



## UNIT

# 11

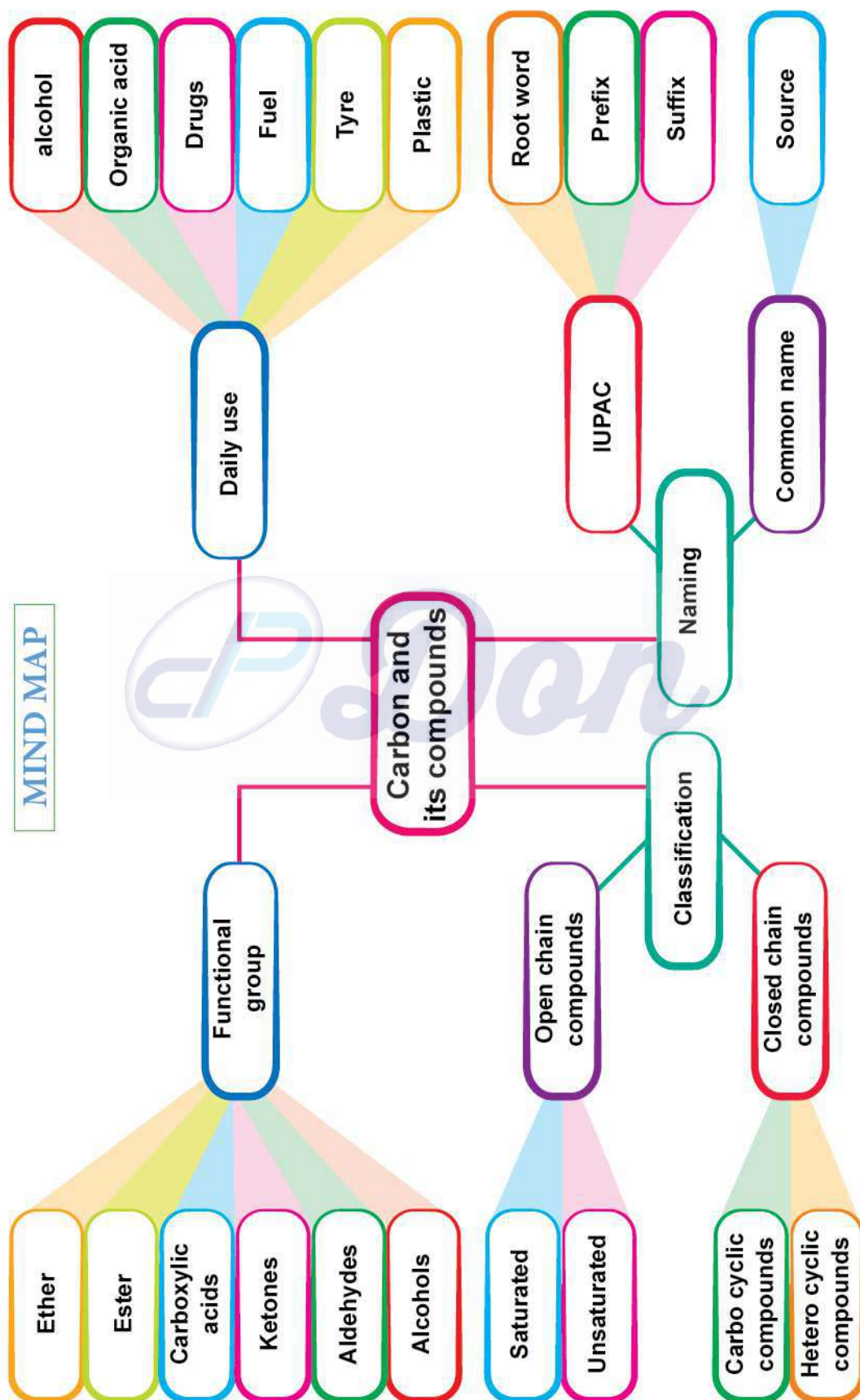
## Carbon and its Compounds

### POINTS TO REMEMBER

- Carbon forms more than 5 million compounds. All these compounds are made of covalent bond.
- Acyclic compounds are the compounds in which the carbon atoms are linked in a linear pattern to form the chain.
- If all the carbon atoms in the chain are connected by single bonds, then the compound is called as saturated.
- Organic compounds in which the chain of carbon atoms is closed or cyclic are called c-smallcyclic compounds.
- Organic compounds are classified as open chain compounds and closed chain compounds.
- The organic compounds that are composed of only carbon and hydrogen atoms are called hydrocarbons.
- The organic compounds that are composed of only carbon and hydrogen atoms are called hydrocarbons.
- These hydrocarbons are classified as Alkanes, Alkenes and Alkynes.
- Alkanes (saturated hydrocarbons)
- Alkenes, Alkynes (unsaturated hydrocarbons) decolourise bromine water.
- If the chain contains only carbon atoms, such compounds are called carbocyclic compounds.
- If the chain contains carbon and other atoms like oxygen, nitrogen, sulphur, etc., these compounds are called heterocyclic compounds.
- Aromatic compounds contain one or more benzene rings.
- A functional group is an atom or group of atoms in a molecule which gives its characteristic chemical properties.
- A functional group is an atom or group of atoms in a molecule which gives its characteristic chemical properties.
- 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  $-\text{CH}_2$  group.

Don

## MIND MAP



## Carbon and its Compounds

- ☞ Components of IUPAC names are
  - i) Root word - depend upon the carbon skeleton
  - ii) Prefix - substituents (other than hydrogen atom)
  - iii) Suffix - functional group, double, triple bonds.
- ☞ Ethanol is commonly known as alcohol. Manufacture of ethanol has four steps. They are
  - i) Dilution of molasses
  - ii) Addition of nitrogen source
  - iii) Addition of yeast
  - iv) Distillation of waste
- ☞ Rectified spirit (mixture of 95.5% of ethanol and 4.5% of water)
- ☞ Power alcohol is the mixture of petrol and ethanol
- ☞ TFM means TOTAL FATTY MATTER.
