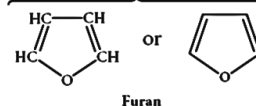


# UNIT – 11

## CARBON AND ITS COMPOUNDS

Heterocyclic 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  
a) alkane                      **b) alkene**                      c) alkyne                      d) alcohol
- The IUPAC name of an organic compound is 3-Methyl butan-1-ol. What type compound it is?  
a) Aldehyde                      b) Carboxylic acid                      c) Ketone                      **d) Alcohol [SEP – 2021]**
- The secondary suffix used in IUPAC nomenclature of an aldehyde is \_\_\_\_\_.  
a) - ol                      b) – oic acid                      **c) - al**                      d) - one
- Which of the following pairs can be the successive members of a homologous series?  
**a)  $C_3H_8$  and  $C_4H_{10}$**                       b)  $C_2H_2$  and  $C_2H_4$                       c)  $CH_4$  and  $C_3H_6$                       d)  $C_2H_5OH$  and  $C_4H_8OH$
- $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$  is a \_\_\_\_\_ **[SEP – 2020]**  
a) Reduction of ethanol                      **b) Combustion of ethanol**  
c) Oxidation of ethanoic acid                      d) Oxidation of ethanol
- Rectified spirit is an aqueous solution which contains about \_\_\_\_\_ of ethanol. **[MAY - 2022]**  
**a) 95.5 %**                      b) 75.5 %                      c) 55.5 %                      d) 45.5 %
- Which of the following are used as anaesthetics?  
a) Carboxylic acids **b) Ethers**                      c) Esters                      d) Aldehydes
- TFM in soaps represents \_\_\_\_\_ content in soap.  
a) mineral                      b) vitamin                      **c) fatty acid**                      d) carbohydrate
- Which of the following statement is wrong about detergents?  
**a) It is a sodium salt of long chain fatty acids**                      b) It is sodium salts of sulphonic acids  
c) The ionic part in a detergent is  $-SO_3^- Na^+$                       d) It is effective even in hard water

### II. Fill in the blanks

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

## III. Match the following

[PTA – 2]

Column I	Column II	Answer
1. Functional group –OH	Benzene	1. Alcohol
2. Heterocyclic	Potassium stearate	2. Furan
3. Unsaturated	Alcohol	3. Ethene
4. Soap	Furan	4. Potassium stearate
5. Carbocyclic	Ethene	5. Benzene

## 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 (A):** Detergents are more effective cleansing agents than soaps in hard water. [PTA – 4]  
**Reason (R) :** Calcium and magnesium salts of detergents are water soluble.

**Ans. (i)**      *A and R are correct, R explains the A.*

2. **Assertion (A) :** Alkanes are saturated hydrocarbons.  
**Reason (R) :** Hydrocarbons consist of covalent bonds.

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

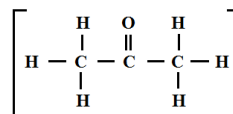
## V. Short answer questions

1. Name the simplest ketone and give its structural (or) molecular formula. [PTA – 2]

*Simplest ketone* : Acetone

*Structural formula* :  $\text{CH}_3\text{—CO—CH}_3$

*IUPAC Name* : Propanone

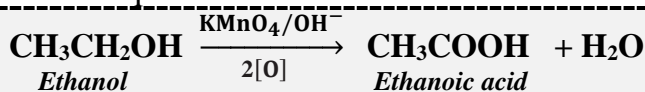


2. Classify the following compounds based on the pattern of carbon chain and give their structural formula: (i) Propane (ii) Benzene (iii) Cyclobutane (iv) Furan [PTA – 1, MAY-2022]

Name	Classification	Molecular formula	Structural formula
i) Propane	Acyclic (or) open chain compounds	$\text{C}_3\text{H}_8$	
ii) Benzene	Aromatic compound	$\text{C}_6\text{H}_6$	
iii) Cyclobutane	Alicyclic compound	$\text{C}_4\text{H}_8$	
iv) Furan	Heterocyclic compound	$\text{C}_4\text{H}_4\text{O}$	

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

Ethanoic acid is prepared from 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.

