KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(EstabilshedUnder Section 3 of UGC Act 1956)
COIMBATORE-21
DEPARTMENT OF CHEMISTRY

B.Sc Chemistry – Syllubus

Semester-III

17CHU313 NITROGEN CONTAINING FUNCTIONAL GROUPS, HETEROCYCLIC CHEMISTRY AND NATURAL PRODUCTS PRACTICAL

4H 2C

Instruction Hours/week:L: 0 T:0 P:4 **Marks: Internal: 40 External: 60 Total:100**

Scope

The lab course involves the qualitative analysis of nitrogen containing functional groups. It also involves the analysis of alcohols, carboxylic acids, phenols, carbonyl compounds and esters.

Programme Outcome

This course enables the student to

1. Identify the presence of nitro, amine and amide groups
2. Identify functional groups like alcohols, carboxylic acids, phenols , carbonyl compounds and esters

Programme Learning Outcome

1. To develop and inculcate laboratory skills and techniques
2. To enable the student to understand the basic chemical concepts.
3. To develop basic competence of analysing and synthesising Functional compounds and mixtures

Methodology

Qualitative analysis of organic compounds

1.Functional group test for nitro, amine and amide groups.

2.Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols , carbonyl compounds and esters)

Suggested Readings

Text Books:

1. Mann, F.G. & Saunders, B.C. (2009). *Practical Organic Chemistry*. Pearson Education
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. (2012). *Practical Organic Chemistry*. 5th Ed. Pearson.
3. Ahluwalia, V.K. & Aggarwal, R. (2012). *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*. University Press

Reference Books

1. Ahluwalia, V.K. & Dhingra, S. (2010). *Comprehensive Practical Organic Chemistry: Qualitative Analysis*. University Press.

KARPAGAM ACADEMY OF HIGHER EDUCATION

Faculty of Arts, Science and Humanities

(Deemed to be University Under Section 3 of UGC Act 1956)

Eachanari Post, COIMBATORE - 641 021, INDIA

DEPARTMENT OF CHEMISTRY

Title of the course : **Nitrogen Containing Functional Groups Heterocyclic Chemistry and Natural Products - Practical** **Course code: 17CHU313**

Class : **II-B.Sc., Chemistry** **Semester - III**

LIST OF EXPERIMENTS

S. No.	Duration Hours	Name of the Experiment
1.	4	Writing experimental procedure and Demonstration for functional groups
2.	4	Identification of functional group of amine (aniline)
3.	4	Identification of functional group of di-amide (Urea)
4.	4	Identification of functional group of amide (benzamide)
5.	4	Identification of functional group of Nitro compounds (Nitro bezene)
6.	4	Identification of functional group of amide (Glucose)
7.	4	Identification of functional group of aldehydes (benzaldehyde)
8.	4	Identification of functional group of alcohols (phenol)
9.	4	Identification of functional group of monocarboxylic acid
10.	4	Identification of functional group of dicarboxylic acid
11.	4	Viva-voice questions
12.	4	Model practical examination

Organic Lab Manual On

QUALITATIVE ANALYSIS OF ORGANIC COMPOUNDS CONTAINING SIMPLE FUNCTIONAL GROUPS

Enable | Enlighten | Enrich
KARPAGAM
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(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)

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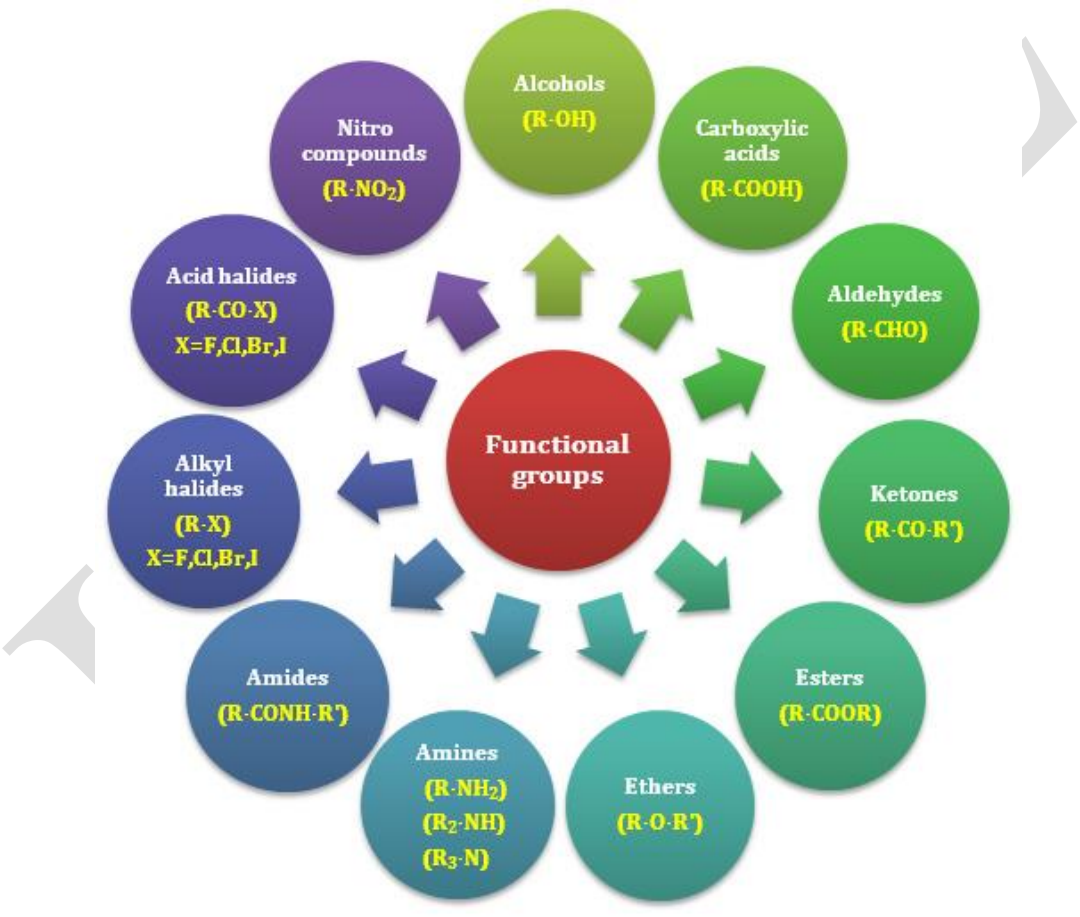
Assistant Professor, Chemistry

Karpagam Academy of Higher Education

What are the functional Groups?

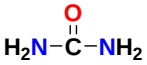
A functional group is a portion of a molecule that is a recognizable/classified group of bound atoms. In organic chemistry it is very common to see molecules comprised mainly of a carbon backbone with functional groups attached to the chain. The functional group gives the molecule its properties, regardless of what molecule contains it; they are centers of chemical reactivity. The functional groups within a molecule need to be identified when naming.



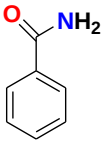
COMPOUNDS GIVEN FOR ORGANIC ANALYSIS

Solids:

1. Nitrogen Containing Functional group

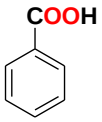


Urea (diamide)

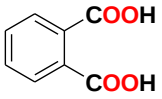


Benzamide
(amide)

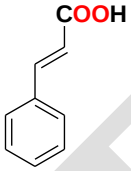
2. Oxygen Containing Functional group



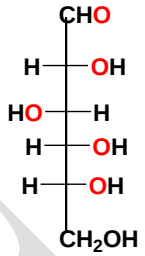
Benzoic acid
(aromatic mono carboxylic acid)



Phthalic acid
(aromatic di carboxylic acid)



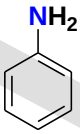
Cinnamic acid
(aromatic unsaturated monocarboxylic acid)



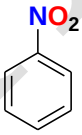
Glucose (carbohydrate)

Liquids:

1. Nitrogen Containing Functional group

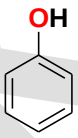


Aniline (amine)

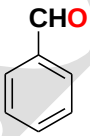


Nitro Benzene (Nitro)

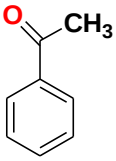
2. Oxygen Containing Functional group



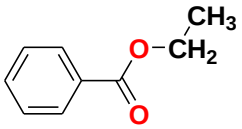
Phenol



Benzaldehyde
(aldehyde)



Acetophenone
(ketone)



Ethyl benzoate
(ester)

QUALITATIVE ANALYSIS OF ORGANIC COMPOUNDS

Aim:

Systematically identify the functional groups in the given organic compound and perform the confirmatory tests after identifying the functional groups.

