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XI-CHEMISTRY

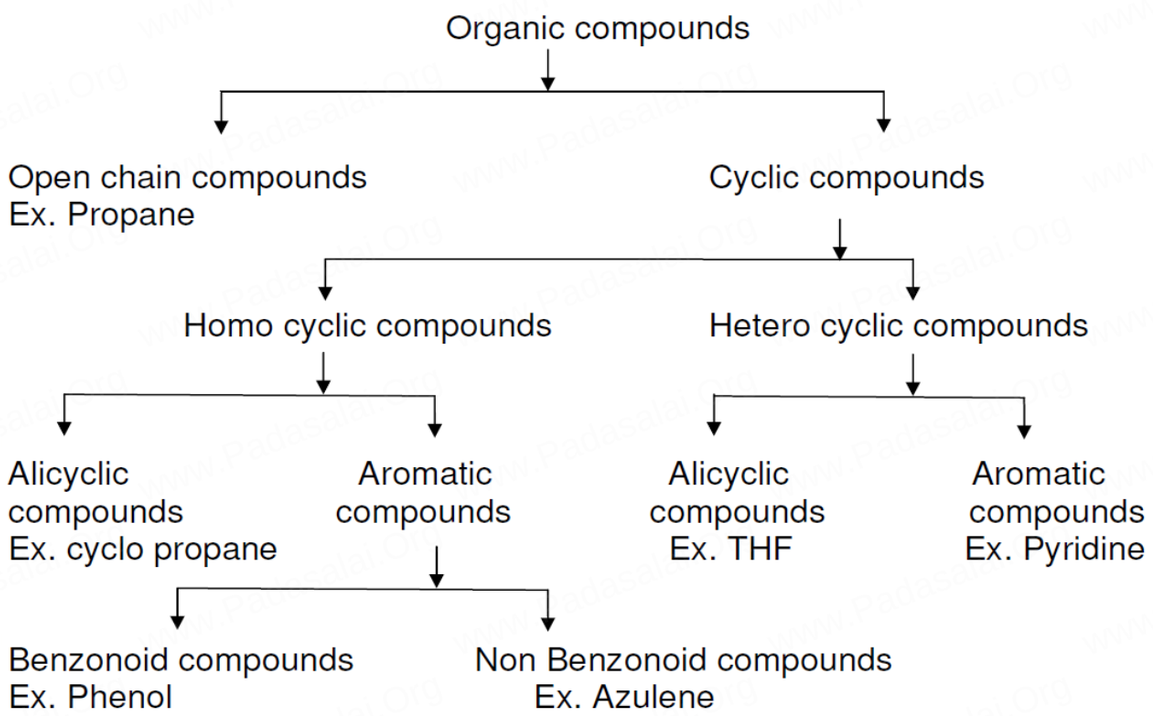
11. FUNDAMENTALS IN ORGANIC CHEMISTRY

ANSWER THE FOLLOWING

1.Give the general characteristics of organic compounds.

- They are covalent compound of carbon.
- They are insoluble in water but soluble in organic solvents like Benzene
- They are highly flammable
- They have low melting and boiling points.
- They have characteristics functional groups, form isomerism ,They form Homologous series

2.Describe the classification of organic compounds based on their structure.



3.Write a note on homologous series.

- They contain a characteristics functional group
- Successive member differ by –CH2 group in their molecular formula
- They are prepared by similar methods
- They have similar chemical properties.
- They have similar general formula
  - a) Alkane = C_nH_{2n+2} (Ex. Propane)
  - b) Alkyne = C_nH_{2n-2} (Ex. Propyne)
  - c) Alkene = C_nH_{2n} (Ex. Propene)

4.What is meant by a functional group? Identify the functional group in the following compounds.

(a) Acetaldehyde (b) oxalic acid (c) di methyl ether (d) methylamine

Functional group is an atom or a specific combination of bonded atoms that react in a characteristic way, irrespective of the organic molecule in which it is present.

(a) Acetaldehyde : - CHO
(b) oxalic acid : - COOH
(c) Di methyl ether : $CH_3 – O - CH_3$
(d) Methylamine : - NH_2

5.Give the general formula for the following classes of organic compounds.

a) Aliphatic monohydric alcohol: R - OH
b) Aliphatic ketones : R-CO-R'
c) Aliphatic amines : RNH2

6.Write the molecular formula of the first six members of homologous series of nitro alkanes.