Detergents having branched hydrocarbon chain are not fully biodegradable by micro-organisms in water. So, they cause water pollution. [PTA – 3]

**Remedy:** We can use straight hydrocarbon chains, which can be easily degraded by bacteria.

## 5. Differentiate soaps and detergents.

[SEP – 2020, PTA – 3, MDL – 19]

Soaps	Detergents
1. Sodium salt of long chain fatty acid	1. Sodium salts of sulphonic acids.
2. Ionic part is $\text{COO}^- \text{Na}^+$	2. Ionic part is $\text{SO}_3^- \text{Na}^+$
3. It is less effective in hard water.	3. 4. It is effective even in hard water.
4. It forms a scum in hard water.	5. It does not form a scum in hard water.
5. Poor foaming capacity.	6. Rich foaming capacity.
6. Biodegradable.	7. Mostly non-biodegradable.

## VI. Long answer questions

## 1. What is called homologous series? Give any three of its characteristics. (write any 3)

Organic compounds having same general formula and similar chemical properties in which the successive members differ by a  $-\text{CH}_2$  group is called homologous series.

*Ex:* Methane  $\text{CH}_4$  Ethane  $\text{CH}_3\text{-CH}_3$  Propane  $\text{CH}_3\text{-CH}_2\text{-CH}_3$

**Characteristics of homologous series:**

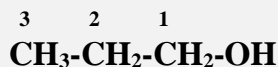
- Each member differs from its preceding or succeeding by methylene ( $-\text{CH}_2$ ) group.
- All members contain same elements and functional group.
- They are represented by a general molecular formula. *Ex:* Alkanes  $\text{C}_n\text{H}_{2n+2}$ .
- Members in each series show regular gradation in their physical properties.
- Chemical properties are similar.
- All the members can be prepared by a common method.

2. Arrive at, systematically, the IUPAC name of the compound:  $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-OH}$ . [TB : 162]

**Step1:** Longest chain has 3 carbon atoms.  $\therefore$  Root word is 'prop'.

**Step2:** It has single bond.  $\therefore$  Primary suffix is "ane".

**Step3:** Functional group is alcohol ( $-\text{OH}$ ).



**Step 4:** Locant number of  $-\text{OH}$  is 1  $\therefore$  Secondary suffix is '1-ol'

$\therefore$  The name of the compound is **Propan-1-ol**

## 3. How is ethanol manufactured from sugarcane?

❖ Ethanol is manufactured by fermentation of molasses.

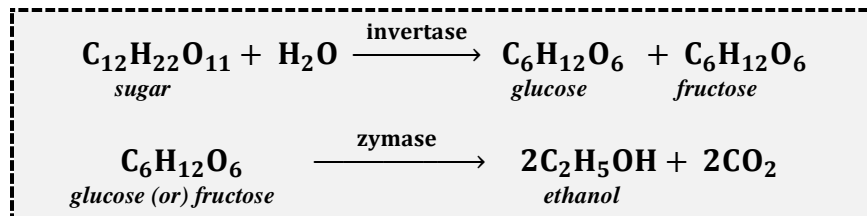
**Steps in conversion of molasses to ethanol:**

(i) *Molasses is diluted* with water to bring the concentration of sugar to 8 to 10%.

(ii) **Addition of Nitrogen Source:** It is fortified by adding ammonium sulphate/phosphate.

## (iii) Addition of yeast:

- ❖ Solution is collected in large 'fermentation tanks'
- ❖ Yeast is added and kept at 303 K for few days.
- ❖ During this period, invertase and zymase in yeast, converts sucrose into ethanol.
- ❖ Fermented liquid is called as 'wash'.



## (iv) Distillation of Wash:

'Wash' contains 15 to 18% alcohol. It is subjected to fractional distillation.

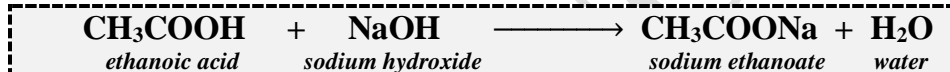
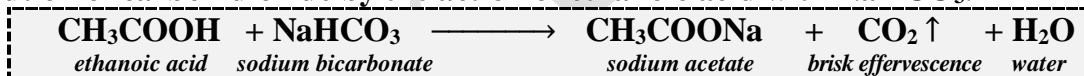
**Rectified spirit:** It contains 95.5% ethanol & 4.5% of water. It is the main fraction of 'wash'.

**Absolute alcohol:** Rectified spirit is refluxed over quicklime for 5 to 6 hours and then allowed to stand for 12 hours. **Pure/absolute alcohol** (100%) is obtained.

