NEET Syllabus (POC)

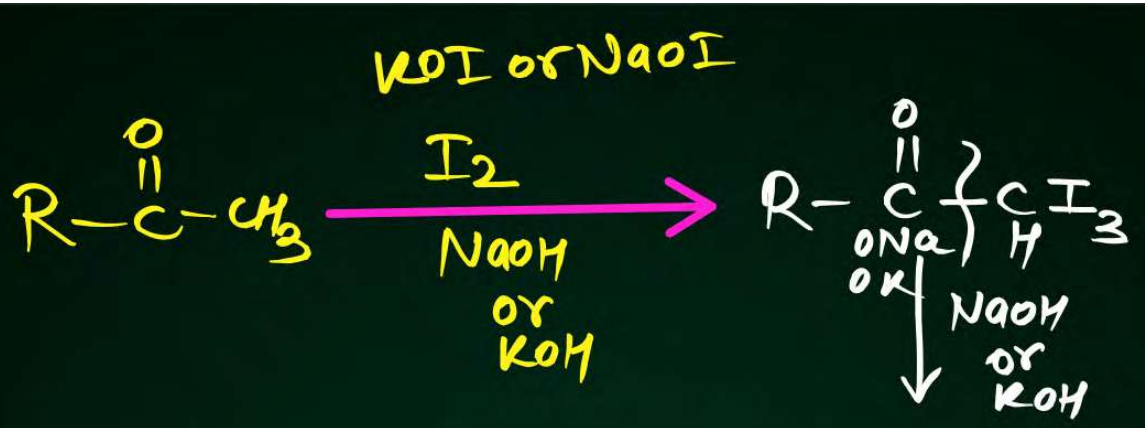
$RCOOH \xrightarrow{NaHCO_3} RCOONa + CO_2 + H_2O$

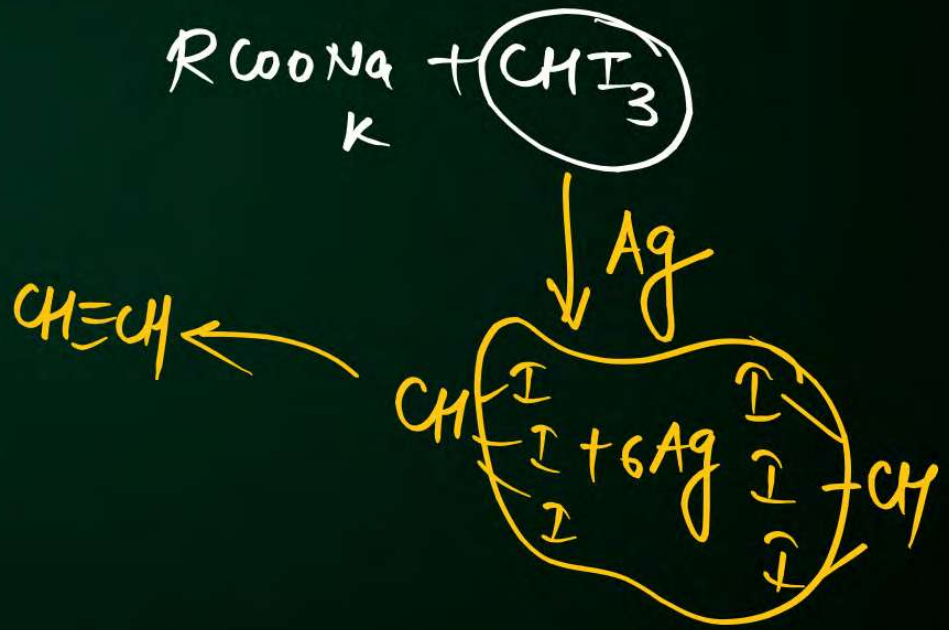
Brisk eff

Unit 20: Principles Related to Practical Chemistry

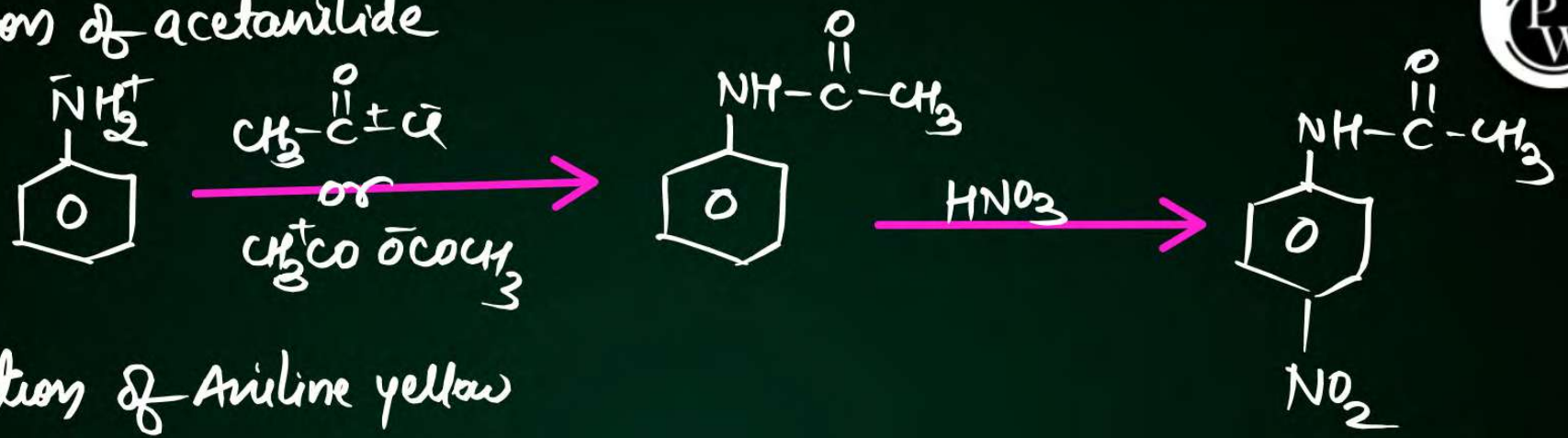
- Detection of extra elements (Nitrogen, Sulphur, Halogens) in organic compounds; Detection of the following functional group; hydroxyl (alcoholic and phenolic), carbonyl (aldehyde and ketones) carboxyl and amino groups in organic compounds.
- The chemistry involved in the preparation of the following:
  Organic compounds: Acetanilide, p-nitro acetanilide, aniline yellow, iodoform.

Iodoform
CHI_3





formation of acetanilide

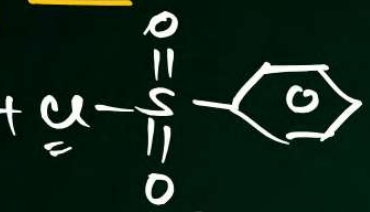
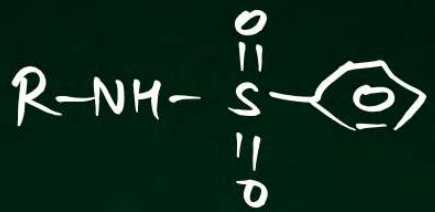


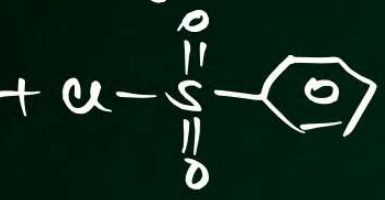
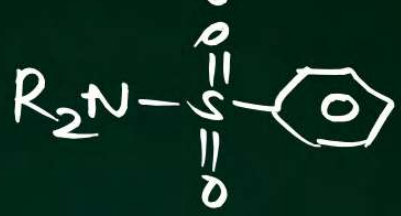
formation of Aniline yellow

P-Amino azobenzene

Yellow dye

Hinsberg's Test :

1° RNH_2 +  →  $\xrightarrow[\text{alkali}]{aq}$ soluble

2° R_2NH +  →  $\xrightarrow{''}$ Insoluble

3° R_3N ⟶ NO RXN

Purification of Organic Compounds

Methods of Purification

Sep of impurity from comp.

- Solids
  - Sublimation
  - Crystallisation
- Liquid or gas
  - Distillation
  - Differential extraction
  - Chromatography

Crystallization

- Based on the difference in the solubilities of the compounds & the impurities in a suitable solvent.
- The impure compound is dissolved in a solvent in which it is sparingly soluble at room temperature but appreciably soluble at higher temperature.
- If the compound is highly soluble in one solvent and very little soluble in another solvent, crystallization can be satisfactorily carried out in a mixture of these solvents.
- Ex: Purification of sugar and purification of potash alum etc.

Sublimation

$[S \rightleftharpoons V]$

Solid is converted directly into vapour without undergoing liquid state.

e.g: Purification of iodine, Camphor, Naphthalene, ammonium chloride etc.

Distillation

Principle: Based on difference in B. P. of components of mixture.

- **Also used to separate:** Volatile liquids from non-volatile impurities

↓ Vapour banaye

Vapour na banaye

Types of Distillations

1. Simple distillation
2. Fractional distillation
3. Vacuum distillation
4. Steam distillation

1. Simple distillation:

To separate liquids which have sufficient difference in B.P. (>२०°C)

e.g: **chloroform (334K) & aniline (457K)**

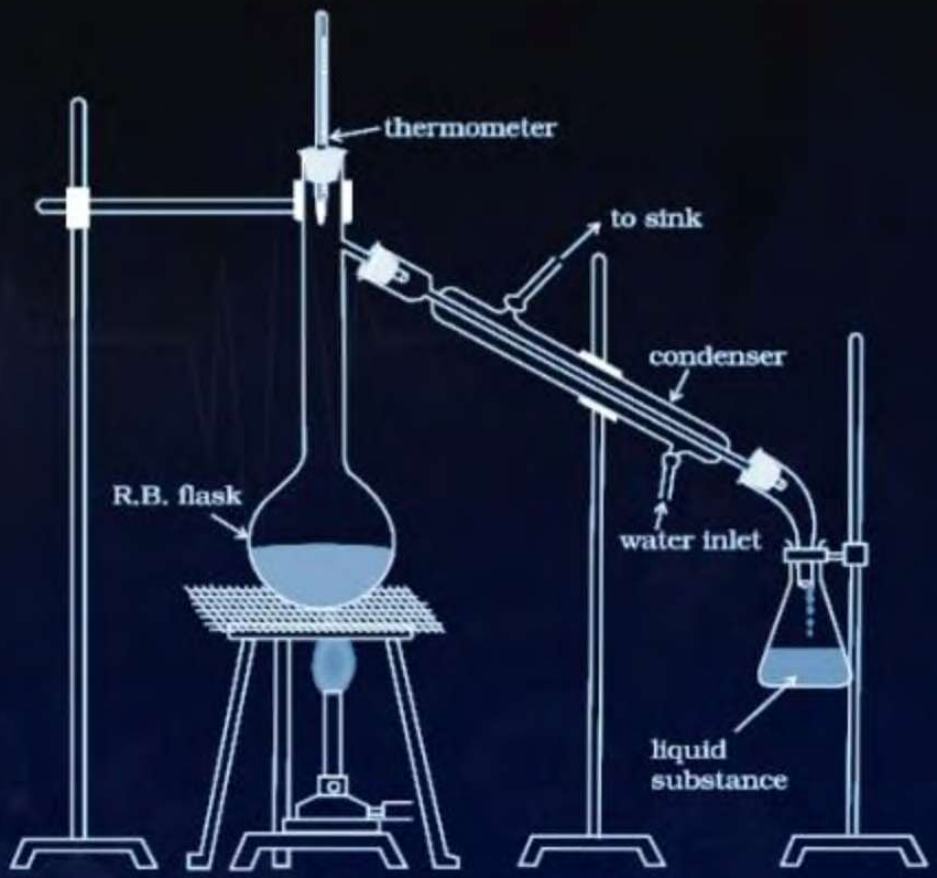


Fig.12.5 *Simple distillation. The vapours of a substance formed are condensed and the liquid is collected in conical flask.*

2. Fractional distillation:

To separate liquids which have small difference in B.P. (< 25°C)

e.g: To separate different fractions of crude oil in petroleum industry.