- ☞ Ethanoic acid is prepared from ethanol.
- ☞ Soaps are sodium (or) potassium salts of so long chain contains caustic soda, soft soap contains potassium salt.
- ☞ Soaps molecule are prepared by adding sulphuric acid to the processed hydrocarbons.
- ☞ Detergents form two ends, one is water loving end (hydrophilic), other is water hating end (hydrophobic).
- ☞ These forms miscells and remove strains in soft and hard waters.
- ☞ Some molcules added to detergents for some specific purpose like fragrant, glow, clothes remove biological strains.

**Equations:**

Number of carbon atoms	Root word
1	Meth-
2	Eth-
3	Prop-
4	But-
5	Pent-
6	Hex-
7	Hept-
8	Oct-
9	Non-
10	Dec-



### General formula for hydrocarbons

Saturated - Alkanes -  $C_nH_{2n+2}$

Unsaturated i) Alkenes -  $C_nH_{2n}$

ii) Alkynes -  $C_nH_{2n-2}$

**I. Choose the most suitable answer from the given four alternatives and write the option code and corresponding answer:**

1. 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
2. The IUPAC name of an organic compound is 3-Methyl butan-1-ol. What type of compound it is?
  - a) Aldehyde
  - b) Carboxylic acid
  - c) Ketone
  - d) Alcohol
3. The secondary suffix used in IUPAC nomenclature of an aldehyde is \_\_\_\_
  - a) - ol
  - b) - oic acid
  - c) - al
  - d) - one

## Carbon and its Compounds

4. 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  $C_4H_8OH$
5.  $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$  is a
- a) Reduction of ethanol                      b) Combustion of ethanol  
 c) Oxidation of ethanoic acid                d) Oxidation of ethanal
6. Rectified spirit is an aqueous solution which contains about \_\_\_\_\_ of ethanol. ★★ ★
- a) 95.5 %                      b) 75.5 %                      c) 55.5 %                      d) 45.5 %
7. Which of the following are used as anaesthetics?
- a) Carboxylic acids                              b) Ethers  
 c) Esters    d) Aldehydes
8. TFM in soaps represents \_\_\_\_\_ content in soap. ★ ★
- a) mineral                      b) vitamin                      c) fatty acid                      d) carbohydrate
9. Which of the following statements 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.