FORMULA	NAME
CH_3NO_2	Nitromethane
$CH_3CH_2NO_2$	Nitroethane
$CH_3CH_2CH_2NO_2$	Nitropropane
$CH_3CH_2CH_2CH_2NO_2$	Nitrobutane
$CH_3CH_2CH_2CH_2CH_2NO_2$	Nitropentane
$CH_3CH_2CH_2CH_2CH_2CH_2NO_2$	Nitrohexane

7.Explain the various Structural or Constitutional isomers in organic compounds.

Structural or Constitutional isomers are isomers have same molecular formula but different bonding sequence. There are 6 types.

a) Chain Isomerism

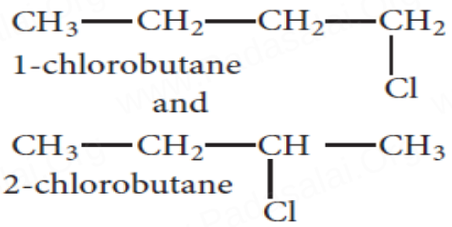
Compounds have same molecular formula but different carbon skeleton is called as chain isomerism.

CH_3-CH_2-CH_2-CH_2-CH_3 $\quad$ CH_3-CH(-CH_3)-CH_2-CH_3

n- Pentane $\quad$ Iso pentane

b) Position isomerism

Compounds have same molecular formula and same carbon skeleton but different position of the functional groups is called as Position isomerism.



c) Functional isomerism

Compounds have same molecular formula but different Functional groups is called as Functional isomerism.

$CH_3 - CH_2 - OH$ $\quad$ and $\quad$ $CH_3 - O - CH_3$

d) Metamerism

Compounds have same molecular formula but different alkyl groups on either side of the functional group is called as Metamerism

Ex. $C_4H_{10}O$

$CH_3 - O - CH_2 - CH_2 - CH_3$ (Methyl-n-propyl ether)

$CH_3 - CH_2 - O - CH_2 - CH_3$ (Diethyl ether)

$CH_3 - CH(-O - CH_3) - CH_3$ (Methyl isopropyl ether)

e) Tautomerism

When a single compound exists in two inter convertible structures that differ in the position of at least one atom is called as Tautomerism

It is divided into two types

i) Dyad system

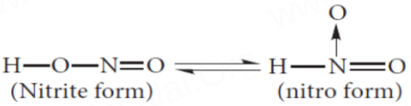
In this type the hydrogen atom oscillates between two directly bonded polyvalent atoms.

Ex. $H - C \equiv N \leftrightarrow H - N \equiv C$

ii)Triad systems

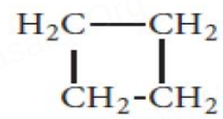
In this type the hydrogen atom oscillates between three poly valent atoms.

Ex.

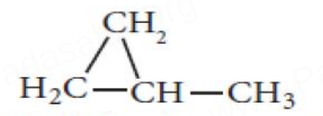


f)Ring Chain Isomerism

Compounds having same molecular formula but different bonding of carbon atoms to form open and cyclic structures.



Cyclobutane



Methylcyclopropane

8. Define Stereoisomerism

Isomers have same bond connectivity but different arrangements of atoms in space is called as Stereoisomerism

9. Define Geometrical isomerism

Compounds having different arrangements of atoms around a rigid double bond are called as Geometrical isomerism

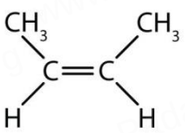
11. Explain the (Geometrical isomerism) or Cis-Trans isomerism using 2-Butene.

Cis isomers

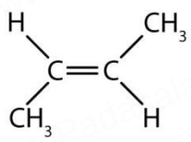
When two identical groups are present on the same side it is called as Cis isomer

