CHAPTER

4 CARBON AND ITS COMPOUNDS

Syllabus

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

Quick Review

TOPIC - 1
Carbon and its Properties, Homologous Series and IUPAC Names .... P. 74

TOPIC - 2
Carbon Compounds, Soap and Detergents. .... P. 86

➢ The element carbon is non-metal. Its symbol is C.

➢ Carbon is a versatile element the percentage of carbon present in earth crust in form of mineral is 0.02% and in atmosphere as CO_2 is 0.03%.

➢ All the living things, plants and animals are made up of carbon based compounds.

Carbon always from covalent bonds :

The atomic number of carbon is 6.

Electronic configuration :

	K	L
C (6)	2	4

How carbon attain noble gas configuration ?

(i) Carbon is tetravalent, it does not form ionic bond by either losing four electrons (C^{4+}) or by gaining four electrons (C^{4-}). It is because, it 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 and nitrogen, 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.

➢ Carbon forms covalent bonds.

➢ **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 gain electrons readily.

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

➢ **Properties of Covalent Compounds :**

(i) Physical states : They are generally liquid 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.

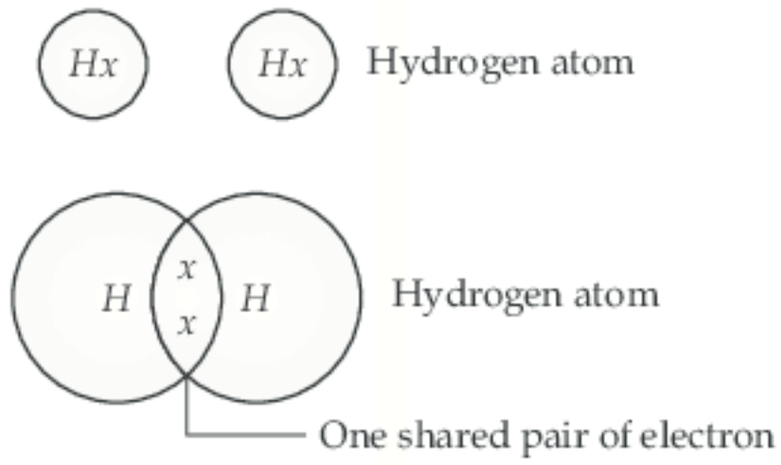
(iv) Electrical conductivity : They do not conduct electrical current.

➢ **Steps for Writing the Lewis Dot Structures of a Covalent Compound :**

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

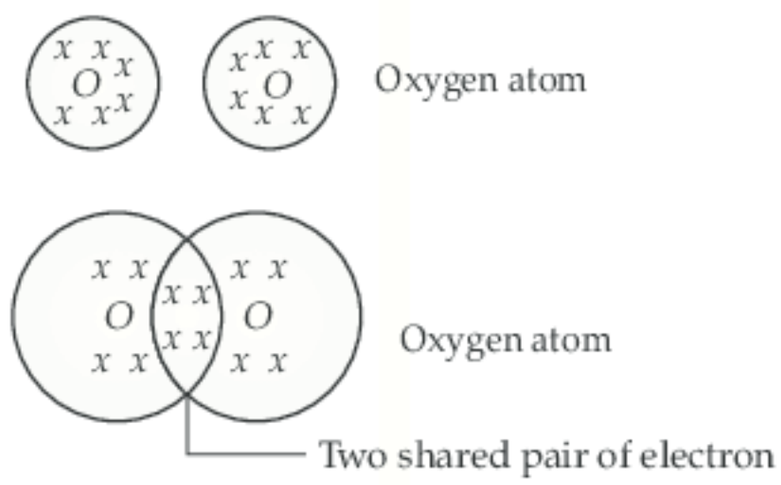
(ii) Identify how many electrons are needed by each atom to attain noble gas configuration.

(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.
(i) H_2



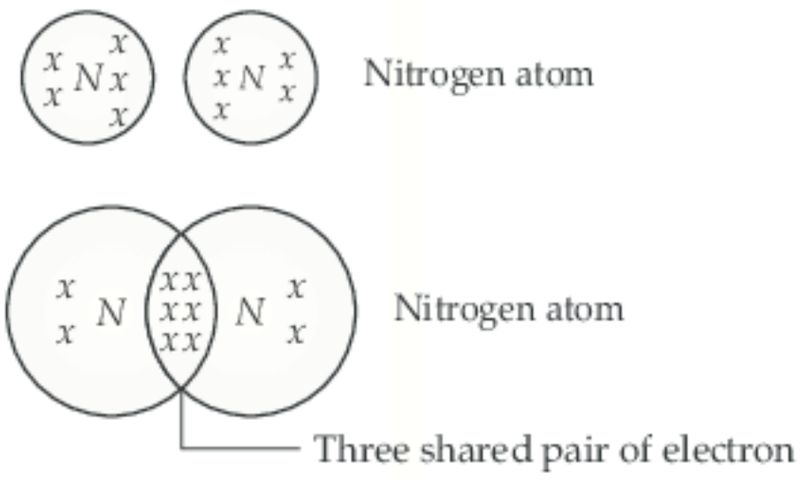
H – H Single bond between hydrogen atoms

(ii) O_2



O = O double bond between oxygen atoms

(iii) N_2



N ≡ N triple bond between nitrogen atoms

Saturated and Unsaturated Carbon Compounds

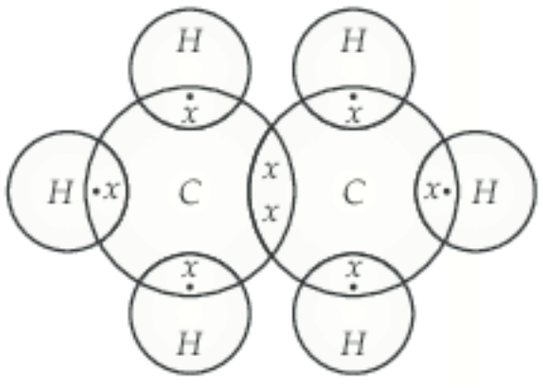
Compounds made up of hydrogen and carbon are called hydrocarbon.

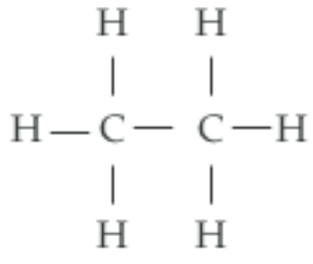
There are acyclic carbon compounds which form open carbon chains.

Saturated	Unsaturated	
➤ Single bond between carbon atoms.	➤ Double or triple bond between carbon atoms.	
➤ – C – C –	➤ – C = C –	– C ≡ C –
➤ Alkanes	➤ Alkenes	Alkynes
General formulae		
C_nH_{2n+2}	C_nH_{2n}	C_nH_{2n-2}

Electron Dot Structure of Saturated Hydrocarbons

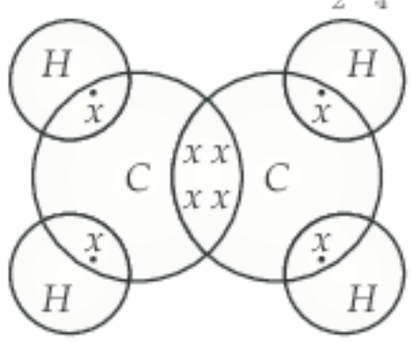
Ethane C_2H_6

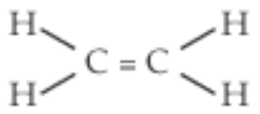




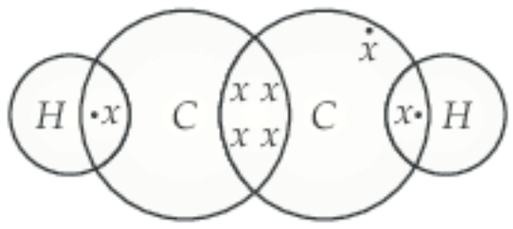
Electron Dot Structure of Unsaturated Hydrocarbons

Ethene C_2H_4





Ethyne C_2H_2



H – C = C – H

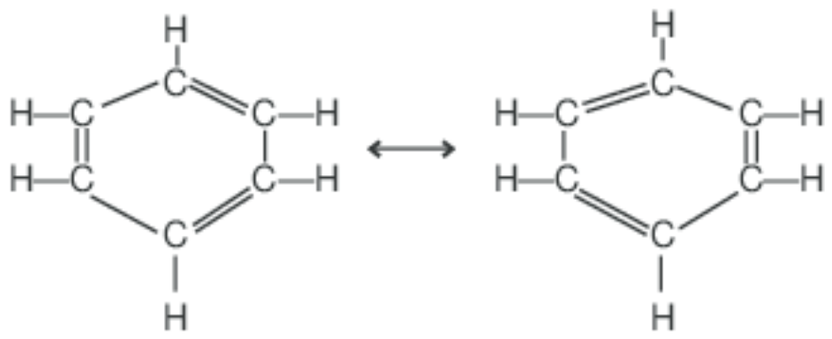
(2) **Cyclic or Closed Chain Hydrocarbons :** These are the hydrocarbons which do not have carbon carbon closed chain.

They are classified as :

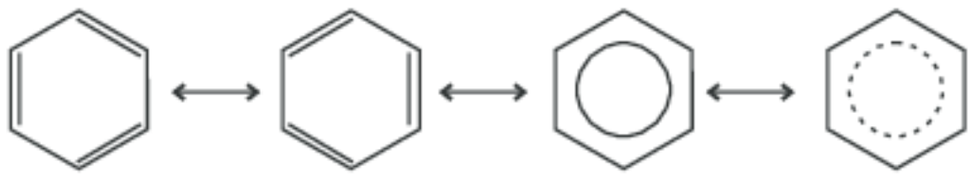
(i) Alicyclic hydrocarbons : These are the hydrocarbons which do not have benzene ring in their structures.

(ii) Aromatic hydrocarbons : These are 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.

Functional Groups

➢ In hydrocarbon chain, one or more hydrogen atom is replaced by other atoms in accordance with their valencies. These are heteroatom.

➢ These heteroatom 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
Dl/Br	Halo (Chloro/Bromo)	— Cl, — Br, — I
Oxygen	1. Alcohol	— OH
	2. Aldehyde	— CHO
	3. Ketone	— C — ‖ O
	4. Carboxylic acid	O ‖ — C — OH
Double bond	1. Alkene group	> C = C <
Triple bond	2. Alkyne group	— C ≡ C —

- **Homologous Series :** A series of organic compounds in which every succeeding member differs from the previous one by – 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 : C_nH_{2n+2}, where n = number of carbon atoms. CH_4, C_2H_6, C_3H_8..
- **Homologous series of alkenes :** General formula : C_nH_{2n}, where n = number of carbon atoms. C_2H_4, C_3H_6, C_4H_8..
- **Homologous series of alkynes :** General formula : C_nH_{2n-2}, where n = number of carbon atoms. C_2H_2, C_3H_4, C_4H_6..

Chemical Properties of Carbon Compounds

(a) Combustion

$$CH_4 + 2O_2 \xrightarrow{\text{Combustion}} CO_2 + 2H_2O + \text{Heat} + \text{Light}$$

- 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.

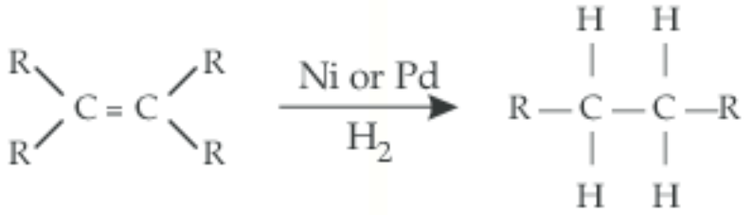
(b) Oxidation

Alcohols can be converted to carboxylic acid in presence of oxidizing agent alkaline $KMnO_4$ (potassium permanganate) or acidic potassium dichromate.

$$CH_3CH_2OH \xrightarrow[\text{Acidic } K_2Cr_2O_7]{\text{Alkaline } KmnO_4 \text{ Or}} CH_3COOH$$

Ethanol Ethanoic acid

(c) Addition Reaction :



Unsaturated hydrocarbon add hydrogen 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 :

$$CH_4 + Cl_2 \xrightarrow{\text{Sunlight}} CH_3Cl + HCl$$

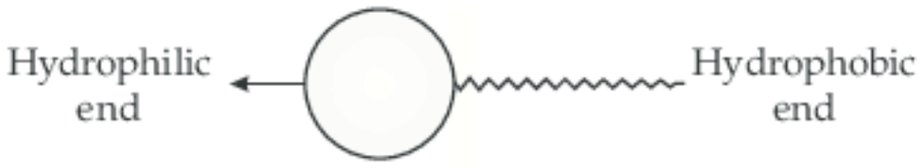
Soaps and Detergents

- Soap is sodium or potassium salt of long chain carboxylic acid. *e.g.*, $C_{17}H_{35}COONa^+$
- 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

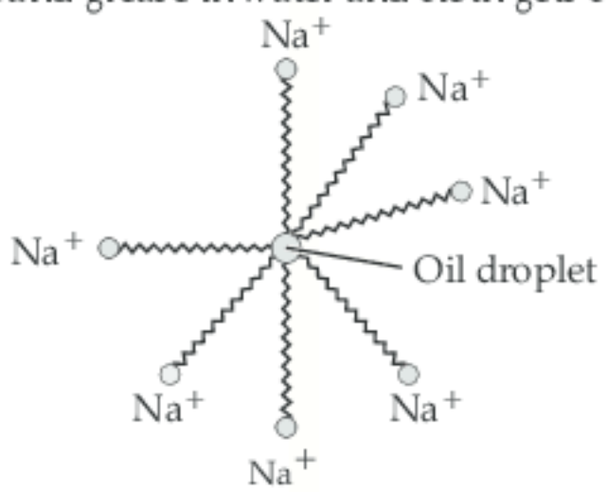
(ii) Long hydrocarbon chain (hydrophobic) part



Structure of soap molecule

Cleansing Action of Soap

- Most dirt is oily in nature and hydrophobic end attaches itself with dirt and the ionic end is surrounded with molecule of water. This result in formation of a radial structure called micelles.
- Soap micelles helps to dissolve dirt and grease in water and cloth gets cleaned.



