

CHAPTER

4

CARBON COMPOUNDS

Syllabus

Covalent bonding in carbon compounds, versatile nature of carbon, homologous series. Nomenclature of carbon compounds containing functional groups (halogens, alcohols, ketones, aldehydes, alkanes and alkynes), difference between saturated and unsaturated hydrocarbons, chemical properties of carbon compounds (combustion, oxidation, addition and substitution reaction). Ethanol and ethanoic acid (only properties and uses), soaps and detergents.

Trend Analysis

List of Concepts	2018	2019		2020	
	OD/D	OD	D	OD	D
Carbon and its properties, Homologous Series and IUPAC Names	1Q (3 M)	1Q (2 M) 1Q (3 M)	1Q (5 M)	1Q (1 M)	1Q (1 M)
Carbon compounds, Soap and Detergents	1Q (2 M)		1Q (5M)	1Q (5 M)	1Q (3 M)



TOPIC - 1

Carbon and its Properties, Homologous Series and IUPAC Names



Revision Notes

Properties of Carbon

- The element carbon is non-metal. Its symbol is C.
- Carbon is a versatile element. The percentage of carbon present in earth's crust in form of mineral is 0.02% and in atmosphere as CO₂ is 0.03%.
- All the living things, like plants and animals are made up of carbon based compounds.
- Carbon always forms covalent bonds.
- The atomic number of carbon is 6.

TOPIC - 1

Carbon and its Properties, Homologous Series and IUPAC Names

TOPIC - 2

Ethanol, Ethanoic acid, Soap and Detergents

➤ **Electronic configuration:**

K L
C (6) 2 4

➤ **How carbon attain noble gas configuration ?**

(i) Carbon is tetravalent in nature. It does not form ionic bond because it has 4 valence electrons, half of an octet. To form ionic bonds, carbon molecules must either gain or lose 4 electrons. It is because, that is difficult to hold four extra electron and would require large amount of energy to remove four electrons. So, carbon can form bond by sharing of its electron with the electrons of other carbon atom or with other element and attain noble gas configuration.

(ii) The atoms of other elements like hydrogen, oxygen, nitrogen and chlorine also form bonds by sharing of electrons.

(iii) The bond formed by sharing of electrons between same or different atoms is covalent bond.

➤ **Covalent Bond:** A covalent bond is formed by sharing of electrons between atoms. In a covalent bond, the shared pair of electrons belongs to the valence shell of both the atoms.

➤ **Conditions for formation of a covalent bond:**

(i) The combining atoms should have 4 to 7 electrons in their valence shell.

(ii) The combining atoms should not lose electrons easily.

(iii) The combining atoms should not gain electrons readily.

(iv) The difference in electronegativity of two bonded atoms should be low.

➤ **Properties of covalent compounds:**

(i) **Physical state:** They are generally liquids or gases. Some covalent compounds may exist as solid.

(ii) **Solubility:** They are generally insoluble in water and other polar solvents but soluble in organic solvents such as benzene, toluene etc.

(iii) **Melting and boiling points:** They generally have low melting and boiling points.

(iv) **Electrical conductivity:** They do not conduct is more apt word instead of electrical current.

➤ **Steps for writing the Lewis dot Structures of a covalent compound:**

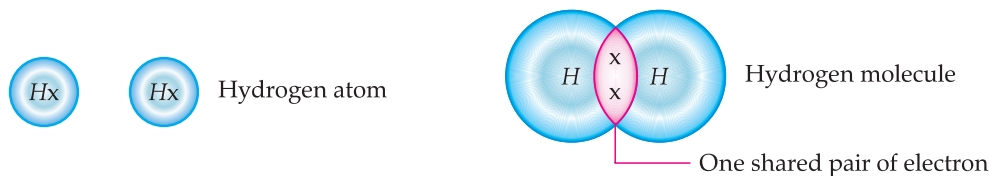
(i) Write the electronic configuration of all the atoms present in the molecule.

(ii) Identify how many electrons are needed by each atom to attain noble gas configuration.

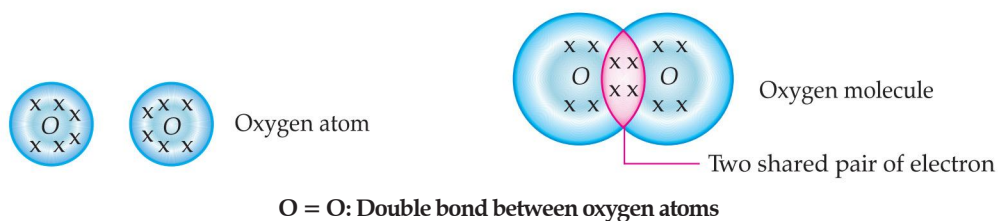
(iii) Share the electrons between atoms in such a way that all the atoms in a molecule have noble gas configuration.

(iv) Keep in mind that the shared electrons are counted in the valence shell of both the atoms sharing it.

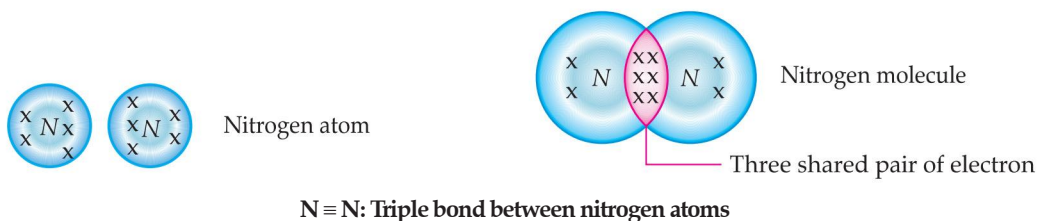
➤ **Examples: (i) H_2**



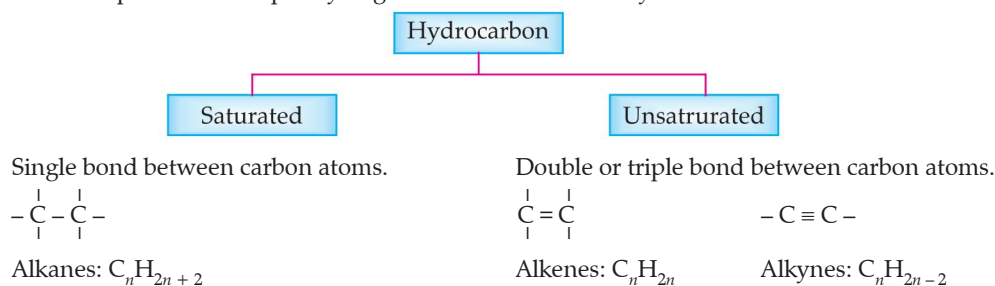
(ii) O_2



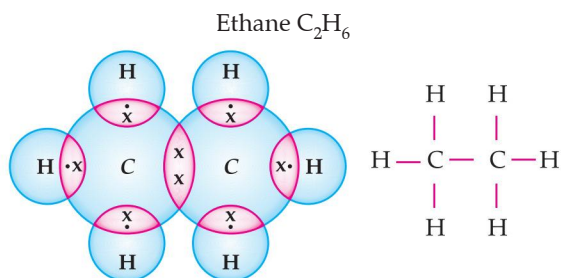
(iii) N_2



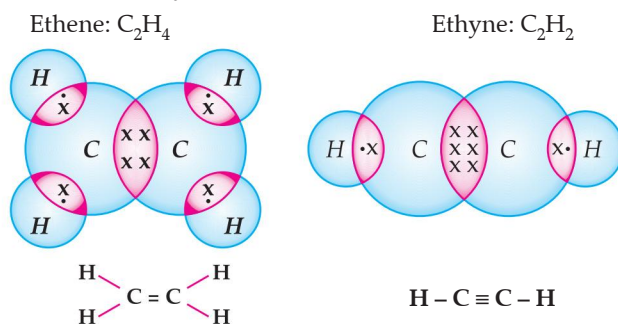
➤ **Hydrocarbon:** Compounds made up of hydrogen and carbon are called hydrocarbon.



➤ **Electron dot structure of saturated hydrocarbons:**



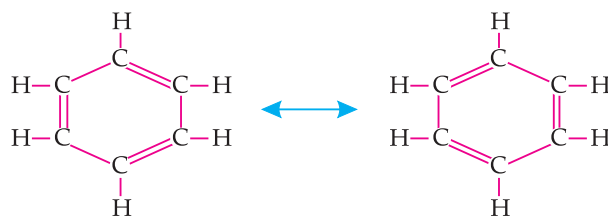
➤ **Electron dot structure of unsaturated hydrocarbons:**



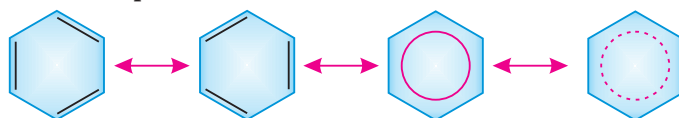
➤ **Cyclic or Closed Chain Hydrocarbons:** These are the hydrocarbons which have carbon - carbon closed chain. They are classified as:

- (i) **Alicyclic hydrocarbons:** These are the hydrocarbons which do not have benzene ring in their structures.
- (ii) **Aromatic hydrocarbons:** The hydrocarbons which have benzene ring in their structures. When hydrogen bonded to carbon of benzene is substituted with halogens, radicals or other functional groups, the derivatives are called aromatic compounds.

- **Benzene:** It is an aromatic hydrocarbon which has the molecular formula C_6H_6 . It has alternating carbon - carbon single and double bonds.



- Benzene can also be represented as:



- IUPAC name of hydrocarbon consists of two parts. It involves:

(i) **Word root:** Number of carbons in the longest carbon chain.

Number of carbon atoms	Word root (Greek name)
1	Meth
2	Eth
3	Prop
4	But
5	Pent
6	Hex
7	Hept
8	Oct
9	Non
10	Dec

(ii) **Suffix:** It depends on the type of carbon - carbon bond, for single bond suffix is -ane; for double bond, suffix is -ene; and for triple bond suffix is -yne.

- **Types of Formula for Writing Hydrocarbons:**

(i) **Molecular formula:** It involves the actual number of each type of atom present in the compound.

(ii) **Structural formula:** The actual arrangement of atoms is written in structural formula.

(iii) **Condensed formula:** It is the shortened form of the structural formula.

- In hydrocarbon chain, one or more hydrogen atom is replaced by other atoms in accordance with their valencies. These are heteroatoms.
- These heteroatoms or group of atoms which make carbon compound reactive and decides its properties are called functional groups.

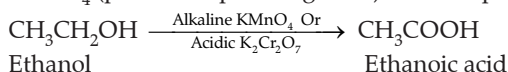
Hetero atom	Functional group	Formula of functional group
Cl/Br	Halo (Chloro/Bromo)	— Cl, — Br, — I
Oxygen	1. Alcohol	— OH
	2. Aldehyde	— CHO
	3. Ketone	$\begin{array}{c} \text{— C —} \\ \\ \text{O} \end{array}$
	4. Carboxylic acid	$\begin{array}{c} \text{O} \\ \\ \text{— C — OH} \end{array}$
Double bond	1. Alkene group	$> \text{C} = \text{C} <$
Triple bond	2. Alkyne group	$\text{— C} \equiv \text{C —}$

- **Homologous Series:** A series of organic compounds in which every succeeding member differs from the previous one by $-\text{CH}_2$ or 14 a.m.u. is called homologous series. The molecular formula of all the members of a homologous series can be derived from a general formula.
- **Properties of a homologous series:** As the molecular mass increases in a series, physical properties of the compounds show a variation, but chemical properties which are determined by a functional group remain the same within a series.
- **Homologous series of alkanes:** General formula: $\text{C}_n\text{H}_{2n+2}$, where n = number of carbon atoms. $\text{CH}_4, \text{C}_2\text{H}_6, \text{C}_3\text{H}_8$.
- **Homologous series of alkenes:** General formula: C_nH_{2n} , where n = number of carbon atoms. $\text{C}_2\text{H}_4, \text{C}_3\text{H}_6, \text{C}_4\text{H}_8$.
- **Homologous series of alkynes:** General formula: $\text{C}_n\text{H}_{2n-2}$, where n = number of carbon atoms. $\text{C}_2\text{H}_2, \text{C}_3\text{H}_4, \text{C}_4\text{H}_6$.
- **Chemical Properties of carbon compounds**

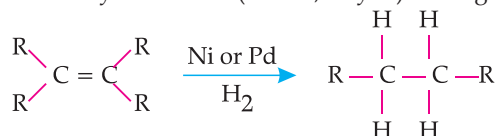
(a) **Combustion:** Carbon compounds burn in air to give carbon dioxide, water, heat and light.