## Ans:

1. b)	alkene	6. a)	95.5 %
2. d)	Alcohol	7. b)	Ethers
3. c)	- al	8. c)	fatty acid
4. a)	$C_3H_8$ and $C_4H_{10}$	9. a)	It is a sodium salt of long chain fatty acids
5. b)	Combustion of ethanol		

## 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 \_\_\_\_\_. ★★ ★
2. The general molecular formula of alkynes is \_\_\_\_\_
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 \_\_\_\_\_
7. Ethanoic acid turns \_\_\_\_\_ litmus to \_\_\_\_\_
8. The alkaline hydrolysis of fatty acids is termed as \_\_\_\_\_ ★★

9. Biodegradable detergents are made of \_\_\_\_\_ (branched / straight) chain hydrocarbons

**Ans:**

1. functional group	2. $C_nH_{2n-2}$
3. root word	4. unsaturated
5. ethene	6. absolute alcohol
7. blue, red	8. saponification
9. straight	

### III Match the following

#### 1. Column I

- 1) Functional group -OH
- 2) Hetero cyclic
- 3) Unsaturated
- 4) Soap
- 5) Carbocyclic

#### Column II

- a) Benzene
- b) Potassium stearate
- c) Alcohol
- d) Furan
- e) Ethene

- (c)
- (d)
- (e)
- (b)
- (a)

### 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 detergent are water soluble.

**Ans : ii)** A is correct, R is wrong.

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

**Reason:** 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 formula.

Simplest ketone	Structural formula
Acetone	$  \begin{array}{c}  \text{H} \quad \text{O} \quad \text{H} \\    \quad    \quad   \\  \text{H} - \text{C} - \text{C} - \text{C} - \text{H} \quad (\text{CH}_3\text{COCH}_3) \\    \quad \quad   \\  \text{H} \quad \quad \text{H}  \end{array}  $

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

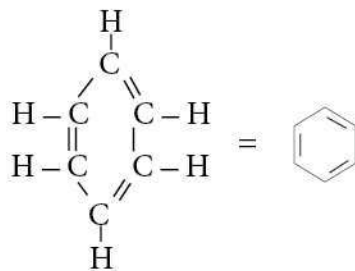
i) Propane - saturated compounds open chain compounds



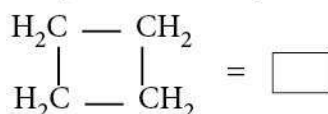


## Carbon and its Compounds

ii) Benzene - Aromatic compound in carbocyclic compounds

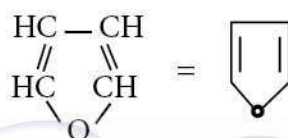


iii) Cyclobutane - Alicyclic compound in carbocyclic compounds.



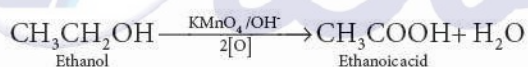
Benzene and cyclobutane are types in carbo cyclic compounds.

iv) Furan - Heterocyclic compounds in cyclic compounds



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

Ethanoic acid is prepared 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 measure to prevent this pollution.

- Some detergents have a highly **branched hydrocarbon** chains, which are not fully bio-degradable by micro organisms present in water.
- So they settle as insoluble chemical in water bodies.
- To avoid this type of water pollution, we should use detergents which have straight hydrocarbon chains.
- Because these are easily degraded by bacteria.