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

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. Carbon has a valency of four. So, it is capable of making bonds with four other atoms of carbon or any other element.
- **Electronegativity :** It is the ability of an atom to attract a shared pairs of electrons towards itself.
  If the atoms forming a covalent bond have different electronegativities, the atom with higher electronegativity pulls the shared pair of electrons towards itself. Thus, the atom with the higher electronegativity develops a partial negative charge and the atom with the lower electronegative develops a partial positive charge. This bond with some polarity is called polar covalent bond.
- **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.

$CH_3 — CH_2 — CH_2 — CH_3$ $\qquad$ $CH_3 — \underset{\displaystyle CH_3}{\underset{|}{CH}} — CH_3$

n-butane $\qquad$ Iso-butane

- **Homologous Series :** It is a family of organic compounds having the same functional group in which the formulae of successive members differ by – CH_2 group. For example, CH_4, C_2H_6, C_3H_8, C_4H_{10} etc. All the members of a homologous series have similar structures and same chemical properties.
- **Oxidation :** Oxidation means controlled combustion. For example, when ethanol is heated with alkaline potassium permanganate solution or acidified potassium dichromate solution, it gets oxidised to ethanoic acid.

$$CH_3CH_2OH \xrightarrow[\text{Acidified } K_2Cr_2O_7 + \text{Heat}]{\text{Al. } KMnO_4 + \text{Heat}} CH_3COOH$$

- **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.

$$\underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow{H_2SO_4} \underset{\text{Ethyl acetate (ester)}}{CH_3COOC_2H_5} + H_2O$$

- **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.

$$CH_3COOC_2H_5 \xrightarrow{NaOH} CH_3COOH + C_2H_5OH.$$

- **Soaps and Detergents :** Soaps are sodium and potassium salts of long chain (higher) fatty acids such as stearic acid, palmitic acid etc. Detergents are ammonium or sulphonate salts of long chain hydrocarbons.

TOPIC-1
Carbon and its Properties, Homologous Series and IUPAC Names

Very Short Answer Type Questions (1 mark each)

R Q.1. **What is a homologous series of carbon compounds ?**
[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 CH_2 unit or 14 mass unit. 1
[CBSE Marking Scheme, 2016]

U Q.2. **Write the molecular formula of first two members of homologous series having function group – Cl. [Delhi 31/1/1, 2017]**

Ans. The molecular formula of two consecutive members of this series is :
CH_3Cl (Chloromethane)
C_2H_5Cl (Chloroethane) ½ + ½

U Q.3. **Write the molecular formula of first two members of homologous series having functional group – Br. [Delhi 31/1/2, 2017]**

Ans. The molecular formula for two consecutive members of this series are :
CH_3Br (Bromomethane)
C_2H_5Br (Bromoethane) ½ + ½

U Q.4. **Write the molecular formula of first two members of homologous series having functional group – OH. [Delhi 31/1/3, 2017]**

Ans. The molecular formula for two consecutive member of this series is :
CH_3OH (Methanol)
C_2H_5OH (Ethanol) ½ + ½

U Q.5. **Write the molecular formula of the 2nd and the 3rd member of the homologous series whose first member is methane. [OD 31/1, 2017]**

Ans. Ethane (C_2H_6)
Propane (C_3H_8) ½ + ½

A Q.6. **Write the molecular formula of the 2nd and 3rd member of the homologous series whose first member is ethane. [OD 31/2, 2017]**

Ans. Propane (C_3H_6)
Butane (C_4H_8) ½ + ½

A Q.7. **Write the molecular formula of the 2nd and 3rd member of the homologous series where the first member is ethyne. [OD 31/3, 2017]**

Ans. Propyne (C_3H_4)
Butyne (C_4H_6) ½ + ½

U Q.8. **Write the next homologue of each of the following :**
(i) C_2H_4 **(ii)** C_4H_6
[Board Term II, Delhi Set-I, 2016]

Ans. (i) C_3H_6 (ii) C_5H_8. ½+½
[CBSE Marking Scheme, 2016]

A Q.9. **Write the name and formula of the 2nd member of homologous series having general formula C_nH_{2n}. [Delhi Set-I, 2015]**

Ans. Name — Propene
Formula — C_3H_6 ½+½
[CBSE Marking Scheme, 2015]

A Q.10. **Write the name and molecular formula of the first member of the homologous series of alkynes.**
[Board Term II, Foreign Set-II, 2015]

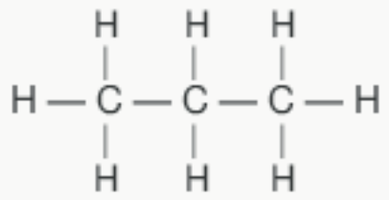
Ans. Ethyne, C_2H_2. **[CBSE Marking Scheme, 2015]** 1

A Q.11. **Write the name and formula of the 2nd member of homologous series having general formula C_nH_{2n+2} [Board Term II, Delhi Set-II, 2013]**

Ans. Name — Ethane
Formula — C_2H_6 ½+½
[CBSE Marking Scheme, 2013]

R Q.12. **Molecular formula of a hydrocarbon is C_3H_8. Draw its complete structure and write its name.**
[Board Term-II, 2013, 2012]

Ans.



The name of the hydrocarbon is propane.
[CBSE Marking Scheme, 2013, 12] ½+½

U Q.13. **Write next two members of the homologous series : C_2H_6, C_3H_8. [Board Term-II, Set (20) 2015, 12]**

Ans. C_4H_{10}, C_5H_{12} **[CBSE Marking Scheme, 2012]** ½+½

U Q.14. **Which of the following belong to the same homologous series ?**
[Board Term-II, Set (2044), 2012]
C_3H_8, C_4H_8, C_4H_6, C_3H_6

Ans. C_4H_8, C_3H_6. ½+½
[CBSE Marking Scheme, 2012]

R Q.15. **How does carbon attain noble gas configuration ?**
[DDE 2017]

Ans. Carbon can form bond by sharing of its electrons with the electrons of other carbon atom or with other element and attain noble gas configuration. 1

A Q.16. **Name the first member of ketones. [DDE 2017]**

Ans. The first member of ketone – Propanone. 1

R **Q. 17. Why Carbon is tetravalent ?** [DDE 2017]

Ans. The outer most shell of carbon atom contains four valence electrons so the valency of carbon is four. It is tetravalent. It is difficult to hold four extra electron and would require large amount of energy to remove four electrons, so, it form bonds by sharing electrons. 1

A **Q. 18. Write the name and formula of the 2nd member of homologous series having general formula C_nH_{2n-2}.** [Board Term II, OD Set-II, 2015]

Ans. Propyne C_3H_4. [CBSE Marking Scheme, 2015] 1

A **Q. 19. What is the difference between two consecutive members in a homologous series in alkanes in terms of :**

(i) Molecular mass,

(ii) Number of atoms of elements.

[Board Term-II, Set (2016), 2012]

Ans. Difference in :

(i) Molecular mass = 14 a.m.u. ½

(ii) Number of atoms of elements = CH_2. ½

[CBSE Marking Scheme, 2012]

U **Q. 20. The molecular formula of 'A' is $C_{10}H_{18}$ and 'B' is $C_{18}H_{36}$. Name the homologous series to which they belong.** [Board Term-II, Set (2022) 2012]

Ans. 'A' belongs to alkyne as general formula of alkyne is $C_{2n}H_{2n-2}$. ½

'B' belongs to alkene as general formula of alkene is C_nH_{2n}. ½

[CBSE Marking Scheme, 2012]

U **Q. 21. Name the following compounds :**

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

(i) $CH_3—CH_2—OH$, (ii) $CH_3—\overset{\overset{H}{|}}{C}=O$

Ans. (i) Ethanol, **(ii)** Ethanal. ½ + ½

[CBSE Marking Scheme, 2016]

U **Q. 22. Which element exhibits the property of catenation to maximum extent and why ?**

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

Ans. Carbon, due to strong C—C bond. 1

[CBSE Marking Scheme, 2016]

R **Q. 23. What is catenation ?** [DDE 2017]

Ans. The self linking property of carbon atoms through covalent bonds to form long chains and rings is called catenation. 1

U **Q. 24. Write the name and molecular formula of the fourth member of alkane series.**

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

Ans. Butane, C_4H_{10}. ½ + ½

[CBSE Marking Scheme, 2016]

A **Q. 25. Select saturated hydrocarbons from the followings : C_3H_6; C_5H_{10}; C_4H_{10}; C_6H_{14}; C_2H_4**

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

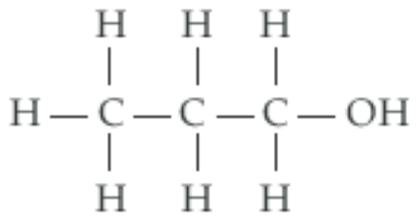
Ans. C_4H_{10}; C_6H_{14}. ½ + ½

[CBSE Marking Scheme, 2016]

A **Q. 26. Write the name and structure of an alcohol with three carbon atoms in its molecule.**

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

Ans. Propanol,

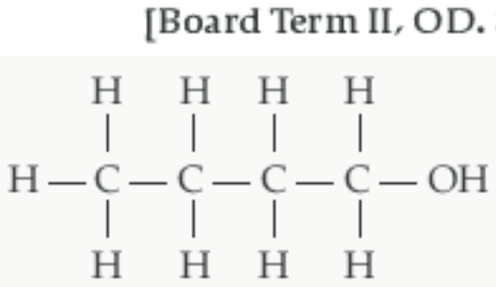


or $CH_3—CH_2—CH_2—OH$ 1

A **Q. 27. Write the name and structure of an alcohol with four carbon atoms in its molecule.**

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

Ans. Butanol,



or $CH_3—CH_2—CH_2—CH_2—OH$ 1

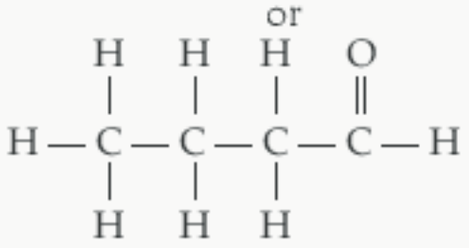
[CBSE Marking Scheme, 2016]

A **Q. 28. Write the name and structure of an aldehyde with four carbon atoms in its molecule.**

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

Ans. Butanal, $CH_3—CH_2—CH_2—CHO$

or



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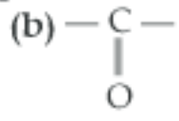
[CBSE Marking Scheme, 2016]

OR

[Topper Answer, 2016]

R **Q. 29. Write the name of each of the following functional groups :** [Foreign Set-II, 2015]

(a) —OH (b) 

Ans. (a) Alcohol **(b)** Ketone. ½ + ½

[CBSE Marking Scheme, 2015]

U **Q. 30. Write the number of covalent bonds in the molecules of butane C_4H_{10}.**

[Board Term II, OD Set-II, 2015]

Ans. Thirteen covalent bonds. 1

[CBSE Marking Scheme, 2015]

R **Q. 31. Name the process of converting vegetable oil to vegetable ghee.** [Board Term II SQP, 2016]

Ans. Hydrogenation. 1

[CBSE Marking Scheme, 2016]

U **Q. 32. Write the number of covalent bonds in the molecule of Ethane.**

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

Ans. Seven covalent bonds. 1

[CBSE Marking Scheme, 2015]

U **Q. 33. Write the number of covalent bonds in the molecule of Propane, C_3H_8**

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

Ans. Ten covalent bonds. 1

[CBSE Marking Scheme, 2015]

R **Q. 34. Name the process by which unsaturated fats are changed to saturated fats.**

[Board Term II Foreign Set-I, 2015]

Ans. Hydrogenation. 1

[CBSE Marking Scheme, 2015]

R **Q. 35. Name the functional group present in CH_3COCH_3 and state the name of this compound.**

[Board Term-II, Set (2018) 2012]

Ans. Functional group : Ketone, name of the compound : Propanone. ½+½

[CBSE Marking Scheme, 2012]

R **Q. 36. Name a functional group present in**
(i) CH_3CHO, (ii) C_2H_5COOH.