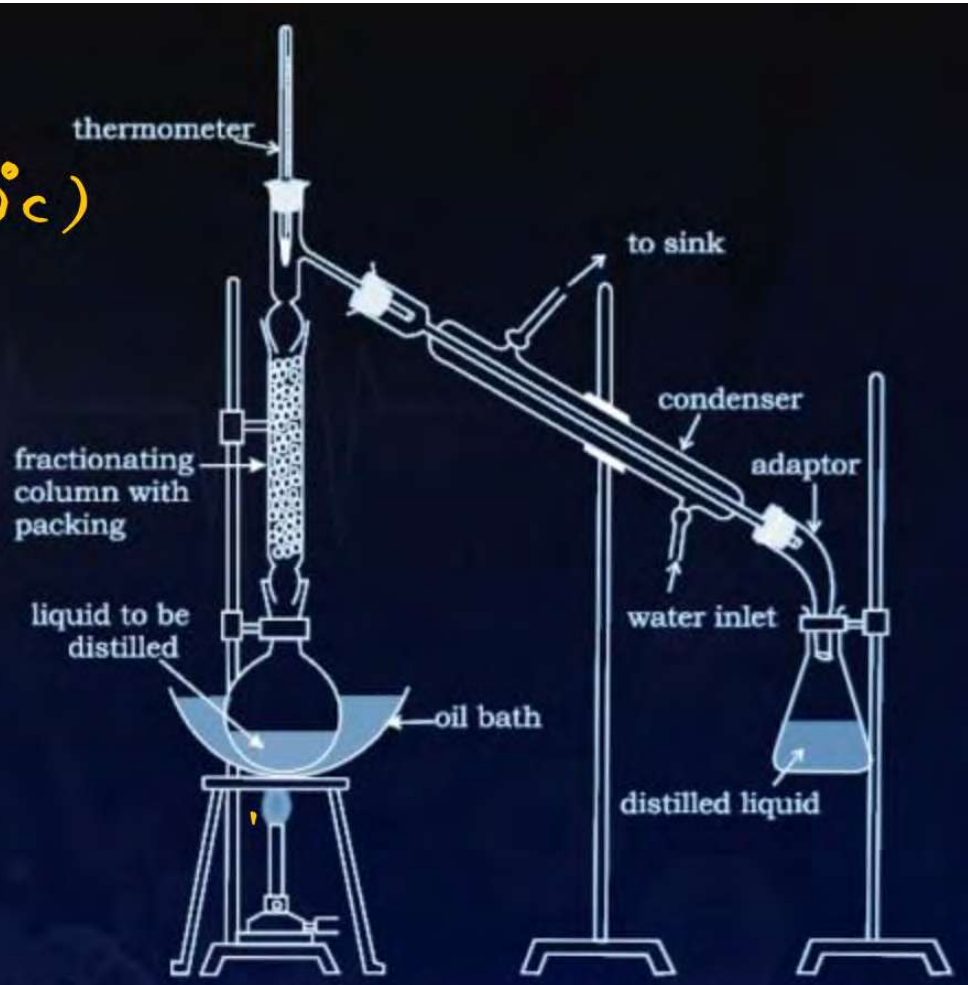


Fig.12.6 *Fractional distillation. The vapours of lower boiling fraction reach the top of the column first followed by vapours of higher boiling fractions.*

3. Vacuum distillation

(distillation under reduced pressure)

BP high

This method is used to purify liquids having very high boiling points but they decompose at or below their boiling points.

e.g: Glycerol is separated from spent - lye in soap industry.

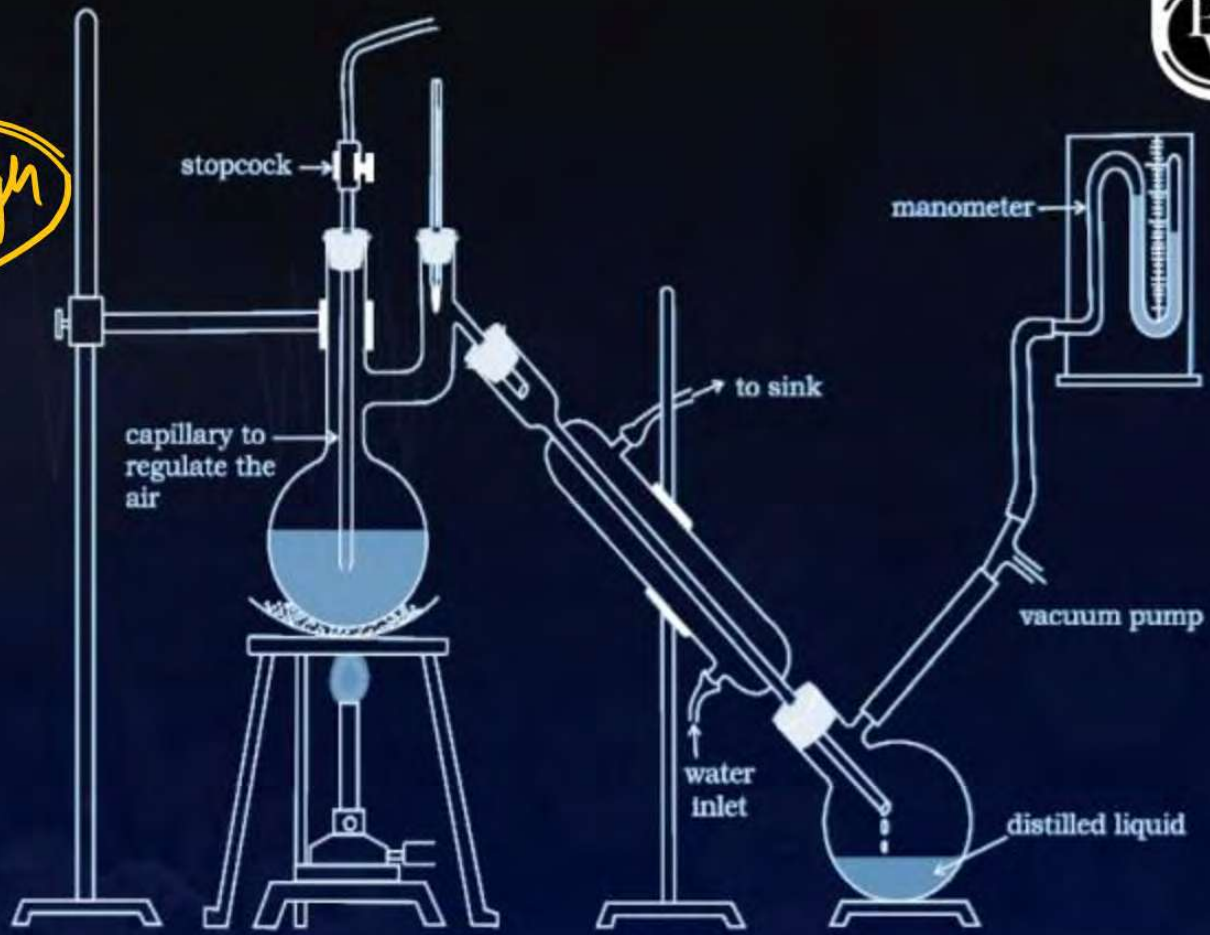


Fig.12.8 *Distillation under reduced pressure. A liquid boils at a temperature below its vapour pressure by reducing the pressure.*

4. Steam Distillation

- To separate substances which are steam volatile and are immiscible with water.

e.g: Aniline, Nitrobenzene, o-nitro phenol & etc.

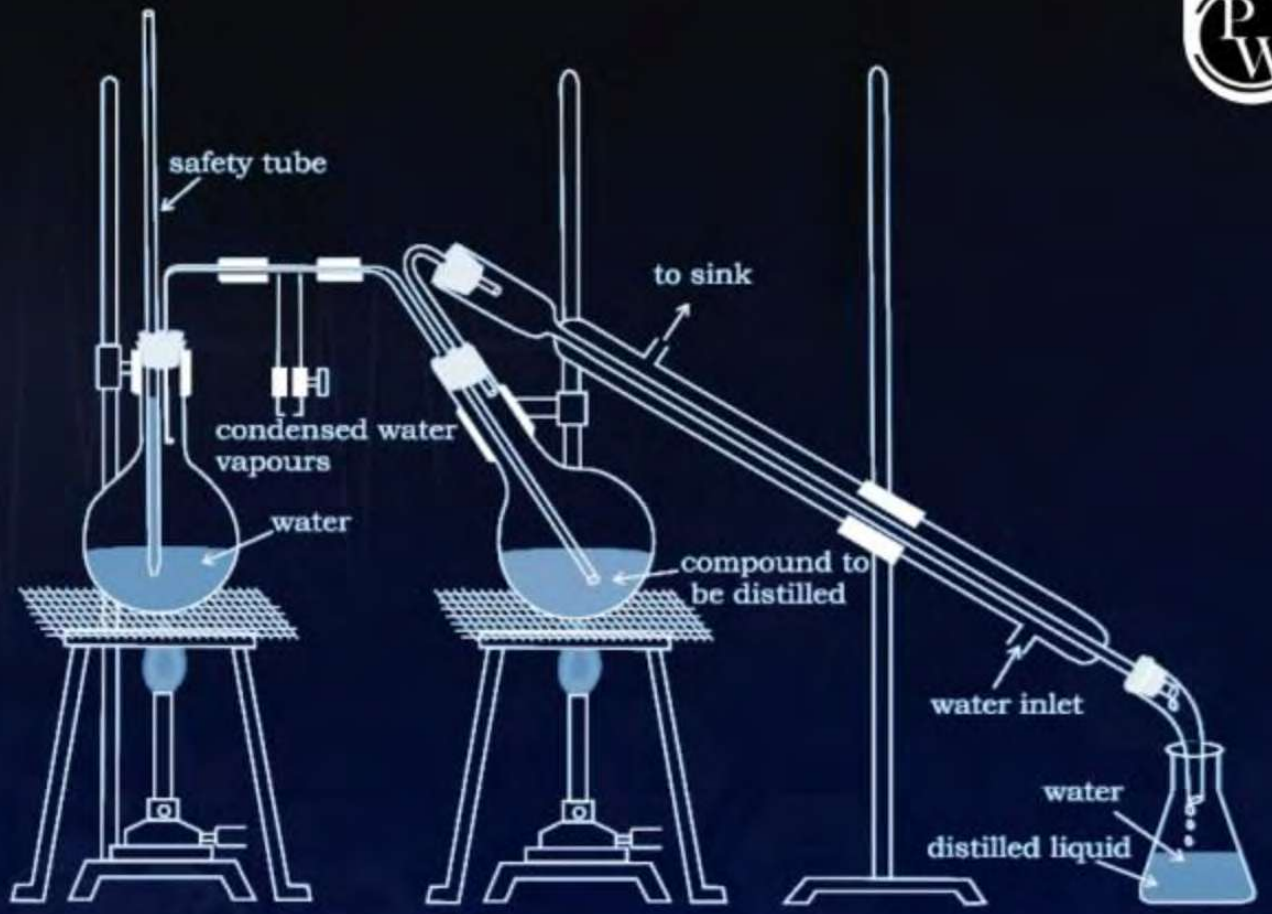
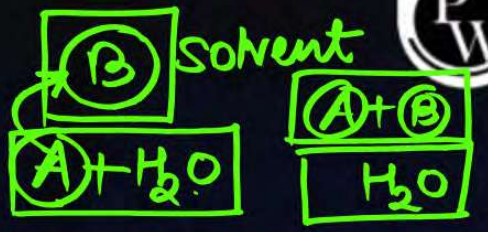


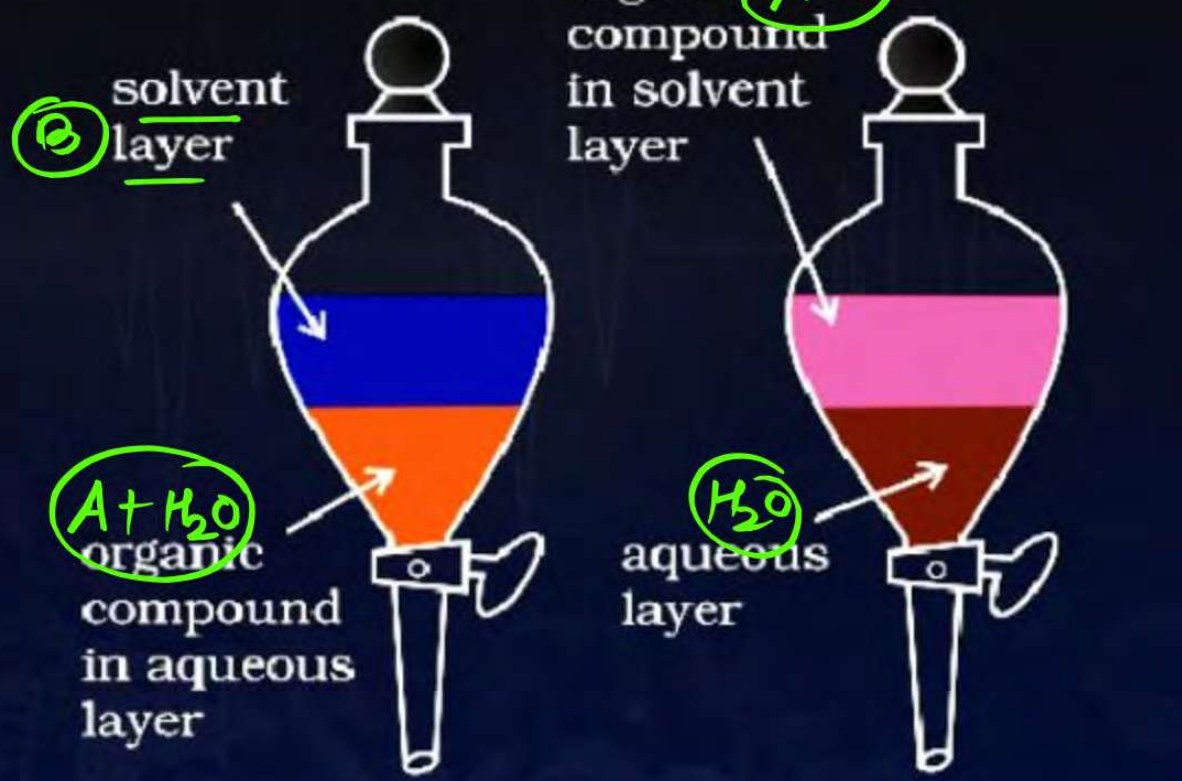
Fig.12.9 *Steam distillation. Steam volatile component volatilizes, the vapours condense in the condenser and the liquid collects in conical flask.*