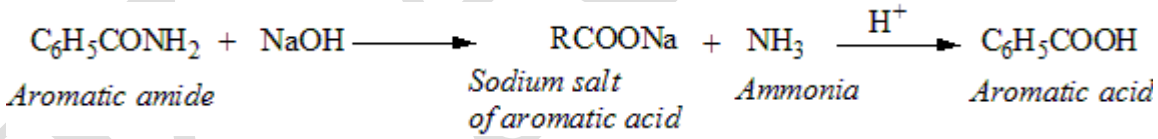
1. Reactions of amides

a. Reaction of NaOH

Amides are decomposed by NaOH to evolve ammonia. The gas can be tested by a moist red litmus paper which is then turned blue.

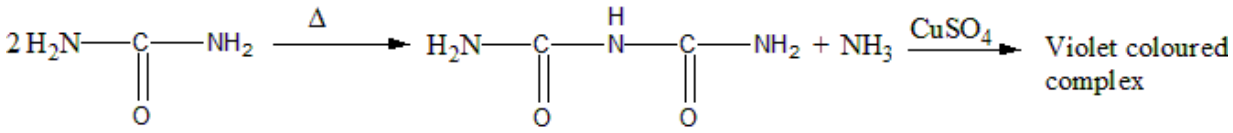
b. Alkaline hydrolysis of aromatic amides to aromatic acid

The soluble sodium salt of aromatic acid formed from aromatic amides upon hydrolysis is regenerated as white precipitate in acidic medium.



c. Biuret Reaction for aliphatic diamide

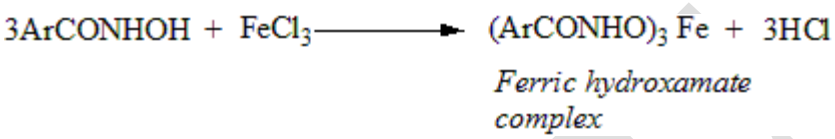
When aliphatic diamide is heated at a temperature above its melting point, ammonia is evolved and crystalline biuret is formed. This biuret in alkaline medium gives a violet colour with a drop of copper sulphate solution.



Biuret reaction

d. Hydroxamic acid test for aromatic primary amides

Hydrogen peroxide reacts with aromatic primary amides to form the hydroxamic acid, which then reacts with ferric chloride to form ferric hydroxamate complex having a violet colour.



2. Reactions of carboxylic acids

a. Reaction with NaOH

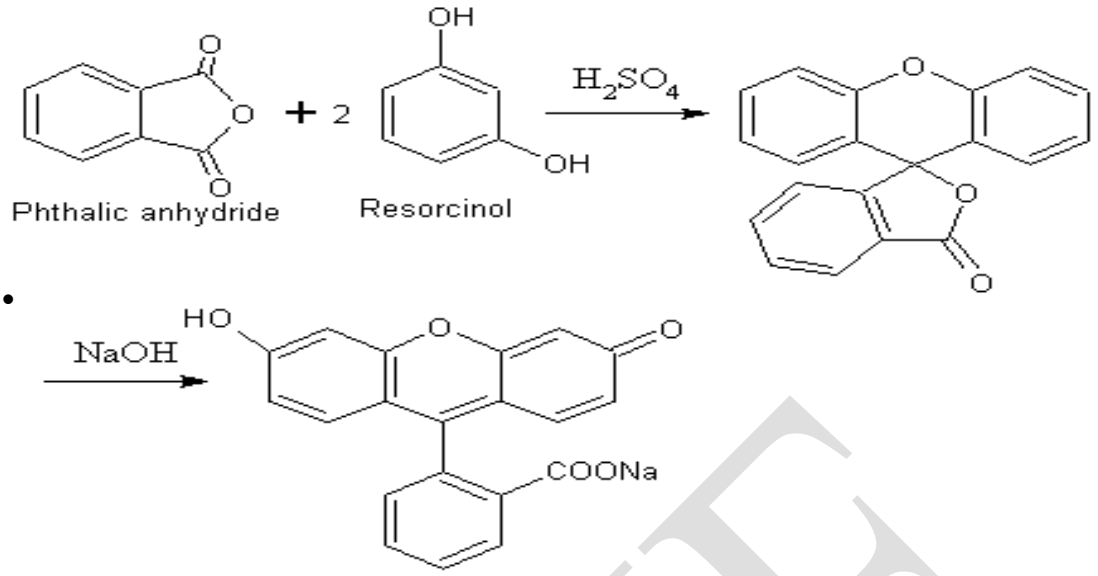
Carboxylic acids being acidic dissolves in NaOH to form sodium salt.

b. Reaction of $NaHCO_3$

Forms salt with sodium bicarbonate solution with the evolution of carbon dioxide.

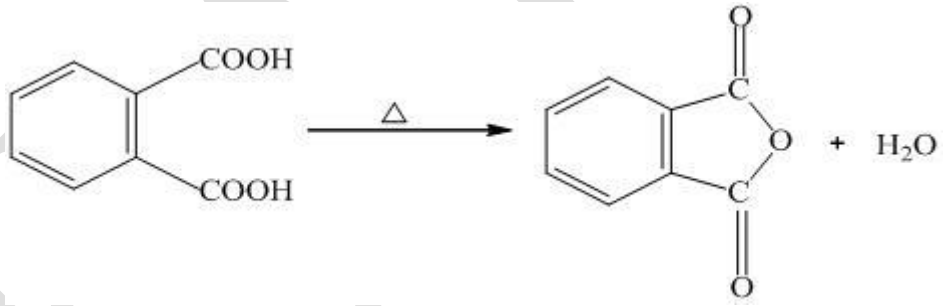
c. Fluorescein Reaction:

The anhydrides of aromatic 1,2-dicarboxylic acids on heating with resorcinol gives a dye fluorescein. This dye in NaOH solution gives a yellowish red solution with green fluorescence.



d. <u>Anhydride formation</u>

Aromatic 1,2-dicarboxylic acids decomposes to give its anhydride when heated at its melting point.



3. Reactions of phenols

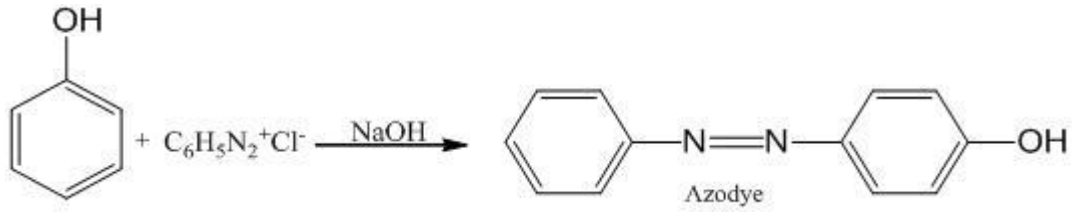
a. <u>Reaction of neutral ferric chloride solution</u>

Phenol form characteristic coloured iron complexes when treated with neutral ferric chloride solution. E.g. phenol and resorcinol - violet colour, catechol-green etc.

$$FeCl_3 + 6C_6H_5OH \longrightarrow [Fe(OC_6H_5)]^{3-} + 3HCl$$

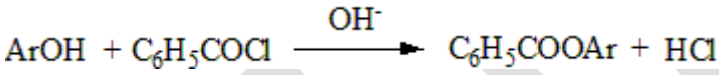
b. Azo dye formation

Aryldiazonium salts react with aromatic rings of phenols to form highly coloured azo compounds. These reactions are called coupling reactions.



c. Benzoylation

Phenols react with benzoyl chloride in presence of NaOH, to form esters.

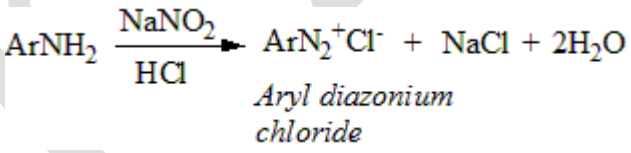


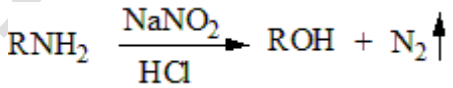
4. Reactions of primary amines:

a. Diazotisation

At low temperature (0-5°C) aromatic primary amines dissolved in strong acids (HCl and H_2SO_4) reacts with nitrous acid ($NaNO_2$+HCl) to form water soluble diazonium salts.