[Board Term-II, Set (2021) 2012]

Ans. (i) Aldehyde, **(ii)** Carboxylic acid. ½+½

[CBSE Marking Scheme, 2012]

R **Q. 37. Write the molecular formula of the following :**
(i) Hexane, (ii) Benzene.

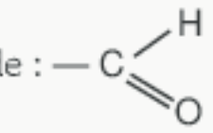
[Board Term-II, Set (2025) 2012]

Ans. (i) Hexane : C_6H_{14}
(ii) Benzene : C_6H_6

[CBSE Marking Scheme, 2012] ½+½

R **Q. 38. Write the formula of functional group :**
(i) aldehyde, (ii) alcohol.

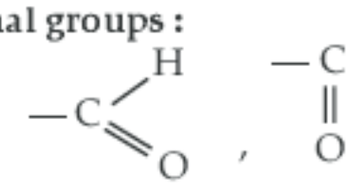
[Board Term-II, Set (2018), 2012]

Ans. (i) Aldehyde :  ½

(ii) Alcohol : — OH ½

[CBSE Marking Scheme, 2012]

R **Q. 39. Given below are the formulae of some functional groups :**



Write the name of these functional groups.

[Board Term-II, Set (2015), 2012]

Ans. Aldehyde, ketone.

[CBSE Marking Scheme, 2012] ½+½

R **Q. 40. Mention the percentage of carbon in earth's crust.** **[Board Term-II, 2013, 2012]**

Ans. 0.02% **[CBSE Marking Scheme, 2012, 13]** 1

Short Answer Type Questions-I

(2 marks each)

U **Q. 1. What are hydrocarbons ? Give examples.**

[DDE 2017]

Ans. The compound containing the molecules of hydrogen and carbon are known as hydrocarbons. Hydrocarbons are organic compounds that are made of only hydrogen and carbon atoms.
Examples— Natural Gas, Methane, Propane, Alcohol. 1 + 1

R **Q. 2. Why does carbon atom forms a large of compounds?** **[DDE 2017]**

Ans. Carbon is an element which shows a unique property of catenation, makes it possible to form a huge number of compounds. It is the property by which it can make bonds with carbon atoms, to form long chains. 2

A **Q. 3. Covalent compounds generally don't conduct electricity. Why?** **[DDE 2017]**

Ans. A covalent bond is formed between non-metal atoms, which combine together by sharing electrons. Covalent compounds have no free electrons and no ions so they don't conduct electricity. 2

R **Q. 4. Why carbon is unique in nature?** **[DDE 2017]**

Ans. Due to its four valence electrons, carbon is the smallest element that is able to make covalent bonds to four different atoms in its neutral form. Because of this, large heavily branched compounds can be made by stringing together carbon and a few other non-metallic atoms in various arrangements. 2

R **Q. 5. What is a covalent bond ? What type of bond exists in (i) CCl_4, (ii) $CaCl_2$?**

Ans. The chemical bonds formed between two atoms by the sharing of electrons between them is known as a covalent bond. The sharing of electrons between the two atoms takes place in such a way that both the atoms acquire stable electronic configuration of their nearest noble gas. 1

(i) CCl_4 — Covalent bond
(ii) $CaCl_2$ — Ionic bond ½+½

U **Q. 6. Why is it not easy for carbon to take part in the formation of ionic compounds ?**

Ans. In order to form ionic bond, carbon atom either has to lose four electrons to form C^{4+} ion or gain four electrons to form C^{4-} ions.
The loss or gain of four electrons is not easy for carbon since energy needed is very high. 2

R **Q. 7. (i) What is a functional group ?**
(ii) State two properties of carbon which lead to huge number of carbon compounds we see around us.

[Board Term II, Set A1, 2011]

Ans. (i) Functional group is an atom or a group of atoms in a carbon compound that gives the molecule its characteristic physical and chemical properties. It is the site of reactivity in an organic compound.

For example —

(i) Alcohol is — OH

(ii) Carboxylic acid is — COOH. **1**

(ii) Two properties of carbon which lead to huge number of carbon compounds we see around us are —

(a) Catenation, **(b)** Tetravalency.

[CBSE Marking Scheme, 2011] ½+½

U **Q. 8. List two differences between saturated and unsaturated hydrocarbons.**

[Board Term II, Set B1, 2011]

Ans.

S. No.	Saturated Hydrocarbons	Unsaturated Hydrocarbons
(i)	Hydrocarbons having single bonds between carbon atoms are called saturated hydrocarbons.	Hydrocarbons having one or more multiple bonds between carbon atoms are called unsaturated hydrocarbons.
(ii)	Gives a clean flame on burning.	They give yellow flame with a lot of black smoke on burning.

[CBSE Marking Scheme, 2011] 2

U **Q. 9. Differentiate between addition reactions and substitution reactions shown by hydrocarbons.**

[Board Term II, Set A1, 2011]

Ans. (i) Reactions between unsaturated hydrocarbons with simple substances to form a single saturated product are addition reactions. **1**

(ii) Those reactions in which one or more hydrogen of a saturated hydrocarbon is replaced by an atom or a group of atoms are substitution reactions.

[CBSE Marking Scheme, 2011] 1

R **Q. 10. (i) Write the name of the following compounds :**

(a) $HCOOH$, **(b)** $CH_3COCH_2CH_3$.

(ii) Explain why carbon generally forms compounds by covalent bonds. [Board Term-II, Set B1 2011]

Ans. (i) (a) Methanoic acid, **(b)** Butan-2-one. ½+½

(ii) Carbon generally forms compounds by covalent bonds because carbon can neither donate nor accept four electrons for completing its octet. So, it shares its four electrons with other atoms forming covalent bonds.

[CBSE Marking Scheme, 2011] 1

A **Q. 11. Write down structural formula of :—**

(a) Propanone, (b) Hexanal [DDE 2017]

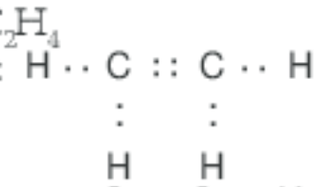
Ans. (a) Propanone—$CH_3—\overset{\overset{O}{\|}}{C}—CH_3$

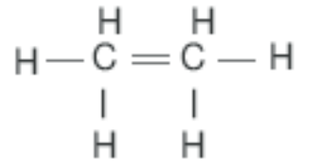
(b) Hexanal—$CH_3—CH_2—CH_2—CH_2—CH_2—\overset{\overset{O}{\|}}{C}—H$

1 + 1

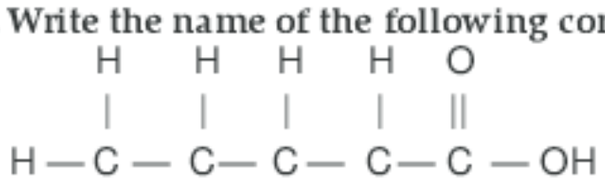
U **Q. 12. Write molecular, electronic and structural formulae of ethene.**

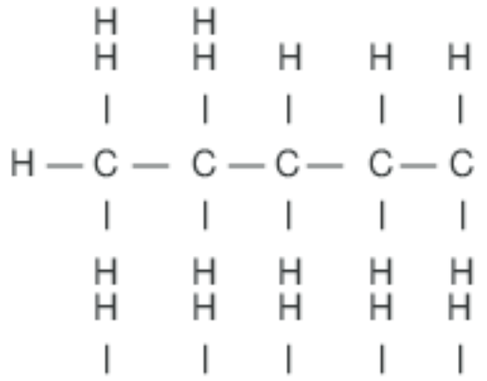
Ans. Molecular formula : C_2H_4 ½

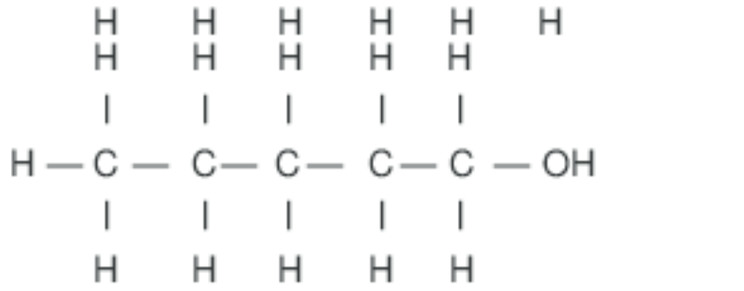
Electron dot formula :  ½

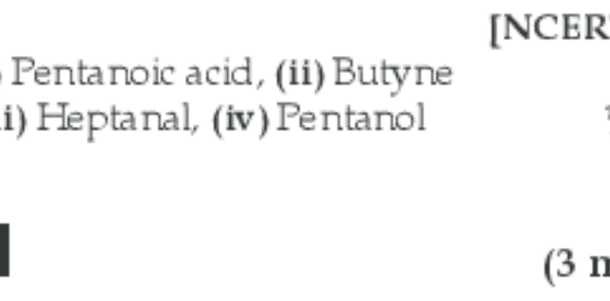
Structural formula :  ½+½

A **Q. 13. Write the name of the following compounds :**

(i) 

(ii) 

(iii) 

(iv) 

[NCERT Exemplar]

Ans. (i) Pentanoic acid, **(ii)** Butyne

(iii) Heptanal, **(iv)** Pentanol ½+½+½+½

Short Answer Type Questions-II

(3 marks each)

U **Q. 1. What is a homologous series of carbon compounds? List its any two characteristics. Write the name and formula of next higher homologous of HCOOH.**

[Delhi set comptt. 1 2017]

Ans. (a) A group of organic compounds having the same functional group and similar structures in which any two successive members differ by – CH_2. **1**

(b) (i) All members have similar chemical properties ½
(ii) There is gradation in the physical properties. ½
(or any other)

(c) Name — Ethanoic acid/Acetic acid ½
Formula — CH_3COOH ½
[CBSE Marking Scheme]

A **Q. 2. What are covalent compounds? How are they different from ionic compounds? List any two properties of covalent compounds.**
[OD Comptt. 2017]

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

(b) 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**

(c) (i) They are poor conductors of electricity ½
(ii) They have low melting and boiling point. ½
(or any other)
[CBSE Marking Scheme]

R **Q. 3. Give reason why carbon can neither form C^{4+} cations nor C^{4-} anions, but forms covalent compounds are bad conductors of electricity and have low melting and boiling points?**
[Delhi Set Comptt. II 2017]

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

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

(c) Hence, carbon atoms share electrons forming covalent compounds **1**

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

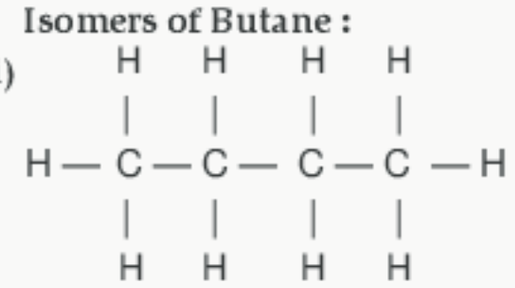
(e) Inter molecular forces of attraction are weak, hence low melting and boiling points. ½
[CBSE Marking Scheme]3

R **Q. 4. 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.** **[Board Term II, Delhi Set-I, 2015]**

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

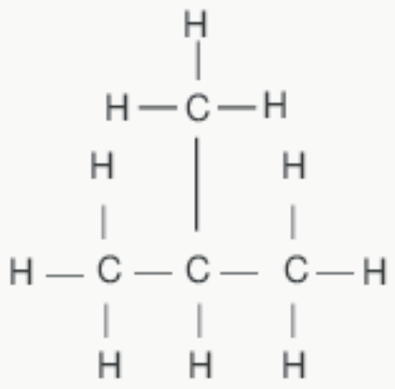
Isomers of Butane :

(i)



n-butane

(ii)



iso-butane

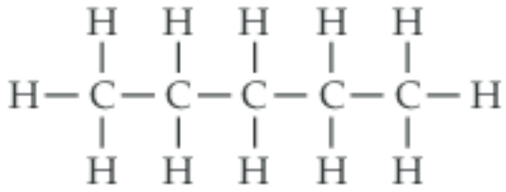
We cannot have isomers of the first three members of the alkane series because of the following laws of isomers :

(i) The parent chain should have the most number of carbon atoms.

