- Pure given organic compound, liquid paraffin.

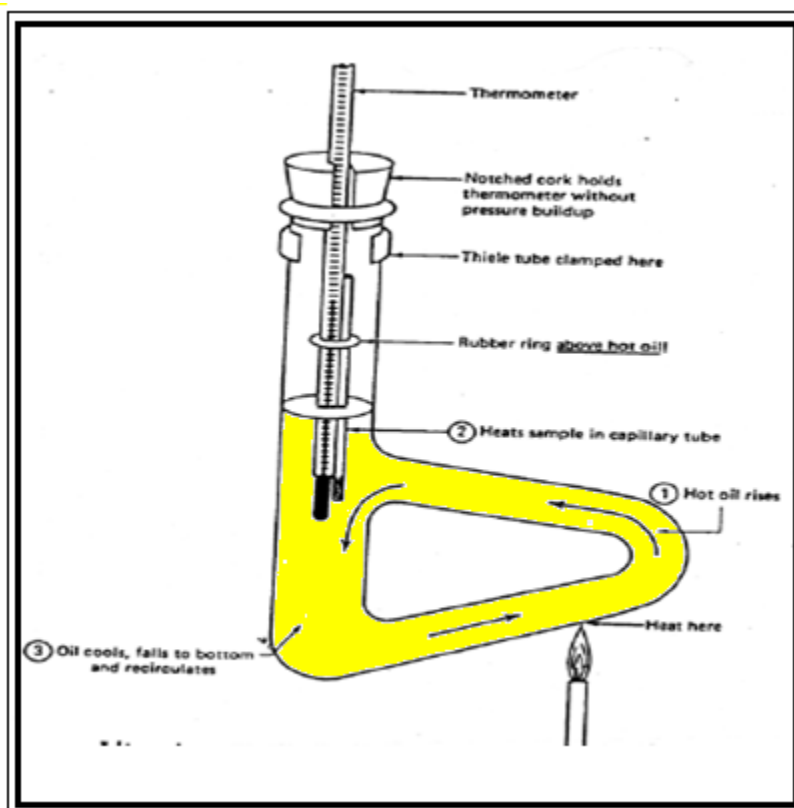
Theory :- The Melting point of a compound is the temperature at which the solid state of a compound changes into liquid state. It is defined as the temperature at which solid phase is in equilibrium with the liquid phase at a given temperature. The presence of impurities lowers its M.P.

Procedure :-

- 1) Take a capillary tube and seal it from one end.
- 2) Fill the capillary tube with given finely powdered organic solid from the non sealed end whose Melting point is to be determined.
- 3) Fasten this capillary tube to the thermometer using a thread or a rubber band.
- 4) Immerse partly the thermometer in the paraffin liquid taken in a Thiele's tube taking care to see that thread is above the level of the liquid bath i.e. it is not coming in contact with liquid bath.
- 5) Heat the Thiele's tube gently at the lower bent arm and no stirring is required as convection currents maintain uniform temperature. As you see the solid changing in to liquid from the lower end of the capillary tube, that is when you see partly powdered compound changed to liquid and still some in the solid state. Note down this temperature, this is the Melting point of the solid.

- Result:-**
- 1) The Melting point of given organic compound _____ is _____ °C
 - 2) The Melting point of given Unknown organic compound is _____ °C
 - 3) The Unknown organic compound is _____**

Diagram



Observation Table

Sr.No	Name of the compound	Melting point in Degree Celsius	Melting point in Kelvin
1	Naphthalene	80	
2	Unknown		

Melting point of some common organic compounds

Sr.No	Name of the compound	Melting point in Degree Celsius	Melting point in Kelvin
1	Oxalic acid	101	
2	Urea	132	
3	Benzoic acid	121	
4	m-Dinitrobenzene	90	