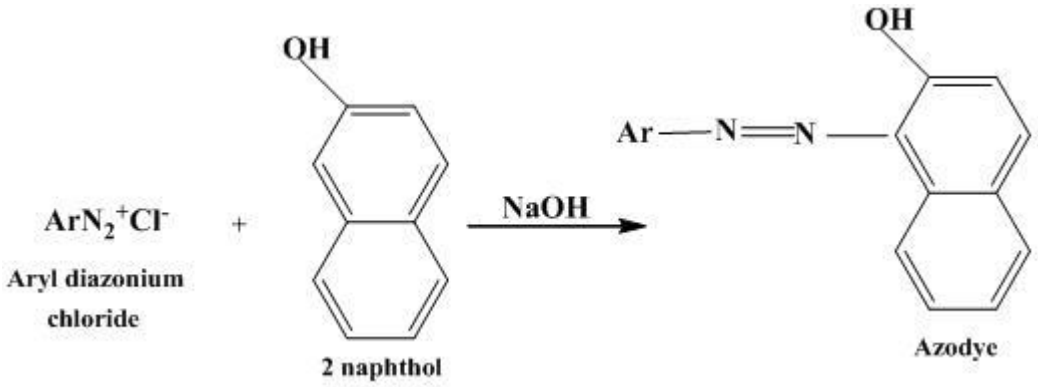
Aliphatic primary amines do not form stable diazonium salts under similar condition. They react with nitrous acid to yield alcohols and nitrogen (causes rapid foaming).





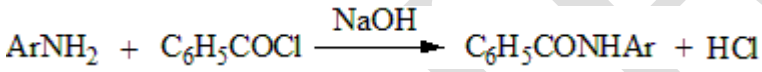
b. Azo dye formation for aromatic primary amines

Aryldiazonium salts react with aromatic rings of phenols to form highly coloured azo compounds. These reactions are calledcoupling reactions.



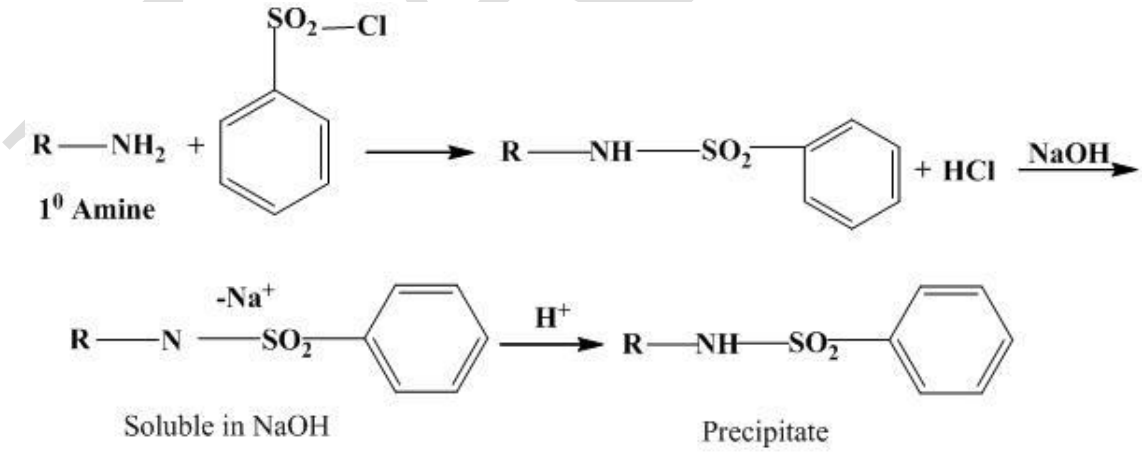
c. <u>Benzoylation</u>

Primary aromatic amines react with benzoyl chloride in presence of NaOH, replacing the H atom attached to the N atom with the benzoyl group to give anilides.



d. <u>Hinsberg reaction</u>

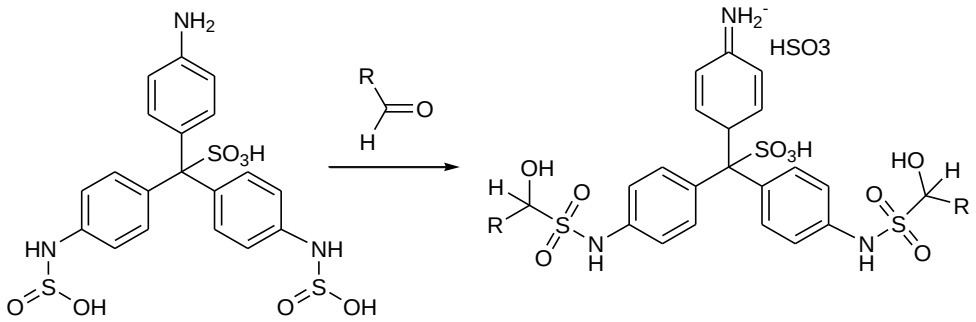
Hinsberg reagent is called benzenesulfonyl chloride. Primary aliphatic amines on reaction with benzenesulfonyl chloride and NaOH gives N-alkylsulphonamide which contains an acidic hydrogen and hence dissolve in NaOH solution to form the soluble sodium salt. The solution thus obtained on acidification gives a precipitate of free sulfonamide which is insoluble in HCl.



5. Reactions of aldehydes:

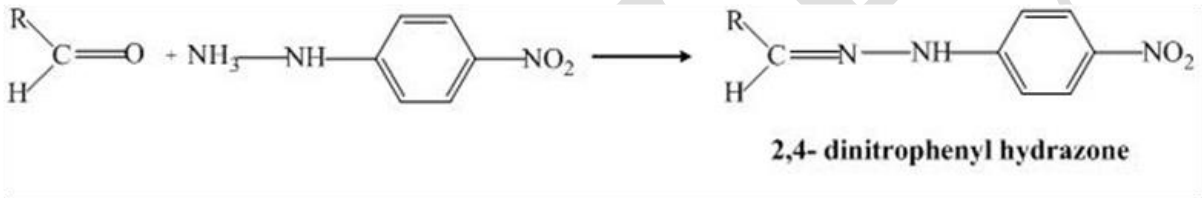
a. <u>Reaction of Schiff's reagent</u>

Schiff's reagent is a red solution of rosaniline hydrochloride dissolved in water which is decolourised by passing sulphur dioxide. Dilute solutions of aldehydes when added to Schiff's reagent restores its red colour slowly.



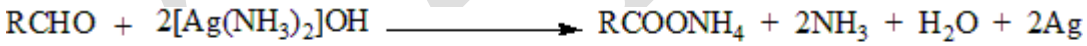
b. Reaction of Borsche's Reagent

Aldehydes reacts with 2,4-dinitrophenyl hydrazine solution to give a orange/red precipitate of aldehyde 2,4-dintrophenylhydrazone derivative.



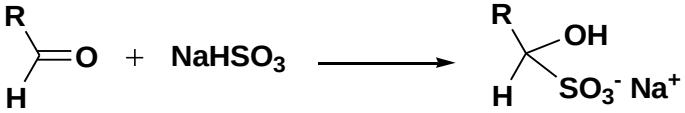
c. Reaction of Tollen's Reagent:

Aldehydes are oxidized to carboxylic acids accompanied by the reduction of silver ions to metallic silver which appears as a mirror under proper conditions.



d. Reaction of sodium bisulphite solution:

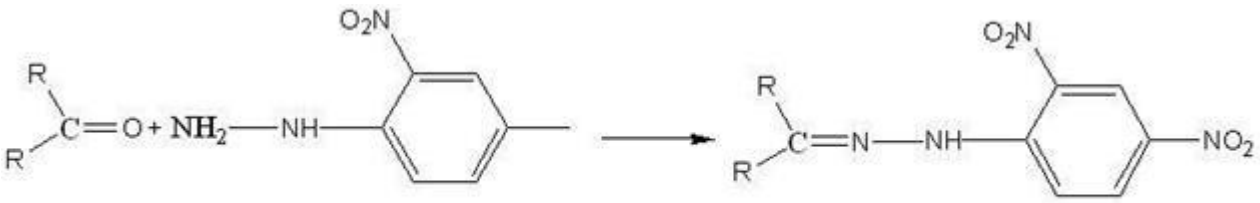
Saturated solution of sodium bisulphite in water, when mixed with aldehydes gives a white crystalline bisulphite addition compounds.