### 5. Differentiate soaps and detergents. ★ ★ ★

S.No	Soaps	Detergents
1	It is a sodium salt of long chain fatty acids	It is sodium salts of sulphonic acids.
2	The ionic part of a soap is $-\text{COO}^-\text{Na}^+$	The ionic part in a detergent is $-\text{SO}_3^-\text{Na}^+$
3	It is prepared from animal	It is prepared from hydrocarbons obtained from crude oil.
4	Soaps are biodegradable	Most of detergents are non-biodegradable.

## VI. Long answer questions

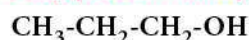
### 1. What is called homologous series? Give any three of its characteristics. ★★ ★

- 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  $\text{CH}_2$  group.
- E.g: Methane      –  $\text{CH}_4$   
Ethane            –  $\text{CH}_3\text{CH}_3$   
Propane          –  $\text{CH}_3\text{CH}_2\text{CH}_3$

#### Characteristics:

- Each member of the series differs from the preceeding or succeeding member by one methylene group ( $-\text{CH}_2$ ) and hence by a molecular mass of 14 amu.
- All members of a homologous series contain the same elements and functional group.
- All the members can be prepared by a common method.

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



#### Step 1:

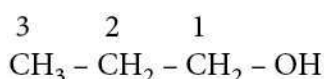
- The parent chain consists of 3 carbon atoms.
- The root word is “Prop”

#### Step 2:

- All are **single bonds** between carbon atoms of the chain.
- So the primary suffix is ‘ane’

#### Step 3:

- Since the compound contains the **-OH** group, it is a alcohol.
- The carbon chain is numbered from the **end** which is closest to **-OH** group.



#### Step 4:

- The locant number of **-OH** group is **1** and thus the secondary suffix is ‘**1 - ol**’.
- Terminal ‘e’ of ‘ane’ is removal as per Rules.
- The name of the compound is  
**prop + ane + (1 - ol) = Propan - 1 - ol**

### 3. How is ethanol manufactured from sugar-cane? ★★ ★

- Molasses** is a **dark coloured syrupy** liquid left after the crystallization of sugar from the concentrated sugarcane juice.
- It contains **30 %** of **sucrose**, which cannot be separated by crystallization.

#### Dilution of molasses:

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



- 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.

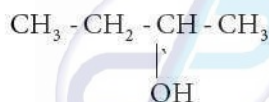
- The polar end is hydrophilic (**Water loving**) in nature and this end is **attracted** towards water.
- The non-polar end is hydrophobic (**water hating**) in nature and it is **attracted** towards **dirt** or **oil** on the cloth, but not attracted towards water.
- Thus, the hydrophobic part of the soap molecules traps the dirt and the hydrophilic part makes the entire molecule soluble in water.
- These forms **miscelles** in water. The **dirt** is thus surrounded by the **non-polar end** of the soap molecules.
- The charged **carboxylate** end of the soap molecules makes the **miscelles** **soluble** in water.
- Thus, the dirt is **washed away** with the soap.

## VII. Higher Order Thinking Skill (HOTS)

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

- Draw its structural formula.
- Give its IUPAC name.
- Is it saturated or unsaturated?

- i) Structural formula:



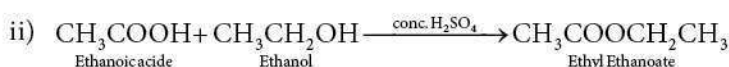
- ii) Butan-2-ol (or) 2-Butanol.

- iii) It is saturated, because all bonds in the structural formula is single.

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'.