Trans isomers

When two identical groups are present on the opposite side it is called as Trans isomer



cis-2-butene



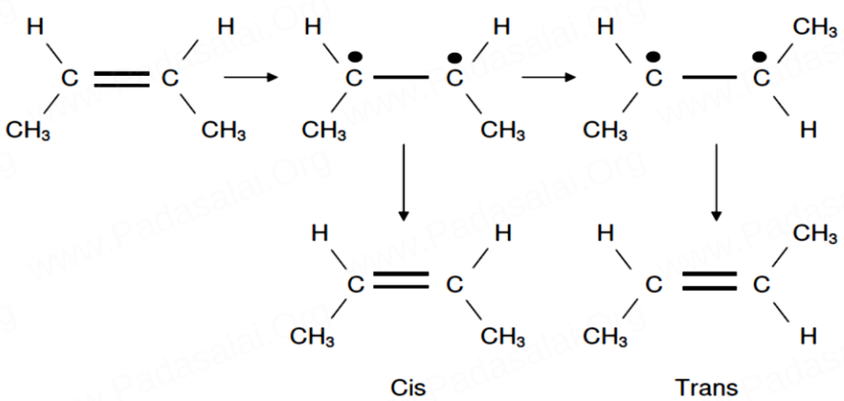
trans-2-butene

11.Why the Trans isomer is more stable than the Cis isomer?

- The Trans isomer is more stable than the Cis isomer. In the Trans isomer the bulky groups are on the opposite side.
- But in the Cis isomer, the bulky groups are on the same side. Hence there will be Steric repulsion in the Cis isomer.

12. How Cis isomer is converted to Transisomer?

- Cis isomer can be converted to trans isomers by heating at high temperature and by the absorption of light.
- On heating, the bond breaks and the sigma bond rotates.• On cooling the reformation the bond takes place giving both cis and trans isomer.



Cis Trans

13.Define Optical isomerism

Compounds having same physical and chemical property but different rotation of the plane polarized light is called as Optical isomerism.

Ex. d(+)Glucose

14. Define Enantiomers

Optically active isomers having same angle of rotation but differ only in the direction of rotation of the plane polarized light is called as Enantiomers

Ex. d (+) Glucose and *l* (–) Glucose

15. What are the conditions for optical activity?

- ✓ The molecule should have Chiral Carbon
- ✓ The molecule should have Non-Super impossible image
- ✓ The molecule should not have Plane of Symmetry

16. Explain Optical isomer with an example

Compounds having same physical and chemical property but different rotation of the plane polarized light is called as Optical isomerism.

Ex. Glucose

Dextro Glucose

It rotates the plane polarized light in the clock-wise direction. It is denoted by the symbol 'd' and a sign (+).

Laevo Glucose :

It rotates the plane polarized light in the anti -clock-wise direction. It is denoted by the symbol 'l' and a sign (–).

17. Define asymmetric or chiral carbon

When a carbon is bonded to four different types of atom is called as asymmetric or chiral carbon and the phenomenon is called as Chirality

18. Explain the detection of Carbon and Hydrogen in an Organic compound.

The given organic compound is heated with dry copper oxide in a test tube

It is fitted with a delivery tube. The other end of the tube is dipped in lime water.

When the mixture is heated, Carbon is converted in to CO2 gas, and it turns lime water milky

$$2CuO + C \rightarrow CO_2 + 2Cu$$

Hydrogen is converted in to water droplets and turns Anhydrous Copper sulphate to Blue colour.

$$CuO + 2H \rightarrow H_2O + Cu$$

19. Explain how Sodium Fusion of Lassaigne's extract is prepared?

- ➢ A small piece of sodium metal is dried using a filter paper.
- ➢ The dry sodium metal is melting in a fusion tube.
- ➢ Add the given organic compound and again heat the tube.
- ➢ Break the red hot tube in 50ml of distilled water in a dish
- ➢ Boil and filter. The filtrate is called as Lassaigne;s extract.
- ➢ It is used to detect Sulphur, Nitrogen and halogens.

20. Explain the detection of Nitrogen in a organic compound.

The Nitrogen is converted in to Sodium cyanide.

Add freshly prepared ferrous sulphate solution, Ferric chloride solution and Conc: Hydrochloric acid.

It gives Prussian blue colour. Confirmsthe presence of Nitrogen.

$$Na + C + N \rightarrow NaCN$$

$$6\ NaCN + Fe(OH)_2 \rightarrow Na_4[Fe(CN)_6] + 2\ NaOH$$

$$Na_4[Fe(CN)_6] + 4FeCl_3 \rightarrow Fe_4[Fe(CN)_6]_3 + 12NaCl$$

Ferricferrocyanide - Prussian blue

21. How will you detect the presence of both Nitrogen and Sulphur?

Add Ferric chloride to the Lassaigne's extract.