Differential Extraction Principle

A → o.c

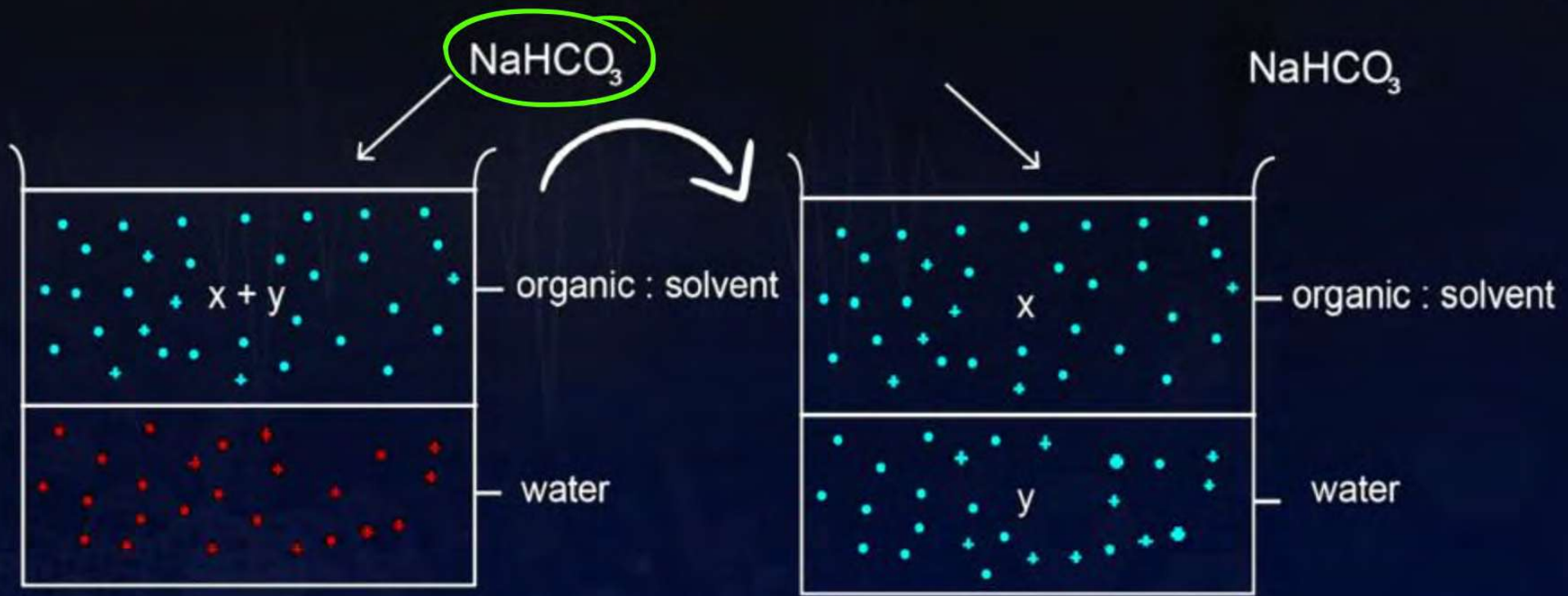


1. Based on difference in solubility of organic compounds in different solvents.
2. When an organic compound is present in an aqueous medium, it is separated by shaking it with an organic solvent in which it is more soluble than in water.
3. The organic & Aq. solvent should be immiscible with each other so that they form 2 distinct layers which can be separated by separatory funnel.
4. The organic solvent is later removed by distillation or evaporation to get back organic compound.

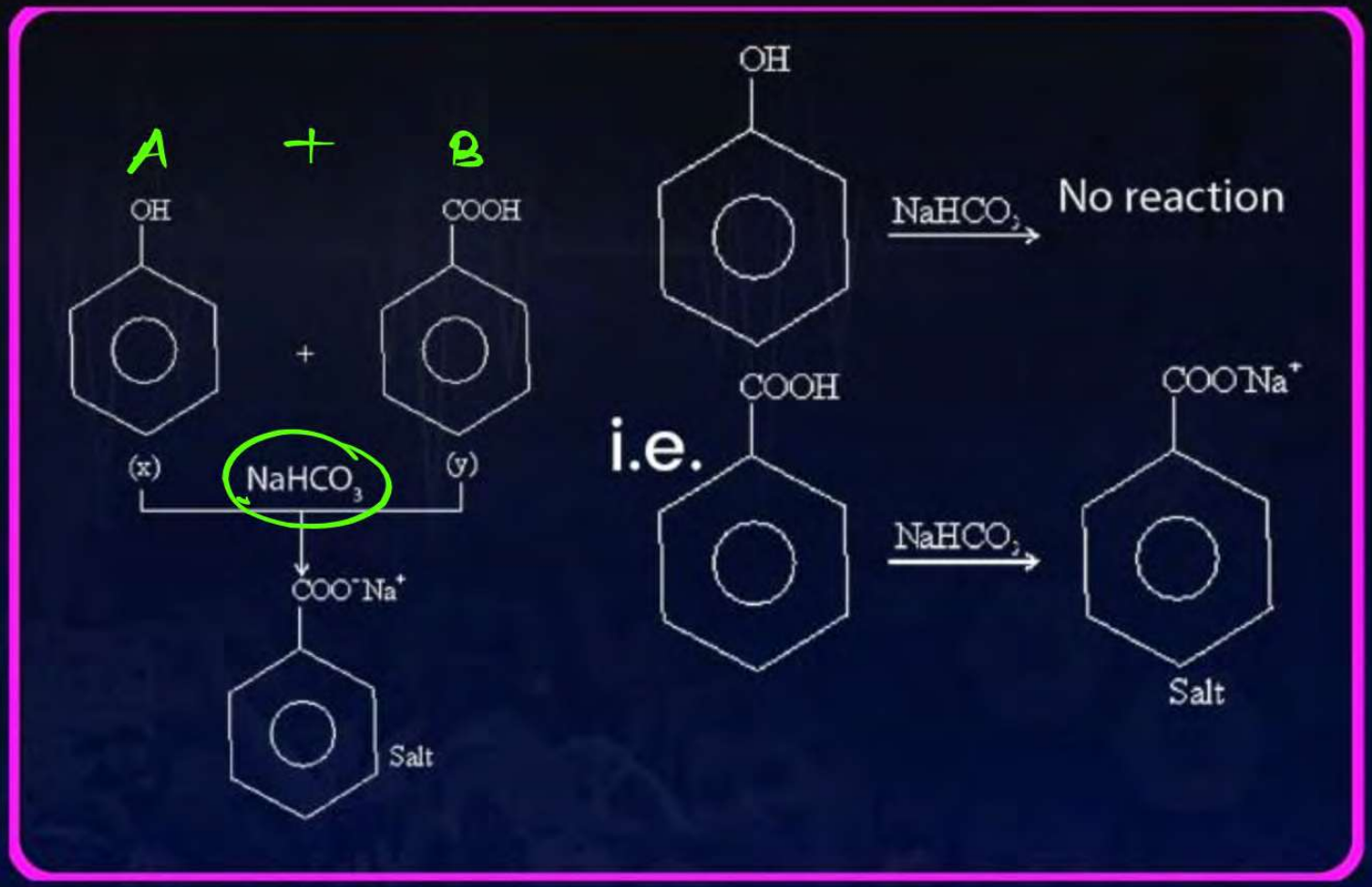

solvent layer
organic compound in solvent layer
organic compound in aqueous layer
aqueous layer
Before extraction
After extraction

Example

Org Comp Contain COOH



Example


A
+
B
OH
COOH
+
(x)
NaHCO3
(y)
COO⁻Na⁺
Salt
OH
NaHCO3
No reaction
i.e.
COOH
NaHCO3
COO⁻Na⁺
Salt

Chromatography

Latest technique

Chromatography is used

- To purify compound
- To separate mix
- To test purity of compound

Chromatography

Latest technique

In Chromatography there are 2 phases

- Stationary phase
  - Solid/liq.
- Mobile phase
  - Pure solvent or mix. of solvents or gases

Types of Chromatography

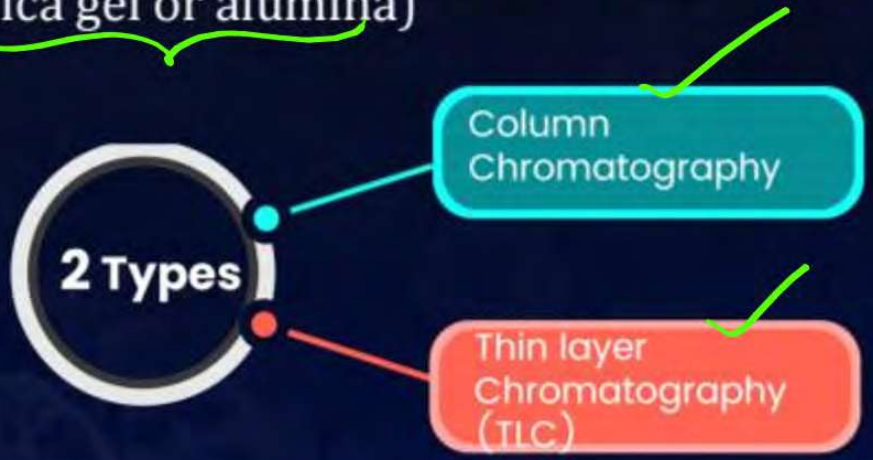
1) Adsorption Chromatography:

Based on the fact that different components of a mixture have different degrees of adsorption on adsorbent (silica gel or alumina)

surface pheno

Stationary phase - solid

Mobile phase - liquid/gas



A) Column Chromatography

- Involves separation of a mixture over a column of adsorbent (stationary phase) packed in a glass tube.
- Component of the mixture which is more soluble in stationary phase is adsorbed first than the component which is less soluble in stationary phase.
- The most readily adsorbed substances are retained near the top and others come down to various distances in the column.

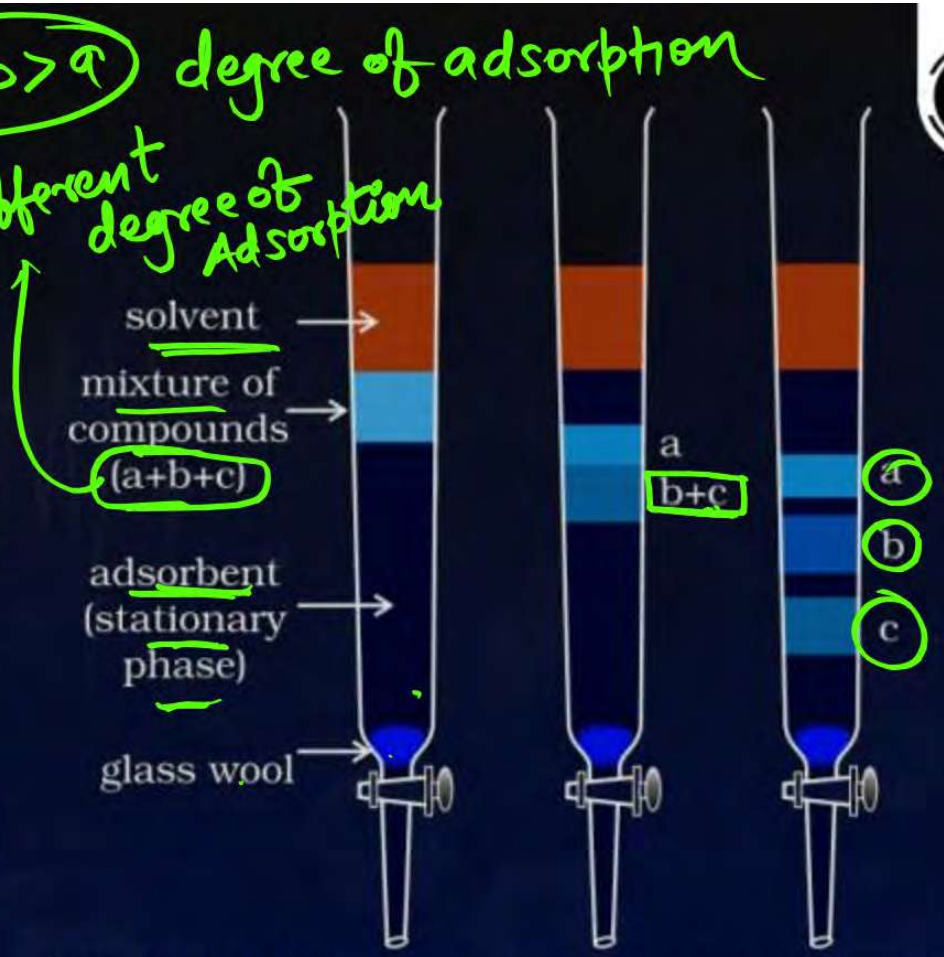


Fig.12.11 *Column chromatography. Different stages of separation of components of a mixture.*

B) Thin layer chromatography (TLC)

- Involves separation of substances of a mixture over thin layer of an adsorbent coated on glass plate.
- The components of the mixture move up along with the eluant to different distances depending on their degree of adsorption and separation takes place.