Analysis of Salts**PRELIMINARY TESTS:**

TEST	OBSERVATION	INFERENCE
<u>DRY TEST OF CATION</u> <u>(BASIC RADICALS)</u>		
1. Colour	(a) Blue or Bluish green (b) Green (c) Reddish Brown or Brown (d) Pink (e) Light Pink, Flesh colour or earthy colour (f) Colourless (white)	Cu^{2+} or Ni^{2+} may be present Ni^{2+} may be present Fe^{3+} may be present Co^{2+} may be present Mn^{2+} may be present $\text{Cu}^{2+}, \text{Ni}^{2+}, \text{Fe}^{3+}, \text{Co}^{2+}, \text{Mn}^{2+}$ may be absent. $\text{Pb}^{2+}, \text{Al}^{3+}, \text{Zn}^{2+}, \text{Ca}^{2+}, \text{Sr}^{2+}, \text{Ba}^{2+}, \text{Mg}^{2+}, \text{K}^{+}, \text{NH}_4^{+}$ may be present
2. Heating in a dry test tube Little of compound heated in a dry heating tube N.B (1) Observe the evolution Of gases also (2) If original compd is coloured then only a black residue obtained (3) Observe the changes by first slowly heating followed by strong heating	(a) Decrepitation (Crackling sound) (b) Coloured residue (including black) (c) White infusible residue (d) White sublimate (e) Yellow residue when hot which turns white when cold (f) White compd gives black residue on strong heating (g) Evolution of gases (1) Colourless gas with Smell of Ammonia turning red litmus paper blue (2) Colourless gas turning blue litmus paper red (3) Colourless gas with having vinegar like smell	$\text{Pb}(\text{NO}_3)_2, \text{KCl}, \text{Ba}(\text{NO}_3)_2$ KNO_3 may be present $\text{Cu}^{2+}, \text{Co}^{2+}, \text{Ni}^{2+}, \text{Fe}^{3+}$ salts may be present $\text{Ba}^{2+}, \text{Sr}^{2+}, \text{Ca}^{2+}$ may be present \therefore Ammonium halides may be present Zn^{2+} may be present $\therefore \text{K}_2 \text{C}_2\text{O}_4$ may be present $\therefore \text{NH}_4^{+}$ may be present $\therefore \text{Cl}^{-}, \text{SO}_4^{2-}, \text{CH}_3\text{COO}^{-}$ may be present $\text{CH}_3 \text{COO}^{-}$ may be present

TEST	OBSERVATION	INFERENCE
	(4) Colourless gas turning lime water milky (5) Brown fumes give out (6) Greenish yellow gas turning starch iodide paper blue (7) Reddish brown gas turning starch iodide paper orange yellow (8) Dark violet vapours give out turning starch iodide paper blue	$C_2O_4^{2-}$ may be present NO_3^-, Br^- may be present Cl^- may be present Br^- may be present I^- may be present
3. Flame test <i>Clean the Pt. loop/Nichrome wire by dipping it in a t.t containing a little conc. HCl and placing it in the blue part of the flame. Moisten a little compd on the watch glass with conc. HCl. Dip the Pt. loop/Nichrome wire in this mixture and hold it in the blue part of the flame. Observe the flame colour</i>	(1) Lilac or Violet flame (2) Bluish white flame (3) Bluish green flame (4) Apple green flame (5) Brick red (Dull red) flame (6) Crimson red (dark red) flame (7) No characteristic colour to the flame	K^+ may be present Pb^{2+} may be present Cu^{2+} may be present Ba^{2+} may be present Ca^{2+} may be present Sr^{2+} may be present $K^+ Pb^{2+} Cu^{2+} Ba^{2+} Ca^{2+} Sr^{2+}$ May be absent.
4. Test for NH_4^+ Compound + dil NaOH. Warm	(1) Gas evolved with smell of ammonia forming dense white fumes with a glass rod dipped in conc. HCl. (2) No smell of ammonia	$\therefore NH_4^+$ may be present $\therefore NH_4^+$ may be absent
<u>DRY TEST FOR ANION (ACIDIC RADICALS)</u> 5. Action of dil. HCl Compd + dil HCl (Observe without heating.)	(1) Effervescence of a gas turning lime water milky (2) No Effervescence	$\therefore CO_3^{2-}$ may be present $\therefore CO_3^{2-}$ may be Absent