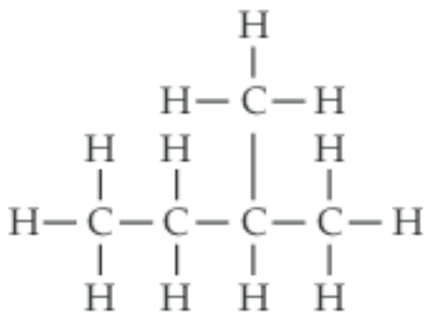
(ii) The branching cannot be done from the first on the last atom carbon atom of the structure. **1+1+1**
[CBSE Marking Scheme, 2015]

A **Q. 5. What is Structural Isomerism? Draw isomers of Pentane (C_5H_{12}).** **[DDE 2017]**

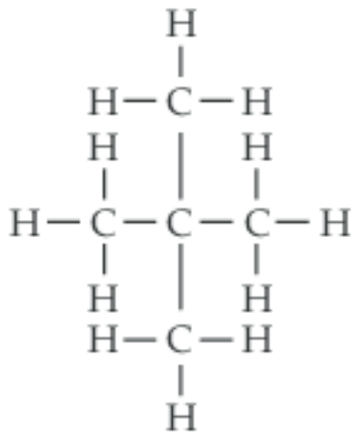
Ans. Structural Isomerism, or constitutional isomerism, is a form of isomerism in which molecules with the same molecular formula have different bonding patterns and atomic organisation.



n – Pentane



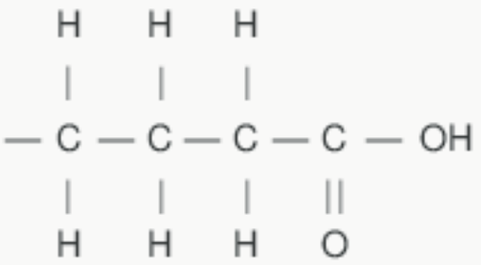
iso – Pentane



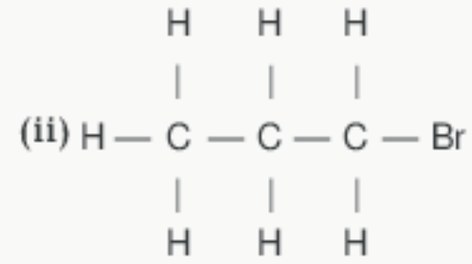
neopentane

A **Q.6. Draw the structures of the following compounds and identify the functional group present in them :**
(i) Butanoic acid
(ii) Bromopropane
(iii) Butyne **[Board Term-II, Set-FF7NBE6, 2015]**

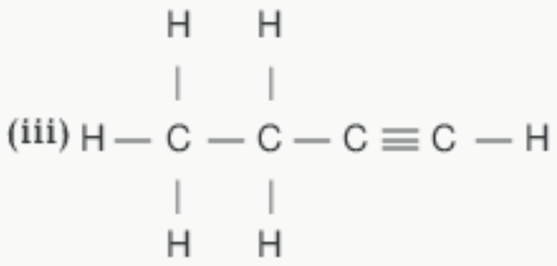
Ans. (i)



Carboxylic group – COOH

(ii) 

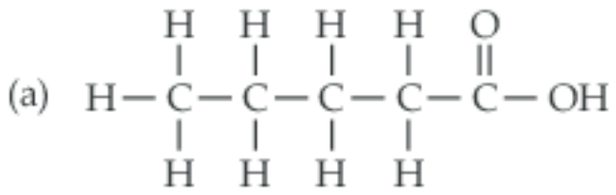
Halogen atom – Br

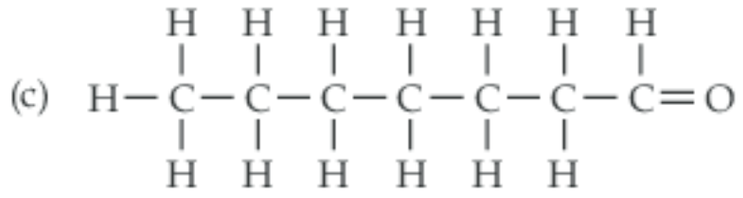
(iii) 

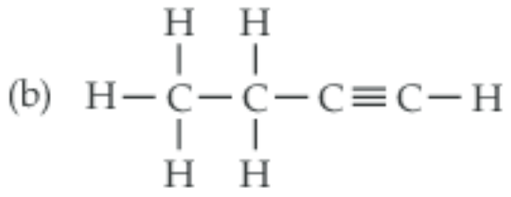
Triple bond C ≡ C

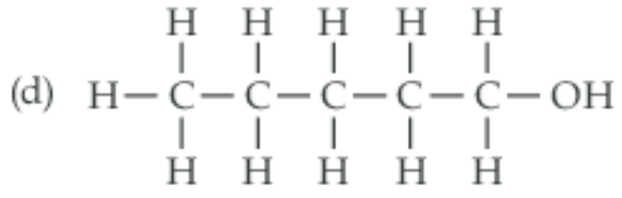
[CBSE Marking Scheme, 2015] 1+1+1

A Q. 7. Write the name of the following compounds

(a) 

(c) 

(b) 

(d) 

(any three)

[NCERT Exemplar 2017]

Ans. (a) Pentanoic acid (b) But-1-yne

(c) Heptanal (d) Pentanol 1 + 1 + 1

R Q. 8. Write the molecular formula of the following compounds and draw their electron-dot structures :

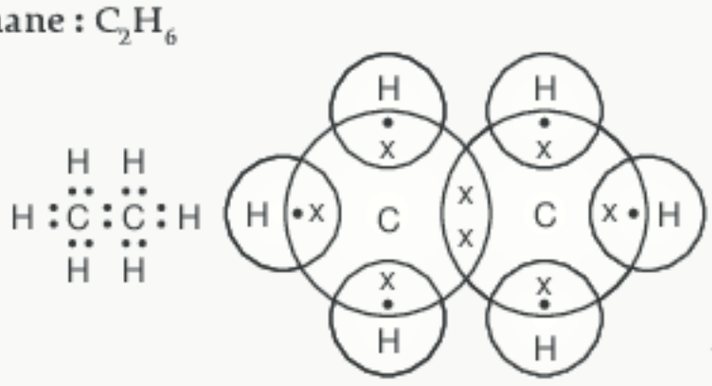
(i) Ethane

(ii) Ethene

(iii) Ethyne [Board Term II, Foreign Set-I, 2015]

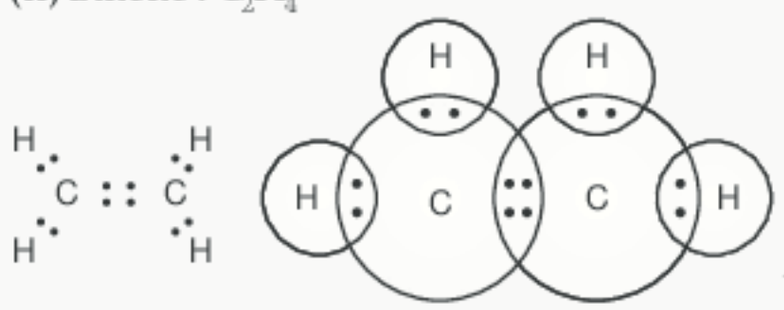
Ans.

(i) Ethane : C_2H_6



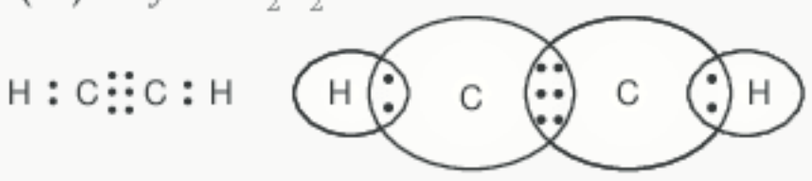
½ + ½

(ii) Ethene : C_2H_4



½ + ½

(iii) Ethyne : C_2H_2



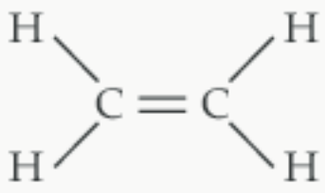
½ + ½

[CBSE Marking Scheme, 2015]

A Q. 9. Write the name and structural formula of the compound formed when ethanol is heated at 443K temperature with excess of conc. H_2SO_4. What is the role of conc. H_2SO_4 in this reaction ? Also give the chemical equation for the reaction.

[Board Term II, Foreign Set-III, 2015]

Ans. (i) Ethene



1

(ii) Conc. H_2SO_4 acts as a dehydrating agent. 1

$$CH_3CH_3OH \xrightarrow[443K]{\text{Conc } H_2SO_4} C_2H_4 + H_2O \qquad 1$$

[CBSE Marking Scheme, 2015]

U Q. 10. What is meant by homologous series of carbon compounds ? Write the general formula of (i) alkenes, and (ii) alkynes. Draw the structures of the first member of each series to show the bonding between the two carbon atoms.

[Board Term-II, Outside Delhi Set-I, II, III, 2014]

[DDE 2017]

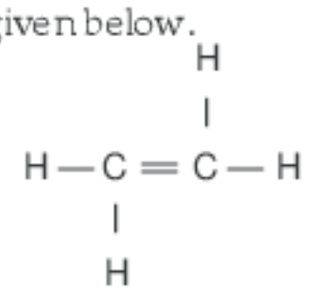
Ans. A homologous series is a series of organic compounds that belongs to the same family (*i.e.*, possesses the same functional group) and show similar chemical properties. The members of this series are called homologues; they differ from each other by the number of CH_2 units in the main carbon chain.

General Formula

Alkenes : C_nH_{2n}, **Alkynes :** C_nH_{2n-2}

Structures

The first member of alkenes is ethene and its structure is given below.



The first member of alkynes is ethyne and its structure is given below :

1+1+½+½

U Q. 11. What is homologous series of carbon compounds? Write the molecular formula of two consecutive members of homologous series of aldehydes.

State which part of these compounds determines their (i) physical and (ii) chemical properties.

[Board Term-II, Outside Delhi Set-II, 2014]

Ans. 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. Molecular formula of two consecutive members of homologous series of aldehydes is CH_3-CHO and CH_3-CH_2-CHO.

In CH_3—CHO compound, —CHO part and in CH_3—CH_2—CHO, —CH_2—CHO part will determine their physical and chemical properties. **1+1+1**

R **Q. 12. State the meaning of functional group in a carbon compound. Write the functional group present in (i) ethanol, and (ii) ethanoic acid and also draw their structures.**

[Board Term II, Delhi Set-I, 2014]

Ans. Functional group is an atom or a group of atoms that is bonded to a carbon chain. It defines the chemical property of the organic compound.

Compound	Functional Group	Structure
Ethanol	Hydroxyl (–OH)	CH_3CH_2OH
Ethanoic acid	Carboxylic acid (–COOH)	CH_3COOH

1+1+1

R **Q. 13. State the meaning of the functional group in an organic compound. Write the formula of the functional group present in alcohols, aldehydes, ketones and carboxylic acids.**

[Board Term II, Delhi Set-II, 2014]

Ans. Functional group is an atom or a group of atoms that is bonded to a carbon chain. It defines the chemical property of the organic compound.

Compound	Functional Group
Alcohol	– OH
Aldehyde	– CHO
Ketone	– C = O
Carboxylic acid	– COOH

1+½+½+½+½

U **Q. 14. Write the name and general formula of a chain of hydrocarbons in which an addition reaction with hydrogen can take place. Stating the essential conditions required for an addition reaction to occur, write the chemical equation giving the name of the reactant and the product of such a reaction.**

[Board Term II, Delhi Set-I, II, III, 2014]

Ans. Name and general formula of hydrocarbons undergoing addition reaction with hydrogen :

Name	General Formula
Alkene	C_nH_{2n}
Alkyne	C_nH_{2n-2}

Essential conditions required for the addition reaction to occur :

(i) Multiple bonds (double and triple bonds) must be present between carbon atoms in the chain of hydrocarbon.

(ii) Addition of hydrogen should be carried out in the presence of catalyst such as nickel or platinum.

Chemical Equation :

$$CH_2=CH_2 + H_2 \xrightarrow{(Ni \text{ or } Pt)} CH_3—CH_3$$

Ethene — Ethane

$$CH \equiv CH + 2H_2 \xrightarrow{(Ni \text{ or } Pt)} CH_2 = CH_2$$

Ethyne — Ethene

1+1+1

U **Q. 15. (a) List four characteristics of homologous series.**

(b) Draw the electron dot structure of carbon dioxide.

[Board Term-II, Set 2021, 2012]

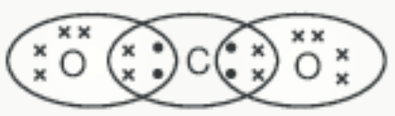
Ans. (a) Four characteristics of homologous series are :

(i) Same functional group. ½

(ii) Similar chemical properties. ½

(iii) Regular gradation in physical properties. ½

(iv) Successive member differ by – CH_2. ½

(b) 

1

[CBSE Marking Scheme, 2012]

U **Q. 16. Carbon has the unique property to form bonds with other atoms of carbon.**

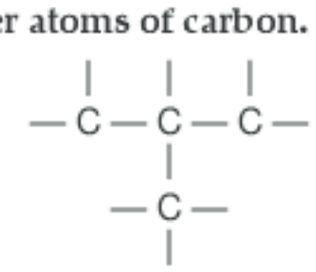


Fig. A

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

(ii) Give reason for this unique property of carbon.

(iii) Draw the structure of cyclohexane.

[Board Term II, Set-8XSVHLC, 2014]

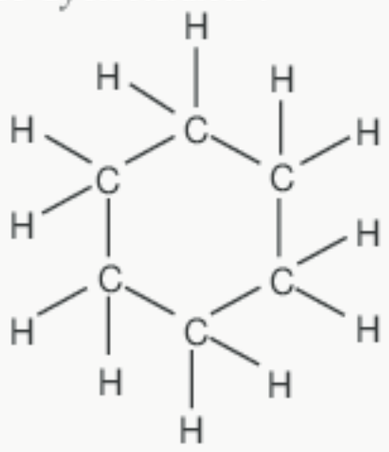
Ans. (i) Catenation.