6. Reactions of ketones:

a. Reaction of Borsche's Reagent:

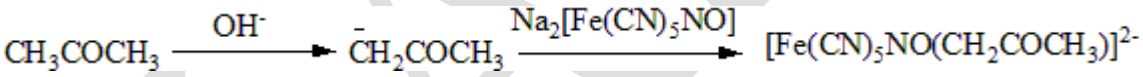
Ketones reacts with 2,4-dinitrophenyl hydrazine solution to give an orange/red precipitate of ketone 2,4 dintrophenylhydrazone derivative.



2,4-dinitrophenyl hydrazone

b. Reaction of sodium nitroprusside solution:

The nitroprusside ion, which may be regarded as a special carrier of the nitrosonium ion, forms a coloured complex with methyl ketones. In presence of alkali eg acetone is converted to CH_3COCH^{2-} ion which reacts with nitroprusside ion $[Fe(CN)_5NO]^{2-}$ to give highly coloured ion $[Fe(CN)_5NOCH_2COCH_3]^{2-}$.



7. Identification of Functional Groups

S. No.	Compound	Nature	Aromatic or Aliphatic	Functional Group
1.	Benzoic acid	Colourless solid	Aromatic	Monocarboxylic acid
2.	Phthalic acid	Colourless solid	Aromatic	Dicarboxylic acid
3.	Cinnamic acid	Colourless solid	Aromatic	Monocarboxylic acid
4.	Benzamide	Colourless solid	Aromatic	Amide
5.	Urea	Colourless solid	Aliphatic	Diamide
6.	Glucose	Colourless solid	Aliphatic	Carbohydrate
7.	Phenol	Colourless liquid	Aromatic	Phenol
8.	Aniline	Pale brown liquid	Aromatic	Amine
9.	Benzaldehyde	Colourless liquid	Aromatic	Aldehyde
10.	Acetophenone	Colourless liquid	Aromatic	Ketone

No	Experiment	Observation	Inference
1	**Reaction of sodium hydroxide solution** i) A little of the substance is boiled with dil. NaOH. ii) Substance is boiled strongly with 20% NaOH solution. Then cooled and acidified with dil. HCl.	a. Ammonia is evolved. b. Substance dissolved. c. White crystalline ppt.	Presence of amides. Presence of acidic substances. Presence of aromatic amides.
2	**Reaction of $NaHCO_3$** To a few ml of the saturated $NaHCO_3$ solution taken in a test tube, a little of the substance is added.	Brisk effervescence with the liberation of CO_2.	Presence of acids.
3	**Reaction of $FeCl_3$ solution** To a little of the substance in water or alcohol a few drops of neutral $FeCl_3$ solution is added.	Violet colour.	Presence of phenols.
4	**Reaction of Schiff's reagent** A little of the substance is added to 1ml of the Schiff's reagent.	Violet colour developed within 2 minutes.	Presence of aldehydes.
5	**Reaction of Borsche's reagent** A little of the substance in methanol is heated with few drops of Borsches reagent in a water bath.	A yellowish orange ppt.	Presence of aldehydes or ketones.

6	**Diazotisation** Dissolve a little of the sample in 2ml con HCl diluted with water and cool in ice. Dissolve sodium nitrite in water and add the solution dropwise to the cold solution nitrite in water and add the solution drop wise to the cold solution.	Rapid foaming.	Presence of primary aliphatic amines.

Tests for aldehydes

Reaction of Tollen's reagent A little of the substance is boiled with few drops of Tollen's reagent.	Black ppt	Presence of aldehydes
Reaction of sodium bisulphite solution Two drops of the aldehyde is shaken with saturated solution of $NaHSO_3$	White crystalline ppt.	Presence of aldehydes.

Tests for ketones

Nitroprusside test: Add a few drops of sodium nitroprusside solution to few drops of ketone. Then add NaOH solution in excess.	Wine red colour.	Presence of methyl ketones.

Test for acids

Fluorescein Reaction: A little of the substance is heated with Conc.H_2SO_4 and Resorcinol in a dry test tube. It is cooled and then	A red solution with intense green fluorescence.	Presence of dicarboxylic acid.

poured into a beaker containing excess of NaOH.		
Anhydride formation: A little of the acid is heated in a dry china dish covered with an inverted funnel whose stem is closed. It is then cooled.	White shiny needles are deposited on the sides of the funnel.	Presence of dicarboxylic acid

Tests for amides:

Biuret reaction: A little of the substance is heated first gently in a dry test tube followed by strong heating. The solid residue is warmed with1 mL 10% NaOH then cooled and one drop of dil.$CuSO_4$ added.	On heating smell of ammonia is evolved and violet colour on adding $CuSO_4$.	Presence of diamide.
Hydroxamic acid test: Place a little of the substance in 5mL water. Add few drops 3% hydrogen peroxide and 2 drops of 5% ferric chloride. Heat the solution.	Magenta colour	Presence of aromatic primary amide.

Test for aromatic amines (primary):

Confirmatory Tests for Functional Groups:

Add 2mL of cold diazonium solution to a solution of 0.1g 2 -naphthol in 2ml 10% NaOH. and 5 mL water.	Orange –red dye.	Presence of aromatic amines**.**
Benzoylation: Dissolved a little of the substance in 10mL 10% NaOH solution contained in a boiling tube. About 1mL of benzoyl chloride is added. The boiling tube is corked and shaken vigorously for about 15 minutes.	A white ppt is formed.	Presence of aromatic amines**.**

Test for aliphatic amines (primary):

To 0.3 mL or 300 mg of unknown substance in a test tube add 5 mL of 10% NaOH solution and 0.4 mL of benzenesulfonyl chloride. Close the test tube with a cork and shake the mixture vigorously. Test the solution to make sure that it is still alkaline using litmus paper.	Soluble in base.	Presence of aliphatic primary amines**.**
Cool the solution and add 10% HCl solution dropwise.	A precipitate is formed.	Presence of aliphatic primary amines**.**

Tests for aromatic alcohol (Phenol):

Azo-dye formation: Dissolve two drops of aniline in 1 mL dil.HCl well cooled in ice. Few drops of saturated sodium nitrite solution are added. Then it is added to a well cooled solution of the phenolic compound in aqueous sodium hydroxide.	A red coloured substance is formed.	Presence of phenols.
Benzoylation: Dissolved a little of the substance in 5mL 20% NaOH solution contained in a boiling tube. About 1mL of benzoyl chloride is added. The boiling tube is corked and shaken vigorously for about 15 minutes.	A precipitate is formed.	Presence of phenols.

GENERAL PROCEDURE

S. No.	Experiment	Observation	Inference
	I. Preliminary test		
1.	**Colour and appearance** Colour and appearance of the substance is noted.	a) Brown or dark coloured solid or liquid b) Colourless liquid c) Colourless solid	a) May be aromatic amines or phenols b) May be aldehyde or ketone c) May be acids or amides or carbohydrates
2.	**Odour of the substance** Odour of the given substance is noted.	a) Phenolic smell b) Aniline like smell c) Odour of almond d) Pleasant odour e) No characteristic odour	a) May be phenols b) May be aromatic amine (aniline) c) May be aldehyde d) May be ketone e) Absence of amine, phenols, aldehyde and ketone.
3.	**Solubility test** Solubility of the given organic substance is tested in the following solvents. a) In water b) In dilute hydrochloric acid	a) Soluble in the cold condition b) Soluble in the hot condition a) Soluble b) Insoluble	a) May be carbohydrates or diamide like urea b) May be aromatic acids or amides a) May be aromatic amine (aniline) b) Absence of aromatic amine (aniline)
4.	**Sodium carbonate test** A little of the substance is added to 1 ml of a strong solution of sodium carbonate.	a) Vigorous effervescence takes place evolving carbon dioxide gas b) No vigorous	a) Presence of acids b) Absence of acids

