Experiment 10.1: Flame Test to Identify Metal Ions

Apparatus:

1. Platinum or nichrome wire
2. Bunsen burner
3. Watch glass
4. Spatula
5. Glass rod
6. Concentrated HCl and HNO_3

Chemicals:

- Salts of sodium, calcium, strontium, barium, copper, and potassium

Procedure:

1. Clean the platinum wire by dipping it in concentrated HNO_3 and heating it in the Bunsen burner flame until it imparts no color.
2. Mix a small amount of the salt with concentrated HCl on a watch glass to form a paste.
3. Dip the cleaned wire into the paste and hold it in the Bunsen burner flame.
4. Observe the color of the flame produced by the metal ion.
5. Repeat the process for each salt and record the flame colors.

Chemical Equation:

- Metal chloride + Heat → Metal ion + Flame color

Observations:

S. No.	Flame Color	Metal Ion
1.	Bluish green	Cu^{2+}

| 2. | Brick red | Ca^{2+} |

| 3. | Crimson red | Sr^{2+} |

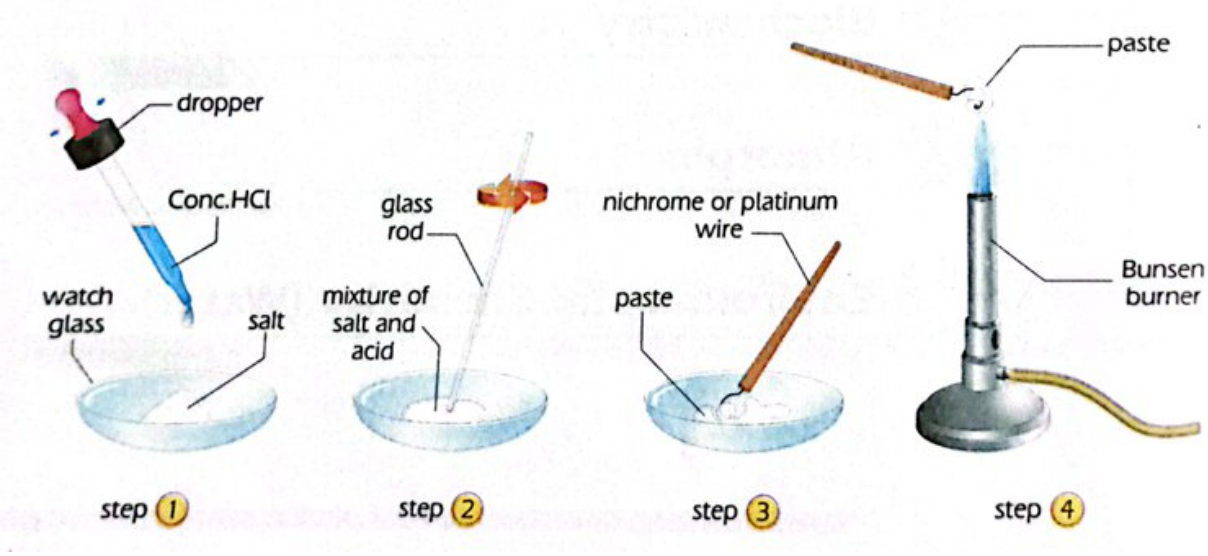
| 4. | Grassy green | Ba^{2+} |

| 5. | Golden yellow | Na^{+} |

| 6. | Violet | K^{+} |

Result:

Different metal ions produce different flame colors, which helps in identifying the metal ions present in the salts.



Experiment 10.2: Standardization of NaOH Solution

Apparatus:

1. Burette
2. Pipette
3. Conical flask
4. Funnel
5. Beaker

6. Iron stand

Chemicals:

- 0.1 M HCl (standard solution)

- NaOH solution

- Phenolphthalein indicator

Procedure:

