

Chapter -12

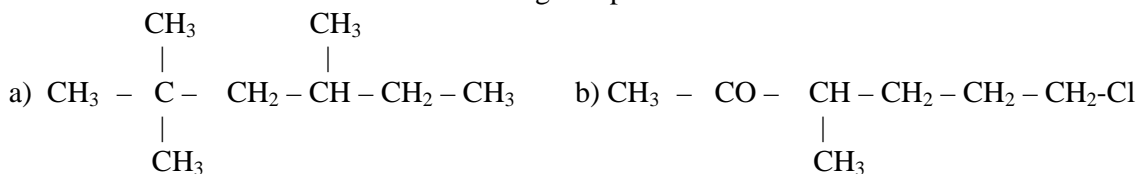
Organic Chemistry-Some Basic Principles and Technique

One Mark questions

1. What is the type of hybridization of each carbon in the following.
a) CH_3CHO b) CH_3CN c) $\text{CH}_2 = \text{CHCl}$ d) $\text{CH}_3\text{-C}\equiv\text{CH}$
2. Give the bond line format of the compound 2-methyl-1-pentene
3. What is a functional group?
4. Write the IUPAC name of the compound $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CHO}$
5. Write the structural formula of 4-chloro-2-hexene.
6. What is Inductive effect?
7. What is +I effect?
8. What is -I effect?
9. Give an example of a groups which exerts -I effect.
10. Give an example of a groups which exerts +I effect
11. Define mesomeric (Resonance) effect.
12. What is +R effect?
13. What is -R(-M) effect?
14. Give an example of a groups which exerts +R(+M) effect.
15. Give an example of a group which exerts -R(-M) effect
16. What is electromeric effect?
17. What is +E effect ? Give example
18. What is - E effect? Give example
19. What is homologous series?
20. During estimation of nitrogen by kjeldahl's method, copper sulphate is added to sulphuric acid. Why?
21. Name two classes of compounds in which kjeldahl's method cannot be used for estimation of nitrogen.
22. Which type of 'E' effect operates during the attack of proton on ethene molecule?
23. What is the formula of Ferric ferrocyanide?
24. Which is the suitable absorbent in the process of Column chromatography?
25. Write the resonance structure of Benzene
26. Why is fusion of organic compound with sodium required?
27. What is steam distillation?
28. What is hyperconjugation?
29. Which gas is liberated in kjeldahl's method?
30. Which gas is liberated in Dumas method?
31. What type of solids are separated by fractional crystallization?
32. Name the compound which is formed during carius method for the estimation of phosphorous.
33. Name the process used to separate sugar & salt.
34. Which effect involves the displacement of electron pair under the influence of an attacking reagent

TWO MARKS QUESTIONS

1. How nitrogen is detected by lassaigne's filterate?
2. How sulphur is detected by lassaigne's filterate?
3. How can carbon & hydrogen detected by copper oxide method?
4. Give the preparation of Lanaigne's filterate.
5. Explain the test for detection of halogen's by sodium fusion extract.
6. What is Resonance energy? Mention the resonance energy of Benzene.
7. Explain the test for the detection of phosphorous in an organic compound.
8. Give the difference between Inductive effect & Mesomeric effect
9. Give the difference between Inductive effect & Electromeric effect
10. What are the characteristics of Homologous series?
11. What is Electrophile? Give example
12. What are nucleophiles? Give example.
13. What is Homolytic fission? Give example
14. What is Heterolytic fission? Give example
15. What are free radical? Give example?
16. What are Carbocations? Give example
17. What are Carbanions? Give example?
18. What are Alicyclic compounds? Give example?
19. What are aromatic compounds? Give example?
20. What are Heterocyclic compounds? Give example?
21. Why is nitric acid added to sodium extraction before adding silver nitrate for testing halogens?
22. Write the IUPAC names of the following compounds



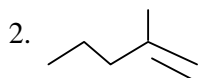
23. Write the structural formulae of the following
 - a) 2, 2, 3-trimethyl pentane
 - b) 4-chloro-3-methyl-but-2-en-1-ol
24. What is a Functional group? Give example.
25. What is position isomerism? Give an example.
26. What is Functional isomerism? Give example.
27. What is substitution reaction? Give example.
28. What is addition reaction? Give example.
29. What are hybridization states of each carbon atom in the following compounds?
 - a) $\text{CH}_2 = \text{C} = \text{O}$
 - b) $\text{CH}_3 - \text{CH} = \text{CH}_2$

FIVE MARKS QUESTIONS

1. How can carbon and hydrogen be estimated in the organic compound by Liebig's process?
2. How is the percentage of nitrogen determined in an organic compound by kjeldahl's process?
3. How is the estimation of Nitrogen in organic compound by Dumas method.
4. How is the estimation of halogens by Carius method?