TEST	OBSERVATION	INFERENCE
<p>6. Action of Conc.H₂SO₄ Compd + Conc.H₂SO₄</p> <p>NB: Test for Cl⁻ in cold. If Cl⁻ absent, warm and observe</p>	<p>(1) Colourless fumes of HCl given out forming dense white fumes with a glass rod dipped in NH₄OH.</p> <p>(2) Colourless vapours given out on warming, having the smell of vinegar.</p> <p>(3) Reddish brown or yellowish brown vapour given out on warming the test tube.</p> <p>(4) Brownish fumes obtained above (3) increases on addition of Cu foil.</p> <p>(5) Violet vapours given out on warming the test tube.</p> <p>(6) No characteristic fumes / vapours</p>	<p>∴ Cl⁻ may be present</p> <p>∴ CH₃COO⁻ may be present</p> <p>∴ Br⁻, NO₂⁻, NO₃⁻ may be present</p> <p>∴ Br⁻ may be absent NO₂⁻, NO₃⁻ may be present</p> <p>∴ I⁻ may be present</p> <p>Cl⁻, Br⁻, I⁻, NO₃⁻, CH₃COO⁻ may be absent</p>
<p>7. Test for PO₄³⁻ Compd.+ Conc HNO₃ (Boil to drive out any coloured fumes if given.) Add excess of ammonium molybdate soln</p>	<p>1) Canary yellow ppt</p> <p>2) No Canary yellow ppt</p>	<p>∴ PO₄³⁻ may be present</p> <p>∴ PO₄³⁻ absent.</p>
<p>8. Test for C₂O₄²⁻ (KMnO₄ Test) Compd. + 2 mldil.H₂SO₄ Boil off any gas evolved, add little more dil.H₂SO₄ and then KMnO₄ soln dropwise.</p>	<p>KMnO₄ Soln is decolourised</p> <p>KMnO₄ Soln is not decolourised</p>	<p>∴ C₂O₄²⁻ may be present</p> <p>∴ C₂O₄²⁻ absent.</p>

NB: If the tests (5), (6), (7) and (8) do not give positive results, the compound may contain SO₄²⁻ anion.

PREPARATION OF SOLUTION (W.E)

Take a 10 ml (approx) of distilled water in a 25 ml beaker, warm and add pinch by pinch the compound, stir till it dissolves, then add more. Solution obtained is (W.E) **Water Extract** (Use this solution to perform the wet tests for cation and anion).

1. TEST FOR HALIDES (Cl⁻, Br⁻, I⁻)	No ppt or Ppt soluble in dil HNO ₃	Halides absent.
W.E + Ag NO ₃	Ppt insoluble in dil HNO ₃	Halides (Cl ⁻ , Br ⁻ , I ⁻) are present
DETECTION OF HALIDES (Cl⁻, Br⁻, I⁻)		
<i>Note the colour of the appt obtained above in</i>	(a) White ppt soluble in NH ₄ OH (b) Pale yellow ppt (c) Yellow ppt	Cl ⁻ is present Br ⁻ is present I ⁻ is present
C.T FOR Cl⁻/Br⁻/I⁻	(a) Faint greenish yellow fumes turning moist blue litmus paper red and finally bleaches it (b) Reddish brown fumes (c) Violet fumes	Cl ⁻ is confirmed Br ⁻ is confirmed I ⁻ is confirmed
(i) W.E + Conc H ₂ SO ₄ + MnO ₂ . Warm gently		
ii) W.E + dil. H ₂ SO ₄ +CCl ₄ or CHCl ₃ + excess of strong chlorine water. Shake well and allow to stand	(a) Colourless CCl ₄ /CHCl ₃ layer (b) Reddish yellow CCl ₄ / CHCl ₃ layer (c) Violet CCl ₄ /CHCl ₃ layer	Cl ⁻ is confirmed Br ⁻ is confirmed I ⁻ is confirmed
2. TEST FOR CARBONATE (CO₃²⁻)	White ppt soluble in dil HNO ₃ with effervescence.	CO ₃ ²⁻ is present
W. E + CaCl ₂	Effervescence of a gas turning lime water milky.	CO ₃ ²⁻ is confirmed
C.T for CO₃²⁻ (i) W.E + dil HCl	Pink colour	CO ₃ ²⁻ is confirmed
(ii) W.E + phenolphthalein	White ppt	CO ₃ ²⁻ is confirmed
3. TEST FOR SULPHATE (SO₄²⁻)		
W.E + di.l HNO ₃ + Ba(NO ₃) ₂	White ppt insoluble in dil. HNO ₃	SO ₄ ²⁻ is present SO ₄ ²⁻ is confirmed
C. T FOR SULPHATE W.E + Pb (CH ₃ COO) ₂		

