

UNIT-11

CARBON AND ITS COMPOUNDS

I. Choose the best answer.

- The molecular formula of an open chain organic compound is C_3H_6 . The class of the compound is
 - alkane
 - alkene**
 - alkyne
 - alcohol
- The IUPAC name of an organic compound is 3-Methyl butan-1-ol. What type compound it is?
 - Aldehyde
 - Carboxylic acid
 - Ketone
 - Alcohol**
- The secondary suffix used in IUPAC nomenclature of an aldehyde is
 - ol
 - oic acid
 - al**
 - one
- Which of the following pairs can be the successive members of a homologous series?
 - C_3H_8 and C_4H_{10}**
 - C_2H_2 and C_2H_4
 - CH_4 and C_3H_6
 - C_2H_5OH and C_4H_8OH
- $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ is a
 - Reduction of ethanol
 - Combustion of ethanol**
 - Oxidation of ethanoic acid
 - Oxidation of ethanal
- Rectified spirit is an aqueous solution which contains about _____ of ethanol
 - 95.5 %**
 - 75.5 %
 - 55.5 %
 - 45.5 %
- Which of the following are used as anaesthetics?
 - Carboxylic acids
 - Ethers**
 - Esters
 - Aldehydes
- TFM in soaps represents _____ content in soap
 - mineral
 - vitamin
 - fatty acid**
 - carbohydrate
- Which of the following statements is wrong about detergents?
 - It is a sodium salt of long chain fatty acids**
 - It is sodium salts of sulphonic acids
 - The ionic part in a detergent is $-SO_3^-Na^+$
 - It is effective even in hard water.

II. Fill in the blanks

1. An atom or a group of atoms which is responsible for chemical characteristics of an organic compound is called **functional group**.
2. The general molecular formula of alkynes is **C_nH_{2n-2}**
3. In IUPAC name, the carbon skeleton of a compound is represented by **(root word / prefix / suffix)**
4. (Saturated / **Unsaturated**) compounds decolourize bromine water.
5. Dehydration of ethanol by conc. Sulphuric acid forms **(ethene/ ethane)**
6. 100 % pure ethanol is called **Absolute Alcohol**
7. Ethanoic acid turns **blue** litmus to **red**
8. The alkaline hydrolysis of fatty acids is termed as **Saponification**
9. Biodegradable detergents are made of **(branched / straight)** chain hydrocarbons

III. Match the following

1	Functional group –OH	Benzene	(5)
2	Heterocyclic	Potassium stearate	(4)
3	Unsaturated	Alcohol	(1)
4	Soap	Furan	(2)
5	Carbocyclic	Ethene	(3)

IV. Assertion and Reason:

Answer the following questions using the data given below:

- i) A and R are correct, R explains the A.
- ii) A is correct, R is wrong.
- iii) A is wrong, R is correct.
- iv) A and R are correct, R doesn't explain A.

1. **Assertion:** Detergents are more effective cleansing agents than soaps in hard water.

Reason: Calcium and magnesium salts of detergents are water soluble.

i) A and R are correct, R explains the A.

2. **Assertion:** Alkanes are saturated hydrocarbons.

Reason: Hydrocarbons consist of covalent bonds.

iv) A and R are correct, R doesn't explain A.

V. Short answer questions

1. Name the simplest ketone and give its structural formula.

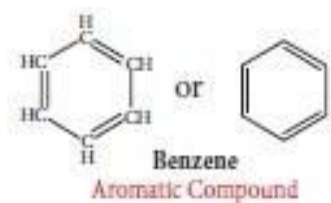
- IUPAC Name: Propanone
- Common Name: Dimethyl Ketone (acetone)
- Structural Formula: CH_3COCH_3