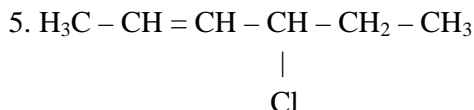
ANSWERS TO ONE MARK QUESTIONS

1. a) sp^3sp^2 b) sp^3sp c) sp^2sp^2 d) $sp^3sp\ sp$



3. Functional group may be defined as an atom (or) group of atoms which determine the properties of an organic compound.

4. 1 –Pentanal



6. The polarization of one σ bond caused by polarization. of adjacent σ bond due to difference in electronegativity.

7. Partial displacement of sigma bond pair of electrons away from the substituent is called +I effect.

8. Partial displacement of σ bond pair of electrons towards substituent is called -I effect.

9. NO_2 , - CN, -F, -COOH, -Cl, -Br, -I, -OCH₃ etc. are electron withdrawing groups

10. Alkyl groups like methyl (-CH₃) & ethyl (-CH₂ - CH₃) are usually considered as electron donating groups.

11. The permanent polarity is produced by the interaction of lone pair & Pi electrons in conjugate system of an organic molecule.

12. Shifting of electron pair away from substituent in a conjugate system.

13. Shifting of electron pair towards the substituent in a conjugate system.

14. -Cl, -Br, -I, -NH₂, -NHR, -OH, -OR, -SH, -OCH₃ etc.

15. -NO₂, -CN, -CHO, - COOH, - COOR etc.

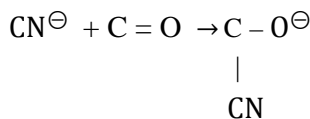
16. It is the complete transfer of Pi – electrons of a multiple bond to one of the atom in the presence of attacking reagent.

17. When the transfer of electrons take place towards the attacking reagent, the effect is called +E effect attacking reagent, the effect is called +effect

Ex. Addition of H^+ to ethene, $H^+ + CH_2 = CH_2 \rightarrow CH_3 - CH_2$

18. When the transfer of electron takes place away from the attacking reagent, the effect is called –effect.

Ex. The addition of cyanide ion (CN^-) to carbonyl group



19. A series of organic compounds which can be represented by a general formula is called Homologous series.

20. Copper sulphate acts as catalyst

21. Nitro compounds, Azo compounds & compounds containing nitrogen in ring

Ex. Pyridine.

22. +E effect.

23. $\text{Fe}_2 [\text{Fe}(\text{CN})_6]_3$

24. Al_2O_3 (alumina)

25.



26. It is done so as to convert organic compound into inorganic compound

27. The method used to separate organic compounds from non-volatile organic or inorganic impurities by distillation with steam.

28. It is due to overlapping of σ - bonding orbital with adjacent π -orbital or p-orbital. It is also known as “no bond resonance” or “Baker-Nathan effect”.

29. Ammonia gas.

30. Nitrogen gas

31. Those solids which are soluble in same solvent but to different extent i.e. differ in their solubility.

32. $\text{Mg}(\text{NH}_4)\text{PO}_4$ which on heating gives $\text{Mg}_2\text{P}_2\text{O}_7$ (Magnesium pyrophosphate)

33. Fractional crystallization using ethanol as a solvent.

34. Electromeric effect

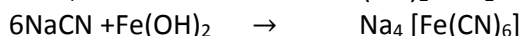
ANSWERS TO TWO MARKS QUESTIONS

1. Ans: Freshly prepared ferrous sulphate solution is added to small portion of SFE & warmed. Then about 2 to 3 drops of FeCl_3 solution are added & acidified with concentrated HCl . The appearance of a prussian blue colour indicates the presence of nitrogen.