<p>4. TEST FOR NITRATE (NO₃⁻) W.E Conc H₂SO₄ +Cu filings. <i>Warm Carefully.</i></p> <p>C.T For NO₃⁻ W.E + Conc H₂SO₄ Cool under tap. then add freshly prepared saturated FeSO₄ soln Carefully along the sides of the test tube .</p>	<p>Brown fumes of NO₂ and Bluish green soln</p> <p>Brown ring (of FeSO₄.NO) at the junction of the two solutions</p>	<p>NO₃⁻ is present</p> <p>NO₃⁻ is confirmed</p>
<p>5. TEST FOR PHOSPHATE (PO₄³⁻) W.E + Conc. HNO₃ boil gently. Add ammonium Molybdate in excess and warm again.</p> <p>C.T For PO₄³⁻ W.E + NH₄Cl + NH₄OH + Mg SO₄ solution</p>	<p>Canary yellow ppt</p> <p>White crystalline ppt of Magnesium ammonium phosphate</p>	<p>PO₄³⁻ is present</p> <p>PO₄³⁻ is confirmed</p>
<p>6. TEST FOR ACETATE (CH₃COO⁻) W.E + neutral FeCl₃ soln</p> <p>C.T for CH₃ COO⁻ To the decanted solution from above add dil HCl</p>	<p>Reddish coloured ppt or soln</p> <p>Reddish colour disappears and a white ppt is formed in a yellow coloured solution</p>	<p>CH₃ COO⁻ is present</p> <p>CH₃ COO⁻ is confirmed</p>
<p>(2) ESTER TEST W.E + Conc. H₂SO₄ (2ml) Heat. Add ethyl alcohol (1ml). Shake warm pour this soln into a beaker containing water.</p>	<p>Pleasant fruity smell of ester.</p>	<p>CH₃ COO⁻ is confirmed.</p>
<p>7. TEST FOR OXALATE (C₂O₄²⁻) W.E + dil CH₃COOH. Boil to remove CO₂. Add CaCl₂ soln.</p> <p>C.T FOR C₂O₄²⁻ W.E + dil H₂SO₄ warm. Add 2-3 drops of KMnO₄</p>	<p>White ppt formed that dissolves on adding dil HNO₃ and warming.</p> <p>Pink colour of KMnO₄ is decolourised with the evolution of CO₂ gas.</p>	<p>C₂O₄²⁻ is present.</p> <p>C₂O₄²⁻ is confirmed</p>

WET TEST FOR CATION
DETECTION OF CATION OF GROUP ZERO (NH₄⁺)

TEST	OBSERVATION	INFERENCE
W.E + 2ml dil NaOH shake well and warm gently	(1) No smell of Ammonia/ NH ₃ gas not evolved (2)NH ₃ gas evolved recognized by its smell turning most red litmus paper blue or moist Turmeric Paper brown or Evolution of dense white fumes when a glass rod dipped in conc.HCl is held over the mouth of the test tube	∴ Group O is absent ∴ NH ₄ ⁺ is absent ∴ Group O is Present ∴ NH ₄ ⁺ is Present
<u>C.T. for NH₄⁺</u> 1ml of Nessler's reagent + 2 drops of W.E	Brown ppt or Colouration	∴ NH ₄ ⁺ is confirmed