1. Rinse the burette with HCl and fill it with 0.1 M HCl.

2. Pipette 10 cm^3 of NaOH solution into a conical flask and add 2 drops of phenolphthalein.

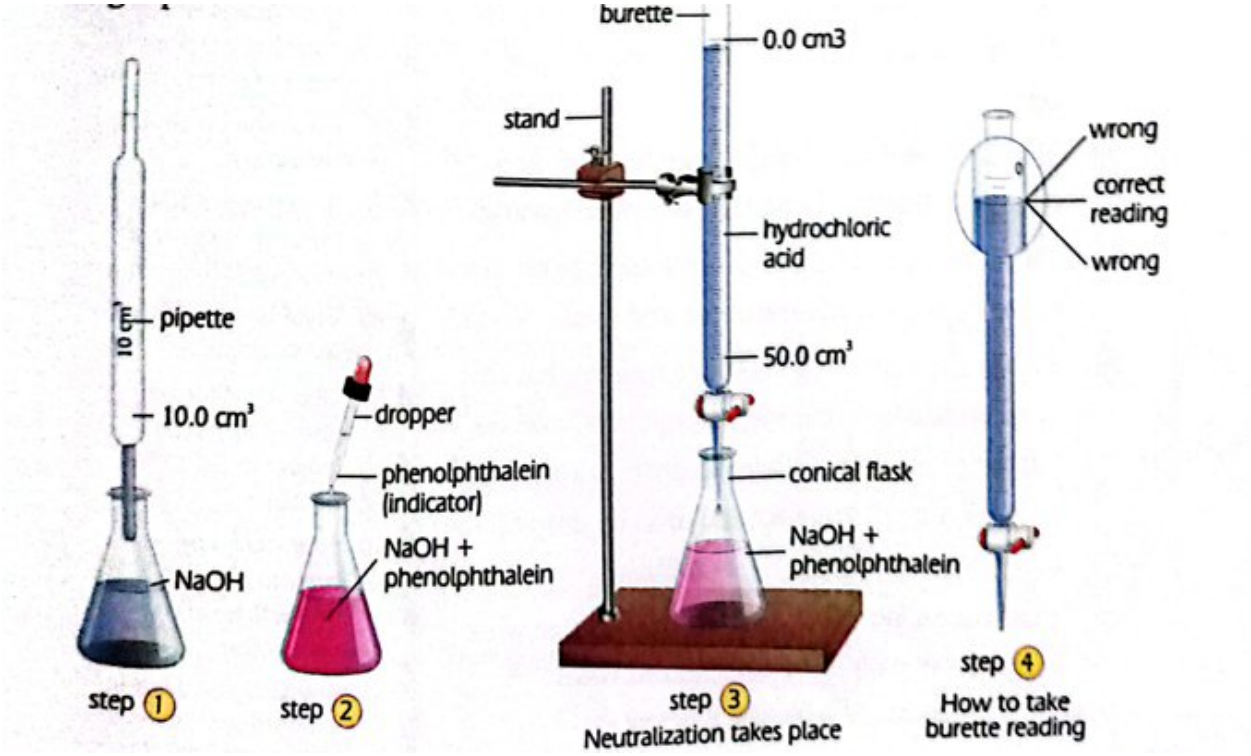
3. Titrate the NaOH solution with HCl until the pink color disappears.

4. Record the volume of HCl used.

5. Repeat the titration to get consistent results.

Chemical Equation:

$NaOH + HCl \rightarrow NaCl + H_2O$



Observations:

S. No.	Initial Reading (cm^3)	Final Reading (cm^3)	Volume of HCl used (cm^3)
1.	0.00	10.0	10.0
2.	10.0	20.0	10.0
3.	20.0	30.0	10.0

Observation:

End point Light pink colour disappears

Calculations:

Acid = Base

$$\frac{M_1 \times V_1}{n_1} = \frac{M_2 \times V_2}{n_2}$$

$$\therefore \frac{0.1 \times 10}{1} = \frac{M_2 \times 10}{1}$$

$$\therefore M_2 = \frac{0.1 \times 10 \times 1}{1 \times 10}$$

$$\therefore M_2 = 0.1\ M$$

Molarity of NaOH = 0.1 M

Result:

The molarity of the NaOH solution is 0.1 M.