(ii) Carbon forms large number of compounds due to the following :

(a) Catenation : Carbon forms bond with other atoms of carbon.

(b) Tetravalency : Carbon share four electrons with other atoms.

(iii) Structure of Cyclohexane :



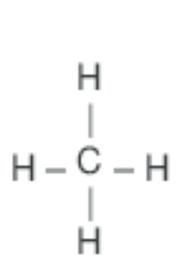
1+1+1

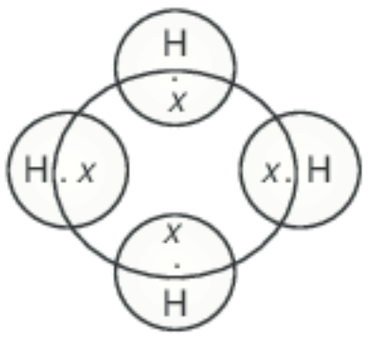
[CBSE Marking Scheme, 2014]

U **Q. 17. Name and draw the chain structure and dot structure of first two alkanes.**

[Board Term II, SQP 2013]

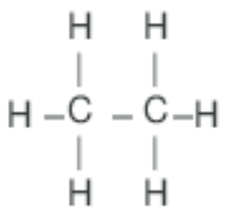
Ans. (i) Methane

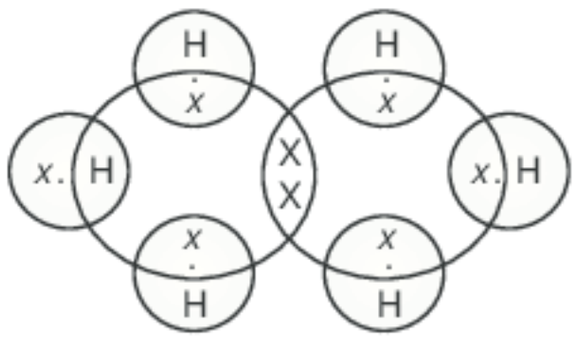




1½

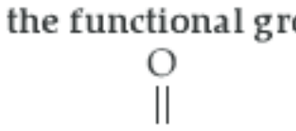
(ii) Ethane



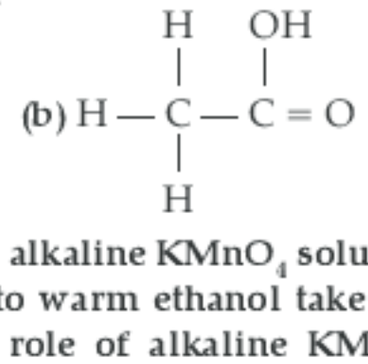


1½

U **Q. 18. (i) Define the term functional group. Identify the functional group present in**



(a),



(b)

(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.

[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 ½ + ½

(ii) Acetic/Ethanoic acid is formed. It is an oxidizing agent. ½ + ½

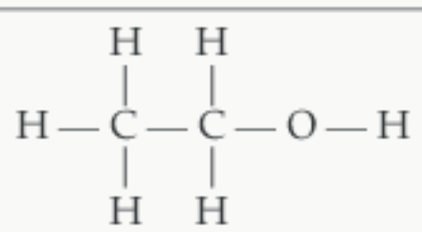
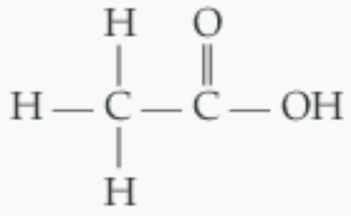
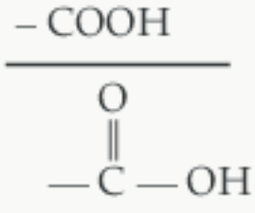
[CBSE Marking Scheme, 2016]

U **Q. 19. What is meant by functional group in carbon compounds ? Write in tabular form the structural formula and the functional group present in the following compounds :**

(i) Ethanol

(ii) Ethanoic acid [Board Term II, Foreign Set-I, 2015]

Ans. An atom or a group of atoms/heteroatoms which determines the chemical properties of an organic compound is called functional group. **1**

Name	Structural Formula	Functional Group
Ethanol		– OH
Ethanoic acid		

[CBSE Marking Scheme, 2015] 1 + 1

A **Q. 20. (i) Identify, from the following, the hydrocarbons that can undergo addition reactions :**

C_3H_4, C_2H_6, CH_4, C_2H_4. Justify your answer.

(ii) Write the name of the homologous series to which they belong to. [Board Term-II, Set 2008, 2012]

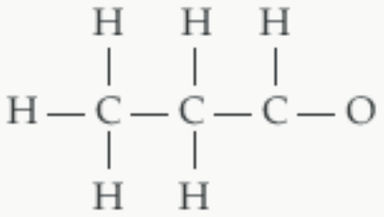
Ans. (i) C_3H_4, C_2H_4 will undergo addition reactions because they are unsaturated compounds. **1**

(ii) C_3H_4 – Alkyne **1**

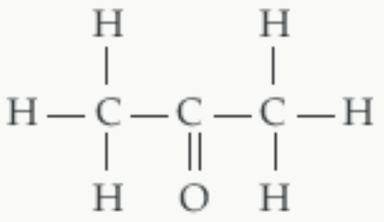
C_2H_4 – Alkene [CBSE Marking Scheme, 2012] 1

A **Q. 21. 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 relation between the two in the language of science.** [OD. Set-I, 2016]

Ans. (i) Propanal (aldehyde); ½ + ½



(ii) Propanone (Ketone); ½ + ½



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

[CBSE Marking Scheme, 2016]

A **Q. 22. Explain the following :**

(i) CH_3COOH is a weak acid

(ii) Propene undergoes addition reaction

(iii) The gas stoves have inlets for air.

[Board Term II, Set GFVTB86, 2015]

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

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

(iii) Sufficient supply of O_2 for complete combustion.

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

U **Q. 23. List two tests for experimentally distinguishing between an alcohol and a carboxylic acid and describe how these tests are performed.**

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

OR

How would you distinguish experimentally between an alcohol and a carboxylic acid ?

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 separately. If brisk effervescence with the evolution of a colorless 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 :

Ans. (i) 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 reacts 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.

(ii) 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**

A **Q. 24. A carboxylic acid (molecular formula $C_2H_4O_2$) reacts with an alcohol in the presence of an acid catalyst to form a compound 'X'. The alcohol on oxidation with alkaline $KMnO_4$ followed by acidification gives the same carboxylic acid $C_2H_4O_2$. Write the name and structure of (i) carboxylic acid, (ii) alcohol and (iii) the compound 'X'.** **[Baord Term II, Outside Delhi Set-I]**

Ans. (i) **$C_2H_4O_4$:** $CH_3–COOH$ - ethanoic acid

(ii) **C_2H_5OH :** ethanol

(iii) X is $CH_3COOC_2H_5$ - ethyl acetate [ethyl ethanoate -ester] **3**

U **Q. 25. Why is homologous series of carbon compounds so called ? Write the chemical formula of two consecutive members of any homologous series and state the part of these compounds that determines their (i) physical and (ii) chemical properties.**

[Delhi Set-II, 2015, Delhi Set-I, 2013]

Ans. (i) All the members of a series have the same functional group, similar structure and same general formula. **(Any two) ½ + ½**

(ii) CH_3OH, C_2H_5OH **½+½**

(iii) The physical properties are determined by alkyl group/hydrocarbon part/part other than the functional group. ½

(iv) The chemical properties are determined by functional group such as –OH group, or any other example from any other homologous series. ½

[CBSE Marking Scheme, 2015]

U **Q. 26. Write the names of the following :**

[Board Term-II, Set (2024) 2012]

(i) $CH_3CH_2 – C \equiv CH$

(ii) CH_3CH_2OH

(iii) CH_3COCH_3.

Ans. (i) Butyne **1**

(ii) Ethanol **1**

(iii) Propanone **[CBSE Marking Scheme, 2012] 1**

Long Answer Type Questions

(5 marks each)

U **Q. 1. 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.** [OD 31/1 2017] 5

R Q. 2. **(i) Define the term 'isomers'.**

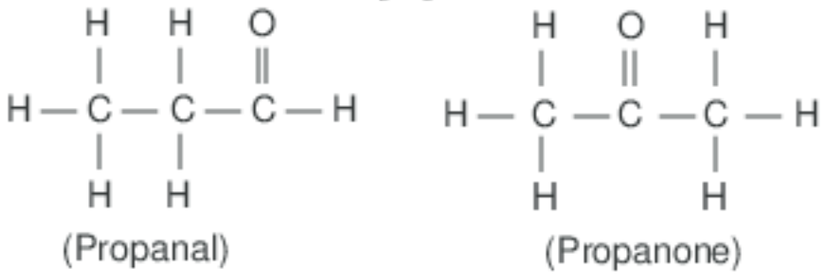
(ii) Draw two possible isomers of the compound with molecular formula C_3H_6O and write their names.

(iii) Give the electron dot structures of the above two compounds.

[NCERT, Board Term II Delhi Set-I, 2013]

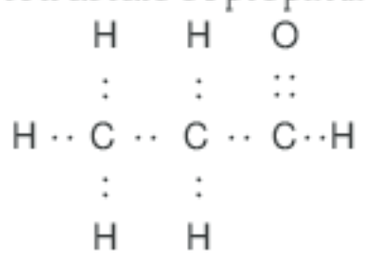
Ans. (i) The compounds that contain the same molecular formula but different structures are called isomers. The isomers of a compound have different physical properties. 1

(ii) The two possible isomers of the compound with molecular formula C_3H_6O are :

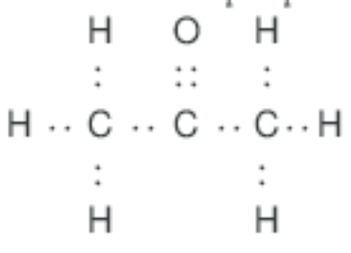


(Propanal) (Propanone) 2

(iii) Electron dot structure of propanal.



Electron dot structure of propanone



2

U Q. 3. **Give two examples of covalent compounds which you have studied. State any four properties in which covalent compounds differ from ionic compounds. [Board Term II, SQP, 2013]**

Ans. Two examples of covalent compounds are ethanol, and ethanoic acid. ½+½

Difference between the properties of Covalent and Ionic compounds :

S. No.	Covalent Compounds	Ionic Compounds
(i)	They are readily soluble in organic solvent.	They are not soluble in organic solvent.
(ii)	They do not ionize.	They ionise in organic medium.
(iii)	They are bad conductor of heat and electricity.	They are good conductors of heat and electricity.
(iv)	They have weak force of attraction between the molecule.	They have strong force of attraction between the molecule.

4

U Q. 4. **(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 ? [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).**

(ii) On burning ethane in air, the products obtained are carbon dioxide and water, along with heat and light. 2

$2C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(l) + \text{Heat} + \text{Light}$ 1

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

R Q. 5. **(a) State any three physical properties of carbon compounds.**

(b) Carbon is a versatile element. Justify this statement. [Board Term-II, 2015]

Ans. (a) Three physical properties of carbon compounds are :

(i) Catenation property.

(ii) Low melting and boiling point compared to ionic compound.

(iii) Poor conductors of electricity.

(b) Carbon is a versatile element because it forms covalent bonds with large number of elements and has catenation capacity to form compounds by chain of bonds with itself. **3 + 2**

[CBSE Marking Scheme, 2015]

U **Q. 6. Explain the following reactions with one example for each giving relevant chemical equations :**

(i) Hydrogenation reaction,

(ii) Oxidation reaction,

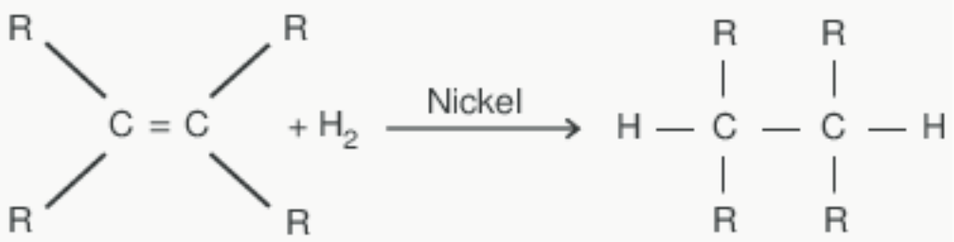
(iii) Substitution reaction,

(iv) Combustion reaction,

(v) Saponification reaction.