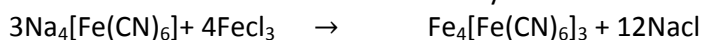
Fuse



Organic compound

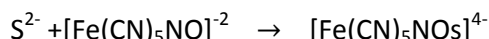


Sodium Ferrocyanide.



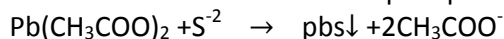
Ferric ferrocyanide(Prussian blue)

2. Ans: a) Lead Acetate:- Few drops of sodiumnitropruside is added to SFE. The appearance of a deep violet colour indicates the presence of Sulphur



Nitropruside ion violet colour

- b) Sulphur can also be detected by adding lead acetate to SFE, acidified with acetic acid. The formation of a black precipitate(pbs) indicates the presence of sulphur.



3. Ans: Carbon & hydrogen present in an organic compound can be detected together by copper oxide method.

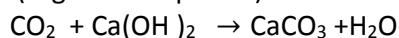
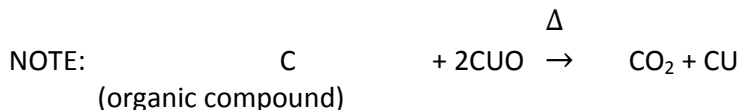
The compound is mixed with dry cupric oxide & is taken in a hard glass test tube.

The hard glass test tube is fitted to one end of delivery tube containing bulb (containing anhydrous CuSO_4) & other end of the delivery tube is dipped in a test tube container lime water.

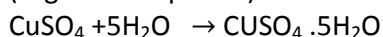
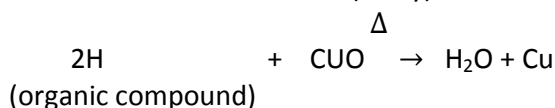
The mixture is strongly heated.

Carbon present in compound is oxidized to CO_2 & turns lime water milky.

Hydrogen present in compound is oxidized to water & turns white anhydrous CuSO_4 to blue hydrated salt.



Lime water (milky)



White blue

4. Ans: A piece of dry sodium is taken into a fusion tube & heated till it melts. A drop of few crystals of the organic compound is added to the fusion tube. The mixture is heated gently & strongly until the tube become red hot & plunged (added) into a mortar

containing distilled water. The contents are crushed & filtered. The filtrate is known as sodium fusion extract.

5. Ans: Silver nitrate test:- A small portion of SFE is boiled with dil HNO_3 , cooled & silver nitrate is added. A white precipitate soluble in ammonium hydroxide, shows the presence of chlorine.

A pale yellow precipitate slightly soluble in ammonium hydroxide insoluble in ammonium hydroxide shows the presence of bromine & yellow precipitate insoluble in ammonium hydroxide shows the presence of iodine

Note: $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{AgCl} \downarrow + \text{NaNO}_3$

White

$\text{NaBr} + \text{AgNO}_3 \rightarrow \text{AgBr} \downarrow + \text{NaNO}_3$

Pale yellow

$\text{NaI} + \text{AgNO}_3 \rightarrow \text{AgI} \downarrow + \text{NaNO}_3$

Yellow

6. Ans: The energy difference between canonical structure & Resonance hybrid is known as Resonance energy. The Resonance energy of benzene is 36 k calories or 150 kJ/mol

7. Ans: Organic compound containing phosphorous is fused with sodium peroxide. The phosphorous present in the organic compound is oxidised to phosphate. The fused mass is extracted with water & filtrate. The filtrate containing sodium phosphate is boiled with nitric acid & then treated with ammonium molybdate. A yellow solution of precipitate indicates the presence of phosphorous.

8. Ans: Inductive effect

Mesomeric effect

1) It operates in saturated compound

1) It operates in conjugated double bond system

2) It involves displacement of sigma electrons

2) It involves displacement of pi electrons

3) It lasts only for a short distance

3) It lasts over long distance

4) Partial charges are developed

4) Complete +ve & -ve charges are developed

9. Ans: Inductive effect

Electromeric effect

1) It involves partial displacement of sigma electrons

1) Involves complete transfer of pi electrons

2) Permanent effect

2) Temporary effect

3) Presence of attacking reagent is not required

3) Attacking reagent is required

4) Partial charges are developed on atoms

4) Complete charge separation takes place

10. Ans: 1) All the members can be represented by a general formula

2) Every successive members of the series differ by $-\text{CH}_2$ group.