Experiment 10.3: Standardization of HCl Solution

Apparatus:

1. Burette

2. Pipette

3. Conical flask

4. Funnel

5. Beaker

6. Iron stand

Chemicals:

- 0.1 M NaOH (standard solution)

- HCl solution

- Phenolphthalein indicator

Procedure:

1. Rinse the burette with HCl and fill it with HCl solution.

2. Pipette 10 cm^3 of 0.1 M NaOH into a conical flask and add 2 drops of phenolphthalein.

3. Titrate the NaOH solution with HCl until the pink color disappears.

4. Record the volume of HCl used.

5. Repeat the titration to get consistent results.

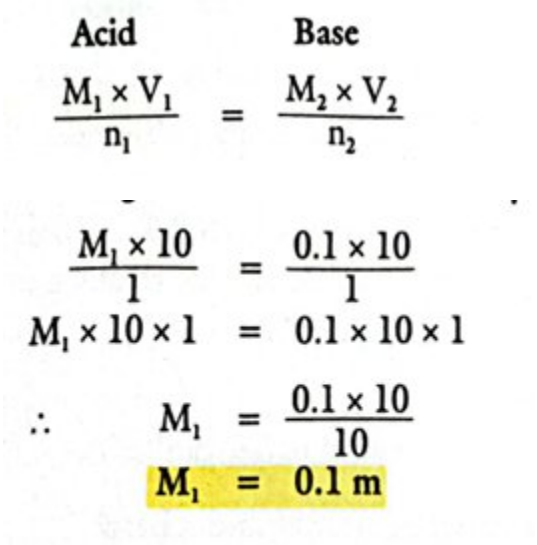
Chemical Equation:

$NaOH + HCl \rightarrow NaCl + H_2O$

Observations:

S. No.	Initial Reading (cm^3)	Final Reading (cm^3)	Volume of HCl used (cm^3)
1.	0.00	10.0	10.0
2.	10.0	20.0	10.0
3.	20.0	30.0	10.0

Calculations:



Result:

The molarity of the HCl solution is 0.1 M.

Experiment 10.4: Determine Molarity of Na_2CO_3 Solution

Apparatus:

1. Burette
2. Pipette
3. Conical flask
4. Funnel
5. Beaker
6. Iron stand

Chemicals:

- 0.1 M HCl (standard solution)
- Na_2CO_3 solution

- Methyl orange indicator

Procedure:

1. Rinse the burette with HCl and fill it with 0.1 M HCl.
2. Pipette 10 cm^3 of Na_2CO_3 solution into a conical flask and add 2 drops of methyl orange.
3. Titrate the Na_2CO_3 solution with HCl until the color changes from yellow to red.
4. Record the volume of HCl used.
5. Repeat the titration to get consistent results.

Chemical Equation:

$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$

Observations:

S. No.	Initial Reading (cm^3)	Final Reading (cm^3)	Volume of HCl used (cm^3)
1.	0.00	10.0	10.0
2.	10.0	20.0	10.0
3.	20.0	30.0	10.0

Calculations:

$$\text{Acid} = \text{Base}$$

$$\frac{M_1 V_1}{n_1} = \frac{M_2 V_2}{n_2}$$

$$\frac{0.1x10}{2} = \frac{M_2 x10}{1}$$

$$0.05M = M_2$$

Result:

The molarity of the Na_2CO_3 solution is 0.05 M.

Experiment 10.5: Determine Molarity of Oxalic Acid Solution

Apparatus:

1. Burette
2. Pipette
3. Conical flask
4. Funnel
5. Beaker
6. Iron stand

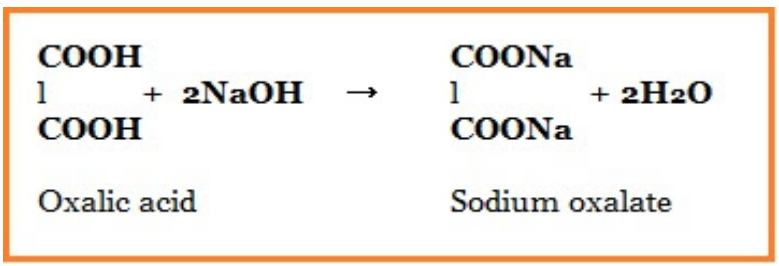
Chemicals:

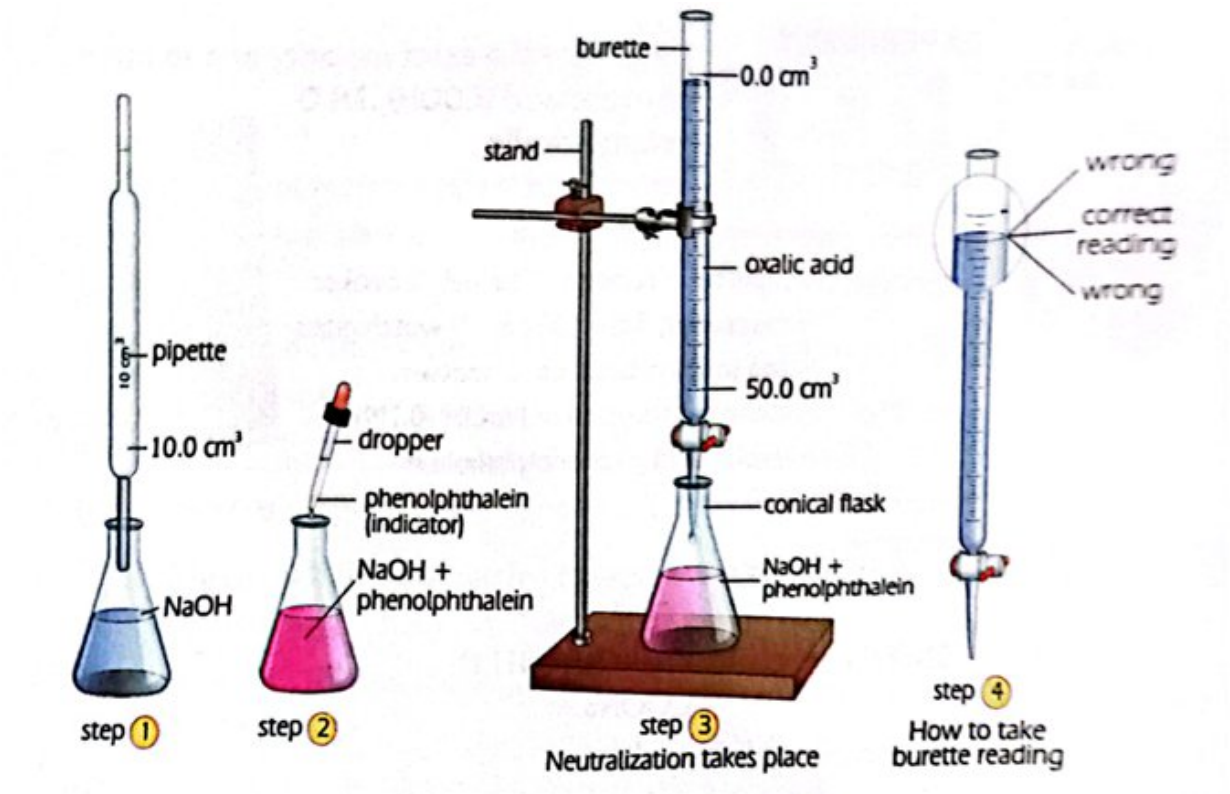
- 0.1 M NaOH (standard solution)
- Oxalic acid solution
- Phenolphthalein indicator

Procedure:

1. Rinse the burette with oxalic acid and fill it with oxalic acid solution.
2. Pipette 10 cm^3 of 0.1 M NaOH into a conical flask and add 2 drops of phenolphthalein.
3. Titrate the NaOH solution with oxalic acid until the pink color disappears.
4. Record the volume of oxalic acid used.
5. Repeat the titration to get consistent results.

Chemical Equation:





Observations:

S. No.	Initial Reading (cm^3)	Final Reading (cm^3)	Volume of Oxalic Acid used (cm^3)
1.	0.00	10.0	10.0
2.	10.0	20.0	10.0
3.	20.0	30.0	10.0

Calculations:

Acid = Base

$$\frac{M_1 V_1}{n_1} = \frac{M_2 V_2}{n_2}$$

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

$$M_1 = 0.05M$$

Result:

The molarity of the oxalic acid solution is 0.05 M.