[Board Term II, Set-QNA4XWT, 2014]

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



Vegetable Oil Vegetable Ghee

(ii) Oxidation reaction : When there is an addition of oxygen in the reaction, it is known as oxidation reaction. **1**

$$CH_3CH_2OH + [O] \xrightarrow[KMnO_4]{\text{Alkaline}} CH_3COOH + H_2O$$

Ethanol Ethanoic acid

(iii) Substitution reaction : Those reactions in which an atom or group of atoms of a compound are replaced by other atom or group of atoms are called substitution reactions.

$$CH_4(g) + Cl_2(g) \xrightarrow{\text{Sunlight}} CH_3Cl(g) + HCl(g)$$

Methane Chlorine Chloromethane Hydrogen chloride **1**

(iv) Combustion reaction : Ethanol is highly inflammable liquid, *i.e.*, it catches fire very easily. It burns with blue flame in presence of oxygen to form carbon dioxide and water.

$$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$$

Ethanol Oxygen Carbon dioxide Water **1**

(v) Saponification reaction : It is the reaction in which an ester reacts with sodium hydroxide to form sodium salts of acid and alcohol.

$$CH_3COOC_2H_5 + NaOH \rightarrow CH_3COONa + C_2H_5OH$$

Ethyl ethanoate Sodium hydroxide Sodium ethanoate Ethanol **1**

[CBSE Marking Scheme, 2014]

R **Q. 7. Describe the following chemical properties of carbon compounds briefly and give one chemical reaction for each :**

[Board Term II, Set-UV6TFLN, 2016]

(i) Combustion

(ii) Addition

(iii) Substitution

(iv) Esterification

(v) Oxidation

Ans. (i) Combustion :

$$CH_4 + O_2 \rightarrow CO_2 + H_2O + \text{Energy} + \text{Light}$$

(ii) Addition

$$CH_2 = CH_2 + H_2 \xrightarrow{Ni} C_2H_6$$

(iii) Substitution

$$CH_4 + Cl_2 \xrightarrow{\text{Sunlight}} CH_3Cl + HCl$$

(iv) Esterification

$$CH_3COOH + C_2H_5OH \xrightarrow{H^+} CH_3COOC_2H_5 + H_2O$$

(v) Oxidation

$$C_2H_5OH \xrightarrow{\text{alk } KMnO_4} CH_3COOH.$$

1 + 1 + 1 + 1 + 1

[CBSE Marking Scheme, 2016]

U **Q. 8. (a) Draw the structure for the following compounds :**

(i) 2-Bromopentane, (ii) 2-methyl propane,

(iii) Butanal, (iv) 1-Hexyne.

(b) Draw the electron dot structure for ethanoic acid.

[Board Term II, Set (2020), 2012]

Ans. (a) (i) $CH_3 — CH_2 — CH_2 — \underset{\displaystyle Br}{\underset{|}{CH}} — CH_3$ **1**

(ii) $CH_3 — \underset{\displaystyle CH_3}{\underset{|}{CH}} — CH_3$ **1**

(iii) $CH_3CH_2CH_2CHO$ **1**

(iv) $HC \equiv C - CH_2 - CH_2 - CH_2 - CH_3$ **1**

(b) Electrons dot structure of ethanoic acid

1

[CBSE Marking Scheme, 2012]

A **Q. 9. Explain why carbon forms compounds mainly by covalent bonds. Explain in brief two main reasons for carbon forming a large number of compounds. Why does carbon form strong bonds with most other elements ?**

[Board Term II, Delhi Set-I, 2015]

OR

What are the two properties of carbon which lead to the huge number of carbon compounds we see around us ?

Ans. (i) Carbon has 4 electrons in its outermost shell, and needs to gain or lose 4 electrons to attain noble gas configuration. **1**

(ii) Losing or gaining 4 electrons is not possible due to energy considerations; hence it shares electrons to form covalent bonds. **1**

Two reasons for large number of carbon compounds :

(i) Catenation : The unique ability of carbon to form bonds with other atoms of carbon, giving rise to long chains of different types of compounds. **1**

(ii) Tetravalency : Since carbon has a valency of 4, it is capable of bonding with four other atoms of carbon or atoms of elements like oxygen, hydrogen, nitrogen, sulphur, chlorine, etc. **1**

The reason for the formation of strong bonds by carbon is its small size which enables the nucleus to hold on to the shared pairs of electrons strongly. **1**

[CBSE Marking Scheme, 2015]

Detailed Answer :

Since carbon has a valency of four, it is capable of bonding with four other atoms of carbon or atoms of some other monovalent elements. In order to satisfy its tetravalency carbon can form double or triple bonds also with other C-atoms or with oxygen, nitrogen etc.

Reasons for carbon forming a large number of compounds are :

(i) Catenation : Carbon has the unique property or ability to form bonds with other atoms of carbon, giving rise to large molecules. This property is called catenation. These compounds may have long chains of carbon, branched chains of carbon or even carbon atoms arranged in rings.

(ii) Tetravalency : Carbon has four valence electrons in its valence shell so the valency of carbon is four. Due to this valency, carbon is a tetravalent element and it has the capability of satisfying its tetravalent by sharing its electrons with some monovalent elements and forming covalent bonds.

(iii) Carbon exhibits catenation much more than any other element due to its smaller size which makes the C — C bonds strong while the bonds between any other element are comparatively weaker due to its large size. **1+2+2**

A **Q. 10. Elements forming ionic compounds attain noble gas electronic configuration by either gaining or losing electrons from their valence shells. Explain giving reason why carbon cannot attain such a configuration in this manner to form its compounds. Name the type of bonds formed in ionic compounds and in the compounds formed by carbon. Also explain with reason why carbon compounds are generally poor conductors of electricity.** **[Board Term II Delhi Set-I, 2015]**

OR

Elements forming ionic compounds attain noble gas configuration by either gaining or losing electrons from their outermost shells. Give reason to explain why carbon cannot attain noble gas configuration in this manner to form its compounds. Name the type of bonds formed in ionic compounds and in the compounds formed by carbon. Also give reason why carbon compounds are generally poor conductors of electricity.

[Board Term-II, Outside Delhi Set-I, II, 2014]

Ans. Carbon has 4 electrons in its outermost shell. It cannot lose 4 electrons to form C^{4+} because very high energy is required to remove 4 electrons. **1½**

In cannot gain 4 electrons to form C^{4-} ions because it is difficult for 6 protons to hold on to 10 electrons. **1½**

(i) Ionic/Electrovalent Bonds. **½**

(ii) Covalent bonds. **½**

(iii) There are no charged particles in carbon compounds and hence poor conductors of electricity. **1**

[CBSE Marking Scheme, 2015]

A **Q. 11. List two reasons for carbon forming a large number of compounds. Name the type of bonding found in most of its compounds. Why does carbon form compounds mainly by this kind of bonding. Give reason why the carbon compounds :**

(i) Generally have low melting and boiling points.

(ii) Do not conduct electricity in molten state.

[Board Term-II, Outside Delhi Set-I, III, 2014]

Ans. Two of the main reasons because of which carbon forms a large number of organic compounds are :

1. **Tetravalent nature of carbon**
2. **Greater C–C bond strength**

Carbon compounds are formed by covalent bonds.

(i) Carbon compounds have low melting and boiling point because these compounds are bonded with covalent bond and also forces of attraction between these molecules are not very strong.

(ii) Because carbon compounds are covalent in nature, they are bad conductors of electricity; they lack free electrons. **2+1+2**

A **Q. 12. State the reason why carbon can neither form C^{4+} cations nor C^{4-} anions but forms covalent compound. Also state the reason to explain why covalent compounds:**

(i) are bad conductors of electricity.

(ii) have low melting and boiling points.

[Board Term-II, Delhi Set-I, III, 2014]

Ans. Atomic number of carbon is six. This means that it has four electrons in its outermost shell and it needs

four more electrons to attain noble gas electronic configuration. It does not form C^{4+} cation, as the removal of four valence electrons will require a huge amount of energy. The cation formed will have six protons and two electrons. This makes it highly unstable. Carbon is unable to form C^{4-} anion as its nucleus with six protons will not be able to hold ten electrons. Thus, carbon achieves noble gas electronic configuration by sharing its four electrons with other elements, *i.e.* it forms covalent compounds.

(i) Covalent compounds are bad conductors of electricity due to lack of free electrons.

(ii) Covalent compounds are formed by covalent bonds and it has been found that the intermolecular forces of attraction in covalent compounds are weak. Thus, their melting and boiling points are quite low. 3+1+1

TOPIC-2
Carbon Compounds, Soap and Detergents

Very Short Answer Type Questions (1 mark each)

U **Q. 1. How many covalent bonds are present in pentane (C_5H_{12})? [DDE 2017]**

Ans. Sixteen (16) Covalent bonds. 1

R **Q. 2. Name the simplest ketone.**

Ans. The simplest ketone is acetone. *e.g.*, CH_3COCH_3. 1

R **Q. 3. What is the common name of CH_3COOH ? [Board Term II, 2014, 2012]**

Ans. Acetic acid or vinegar.
[CBSE Marking Scheme, 2012] 1

A **Q. 4. Name the gas evolved when ethanoic acid is added to sodium carbonate? [DDE 2017]**

Ans. $2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + H_2O + CO_2\uparrow$ 1

A **Q. 5. Write balanced Chemical equation of dehydration of ethanol by hot conc. H_2SO_4. [DDE 2017]**

Ans. $CH_3CH_2OH \xrightarrow[H_2SO_4,\ 443k]{\text{Hot Conc}} CH_2 = CH_2 + H_2O$. 1

R **Q. 6. Why is ethanol used in making of tincture, iodine, cough syrup, tonic etc. ?**

(i) **What is the role of conc. H_2SO_4 in making ethane from ethanol ? [Board Term II, SQP, 2013]**

Ans. (a) Ethanol is a solvent used to make tincture of Iodine because the cell membrane of micro-organisms is made up of lipids and ethanol is a the solvent, which can dissolve the lipid of easily and kill the micro-organisms that may be pathogenic.

(b) Concentrated sulphuric acid acts as dehydrating agent *i.e.,* removes water molecule from ethanol and also catalyse the reaction and convert ethanol to ethane. ½ + ½

A **Q. 7. An organic compound burns with a sooty flame. Is it saturated or unsaturated compound ? Justify. [Board Term II, 2013, 2012]**

Ans. It is unsaturated compound because they have more carbon. It burns with sooty or smoky flame.
[CBSE Marking Scheme, 2012] 1

R **Q. 8. Draw the electron dot structure of nitrogen molecule. [Board Term II, 2013, 2012]**

Ans. 
[CBSE Marking Scheme, 2012] 1

U **Q. 9. In an organic compound, which part largely determine its physical and chemical properties ?**

Ans. The alkyl part (carbon chain) of an organic compound determines its physical properties whereas the functional group determines its chemical properties. 1

U **Q. 10. What happens when methane is burnt in air ?**

Ans. Methane burns in air with the formation of carbon dioxide and water.

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + Heat energy 1

R **Q. 11. Complete the following reaction :**

$CH_3COOH + NaHCO_3 \rightarrow$

[Board Term II, 2013, 2012]

Ans. $CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$
[CBSE Marking Scheme, 2012] 1

R **Q. 12. Write the chemical equations for the conversion of ethanol to ethanoic acid in the presence of $KMnO_4$. [Board Term II, Set-8X5VHLC, 2014]**

Ans. $CH_3CH_2OH \xrightarrow{KMnO_4\ [O]} CH_3COOH$
Ethanol — Ethanoic acid
[CBSE Marking Scheme, 2014] 1

A **Q. 13. What happens when bromine water is added to ethene gas ?**

Ans. Ethene gas decolourises the brown colour of bromine water. 1

A **Q. 14. Why is pure ethanoic acid called glacial ethanoic acid (or glacial acetic acid) ?**

[DDE 2017]

Ans. When pure ethanoic acid is cooled, it freezes to form a colourless, ice-like liquid. This pure ethanoic acid is called ethanoic acid (or glacial acetic acid). 1

Short Answer Type Questions-I

(2 marks each)

R Q. 1. **What is meant by saponification ? Give an example. [NCERT][Board Term II, Set B1, 2011]**

Ans. When an ester reacts with water in presence of a base, a salt of carboxylic acid and an alcohol are produced. Such a reaction is called saponification. **1**

For example : When ethyl ethanoate is heated with a solution of sodium hydroxide, sodium ethanoate and ethanol are produced. ½

$CH_3COOC_2H_5 + NaOH \xrightarrow{Boil} CH_3COONa + C_2H_5OH$. **[CBSE Marking Scheme, 2011]** ½

R Q. 2. **Which is better for health, butter or vegetable oil? Why? [DDE 2017]**

Ans. Butter is mostly made up of heart healthy saturated fat and is low in polysaturated fat. Saturated fats are good for health. A vegetable oil is a triglyceride extracted from a plant, that are liquid at room temperature. There oil contain very large amounts of biologically active fats called Omega-6 polyunsaturated fatty acids, which are harmful in excess. 2

U Q. 3. **(i) What is vinegar ? Give its uses.**

(ii) Why does carbon form compounds having low melting and boiling points ?

[Board Term II, Set A1, 2011]

Ans. (i) 5 to 8% solution of acetic acid in water is called Vinegar. It is used as a preservative in pickles.

(ii) Carbon compounds have low melting and boiling point because force of attraction between carbon compounds are not very strong.

