

Organic Functional groups

1. Flame test

a. **Aliphatic compounds:** Aliphatic compounds burn with a non sooty flame

Burn on a spatula or crucible and note the flame of ethanol below

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b. **Aromatic compound:** burn with a sooty flame

Burn on a spatula or crucible and note the flame of phenol/ benzoic acid or benzaldehyde below

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2. Solubility test

(a) Solubility in water

Polar compounds such as alcohols, carbonyl compounds, carboxylic acids, amines are soluble in water. In fact all compounds for your organic practical are soluble in water.

(b) Solubility in acidic solution

Neutral compounds such as alcohols, carbonyl compounds and amines are soluble in acidic solution while carboxylic acids do not.

(c) Solubility in alkaline solution

Neutral compounds and carboxylic acid are soluble in alkaline solution while amines do not.

Dissolve $\frac{1}{2}$ spatula end full of benzoic acid in about 3cm^3 of water. Add sodium hydroxide solutions drop wise until it just dissolves, followed by 1cm^3 of concentrated hydrochloric acid.

Record your observations.

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3. pH test

a. Alcohols, carbonyl compounds, esters, are neutral to litmus paper; add a drop of ethanol or propanone in about 5cm^3 of water and test the pH of each solution with both red and blue litmus paper i.e. have no effect of litmus paper

i. Alcohol (Ethanol)

ii. Carbonyl compounds (Propanone).....

b. Phenol and carboxylic acid are acidic. i.e. turn blue litmus paper red: Add 1 drop of phenol and a carboxylic acid (ethanoic acid) separately to 5cm^3 of water. Test the pH of solution with both blue and red litmus paper.

Observations

i. Phenol solution

ii. Carboxylic acid solution

c. Amines are basic. i.e. turn Red litmus paper

Dissolve 1 drop of ammonia in about 5cm^3 of water. Test the resultant solution with both red and blue litmus paper and record your observations below

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4. Confirmatory test for phenol

Add one drop of phenol to about 5 cm³ of water (the solution must be colorless) and add 2 or 3 drops of iron (III) chloride (FeCl₃) solution. Record your observation below

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5. Distinguishing phenol and carboxylic acid using sodium carbonate or sodium hydrogen carbonate

Carboxylic acids liberate carbon dioxide from carbonates and bicarbonate while phenols do not. Add 2 drops of phenol and ethanoic acid to about 5cm³ of water in separate test tubes and to each add a half spatula end full of sodium bi carbonate. Record your observation

1. Phenol

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2. Ethanoic acid

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6. Testing for carbonyl compounds using 2,4- dinitrophenylhydrazine or Brady's reagent

Carbonyl compounds (Aldehydes and ketones) react with Brady's reagent to form a yellow precipitates. It is occasionally oily but turns crystalline upon standing.

To 2 drops of Aldehydes (ethanal) and ketone (propanal) in about 1cm³ of water in separate test tubes, add a few drops of Brady's reagent. Record your observations;

(a) Aldehyde

(b) Ketone

7. Distinguishing between Aldehydes and ketone

(i) *Using Fehling's solution(alkaline copper sulphate solution)*

Aldehydes reduce Fehling's solution from blue to green to yellow and finally to orange precipitate.

Mix 1cm³ each of Fehling's solution 1 and 2; and then divide the resultant solution into two.

To the first portion add 3 drops of Aldehyde (ethanal) and to the other add 3 drops of ketone (propanone) warm the test tubes in warm water for about 15 minutes. Record your observations.

(a) Aldehyde

(b) Ketone

(ii) *Using ammoniacal silver nitrate (Tollen's reagent)*

Aldehydes give a silver mirror with ammoniacal silver nitrate while ketones do not.

To 1cm³ of silver nitrate solution, a few drops of sodium hydroxide solution, followed by ammonia solution drop wise until the precipitate just dissolves. Divide the solution into two portions. To the first portion add two drops and Aldehyde and then two drops of ketone to the second portion. Observe for about five minutes and record your observations.

(a) Aldehyde

(b) Ketone

8. Testing for carbonyl compounds with methyl ketone group (CH₃CO-)

These give a yellow precipitate with alkaline iodine solution (iodoform test)

To 1cm³ of water add a drop of propanone, then equal amount of iodine solution followed by 1M sodium hydroxide drop wise until in excess. Record your observations.

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NB. Secondary alcohols with the group (CH₃CH(OH)- also give a positive iodoform test.

Ethanol is the only primary alcohol and Ethanal, the only Aldehyde that give positive iodoform test.

9. Testing for reducing property using acidified potassium dichromate

Primary alcohol, secondary alcohols, and Aldehydes reduce potassium dichromate for orange to green solution. Secondary alcohol are oxidized to ketone and the final solution give a positive Brady's reagent test however, primary alcohols are oxidized to carbonyl compounds and then in excess reagent to carboxylic acid.

To 1cm³ of potassium dichromate solution add three drops of ethanol followed by **(CARE)** 3 drops of concentrated sulphuric acid. Boil the mixture and record your observations.

10. Testing for alcohols by dehydration to alkenes

Alcohols are dehydrated with concentrated sulphuric acid to alkenes. Alkenes decolorize acidified potassium permanganate solution or turn acidified potassium dichromate green or decolorize bromine water.

Carry out the experiment as follows

To 1cm³ of alcohol (ethanol) in a boiling tube, add equal amount of concentrated sulphuric acid, and 1 or 2 glass pieces (*to prevent bumping out of solution*). The apparatus is connected as shown below, heat the mixture and bubble the gas given off through acidified potassium permanganate solution.

11. Formation of an ester

Alcohols react with carboxylic acids to form ester (sweet smelling compounds) in presence of mineral acids such as sulphuric and phosphoric acids. The test is useful for confirming alcohols or carboxylic acid based on what is known to find unknown.

To 2cm³ of alcohol (ethanol) add 2cm³ of carboxylic acid (ethanoic acid) followed by 1cm³ of concentrated sulphuric acid **(CARE)**. To the mixture add 1 or 2 pieces of glasses (*prevents bumping out of solution*). Boil for about 2 minutes (**face the test tube away from your friends**) and pour the mixture into a beaker containing water. Smell immediately.

List of reagents

Ethanol

Phenol

Benzoic acid

Propanone/ketone

Ethanoic acid

iron (III) chloride

Ethanal/ Aldehyde

Sodium hydrogen carbonate

Brady's reagent

sodium hydrogen sulphite.

Fehling's solutions 1

Fehling's solution 2

silver nitrate solution

Ammonia solution

Iodine solution

sodium hydroxide

Potassium dichromate

Conc. H_2SO_4

potassium permanganate solution

propan-2-ol

methylpropan-2-ol