Experiment 10.6: Demonstrate Natural Substances as Weak Acids

Apparatus:

1. Test tubes
2. pH paper
3. Knife

Chemicals:

- Lemon juice
- Orange juice
- Apple juice
- Vinegar

Procedure:

1. Take small amounts of each juice in separate test tubes.
2. Dip pH paper into each solution.
3. Compare the color of the pH paper with the pH chart.
4. Record the pH of each solution.

Observations:

Substance	pH Value
Lemon juice	2
Orange juice	4
Apple juice	5

| Vinegar | 4 |

Result:

Natural substances like lemon juice, orange juice, apple juice, and vinegar are weak acids as they have pH values less than 7.

Experiment 10.7: Classify Substances as Acidic, Basic, or Neutral

Apparatus:

1. Test tubes
2. Red and blue litmus paper

Chemicals:

- Hydrochloric acid
- Sodium hydroxide
- Ethanol
- Distilled water

Procedure:

1. Take small amounts of each substance in separate test tubes.
2. Dip red and blue litmus paper into each solution.
3. Observe the color change in the litmus paper.
4. Record whether the substance is acidic, basic, or neutral.

Observations:

| Substance | Action on Litmus Paper | Inference |

| Hydrochloric acid | Turns blue litmus red | Acidic |

| Sodium hydroxide | Turns red litmus blue | Basic |

| Ethanol | No change | Neutral |

| Distilled water | No change | Neutral |

Result:

- Hydrochloric acid is acidic.
- Sodium hydroxide is basic.
- Ethanol and distilled water are neutral.

Experiment 11.1: Identify Aldehydes using Fehling's and Tollen's Test

Apparatus:

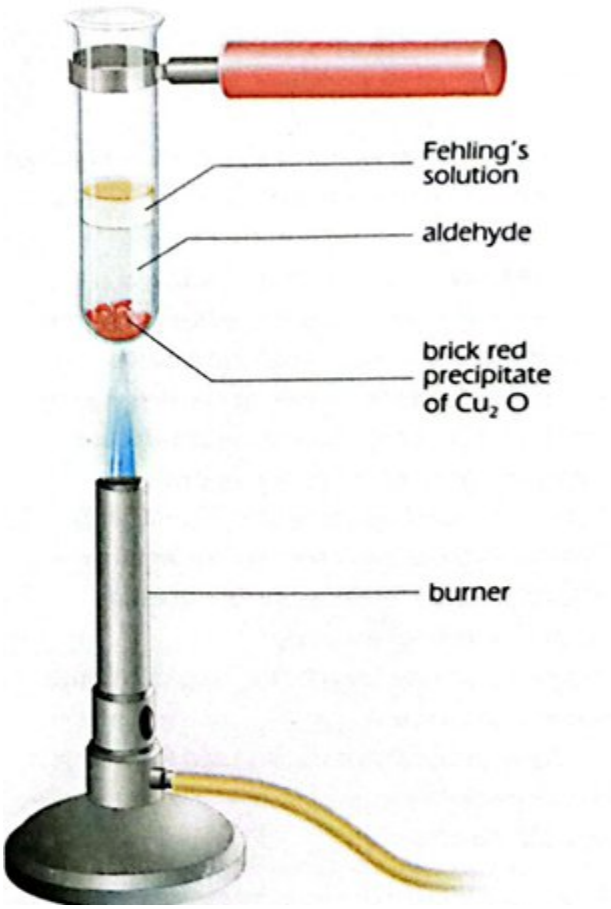
1. Test tubes
2. Water bath
3. Dropper

Chemicals:

- Fehling's solution A and B
- Tollen's reagent
- Glucose solution

Procedure (Fehling's Test):

1. Mix Fehling's solution A and B in a test tube.
2. Add glucose solution and heat the mixture.
3. Observe the formation of a brick red precipitate.