[CBSE Marking Scheme, 2011] 1+1

U Q. 4. **Give a chemical test to distinguish between butter and cooking oil.**

[Board Term II, Set A1, 2011]

Ans. Butter and cooking oil can be distinguished by using alkaline $KMnO_4$. Being unsaturated only cooking oil decolourises the pink colour of alkaline $KMnO_4$ where as butter does not, because it is saturated. Bromine water test is also used where brown colour is discharged by the cooking oil.

[CBSE Marking Scheme, 2011] 1+1

U Q. 5. **List any four differences between soaps and detergents. [Board Term II, Set A1, 2011]**

Ans.

S. No.	Soaps	Detergents
(i)	They are sodium 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.

[CBSE Marking Scheme, 2011] ½+½+½+½

R Q. 6. **Why is ethanol used in making of tincture, iodine, cough syrup, tonic etc.?**

(a) What is the role of conc. H_2SO_4 in making ethane from ethanol? [DDE 2017]

Ans. (a) Ethanol is a solvent used to make tincture of Iodine because the cell membrane of micro-organisms is made up of lipids and ethanol is a the solvent, which can dissolve the lipid of the cell membrane easily and kill the micro-organisms that may be pathogenic.

(b) Concentrated sulphuric acid acts as dehydrating agent *i.e.,* removes water molecule from ethanol and also catalyse the reaction and convert ethanol to ethane. ½ + ½

U Q. 7. **(i) What is a catalyst ? Write the chemical equation to represent the hydrogenation of ethene.**

(ii) Which of the following compounds belong to the same homologous series ? C_2H_6, $C_2H_6O_2$, C_2H_6O, C_4H_{10}.

Ans. (i) Catalyst is a substance that cause a reaction to occur or proceed at a different rate without being affected itself.

$CH_2 = CH_2 \xrightarrow[H_2]{Nickel\ Catalyst} CH_3 - CH_3$ **1**

(ii) C_2H_6 and C_4H_{10}. ½+½

A Q. 8. **Identify the functional in following—**

(a) HCHO **(b) CH_3 COOH**

(c) CH_3CH_2OH **(d) CH_3COCH_3**

[DDE 2017]

Ans. (a) Aldehyde **(b)** Carboxylic acid

(c) Alcohol **(d)** Acetone

½ + ½ + ½ + ½

U Q. 9. **Complete the following reactions—**

(a) $CH_4 + O_2 \rightarrow$

(b) $CH_4 + Cl_2 \xrightarrow{Sunlight}$ **[DDE 2017]**

Ans. (a) $CH_4 + O_2 \rightarrow CO_2 + 2H_2O$ + Heat + Light

(b) $CH_4 + Cl_2 \xrightarrow{Sunlight} CH_3Cl + HCl$ **1 + 1**

U Q. 10. **(a) Complete the following reactions :**

(i) $CH_4 + Cl_2 \xrightarrow{Sunlight}$ ..... + HCl

(ii) $CH_3CH_2OH \xrightarrow[H_2SO_4]{Hot.conc.}$ ..... + H_2O

(b) How is scum formed ?

[Board Term II, Set B1, 2011]

Ans. (a) Complete reactions are —

(i) $CH_4 + Cl_2 \xrightarrow{Sulight} CH_3Cl + HCl$

(ii) $CH_3CH_2OH \xrightarrow[H_2SO_4]{Hot.conc.} H_2C=CH_2 + H_2O$ (½+½)

(b) When soap reacts with hard water, the minerals present in water react with soap and form a white curdy substance known as scum.

It reduces the cleansing ability of soap.

[CBSE Marking Scheme, 2011] ½ + ½

A **Q. 11. (i) What would be observed on adding a 5% alkaline potassium permanganate drop by drop to some warm ethanol taken in a test-tube ?**

(ii) Write the name of the compound formed during the chemical reaction. [Board Term II, Set A1, 2011]

Ans. (i) Colour of $KMnO_4$ disappears because it takes part in the oxidation of ethanol. **1**

(ii) Ethanol is oxidized to produce ethanoic acid. **1**

[CBSE Marking Scheme, 2011]

A **Q. 12. (i) An organic compound 'X' reacts with sodium metal to form sodium ethoxide and a gas 'Y'. Identify 'X' and 'Y'.**

(ii) What happens when ethanol is heated at 443 K with conc. H_2SO_4 ? [Board Term II, Set A1, 2011]

Ans. (i) $2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2$ ½+½

'X' is ethanol and Y is hydrogen.

(ii) $CH_3CH_2OH \xrightarrow[443\,K]{\text{Conc. } H_2SO_4} CH_2 = CH_2 + H_2O$ **1**

[CBSE Marking Scheme, 2011]

A **Q. 13. An organic acid 'X' is a liquid which often freezes during winter time in cold countries. It has molecular formula $C_2H_4O_2$. On warming with ethanol in the presence of a few drops of conc. H_2SO_4 a compound Y with a sweet smell is formed.**

(i) Identify 'X' and 'Y'.

(ii) Write chemical equations for the reactions involved. [Board Term II, Set A1, 2011]

Ans. (a) 'X' is CH_3COOH and 'Y' is $CH_3COOCH_2CH_3$. **1**

(b) $CH_3COOH + C_2H_5OH \xrightarrow{H_2SO_4} CH_3COOC_2H_5 + H_2O$ **[CBSE Marking Scheme, 2011]** **1**

R **Q. 14. (i) Describe the mechanism of cleansing action of soaps.**

(ii) Why do soaps not work in hard water ?

[Board Term II, Set A1, 2011]

Ans. (i) Soap molecules form micelles where ionic end of soap dissolves in water while carbon chain dissolves in oil. The emulsion in water thus formed helps in dissolving the dirt in water and we can wash our clothes clean. **1**

(ii) Soaps react with calcium or magnesium ions to form an insoluble substance which results in wastage of soap. **[CBSE Marking Scheme, 2011]** **1**

R **Q. 15. Why is the conversion of ethanol to ethanoic acid an oxidation reaction? [KVS 2017]**

Ans. Since the conversion of ethanol to ethanoic acid involves the addition of oxygen to ethanol it is an oxidation reaction.

$CH_3CH_2OH \xrightarrow{[O]} CH_3COOH$

(Ethanol) (Ethanoic acid) **2**

A **Q. 16. What is meant by denatured alcohol? What is the need to denature alcohol? [KVS 2017]**

Ans. Ethyl alcohol mixed with methyl alcohol is called denatured alcohol.

Methyl alcohol is added to ethyl alcohol in order to make it unfit for drinking purposes. **1 + 1**

R **Q. 17. Why soap is not suitable for washing cloth when water is hard? [DDE 2017]**

Ans. The magnesium and calcium salt present in hard water react with soap molecule to form insoluble product called scum. This scum create difficulty in cleansing action. **2**

Short Answer Type Questions-II

(3 marks each)

A **Q. 1. What is an oxidising agent ? What happens when an oxidising agent is added to propanol ? Explain with the help of a chemical equation.**

[Board Term II, Delhi Set-II, 2016] [DDE 2017]

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

(ii) $CH_3—CH_2—CH_2—OH \xrightarrow[\text{OR Acidified } K_2Cr_2O_7 + \text{Heat}]{\text{Alkaline } KMnO_4 + \text{Heat}}$

Propanol

$CH_3 — CH_2 — \underset{\underset{O}{\|}}{C} — OH$ **1**

Propanoic acid

(iii) Propanol is oxidised to Propanoic acid. **1**

[CBSE Marking Scheme, 2016]

R **Q. 2. What is meant by hydrogenation ? With the help of a chemical equation, explain the role of this reaction in industry.**

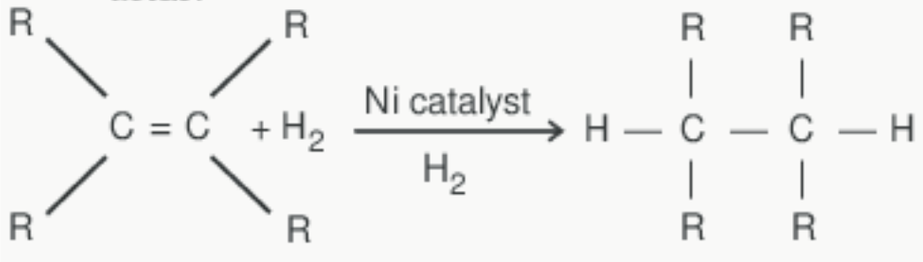
[Board Term II, Set-205, 2012]

OR

What is hydrogenation ? What is its industrial application ? [NCERT]

Ans. Hydrogenation: The process in which unsaturated compounds reacts with hydrogen in the presence of nickel (as a catalyst) to form saturated compounds are called hydrogenation. **1**

This reaction is commonly used in the hydrogenation of vegetable oils. Vegetable oils have long unsaturated carbon chains, which are converted into vegetable ghee *i.e.*, saturated fatty acids. **1**



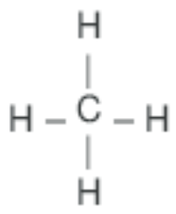
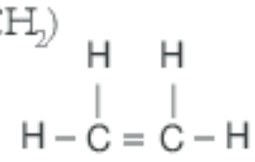
1

[CBSE Marking Scheme, 2012]

U Q.3. **(i) Differentiate between alkanes and alkenes. Name and draw the structure of one member of each. [Board Term-II, Foreign Set-I 2014]**

(ii) Alkanes generally burn with clean flame. Why ? [Board Term II Delhi Set-II, 2013]

Ans. (i) Difference between alkanes and alkenes.

S. No.	Alkanes	Alkenes
(i)	In all the compounds, carbon and hydrogen are attached with single bonds.	These are unsaturated hydrocarbons which have one or more double bonds.
(ii)	Member — Methane (CH_4) 	Member — Ethene ($CH_2 = CH_2$) 

1 + 1

(ii) Alkanes are saturated hydrocarbons which always burn with a clean blue flame because complete combustion takes place in sufficient oxygen to give CO_2 and H_2O with the liberation of large amount of heat and light. 1

A Q.4. **Explain why it is difficult to wash clothes with soap when water is hard. How do detergents help in overcoming this problem ? [Board Term-II, 2012]**

Ans. In hard water, soap reacts with calcium and magnesium salts which are present in hard water and form insoluble substances called scum. 1

Detergents are ammonium or sulphonate salts of long chain carboxylic acids. The charged end of these compounds do not form insoluble precipitates with calcium and magnesium ions in hard water. **[CBSE Marking Scheme, 2012]** 2

A Q.5. **Differentiate between Soap and Detergents. [DDE 2017]**

Ans. Difference between Soap and Detergents

S. No.	SOAP	DETERGENTS
(i)	Soap is the Sodium or Potassium salt of a higher fatty acid like Palmitic, Oleic or Stearic acid.	Detergents are the Sodium salts of a long chain benzene sulphonic acid or a long hydrogen sulphate.
(ii)	When used with hard water a lot of it is wasted in removing Ca^{2+} / Mg^{2+} salts as curdy ppt.	It forms good lather with hard water and thus can be safely used even with hard water.
(iii)	It is completely oxidised to CO_2 by bacteria present in sewage and so it does not create any pollution problems in rivers.	Its excess creates pollution problem in rivers since it is not fully biodegradable.

1 + 1 + 1

R Q.6. **Write the molecular, electronic and structural formulae of ethyne. [Board Term-II, Delhi Set-GFUTB86, 2015]**

OR

Draw the electron dot structure of ethyne and also draw its structural formula. [NCERT Exemplar]

Ans. Molecular formula of ethyne = C_2H_2

Electronic formula = $H\bullet\bullet C \vdots\vdots C \bullet\bullet H$

Structural formula = $H — C \equiv C — H$

[CBSE Marking Scheme, 2015] 1+2

A Q.7. **Write IUPAC names of—**

(a) $HC \equiv CH$

(b) $CH_3CH_2CH_2OH$

(c) CH_3CHO. **[DDE 2017]**

Ans. (a) Ethyne

(b) Propanol

(c) Ethanol 1 + 1 + 1

A Q.8. **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.[OD 31/1 2017]** 3

Ans.

R Q.9. **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. [OD 31/1 2017]** 3

Ans.

Detailed Answer.

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

$$RCOOH + R'OH \xrightarrow{H^+} RCOOR' + H_2O \qquad RCOONa + R'OH$$

Ester

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

$RCOOR' + NaOH \rightarrow RCOONa\ R'OH$ 2

Soap

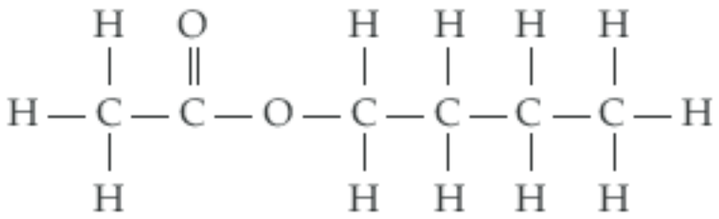
(i) Use of esters

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. 23. The structural formula of an ester is :

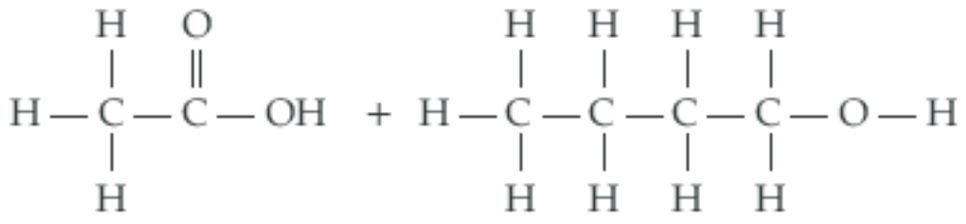


Write the structural formula of the acid and the alcohol from which it might be prepared. Name the process of formation of ester.