		effervescence takes place	
5.	**Sodium hydroxide test:** To a little of the substance about 2 ml of 10% sodium hydroxide solution is added and boiled gently.	a) Dissolves readily in the cold condition and the substance is regenerated on adding dilute hydrochloric acid b) Solution turns yellow or brown on boiling	a) Presence of acids b) May be carbohydrates
6.	**Soda-Lime test** A little of the substance is heated with powdered soda lime and heated strongly.	c) On heating ammonia gas is evolved. It gives dense white fumes with a glass rod dipped in conc. hydrochloric acid	c) May be amides
		a) Ammonia gas is evolved b) No ammonia gas is evolved	a) May be amides b) Absence of amides
7.	**Conc. sulphuric acid test** A little of the substance is treated with 2 ml of conc. sulphuric acid and warmed.	a) The substance chars with smell of burnt sugar b) No characteristic change	a) May be carbohydrates b) Absence of carbohydrates
8.	**Neutral $FeCl_3$ test** To a little of the substance dissolved in water or alcohol, about 2 ml of neutral ferric chloride is added.	a) Violet or blue or green colour is obtained b) No violet or blue or green colour is obtained	a) Presence of phenol b) Absence of phenol
	II. Test for functional groups		
1.	**Test for acids** **a) Ester test** A little of the substance is mixed with a few drops of alcohol and 2 drops of conc. sulphuric acid. The mixture is gently warmed and poured into a beaker containing dilute sodium carbonate solution.	a) A pleasant fruity odour is noted b) No fruity odour is noted	a) Presence of carboxylic acid b) Absence of carboxylic acid

	b) Phenolphthalein test To about 2 ml of sodium hydroxide solution, 1 drop of dilute phenolphthalein indicator is added pink colour appears. To this, the substance dissolved in water or alcohol is added drop by drop in excess.	a) Pink colour disappears b) Pink colour does not disappear	a) Presence of carboxylic acid b) Absence of carboxylic acid
	c) Fluorescein test A small amount of the substance is mixed with few drops of resorcinol in a dry test tube. 3 drops of conc. sulphuric acid is added. Shake well, boil gently and then pour into 100 ml of cold water taken in a beaker. Stir well and then sodium hydroxide solution is added in drops.	a) An intense greenish yellow fluorescence is produced b) No intense greenish yellow fluorescence is produced	a) Presence of dicarboxylic acid b) Presence of monocarboxylic acid
2.	**Test for carbohydrates** **a) Molisch's test** To a little of the substance in water a few drops of an alcoholic solution of 1-naphthol are added. To this mixture, conc. sulphuric acid is added along the sides of the test tube without shaking.	a) Violet ring is obtained at the junction of the two layers and this spreads slowly b) No violet ring is obtained	a) Presence of carbohydrate b) Absence of carbohydrate
	b) Tollen's reagent test To a little of the substance add about 2 ml of Tollen's reagent. This is shaken well and heated in a boiling water bath.	a) Black precipitate or bright silver mirror is formed b) No black precipitate or bright silver mirror is formed	a) Presence of carbohydrate b) Absence of carbohydrate
	c) Fehling's test 1 ml of Fehling solution (A) is mixed with 1 ml of Fehling solution (B). The mixture is added to a little of the substance dissolved in water, shaken well and heated in a boiling water bath.	a) Red precipitate is obtained b) No red precipitate is obtained	a) Presence of reducing sugars b) Absence of reducing sugars

3.	**Test for carbohydrates** **a) Molisch's test** To a little of the substance in water a few drops of an alcoholic solution of 1-naphthol are added. To this mixture, conc. sulphuric acid is added along the sides of the test tube without shaking.	a) Violet ring is obtained at the junction of the two layers and this spreads slowly b) No violet ring is obtained	a) Presence of carbohydrate b) Absence of carbohydrate
	b) Tollen's reagent test To a little of the substance add about 2 ml of Tollen's reagent. This is shaken well and heated in a boiling water bath.	a) Black precipitate or bright silver mirror is formed b) No black precipitate or bright silver mirror is formed	a) Presence of carbohydrate b) Absence of carbohydrate
	c) Fehling's test 1 ml of Fehling solution (A) is mixed with 1 ml of Fehling solution (B). The mixture is added to a little of the substance dissolved in water, shaken well and heated in a boiling water bath.	a) Red precipitate is obtained b) No red precipitate is obtained	a) Presence of reducing sugars b) Absence of reducing sugars
4.	**Test for Aldehyde and Ketone** **a) Schiff's reagent test** To a little of the substance Schiff's reagent is added and shaken well.	a) Violet colour is formed b) No violet colour is formed	a) Presence of aromatic aldehyde b) Absence of aromatic aldehyde
	b) Tollen's reagent test To a little of the substance a few drops of Tollen's reagent is added and kept it in a hot water bath.	a) Silver mirror is obtained b) No silver mirror is obtained	a) Presence of aldehyde b) Presence of ketone
	c) Legal's test To a little of the substance a few drops of freshly prepared sodium nitroprusside and a few drops of 10% sodium hydroxide is added.	a) Wine red or blue colour is formed b) No wine red or blue colour is formed	a) Presence of ketone like acetophenone b) Absence of ketone

	d) *m*-Dinitrobenzene test To a little of the substance a small amount of *m*-dinitrobenzene and a few drops of dilute sodium hydroxide is added.	a) Violet or red colour is formed b) No violet or red colour is formed	a) Presence of ketone like acetophenone b) Absence of ketone
5.	**Test for amides** **a) Sodium hydroxide test** A little of the substance is heated with 5 ml of 10% sodium hydroxide solution till no more ammonia is evolved. It is then cooled and acidified with conc. hydrochloric acid. **b) Biuret test** A little of the substance is heated in a dry test tube for a few minutes. It is cooled and the residue is dissolved in 2 ml of water. To this 2 drops of dilute copper sulphate solution are added and then 10% sodium hydroxide solution is added dropwise. **c) Oxalic acid test** To a strong aqueous solution of the substance added oxalic acid solution, shaken well.	a) White precipitate is obtained b) No white precipitate is obtained a) Violet colour is obtained b) No violet colour is obtained a) White precipitate is obtained b) No white precipitate is obtained	a) Presence of an aromatic amide b) Presence of an aliphatic amide (urea) a) Presence of a diamide like urea b) Absence of a diamide like urea a) Presence of a diamide like urea b) Absence of a diamide like urea
6.	**Test for amines** **a) Reaction on nitrous acid** A little of the substance is dissolved in about 3 ml of dilute hydrochloric acid. To this a strong solution of sodium nitrate is added drop wise cooling the mixture in ice cold water. To the clear solution, a solution of 2-naphthol in sodium hydroxide is added.	a) A clear solution is produced b) No clear solution is produced a) Scarlet red dye is obtained b) No scarlet red dye is obtained	a) Presence of aromatic primary amine (aniline) b) Absence of aromatic primary amine (aniline) a) Presence of aromatic primary amine (aniline) b) Absence of aromatic primary amine (aniline)

Report:

1. Functional group present ……..
2. The given organic compound is…….....

MODEL ANALYSIS-1

Urea (Diamide)

S. No.	Experiment	Observation	Inference
	I. Preliminary test		
1.	**Colour and appearance** Colour and appearance of the substance is noted.	Colourless solid	May be acids or amides or carbohydrates
2.	**Odour of the substance** Odour of the given substance is noted.	No characteristic odour	Absence of amine, phenols, aldehyde and ketone.
3.	**Solubility test** Solubility of the given organic substance is tested in the following solvents. In water	 Soluble in the cold condition	 May be carbohydrates or diamide like urea
4.	**Sodium carbonate test** A little of the substance is added to 1 ml of a strong solution of sodium carbonate.	No vigorous effervescence takes place	Absence of acids
5.	**Sodium hydroxide test:** To a little of the substance about 2 ml of 10% sodium hydroxide solution is added and boiled gently.	On heating ammonia gas is evolved. It gives dense white fumes with a glass rod dipped in conc. hydrochloric acid	May be amides
6.	**Soda-Lime test** A little of the substance is heated with powdered soda lime and heated strongly.	Ammonia gas is evolved	May be amides
7.	**Conc. sulphuric acid test** A little of the substance is treated with 2 ml of conc. sulphuric acid and warmed.	No characteristic change	Absence of carbohydrates
8.	**Neutral $FeCl_3$ test** To a little of the substance dissolved in water or alcohol, about 2 ml of neutral ferric chloride is added.	No violet or blue or green colour is obtained	Absence of phenol
	II. Test for functional groups		
1.	**Test for acids** **Ester test** A little of the substance is	No fruity odour is	Absence of carboxylic

	mixed with a few drops of alcohol and 2 drops of conc. sulphuric acid. The mixture is gently warmed and poured into a beaker containing dilute sodium carbonate solution.	noted	acid
2.	**Test for phenols** **Liebermann's reaction** A little of the substance is mixed with a few crystals of sodium nitrate and 3 or 4 drops of conc. sulphuric acid. This is gently warmed and poured into water. To this sodium hydroxide is added and stirred well.	No red solution is obtained	Absence of phenol
3.	**Test for carbohydrates** **Molisch's test** To a little of the substance in water a few drops of an alcoholic solution of 1-naphthol are added. To this mixture, conc. sulphuric acid is added along the sides of the test tube without shaking.	No violet ring is obtained	Absence of carbohydrate
4.	**Test for Aldehyde and Ketone** **a) Schiff's reagent test** To a little of the substance Schiff's reagent is added and shaken well. **b) Legal's test** To a little of the substance a few drops of freshly prepared sodium nitroprusside and a few drops of 10% sodium hydroxide is added.	No violet colour is formed No wine red or blue colour is formed	Absence of aromatic aldehyde Absence of ketone