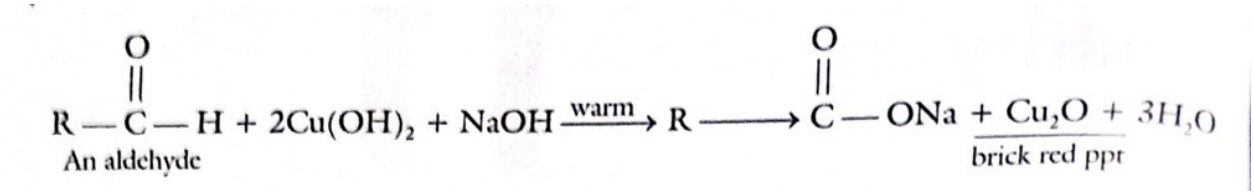


Procedure (Tollen's Test):

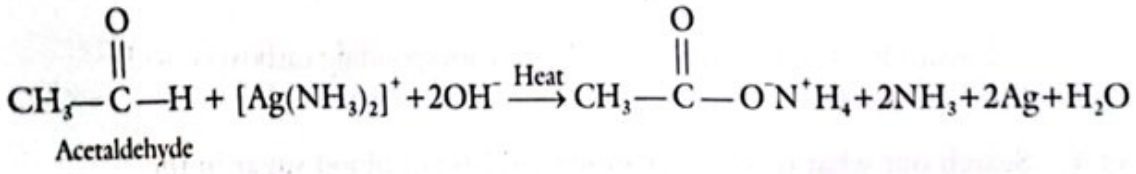
1. Mix glucose solution with Tollen's reagent.
2. Heat the mixture in a water bath.
3. Observe the formation of a silver mirror.

Chemical Equation:

- Fehling's Test:



- Tollen's Test:



Observations:

- Fehling's Test: Brick red precipitate formed.

- Tollen's Test: Silver mirror formed.

Result:

The given compound is an aldehyde as it gives positive Fehling's and Tollen's tests.

Experiment 11.2: Identify Ketones using 2,4-Dinitrophenylhydrazine Test

Apparatus:

1. Test tubes

2. Water bath

3. Dropper

Chemicals:

- 2,4-Dinitrophenylhydrazine (2,4-DNPH)

- Fructose solution

Procedure:

1. Take small quantity of 2,4-DNPH in 5 cm3 ethanol.
2. Add into 1-2 drops of conc. H2SO4
3. Shake to dissolve fructose crystals in 95% ethanol.
4. Mix the above two solution and stand.
5. If precipitate does not appear, dilute it with 1M H2SO4.

Observations:

- Orange precipitate formed.

Result:

The given compound is a ketone as it gives a positive 2,4-DNPH test.

Experiment 11.3: Identify Carboxylic Acids using Sodium Carbonate Test

Apparatus:

1. Test tubes
2. Delivery tube
3. Cork

Chemicals:

- Acetic acid
- Sodium carbonate
- Lime water

Procedure:

1. Add sodium carbonate to acetic acid in a test tube.
2. Pass the evolved gas through lime water.
3. Observe the lime water turning milky.

Chemical reaction

$$CH_3COOH_{(aq)} + Na_2CO_{3(aq)} \longrightarrow CH_3COONa_{(aq)} + H_2O_{(l)} + CO_{2(g)}$$

Observations:

- Effervescence observed.

- Lime water turns milky.

Result:

The given compound is a carboxylic acid as it produces CO_2 gas with sodium carbonate.

Experiment 11.4: Identify Phenol using Ferric Chloride Test

Apparatus:

1. Test tubes

2. Dropper

Chemicals:

- Phenol solution

- Ferric chloride solution

Procedure:

1) Take dilute solution of phenol in test tube.
2) Add a few drops of ferric chloride solution to phenol solution.
3) Observe the color change.

Observations:

- Violet color produced.

Result:

The given compound is phenol as it gives a violet color with ferric chloride.

Simplified Experiment: Identifying Saturated and Unsaturated Compounds

Objective:

Use potassium permanganate ($KMnO_4$) and bromine water to test if cinnamic acid and tartaric acid are saturated or unsaturated.

Materials Needed:

- Test tubes
- Dropper
- Glass rod
- Chemicals:
  - Cinnamic acid
  - Tartaric acid
  - Acidified $KMnO_4$ solution
  - Bromine water
  - Dilute H_2SO_4

Procedure:

Part 1: $KMnO_4$ Test

1. Prepare acidified $KMnO_4$:
   - Dissolve a few $KMnO_4$ crystals in water. Add a few drops of dilute H_2SO_4.

2. Test cinnamic acid:

- Mix cinnamic acid with water (it won't fully dissolve).
- Add acidified $KMnO_4$.
- Observation: Purple color disappears.