- Carbon and its compounds are used as fuels because they burn in air releasing lot of heat energy.
 - Saturated hydrocarbon generally burn in air with blue and non-sooty flame.
 - Unsaturated hydrocarbon burns in air with yellow sooty flame because percentage of carbon is higher than saturated hydrocarbon which does not get completely oxidized in air.
- (b) **Oxidation:** Alcohols can be converted into carboxylic acid in the presence of oxidizing agent like alkaline KMnO_4 (potassium permanganate) or acidic potassium dichromate $\text{K}_2\text{Cr}_2\text{O}_7$.

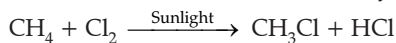


(c) **Addition Reaction:** Unsaturated hydrocarbons (alkene, alkyne) undergo addition reactions.



In unsaturated hydrocarbon, hydrogen added in the presence of catalyst palladium or nickel. Vegetable oils are converted into vegetable ghee using this process. It is also called hydrogenation of vegetable oils.

(d) **Substitution Reaction:** Saturated hydrocarbons undergo substitution reaction in the presence of sunlight.



Mnemonics

Concept: saturated and unsaturated compounds		Concept: homologous series	
Mnemonics: Thank You DeSa		Mnemonics: Monkeys Eat Peeled Bananas	
Interpretation:		Interpretation:	
T: Triple bond	Y: Alkyne	M: Methane (1C)	
D: Double bond	e: Alkene	E: Ethane (2C)	
S: Single bond	a: Alkane	P: Propane (3C)	
		B: Butane (4C)	
Concept: Reaction in saturated and Unsaturated compounds			
Mnemonics: SaSUnA			
Interpretation:			
Sa: Saturated			
S: Substitution			
Un: Unsaturated			
A: Addition			

How is it done on the GREENBOARD?

Q. What is a homologous series of carbon compounds? List its any two characteristics. Write the name and formula of next higher homologous of HCOOH .

Ans. Step I: A group of organic compounds having the same functional group and similar structures in

which any two successive members differ by $-\text{CH}_2$.

Step II: All members have similar chemical properties

Step III: There is gradation in the physical properties. (or any other)

Name — Ethanoic acid/Acetic acid

Formula — CH_3COOH



Objective Type Questions

1 mark each

A

Multiple Choice Questions

Q. 1. Which of the following is not observed in a homologous series? Give reason for your choice.

[SQP 2020]

- (a) Change in chemical properties
- (b) Difference in $-\text{CH}_2$ and 14u molecular mass
- (c) Gradation in physical properties
- (d) Same functional group

Ans. Correct option: (a)

Explanation: Change in chemical properties due to presence of same functional group

Q. 2. Ethane, with the molecular formula C_2H_6 has

- (a) 6 covalent bonds
- (b) 7 covalent bonds
- (c) 8 covalent bonds
- (d) 9 covalent bonds

Ans. Correct option: (b)

Explanation: Ethane has 7 covalent bonds. One bond is between two carbon atoms and rest of the six are between hydrogen atoms.

Q. 3. Carbon forms four covalent bonds by sharing its four valence electrons with four univalent atoms, e.g. hydrogen. After the formation of four bonds, carbon attains the electronic configuration of

- (a) helium
- (b) neon
- (c) argon
- (d) krypton

Ans. Correct option: (b)

Explanation: The nearest inert gas from carbon is Neon and. An element try to attain the electronic configuration of its nearest noble gas while attaining a fully-filled outermost shell.

Q. 4. The correct electron dot structure of a water molecule is

- (a) $\text{H} \cdot \ddot{\text{O}} \cdot \text{H}$
- (b) $\text{H} : \ddot{\text{O}} : \text{H}$
- (c) $\text{H} : \ddot{\text{O}} : \text{H}$
- (d) $\text{H} : \text{O} : \text{H}$

Ans. Correct option: (c)

Explanation: Oxygen has a complete after octet, while each atom of hydrogen has two electrons in outermost shell.

Q. 5. Which among the following are unsaturated hydrocarbons?

- (i) $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_3$
- (ii) $\text{H}_3\text{C}-\text{C}\equiv\text{C}-\text{CH}_3$
- (iii) $\text{H}_3\text{C}-\underset{\text{CH}_3}{\text{CH}}-\text{CH}_3$
- (iv) $\text{H}_3\text{C}-\underset{\text{CH}_3}{\text{C}}=\text{CH}_2$

- (a) (i) and (iii)
- (b) (ii) and (iii)
- (c) (ii) and (iv)
- (d) (iii) and (iv)

Ans. Correct option: (c)

Explanation: Unsaturated hydrocarbons have multiple covalent bonds (double or triple bond) like alkene and alkyne.

Q. 6. Oils on treating with hydrogen in the presence of palladium or nickel catalyst form fats. This is an example of

- (a) Addition reaction
- (b) Substitution reaction
- (c) Displacement reaction
- (d) Oxidation reaction

Ans. Correct option: (a)

Explanation: Hydrogenation reaction means addition of hydrogen to double bonds of unsaturated compounds found in oil in the presence of catalysts such as palladium or nickel to give saturated hydrocarbons. 1

Q. 7. In which of the following compounds, $-\text{OH}$ is the functional group?

- (a) Butanone
- (b) Butanol
- (c) Butanoic acid
- (d) Butanal

Ans. Correct option: (b)

Explanation: Compounds with $-\text{OH}$ functional group are ended with suffix -ol. 1

B Assertions and Reasons Type Questions

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

- Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
- Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
- Assertion (A) is true but reason (R) is false.
- Assertion (A) is false but reason (R) is true.

AI Q. 1. Assertion (A): In a homologous series of alcohols, the formula for the second member is C_2H_5OH and the third member is C_3H_7OH .

Reason (R): The difference between the molecular masses of the two consecutive members of a homologous series is 14u. [AE]

Ans. Correct option: (c)

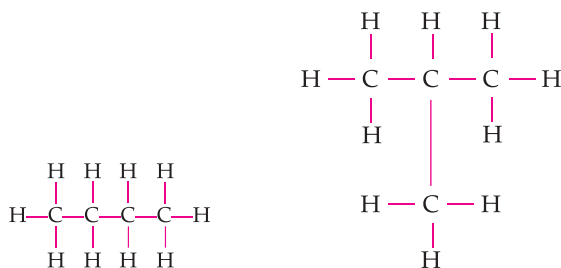
Explanation: In homologous series of alcohols, the formula for the second member is C_2H_5OH and the third member is C_3H_7OH . The difference between the molecular masses of the two consecutive members of a homologous series is 14u.

Q. 2. Assertion (A): Following are the members of a homologous series : CH_3OH , CH_3CH_2OH , $CH_3CH_2CH_2OH$

Reason (R): A series of compounds with same functional group but differing by $-CH_2-$ unit is called a homologous series. [Delhi Set-II, 2020]

Ans. Correct option: (a)

Q. 3. Assertion: Following are the structural isomers of butane.



Reason: Structural isomers have the same molecular formula but they differ in their structures. [Board SQP, 2020]

Ans. Correct option: (a)

Explanation: Isomers are defined as those compounds that possess same molecular formula but different structural arrangement. Butane has the molecular formulae C_4H_{10} . Therefore, the structural isomers of butane will be n-butane and iso-butane.

[1]

Q. 4. Assertion (A): Third member of alkane is propane (C_3H_8)

Reason (R): It is obtained from general formula C_nH_{2n+2}

Ans. Correct option: (a)

Explanation: C_3H_8 can be obtained from general formula, C_nH_{2n+2} . 1

Q. 5. Assertion (A): Iso-butane is the isomer of C_4H_{10} .

Reason (R): Iso-butane has four C and ten-H atom.

Ans. Correct option: (b)

Explanation: $\begin{array}{c} CH_3 \\ | \\ CH_3 - CH - CH_3 \end{array}$ is the structural isomer of butane. 1

Q. 6. Assertion (A): CH_3Cl is obtained from CH_4 by the action of Cl_2 in the presence of sunlight.

Reason (R): It is obtained by addition reaction.

Ans. Correct option: (c)

Explanation: CH_3Cl is obtained from CH_4 by substitution reaction by the action of Cl_2 in the presence of sunlight. 1

Q. 7. Assertion (A): Most of the carbon compounds are good conductors of electricity.

Reason (R): They do not dissociate to form ions and remain as molecules.

Ans. Correct option: (d)

Explanation: Carbon compounds are mainly poor conductors of electricity. 1

C Very Short Answer Type Questions

Q. 1. Define catenation. [R] [Board SQP, 2020]

Ans. The property of self-linking of atoms of an element through covalent bonds in order to form straight chain, branched chains or cyclic chains of different sizes is called catenation. 1

[CBSE SQP Marking Scheme, 2020]

Q. 2. Name a cyclic unsaturated carbon compound. [R]

Ans. Benzene. [CBSE, 2020] 1

AI Q. 3. Name the functional group present in propanone. [CBSE Delhi Set-II, 2020] [R]

Ans. Ketone. 1

Q. 4. How are covalent bonds formed ?

[CBSE OD Set-I, 2020] [R]

Ans. Covalent bonds are formed by the sharing of electrons between the atoms. 1

AI Q. 5. Write the molecular formula of first two members of homologous series having function group $-Cl$. [U] [Delhi 31/1/1, 2017]

Ans. The molecular formula of first two consecutive members of this series is:

CH_3Cl (Chloromethane)

C_2H_5Cl (Chloroethane)

$\frac{1}{2} + \frac{1}{2}$

Q. 6. Write the molecular formula of the 2nd and the 3rd member of the homologous series whose first member is methane.

[AE] [CBSE OD 31/1, 2017]
[SA-II, OD. Set-I, 2017]

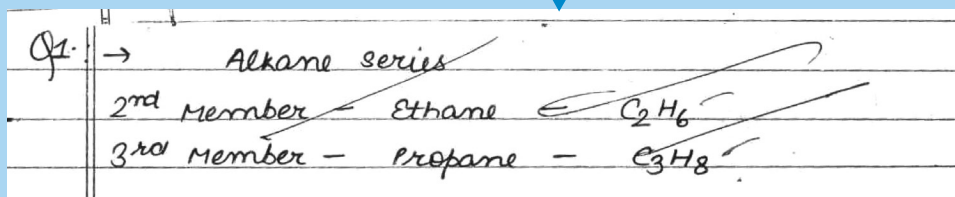
Ans. Ethane (C₂H₆)

Propane (C₃H₈)

½ + ½



Topper Answer, 2017



COMMONLY MADE ERROR

- ➔ Usually students get confused between the first few members of alkane, alkene and alkyne series.

ANSWERING TIP

- ➔ Learn and practice the first few members of alkane, alkene and alkyne series with their formulae.

Q. 7. Write the molecular formula of first two members of homologous series having functional group -Br.

Ans. CH₃Br, C₂H₅Br

1

[CBSE Marking Scheme, 2017]

[AI] Q. 8. Write the molecular formula of the 2nd and 3rd member of the homologous series whose first member is ethene.

[C]

Ans. C₃H₆ and C₄H₈

1

[CBSE Marking Scheme, 2017]

Q. 9. Write the molecular formula of the 2nd member of the homologous series where the first member is ethyne.

[U] [CBSE OD Set-III, 2017]

Ans. C₃H₄, C₄H₆

1

[CBSE Marking Scheme, 2017]

Q. 10. What is a homologous series of carbon compounds?

[R] [Board Term II, Foreign Set-II, 2016]

Ans. A homologous series is the family of organic compound having the same functional group, and the successive (adjacent) members of which differ by CH₂ unit or 14 mass unit.

1

[CBSE Marking Scheme, 2016]

Q. 11. Write the next homologue of each of the following:

(i) C₂H₄

(ii) C₄H₆

[U] [Board Term II, Delhi Set-I, 2016]

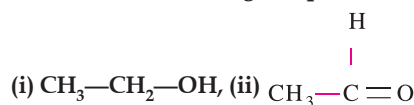
Ans. (i) C₃H₆

(ii) C₅H₈

½ + ½

[CBSE Marking Scheme, 2016]

Q. 12. Name the following compounds:



[C] [Board Term II, Delhi Set-I, 2016]

Ans. (i) Ethanol, (ii) Ethanal.

½ + ½

[CBSE Marking Scheme, 2016]

Q. 13. Which element exhibits the property of catenation to maximum extent and why?

[U] [Board Term II, Delhi Set-I, 2016]

Ans. Carbon, due to strong C—C bond.