- Identify the compound 'A'
- Write the chemical equation for its reaction with ethanol to form compound 'B'
- Name the process

- i) Compound 'A' is Ethanoic acid -  $CH_3COOH$  [ $C_2H_4O_2$ ]



- iii) Esterification

**Reason:** Ethyl ethanoate is an ester.

## Carbon and its Compounds

## Additional Questions

**I. Choose the most suitable answer from the given four alternatives and write the option code and corresponding answer:**

- All carbon compounds are made of**
  - Atomic bonds
  - Co-ordinated bonds
  - Covalent bonds
  - Metallic bonds
- Volatile substance means**
  - high melting point
  - low melting point
  - easily evaporates
  - high density
- Benzene is a**
  - aromatic compounds
  - alicyclic compounds
  - number of moles
  - acyclic compounds
- C<sub>5</sub>H<sub>8</sub> is \_\_\_\_\_ classes**
  - Alkanes
  - Alkynes
  - Alkenes
  - saturated carbons
- Physical properties of a carbon compounds depends on**
  - functional group
  - alkyl group
  - oxygen presence
  - both a and b
- In a homogeneous series, each member has** ★ ★
  - same functional group
  - same general molecular formula
  - same physical properties
  - both a and b
- CH<sub>3</sub> -  $\begin{array}{c} \text{CH} \\ | \\ \text{CH}_2 \\ | \\ \text{CH}_3 \end{array}$  - CH<sub>2</sub> - CH<sub>3</sub> IUPAC name of this compound** ★
  - 2 Ethyl pentane
  - 2 Ethyl butane
  - 3-methyl hexane
  - 2-methyl hexane
- The enzyme zymase converts \_\_\_\_\_ into \_\_\_\_\_.**
  - molassess, sugar
  - sugar, fructose
  - sugar, glucose
  - fructose, ethanol
- Soda lime is a mixture of**
  - NaOH, CaCl<sub>2</sub>
  - Ca(OH)<sub>2</sub>, NaO
  - CaO, NaOH
  - CaO, Na(CH)<sub>2</sub>
- The substance sodium silicate is used to** ★
  - not damage the washing machine
  - glow clothes
  - remove blood strain
  - give fragrant smell
- A soap molecule contains two parts when dissolved in water, one is polar end. other is**
  - carboxylate group
  - hydrophilic end
  - hydrocarbon chain
  - water loving end



12. \_\_\_\_\_ is used as pain killer

a) Aldehydes

b) Ethers

c) Esters

d) Ketones

**Ans:**

1. c)	Covalent bonds	7. c)	3-methyl hexane
2. c)	easily evaporates	8. d)	fructose, ethanol
3. a)	aromatic compounds	9. c)	CaO, NaOH
4. b)	Alkynes	10. a)	not damaging the washing machine
5. b)	alkyl group	11. c)	hydrocarbon chain
6. d)	both a and b	12. b)	Ethers

## II. Fill in the blanks

- Generally covalent compounds have \_\_\_\_\_ melting and boiling points. (high, low, moderate).
- Fourth member of the alkene family is \_\_\_\_\_.
- Saturated hydrocarbons are called \_\_\_\_\_.
- Chemical properties of a carbon compound depend upon its \_\_\_\_\_. ★
- Root word for 7 carbon atoms is \_\_\_\_\_.
- The fermented liquid is technically called \_\_\_\_\_.
- Denaturated spirit is a mixture of ethanol and \_\_\_\_\_.
- The prefix word used for  $\text{-NH}_2$  is \_\_\_\_\_.
- IUPAC name of  $\text{CH}_3\text{CH}_2\text{COOH}$  is \_\_\_\_\_. ★
- The product of dehydrogenation of ethanol \_\_\_\_\_.
- All the cooking oils and liquids contain \_\_\_\_\_.