5.	**Test for amides** **a) Sodium hydroxide test** A little of the substance is heated with 5 ml of 10% sodium hydroxide solution till no more ammonia is evolved. It is then cooled and acidified with conc. hydrochloric acid. **b) Biuret test** A little of the substance is heated in a dry test tube for a few minutes. It is cooled and the residue is dissolved in 2 ml of water. To this 2 drops of dilute copper sulphate solution are added and then 10% sodium hydroxide solution is added dropwise. **c) Oxalic acid test** To a strong aqueous solution of the substance added oxalic acid solution, shaken well.	No white precipitate is obtained Violet colour is obtained White precipitate is obtained	Presence of an aliphatic amide (urea) Presence of a diamide like urea Presence of a diamide like urea
6.	**Test for amines** **Action on nitrous acid** A little of the substance is dissolved in about 3 ml of dilute hydrochloric acid. To this a strong solution of sodium nitrate is added drop wise cooling the mixture in ice cold water.	No characteristic change	Absence of aromatic primary amine (aniline)

Report:

1. Functional group present - **Diamide**
2. The given organic compound is **urea**

MODEL ANALYSIS-2

Aniline (Amine)

S. No.	Experiment	Observation	Inference
	I. Preliminary test		
1.	**Colour and appearance** Colour and appearance of the substance is noted.	Brown coloured liquid	May be aromatic amines
2.	**Odour of the substance** Odour of the given substance is noted.	Aniline like smell	May be aromatic amine (aniline)
3.	**Solubility test** Solubility of the given organic substance is tested in the following solvents. In dilute hydrochloric acid	 Soluble	 May be aromatic amine (aniline)
4.	**Sodium carbonate test** A little of the substance is added to 1 ml of a strong solution of sodium carbonate.	No vigorous effervescence takes place	Absence of acids
5.	**Sodium hydroxide test:** To a little of the substance about 2 ml of 10% sodium hydroxide solution is added and boiled gently.	No characteristic change	Absence of acids, carbohydrates and amides
6.	**Soda-Lime test** A little of the substance is heated with powdered soda lime and heated strongly.	No ammonia gas is evolved	Absence of amides
7.	**Conc. sulphuric acid test** A little of the substance is treated with 2 ml of conc. sulphuric acid and warmed.	No characteristic change	Absence of carbohydrates
8.	**Neutral $FeCl_3$ test** To a little of the substance dissolved in water or alcohol, about 2 ml of neutral ferric chloride is added.	No violet or blue or green colour is obtained	Absence of phenol
	II. Test for functional groups		
1.	**Test for acids** **Ester test**		

	A little of the substance is mixed with a few drops of alcohol and 2 drops of conc. sulphuric acid. The mixture is gently warmed and poured into a beaker containing dilute sodium carbonate solution.	No fruity odour is noted	Absence of carboxylic acids
2.	**Test for phenols** **Liebermann's reaction** A little of the substance is mixed with a few crystals of sodium nitrate and 3 or 4 drops of conc. sulphuric acid. This is gently warmed and poured into water. To this sodium hydroxide is added and stirred well.	No red solution is obtained	Absence of phenol
3.	**Test for carbohydrates** **Molisch's test** To a little of the substance in water a few drops of an alcoholic solution of 1-naphthol are added. To this mixture, conc. sulphuric acid is added along the sides of the test tube without shaking.	No violet ring is obtained	Absence of carbohydrate
4.	**Test for Aldehyde and Ketone** **a) Schiff's reagent test** To a little of the substance Schiff's reagent is added and shaken well. **b) Legal's test** To a little of the substance a few drops of freshly prepared sodium nitroprusside and a few drops of 10% sodium hydroxide is added.	No violet colour is formed No wine red or blue colour is formed	Absence of aromatic aldehyde Absence of ketone

5.	**Test for amides** **Sodium hydroxide test** A little of the substance is heated with 5 ml of 10% sodium hydroxide solution till no more ammonia is evolved. It is then cooled and acidified with conc. hydrochloric acid.	No characteristic change	Absence of amides
6.	**Test for amines** **Action on nitrous acid** A little of the substance is dissolved in about 3 ml of dilute hydrochloric acid. To this a strong solution of sodium nitrate is added drop wise cooling the mixture in ice cold water. To the clear solution, a solution of 2-naphthol in sodium hydroxide is added.	A clear solution is produced Scarlet red dye is obtained	Presence of aromatic primary amine (aniline) Presence of aromatic primary amine (aniline)

Report:

1. Functional group present - **aromatic amine**
2. The given organic compound is **aniline**

MODEL ANALYSIS-3

Carbohydrate (Glucose)

S. No.	Experiment	Observation	Inference
	I. Preliminary test		
1.	**Colour and appearance** Colour and appearance of the substance is noted.	Colourless solid	May be acids or amides or carbohydrates
2.	**Odour of the substance** Odour of the given substance is noted.	No characteristic odour	Absence of amine, phenols, aldehyde and ketone.
3.	**Solubility test** Solubility of the given organic substance is tested in the following solvents. In water	Soluble in the cold condition	May be carbohydrates or diamide like urea
4.	**Sodium carbonate test** A little of the substance is added to 1 ml of a strong solution of sodium carbonate.	No vigorous effervescence takes place	Absence of acids
5.	**Sodium hydroxide test:** To a little of the substance about 2 ml of 10% sodium hydroxide solution is added and boiled gently.	Solution turns yellow or brown on boiling	May be carbohydrates
6.	**Soda-Lime test** A little of the substance is heated with powdered soda lime and heated strongly.	No ammonia gas is evolved	Absence of amides
7.	**Conc. sulphuric acid test** A little of the substance is treated with 2 ml of conc. sulphuric acid and warmed.	The substance chars with smell of burnt sugar	May be carbohydrates
8.	**Neutral $FeCl_3$ test** To a little of the substance dissolved in water or alcohol, about 2 ml of neutral ferric chloride is added.	No violet or blue or green colour is obtained	Absence of phenol
	II. Test for functional groups		

1.	**Test for acids** **Ester test** A little of the substance is mixed with a few drops of alcohol and 2 drops of conc. sulphuric acid. The mixture is gently warmed and poured into a beaker containing dilute sodium carbonate solution.	No fruity odour is noted	Absence of carboxylic acids
2.	**Test for phenols** **Liebermann's reaction** A little of the substance is mixed with a few crystals of sodium nitrate and 3 or 4 drops of conc. sulphuric acid. This is gently warmed and poured into water. To this sodium hydroxide is added and stirred well.	No red solution is obtained	Absence of phenol
3.	**Test for carbohydrates** **a) Molisch's test** To a little of the substance in water a few drops of an alcoholic solution of 1-naphthol are added. To this mixture, conc. sulphuric acid is added along the sides of the test tube without shaking.	Violet ring is obtained at the junction of the two layers and this spreads slowly	Presence of carbohydrate
	b) Tollen's reagent test To a little of the substance add about 2 ml of Tollen's reagent. This is shaken well and heated in a boiling water bath.	Black precipitate or bright silver mirror is formed	Presence of carbohydrate
	c) Fehling's test 1 ml of Fehling solution (A) is mixed with 1 ml of Fehling solution (B). The mixture is added to a little of the substance dissolved in water, shaken well and heated in a boiling water bath.	Red precipitate is obtained	Presence of reducing sugars
4.	**Test for Aldehyde and Ketone** **a) Schiff's reagent test**		