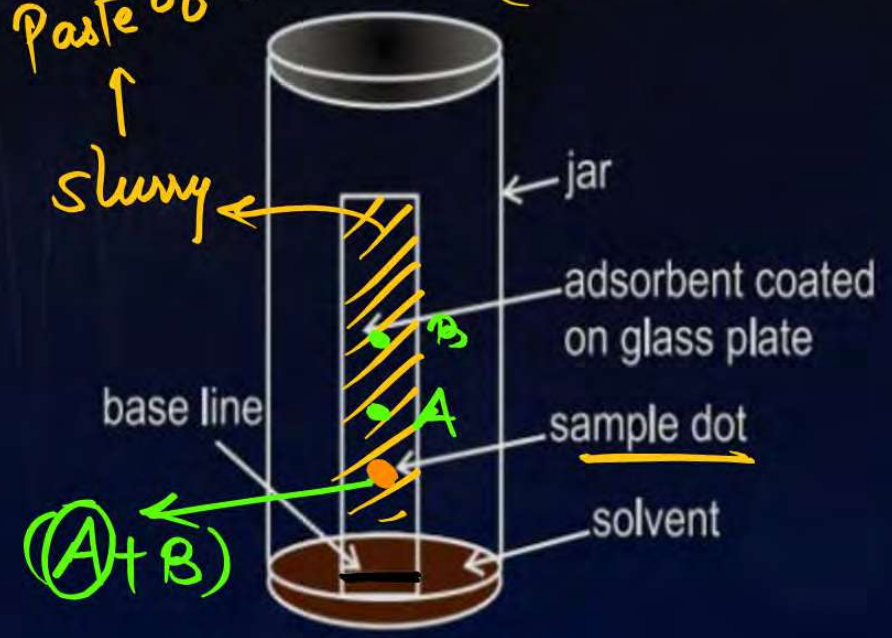


Fig.12.12 (a) *Thin layer chromatography. Chromatogram being developed.*

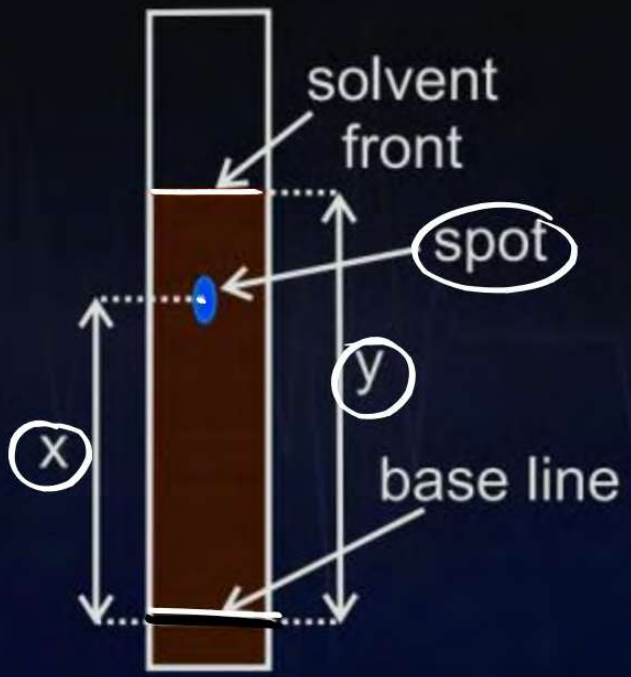


Fig.12.12 (b) *Developed chromatogram.*

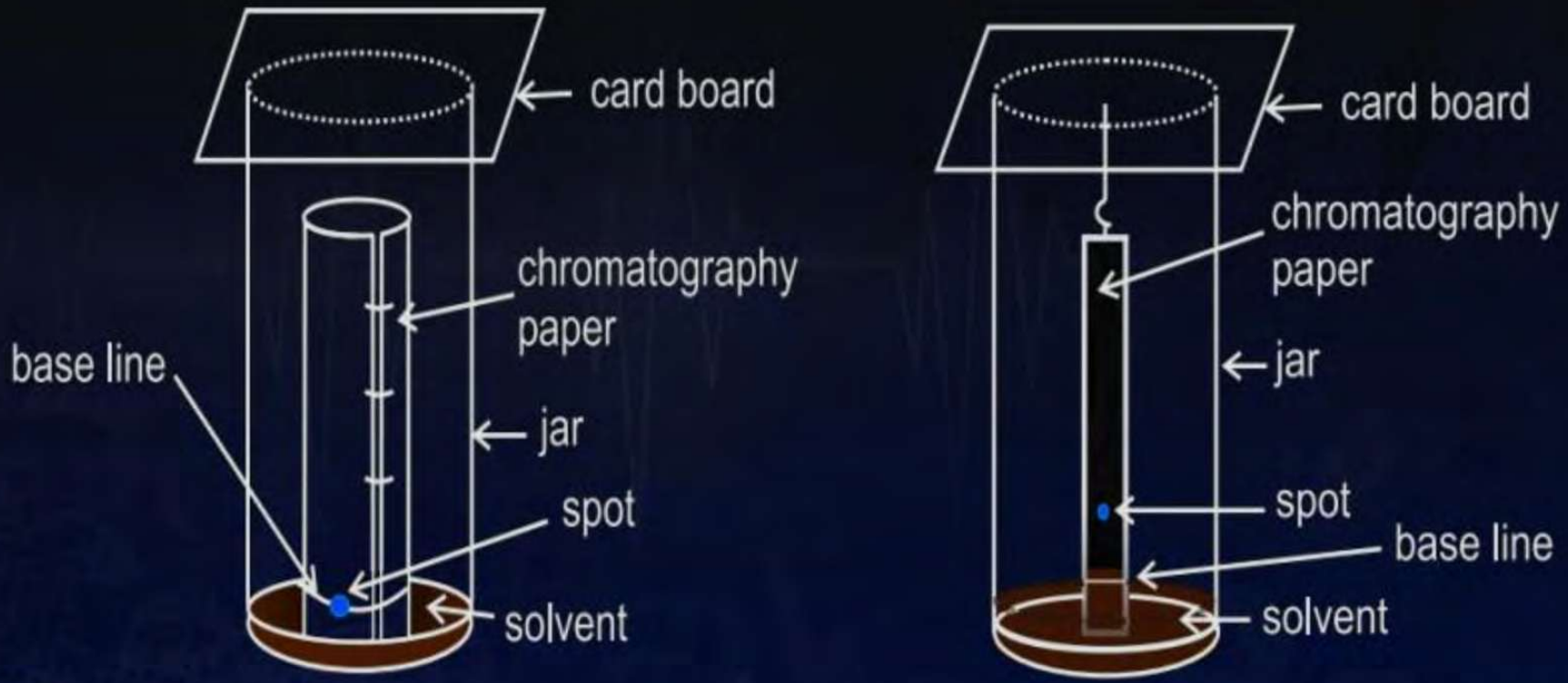


Fig.12.13 *Paper chromatography. Chromatography paper in two different shapes.*

Retardation factor:

express degree of adsorption of each Component of mixture.

$$R_f = \frac{\text{distance moved by component of mixture from base line}}{\text{distance moved by solvent (mobile phase) from base line.}} = \frac{X}{Y}$$

Rf factor ↓ more adsorbing power (polar compound)

2) Partition Chromatography:

- Based on continuous differential partitioning of components of a mixture between stationary & mobile phase. Also known as **liquid paper chromatography**

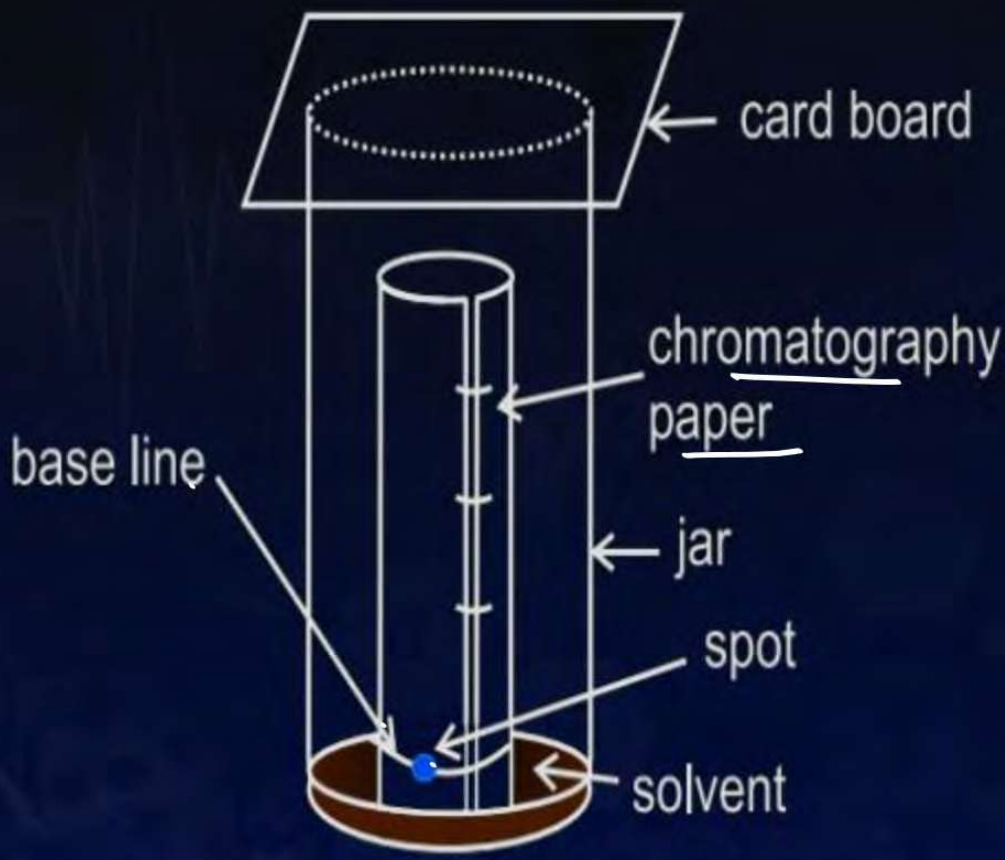
  Stationary phase - liquid

  Mobile phase - liquid

- A special quality paper known as chromatography paper is used. **eg:** cellulose paper

- Chromatography paper contains water trapped in it, which works as Stationary phase.

- Moving phase is a solvent or a mixture of solvents in which spotted chromatography paper is suspended.
- The solvent rises up the paper by capillary action and flows over the spot. The paper selectively retains different components according to their differing partition in the two phases. The paper strip so developed is called Chromatogram.



C.Q. 01 (NEET 2024)

On heating, some solid substances change from solid to vapour state without passing through liquid state. The technique used for the purification of such solid substances based on the above principle is known as

A Distillation

B Chromatography

C Crystallization

D Sublimation

C.Q. 02 [NEET 2020]

Paper chromatography is an example of:

A Partition chromatography

B Thin layer chromatography

C Column chromatography

D Adsorption chromatography

C.Q. 03 [AIIMS 2019, 25 May]

Which is incorrect statements for paper chromatography?

A. It is a part of partition chromatography.

B. It is a stationary phase.

C. R_f value decreases when rate adsorption increases.

$\gamma_f \downarrow$ Ad more

D. None of these

C.Q. 04 (NCERT Exemplar)

The fragrance of flowers is due to the presence of some steam volatile organic compounds called essential oils. These are generally insoluble in water at room temperature but are miscible with water vapour in vapour phase. A suitable method for the extraction of these oils from the flowers is:

A Distillation

B Crystallisation

C Distillation under reduced pressure

D Steam distillation

C.Q. 05 (NCERT Exemplar)

During hearing of a court case, the judge suspected that some changes in the documents had been carried out. He asked the forensic department to check the ink used at two different places. According to you which technique can give the best results?

A Column chromatography

B Solvent extraction

C Distillation

D Thin layer chromatography

C.Q. 06 (NCERT Exemplar)

Assertion (A): Simple distillation can help in separating a mixture of propan-1-ol (boiling point 97°C) and propanone (boiling point 56°C).
Reason (R): Liquids with a difference of more than 20°C in their boiling points can be separated by simple distillation.

A Both A and R are correct and R is the correct explanation of A.

B Both A and R are correct but R is not the correct explanation of A.

C Both A and R are not correct.

D A is not correct but R is correct.

C.Q. 07 (NCERT Exemplar)

Assertion (A): Components of a mixture of red and blue inks can be separated by distributing the components between stationary and mobile phases in paper chromatography.

Reason (R): The coloured components of inks migrate at different rates because paper selectively retains different components according to the difference in their partition between the two phases.

A Both A and R are correct and R is the correct explanation of A.

B Both A and R are correct but R is not the correct explanation of A.

C Both A and R are not correct.

D A is not correct but R is correct.

C.Q. 08 (JEE Mains 2025, 29 January Shift-2)

Given below are two statements:

Statement (I): In partition chromatography, stationary phase is thin film of liquid present in the inert support.

Statement (II): In paper chromatography, the material of paper acts as a stationary phase.

In the light of the above statements, choose the correct answer from the options given below:

A Statement I is false but Statement II is true.

B Both Statement I and Statement II are false.

C Statement I is true but Statement II is false.

D Both Statement I and Statement II are true.

C.Q. 09 [JEE Mains 2025, 24 January Morning Shift]

Statement-1: In paper chromatography stationary phase is paper.

Statement-2: In thin layer chromatography liquid used as stationary phase.

Adsorbent

A Statement 1 and statement 2 both are correct.

B Statement 1 is correct and statement 2 is incorrect.

C Statement 1 is incorrect and statement 2 is correct.

D Statement 1 and statement 2 both are incorrect.

C.Q. 10 (JEE Mains 6th April 2024, Evening Shift)

$R_f = \frac{x}{y} < 1 \quad (y > x)$

The correct statement among the following, for a "chromatography" purification method is:

A Organic compounds run faster than solvent in the thin layer chromatographic plate.

B Non-polar compounds are retained at top and polar compounds come down in column chromatography.

C R_f of a polar compound is smaller than that of a non-polar compound.

D R_f is an integral value.

C.Q. 11 (JEE Mains 27th January 2024, Evening Shift)

The technique used for purification of steam volatile water immiscible substance is:

A Fractional distillation

B Fractional distillation under reduced pressure

C Distillation

D Steam distillation

C.Q. 12 (JEE Mains 30 January 2024, Morning Shift)

On a thin layer chromatographic plate, an organic compound moved by 3.5 cm, while the solvent moved by 5 cm. The retardation factor of the organic compound is

7 $\times 10^{-1}$

$$R_f = \frac{x}{Y} = \frac{3.5}{5}$$

$$= 0.7$$

$$= 7 \times 10^{-1}$$

C.Q. 13 (JEE Mains 30 Jan. 2023, Shift (II))

Match List-I with List-II:

List-I (Mixture)	List-II (Separation Technique)
(A) $CHCl_3 + C_6H_5NH_2$	(I) Steam distillation
(B) $C_6H_{14} + C_5H_{12}$	(II) Differential extraction
(C) $C_6H_5NH_2 + H_2O$	(III) Distillation
(D) Organic compound in H_2O	(IV) Fractional distillation

A (A)-(IV), (B)-(I), (C)-(III), (D)-(II)

B (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

C (A)-(II), (B)-(I), (C)-(III), (D)-(IV)

D (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

Qualitative & Quantitative Analysis

detection of element

% age of element

Qualitative Analysis of O.C

- Carbon and hydrogen are detected by heating the compound with cupric oxide (CuO).
- Carbon present in the compound is oxidized to carbon dioxide, which turns lime water milky.
- Hydrogen present in the compound is converted into water, which turns anhydrous copper sulphate into blue.