**Ans:**

1. low	2. pentene
3. alkane	4. functional group
5. Hept-	6. wash
7. pyridine	8. amino
9. propanoic acid	10. acetadehyde (or) ethanal
11. esters	

## III Match the following

### 1. Column I

- Alkene
- Alkyne
- R-OH here 'R' is
- 8 carbons
- R-COOH

### Column II

- a) Alkyl group
- b) oct-
- c) Bromine test
- d) Acid
- e)  $\text{C}_2\text{H}_4$

- (e)
- (c)
- (a)
- (b)
- (d)

## Carbon and its Compounds

## 2. Column I

- 1) Butanol
- 2) Fermentation tank
- 3) Butanal
- 4) invertase
- 5) zymase

## Column II ★

- a) Glucose to Ethanol
- b)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
- c) Sugar to Glucose
- d) 303 K
- e)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$

(b)  
(d)  
(e)  
(c)  
(a)

## 3. Column I

- 1) 95 % ethanol with methanol
- 2) 95.5 % ethanol with water
- 3) Petrol with ethanol
- 4) Coagulating rubber
- 5) Anti-freezer

## Column II ★

- a) Ethanoic acid
- b) Poisonous alcohol
- c) Ethanol
- d) Power alcohol
- e) Rectified spirit

(b)  
(e)  
(d)  
(a)  
(c)

## 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:** Alkaline  $\text{KMnO}_4$  is an oxidising agent.

**Reason:** It changes ethanol into ethanoic acid.

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

2. **Assertion:**  $\text{CH}_3\text{CH}_2\text{OCH}_3$  and  $\text{CH}_3\text{CH}_2\text{OH}$  are isomers. ★

**Reason:** Isomerism is a phenomenon where two or more compounds have the same chemical formula but possess different structural formula i.e., different properties.

**Ans : iii)** A is wrong, R is correct.

3. **Assertion:** The compounds formed by carbon are very stable.

**Reason:** Nucleus of the carbon is of small size. So electrons are nearer to the nucleus.

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

## V. Interpretation

## 1. What do we get if we add ethanoic acid to sodium hydroxide?

Generally we get salt and water when an acid reacts with base. So when ethanoic acid reacts with sodium hydroxide and gives sodium ethanoate and water.

## 2. What happens when propyne is added to bromine water?

Propyne is an unsaturated hydrocarbon. So it decolourises the bromine water.

## 3. What will happen when soap is used in hard water?

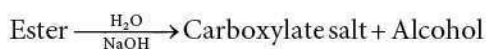
Soap reacts with salt in hard water and forms scum which does not easily rinse away.

- Alkaline solution (10 %) is added to oil.
- This mixture is boiled by passing steam through it.



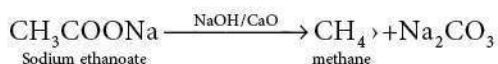
## Carbon and its Compounds

- The oil gets hydrolysed after several hours of boiling.
- This process is called saponification. It is the reverse process of esterification.



## 6. Write about decarboxylation salt of ethanoic acid.

When a sodium salt of ethanoic acid is heated with soda lime [solid mixture of 3 part of NaOH and 1 part CaO], methane gas is formed.

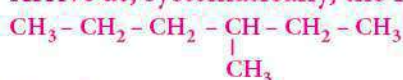


## VII. Long answer questions:

## 1. Write the general characteristics of organics compounds.

- Organic compound have high molecular weight and a complex structure.
- They are mostly insoluble in water, but soluble in organic solvents.
- They are highly inflammable in nature.
- Organic compounds are less reactive compared to inorganic compounds.
- Mostly organic compounds form covalent bonds in nature.
- They have lower melting point and boiling point when compared to inorganic compounds.
- They exhibit the phenomenon of isomerism.
- They are volatile in nature.
- Organic compounds can be prepared in the laboratory.

## 2. Arrive at, systematically, the IUPAC name of the compound.

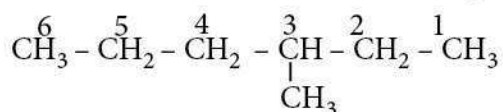


## Step 1:

- The longest chain contains **six** carbon atoms and hence the root word is 'Hex'

## Step 2:

- There is a substituent.
- So the **carbo chain** is numbered from the right end which is closest to a substituent.



## Step 3:

- All are **single bonds** between the carbon atoms and thus the suffix is 'ane'.