3) All the members can be prepared by similar methods

4) All the members will have similar chemical properties

11. Ans: The electron deficient species or positively charged ions which are capable of accepting an electron from substrate molecule are called electrophiles.

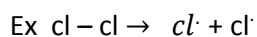
Ex: Positive electrophiles: H^+ , Cl^+ , Br^+ , NO_2 etc.

Neutral electrophiles: SO_3 , BF_3 , AlCl_3 etc.

12. Ans: the a negatively charged ions which are capable of donating an electron pair

Eg. Cl^- , Br^- , OH^- etc

13. Ans: Symmetrical breaking of a covalent bond, in which each of the two species contain one electron of shared electron pair is called homolytic fission or homolysis.

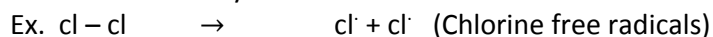


Chlorine free radicals

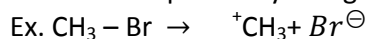
14. Ans: Un symmetrical breaking of a covalent bond, in which one the species carry bonded electron pair is called heterolytic fission or heterolysis.

15. Ans: Free radicals can be defined as an atom or group of atoms having an unpaired electron.

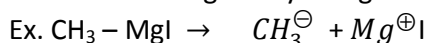
homolysis



16. Ans: A reaction intermediate formed by heterolytic fission of a covalent bond which contains one positively charged carbon is called carbocation.



17. Ans: A reaction intermediate formed by heterolytic fission of a covalent bond which contains one negatively charged carbon is called carbonion.



18. Ans: These are saturated hydrocarbons joined by covalent bond to form ring structure.



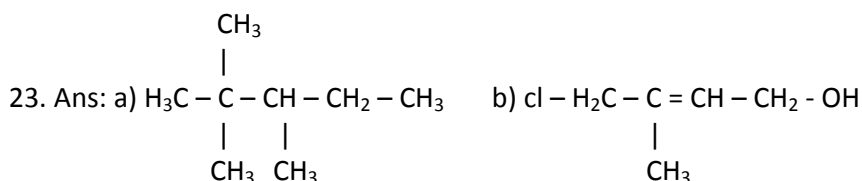
19. Ans: These are the compounds containing one benzene ring

Ex. Benzene, Napthalene etc.

20. Ans: These are the compounds containing ring structure in which one or more carbon atoms are replaced by hetero atoms such as N, S, O etc.

21. Ans: It is done so as to decompose NaCN to HCN & Na_2S to H_2S

22. Ans: a) 2,2,4-trimethylhexane b) 6-chloro-3-methyl - 2 hexanone

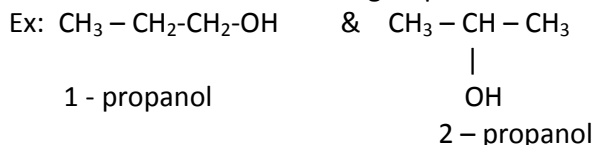


24. Ans: A functional group is an atom or group of atoms present in a molecule which determines the properties of the organic compounds.

Ex: $\text{C}_2\text{H}_5 - \text{OH}$, $-\text{OH}$ is F.G present in ethyl alcohol

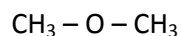
CH_3COOH , $-\text{COOH}$ is F.G. present in Acetic acid.

25. Ans: Two or more compounds having same molecular formula but differ in position of the same functional group

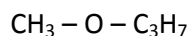


26. Ans: Two or more compounds having same molecular formula but differ in the functional group

Ex. Alcohol and ether



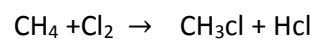
Dimethyl ether



methyl propyl ether.

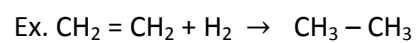
27. Ans: The reaction in which one group replaces another.