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

$$H_2 + CuO \longrightarrow Cu + H_2O$$

$C + CuO \longrightarrow CO_2 \xrightarrow{Ca(OH)_2} \underset{\text{Milky}}{CaCO_3\downarrow}$

$2H + CuO \longrightarrow H_2O \xrightarrow{CuSO_4} CuSO_4 \cdot 5H_2O$

Blue vitriol

Lassaigne's Test

[P, S, N, X]

- Nitrogen, Sulphur, halogens and phosphorus present in an organic compound are detected by Lassaigne's test.
- During preparation of sodium fusion extract covalent compound is converted into ionic compound.
- The following reactions takes place

NH_2NH_2 No Lass Test

$Na + C + N \longrightarrow NaCN$

$2Na + S \longrightarrow Na_2S$

$2Na + X_2 \longrightarrow 2NaX$ (X = Cl, Br or I)

(X = Cl, Br or I)

$Na + P \xrightarrow[Na_2O_2]{O.A} Na_3PO_4$

Test for Nitrogen

1. Sodium fusion extract is boiled with freshly prepared ferrous sulphate ($FeSO_4$) solution and then acidified with concentrated Sulphuric acid.
2. The formation of Prussian blue colour confirms the presence of nitrogen.

$$2NaCN + FeSO_4 \longrightarrow Fe(CN)_2 + Na_2SO_4$$

$$Fe(CN)_2 + 4NaCN \longrightarrow Na_4[Fe(CN)_6]$$

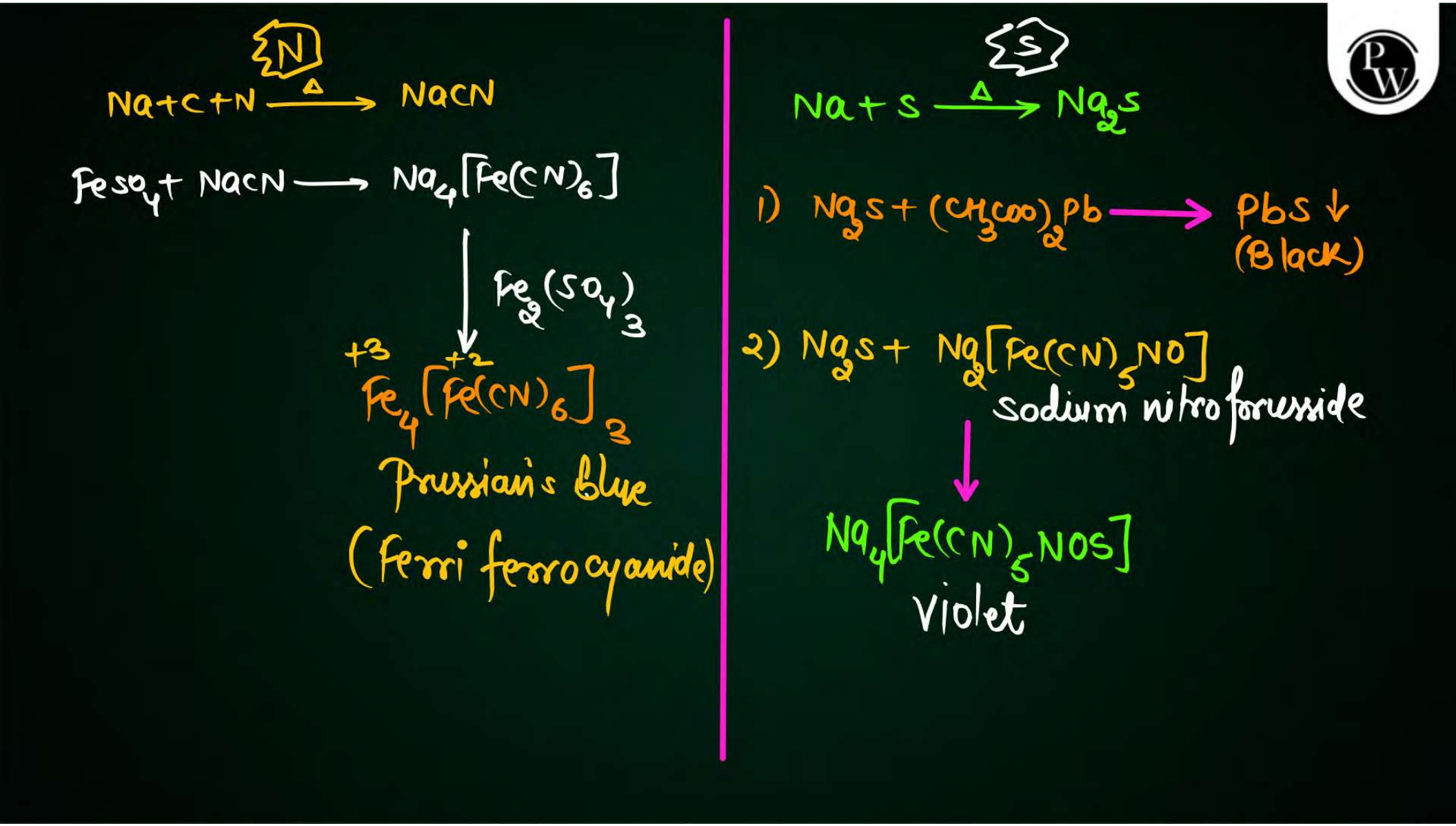
sodium hexacyanoferrate (II)

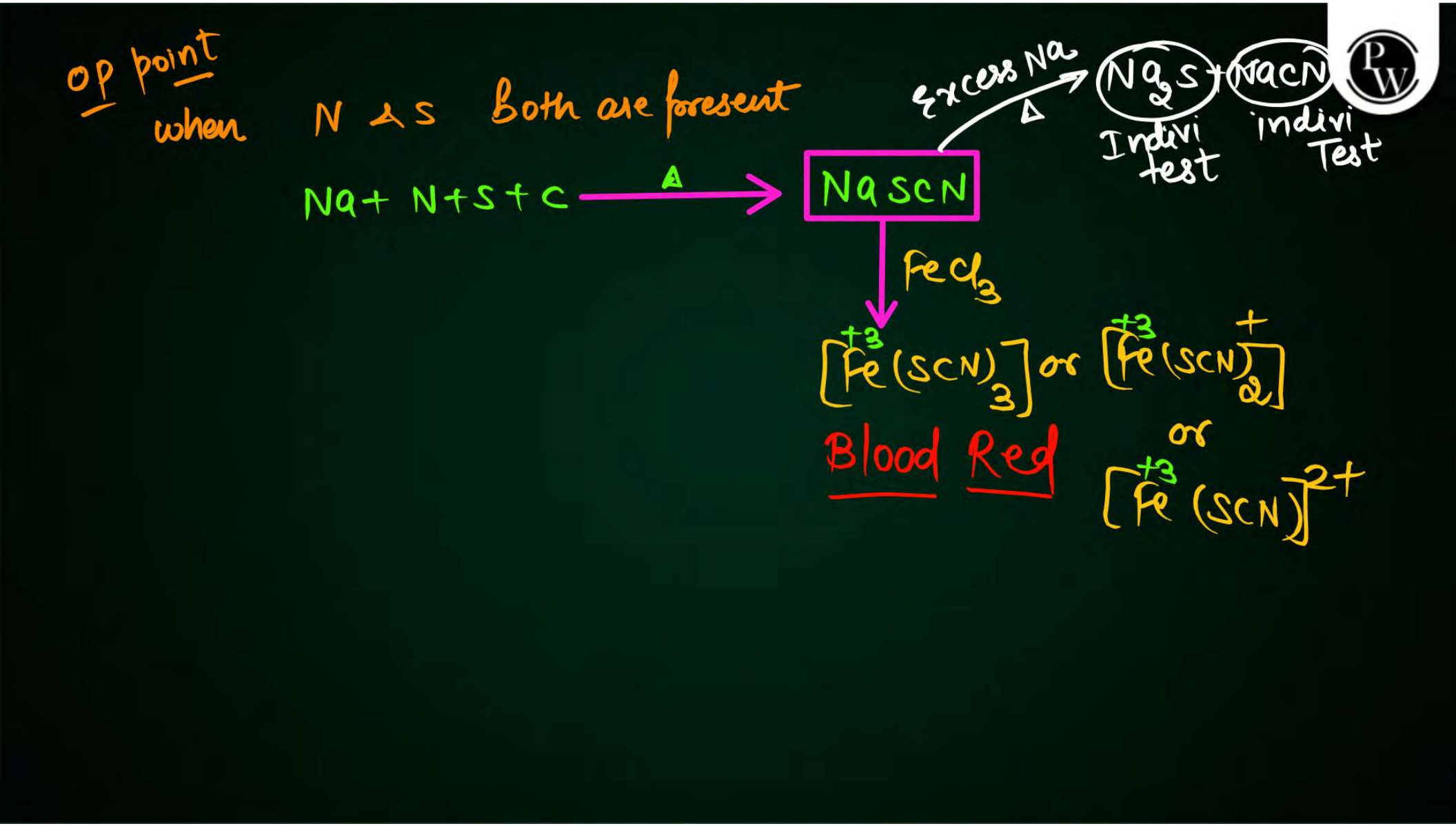
$$FeSO_4 + 6NaCN \longrightarrow Na_4[Fe(CN)_6] + Na_2SO_4$$

On heating with concentrated Sulphuric acid some Iron (II) ions are oxidized to Iron (III) ion, which reacts with sodium hexacyanoferrate (II) to produce Iron (III) hexacyanoferrate (II) (ferric ferrocyanide) which is Prussian blue in colour.

$$3Na_4[Fe(CN)_6] + 2\overset{+3}{Fe}_2(SO_4)_3 \longrightarrow \underset{\text{Ferriferrocyanide (prussianblue)}}{\overset{+3\ \ +2}{Fe_4[Fe(CN)_6]_3}} + 6Na_2SO_4$$

- This test fails in case of diazo compounds.


N
Na + C + N → NaCN
FeSO4 + NaCN → Na4[Fe(CN)6]
Fe2(SO4)3
+3 +2
Fe4[Fe(CN)6]3
Prussian's blue
(Ferri ferrocyanide)
S
Na + S → Na2S
1) Na2S + (CH3COO)2Pb → PbS ↓ (Black)
2) Na2S + Na2[Fe(CN)5NO]
Sodium nitroferrusside
Na4[Fe(CN)5NOS]
Violet


op point
when N & S Both are present
Na + N + S + C
Δ
NaSCN
excess Na
Δ
Na2S
Indivi test
NaCN
indivi Test
FeCl3
[Fe(SCN)3] or [Fe(SCN)2]+
Blood Red
or
[Fe(SCN)]2+

Test for Sulphur

- Sodium fusion extract is acidified with acetic acid and lead acetate is added to it, a black precipitate of lead sulphide is formed, which indicates presence of sulphur.

$$Na_2S + (CH_3COO)_2Pb \longrightarrow \underset{\text{Black}}{PbS\downarrow} + 2CH_3COONa$$

- Sodium fusion extract is treated with freshly prepared sodium nitroprusside, appearance of violet colour (purple) indicates presence of sulphur.

$$\underset{\text{(sodium nitro prusside)}}{Na_2[Fe(CN)_5NO]} + Na_2S \longrightarrow \underset{\text{(violet)}}{Na_4[Fe(CN)_5NOS]}$$