Gives Blood red colour. Confirms the presence of Nitrogen and Sulphur.

$$Na + C + N + S \rightarrow NaCNS$$

$$3\ NaCNS + FeCl_3 \rightarrow Fe(CNS)_3 + 3NaCl$$

22. Explain the detection of Halogens in a organic compound

Boil the Lassaigne's extract with Nitric acid and add Silver Nitrate solution

$$Na + X \rightarrow NaX$$

$$NaX + AgNO_3 \rightarrow AgX + NaNO_3$$

S.no	Halogen	Colour	Solubility in Ammonia
1	Chlorine	Curdy white	Soluble
2	Bromine	Pale yellow	Sparingly soluble
3	Iodine	Yellow	insoluble

23.During the detection of halogen , why we should first boil with nitric acid ?

If the compound contains nitrogen and sulphur, it gives NaCN and Na_2S.
This will interfere during the detection of the halogens
On boiling with nitric acid, it will decompose the NaCN and Na_2S.

$$NaCN + HNO_3 \rightarrow NaNO_3 + HCN$$
$$Na_2S + 2HNO_3 \rightarrow 2NaNO_3 + H_2S$$
$$NaCN + AgNO_3 \rightarrow NaNO_3 + AgCN$$
$$Na_2S + 2AgNO_3 \rightarrow 2NaNO_3 + Ag_2S$$

24. Explain the detection of Phosphorous in an organic compound

The organic compound is heated with Sodium Carbonate and Potassium nitrate.
Phosphorous present is converted into Sodium Phosphate.
Add Ammonium Molybdate solution. Gives a Yellow Precipitate.Confirms Phosphorous.

25.Explain the estimation of Carbon and Hydrogen

- ✓ A known weight of the organic compound is heated with excess of oxygen in a
- ✓ combustion tube.
- ✓ The carbon is converted in to CO_2 gas and the hydrogen is converted in to water vapour.
- ✓ The CO_2 gas is absorbed by the bulb containing KOH solution.
- ✓ The Water Vapour is absorbed by the U-tube containing pumice.

Note down the weight of the tubes before and after the experiment.

Calculation:

Weight of the Organic compound = W g
Increase in the Weight of H_2O = X g
Increase in the weight of CO_2 gas = Y g

Percentage of Hydrogen

18g of water contains 2 g of Hydrogen

$$\text{Hydrogen \%} = \frac{2}{18} \times \frac{X}{W} \times 100\ \%$$

Percentage of Carbon

44g of CO2 contains 12 g of Carbon

$$\text{Carbon \%} = \frac{12}{44} \times \frac{Y}{w} \times 100\ \%$$

26. Explain the Estimation of Sulphur by Carius method.

- ✓ A known weight of the organic compound is heated with Conc:Nitric acid in a Carius tube.
- ✓ Sulphur present is converted in to Sulphuric acid.
- ✓ Add Barium Chloride solution.
- ✓ It forms Barium sulphate precipitate.
- ✓ The precipitate is filtered, washed, dried and its weight is noted.

Calculation:

Weight of the Organic compound = W g

Weight of Barium sulphate precipitate = X g

233g of Barium sulphate contains 32 g of Sulphur

$$\text{Sulphur \%} = \frac{32}{233} \times \frac{X}{W} \times 100\ \%$$

27. Explain the Estimation of Halogen by Carius method.

- ✓ A known weight of the organic compound is heated with Conc:Nitric acid and Silver Nitrate in a Carius tube.
- ✓ Carbon and Hydrogen is converted in to CO_2 and H_2O.
- ✓ The Halogens are converted into AgX precipitate.

The precipitate is filtered, washed, dried and its weight is noted.

$$\mathbf{AgNO_3 + X \xrightarrow{HNO3} AgX}$$

Calculation:

Weight of Chlorine:

Weight of the Organic compound = W g

Weight of AgCl precipitate = a g

143.5 g of AgCl contains 35.5 g of Chlorine

$$\textbf{Chlorine \%} = \frac{35.5}{143.5} \times \frac{a}{W} \times 100$$

Weight of Bromine:

Weight of the Organic compound = W g

Weight of AgBr precipitate = b g

188 g of AgBr contains 80 g of Bromine

$$\textbf{Bromine\%} = \frac{80}{188} \times \frac{b}{W} \times 100$$

Weight of Iodine:

Weight of the Organic compound = W g

Weight of AgI precipitate = c g

235 g of Agl contains 127 g of Iodine

$$\textbf{Iodine\%} = \frac{127}{235} \times \frac{C}{W} \times 100$$

28. Explain the estimation of Nitrogen by Dumas method.

The apparatus consist of CO_2 generator, combustion tube and Schiff's nitro meter.