Uv



28. Ans: The reaction in which the reagent adds up to the substrate molecule without elimination of any molecule is called addition reaction

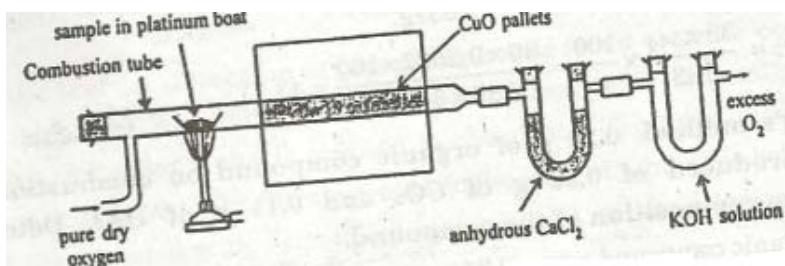
Ni



29. Ans: sp^2 , sp^2 sp^3 , sp^2 , sp^2

ANSWERS TO FIVE MARKS QUESTIONS

1. Ans: Principle : A known mass of Organic substance is heated with excess oxygen. The Carbon and Hydrogen present in the substance are oxidized to Carbon dioxide and water. The masses of CO_2 and H_2O are determined. From which the percentage of Carbon and Hydrogen can be determined.



Method:

1. The apparatus is arranged as shown in the diagram.
2. It contains a combustion tube connected to a 'U' shaped tube containing anhydrous calcium chloride and a glass bottle containing Potassium hydroxide solution in series [Which is then connected to guard tube containing anhydrous Calcium chloride to avoid the entry of moisture and CO_2 into the apparatus.]
3. A known mass of organic compound is mixed with cupric oxide and placed in the combustion tube which is heated strongly.
4. Carbon present in organic compound is oxidized to carbon dioxide and absorbed in potassium hydroxide solution.
5. Hydrogen present in the organic compound is oxidized to water and absorbed in anhydrous calcium chloride.
6. The 'U' tube and glass bottle are weighted before and after the experiment.

Calculation:

I. Estimation of hydrogen :

- a) Mass of organic compound = W g
- b) Mass of 'U' tube before experiment = m_1 g.
- c) Mass of 'U' tube after experiment = m_2 g
- d) Increase in mass of CaCl_2 = Mass of water = $(m_2 - m_1)$ g
- e) 18 grams of water contains 2 grams of hydrogen
 $(m_2 - m_1)$ g of water contains $\rightarrow \frac{2 \times (m_2 - m_1) \text{g}}{18}$
 $= 0.1111(m_2 - m_1)$ grams
- f) W grams of organic compound contains $0.1111(m_2 - m_1)$ g of hydrogen
 100 grams of organic compound contains $\rightarrow \frac{0.1111 (m_2 - m_1) \times 100}{W}$
 \therefore percentage of hydrogen = $\frac{11.11 (m_2 - m_1)}{W}$

II. Estimation of Carbon:

- a) Mass of organic Compound = W g
- b) Mass of glass bottle before experiment = m_1 g
- c) Mass of glass bottle after experiment = m_2 g
- d) Increase in mass of KOH = Mass CO_2 = $(m_2 - m_1)$ grams.
- e) 44g of CO_2 contains 12g of Carbon.
 $(m_2 - m_1)$ g of CO_2 contains = $\frac{12 \times (m_2 - m_1)}{44}$ g of carbon

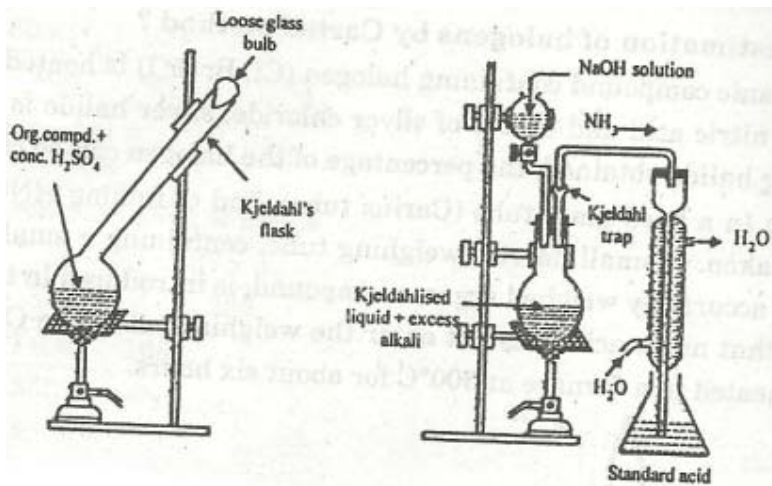
$$= 0.2727(m_2 - m_1) \text{ g of carbon}$$