2. Classify the following compounds based on the pattern of carbon chain and give their structural formula:

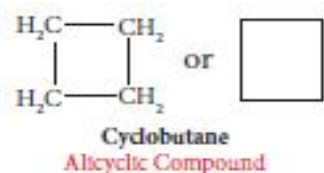
(i) **Propane**- Alkane



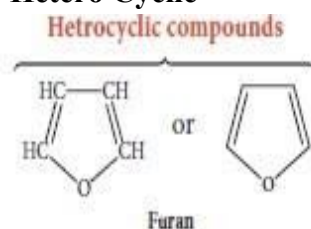
(ii) **Benzene** – Carbocyclic
Aromatic



(iii) **Cyclobutane**- Carbocyclic
Alicyclic

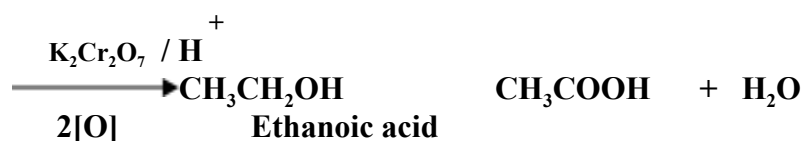


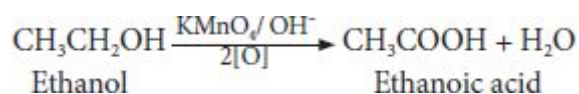
(iv) **Furan** – Hetero Cyclic



3. How is ethanoic acid prepared from ethanol? Give the chemical equation.

Ethanoic acid is prepared in large scale, by the oxidation of ethanol in the presence of alkaline potassium permanganate or acidified potassium dichromate.





4. How do detergents cause water pollution? Suggest remedial measures to prevent this pollution?
- Some detergents having a branched hydrocarbon chain are not fully biodegradable by micro-organisms present in water. So, they cause water pollution.
 - Using detergents having straight hydro carbon chain which can be easily degraded by bacteria may prevent water pollution.
5. Differentiate soaps and detergents.

Soap	Detergent
It is a sodium salt of long chain fatty acids.	It is sodium salts of sulphonic acids.
The ionic part of a soap is $\text{-COO}^-\text{Na}^+$.	The ionic part in a detergent is $\text{-SO}_3^-\text{Na}^+$.
It is prepared from animal fats or vegetable oils.	It is prepared from hydrocarbons obtained from crude oil.
Its effectiveness is reduced when used in hard water.	It is effective even in hard water.
It forms a scum in hard water.	Does not form a scum in hard water.
It has poor foaming capacity.	It has rich foaming capacity.
Soaps are biodegradable.	Most of the detergents are non-biodegradable.

VI. Long answer questions

1. What is called homologous series? Give any three of its characteristics?

Homologous series is a group or a class of organic compounds having same general formula and similar chemical properties in which the successive members differ by a -CH_2 group.

CHARACTERISTICS OF HOMOLOGOUS SERIES :

- Each member of the series differs from the preceding or succeeding member by one methylene group (-CH_2) and hence by a molecular mass of 14 amu.
- All members of a homologous series contain the same elements and functional group.
- They are represented by a general molecular formula. e.g. Alkanes, $\text{C}_n\text{H}_{2n+2}$.
- The members in each homologous series show a regular gradation in their physical properties with respect to their increase in molecular

mass.

(v) Chemical properties of the members of a homologous series are similar. (vi) All the members can be prepared by a common method.

2. Arrive at, systematically, the IUPAC name of the compound: $\text{CH}_3\text{--CH}_2\text{--CH}_2\text{--OH}$.

Step 1: The parent chain consists of 3 carbon atoms. The root word is 'Prop'.

Step 2: There are single bonds between the carbon atoms of the chain. So, the **primary suffix** is 'ane'.

Step 3: Since, the compound contains --OH group, it is an alcohol. The carbon chain is numbered from the end which is closest to --OH group. (Rule 3)

3 2 1

$\text{CH}_3\text{--CH}_2\text{--CH}_2\text{--OH}$

Step 4: The locant number of --OH group is 1 and thus the secondary suffix is '1-ol'.

The name of the compound is **Prop + ane + (1-ol) = Propan-1-ol**

Note: Terminal 'e' of 'ane' is removed as per Rule 5

3. How is ethanol manufactured from sugarcane?

Ethanol is manufactured in industries by the fermentation of **molasses**, which is a by-product obtained during the manufacture of sugar from sugarcane. **Molasses is a dark coloured syrupy liquid left after the crystallization of sugar from the concentrated sugarcane juice.** Molasses contain about 30% of sucrose, which cannot be separated by crystallization. It is converted into ethanol by the following steps:

(i) Dilution of molasses :

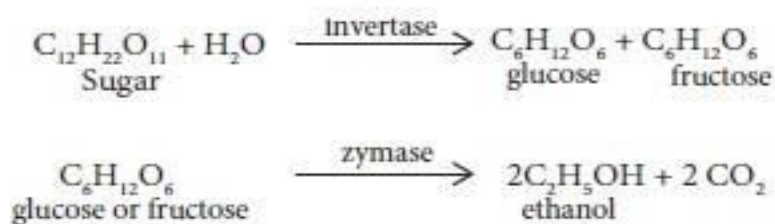
Molasses is first diluted with water to bring down the concentration of sugar to about 8 to 10 percent.

(ii) Addition of Nitrogen source :

Molasses usually contains enough nitrogenous matter to act as food for yeast during the fermentation process. If the nitrogen content of the molasses is poor, it may be fortified by the addition of **ammonium sulphate** or **ammonium phosphate**.