A known weight of the organic compound is heated with copper oxide in a combustion tube.

The nitrogen present in the organic compound converted in to Nitrogen gas.

Excess of CO_2 Gas is passed to remove the last traces of Nitrogen gas.

The Nitrogen gas is collected in the Nitro meter. And CO_2 Gas is absorbed by the KOH solution.

The volume of Nitrogen gas collected in noted.

$$\frac{P_0 V_0}{T_0} = \frac{P_1 V_1}{T_1}$$

$$V_0 = \frac{P_1 V_1}{T_1} \times \frac{T_0}{P_0}$$

$$V_0 = \left(\frac{P_1 V_1}{T_1} \times \frac{273K}{760} \right) \text{mmHg}$$

Weight of the organic compound = W g
Volume of Nitrogen gas = V_1 liter
Room temperature = T_1 K
Pressure of Dry Nitrogen gas = P_1 mm of Hg
22.4 liters of Nitrogen gas at STP = 28g

Nitrogen % = $\frac{28}{22.4} x \frac{V0}{W} x 100\%$

29. Explain the estimation of Nitrogen by Kjeldahl's method.

- ✓ A known weight of the organic compound is heated with Conc: Sulphuric acid.
- ✓ The nitrogen present in the organic compound is converted in to Ammonium Sulphate.
- ✓ The formed Ammonium Sulphate is heated with sodium hydroxide in a Kjeldahl's flask to form ammonia gas.
- ✓ The ammonia gas is absorbed by Std:Sulphuric acid.
- ✓ The amount of ammonia formed is determined by titrating the Std acid against a Std solution of NaOH using Phenolphthalein indicator.

Calculation:
Weight of the organic compound = W g
Volume of the Std:Sulphuric acid consumed = V ml
Normality of the Std:Sulphuric acid = N

Nitrogen % = $\frac{14 \times N \times V}{1000 \times W}$ × 100%

30.Why should we purify the organic compounds? Give Examples.
In order to study the structures, physical and chemical and the Biological properties we must purify the organic compounds.
Example. Sublimation, distillation and steam distillation.

31.Explain Sublimation.
When a solid is heated, if it directly changes into vapour without melting.It is called as sublimation. Ex. Camphor, Naphthalene and Benzoic acid.
The impure compound is taken in a beaker.
The beaker is covered with a watch glass.
When the beaker is heated, the pure compound sublimes and condenses on the watch glass.
From the watch glass, the pure compound is collected.
In this method organic compounds having high vapour pressure below its melting point can be purified

32. Explain the Crystallization process of purification of a organic compounds.
There are five steps
Selection of the Solvent.
The organic compound is taken a test tube and adds the solvent slowly.
Heat the test tube and dissolve the organic compound. On cooling, if it gives maximum crystals, then it is a suitable solvent. The process is repeated with solvents like benzene, ether, alcohol and acetone.
Preparation of the Solution.
The organic compound is dissolved in a suitable solvent and heated on a water bath. A small amount of animal charcoal is added to decolorize the colour.
Filtration of the Solution
The hot solution is filtered using a filter paper and a funnel
Crystallization
When the hot filtrate is allowed to cool, the pure crystals are formed.
Isolation and drying of the crystals
The pure crystals are separated by filtration. The crystals washed and dried.

36. How can we induce (increase) the rate of crystallization?
By scratching on the walls of the beaker with a glass rod.
By adding a few crystals of the pure compound in the solution.

33. What are the different types of distillation?

- ✓ Simple distillation
- ✓ Fractional distillation
- ✓ Steam distillation
- ✓ Azeotropic distillation

34. Explain the Simple distillation method and give the conditions.

- ✓ When the impure liquid is boiled to give vapours.
- ✓ The vapours are condensed and the pure liquid collected in a receiver.