f) W grams of organic compound contains $0.2727(m_2 - m_1)$ grams of carbon

$$100 \text{ grams of organic compound contains } \rightarrow \frac{0.2727 (m_2 - m_1) \times 100}{W}$$

$$\therefore \text{percentage of Carbon} = \frac{27.27 (m_2 - m_1)}{W}$$

2. Ans: Principle: A known mass of organic compound is heated with concentrated sulphuric acid. Nitrogen is converted into ammonium sulphate. Which is treated with sodium hydroxide solution to liberate ammonia. This ammonia is absorbed in excess of standard sulphuric acid. The unreacted acid is estimated by titration with standard alkali. From which the amount of ammonia is determined and the percentage of nitrogen in the compound is calculated.



Method: A known mass of organic compound is taken in a Kjeldahl's flask concentrated sulphuric acid, anhydrous potassium sulphate and copper sulphate are added (K_2SO_4 rises the boiling point and $CuSO_4$ acts as catalyst). The flask is heated, so that all Nitrogen is converted into ammonium sulphate. The flask is cooled and the contents are diluted with distilled water. This mixture is taken in a round bottomed flask and sodium hydroxide solution is added. The flask is fitted to one end of water condenser and the other end of condenser is placed in a flask containing a known volume of standard sulphuric acid. The flask is heated. Ammonia gas liberated is absorbed in sulphuric acid solution. The excess acid left is determined by titrating against standard NaOH using phenolphthalein indicator.

Calculation:

$$\begin{aligned} \text{Weight of organic substance} &= W \text{ g} \\ \text{Volume of standard acid taken} &= V_1 \text{ cm}^3 \\ \text{Volume of standard acid left over} &= V_2 \text{ cm}^3 \\ \text{Volume of standard acid} &= (V_1 - V_2) \text{ cm}^3 = V \text{ cm}^3 \\ \text{Neutralised with ammonia} &= (V_1 - V_2) \text{ cm}^3 = V \text{ cm}^3 \\ \text{Now, } V \text{ cm}^3 \text{ of N acid} &= V \text{ cm}^3 \text{ of N ammonia.} \\ 1000 \text{ cm}^3 \text{ of 1 N ammonia} &\text{ contains } 17 \text{ g of } NH_3 = 14 \text{ g of nitrogen} \end{aligned}$$

$$\begin{aligned} V \text{ cm}^3 \text{ of N ammonia} &= \frac{14 \times V \times N}{1000} \text{ g of nitrogen} \\ &= 'a' \text{ grams (say)} \end{aligned}$$

i.e., Wg of organic compound contains 'a' grams of nitrogen

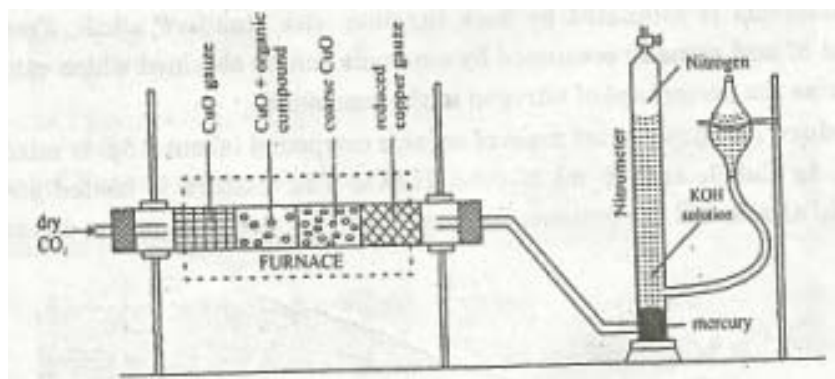
$$100 \text{ g of organic compound contains } \frac{100 \times a}{W}$$

$$\text{Percentage of Nitrogen} = \frac{a \times 100}{W}$$

3. Ans: Principle: The organic compound containing nitrogen when heated with excess of copper oxide in the atmosphere of carbon dioxide, gives nitrogen in addition to carbon dioxide and water.

Traces of nitrogen oxides formed during combustion of organic compound are reduced to nitrogen by passing the gaseous mixture over a heated copper gauze. The percentage of nitrogen present in a given organic compound is calculated from the volume of nitrogen collected over potassium hydroxide solution from a known mass of organic compound.