SEPARATION OF CATIONS INTO GROUPS (I – VI)

TEST	OBSERVATION	INFERENCE
1)W.E + dil. HCl	White ppt No white ppt	Group I is present ∴ Pb ²⁺ is present (Refer table No 2) Group I is absent
2)W.E + dil. HCl + warm and add H ₂ S water.	Black ppt No black ppt	∴ Group II is present ∴ Cu ²⁺ is present (Refer Table No 3) Group II is absent
3) W.E + Solid NH ₄ Cl + NH ₄ OH till alkaline	Coloured ppt (white or Brown) No coloured ppt	∴ Group III is present ∴ Al ³⁺ , Fe ³⁺ , Mn ²⁺ are present (Refer Table No 4) ∴ Group III is absent

4) W.E + solid NH_4Cl + NH_4OH till alkaline + H_2S gas / H_2S water	Coloured ppt (Black, White, Pink) No coloured ppt	Group IV is present Co^{2+} , Ni^{2+} , Zn^{2+} and Mn^{2+} are present (Refer Table No 5) \therefore Group IV is absent
5) W. E + Solid NH_4Cl + NH_4OH till alkaline + $(\text{NH}_4)_2\text{CO}_3$. Warm	White ppt No white ppt	Group V is present \therefore Ba^{2+} , Sr^{2+} , Ca^{2+} are present (Refer Table No 6) \therefore Group V is absent \therefore Group VI is present \therefore K^+ , or Mg^{2+} may be present (Refer Table No 7.)

TABLE NO. 2

Analysis of Group I (Pb^{2+})

The colour of the group I ppt (PbCl_2) is white
 \therefore Pb^{2+} is present.

C.T. for Pb^{2+}

TEST	OBSERVATION	INFERENCE
1) W.E + $\frac{1}{2}$ ml KI	Yellow ppt of PbI_2	\therefore Pb^{2+} is confirmed
2) W.E + $\frac{1}{2}$ ml K_2CrO_4	Yellow ppt	\therefore Pb^{2+} is confirmed
3) W.E + $\frac{1}{2}$ ml dil H_2SO_4	White ppt of PbSO_4	\therefore Pb^{2+} is confirmed

TABLE NO 3Analysis of Group II (Cu^{2+})

The colour of the group II ppt (CuS) is black $\therefore \text{Cu}^{2+}$ is present.

C.T. for Cu^{2+}

Test	OBSERVATION	INFERENCE
1. W.E + KI soln	Brown ppt of CuI_2	$\therefore \text{Cu}^{2+}$ is confirmed
2. W.E + dil NaOH	Blue ppt of $\text{Cu}(\text{OH})_2$ turning black on heating	$\therefore \text{Cu}^{2+}$ is confirmed

TABLE NO. 4Analysis of Group III (Al^{3+} , Fe^{3+} , Mn^{2+})

The colour of the ppt of Group III hydroxides is white / Reddish brown

White gelatinous ppt. $\therefore \text{Al}^{3+}$ is present.	Reddish brown or brown or pink ppts $\therefore \text{Fe}^{3+}$ or Mn^{2+} are present.	
C.T. for Al^{3+}: 1) W.E + NaOH soln dropwise \rightarrow gelatinous white ppt soluble in excess of NaOH. 2) W.E + Na_2CO_3 solution \rightarrow white ppt. 3) W.E + ammonium acetate soln. \rightarrow No ppt in cold but on boiling a white gelatinous ppt. Al^{3+} is confirmed.	: W.E + $\text{K}_4\text{Fe}(\text{CN})_6 \rightarrow$ Deep blue ppt / no deep blue ppt.	
	Deep blue ppt or colouration Fe^{3+} is present.	No deep blue ppt Mn^{2+} is present
	C.T for Fe^{3+} W.E. + $\text{KSCN}/\text{NH}_4\text{CN}$ \rightarrow Blood red colouration. Fe^{3+} is confirmed	C.T for Mn^{2+} 1) W.E. + NH_4OH till alkaline \rightarrow white ppt turning brown on heating 2) W.E + 5ml of dil HNO_3 + pinch of solid Sodium bismuthate. Shake, allow to stand \rightarrow violet colouration. Mn^{2+} is confirmed

Note: With concentrated W.E the Mn^{2+} is precipitated In Group III as $\text{Mn}(\text{OH})_2$ (brown or buff ppt) Otherwise Mn^{2+} will be precipitated as MnS (Pinkish ppt) in Group IV. Thus, Mn can analysed either in **Group III** or in **Group IV**.