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

## (i) Neutralization of NaOH with ethanoic acid.

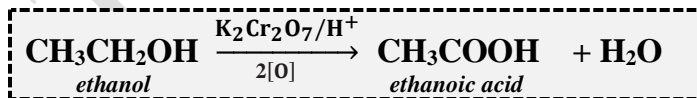
[PTA – 6]

(ii) Evolution of carbon dioxide by the action of ethanoic acid with NaHCO<sub>3</sub>.

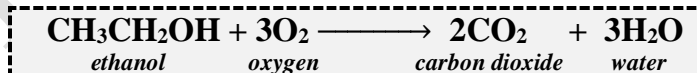
## (iii) Oxidation of ethanol by acidified potassium dichromate. [PTA – 6] (or)

Write a reaction which is used for the identification of alcohol., [SEP - 2020]

- ❖ Ethanol is oxidized to ethanoic acid in presence of acidified potassium dichromate.
- ❖ Orange color of K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> is changed to green colour. Thus, it is used to identify alcohol.



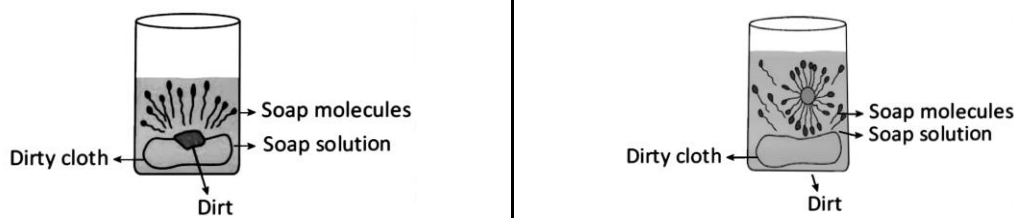
## (iv) Combustion of ethanol.



## 5. Explain the mechanism of cleansing action of soap. [PTA – 6] (or) Explain how micelles formation take place with a diagram when soap is added to water? [PTA – 5]

Structure of Soap :

- \* **Polar end:** It is hydrophilic (water loving). Short head with carboxylate group (–COONa)
- \* **Non-polar end :** It is hydrophobic (water hating). Long tail of hydrocarbon chain.

Cleansing action of Soap:

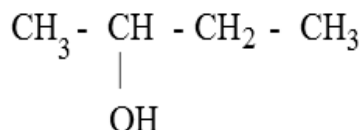
- ❖ When a soap is dissolved in water, molecules join together as clusters called micelles.
- ❖ Dirt is surrounded by non-polar end.
- ❖ Polar end makes micelles soluble in water.
- ❖ Thus, dirt is washed away with the soap.

### VII. HOT questions

1. The molecular formula of an alcohol is  $C_4H_{10}O$ . The locant number of its  $-OH$  group is 2.

(i) Draw its structural formula.

[PTA – 1]



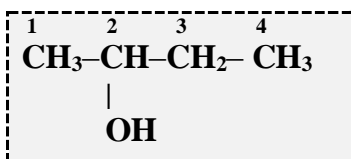
(ii) Give its IUPAC name.

[PTA – 1]

*Step 1:* Chain has 4 carbon atoms.  $\therefore$  Root word is 'But'

*Step 2:* It has single bond.  $\therefore$  Primary suffix is 'ane'.

*Step 3:* Functional group is alcohol ( $-OH$ ).



*Step 4:* Locant number of  $-OH$  group is 2.  $\therefore$  Secondary suffix is '2-ol'

$\therefore$  The name of compound is **Butan-2-ol**

(iii) Is it saturated or unsaturated?

[PTA – 1]

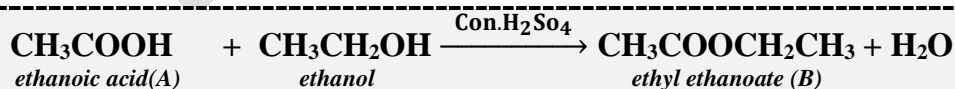
Butan-2-ol is **saturated** as it has only single bonds

2. An organic compound 'A' is widely used as a preservative and has the molecular formula  $C_2H_4O_2$ . This compound reacts with ethanol to form a sweet smelling compound 'B'. [PTA – 5]

(i) Identify the compound 'A' and 'B'.

Compound (A) is **Ethanoic acid** or **Acetic acid**. Its structural formula is  $CH_3COOH$ .

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



(iii) Name the process (or) chemical reaction.

This process is esterification.

A $\rightarrow$ Ethanoic acid
B $\rightarrow$ Ethyl ethanoate
Process $\rightarrow$ Esterification