1

[CBSE Marking Scheme, 2016]

[AI] Q. 14. Select saturated hydrocarbons from the followings: C₃H₆, C₅H₁₀, C₄H₁₀, C₆H₁₄, C₂H₄

[A] [Board Term II, Delhi Set-III, 2016]

Ans. C₄H₁₀, C₆H₁₄

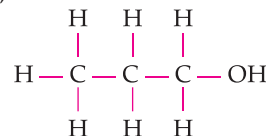
½ + ½

[CBSE Marking Scheme, 2016]

Q. 15. Write the name and structure of an alcohol with three carbon atoms in its molecule.

[C] [Board Term II, O.D. Set-I, 2016]

Ans. Propanol,



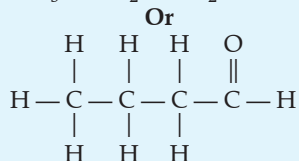
Or CH₃—CH₂—CH₂—OH

1

Q. 16. Write the name and structure of an aldehyde with four carbon atoms in its molecule.

[C] [Board Term II, OD. Set-III, 2016]

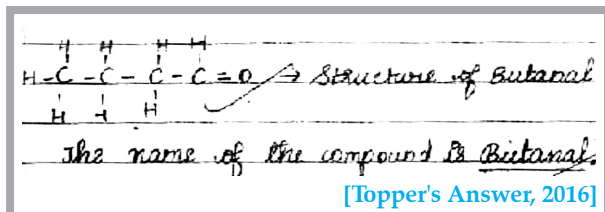
Ans. Butanal, $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CHO}$



1

[CBSE Marking Scheme, 2016]

OR



[Topper's Answer, 2016]

COMMONLY MADE ERROR

- ➔ Sometimes students get confused and do mistakes while writing the structure, its name and also with the functional group involved.

ANSWERING TIP

- ➔ Please understand the basic concept of functional groups. Drawing structures and practicing them is mandatory.

AI Q. 17. Name the process of converting vegetable oil to vegetable ghee. **R** [Board Term II SQP, 2016]

OR

Name the process by which unsaturated fats gets changed to saturated fats.

R [Board Term II Foreign Set-I, 2015]

Ans. Hydrogenation.

1

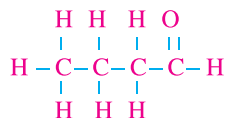
[CBSE Marking Scheme, 2016]

Q. 18. Write the name and structure of an aldehyde with four carbon atoms in its molecule. **AE**

[CBSE OD, 2016]

Ans. Butanal, $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CHO}$

OR



AI Q. 19. Write the name and formula of the 2nd member of homologous series having general formula C_nH_{2n} . **A** [Delhi Set-I, 2015]

Ans. Name: Propene

Formula: C_3H_6

$\frac{1}{2} + \frac{1}{2}$

[CBSE Marking Scheme, 2015]

Q. 20. Write the number of covalent bonds in the molecule of ethane.

U [Board Term II O.D. Set-I, 2015]

Ans. Seven covalent bonds.

1

[CBSE Marking Scheme, 2015]

COMMONLY MADE ERROR

- ➔ Students do mistakes in counting the covalent bonds in the structure. They must remember a covalent bond between two carbon atoms too.

ANSWERING TIP

- ➔ Draw the structure and count the covalent bonds by numbering them.



Short Answer Type Questions-I

2 marks each

Q. 1. Give a test that can be used to confirm the presence of carbon in a compound. With a valency of 4, how is carbon able to attain noble gas configuration in its compounds? **C** [SQP 2020]

Ans. Burn compound in air/ oxygen;

Gas evolved turns lime water milky - By sharing its four valence electrons with other elements.

Q. 2. The number of carbon compounds is more than those formed by all other elements put together. Justify the statement by giving two reasons.

U [SQP 2020]

Ans. (i) Due to self linking ability of carbon/catenation.

(ii) Since carbon has a valency of four it can form bonds with four other atoms of carbon or atoms of some other mono-valent element.

(iii) Due to small size of carbon it forms very strong and (or) stable bonds with other elements.

Q. 3. Unsaturated hydrocarbons contain multiple bonds between two carbon atoms and these compounds show addition reactions. Out of saturated and unsaturated carbon compounds, which compounds are more reactive? Write a test to distinguish ethane from ethene. **AE**

[CBSE OD, III 2019]

Ans. Unsaturated compounds are more reactive. 1
 Test: Bayer's reagent test / Bromine water test given by ethene and not by ethane / Ethane gives clear

flame while ethene gives a yellow flame with lots of black smoke. (any one test) 1

[CBSE Marking Scheme, 2019]

Q. 4. On dropping a small piece of sodium in a test-tube containing carbon compound 'X' with molecular formula C_2H_6O , a brisk effervescence is

observed and a gas 'Y' is produced. On bringing a burning splinter at the mouth of the test-tube the gas evolved burns with a pop sound. Identify 'X' and 'Y'. Also write the chemical equation for the reaction. Write the name and structure of the product formed, when you heat 'X' with excess conc. sulphuric acid. [AE] [CBSE OD Set -3, 2016]

Ans. X — C_2H_5OH ; Y — H_2 gas



Ethene; C_2H_4 $\frac{1}{2} + \frac{1}{2}$

✓ Short Answer Type Questions-II

3 marks each

Q. 1. What is a homologous series of carbon compounds? Give an example and list its three characteristics.

[R] [Outside Delhi, Set-I, 2019]

Ans. A series of compounds in which the same functional group substitutes for hydrogen in a carbon chain is called a homologous series. 1

Example: Alkane / Alkene / Alkyne / Alcohol or any other one correct example. $\frac{1}{2}$

Characteristics:

- (i) They have same general formula.
- (ii) They have same functional group.
- (iii) The difference in the molecular mass of two successive member in $14u$.
- (iv) The difference in the molecular formula of two successive member is of CH_2 unit.
- (v) They have similar chemical properties.

(Any three points) $\frac{1}{2} \times 3$

[CBSE Marking Scheme, 2019]

Q. 2. Which compounds are called (i) alkanes, (ii) alkenes and (iii) alkynes? C_4H_{10} belongs to which of these? Draw two structural isomers of this compound.

[R] [Board Outside Delhi, Set- II, 2019]

Ans. • Alkane

Saturated hydrocarbon with C—C single bond

• **Alkene**

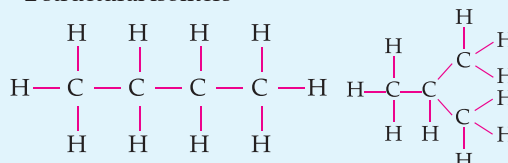
Unsaturated Hydrocarbon with double bond in $C=C$

• **Alkyne**

Unsaturated Hydrocarbon with triple bond in $C \equiv C$ (or any other) $\frac{1}{2} \times 3$

• **Alkane**

2 structural isomers $\frac{1}{2}$



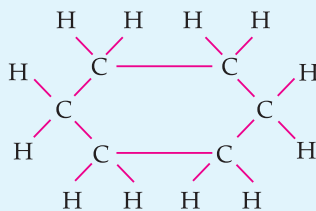
[CBSE Marking Scheme, 2019] $\frac{1}{2} + \frac{1}{2}$

Q. 3.(a) Why most of the carbon compounds are poor conductor of electricity?

(b) Write the name and structure of a saturated compound in which the carbon atoms are arranged in a ring. Give the number of single bonds present in this compound. [U] + [R] [Delhi/Outside Delhi, 2018]

Ans. (a) Carbon compounds form covalent bonds/do not dissociate into ions/do not have charged particles (ions)

(b) Cyclohexane



Total no. of single bonds = 18

(OR any other cycloalkane with corresponding number of bonds) [CBSE Marking Scheme, 2018] 1 + 1 + 1

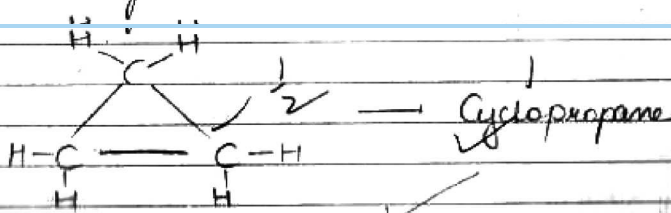
Or



Topper Answer, 2018

Ans.

(3) (a) Carbon compounds are covalently bonded and hence the bond is formed by sharing of 1 electron between two or more combining atoms. Due to this, they don't form any ions or charged particles within the solution nor they give free electrons. As we know, conduction of electricity requires flow of free electrons in solids & ions in fluids, they don't conduct electricity.

(b) 

Structure

Name of the structure :-
Cyclopropane

No. of single bonds :- '9' single covalent bonds

COMMONLY MADE ERROR

- Students usually get confused in the structure and the number of single bonds present in the compound.

ANSWERING TIP

- Practice the structure of different compounds involved in the homologous series.

Q. 4. What happens when hydrogen is added to a vegetable oil in the presence of nickel? Name the reaction and write one difference between the physical property of the vegetable oil and the product obtained in this reaction. Write the role of nickel in this reaction.

© [Comptt. Set 1, 2, 3, 2018]

- Ans. (i) Vegetable oil is converted into saturated fat. $\frac{1}{2}$
(ii) The reaction is Hydrogenation 1
(iii) Unsaturated vegetable oil is liquid and saturated fat is solid at room temperature 1
(iv) Nickel acts as a catalyst. $\frac{1}{2}$

[CBSE Marking Scheme, 2018]

COMMONLY MADE ERROR

- Students write irrelevant answers. Be specific. Read question carefully and write only what is asked.

ANSWERING TIP

- Do not overlook any part of a question and avoid being in a hurry to conclude the answer.

AI Q. 5. What are covalent compounds? How are they different from ionic compounds? List any two properties of covalent compounds.

A [CBSE OD Comptt., 2017]

Ans. The compounds that are formed due to sharing of electrons between two atoms/compounds having covalent bonds. 1

Ionic compounds are formed due to transfer of electrons from one atom to another/compounds having ionic bonds/compounds having attraction between oppositely charged ions 1

(i) They are poor conductors of electricity ½

(ii) They have low melting and boiling point. ½

(or any other)

[CBSE Marking Scheme, 2017]

Q. 6. Give reason why carbon can neither form C^{4+} cations nor C^{4-} anions, but forms covalent compounds. Also, state the reason to explain why covalent compounds are bad conductors of electricity and have low melting and boiling points? **AE** [Delhi Set Comptt. II, 2017]

Ans. Carbon cannot form C^{4+} cation because removal of 4 electrons from a carbon atom would require a large amount of energy. ½

Carbon cannot form C^{4-} anion because it would be difficult for the nucleus with 6 protons to hold on to 10 electrons. ½

Hence, carbon atoms share electrons forming covalent compounds 1

Covalent compounds do not form ions/ charged particles and therefore do not conduct electricity. ½

Inter molecular forces of attraction are weak, hence they have low melting and boiling points. ½

[CBSE Marking Scheme, 2017]



Topper Answer, 2017

18:

a) Carbon has a tetra valency but can't gain or lose electrons because — .

① If it gains 4 electrons, it will C^{4-} negative charge. It is very difficult for 4 protons to hold on to 8 electrons and it becomes unstable.

② If it loses 4 electrons, it requires a lot of energy to lose it which it can't afford and again becomes unstable.

(i) Covalent bonds are formed by sharing of electrons and share them as molecules, so no transfer of ~~electrons~~ electrons or involvement of ions takes place.

Since ions are responsible for conducting electricity and they do not have free ions, so they are bad conductors of electricity.
eg. CCl_4 , H_2 , CH_4 etc.

(ii) Since the molecules of 2 different elements share electrons, they have weak forces of attraction and weak electrostatic forces due to which their bond can be broken easily.

The bonds are strong within the molecule but inter ionic bonds are weak making them have low melting and boiling points. eg. Naphthalene has a melting point of about 80°C.

Q. 7. Two carbon compounds X and Y have the molecular formula C_4H_8 and C_5H_{12} respectively. Which one of these is most likely to show addition reaction? Justify your answer. Also, give the chemical equation to explain the process of addition reaction in this case. [AE] [Delhi 31/1/2017]

Ans. C_4H_8 , it is an unsaturated hydrocarbon due to the presence of a double bond. 1 + 1



$\frac{1}{2}$ Equation
(or any other) $\frac{1}{2} + \frac{1}{2}$

[CBSE Marking Scheme, 2017]

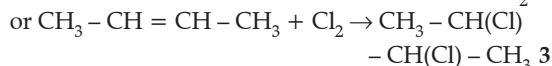
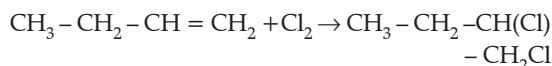
Detailed Answer:

Saturated compound — C_5H_{12} (Compound Y) undergo substitution reaction.

Unsaturated compound — C_4H_8 (Compound X) undergo addition reaction at the multiple bonds.

For example, 1-butene and 2-butene will add a chlorine molecule (Cl_2) to form 1, 2-dichlorobutane and 2, 3-dichlorobutane respectively.

The reaction will be:



COMMONLY MADE ERROR

- ➔ Generally students get confused between saturated and unsaturated compounds and their molecular formula.

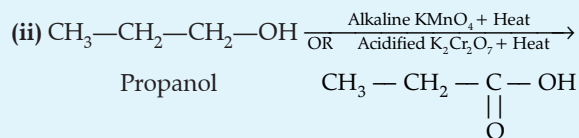
ANSWERING TIP

- ➔ Be clear with basic concepts, saturated and unsaturated compounds, their molecular formulas. Also remember how saturated and unsaturated compounds react differently.