3. Test tartaric acid:
- Dissolve tartaric acid in water.
- Add acidified $KMnO_4$.
- Observation: Purple color remains.

Part 2: Bromine Water Test

1. Test cinnamic acid:
- Add bromine water to cinnamic acid suspension.
- Observation: Orange color disappears.

2. Test tartaric acid:
- Add bromine water to tartaric acid solution.
- Observation: Orange color stays.

Results:

Compound	$KMnO_4$ Test (Color Change)	Bromine Water Test (Color Change)	Inference
Cinnamic acid	Disappears (Positive)	Disappears (Positive)	Unsaturated
Tartaric acid	No change (Negative)	No change (Negative)	Saturated

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Conclusion:

- Cinnamic acid is unsaturated (reacts with $KMnO_4$ and bromine water).

- Tartaric acid is saturated (no reaction).

Unsaturated compounds (like cinnamic acid) decolorize $KMnO_4$ and bromine water due to double bonds. Saturated compounds (like tartaric acid) do not react.

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Experiment 13.1: Decomposition of Sugar

Apparatus:

1. Test tube

2. Bunsen burner

3. Cobalt chloride paper

Chemicals:

- Sugar

- Concentrated sulphuric acid

Procedure:

1) Take dry crystals of sugar in a test tube.
2) Heat sugar in a test tube.
3) Bring cobalt chloride paper near the mouth of the test tube.
4) Observe the color change.

Chemical Equation:

$$C_{12}H_{22}O_{11} \xrightarrow{heat} 12C + 11H_2O$$

Observations:

On slight heating, sugar turns brown

On strong heating, Sugar turns black.

Cobalt chloride paper near the mouth of test tube turns blue.

Result:

Sugar decomposes into carbon and water on heating.

Experiment 15.1: Softening of Hard Water

Apparatus:

1. Test tubes
2. Beaker
3. Distilled water

Chemicals:

- Sodium bicarbonate
- Calcium chloride
- Soap solution

Procedure:

1. Take distilled water in three test tubes labelled as A, B and C.
2. Add Na_2SO_4 in test tube A.
3. Add few drops of soap solution in test tube A and observe
4. Add $NaHCO_3$ and $CaCl_2$ in test tube B and shake to dissolve in test tube B and
5. Add soap solution to hard water and observe the formation of scum.
6. Boil the hard water and add soap solution again.
7. Observe the formation of lather.
8. In test tube C, add $CaCl_2$ and add few drops of solution.

Chemical Equation:

$CaCl_2 + Na_2CO_3 \rightarrow CaCl_2 + 2NaCl$

$MgSO_4 + Na_2CO_3 \rightarrow MgCO_3 + Na_2SO_4$

Observations

S. No.	Experiments	Observations
1.	Add a few drops of soap solution in test tube A and shake.	Lather is formed
2.	Add a few drops of soap solution in a portion of solution in test tube B and shake. $NaHCO_3$ $LaCl_2$	Scum is produced
3.	Boil the solution present in test tube B. Add a few drops of soap solution and shake.	Lather is formed
4.	Take a portion of the solution in test tube C. Add a few drops of soap solution and shake.	Scum is produced
5.	Boil 2nd portion of solution in test tube C. Add a few drops of soap solution and shake.	Scum is produced
6.	Add Na_2CO_3 in the remaining solution in test tube C. Shake and filter. Then add a few drops of soap solution in the filterate and shake.	Lather is produced

Observations:

- Scum forms in hard water.

- Lather forms after boiling or adding sodium carbonate.

Result:

Hard water can be softened by boiling or adding sodium carbonate.

Result

1. Test tube contains soft water. (Experiment 1 above).
2. Experiment 2: Water in test tube B is temporary hard water.
3. Experiment 3: On boiling temporary hardness of water was removed in test tube B.
4. Experiment 4: Test tube C contains permanent hard water.
5. Experiment 5: Permanent hardness of water could not be removed by boiling test tube C.
6. Experiment 6: Permanent hardness of water was removed by adding Na_2CO_3 in test tube C.