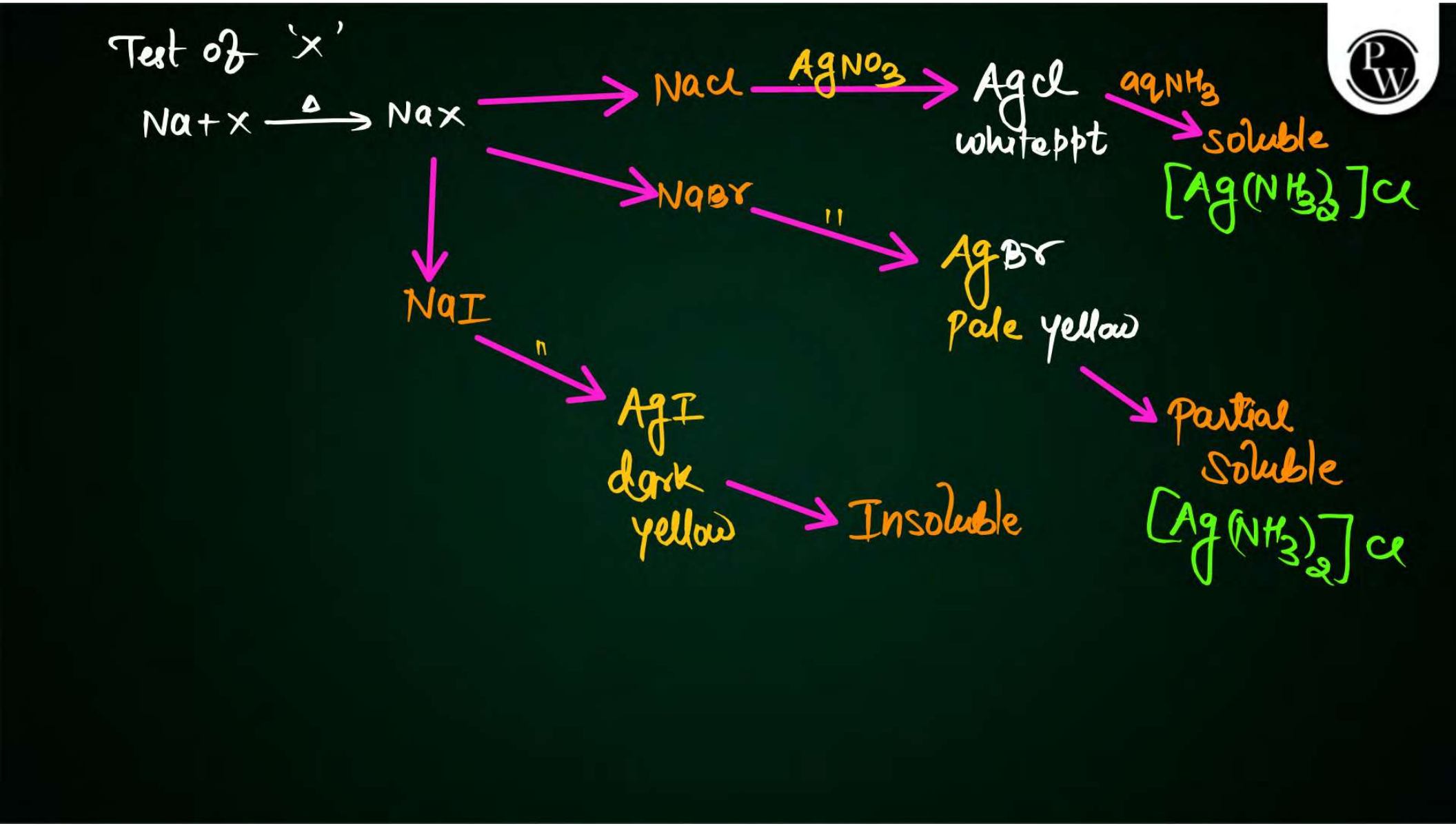
- In case both nitrogen and sulphur are present in an organic compound sodium thiocyanate is formed, which gives blood red colour with neutral solution, $FeCl_3$ solution.

  $Na + C + N + S \longrightarrow NaSCN$

  $3NaSCN + FeCl_3 \longrightarrow Fe(SCN)_3 + 3NaCl$

  (blood red)

- If sodium fusion is carried out with excess of sodium, the thiocyanate decomposes to yield cyanide and sulphide, these ions given their usual tests.


Test of 'X'
Na + X → NaX
NaCl
AgNO3
AgCl
white ppt
aq NH3
soluble
[Ag(NH3)2]Cl
NaBr
"
AgBr
Pale yellow
Partial
Soluble
[Ag(NH3)2]Cl
NaI
"
AgI
dark
yellow
Insoluble

Test for Halogens

- **Sodium fusion extract is acidified with nitric acid and then treated with silver nitrate solution.**

  (i) **White precipitate, soluble in ammonium hydroxide indicates presence of chlorine.**

$$NaCl + AgNO_3 \longrightarrow AgCl\downarrow + NaNO_3$$

(white ppt)

$$AgCl + 2NH_4OH \longrightarrow [Ag(NH_3)_2]Cl + 2H_2O$$

(soluble complex)

(ii) Yellowish precipitate, sparingly soluble in ammonium hydroxide indicates presence of bromine.

$$NaBr + AgNO_3 \longrightarrow AgBr\downarrow + NaNO_3$$

Yellowish ppt

(iii) Yellow precipitate, insoluble in ammonium hydroxide indicates presence of Iodine.

$$NaI + AgNO_3 \longrightarrow AgI\downarrow + NaNO_3$$

Yellow precipitate

- Nitrogen and Sulphur are also present in the compound, the sodium fusion extract is boiled with concentrated nitric acid to decompose sodium cyanide and sodium sulphide formed during Lassaigne's test, otherwise they interfere with silver nitrate test for halogens.

$$NaCN + HNO_3 \xrightarrow{Boil} NaNO_3 + HCN\uparrow$$

$$Na_2S + 2HNO_3 \longrightarrow 2NaNO_3 + H_2S\uparrow$$

- If NaCN and Na_2S are not decomposed, then white and black precipitates of AgCN and Ag_2S are formed respectively with silver nitrate solution.

C.Q. 14 (JEE Mains 2025, 22 January Shift-2)

Given below are two statements:

Statement-(I): Nitrogen, sulphur halogen and phosphorus present in an organic compound are detected by Lassaigne's Test.

Statement-(II): The elements present in the compound are converted from covalent form into ionic form by fusing the compound with Magnesium in Lassaigne's test.

In the light of the above statements, choose the correct answer from the options given below:

A Statement I is true but Statement II is false.

B Statement I is false but Statement II is true.

C Both Statement I and Statement II are true.

D Both Statement I and Statement II are false.

C.Q. 15 (NEET 2023)

In Lassaigne's extract of an organic compound, both nitrogen and Sulphur are present, which gives blood red colour with Fe^{3+} due to the formation of

A $[Fe(SCN)]^{2+}$

B $Fe_4[Fe(CN)_6]_3 xH_2O$

C NaSCN

D $[Fe(CN)_5NOS]^{4-}$

$Na + S + C + N \longrightarrow NaSCN$

$\downarrow Fe^{3+}$

Beilstein's Test

1. A copper wire flattened at one end is heated in an oxidizing flame of Bunsen burner.
2. The heating is continued till it does not impart blue colour flame.
3. The hot end of copper wire is now touched with the organic substance and is once again kept in flame, the appearance of green or blue colour indicates the presence of halogens in the organic compound

Limitations

- Substances such as urea, thio-urea do not contain halogen but gives this test.
- It does not tell which halogen is present in organic compound.

Test of 'P'

$$Na + P + O \cdot A \xrightarrow{Na_2O_2} Na_3PO_4$$

$$Na_3PO_4 + (NH_4)_2 MoO_4 \longrightarrow (NH_4)_3 PO_4 \cdot 12MoO_3$$

Ammonium molybdate

Ammonium phosphomolybdate

Canary yellow

Quantitative Analysis of O.C

- **Estimation of Carbon and Hydrogen:**

$C \longrightarrow CO_2$

$H \longrightarrow H_2O$

⇒ **Carbon and hydrogen are estimated by Liebig's combustion method.**

wt of o.c = w gm

wt of $CO_2 = w_1$ gm

wt of $H_2O = w_2$ gm

CO_2

H_2O

12 gm 'c' is present in 44 gm CO_2

$\frac{12}{44}$ " " " " " 1 gm CO_2

$\frac{12 w_1}{44}$ " " " " " w_1 gm CO_2

$$\% H = \frac{2}{18} \times \frac{w_2}{w} \times 100$$

$$\% C = \frac{12}{44} \times \frac{w_1}{w} \times 100$$

C.Q. 16

An organic compound contains 69% carbon and 4.8% hydrogen, the remainder being oxygen. Calculate the masses of carbon dioxide and water produced when 0.20 g of this substance is subjected to complete combustion.

A 0.506g, 0.0864g

B 0.507g, 0.0862g

C 0.0629g, 0.0874g

D 0.834g, 0.0879g

$$\left[69 = \frac{12}{44} \times \frac{w_1}{0.2} \times 100\right]$$

$$\left[4.8 = \frac{2}{18} \times \frac{w_2}{0.2} \times 100\right]$$

Estimation of Halogens

wt of o.c = w gm

- **Carius Method**

w_1 gm AgCl | w_2 gm AgBr | w_3 gm AgI

$$\%\,Cl = \frac{35.5}{143.5} \times \frac{w_1}{w} \times 100$$

$$\%\,Br = \frac{80}{188} \times \frac{w_2}{w} \times 100$$

$$\%\,I = \frac{127}{235} \times \frac{w_3}{w} \times 100$$

C.Q. 17 (JEE Mains 2025, 22 January Shift-1)

In Carius method for estimation of halogens, 180 mg of an organic compound produced 143.5 mg of AgCl. The percentage composition of chlorine in the compound is.....% (Given: molar mass in g mol^{-1} of Ag: 108, Cl: 35.5)

$$\left[\%\,Cl = \frac{35.5}{143.5} \times \frac{143.5}{180} \times 100\right]$$

C.Q. 18 [JEE Mains 2025, 22 January Morning Shift]

The Lassaigne's extract is boiled with dil. HNO_3 before testing for halogens because

A $AgCN$ is soluble in HNO_3

B Silver halides are soluble in HNO_3

C Ag_2S is soluble in HNO_3

D Na_2S and $NaCN$ are decomposed by HNO_3

$Na_2S \downarrow \; H_2S \uparrow$

$NaCN \downarrow \; HCN \uparrow$

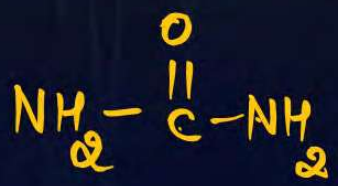
C.Q. 19 (JEE Mains 4th April 2024, Morning Shift)

Which of the following nitrogen containing compound does not give Lassaigne's test?

A Phenyl hydrazine

B Glycene

C Urea



D Hydrazine

C.Q. 20 (JEE Mains 06 April 2023, Shift (I))

Match List-I with List-II.

List-I Element detected	List-II Reagent used/Product formed
A. Nitrogen (III)	(I) $Na_2[Fe(CN)_5NO]$
B. Sulphur (I)	(II) $AgNO_3$
C. Phosphorous (IV)	(III) $Fe_4[Fe(CN_6)]_3$
D. Halogen (II)	(IV) $(NH_4)_2MoO_4$

Choose the correct answer from the options given below:

A (A)-(II), (B)-(IV), (C)-(I), (D)-(III)

B (A)-(IV), (B)-(II), (C)-(I), (D)-(III)

C (A)-(II), (B)-(I), (C)-(IV), (D)-(III)

D (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

Estimation of Sulphur

O.C wt = w gm

- **Carius Method**

w_1 gm $BaSO_4$

$$\% S = \frac{32}{233} \times \frac{w_1}{w} \times 100$$

C.Q. 21 (JEE Mains 2025, 23 January Shift-1)

During "S" estimation, 160 mg of an organic compound gives 466 mg of barium sulphate. The percentage of sulphur in the given compound is _____ %.
(Given molar mass in g mol^{-1} of Ba : 137, S : 32, O : 16)

$$\% S = \frac{32}{233} \times \frac{466}{160} \times 100$$

C.Q. 22 (NCERT Exemplar)

Assertion (A): Sulphur present in an organic compound can be estimated quantitatively by Carius method.

Reason (R): Sulphur is separated easily from other atoms in the molecule and gets precipitated as light yellow solid.

Basoy

A Both A and R are correct and R is the correct explanation of A.

B Both A and R are correct but R is not the correct explanation of A.

C Both A and R are not correct.

D A is not correct but R is correct.

not

Estimation of Phosphorous

- **Carius Method**

w_1 gm $(NH_4)_3PO_4 \cdot 12MoO_3$
w gm O.C

$$\%P = \frac{31}{1877} \times \frac{w_1}{w} \times 100$$

w_1 gm $Mg_2P_2O_7$, wt of O.C = w

$$\%P = \frac{62}{222} \times \frac{w_1}{w} \times 100$$

C.Q. 23

In an organic compound, phosphorus is estimated as:

A $Mg_2P_2O_7$

B $Mg_3(PO_4)_2$

C H_3PO_4

D P_2O_5

Estimation of Nitrogen

⇒ Nitrogen present in organic compound is estimated by

(A) Duma's Method (B) Kjeldahl's Method

H_2SO_4 → NH_4OH → $(NH_4)_2SO_4$ → NaOH

(N_2)

$$\%N = \frac{28}{22400} \times \frac{V_2(mL)}{W} \times 100$$

At STP
$P_2 = 760$ mm Hg
$V_2 = ?$
$T_2 = 273K$

$$\frac{(P-P_1)V_1}{T_1} = \frac{P_2V_2}{T_2}$$

P_1 = aq tension of H_2O
V_1 = Volume in mL
T_1 = Temp K
P = Pressure of moist N_2