Q. 8. What is an oxidising agent? What happens when an oxidising agent is added to propanol? Explain with the help of a chemical equation.

[A] [Delhi Set-II, 2016] [DDE 2017]

Ans. (i) It is a substance which can give oxygen to other substances. 1



Propanol Propanoic acid 1

(iii) Propanol is oxidised to Propanoic acid. 1

[CBSE Marking Scheme, 2016]

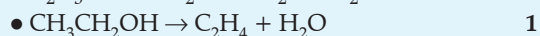
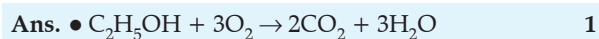
Q. 9. What happens when (write chemical equation in each case)

(a) ethanol is burnt in air?

(b) ethanol is heated with excess conc. H_2SO_4 at 443 K?

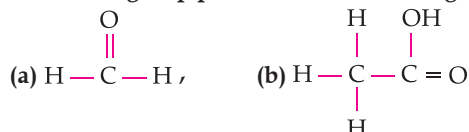
(c) a piece of sodium is dropped into ethanol?

[CBSE OD Set-II, 2017]



[CBSE Marking Scheme, 2017]

Q. 10. (i) Define the term functional group. Identify the functional group present in the following:



(ii) What happens when 5% alkaline $KMnO_4$ solution is added drop by drop to warm ethanol taken in a test-tube? State the role of alkaline $KMnO_4$ solution in this reaction.

[U] [Board Term II Foreign Set-I, 2016]

Ans. (i) **Functional group:** Hetero atom or group of atoms attached to the carbon chain, which gives specific properties to the compounds, is called a functional group. 1

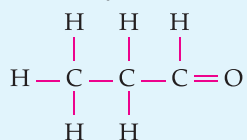
(a) Aldehyde group, (b) Carboxylic acid $\frac{1}{2} + \frac{1}{2}$

(ii) Acetic/Ethanoic acid is formed. It is an oxidizing agent. $\frac{1}{2} + \frac{1}{2}$

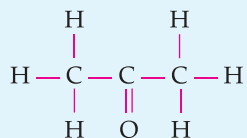
[CBSE Marking Scheme, 2016]

Q. 11. An aldehyde as well as a ketone can be represented by the same molecular formula, say C_3H_6O . Write their structures and name them. State the scientific relation between the two. [A] [OD. Set-I, 2016]

Ans. (i) Propanal (aldehyde); $\frac{1}{2} + \frac{1}{2}$



(ii) Propanone (Ketone); $\frac{1}{2} + \frac{1}{2}$



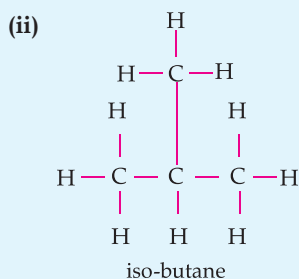
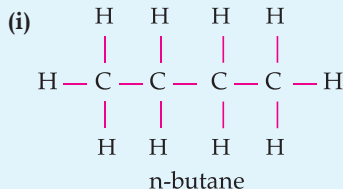
(iii) Isomers (same molecular formula but different structural formula/different functional group) 1

[CBSE Marking Scheme, 2016]

Q. 12. What is meant by isomers? Draw the structure of two isomers of butane, C_4H_{10} . Explain why we cannot have isomers of first three members of alkane series. [AE] [Board Term II, Delhi Set-I, 2015]

Ans. Isomers are the compounds which have the same molecular formula but different structural formula.

Isomers of Butane:



We cannot have isomers of the first three members of the alkane series because of the following laws of isomers:

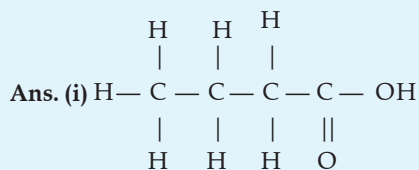
- The parent chain should have the most number of carbon atoms.
- The branching cannot be done from the first and the last carbon atom of the structure. 1+1+1

[CBSE Marking Scheme, 2015]

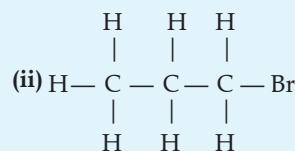
AI Q. 13. Draw the structures of the following compounds and identify the functional group present in them:

- Butanoic acid
- Bromopropane
- Butyne

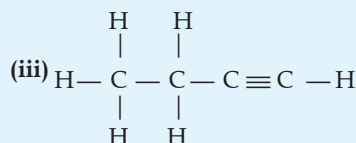
[AE] [Board Term-II, 2015]



Carboxylic group – COOH



Halogen atom – Br



Triple bond – $\text{C}\equiv\text{C}$ –

[CBSE Marking Scheme, 2015] 1+1+1

COMMONLY MADE ERROR

- ➔ Students mostly commit errors in writing structural formulae.

ANSWERING TIP

- ➔ Sufficient practice must be taken to write the structural formulae of organic compounds with correct functional groups.

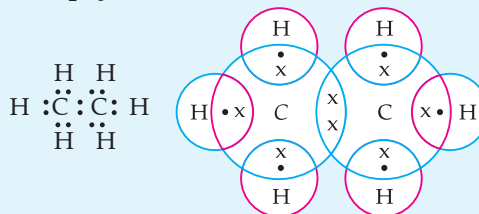
Q. 14. Write the molecular formula of the following compounds and draw their electron-dot structures:

- Ethane
- Ethene
- Ethyne

[C] [Foreign Set-I, 2015]

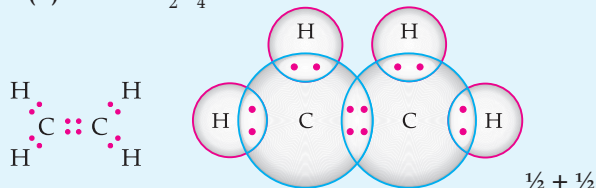
Ans.

(i) Ethane: C_2H_6

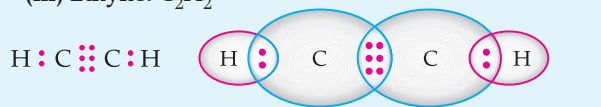


$\frac{1}{2} + \frac{1}{2}$

(ii) Ethene: C_2H_4



(iii) Ethyne: C_2H_2



[CBSE Marking Scheme, 2015] $\frac{1}{2} + \frac{1}{2}$

COMMONLY MADE ERROR

- Students often make mistake while drawing electron dot structures.

ANSWERING TIP

- Understand the basic concepts involved in drawing the dot structure. Make sure that you have made dots for all shared bonds.

Q. 15. Explain the following:

- CH_3COOH is a weak acid.
- Propene undergoes addition reaction.
- The gas stoves have inlets for air.

[A] [Board Term II, 2015]

Ans. (i) Due to the incomplete ionization of acetic (CH_3COOH) acid.

(ii) $CH_3-CH=CH_2$ (Propene) undergoes addition reaction because of double bond.

(iii) To supply sufficient oxygen for complete combustion.

[CBSE Marking Scheme, 2015] 1+1+1

Long Answer Type Questions

5 marks each

Q. 1. The formulae of four organic compounds are given below:

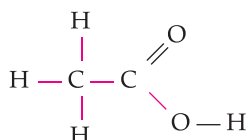
A	B	C	D
C_2H_4	CH_3COOH	C_2H_5OH	C_2H_6

- Which one of these compounds A, B, C or D is a saturated hydrocarbon?
- Identify the organic acid and give its structural formula.
- Which of the above compounds when heated at 443K in the presence of concentrated H_2SO_4 forms ethene as the major product? What is the role played by concentrated H_2SO_4 in this reaction? Also, write the chemical equation involved.
- Give a chemical equation when B and C react with each other in presence of concentrated H_2SO_4 . Name the major product formed and mention one of its important use. [A] [Board SQP, 2020]

Ans. (i) D is a saturated hydrocarbon.

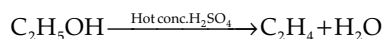
(ii) B is an organic acid.

Structural formula:



(iii) C is an alcohol.

conc. H_2SO_4 acts as a dehydrating agent and remove a water molecule from ethanol.



(iv) $CH_3COOH + C_2H_5OH \xrightarrow{\text{conc } H_2SO_4} CH_3COOC_2H_5 + H_2O$

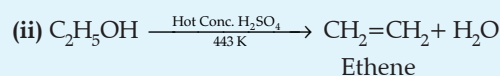
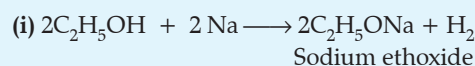
Major product is an ester and it is used in making perfumes / flavouring agents. $\frac{1}{2} + 1 + 2 + 1 \frac{1}{2}$

Q. 2. Write the chemical formula and name of the compound which is the active ingredient of all alcoholic drinks. List its two uses. Write chemical equation and name of the product formed when this compound reacts with: (i) sodium metal (ii) hot concentrated sulphuric acid.

[R] [CBSE Board Delhi, Set-I, 2019]

Ans. • C_2H_5OH , Ethanol/Ethyl alcohol

• Good solvent; used in medicines (Any other)



[CBSE Marking Scheme, 2019] 1+1+1+ $\frac{1}{2}$ + 1 + $\frac{1}{2}$

Detailed Answer:

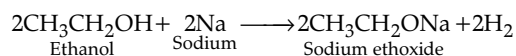
Ethanol with chemical formula: CH_3CH_2OH is an active ingredient of all alcoholic drinks. 1

Two uses are:

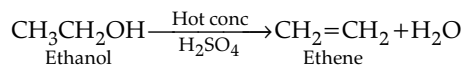
- It is used in the manufacture of paints and varnishes.
- It is used in medical swabs and hand sanitizers. 2

Chemical reactions of ethanol:

(i) With sodium metal:



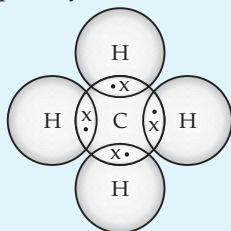
(ii) With hot concentrated sulphuric acid:



Q. 3. What is methane ? Draw its electron dot structure. Name the type of bonds formed in this compound. Why are such compounds: (i) poor conductors of electricity and (ii) have low melting and boiling points ? What happens when this compound burns in oxygen ?

[R] + [A] [CBSE Board Delhi, Set- I, 2019]

Ans. • CH_4 /Simplest hydrocarbon

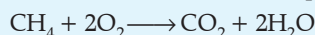


• Covalent bonds

(i) No ions or charged particles are formed

(ii) Due to weak covalent bonds

• Carbon dioxide and water are produced/



[CBSE Marking Scheme, 2019] $\frac{1}{2} + 1 + \frac{1}{2} + 1 + 1 + 1$

Detailed Answer:

Methane is a colourless and highly flammable gas produced on decomposition of vegetation naturally in marshlands. It is the simplest hydrocarbon (CH_4).

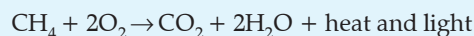
Electron dot structure:

All the bonds present between four hydrogen atoms and one carbon atom at the centre are covalent bonds.

(i) Methane is a poor conductor of electricity as all the bonds present are covalent bonds. Hence, no free electrons are available for conduction of electricity.

(ii) As force of attraction between the molecules are not very strong in covalently bonded carbon compounds, therefore, methane being a covalent compound has very low melting and boiling point.

When methane burns in oxygen, carbon dioxide, water and large amount of heat and light is released.



[CBSE Marking Scheme, 2019] 1+1+1+1+1

Q. 4. Why are certain compounds called hydrocarbons ? Write the general formula for homologous series of alkanes, alkenes and alkynes and also draw the structure of the first member of each series. Write the name of the reaction that converts alkenes into alkanes and also write a chemical equation to show the necessary conditions for the reaction to occur. [U] [OD Set-1 2017]

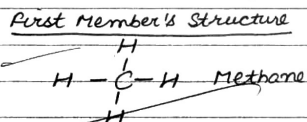


Topper Answer, 2017

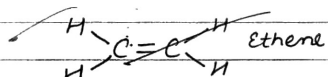
Ans.

Compounds containing carbon & hydrogen are called hydrocarbons. Oxides, carbonates, hydrogen carbonates of carbon are not called hydrocarbons as they are inorganic compounds.

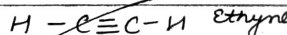
General Formula
Alkanes $\text{C}_n\text{H}_{2n+2}$
where $n = 1, 2, 3, \dots$



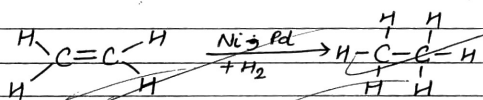
Alkenes C_nH_{2n}
where $n = 2, 3, \dots$



Alkynes $\text{C}_n\text{H}_{2n-2}$
where $n = 2, 3, \dots$



Addition Reaction converts alkenes to alkanes
(unsaturated) (saturated)



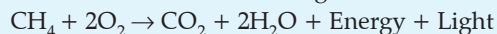
Reactions occur at high temperature & in presence of catalysts such as nickel or palladium.