Procedure: The apparatus used for the estimation of nitrogen by this method is shown in the figure.



A known mass of organic compound is mixed with copper oxide and placed in the combustion tube. The carbon dioxide gas is passed through the combustion tube to displace air present in the tube. The combustion tube is now heated in the furnace. The nitrogen evolved collects in the nitrometer. The volume of the nitrogen collected is recorded after adjusting the levels of potassium hydroxide solution in the two limbs are equal. Room temperature and atmosphere pressure are recorded.

Calculation: Mass of organic Compound = m mg

Volume of nitrogen in nitrometer = V cm³

Room temperature = $t^{\circ}\text{C} = (273 + t)\text{K}$

Atmosphere pressure = P_1 mm

Aqueous tension at room temperature = P' mm

Pressure of dry nitrogen gas formed = $P = (P - P')$ mm .

Volume of nitrogen at STP (V_0) = $\frac{PV \times 273}{760 \times (273 + t)} \text{cm}^3$

22,400 cm³ of nitrogen of STP = 28g of nitrogen

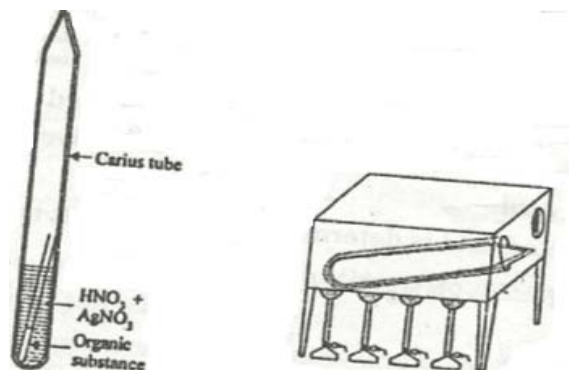
Mass of V_0 cm³ of nitrogen = $\frac{28 \times V}{22,400} \text{g}$

Percentage of Nitrogen = $\frac{28 \times V_0 \times 100}{22,400 \times m}$

4. Ans: When an organic compound containing halogen (Cl, Br or I) is heated in a sealed tube with fuming nitric acid and excess of silver chloride, silver halide is formed from the mass of silver halide obtained, the percentage of the halogen can be calculated.

Procedure: In a hard glass tube (Carius tube), 5ml of fuming HNO₃ and 2 to 2.5 g AgNO₃ are taken. A small narrow weighing tube, containing a small amount (nearly 0.15 – 0.2g) of accurately weighed organic compound, is introduced in the Carius tube in such a way that

nitric acid does not enter the weighing tube. The Carius tube is now sealed and heated in a furnace at 300⁰ C for about six hours.



The tube is then cooled and its narrow end is cut off and the contents are completely transferred to a beaker by washing with water. The precipitate of silver halide formed is filtered through a weighed sintered glass crucible. It is washed, dried and weighed.

Observation and calculation:

i) Mass of organic compound taken = W_1 g

ii) Mass of silver halide obtained = W_2 g

a) For chlorine: $\text{AgCl} \equiv \text{Cl}$

143.5g 35.5g

143.5g of AgCl contains 35.5g of chlorine

w_2 g of AgCl will contain $\frac{35.5 \times w_2}{143.5}$ g of chlorine
= 'a' grams (say)

This amount of chlorine was present in w_1 g of the compound.

$$\therefore \% \text{Cl}_2 = \frac{35.5 \times w_2}{143.5} \times \frac{100}{w_1}$$

b) For bromine: $\text{AgBr} \equiv \text{Br}$

188g 80g

188g of AgBr contains 80 g of bromine

w_2 g of AgBr will contain $\frac{80 \times w_2}{188}$ g of bromine.

$$\therefore \% \text{Br}_2 = \frac{80 \times w_2}{188} \times \frac{100}{w_1}$$

c) For Iodine: $\text{AgI} \equiv \text{I}$

235g 127g

235g of AgI contains 127g of iodine

w_2 g of AgI will contain $\frac{127 \times w_2}{235}$ g of Iodine

$$\therefore \% \text{I}_2 = \frac{127 \times w_2}{235} \times \frac{100}{w_1}$$