$$\%N = \frac{1.4}{W} \times N \times V_{(mL)}$$

Volume of acid

↓

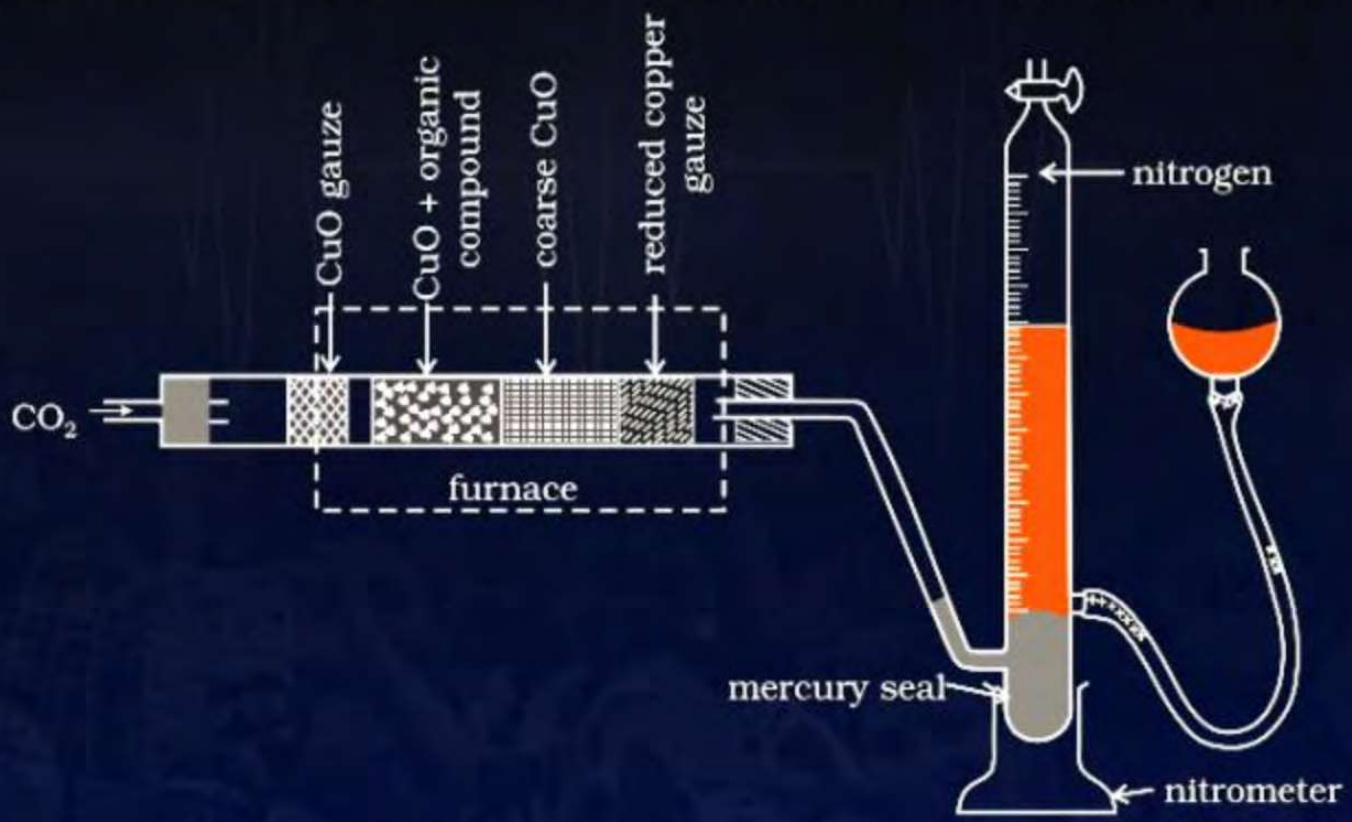
Normality of acid ($M \times n_f$)

A. Duma's Method

- A weighed amount of organic compound is heated with cupric oxide in an atmosphere of carbon dioxide.
- Carbon and hydrogen present in the compound are oxidized to CO_2 and H_2O, while N_2 is set free.
- The mixture of gases produced is collected over caustic potash solution (KOH solution) which absorbs CO_2.
- Nitrogen is collected in the upper part of nitrogen meter.

Duma's Method

$$C_xH_yN_z + (2x+y/2)\,CuO \longrightarrow xCO_2 + y/2\,H_2O + z/2\,N_2 + (2x+y/2)\,Cu$$



C.Q. 24 (JEE Mains 2025, 24 January Shift-1)

Given below are two statements I and II.

Statement I: Dumas method is used for estimation of "Nitrogen" in an organic compound.

Statement II: Dumas method involves the formation of ammonium sulphate by heating the organic compound with cone H_2SO_4.

In the light of the above statements, choose the correct answer from the options given below

A Statement I is false but Statement II is true.

B Statement I is true but Statement II is false

C Both Statement I and Statement II are false.

D Both Statement I and Statement II are true.

C.Q. 25 [NEET 2015]

In Duma's method for estimation of nitrogen, 0.25 g of an organic compound gave 40 mL of nitrogen collected at 300 K temperature and 725 mm pressure. If the aqueous tension at 300 K is 25 mm, the percentage of nitrogen in the compound is:

A 18.20

B 16.76

C 15.76

D 17.36

V_1 T_1 P P_1 W

$$\frac{(P-P_1)V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{(725-25)40}{300} = \frac{760 \times V_2(mL)}{273}$$

$V_2 = ?$

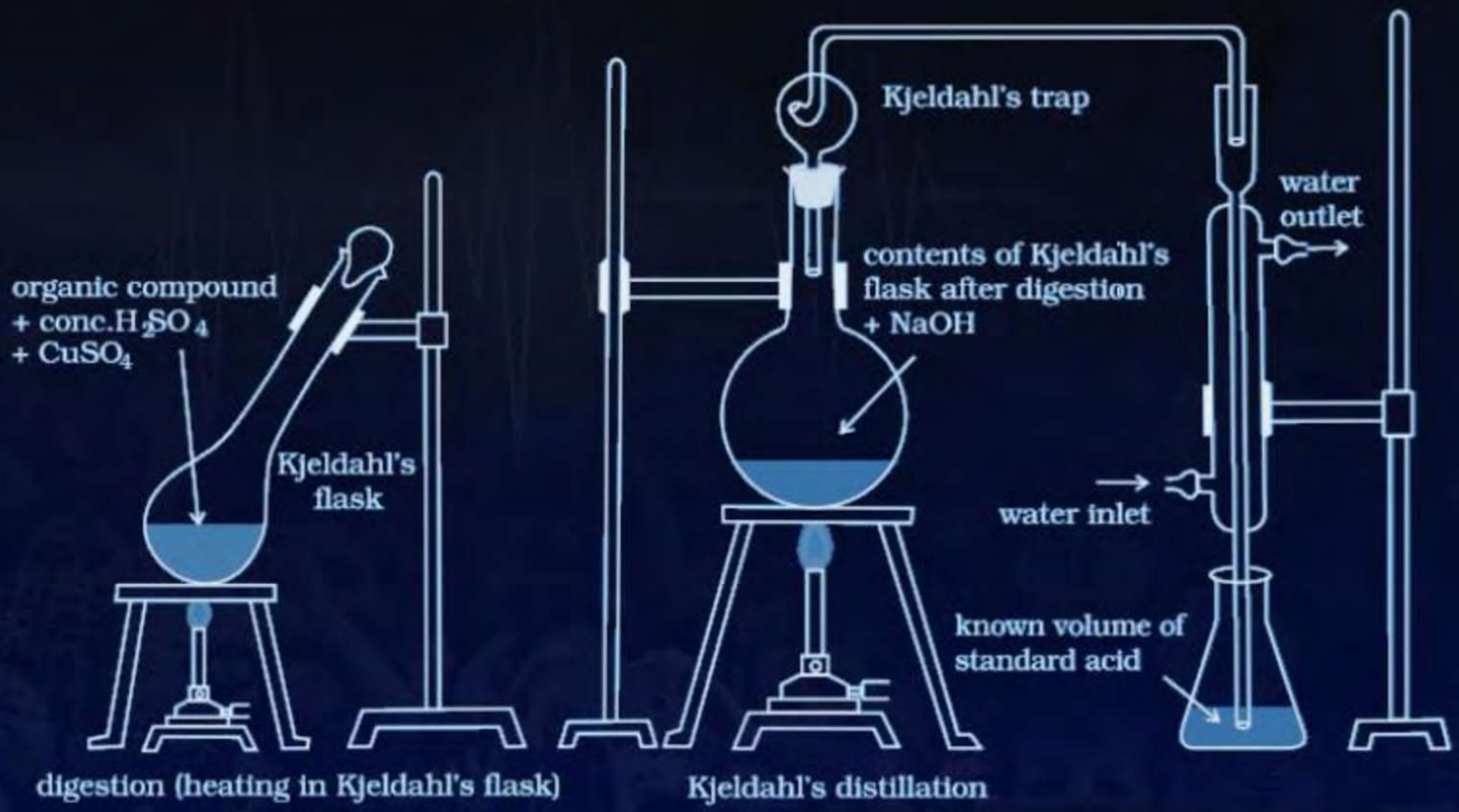
$$\%N = \frac{28}{22400} \times \frac{V_2(mL)}{W} \times 100$$

$$= \frac{28}{224} \times \frac{\quad}{0.25}$$

B. Kjeldahl's Method

- In this method nitrogen present in the organic compound is converted into ammonia (NH_3).
- Kjeldahl's method is not applicable to compounds containing nitro ($-NO_2$), Nitroso (NO), azo group (–N = N–), azoxy compound $\begin{pmatrix} O \\ \uparrow \\ -N = N - \end{pmatrix}$ and nitrogen present in the ring (pyridine, quinoline) because nitrogen present in these compound is not quantitatively converted into ammonium sulphate.

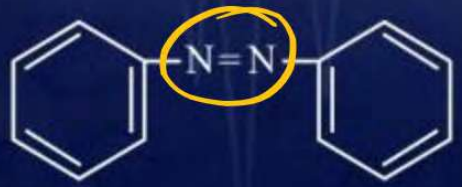
Kjeldahl's Method



C.Q. 26 (NEET 2022)

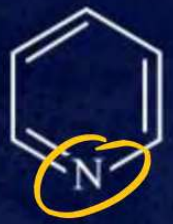
The Kjeldahl's method for the estimation of nitrogen can be used to estimate the amount of nitrogen in which one of the following compounds?

A



B

C



D

C.Q. 27 [NEET 2014]

In the Kjeldahl's method for estimation of nitrogen present in a soil sample, ammonia evolved from 0.75 g of sample neutralized 10 mL of 1 M H_2SO_4. The percentage of nitrogen in the soil is:

$N = 1 \times 2 = 2$

$\therefore \% N = \frac{1.4}{0.75} \times 2 \times 10$

A 45.33

B 35.33

C 43.33

D 37.33

C.Q. 28 (JEE Mains 1st Feb 2024, Morning Shift)

In Kjeldahl's method for estimation of nitrogen, $CuSO_4$ acts as:

A Reducing agent

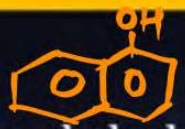
B Catalytic agent

C Hydrolysis agent

D Oxidising agent

Tests of Biomolecules

Test of Carbohydrates



1. Molisch Test:

5% solution of α-naphthol + EtOH

↓ Carbohydrate

Purple ring at the junction of two liquid

MONO → FAST

Di or Poly → SLOW

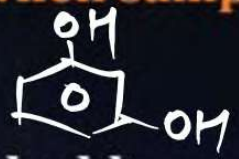
2. Seliwanoff's Test (for ketose):

(Fructose)

5 hydroxymethyl furfural

- This test is to be performed when sample gives positive test for Benedict's or Fehling's test.

Resorcinol



- Take Seliwanoff's reagent and add sample.
- Boil for two minutes. Appearance of red to orange colour indicates the presence of fructose.
- If no colour appears in 2 minutes, continue boiling for 5 minutes.
- If faint orange or no colour appears, then it indicated the presence of glucose.

3. Barfoed Test (for mono and Disaccharides):

$CuSO_4 + CH_3COOH$

↓ Mono Saccharides

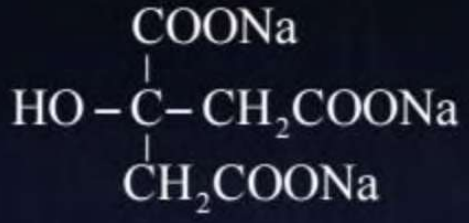
Red ppt

$(Cu^{2+} \rightarrow Cu_2O\downarrow)$

Red

4. Benedict's test (for Reducing sugar):

Aq. $\overset{+2}{Cu}SO_4$ + sodium citrate



$Cu^{2+} \longrightarrow \overset{+1}{Cu_2O}$

Red ppt

$-CHO \longrightarrow -COO^-$

5. Tollen's Test (for reducing sugar):

T. R. → $AgNO_3 + NH_4OH$

$-CHO \rightarrow -COO^-$

$Ag^+ \rightarrow Ag\downarrow$

Silver ppt

6. Fehling Test (for reducing sugar):

+2

Aq. $CuSO_4$ + NaKT (Rochelle's salt)

COONa
|
CHOH
|
CHOH
|
COOK

Sodium potassium tartarate

$-CHO \rightarrow COO^-$

$Cu^{2+} \rightarrow Cu_2O\downarrow$

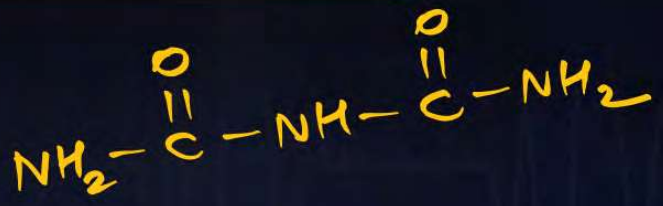
Red ppt

7. Iodine Test (for starch):

Starch $\xrightarrow{I_2}$ Black Colouration due to adsorption of iodine.

Test of Amino acids

Tests of Proteins:



(A) Biuret test:

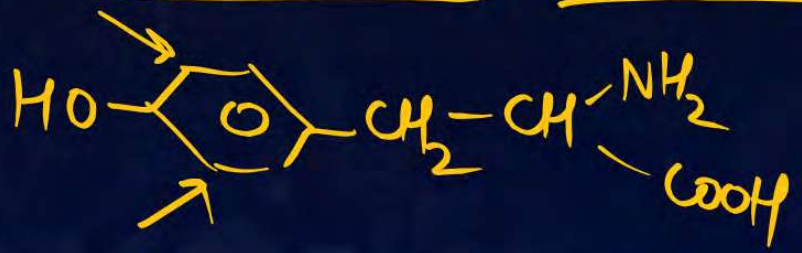
- Take protein solution in a test tube.
- Add NaOH solution and 1 or 2 drops of $CuSO_4$ solution.
- A violet colour indicates the presence of proteins.
- Biuret test is for peptide bond in the molecule of a protein.

Care must be taken that excess of copper sulphate is not added otherwise there will be blue colour instead of violet colour.