TABLE NO 5
Analysis of Group IV (Co^{2+} , Ni^{2+} , Zn^{2+} , Mn^{2+})

The colour of the ppt.of Group IV sulphides is Black / White / Pinkish

<p>Black ppt. : Co^{2+} or Ni^{2+} are present</p>		<p>White ppt. Zn^{2+} is present.</p> <p><u>C.T for Zn^{2+}:</u> 1) W.E. + $\text{K}_4\text{Fe}(\text{CN})_6 \rightarrow$ White ppt. 2) W.E.+NaOH soln. dropwise \rightarrow White ppt. Soluble in excess of NaOH and is reppt. as ZnS on addition of H_2S gas.</p> <p>$\therefore \text{Zn}^{2+}$ is confirmed</p>	<p>Pinkish ppt. : Mn^{2+} is present.</p> <p><u>C.T. for Mn^{2+}:</u> 1) W.E + $\text{NH}_4\text{OH} \rightarrow$ White ppt.turning brown on heating. 2) W.E +5ml dil HNO_3 pinch of sodium bismuthate. Shake and allow to stand \rightarrow Violet colouration. 3) W.E + PbO_2 (0.1g) +1/2 ml of dil.(1:1) HNO_3; boil and allow to settle \rightarrow Violet colouration.</p> <p>$\therefore \text{Mn}^{2+}$ is confirmed</p>
<p>W.E + equal volume acetone + $\text{NH}_4\text{SCN} \rightarrow$ Blue colour / no blue colour</p>			
<p><u>Blue colour</u> Co^{2+} is present. <u>C. T. for Co^{2+}</u> 1) W.E.+1ml of a-nitroso β- naphthol \rightarrowBrown ppt. 2) W.E.+NaOH \rightarrowblue ppt changing to brown on heating. 3) W.E.+ $\text{NH}_4\text{Cl}+\text{NH}_4\text{OH}$ till alkaline +$\text{K}_4\text{Fe}(\text{CN})_6 \rightarrow$ Red soln. Warm \rightarrowReddish brown ppt. $\therefore \text{Co}^{2+}$ is confirmed</p>	<p><u>No Blue colour</u> Ni^{2+} is present. <u>C.T. for Ni^{2+}</u> 1) W.E. + $\text{NH}_4\text{Cl} +\text{NH}_4\text{OH}$ till alkaline + dimethyl glyoxime. \rightarrowScarlet red ppt. 2) W.E. + NH_4OH in excess. \rightarrow Pale green ppt. soluble in excess giving blue soln. $\therefore \text{Ni}^{2+}$ is confirmed</p>		

TABLE NO 6
Analysis of Group V (Ba²⁺, Sr²⁺, Ca²⁺)

The colour of the ppt. of Group V carbonates is white therefore Ba²⁺, Sr²⁺ or Ca²⁺ are present
W.E + Acetic acid + K₂CrO₄ → yellow ppt / no yellow ppt.