AI Q. 5. Describe the following chemical properties of carbon compounds briefly and give one chemical reaction for each:

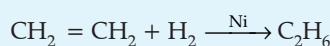
- (i) Combustion
- (ii) Addition
- (iii) Substitution
- (iv) Esterification
- (v) Oxidation

R [CBSE, 2016]

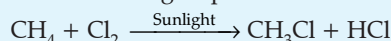
Ans. (i) Combustion: 'This reaction involves burning of carbon compounds releasing carbon dioxide and water with excess heat and light'



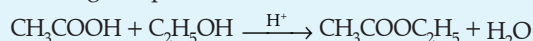
(ii) Addition: It is the reaction in which unsaturated compound reacts with hydrogen in presence of nickel as a catalyst to form saturated compound.'



(iii) Substitution: This is a reaction in which an atom or group of atoms of a compound are replaced by other atom or group of atoms.



(iv) Esterification: Reaction between an acid and an alcohol, where acid is catalysed to form sweet-smelling compound called esters.



(v) Oxidation: When there is an addition of oxygen in the reaction, it is known as oxidation reaction. This reaction takes place in the presence of oxidising agents.



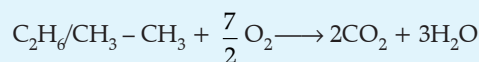
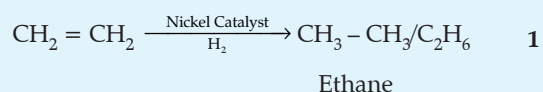
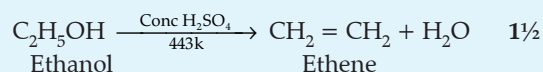
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[CBSE Marking Scheme, 2016]

Q. 6. A carbon compound 'P' on heating with excess conc. H_2SO_4 forms another carbon compound 'Q' which on addition of hydrogen in the presence of nickel catalyst forms a saturated carbon compound 'R'. One molecule of 'R' on combustion forms two molecules of carbon dioxide and three molecules of water. Identify P, Q and R and write chemical equations for the reactions involved.

C [CBSE O.D. Set-I, 2016]

Ans. P = Ethanol/ $\text{C}_2\text{H}_5\text{OH}$, Q = Ethene/ $\text{CH}_2 = \text{CH}_2$, R = Ethane/ C_2H_6 3 × ½

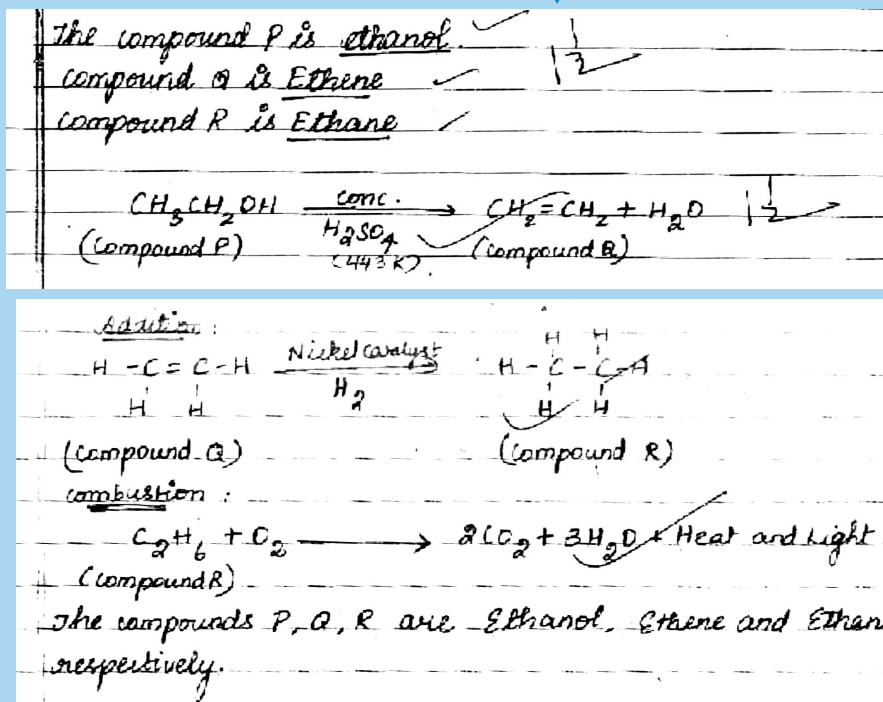


[CBSE Marking Scheme, 2016] 1



Topper Answer, 2017

Ans.



Q. 7. (i) Give a chemical test to distinguish between saturated and unsaturated hydrocarbon.

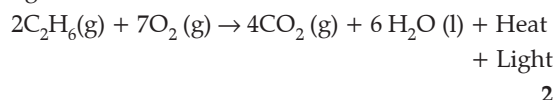
(ii) Name the products formed when ethane burns in air. Write the balanced chemical equation for the reaction showing the types of energies liberated.

(iii) Why is reaction between methane and chlorine in the presence of sunlight considered a substitution reaction ?

[U] [OD Comptt., 2017] [Delhi Set-I, 2015]

Ans. (i) Pass the vapours of the given samples of saturated and unsaturated hydrocarbons into bromine water taken in two separate test-tubes. The one which discharges the colour of bromine water is that of unsaturated hydrocarbon and the other represents saturated hydrocarbon. (Or any other test) 2

(ii) On burning ethane in air, the products obtained are carbon dioxide and water, along with heat and light.



(iii) It is considered a substitution reaction because the hydrogen atoms of methane (CH_4) are replaced by chlorine atoms one by one. 1

Q. 8. Describe the addition reaction of carbon compounds with its application. State the function of catalyst in this reaction. How this reaction is different from a substitution reaction?

[U] [Board Term II, Delhi, 2015]

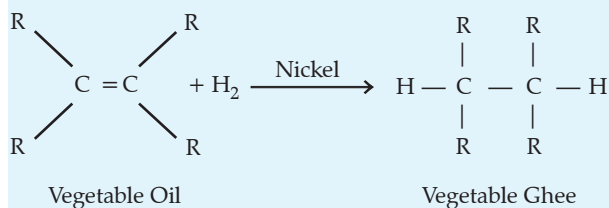
Ans. When any molecule like H_2 adds to unsaturated hydrocarbon because of double and triple bond in the presence of Ni as catalyst, it is called addition reaction.



Use: Hydrogenation of vegetable oils in the presence of Ni as catalyst. 2

Catalyst: Increases the rate of reaction. 1

Hydrogenation reaction: It is the process in which unsaturated compound reacts with hydrogen in presence of nickel as a catalyst to form saturated compound.



[CBSE Marking Scheme, 2015] 2



TOPIC - 2

Ethanol, Ethanoic acid, Soap and Detergents

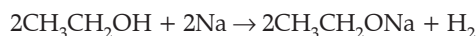


Revision Notes

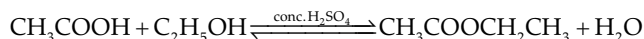
➤ Ethanol:

• Chemical Properties:

(i) **Reaction with sodium:** Formation of sodium ethoxide and hydrogen.



(ii) **Reaction with acid:** Formation of ester (ethyl ethanoate) – a sweet smelling ester. This process is called esterification.



• **Uses:** In preparation of soap, cosmetics, in alcoholic beverages, in medicines, in laboratory reagent.

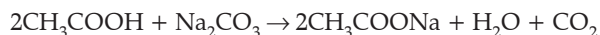
➤ Ethanoic acid:

• Vinegar — 5-8 % solution of acetic acid in water.

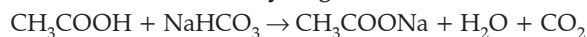
• Glacial acetic acid — Pure acetic acid

• Chemical Properties of ethanoic acid

(i) **Reaction with sodium carbonate:**

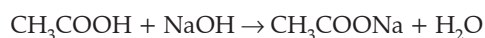


(ii) **Reaction with sodium hydrogen carbonate:**

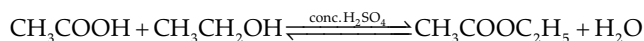


Brisk effervescence marks the presence of carbon dioxide.

(iii) **Reaction with NaOH:**

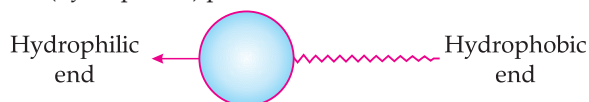


(iv) Reaction with ethanol (Esterification):



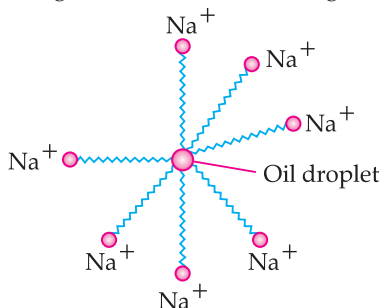
On hydrolysis, ester gives parent alcohol and sodium salt of carboxylic acid. Alkaline hydrolysis of ester is called saponification.

- Soap is sodium or potassium salt of long chain carboxylic acid. *e.g.*, $\text{C}_{17}\text{H}_{35}\text{COONa}^+$
- Soaps are effective only in soft water.
- Detergents are ammonium or sulphonate salt of long chain of carboxylic acid.
- Detergents are effective in both hard and soft water.
- **Soap molecule has:**
 - (i) Ionic (hydrophilic) part
 - (ii) Long hydrocarbon chain (hydrophobic) part



Structure of soap molecule

- **Cleansing Action of Soap:** Most dirt is oily in nature. The hydrophobic end of soap molecule attaches itself with dirt and the ionic end is surrounded with molecule of water. This results in formation of a radial structure called micelles.
- Soap micelles help to dissolve dirt and grease in water and cloth gets cleaned.



- The magnesium and calcium salt present in hard water reacts with soap molecule to form insoluble product called scum. This scum creates difficulty in cleansing action.
- By use of detergent, insoluble scum is not formed with hard water and clothes get cleaned effectively.

How is it done on the GREENBOARD?

Q. What are micelles? Why does it form when soap is added to water? Will a micelle be formed in other solvents such as ethanol also? State briefly how the formation of micelles help to clean the clothes having oily spots.

Ans. Step I: Soap molecules have two ends— one end is the hydrocarbon chain which is water repellent, whereas the other end is the ionic part that is water soluble end. When soap is dissolved in water it forms a

group of many molecules, known as micelle. 1

Step II: These micelles are formed because their hydrocarbon chains come together and the polar ends are projected outwards that help to remove oily spots from clothes. 1

Step III: Micelle formation in ethanol will not occur because the hydrocarbon chain end of the soap will dissolve in ethanol. 1



Objective Type Questions

1 mark each

A Multiple Choice Questions

Q. 1. When sodium hydrogen carbonate is added to ethanoic acid a gas evolves. Consider the following statements about the gas evolved.

- (a) It turns lime water milky.
- (b) It is evolved with a brisk effervescence.
- (c) It has a smell of burning sulphur.
- (d) It is also a by-product of respiration.

The correct statements are :

- (a) (A) and (B) only
- (b) (B) and (D) only
- (c) (A), (C) and (D)
- (d) (A), (B) and (D) [CBSE Delhi Set-III, 2020]

Ans. Correct option: (d)

Explanation: (A), (B) and (D). The gas evolved is carbon dioxide with brisk effervescence. It turns lime water milky. It is also a by-product of respiration.

Q. 2. While studying the saponification reaction, what do you observe when you mix an equal amount of colourless vegetable oil and 20% aqueous solution of NaOH in a beaker?

- (a) The colour of the mixture has become dark brown
- (b) A brisk effervescence is taking place in the beaker
- (c) The outer surface of the beaker has become hot
- (d) The outer surface of the beaker has become cold

[CBSE Board, All India Region, 2017]

Ans. Correct option: (c)

Explanation: The beaker becomes hot because it is an exothermic reaction.

Q. 3. When you add a few drops of acetic acid to a test-tube containing sodium bicarbonate powder, which one of the following is your observation ?

- (a) No reaction takes place.
- (b) A colourless gas with pungent smell is released with brisk effervescence.
- (c) A brown coloured gas is released with brisk effervescence.
- (d) Formation of bubbles of a colourless and odourless gas.

[AE] [SA-II, OD. Set-I, 2017]

Ans.

(D) Formation of bubbles of a colourless and odourless gas.

[Topper's Answer, 2017]

Q. 4. In the soap micelles

- (a) the ionic end of soap is on the surface of the cluster while the carbon chain is in the interior of the cluster.

(b) ionic end of soap is in the interior of the cluster and the carbon chain is out of the cluster.

(c) both ionic end and carbon chain are in the interior of the cluster.