(B) Xanthoproteic test: Aromatic amino acid

- Add concentrated HNO_3 to protein solution.
- A white precipitate is formed.
- Boil the solution and the colour changes to yellow.
- Cool the test tube and add NaOH (or ammonia solution) to make it alkaline.
- The colour changes to orange indicating the presence of proteins.
- Xanthoproteic test is specific for protein containing aromatic amino acids. The benzene ring in the amino acids is nitrated by heating with nitric acid and forms yellow nitro-compounds which turns to orange colour with alkali.

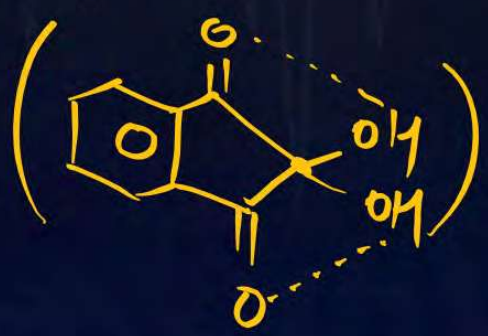
(white → yellow → orange)



(C) Ninhydrin test:

- This test is given by all proteins.
- When protein is boiled with a dilute solution of ninhydrin, a violet colour is produced called Ruhemann's Purple.
- In case of Proline Yellow Orange Colour is produced.

(2° amino group)



(D) Millon's Test:

Protein solution + Millon's reagent → pink colour

Millon's reagent is solution of mercuric nitrate and nitrite in nitric acid containing traces of nitrous acid.

$Hg(NO_3)_2 + Hg(NO_2)_2$ $HNO_3 + HNO_2$

C.Q. 29 (JEE Mains 5th April 2024, Morning Shift)

Amino acid or protein

Which of the following gives a positive test with ninhydrin?

A Cellulose

B Starch

C Polyvinyl chloride

D Egg albumin ✓

C.Q. 30 (JEE Mains 27th January 2024, Evening Shift)

Phenolic group can be identified by a positive:

A Phthalein dye test ✓ # Phenol

B Lucas test (Conc HCl, Anhy $ZnCl_2$) Alcohol $1^\circ, 2^\circ, 3^\circ$ — No min sec

C Tollen's test — Ald ✓ Ket ×, Reducing sugar

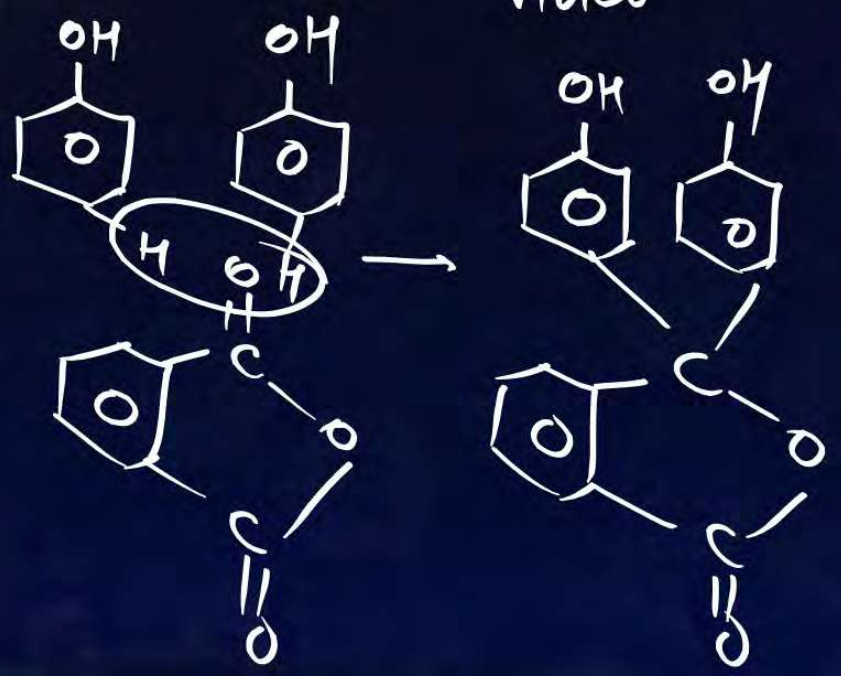
D Carbylamine test

Ali & Aro 1° amine

$R-NH_2 \rightarrow R-NC$ (Bad smell / foul smell)

1) $FeCl_3 + 6PhOH \longrightarrow [Fe(OPh)_6]^{3-}$ (Violet)

$3HCl + 3H^+ +$



2)

C.Q. 31 [30 Jan, JEE Mains 2023(Shift-1)]

Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Ketoses give Seliwanoff's test faster than aldoses.

Reason (R): Ketoses undergo β-elimination followed by formation of furfural.

In the light of the above statements, choose the correct answer from the options given below:

A (A) is false but (R) is true.

B Both (A) and (R) are true and (R) is the correct explanation of (A).

C (A) is true but (R) is false.

D Both (A) and (R) are true but (R) is not the correct explanation of (A).

C.Q. 32 [11 April, JEE Mains 2023 (Shift-II)]

Number of Compounds from the following which will not produce orange red precipitate with Benedict solution is 2.

Glucose, maltose, sucrose, ribose, 2-deoxyribose, amylose, lactose.

X X ✓ X X ✓ X

C.Q. 33 [27 July, JEE Mains 2021 (Shift-I)]

Which one among the following chemical tests is used to distinguish monosaccharide from disaccharide?

A Seliwanoff's test

B Iodine test

C Barfoed test

D Tollen's test

C.Q. 34

Iodine test is shown by:

A polypeptide

B glycogen

C starch

D glucose

C.Q. 35

Which of the following compounds can be detected by Molisch's test?

A Nitro compounds

B Sugars

C Amines

D Primary alcohols

C.Q. 36

Molisch's test reagent is:

A 5 % solution of α-Naphthol in alcohol and few droplets of conc. H_2SO_4

B 1% of ß-Naphthol in alcohol

C Both (A) and (B)

D None of these

C.Q. 37

Which is the chemical test for polysaccharide?

Starch

A Iodine solution

B Ninhydrin test

C Tollen's test

D Benedict solution

C.Q. 38

Protein gives blue colour with

A Benedict reagent Cu_2O Red

B Iodine solution starch Black

C Ninhydrin Ruhemann's purple

D Biuret Violet

C.Q. 39

Biuret test is used for

A Proteins

B Fats

C Sugar

D None of these

C.Q. 40

In iodine test of starch which colour of ppt had been observed?

A blue

B black

C red

D white

Test of Alcohol

① Lucas Test — Lucas reagent: conc HCl + anhy $ZnCl_2$

1°, 2°, 3°	
NO	min sec

② V·M·T (Victor meyer Test)

$$R-CH_2-OH \xrightarrow{Red\,P+I_2} R-CH_2-I \xrightarrow{AgNO_2} R-CH_2-ONO \xrightarrow{HNO_2} \underset{\underset{R-C-NO_2}{\|}}{N-OH}$$

nitrolic acid

$$\xrightarrow{aq\,NaOH} \text{Salt (red)}$$

$$R-\underset{R}{\overset{R}{\underset{|}{\overset{|}{C}}}}-OH \xrightarrow{\quad} R-\underset{R}{\overset{R}{\underset{|}{\overset{|}{C}}}}-I \xrightarrow{\quad} R-\underset{R}{\overset{R}{\underset{|}{\overset{|}{C}}}}-NO_2$$

Colourless

$$\xrightarrow{HONO} R-\underset{R'}{\overset{NO}{\underset{|}{\overset{|}{C}}}}-NO_2$$

Blue Pseudonitrole

3) CAN (Cerric ammonium nitrate)

$$2ROH + (NH_4)_2[Ce(NO_3)_6] \downarrow$$

$$(NH_4)_2[Ce(NO_3)_4(ROH)_2]$$

Red or pin

R	B	C
1°	2°	3°

Practical Organic Chemistry
Practice Problems

QUESTION-1

The complex formed when sodium nitroprusside is added to alkaline Na_2S solution is:

violet

A $Na_4[Fe(CN)_5NOS]$

B $Na_4[Fe(CN)_5NO_2]$

C $[Fe(H_2O)_5(NO)]SO_4$

D $Na_4[Fe(CN)_5S_2]$

QUESTION-2

Organic compound is fused with metallic sodium for testing nitrogen, sulphur and halogens:

A To make the solution alkaline.

B To convert into elemental state of nitrogen, sulphur and halogens.

C To convert covalent compound into ionic compound.

D To decrease fusion temperature

QUESTION-3

Method used to purify liquids having very high boiling points and those which decompose at or below their boiling points is:

A Chromatography

B Crystallisation

C Distillation under reduced pressure

D Sublimation

QUESTION-4

The process where a solid substance changes to vapour state without passing through the liquid state is called as;

A Sublimation

B Crystallization

C Differential extraction

D Distillation

QUESTION-5

Match List I with List II:

List-I (Mixture or Compound)		List-II (Separation Technique)	
A.	Two solids which have different solubilities in a solvent and which do not undergo a reaction when dissolved in it. (III)	I.	Fractional distillation
B.	Different degree of adsorption of compound on adsorbent (IV)	II.	Steam distillation
C.	Steam volatile liquid (II)	III.	Crystallisation
D.	Two liquids that have boiling points close to each other (I)	IV.	Chromatography

Choose the correct answer from the options given below:

A A-III, B-I, C-II, D-IV

B A-III, B-II, C-IV, D-I

C A-II, B-I, C-III, D-IV

D A-III, B-IV, C-II, D-I

QUESTION-6

In qualitative test for identification of presence of phosphorous, the compound is heated with an oxidizing agent, which is further treated with nitric acid and ammonium molybdate respectively. The colour of the precipitate obtained is:

A Canary yellow

B Red

C Black

D Green

QUESTION-7

Consider the following reaction:
$3NaSCN + FeCl_3 \rightarrow X + 3NaCl$
Compound 'X' and its colour is:

A $Fe(SCN)_2$ and blue

B $Fe(SCN)_3$ and blood red

C $Fe(CN)_2$ and green

D $Fe(CN)_3$ and blood red

QUESTION-8

Given below are two statements:

Statements-I: Glycerol can be separated from spent-lye in soap industry using distillation under reduced pressure.

Statements-II: Crude oil in petroleum industry is separated using fractional distillation.

In the light of the above statements, choose the correct answer from the options given below:

A Statement I is incorrect, but Statement II is correct.

B Statement I is correct, but Statement II is incorrect.

C Both Statement I and Statement II are correct.

D Both Statement I and Statement II are incorrect.

QUESTION-9

The correct expression to calculate percentage of carbon in organic compound is:

A $\frac{\text{mass of } CO_2 \text{ formed}}{\text{mass of compound}} \times 100$

B $\frac{12}{44} \times \frac{\text{mass of } CO_2 \text{ formed}}{\text{mass of compound}} \times 100$

C $12 \times \text{mass of } CO_2 \text{ formed} \times \text{mass of compound}$

D $\frac{44}{12} \times \frac{\text{mass of } CO_2 \text{ formed}}{\text{mass of compound}} \times 100$

QUESTION-10

Aniline is separated from aniline water mixture by;

A steam distillation

B simple distillation

C fractional distillation

D extraction with a solvent

QUESTION-11

The best method for the separation of naphthalene and benzoic acid from their mixture is:

A distillation

B sublimation

C chromatography

D crystallisation

QUESTION-12

An organic compound from aqueous layer can be separated by:

A distillation

B steam distillation

C fractional distillation

D extraction with organic solvent ✓ Differen extrac.

QUESTION-13

Victor Meyer test is used to detect:

A Aldehydes

B Ketones

C Carboxylic acids

D Alcohols ✓

R B C
1° 2° 3°

QUESTION-14

A compound 'X' gave violet color on addition of $FeCl_3$. The compound X is:

A Phenol

B Benzoic acid

C Benzaldehyde

D Benzene

QUESTION-15

Match List I with List II:

List-I		List-II	
A.	Duma's method (III)	I.	$AgNO_3$
B.	Kjeldahl's method (IV)	II.	silica gel
C.	Carius method (I)	III.	nitrogen gas
D.	Chromatography (II)	IV.	ammonium sulphate

Choose the correct answer from the options given below:

A A-III, B-I, C-II, D-IV

B A-I, B-II, C-III, D-IV

C A-I, B-IV, C-III, D-II

D A-III, B-IV, C-I, D-II

QUESTION-16

Two substances when separated out on the basis of their extent of adsorption by one material, the phenomenon is known as:

A chromatography

B filtration

C sublimation

D steam distillation

QUESTION-17

$>C=O + H_2NR \rightarrow >C=NR$ (Schiff's Base, magenta)

The reagent prepared by decolorizing aqueous solution of p-rosaniline hydrochloride dye by adding sodium sulphite is:

A. Schiff's reagent ✓

B. Tollen's reagent

C. Fehling reagent

D. Cerric ammonium nitrate

P-Rosani + Na_2SO_3 → (magenta) colourless

colourless —Acid→ magenta restore

Schiff's Test

Acid ✓

Ket ×

QUESTION-18

Purple color obtained on addition of Molisch reagent confirms the presence of:

A Formaldehyde

B Benzene

C Glucose

D Benzoic acid

QUESTION-19

In Carius method of estimation of halogens, 250 mg of an organic compound gave 141 mg of AgBr. The percentage of bromine in the compound is (Atomic mass Ag = 108 amu; Br = 80 amu)

A 48%

B 60%

C 24%

D 36%

$$\left[\%\,Br = \frac{80}{188} \times \frac{141}{250} \times 100\right]$$

QUESTION-20

The percentage of sulphur in the organic compound, when 0.2595 g of a sulphur containing organic compound in a quantitative analysis by Carius method yielded 0.35 g of barium sulphate is:

A 14.52%

B 18.52%

C 16.52%

D 19.52%

$$\%\,S = \frac{32}{233} \times \frac{0.35}{0.2595} \times 100$$