## Step 4:

- The substituent is a methyl group and it is located at 3 carbon atom.
- So its locant number is 3. Thus the prefix '3 - methyl'
- The name of the compound

3-methyl + Hex + ane = **3-methyl Hexane**

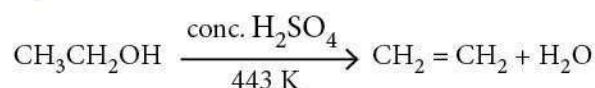
3. Write the balanced equation for the following

i) Dehydration of ethanol

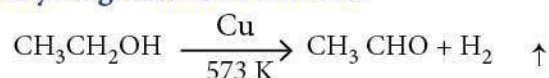
ii) Dehydrogenation of ethanol

iii) Decarboxylation of ethanoic acid

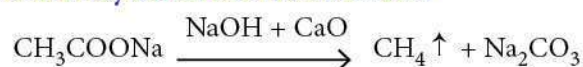
i) Dehydration of ethanol:



ii) Dehydrogenation of ethanol:



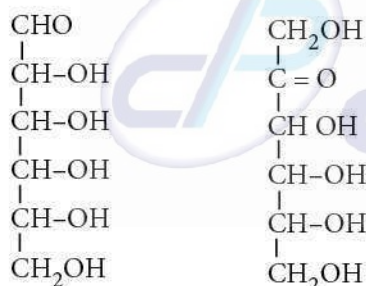
iii) Decarboxylation of ethanoic acid:



## VIII. Higher Order Thinking Skill (HOTS)

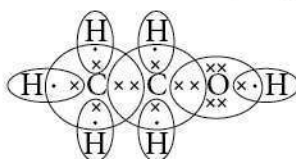
1. What is the difference in fructose and glucose structures?

- Glucose and fructose have same molecular formula, but they have different structures.

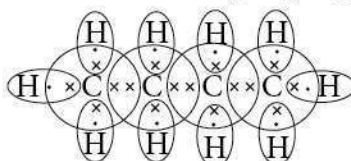


2. Draw the electron dot structure for ethanol and butane.

- Molecular formula for butane is CH<sub>3</sub>CH<sub>2</sub>OH



- Molecular formula for butane is CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>



- hydrogen electrons
- X carbon (or) oxygen electrons.



## Carbon and its Compounds

## Unit Test - 11

## Carbon and its Compounds

Time : 1 hr

Marks : 30

**I. Choose the most suitable answer and write the code with the corresponding answer.**

5 × 1 = 5

- The IUPAC name of an organic compound is 3-Methyl butan-1-ol. What type of compound it is?
  - Aldehyde
  - Carboxylic acid
  - Ketone
  - Alcohol
- 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  $C_4H_8OH$
- TFM in soaps represents \_\_\_\_\_ content in soap
  - mineral
  - vitamin
  - fatty acid
  - carbohydrate
- Sodalime is a mixture of
  - $NaOH$ ,  $CaCl_2$
  - $Ca(OH)_2$ ,  $NaO$
  - $CaO$ ,  $NaOH$
  - $CaO$ ,  $Mg(OH)_2$
- The substance sodium silicate is used for
  - not damaging the washing machine
  - glow to clothes
  - remove blood stain
  - fragrant smell

**II. Answer the following questions in one or two lines.**

5 × 2 = 10

- Name the simplest ketone and give its structure formula.
- Differentiate soaps and detergents.
- What is homologous series?
- What is Esterification? Write equation for that reaction.
- What is saponification of oil? Write a general equation for it.

**III. Answer the following questions in brief.**

2 × 4 = 8

- Classify the following compounds based on the pattern of carbon chain and give their structural formula: i) Propane, ii) Benzene, iii) Cyclobutane, iv) Furan
- Differentiate soaps and detergents.

**IV. Answer the following questions in detail.**

1 × 7 = 7

- What is the difference in fructose and glucose structures?
- Write the general characteristics of organics compounds.