(d) both ionic end and carbon chain are on the exterior of the cluster.

Ans. Correct option: (a)

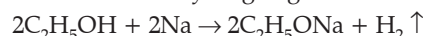
Explanation: A micelle is a spherical aggregation of soap molecules in water in which hydrocarbon ends are directed towards the centre and ionic ends are directed outwards.

Q. 5. Ethanol reacts with sodium and forms two products. These are

- (a) sodium ethanoate and hydrogen
- (b) sodium ethanoate and oxygen
- (c) sodium ethoxide and hydrogen
- (d) sodium ethoxide and oxygen

Ans. Correct option: (c)

Explanation: Ethanol (C_2H_5OH) reacts with sodium to form sodium ethoxide (C_2H_5ONa) along with liberation of hydrogen gas.



Q. 6. Vinegar is a solution of

- (a) 50% – 60% acetic acid in alcohol
- (b) 5% – 8% acetic acid in alcohol
- (c) 5% – 8% acetic acid in water
- (d) 50% – 60% acetic acid in water

Ans. Correct option: (c)

Explanation: Vinegar is a 5%–8% aqueous solution of acetic acid.

B Assertions and Reasons Type Questions

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

- (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
- (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
- (c) Assertion (A) is true but reason (R) is false.
- (d) Assertion (A) is false but reason (R) is true.

Q. 1. Assertion (A): Esterification is a process in which a sweet smelling substance is produced.

Reason (R): When esters react with sodium hydroxide an alcohol and sodium salt of carboxylic acid are obtained.

[AE] [CBSE, 2020]

Ans. Correct option: (b)

Explanation: Esterification is a reaction in which alcohol like ethanol reacts with carboxylic acids to form esters and water in the presence of sulphuric acid. Esters are generally sweet smelling substances



Q. 5. Which organic compound is added to make ethanol unfit for drinking? Name the mixture thus formed?

Ans. Methanol, a highly poisonous substance is added to make ethanol unfit for drinking. The mixture thus formed is methylated spirit or denatured alcohol.

Q. 6. Why the mixture of ethyne and air is not used for welding though air is easily available. Instead, a mixture of ethyne and oxygen is used for welding.

Ans. Air contains a mixture of nitrogen and oxygen. Nitrogen which is more in quantity does not support combustion.

While when ethyne is burnt in oxygen, large quantity of heat and light is evolved. The heat evolved can be used for welding.

Q. 7. Butter and cooking oil can be distinguished using alkaline KMnO_4 . Cooking oil is unsaturated compound and thus decolourises the pink colour of KMnO_4 while butter is a saturated compound so it does not.

Ans. Bromine water test in which only cooking oil discharges brown colour due to cooking oil being unsaturated compound.

Q. 8. What is a homologous series of carbon compounds? Give an example and list its three characteristics.

Ans. A series of compounds in which the same functional group substitutes for hydrogen in a carbon chain is called a homologous series.

Example: Alkane / Alkene / Alkyne / Alcohol or any other one correct example.

Characteristics:

- They have same general formula.
- They have same functional group.
- The difference in the molecular mass of two successive member is 14u.
- The difference in the molecular formula of two successive member is of CH_2 unit
- They have similar chemical properties.

(Any three points) $\frac{1}{2} \times 3$

Q. 9. What are covalent compounds? How are they different from ionic compounds? List any two properties of covalent compounds.

- Ans.**
- The compounds that are formed due to sharing of electrons between two atoms/compounds having covalent bonds. 1
 - Ionic compounds are formed due to transfer of electrons from one atom to another/ compounds having ionic bonds/compounds having attraction between oppositely charged ions. 1

Properties:

- They are poor conductors of electricity $\frac{1}{2}$
- They have low melting and boiling point. $\frac{1}{2}$



Short Answer Type Questions-II

3 marks each

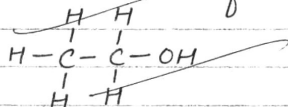
Q. 1. Write the structural formula of ethanol. What happens when it is heated with excess of conc. H_2SO_4 at 443 K? Write the chemical equation for the reaction stating the role of conc. H_2SO_4 in this reaction.

[A] [CBSE OD Set-I, 2017] 3

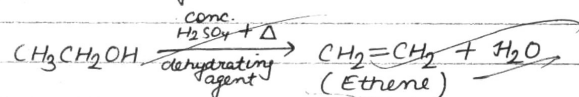


Topper Answer, 2017

Ans. → Structural Formula of Ethanol



When ethanol is heated with excess H_2SO_4 at 443K, dehydration reaction occurs and ethene & water are formed as by products.



Here, H_2SO_4 acts as dehydrating agent to remove water from ethanol.

AI Q. 2. Distinguish between esterification and saponification reactions with the help of the chemical equations for each. State one use of each (i) esters, and (ii) saponification process.

[R] [CBSE OD Set-I, 2017]



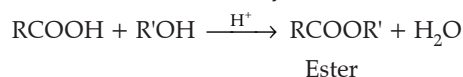
Topper Answer, 2017

Ans.

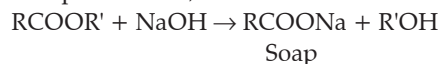
ESTERIFICATION REACTION	SAPONIFICATION REACTION
1) In this reaction, alcohol (like ethanol) reacts with carboxylic acid (like CH_3COOH) to form esters & H_2O in the presence of sulphuric acid. $\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \xrightarrow{\text{Conc. H}_2\text{SO}_4} \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$ (Ethyl ethanoate) <u>Use</u> (i) Esters $\rightarrow$ used in perfumes or as flavouring agents. (ii) Saponification process $\rightarrow$ used to prepare soap.	1) In this reaction, alkaline (NaOH) hydrolysis of so esters gives soap & alcohol. (Salt) $\text{CH}_3\text{COOC}_2\text{H}_5 + \text{NaOH} \rightarrow \text{CH}_3\text{COONa} + \text{C}_2\text{H}_5\text{OH}$

OR

In esterification, a carboxylic acid and alcohol react to form ester in presence of acid. It is reverse of saponification.



In saponification, an ester reacts with a strong base or an acid to give soap and alcohol.



2

(i) Use of esters:

As esters have fragrant odours, they are used as a constituent of perfumes, essential oils, food flavourings etc.

(ii) Use of saponification process:

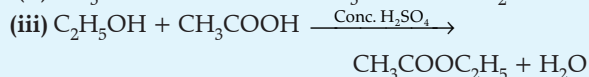
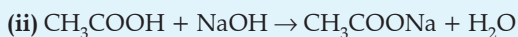
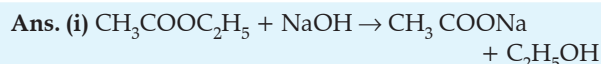
In the manufacturing of soap used as cleansing agent.

1

Q. 3. Complete the following chemical equations:



[A] [Delhi 31/1/17]



[CBSE Marking Scheme, 2017] 1 × 3

COMMONLY MADE ERROR

Students often write incorrect reactions.

ANSWERING TIP

Understand the reactions and how it takes place. Make a list of important reactions (reactants, conditions and products) of this chapter and practice them.

Q. 4. With the help of a diagram, explain cleansing action of soap. [R] [Board Term II, 2017] [DDE, 2017]

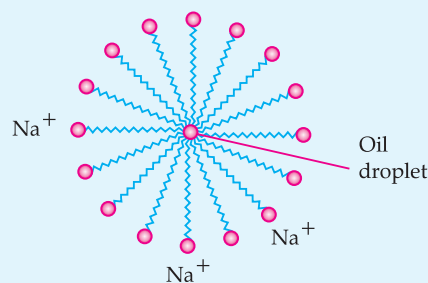
Ans. Soap molecules form micelles where one end, i.e. hydrocarbon is towards the oil droplet while the ionic end faces outside.

1

The micelle stays in solution as an emulsion. The soap solution thus helps in dissolving the dirt in water and we can wash the clothes clean.

1

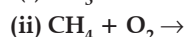
hydrophilic end hydrophobic end Soap molecule

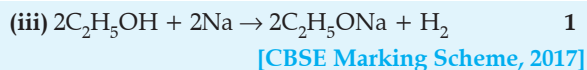


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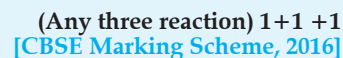
[CBSE Marking Scheme, 2017]

Q. 5. Complete the following chemical equations:





U [Board Term II, O.D. Set-III, 2016]



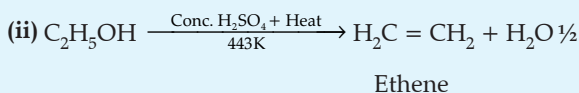
Product's chemical name—Ethyl ethanoate $\frac{1}{2}$

- (ii) Conc. H_2SO_4 acts as a dehydrating agent. (Helps in the removal of water formed in the reaction.) 1
[CBSE Marking Scheme, 2016]

Q. 8. Name the compound formed when ethanol is heated in excess of conc. sulphuric acid at 443 K. Also write the chemical equation of the reaction stating the role of conc. sulphuric acid in it. What would happen if hydrogen is added to the product of this reaction in the presence of catalysts such as palladium or nickel?

[A] [Board Term II, Delhi Set-III, 2016]

Ans. (i) Ethene $\frac{1}{2}$



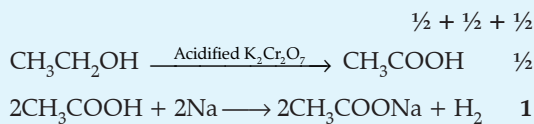
(iii) Conc. H_2SO_4 acts as a dehydrating agent/removes water from the reactant. 1

(iv) Ethane/ C_2H_6 will be formed. 1
[CBSE Marking Scheme, 2016]

Q. 9. An organic compound 'P' is a constituent of wine. 'P' on reacting with acidified $\text{K}_2\text{Cr}_2\text{O}_7$ forms another compound 'Q'. When a piece of sodium is added to 'Q' a gas 'R' evolves which burns with a pop sound. Identify P, Q and R and write the chemical equations of the reactions involved.

[C] [CBSE Foreign Set-I, 2016]

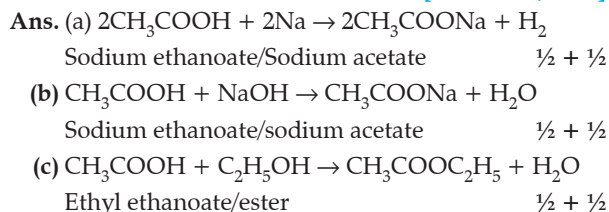
Ans. P-Ethanol, Q-Ethanoic acid, R-Hydrogen



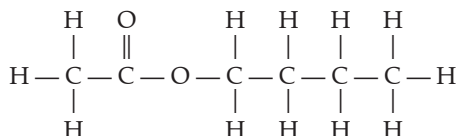
Q. 10. Write chemical equation of the reaction of ethanoic acid with the following:

- (a) Sodium
(b) Sodium hydroxide
(c) Ethanol

Write the name of one main product of each reaction. [CBSE OD, 2016]

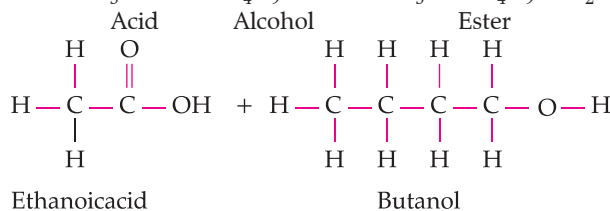
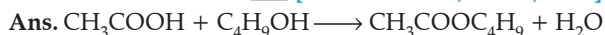


Q. 11. The structural formula of an ester is:



Write the structural formula of the acid and the alcohol from which it might be prepared. Name the process of formation of ester.

[AE] [Board Term-II, Delhi, 2015]



Process is Esterification.

1 + 1 + 1

COMMONLY MADE ERROR

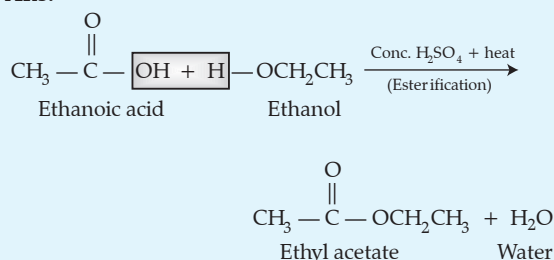
Students often write incorrect formula.

ANSWERING TIP

Be clear with concepts and how the reaction occurs. In the above reaction a water is removed from reactants (acid and alcohol) to form ester. Cautiously count the number of carbon atoms present and then write the name.

Q. 12. When we take 1 ml ethanol and 1 ml ethanoic acid along with a few drops of concentrated sulphuric acid in a test-tube, a sweet smelling substance is formed. Name the compound and give the balanced chemical equation for the reaction. What do we call the reverse reaction to give back alcohol and carboxylic acid which is used in the preparation of soap? [U] [CBSE Delhi, 2015]

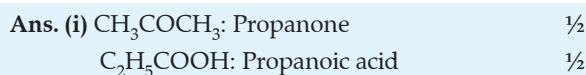
Ans.