	To a little of the substance Schiff's reagent is added and shaken well. **b) Legal's test** To a little of the substance a few drops of freshly prepared sodium nitroprusside and a few drops of 10% sodium hydroxide is added.	No violet colour is formed No wine red or blue colour is formed	Absence of aromatic aldehyde Absence of ketone
5.	**Test for amides** **Sodium hydroxide test** A little of the substance is heated with 5 ml of 10% sodium hydroxide solution till no more ammonia is evolved. It is then cooled and acidified with conc. hydrochloric acid.	No characteristic change	Absence of amides
6.	**Test for amines** **Action on nitrous acid** A little of the substance is dissolved in about 3 ml of dilute hydrochloric acid. To this a strong solution of sodium nitrate is added drop wise cooling the mixture in ice cold water.	No characteristic change	Absence of aromatic primary amine (aniline)

Report:

1. Functional group present - **aliphatic aldehyde**
2. The given organic compound is **carbohydrate**

MODEL ANALYSIS-4

Benzoic acid (Monocarboxylic acid)

S. No.	Experiment	Observation	Inference
	I. Preliminary test		
1.	**Colour and appearance** Colour and appearance of the substance is noted.	Colourless solid	May be acids or amides or carbohydrates
2.	**Odour of the substance** Odour of the given substance is noted.	No characteristic odour	Absence of amine, phenols, aldehyde and ketone.
3.	**Solubility test** Solubility of the given organic substance is tested in the following solvents. In water	 Soluble in the hot condition	 May be aromatic acids or amides
4.	**Sodium carbonate test** A little of the substance is added to 1 ml of a strong solution of sodium carbonate.	Vigorous effervescence takes place evolving carbon dioxide gas	Presence of acids
5.	**Sodium hydroxide test:** To a little of the substance about 2 ml of 10% sodium hydroxide solution is added and boiled gently.	Dissolves readily in the cold condition and the substance is regenerated on adding dilute hydrochloric acid	Presence of acids
6.	**Soda-Lime test** A little of the substance is heated with powdered soda lime and heated strongly.	No ammonia gas is evolved	Absence of amides
7.	**Conc. sulphuric acid test** A little of the substance is treated with 2 ml of conc. sulphuric acid and warmed.	No characteristic change	Absence of carbohydrates
8.	**Neutral $FeCl_3$ test** To a little of the substance dissolved in water or alcohol, about 2 ml of neutral ferric chloride is added.	No violet or blue or green colour is obtained	Absence of phenol
	II. Test for functional groups		

1.	**Test for acids** **a) Ester test** A little of the substance is mixed with a few drops of alcohol and 2 drops of conc. sulphuric acid. The mixture is gently warmed and poured into a beaker containing dilute sodium carbonate solution.	A pleasant fruity odour is noted	Presence of carboxylic acid
	b) Phenolphthalein test To about 2 ml of sodium hydroxide solution, 1 drop of dilute phenolphthalein indicator is added pink colour appears. To this, the substance dissolved in water or alcohol is added drop by drop in excess.	Pink colour disappears	Presence of carboxylic acid
	c) Fluorescein test A small amount of the substance is mixed with few drops of resorcinol in a dry test tube. 3 drops of conc. sulphuric acid is added. Shake well, boil gently and then pour into 100 ml of cold water taken in a beaker. Stir well and then sodium hydroxide solution is added in drops.	No intense greenish yellow fluorescence is produced	Presence of monocarboxylic acid
2.	**Test for phenols** **Liebermann's reaction** A little of the substance is mixed with a few crystals of sodium nitrate and 3 or 4 drops of conc. sulphuric acid. This is gently warmed and poured into water. To this sodium hydroxide is added and stirred well.	No red solution is obtained	Absence of phenol

3.	**Test for carbohydrates** **Molisch's test** To a little of the substance in water a few drops of an alcoholic solution of 1-naphthol are added. To this mixture, conc. sulphuric acid is added along the sides of the test tube without shaking.	No violet ring is obtained	Absence of carbohydrate
4.	**Test for Aldehyde and Ketone** **a) Schiff's reagent test** To a little of the substance Schiff's reagent is added and shaken well. **b) Legal's test** To a little of the substance a few drops of freshly prepared sodium nitroprusside and a few drops of 10% sodium hydroxide is added.	No violet colour is formed No wine red or blue colour is formed	Absence of aromatic aldehyde Absence of ketone
5.	**Test for amides** **Sodium hydroxide test** A little of the substance is heated with 5 ml of 10% sodium hydroxide solution till no more ammonia is evolved. It is then cooled and acidified with conc. hydrochloric acid.	No characteristic change	Absence of amides
6.	**Test for amines** **Action on nitrous acid** A little of the substance is dissolved in about 3 ml of dilute hydrochloric acid. To this a strong solution of sodium nitrate is added drop wise cooling the mixture in ice cold water.	No characteristic change	Absence of aromatic primary amine (aniline)

Report:

1. Functional group present - **Aromatic monocarboxylic acid**
2. The given organic compound is **Benzoic acid**.

VIVA-VOCE QUESTIONS

Detection of functional group present in the organic compound.

Q.1. What are the functional group?

Q.2. What do you understand by the term nitrogen containing functional group? Give a few examples.

Q.3. What do you understand by the term oxygen containing functional group? Give a few examples.?

Q. 4. Write the Biuret reaction? This test is used for which class of Functional group?

Q.5. What is different between the amide and amine? Give examples?

Q.6. List out the carboxylic acid with examples.

Q.7. Why monocarboxylic acid should not answer the fluorescein test?

Q.8. Give the formulae of the complex responsible for violet colour in test for phenol.

Q.9. How to prepare the aryldiazonium salts? Explain the coupling reactions

Q.10. What is primary amine? Give a few examples

Q.11. What is color of Schiff base solution?

Q.12. Schiff's test is used for which class of compounds?

Q.13. Name a reagent used to detect carbonyl group in a compound?

Q.14. What is nitrous acid?

Q.15. Aldehyde when treated with Fehling's solution A and Fehling's solution B gives a red coloured precipitate. What is that precipitate?

Q.16. Which one is more acidic alcohol or phenol?

Q.17. Name a test by which you can distinguish between hexylamine and aniline?

Q.18. White precipitate of silver chloride dissolves in ammonia solution. Why?

Q.19. Name two tests which distinguish aldehydes and ketones?

Q.20. Name of the reagent used to detect the aldehydes group in a compound?

Q.21. What is Tollen's reagent?

Q.22. What is the application of carbylamines test?

Q.23. Why aniline is weaker base than ammonia?

Q.24. How can you distinguish methanol and Ethanol?

Q.25. When ……..compound treated with Br_2 water gives white precipitate?

Q.26. Explain the bromination test for phenol and aniline?

Q.27. Why Tollen's reagent give block precipitate for aromatic aldehyde?

Q.28. Which compound give silver mirror with Tollen's reagent? Why.

Q.29. Carboxylic acid react with alcohol give which compound?

Q.30. In fruity odour test what is role for sulfuric acid?

Q.31. What type of reaction involve in the Phenolphthalein test?

Q.32. Which reaction evolves the CO_2 gas?

Q.33. Which reaction evolves the NH_3 gas?

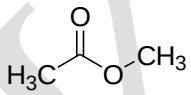
Q.34. What is functional group present in alkene and alkyne?

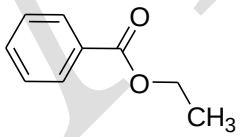
Q.35. What is lime water?

Q.36. Explain two test for identification of carboxylic acid?

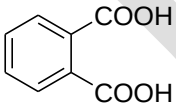
Q.37. Write chemical reaction for "naturalization"?

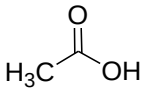
Q.38. Identify the organic class to which the functional group belongs.

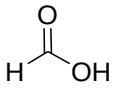


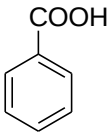


Q.39. Identify the solid carboxylic acids

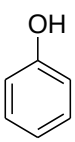


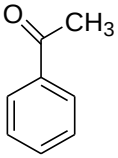


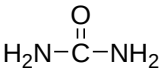


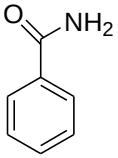


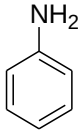
Q.40. Identify the liquid organic compounds.