Conditions:

- ✓ Liquids having larger boiling point difference of 40K can be purified.
- ✓ Liquids that do not decompose in ordinary pressure can be purified.
- ✓ Example Benzene and Nitro Benzene

35.Explain Fractional distillation

- ✓ In this method liquids having boiling points very close to each other are separated and purified. This is called as Fractional Distillation.
- ✓ The distillation flask is fitted with a Fractionating Column, condenser and a receiver.
- ✓ To measure the temperature, the Fractionating Column is fitted with a thermometer.
- ✓ When the impure liquid is boiled to give vapours.
- ✓ The vapours are condensed and the pure liquid collected in a receiver
- ✓ Crude oil and Petroleum is separated in this method

36.Explain Steam Distillation. And what are the conditions? (what type ofCompounds are purified in this method)

- ✓ The impure liquid is taken in a round bottom flask and connected to a water condenser
- ✓ The flask is kept in a slanting position to prevent the mixture from entering into the condenser while boiling.
- ✓ The flask is heated and steam is passed through the mixture.
- ✓ The compound vapours and steam is condensed and collected in thereceiver.
- ✓ The mixture of water and the compound is separated.
- ✓ Essential oil from Flowers can be separated in this method.

Conditions (Characteristics of the compounds)

- ✓ The compound should not decompose in the steam's temperature
- ✓ The impurities should be non- volatile
- ✓ The impurities should be insoluble in water.

37.What are Azeotropes? Explain the Azeotropic distillation.

- ✓ A constant boiling mixture, which distills as a single component at a given temperature are called as Azeotropes**. Ex. Water and ethanol**
- ✓ So a third compound like benzene or glycol is added, which decreases the partial pressure and increases the boiling point of one component.
- ✓ When Benzene is added it decreases the partial pressure and the boiling point of Ethanol
- ✓ When glycol is added it decreases the partial pressure and the boiling point of Water.

38.Explain Differential Extraction

- ✓ The process of separating a substance from an aqueous solution by shaking with an organic solvent is called as Differential Extraction.
- ✓ The aqueous solution is taken is separating funnel.
- ✓ A little amount of ether is added and gently shaken.
- ✓ The compound is more soluble in the organic solvent.
- ✓ The organic solvent is removed by opening the tap of the separating funnel.
- ✓ The substance is collected separately.

39. Define chromatography

- ✓ The process of separation of a mixture by the differential movement of the compound through a porous medium under the influence of a moving solvent is called as Chromatography.

There are 5 types

- ✓ Column chromatography
- ✓ Thin layer chromatography
- ✓ Paper chromatography
- ✓ Gas-Liquid chromatography
- ✓ Ion exchange chromatography

40. Explain the Column chromatography

- ✓ A long glass column is taken and a small piece of cotton is placed at the lower end of the column.
- ✓ The column is packed with the adsorbent like silica or alumina which acts as the Stationery phase.
- ✓ The mixture to be separated is placed on the top of the adsorbent and a suitable solvent is added.
- ✓ As the solvent flows down the column, the compounds are separated depending upon the degree of adsorption.
- ✓ The compound which is readily adsorbed is retained near the top of the column.

41.Explain the Thin layer Chromatography

- ✓ It is an example of Adsorption Chromatography.
- ✓ A Glass sheet is coated with a thin layer of Silica. This glass sheet is called as Chromo plate.
- ✓ A mixture is placed just above the lower edge of the glass plate.
- ✓ The glass plate is placed in a closed Jar, containing the Solvent.
- ✓ The solvent moves up the glass plate due to capillary action.
- ✓ The components present in the mixture get separated at different distances depending upon the degree of adsorption.
- ✓ Colourless compound are viewed under the UV light.
- ✓ Retention Factor,

$$R_f = \frac{\textit{Distance moved by the substance from the base line}}{\textit{Distance moved by the Solvent from the base line}}$$

42. Explain Partition Chromatography or Paper Chromatography

- ✓ It is an example of Partition Chromatography.
- ✓ A strip of paper acts as the Stationery phase. This paper is called as Chromatographic paper.
- ✓ The mixture is placed at the base of the paper.
- ✓ The paper is suspended in a solvent which is the mobile phase.
- ✓ The solvent moves up the paper.
- ✓ The different components present in the mixture are retained by the paper depending upon the partitions in the two phases.
- ✓ This is called as the **Chromatogram**.
- ✓ The coloured components are visible at different heights on the chromatogram.
- ✓ Colourless compound are viewed under the UV light.

Mr. UTHRAKUMAR
PGT CHEMISTRY
VMHSS
CHENNAI