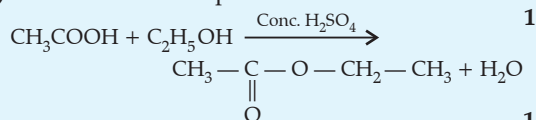
Reverse reaction = Saponification 2 + 1
[CBSE Marking Scheme, 2015]

Q. 13. (i) Write the chemical names of CH_3COCH_3 , $\text{C}_2\text{H}_5\text{COOH}$.

(ii) What happens when acetic acid and ethanol react in presence of concentrated H_2SO_4 ? Write the reactions. [A] [CBSE 2012, 2015]



(ii) Esterification takes place



[CBSE Marking Scheme, 2012]

COMMONLY MADE ERROR

- Students usually get confused while writing the name of the structures and also writing products in reactions.

ANSWERING TIP

- Understand the basic concept of naming in carbon compounds (involving saturated, unsaturated hydrocarbons, functional groups). Understand how the reactions take place and practice them.

Q. 14. List two tests for experimentally distinguishing between an alcohol and a carboxylic acid and describe how these tests are performed.

[CBSE O.D. Set-I, 2015]

Ans. (i) **Test 1 (Litmus Test):** Take two strips of blue litmus paper. Place a drop each of the alcohol and carboxylic acid on these strips separately. The blue litmus paper turns red in the case of carboxylic acid and remains unaffected in the case of alcohol. 1

(ii) **Test 2 (Sodium hydrogen carbonate test/sodium carbonate test):** A pinch of sodium hydrogen carbonate or sodium carbonate is added to both test tubes, separately.

If brisk effervescence with the evolution of a colourless gas is observed, it indicates the presence of carboxylic acid. ½

If no change is observed then it confirms the presence of the alcohol. ½

(iii) **Test 3 (Ester test or any other suitable test)**

(Any two) ½ + ½

[CBSE Marking Scheme, 2015]

Detailed Answer:

(ii) We can distinguish between an alcohol and a carboxylic acid on the basis of their reaction with sodium carbonate and sodium hydrogen carbonate. Carboxylic acids react with sodium carbonate and sodium hydrogen carbonate to evolve CO_2 gas that turns lime water milky.

Alcohol, on the other hand, do not react with sodium carbonate and sodium hydrogen carbonate.

(iii) Alcohol reacts with sodium metal to produce hydrogen gas with rapid effervescence. On the other hand, carboxylic acid does not show this type of chemical reaction with sodium metal. 1½+1½

COMMONLY MADE ERROR

- Students usually get confused between various distinguishing tests for functional groups.

ANSWERING TIP

- Keenly observe experimental tests done during practicals, understand and then learn the tests. Make a list of experimentally done tests used for distinguishing organic compounds with different functional groups and practice them.

✓ Long Answer Type Questions

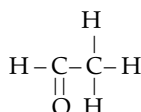
5 marks each

Q. 1. (a) Compare soaps and detergents on the basis of their composition and cleansing action in hard water.

(b) What happens when ethanol is treated with sodium metal? State the behaviour of ethanol in this reaction.

(c) Draw the structure of cyclohexane.

(d) Name the following compound.

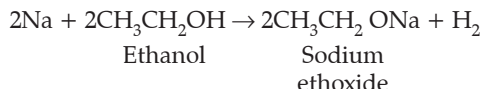


[CBSE OD., 2020]

Ans. (a) Difference between soap and detergent:

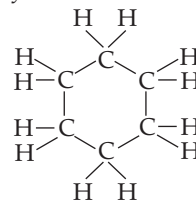
Property	Soap	Detergents
Composition	Soaps are sodium or potassium salts of long chain carboxylic acids/fatty acids	Detergents are the ammonium or sulphonate salts of long chain carboxylic acids.
Cleansing action in hard water	Ca^{2+} and Mg^{2+} present in hard water form insoluble substance (scum) with soap.	Detergents work well with hard and soft water both.

- (b) Ethanol reacts with sodium metal to produce sodium ethoxide and hydrogen gas. This salt is colourless and soluble in water.



The reaction is used to test the presence of ethanol or alcohol as hydrogen gas is evolved during the reaction.

- (c) Structure of cyclohexane:

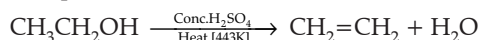


- (d) ethanal

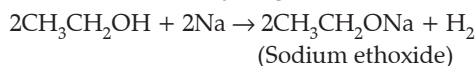
Q. 2. A compound 'X' on heating with excess conc. Sulphuric acid at 443K gives an unsaturated compound 'Y', 'X' also reacts with sodium metal to evolve a colourless gas 'Z'. Identify 'X', 'Y' and 'Z'. Write the equation of the chemical reaction for formation of 'Y' and also write the role of sulphuric acid in the reaction.

[CBSE Delhi/O.D, 2018]

Ans. Compound X is ethanol, Y is ethene and Z is hydrogen gas.



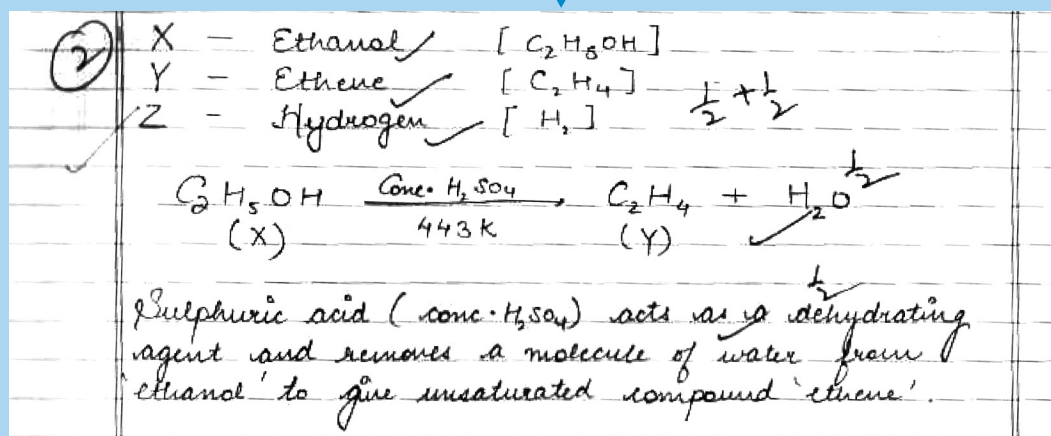
Here, sulphuric acid acts as dehydrating agent. When ethanol (X) reacts with sodium metal, a colourless gas is evolved known as hydrogen.



1 + 1 + 1 + 1 + 1

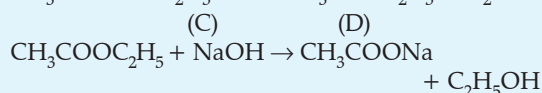
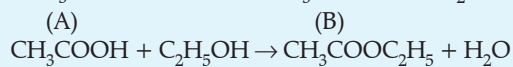
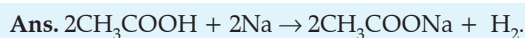


Topper Answer, 2018



Q. 3. A compound A ($\text{C}_2\text{H}_4\text{O}_2$) reacts with Na metal to form a compound 'B' and evolved a gas which burns with a pop sound. Compound 'A' on treatment with an alcohol 'C' in presence of an acid forms a Sweet smelling compound 'D' ($\text{C}_4\text{H}_8\text{O}_2$). On addition of NaOH to 'D' gives back B and C. Identify C and D write the reactions involved.

[AE] [SQP 2018]



(A) CH_3COOH

(B) CH_3COONa

(C) $\text{C}_2\text{H}_5\text{OH}$

(D) $\text{CH}_3\text{COOC}_2\text{H}_5$ [CBSE Marking Scheme, 2018] 5

Q. 4. Soaps and detergents are two types of salts. State the difference between the two. Write the mechanism of the cleansing action of soaps. Why do soaps not form lather (foam) with hard water? Mention any two problems that arise due to the use of detergents instead of soaps.

[U] [Delhi 31/1/11 2017]

Ans. (i) Soaps are the sodium or potassium salts of long chain carboxylic acids while detergents are the ammonium or sulphonate salts of long chain carboxylic acids.

(ii) The dirt is oily in nature and when soap is added to water, its molecules form structures called micelles in which carbon chain of the molecules dissolves in the oil while the ionic end dissolves in water and faces outside. The micelles thus help in dissolving the dirt in water. (Note: 1 mark to be awarded if only labelled diagram of micelle is given)

Ca^{2+} and Mg^{2+} present in hard water form insoluble substance (scum) with soap.

Two problems:

- (a) Non-biodegradable
- (b) Water pollution / soil pollution

(Note: 1 mark to be awarded for any one of the problems.) [CBSE Marking Scheme, 2017]

Detailed Answer:

S.No.	Soap	Detergents
(i)	They are sodium or potassium salts of long chain fatty acids.	These are sodium or potassium salts of sulphonic acids of hydrocarbons.
(ii)	Soaps cannot be used with hard water.	Detergents work well with hard and soft water both.
(iii)	They are fully biodegradable.	They are non-biodegradable.
(iv)	They take time to dissolve in water.	They dissolve faster in water.

Cleansing Action of Soap: When soap is dissolved in water, it forms a colloidal suspension. In this colloidal suspension, the soap molecules cluster together to form micelles and remain radially suspended in water with the hydrocarbon end towards the centre and the ionic end directed outward. The dirt particles always adhere to the oily or greasy layer present on the skin or clothes. When a dirty cloth is dipped into a soap solution, its non-polar hydrocarbon end of micelles gets attached to the grease or oil present in dirt and polar end remains in water layer.

The mechanical action of rubbing subsequently dislodges the oily layer from the dirty surface shaping it into small globules. A stable emulsion of oil in water is formed. The emulsified oil or grease globules bearing the dirt can now be readily washed with water.

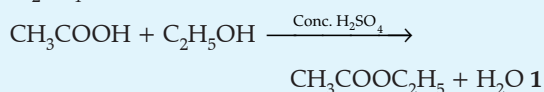
Soaps do not form lather when the water is hard. When soap is added to hard water, calcium and magnesium salts present in water displace sodium or potassium ions from the soap molecules forming an insoluble substance called scum.

Problems that arise due to use of detergents instead of soap:

- (i) Detergents being non-biodegradable, they accumulate in the environment causing pollution.
- (ii) In soil, the presence of detergents leads to pH changes making soil infertile.
- (iii) The entry of detergents into food chain leads to bioaccumulation in living beings and leads to serious health issues. (Any two) 5

Q. 5. Explain esterification reaction with the help of a chemical equation. Describe an activity to show esterification.

Ans. • **Esterification** : A process in which an alcohol and a carboxylic acid react in the presence of conc. H_2SO_4 to form an ester. $\frac{1}{2}$



Activity :

- Take 1 mL of ethanol mixed with 1 mL of acetic acid along with few drops of conc. H_2SO_4 in a test tube.
- Warm it for 5 min. in a water bath
- Pour the contents in a beaker containing 20 – 50 mL of water and smell the resulting mixture.
- It will give a fruity smell indicating the formation of ester. $1\frac{1}{2}$

[CBSE Marking Scheme, 2017]

AI Q. 6. What are micelles ? Why does it form when soap is added to water ? Will a micelle be formed in other solvents such as ethanol also ? State briefly how the formation of micelles help to clean the clothes having oily spots.

Ans. (i) Soap molecules have two ends– one end is the hydrocarbon chain which is water repellent, where as the other end is the ionic part that is water soluble end. When soap is dissolved in water it forms a group of many molecules, known as micelle. 1

(ii) These micelles are formed because their hydrocarbon chains come together and the polar ends are projected outwards. 1

(iii) Micelle formation in ethanol will not occur because the hydrocarbon chain end of the soap will dissolve in ethanol. 1

(iv) Soaps in the form of micelle are able to clean dirty clothes having oily spots, as the oily dirt is collected in the centre of the micelle, which forms an emulsion in water and on rinsing, the water washes away the micelles with dirt attached to them. 2

Q. 7. (i) You have three unlabelled test-tubes containing ethanol, ethanoic acid and soap solution. Explain the method you would use to identify the compounds in different test tubes by chemical tests using litmus paper and sodium metal.

(ii) Give the reason of formation of scum when soaps are used with hard water.

[A] [CBSE Foreign Set-I, 2016]

Ans. (i)

Solution	Blue Litmus Paper	Red Litmus Paper	Sodium Metal
Ethanol	No change	No change	Hydrogen gas 1
Ethanoic acid	Turns red	No change	Hydrogen gas 1
Soap	No change	Turns blue	Hydrogen gas 1

(full credit may be given to the candidate with the answer showing test only with litmus paper)

(ii) Hard water contains calcium ions or magnesium ions or both. These ions on reacting with soap solution form insoluble substance called scum.