(iii) Addition of Yeast

The solution obtained in step (ii) is collected in large '**fermentation tanks**' and yeast is added to it. The mixture is kept at about 303K for a few days. During this period, the enzymes **invertase** and **zymase** present in yeast, bring about the conversion of sucrose



into ethanol.

The fermented liquid is technically called **wash**.

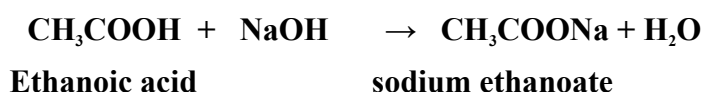
(iv) Distillation of 'Wash'

The fermented liquid (i.e. wash), containing 15 to 18 percent alcohol, is now subjected to fractional distillation. The main fraction drawn is an aqueous solution of ethanol which contains 95.5% of ethanol and 4.5% of water. This is called **rectified spirit**. This mixture is then refluxed over quicklime for about 5 to 6 hours and then allowed to stand for 12 hours. On distillation of this mixture, pure alcohol (100%) is obtained. This is called **absolute alcohol**.

4. Give the balanced chemical equation of the following reactions:

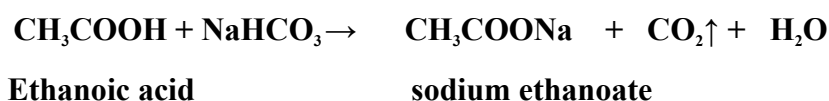
(i) Neutralization of NaOH with ethanoic acid.

Ethanoic acid reacts with **sodium hydroxide** to form **sodium ethanoate** and **water**.



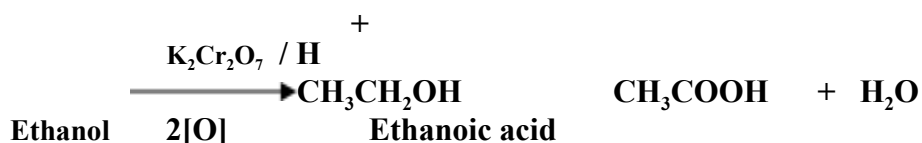
(ii) Evolution of carbon dioxide by the action of ethanoic acid with NaHCO₃.

Ethanoic acid reacts with sodium carbonate and **sodium bicarbonate**, which are weaker bases and **liberates CO₂**, with **brisk effervescence**.



(iii) Oxidation of ethanol by acidified potassium dichromate.

Ethanol is oxidized to **ethanoic acid** with alkaline **KMnO₄** or acidified **K₂Cr₂O₇**



During this reaction, the orange colour of **K₂Cr₂O₇** changes to green. Therefore, this reaction can be used for the identification of alcohols.

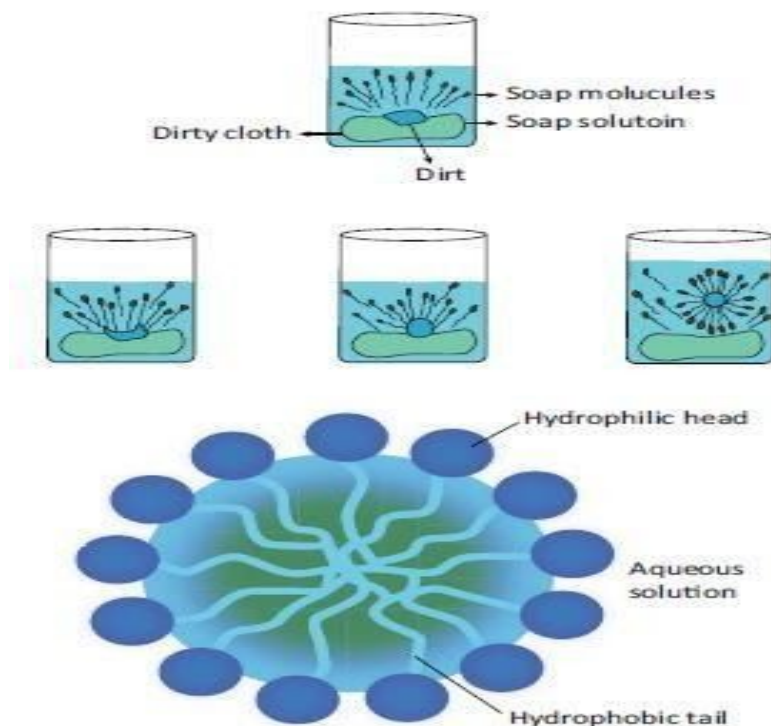
(iv) Combustion of ethanol.