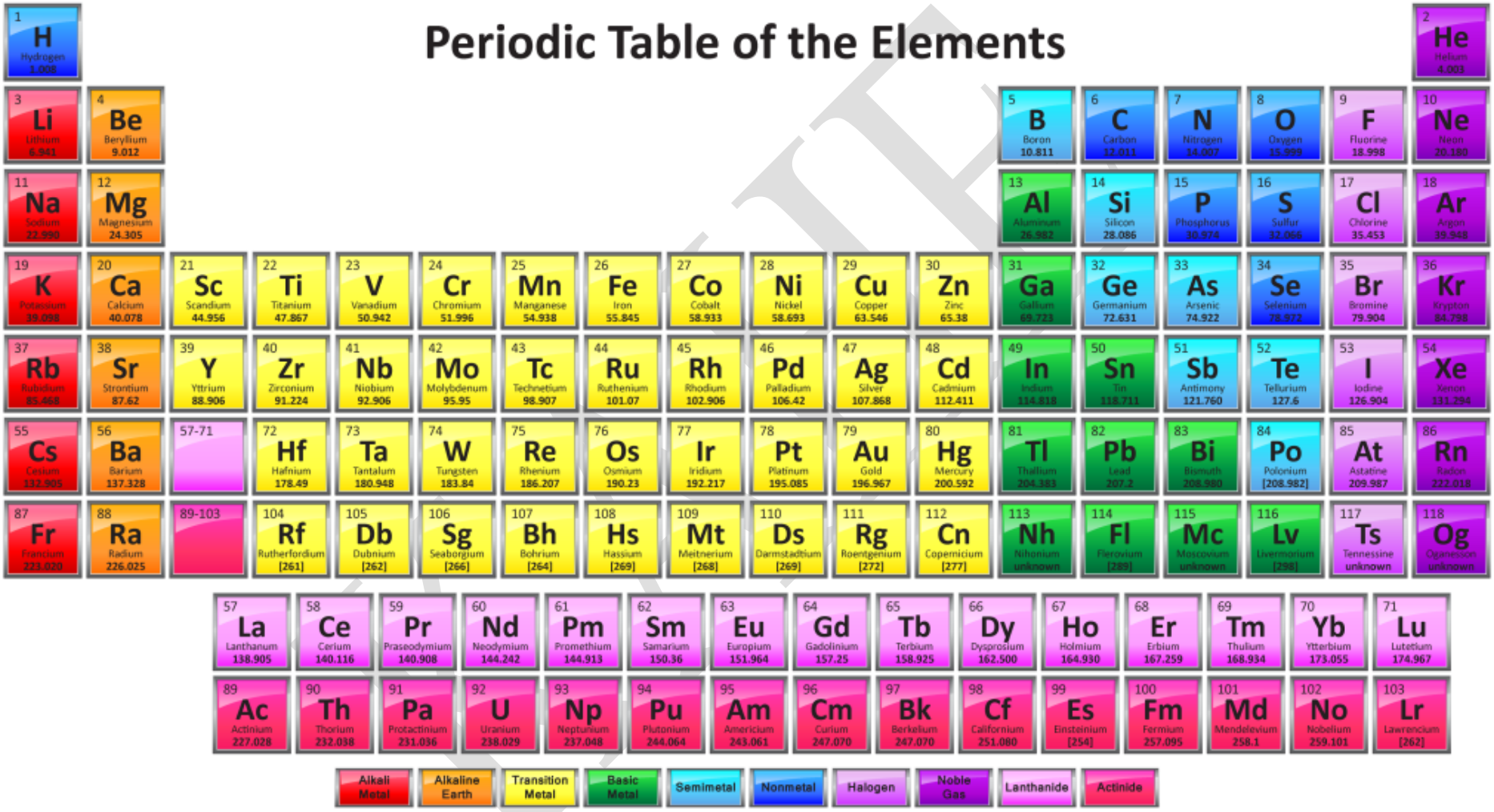











Periodic Table of the Elements
1 H Hydrogen 1.008
2 He Helium 4.003
3 Li Lithium 6.941
4 Be Beryllium 9.012
5 B Boron 10.811
6 C Carbon 12.011
7 N Nitrogen 14.007
8 O Oxygen 15.999
9 F Fluorine 18.998
10 Ne Neon 20.180
11 Na Sodium 22.990
12 Mg Magnesium 24.305
13 Al Aluminium 26.982
14 Si Silicon 28.086
15 P Phosphorus 30.974
16 S Sulfur 32.066
17 Cl Chlorine 35.453
18 Ar Argon 39.948
19 K Potassium 39.098
20 Ca Calcium 40.078
21 Sc Scandium 44.956
22 Ti Titanium 47.867
23 V Vanadium 50.942
24 Cr Chromium 51.996
25 Mn Manganese 54.938
26 Fe Iron 55.845
27 Co Cobalt 58.933
28 Ni Nickel 58.693
29 Cu Copper 63.546
30 Zn Zinc 65.38
31 Ga Gallium 69.723
32 Ge Germanium 72.631
33 As Arsenic 74.922
34 Se Selenium 78.972
35 Br Bromine 79.904
36 Kr Krypton 84.798
37 Rb Rubidium 85.468
38 Sr Strontium 87.62
39 Y Yttrium 88.906
40 Zr Zirconium 91.224
41 Nb Niobium 92.906
42 Mo Molybdenum 95.95
43 Tc Technetium 98.907
44 Ru Ruthenium 101.07
45 Rh Rhodium 102.906
46 Pd Palladium 106.42
47 Ag Silver 107.868
48 Cd Cadmium 112.411
49 In Indium 114.818
50 Sn Tin 118.711
51 Sb Antimony 121.760
52 Te Tellurium 127.6
53 I Iodine 126.904
54 Xe Xenon 131.294
55 Cs Cesium 132.905
56 Ba Barium 137.328
57-71
72 Hf Hafnium 178.49
73 Ta Tantalum 180.948
74 W Tungsten 183.84
75 Re Rhenium 186.207
76 Os Osmium 190.23
77 Ir Iridium 192.217
78 Pt Platinum 195.085
79 Au Gold 196.967
80 Hg Mercury 200.592
81 Tl Thallium 204.383
82 Pb Lead 207.2
83 Bi Bismuth 208.980
84 Po Polonium [208.982]
85 At Astatine 209.987
86 Rn Radon 222.018
87 Fr Francium 223.020
88 Ra Radium 226.025
89-103
104 Rf Rutherfordium [261]
105 Db Dubnium [262]
106 Sg Seaborgium [266]
107 Bh Bohrium [264]
108 Hs Hassium [269]
109 Mt Meitnerium [268]
110 Ds Darmstadtium [269]
111 Rg Roentgenium [272]
112 Cn Copernicium [277]
113 Nh Nihonium unknown
114 Fl Flerovium [289]
115 Mc Moscovium unknown
116 Lv Livermorium [298]
117 Ts Tennessine unknown
118 Og Oganesson unknown
57 La Lanthanum 138.905
58 Ce Cerium 140.116
59 Pr Praseodymium 140.908
60 Nd Neodymium 144.242
61 Pm Promethium 144.913
62 Sm Samarium 150.36
63 Eu Europium 151.964
64 Gd Gadolinium 157.25
65 Tb Terbium 158.925
66 Dy Dysprosium 162.500
67 Ho Holmium 164.930
68 Er Erbium 167.259
69 Tm Thulium 168.934
70 Yb Ytterbium 173.055
71 Lu Lutetium 174.967
89 Ac Actinium 227.028
90 Th Thorium 232.038
91 Pa Protactinium 231.036
92 U Uranium 238.029
93 Np Neptunium 237.048
94 Pu Plutonium 244.064
95 Am Americium 243.061
96 Cm Curium 247.070
97 Bk Berkelium 247.070
98 Cf Californium 251.080
99 Es Einsteinium [254]
100 Fm Fermium 257.095
101 Md Mendelevium 258.1
102 No Nobelium 259.101
103 Lr Lawrencium [262]
Alkali Metal
Alkaline Earth
Transition Metal
Basic Metal
Semimetal
Nonmetal
Halogen
Noble Gas
Lanthanide
Actinide