[CBSE Marking Scheme, 2016] 1 + 1



Visual Case-based Questions

4 marks each

Q. 1. Read the passage and answer any four questions (a) to (e).

A homologous series is a series of organic compounds which belong to the same family (i.e. possess same functional group) and show similar chemical properties. The members of this series are called homologous and differ from each other by the number of CH_2 units in the main carbon chain.

- The chemical properties of which of the following compounds is similar to the butane ?
 - Butyne
 - Propene
 - Propyne
 - Pentane
- What is the difference between two consecutive members in a homologous series in alkanes in terms of molecular mass and number of atoms of elements is:
 - 14 a.m.u and CH_2 respectively
 - 12 a.m.u and CH_3 respectively
 - 14 a.m.u and CH respectively
 - 12 a.m.u and CH_3 respectively
- The compound $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$ belongs to which of the following homologous series ?
 - Aldehydes
 - Alcohols
 - Ketones
 - Carboxylic acid
- Which of the following is not the property of a homologous series ?
 - They show similar chemical properties.
 - They differ by 14 units by mass.
 - They all contain double bond
 - They can be represented by a general formula.
- Which of the following represent the name and formula of the 2nd member of homologous series having general formula $\text{C}_n\text{H}_{2n+2}$?
 - Methane CH_4
 - Ethane C_2H_6
 - Ethene C_2H_4
 - Ethyne C_2H_2

Ans. (a) (iv) Pentane

(b) (i) 14 a.m.u and CH_2 respectively

(c) (ii) Alcohols

(d) (iii) They all contain double bond

(e) (ii) Ethane, C_2H_6 1+1+1+1

Q. 2. Carbon has the unique property to form bonds with other atoms of carbon. Answer any four questions (a) to (e) as given. U

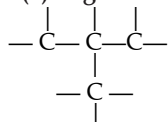


Fig.A

(a) Name the characteristic property of carbon as depicted in the fig. A

- Catenation
 - Polymerisation
 - Isomerisation
 - None of the above.
- (b) Carbon forms large number of compounds due to :
- Catenation only
 - Tetravalency only
 - Both catenation and tetravalency
 - None of the above
- (c) Write the name and structure of a saturated compound in which 6 carbon atoms are arranged in a ring.
- Hexane
 - Cyclohexane
 - Pentane
 - cyclopentane
- (d) Give the number of single bonds present in the above mentioned compound.
- 16
 - 14
 - 6
 - 18
- (e) Carbon is :
- Divalent
 - Monovalent
 - tetravalent
 - Trivalent

Ans. (a) (i) Catenation.

(b) (iii) Both catenation and tetra valency

(c) (ii) Cyclohexane

(d) (iv) 18

(e) (iii) tetravalent 1+1+1+1

Q. 3. Read the passage and answer any four questions (a) to (e).

An organic compound A of molecular formula C_2H_4 on reduction gives another compound B of molecular formula C_2H_6 . B on reaction with chlorine in the presence of sunlight gives C of molecular formula $\text{C}_2\text{H}_5\text{Cl}$.

- Name the compounds A, B and C.
 - A: ethene B: ethane C: chloroethane
 - A: ethane B: ethyne C: chloromethane
 - A: ethyne B: ethane C: chloroethane
 - A: ethene B: A: ethyne C: chloroethane
- Name the type of reaction.
 - Substitution
 - Halogenation
 - Addition
 - All of the above
- Essential conditions required for the addition reaction to occur :
 - Addition of hydrogen does not require catalyst.
 - Multiple bonds (double and triple bonds) must be present between carbon atoms in the chain of hydrocarbon.
 - Multiple bonds are not required for the reaction to take place.
 - None of the above.
- The general formula for alkene is :
 - C_nH_{2n}
 - $\text{C}_n\text{H}_{2n+2}$
 - $\text{C}_n\text{H}_{2n-2}$
 - $\text{C}_n\text{H}_{2n+1}$

(e) Choose the correct condition for conversion of ethene to ethane:

- (i) Dehydrogenation at 450°C
- (ii) Hydrogenation in presence of catalyst like nickel or platinum
- (iii) Photolytic decomposition
- (iv) All of the above

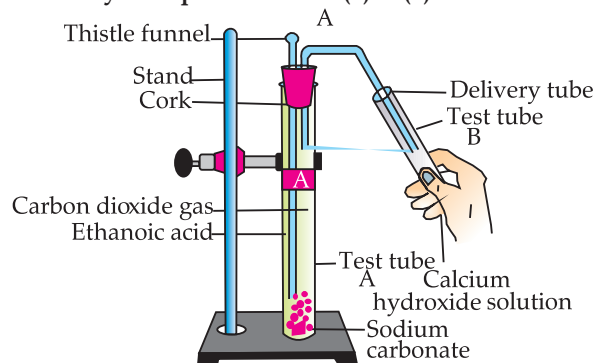
Ans. (a) (i) A: $\text{CH}_2 = \text{CH}_2$ Ethene

B: $\text{CH}_3 - \text{CH}_3$ Ethane

C: $\text{CH}_3 - \text{CH}_2 - \text{Cl}$ Chloroethane

- (b) (iii) Addition
- (c) (ii) Multiple bonds (double and triple bonds) must be present between carbon atoms in the chain of hydrocarbon.
- (d) (i) $\text{C}_n \text{H}_{2n}$
- (e) (ii) Hydrogenation in presence of catalyst like nickel or Palladium. 1+1+1+1+1

Q. 4. Study the given experimental set-up and answer any four questions from (a) to (e).



- (a) Name the gas released in test tube B: [R]
 - (i) CO
 - (ii) CO_2
 - (iii) H_2
 - (iv) Cl_2
- (b) Name the salt produced in the above activity: [C]
 - (i) Sodium chloride
 - (ii) Ethyl acetate
 - (iii) Sodium acetate
 - (iv) Acetic acid
- (c) What happens when ethanol is used instead of ethanoic acid: [AE]
 - (i) Same products are formed
 - (ii) No reaction
 - (iii) A different salt is produced
 - (iv) None of the above
- (d) Choose the correct reaction which justifies the above activity: [U]
 - (i) $2\text{CH}_3\text{COOH} + \text{Na}_2\text{CO}_3 \rightarrow 2\text{CH}_3\text{COONa} + \text{H}_2\text{O} + \text{CO}_2$
 - (ii) $\text{Na}_2\text{CO}_3 \rightarrow 2\text{CH}_3\text{COONa} + \text{H}_2\text{O} + \text{CO}_2$
 - (iii) $2\text{CH}_3\text{CHO} + \text{Na}_2\text{CO}_3 \rightarrow 2\text{CH}_3\text{COONa} + \text{H}_2\text{O}$
 - (iv) $2\text{CH}_3\text{COOH} + \text{Na}_2\text{CO}_3 \rightarrow \text{H}_2\text{O} + \text{CO}_2$
- (e) Which gas turns lime water milky: [C]
 - (i) CO
 - (ii) CO_2
 - (iii) H_2
 - (iv) O_2

Ans. (a) (ii) CO_2

(b) (iii) Sodium acetate

(c) (ii) No reaction

(d) (i) $2\text{CH}_3\text{COOH} + \text{Na}_2\text{CO}_3 \rightarrow 2\text{CH}_3\text{COONa} + \text{H}_2\text{O} + \text{CO}_2$

(e) (ii) CO_2 1+1+1+1

Q. 5. Read the below passage and answer any four questions from (a) to (e).

An organic compound A is a constituent of many medicines and is used as antifreeze. Its molecular formula is $\text{C}_2\text{H}_6\text{O}$. Upon the reaction with alk. KMnO_4 , the compound A is oxidized to another compound B with formula $\text{C}_2\text{H}_4\text{O}_2$.

(a) Identify the compounds A and B.

(i) Ethanol, ethanoic acid

(ii) ethanoic acid, Ethanol

(iii) ethane, ethanoic acid

(iv) ethanol, acetic acid

(b) What is the role of alk. KMnO_4 .

(i) It is a reducing agent

(ii) It is an oxidising agent

(iii) It is a catalyst

(iv) It helps in precipitation.

(c) Choose the correct compound which can be used instead of alk. KMnO_4 :

(i) Acidified potassium dichromate

(ii) Manganese dioxide

(iii) Platinum

(iv) Palladium with hydrogen

(d) Which of the following statement is true:

(i) Ethanol is more lethal than methanol.

(ii) Methanol is more lethal than ethanol

(iii) Both ethanol and methanol are equally poisonous.

(iv) Methanol when taken only cause little drowsiness.

(e) Which of the following statement is true for ethanol:

(i) It does not affect litmus paper.

(ii) It turns red litmus blue

(iii) It turns blue litmus red.

(iv) It is basic in nature.

Ans. (a) (i) A- Ethanol, B is Ethanoic acid

(b) (ii) Alk. KMnO_4 is used as oxidizing agent.

(c) (i) Acidified potassium dichromate

(d) (ii) Methanol is more lethal than ethanol

(e) (i) It does not affect litmus paper. 1+1+1+1

Q.6. Read the given passage and answer any four questions from (a) to (e).

A sample of water which gives lather with soap with difficulty is known as hard water, while a sample of water which gives lather with soap easily is known as soft water.

Hardness of water is due to the presence of bicarbonates, sulphates and chlorides of calcium

and magnesium. Hardness of water is of two types, temporary and permanent hardness. When hardness of water is due to the presence of bicarbonates of magnesium and calcium, it is called temporary hardness. When hardness of water is due to the presence of sulphates and chlorides of magnesium and calcium, it is called permanent hardness.

The amount of hardness causing substances in a certain volume of water measures the extent of hardness or degree of hardness. Hardness of water is always calculated in terms of calcium carbonate although it is never responsible for causing hardness of water because of its insoluble nature. The reason for choosing calcium carbonate as the standard for calculating hardness of water is the ease in calculation as its molecular weight is exactly 100. Degree of hardness is usually expressed as parts per million (ppm).

- (a) A student requires hard water for an experiment in his laboratory which is not available in the neighbouring area. In the laboratory there are some salts, which when dissolved in distilled water can convert it into hard water. Select from the following groups of salts, a group, and each salt of which when dissolved in distilled water will make it hard.
- (i) Sodium chloride, Potassium chloride
 - (ii) Sodium sulphate, Potassium sulphate
 - (iii) Sodium sulphate, Calcium sulphate
 - (iv) Calcium sulphate, Calcium chloride
- (b) Hardness of water is due to :
- (i) Carbonates and sulphides of calcium only

- (ii) sulphates and chlorides of magnesium only
 - (iii) bicarbonates of magnesium and calcium.
 - (iv) bicarbonates, sulphates and chlorides of calcium and magnesium
- (c) Why do soaps not form lather (foam) with hard water?
- (i) Ca^{2+} and Mg^{2+} present in hard water form insoluble substance with soap.
 - (ii) Ca^{2+} and Mg^{2+} present in hard water form soluble substance with soap
 - (iii) HCO_3^- present in hard water form insoluble substance with soap
 - (iv) SO_4^{2-} present in hard water form soluble substance with soap
- (d) Hardness of water is calculated in terms of :
- (i) Calcium oxide
 - (ii) Calcium hydroxide
 - (iii) Calcium carbonate
 - (iv) Calcium bicarbonate.
- (e) Which statement is not true:
- (i) Hard water does not form lather with soap
 - (ii) Hard water forms lather with soap
 - (iii) Permanent hardness can't be removed by boiling
 - (iv) Water obtained from rains is soft water
- Ans. (a)(iv) Calcium sulphate, Calcium chloride
- (b) (iv) bicarbonates, sulphates and chlorides of calcium and magnesium
 - (c) (i) Ca^{2+} and Mg^{2+} present in hard water form insoluble substance with soap
 - (d) (iii) Calcium carbonate
 - (e) (ii) Hard water forms lather with soap 1+1+1+1



Know the Terms

- **Catenation:** The self linking property of carbon atoms through covalent bonds to form long chains and rings is called catenation.
- **Tetravalency:** Tetravalency is the state of an atom in which there are four electrons available with the atom for covalent chemical bonding.
- **Electronegativity:** It is the ability of an atom to attract a shared pairs of electrons towards itself.
- **Isomerism:** The compounds which possess the same molecular formula but different structural formulae, are called isomers, and the phenomenon is known as isomerism. For example, butane with a molecular formula C_4H_{10} has two isomers.
- **Esterification Reaction:** When an organic acid reacts with an alcohol in the presence of acid catalyst, it produces a sweet smelling (fruity smell) substance called ester. The reaction is known as esterification reaction.
- **Saponification Reaction:** Esters react in the presence of an acid or a base to give back the alcohol and the carboxylic acid. This reaction is known as saponification because it is used in the preparation of soap.