Ethanol is highly inflammable liquid. It burns with oxygen to form carbon dioxide and water.



5. Explain the mechanism of cleansing action of soap.

Cleansing action of soap :



A soap molecule contains two chemically distinct parts that interact differently with water. It has one polar end, which is a *short head* with a carboxylate group ($-\text{COONa}$) and one non-polar end having the *long tail made of the hydrocarbon chain*.

The polar end is *hydrophilic (Water loving)* in nature and this end is attracted towards water. The non-polar end is *hydrophobic (Water hating)* in nature and it is attracted towards dirt or oil on the cloth, but not attracted towards water. Thus, the hydrophobic

part of the soap molecule traps the dirt and the hydrophilic part makes the entire molecule soluble in water.

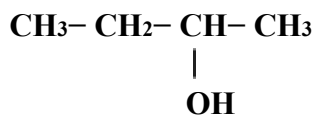
When a soap or detergent is dissolved in water, the molecules join together as clusters called 'micelles'. Their long hydrocarbon chains attach themselves to the oil and dirt. The dirt is thus surrounded by the non-polar end of the soap molecules (Figure 11.3). The charged carboxylate end of the soap molecules makes the micelles soluble in water. Thus, the dirt is washed away with the soap.

VII. HOT questions

1. The molecular formula of an alcohol is $\text{C}_4\text{H}_{10}\text{O}$.

The locant number of its $-\text{OH}$ group is 2.

(i) Draw its structural formula.



- (ii) Give its IUPAC name.

Butan-2-ol

- (iii) Is it saturated or unsaturated?

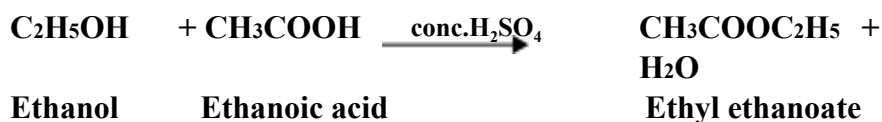
It is a saturated compound

2. An organic compound 'A' is widely used as a preservative and has the molecular formula $\text{C}_2\text{H}_4\text{O}_2$. This compound reacts with ethanol to form a sweet smelling compound 'B'.

- (i) Identify the compound 'A'.

A is Ethanoic acid CH_3COOH

- (ii) Write the chemical equation for its reaction with ethanol to form compound 'B'.



**B is $\text{CH}_3\text{COOC}_2\text{H}_5$
Ethyl ethanoate (Ester)**

- (iii) Name the process.

Ethanol reacts with ethanoic acid in the presence of conc. H_2SO_4 to form ethyl ethanoate, an ester. **The reaction is called esterification.**

Test yourself: Pg.No.162

Obtain the IUPAC name of the following compounds systematically:

- (a) CH_3CHO

Step1: The parent chain consists of 2 carbon atoms. The root word is 'Eth'.

Step 2: All are single bonds between the carbon atoms of the chain. So the primary suffix is 'ane'.

Step 3: Since the compound contains the $-\text{CHO}$ group, it is an **aldehyde**. The secondary suffix is 'al'

The name of the compound is **Eth + ane + al = Ethanal**

Note: Terminal 'e' of 'ane' is removed as per Rule 5

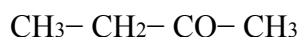
(b) $\text{CH}_3\text{CH}_2\text{COCH}_3$

Step 1: The parent chain consists of 4 carbon atoms. The root word is '**But**'.

Step 2: There are single bonds between the carbon atoms of the chain. So, the **primary suffix** is 'ane'.

Step 3: Since, the compound contains -CO- group, it is a **Ketone**. The carbon chain is numbered from the end which is closest to -CO- group. (Rule 3)

4 3 2 1



Step 4: The locant number of -CO- group is 2 and thus the secondary suffix is '-one'. The name of the compound is **But + ane + (- 2- one) = Butan-2-one**

Note: Terminal 'e' of 'ane' is removed as per Rule 5

(c) $\text{ClCH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_3$

Step 1: The parent chain consists of 4 carbon atoms. The root word is '**But**'.

Step 2: There are single bonds between the carbon atoms of the chain. So, the **primary suffix** is 'ane'.

Step 3: Since, the compound contains -Cl group, it is an **Haloalkane**. The carbon chain is numbered from the end which is closest to -Cl group. (Rule 3)

1 2 3 4



Step 4: The locant number of -Cl group is 1 and thus the **prefix** is '**1- chloro**'

The name of the compound is **1- ChloroButane**