Yellow ppt. Ba ²⁺ is present.	No yellow ppt. Sr ²⁺ or Ca ²⁺ are present . W.E + Acetic acid + NH ₄ OH till alkaline + solid (NH ₄) ₂ SO ₄ + boil → white ppt. / No white ppt	
<p><u>C.T. for Ba²⁺:</u></p> <p>1) W.E + Acetic acid. + ammonium oxalate soln. → White ppt. insoluble in acetic acid.</p> <p>2) W.E + Acetic acid. + dil. H₂SO₄ → White ppt.</p> <p>3) Flame test → Apple green flame.</p> <p>∴ Ba²⁺ is confirmed.</p>	<p><u>White ppt.</u> Sr²⁺ is present <u>C.T. for Sr²⁺:</u></p> <p>1) W.E + Acetic acid + Ammonium oxalate → White ppt. Insoluble in acetic acid.</p> <p>2) W.E + Acetic acid. + dil. H₂SO₄ → White ppt.</p> <p>3) Flame test → Crimson red flame.</p> <p>∴ Sr²⁺ is confirmed.</p>	<p><u>No white ppt</u> Ca²⁺ is present <u>C.T. for Ca²⁺</u></p> <p>1) W.E + Acetic acid. + CaSO₄ → No ppt.</p> <p>2) W.E + Acetic acid. + (NH₄)₂C₂O₄ → White ppt. Insoluble in acetic acid.</p> <p>3) Flame test → Brick red Flame.</p> <p>∴ Ca²⁺ is confirmed.</p>

TABLE NO 7

Analyses of Group VI (Mg²⁺, K⁺)

<p><u>TEST FOR K⁺</u> W.E + 1-2ml of fresh and clear solution of sodium cobaltinitrite. → Yellow ppt ∴ K⁺ is present.</p> <p><u>C. T for K⁺</u> (1) W.E + picric acid → yellow ppt. ∴ K⁺ is confirmed</p> <p>Note:-If K⁺ is absent test for <u>Mg²⁺</u></p>	<p><u>TEST FOR Mg²⁺</u> W.E add NH₄Cl and NH₄OH till alkaline (in slight excess) and then add ammonium phosphate solution. Scratch the inner side of the test tube with a glass rod → 1. white crystalline ppt ∴ Mg²⁺ is present 2. No white ppt ∴ Mg²⁺ is Absent</p> <p><u>C.T for Mg²⁺</u> W.E + NaOH solution → White ppt soluble in NH₄Cl solution ∴ Mg²⁺ is confirmed</p>
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Result:-

- a. Cation_____
- b. Anion_____
- c. Formula_____
- d. Name of the Compound_____

Instructions:

1. Always be in time for your practical's.
2. Always come prepared for the experiment. This will help in understanding the experiment better.
3. Always listen to the teacher's instructions carefully and note down the important points and precautions to be followed.
4. Do only the experiments assigned, unallotted experiments should not be done.
5. Do your experiment honestly without caring for the final result. Record the observations on a rough note-book instead of writing on pieces of paper.
6. Be economical with the reagents. Only small quantities of the reagent are to be used.
7. Handle the glass apparatus very carefully. In case of any breakage, report it to your teacher at once.
8. Dispose of all waste liquids in the sink and allow the water to run for sometime by opening the water tap.
9. Keep your work place clean. If an acid or other corrosive chemical is spilled, wash it off with water.
10. In case of any injury or accident or breakage of the apparatus, report it to the teacher immediately.
11. Wash your hands with soap after the experiment.

Precautions:

1. Do not touch any chemical with the hand as some of them may be corrosive.
2. Never taste a chemical. It may be poisonous.
3. Do not place the chemical on the palm of your hand.
4. Do not keep the reagent bottles open.
5. Do not roam here and there in the laboratory uselessly.
6. Do not put any object into the reagent bottle.
7. Do not bring inflammable liquids such as alcohol or ether near the flame.
8. Do not take the reagent from the shelf to your work place.
9. Do not disturb the arrangement of the reagents placed on the shelf.
10. Do not use cracked glass apparatus such as beakers for heating purposes.
11. Do not keep the water tap running when not required.
12. Do not throw solid waste materials like pieces of filter paper, broken test-tubes, etc in the sink. Throw them in the waste box only.
13. Do not heat beakers or a china dish directly on a flame. Always make use of wire gauze.

Always wear: 1.Safety gloves 2.Safety glasses 3.Gas masks and 4.Lab coat (Apron) in the Lab

*******Work Safely*******