[Board Term-II, Delhi Set-UV6TFLN, 2015]

Ans. $CH_3COOH + C_4H_9OH \longrightarrow CH_3COOC_4H_9 + H_2O$

Acid Alcohol Ester



Ethanoic acid Butanol

Process is Esterification. 1+ 1 + 1

U **Q. 24. Write three different chemical reactions showing the conversion of ethanoic acid to sodium ethanoate. Write balanced chemical equation in each case. Write the name of the reactants and the products other than ethanoic acid and sodium ethanoate in each case.**

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

Ans. $CH_3COOH + Na_2CO_3 \longrightarrow$

Sodium carbonate

$$2CH_3COONa + H_2O + CO_2$$

Water Carbondioxide

$CH_3COOH + NaHCO_3 \longrightarrow$

Sodium hydrogen carbonate $CH_3COONa + H_2O + CO_2$

Water Carbon dioxide

$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$

Sodium hydroxide Water

$2CH_3COOH + 2\,Na \longrightarrow CH_3COONa + H_2$

Sodium Hydrogen gas

(Any three reaction) 1+1 +1

[CBSE Marking Scheme, 2016]

A **Q. 10. When ethanol reacts with ethanoic acid in the presence of conc. H_2SO_4, a substance with fruity smell is produced. Answer the following :**

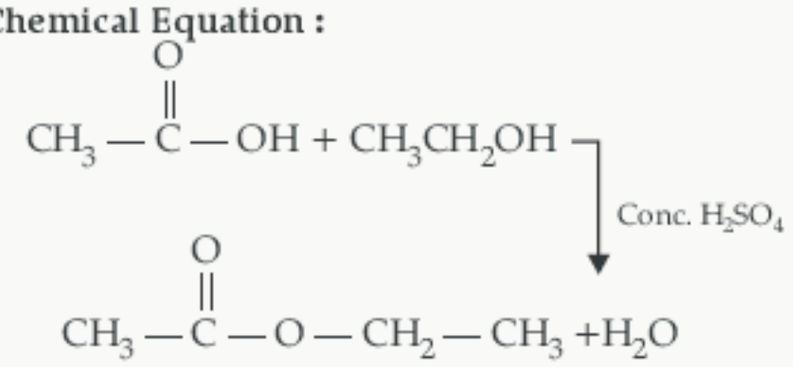
(i) State the class of compounds to which the fruity smelling compounds belong. Write the chemical equation for the reaction and write the chemical name of the product formed.

(ii) State the role of conc. H_2SO_4.

[Board Term II, Set-I, III, 2016]

Ans. (i) Esters. ½

Chemical Equation :



1

Product's chemical name—Ethyl ethanoate ½

(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]

A **Q. 11. 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 ?**

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

Ans. (i) Ethene ½

(ii) $C_2H_5OH \xrightarrow[443K]{\text{Conc. } H_2SO_4 + \text{Heat}} \underset{\text{Ethene}}{H_2C = CH_2} + H_2O$ ½

(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]

A **Q. 12. Write the name and molecular formula of an organic compound having its name suffixed with 'ol' and having two carbon atoms in its molecule. Write balanced chemical equation to indicate what happens when this compound is heated with excess conc. H_2SO_4 and the name of main product formed. Also state the role of conc. H_2SO_4 in the reaction.**

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

Ans. Ethanol, C_2H_5OH **1**

$C_2H_5OH \xrightarrow{\text{Conc. } H_2SO_4} \underset{\text{Ethene}}{CH_2 = CH_2} + H_2O$ **1**

Role of conc. H_2SO_4— It act as a dehydrating agent. **1**

[CBSE Marking Scheme, 2016]

A **Q. 13. 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.**

[Delhi 31/1/1 2017]

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

$C_4H_8 + H_2 \xrightarrow{Ni//Pd} C_4H_{10}$

½ Catalyst

½ Equation

(or any other) ½ + ½

[CBSE Marking Scheme]

Detailed Answer.

Saturated compounds — 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 :

$CH_3 - CH_2 - CH = CH_2 + Cl_2 \rightarrow CH_3 - CH_2 - CH(Cl) - CH_2Cl$

or $CH_3 - CH = CH - CH_3 + Cl_2 \rightarrow CH_3\,CH(Cl) - CH(Cl) - CH_3$

3

A **Q. 14. Complete the following chemical equations :**

(i) $CH_3COOC_2H_5 + NaOH \rightarrow$

(ii) $CH_3COOH + NaOH \rightarrow$

(iii) $C_2H_5OH + CH_3COOH \xrightarrow{\text{Conc. } H_2SO_4}$

[Delhi 31/1/1 2017]

Ans. (i) $CH_3COOC_2H_5 + NaOH \rightarrow CH_3\,COONa + C_2H_5OH$

(ii) $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

(iii) $C_2H_5OH + CH_3COOH \xrightarrow{\text{Conc. } H_2SO_4} CH_3COOC_2H_5 + H_2O$ **1 × 3**

[CBSE Marking Scheme]

A **Q. 15. An organic compound 'P' is a constituent of wine. 'P' on reacting with acidified $K_2Cr_2O_7$ 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. [Board Term II Foreign Set-I, 2016]**

Ans. P-Ethanol, Q-Ethanoic acid, R-Hydrogen ½ + ½ + ½

$CH_3CH_2OH \xrightarrow{\text{Acidified } K_2Cr_2O_7} CH_3COOH$ ½

$2CH_3COOH + 2Na \longrightarrow 2CH_3COONa + H_2$ **1**

[CBSE Marking Scheme, 2016]

U **Q. 16. Write chemical equation of the reaction of ethanoic acid with the following :**

(i) Sodium

(ii) Sodium hydroxide

(iii) Ethanol.

Write the name of one main product of each reaction. [Board Term-II, O.D. Set-I, 2016]

Ans. (i) $2CH_3COOH + 2Na \longrightarrow 2CH_3COONa + H_2$

Sodium ethanoate/Sodium acetate ½ + ½

(ii) $CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$

Sodium ethanoate/Sodium acetate ½ + ½

(iii) $CH_3COOH + C_2H_5OH \longrightarrow CH_3COOC_2H_5 + H_2O$

Ethyl ethanoate/Ester ½ + ½

[CBSE Marking Scheme, 2016]

A **Q. 17. 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.

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

Ans. X — C_2H_5OH, Y—H_2 gas ½ + ½

$2C_2H_5OH + 2Na \longrightarrow 2C_2H_5ONa + H_2\uparrow$ 1

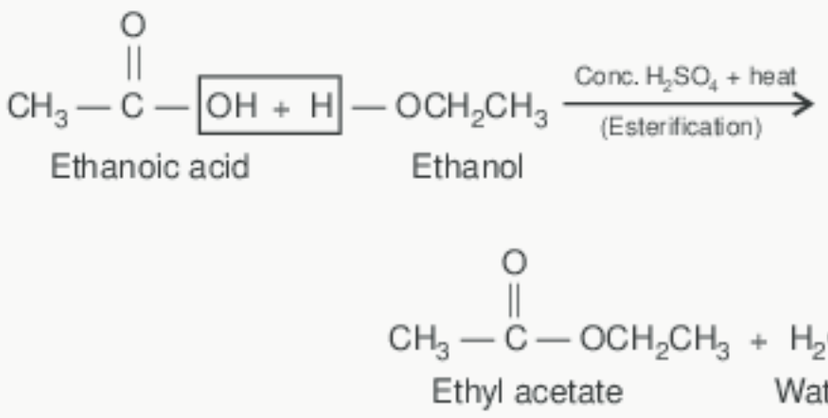
Ethene, C_2H_4. ½ + ½

[CBSE Marking Scheme, 2016]

U **Q. 18. 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 ?**

[Board Term II, Delhi Set, FF7NBE6, 2015]

Ans.



Reverse reaction = Saponification 2 + 1

[CBSE Marking Scheme, 2015]

A **Q. 19. Two carbon compounds X and Y have the molecular formula C_3H_6 and C_4H_{10} respectively. Which one of the two 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.**

[Delhi 31/1/2 2017]

Ans. (i) C_3H_6 / X 1

(ii) It is an unsaturated compound / due to the presence of a double bond. 1

(iii) $C_3H_6 + H_2 \xrightarrow{Ni/Pd} C_3H_8$ 1

(or any other)

[CBSE Marking Scheme]

Detailed Answer.

Saturated compounds — C_4H_{10} (Compound Y) undergo substitution reaction.

Unsaturated compound — C_3H_6 (Compound X) undergo addition reaction at the multiple bonds.

For example, propane will add a chlorine molecule (Cl_2) to form 1, 2 dichloropropane.

The reaction will be :

$CH_3 - CH = CH_2 + Cl_2 \rightarrow CH_3 - CH(Cl) - CH_2Cl$

1 + 1 + 1

A **Q. 20. Complete the following chemical equations :**

(i) $CH_3COOH + Na_2CO_3 \rightarrow$

(ii) $CH_4 + O_2 \rightarrow$

(iii) $C_2H_5OH + Na \rightarrow$ **[Delhi 31/1/3 2017]**

Ans. (i) $2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + H_2O + CO_2$ 1

(ii) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ 1

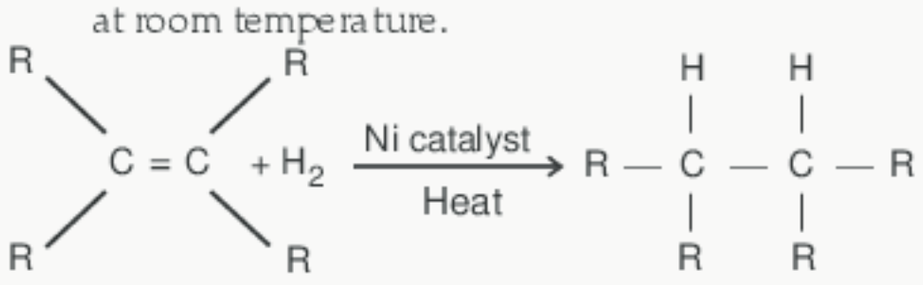
(iii) $2C_2H_5OH + 2Na \rightarrow 2\ C_2H_5ONa + H_2$ 1

[CBSE Marking Scheme]

R **Q. 21. With the help of an example, explain the process of hydrogenation. Mention the essential conditions for the reaction and state the change in physical property with the formation of the product. [Board Term I, Delhi Set-I, 2015]**

Ans. The addition of hydrogen to an unsaturated hydrocarbon to get a saturated hydrocarbon is called hydrogenation.

Example : Vegetable oils such as groundnut oils, cotton seed oils and mustard oils are unsaturated and also contain double bonds (C=C). They are in the liquid state. On hydrogenation (addition of hydrogen) in the presence of nickel as catalyst vegetable oil produces vanaspati ghee. This is solid at room temperature.



Vegetable oil (Liquid state) Vanaspati ghee (Solid state)

The essential condition for the reaction is presence of nickel as a catalyst and temperature.

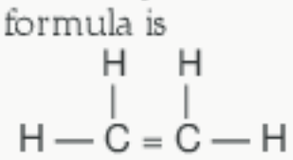
Change observed in the physical property during hydrogenation is the change of the unsaturated compound from the liquid state to the corresponding saturated compound in the solid state/its boiling on melting point will increase. 1+2

[CBSE Marking Scheme, 2015]

U **Q. 22. Write the name and structural formula of the compound obtained when ethanol is heated at 443K with excess of conc. H_2SO_4. Also write chemical equation for the reaction stating the role of conc. H_2SO_4 in it.**

[Board Term II, Delhi Set-III, 2015]

Ans. The name of the compound formed is Ethene and its structural formula is



Chemical equation :

$CH_3CH_2OH \xrightarrow[443K]{Conc\ H_2SO_4} CH_2=CH_2+H_2O$

Ethanol Ethene

Role of H_2SO_4 : It works as a catalyst to initiate the reaction to lose water molecule to form alkene.

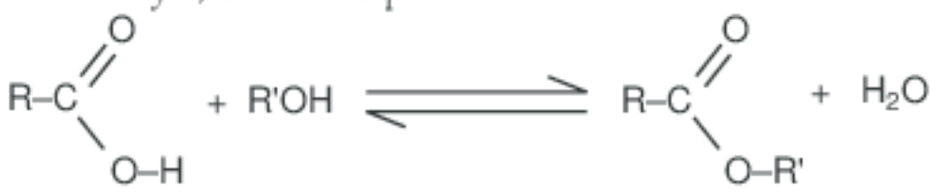
[CBSE Marking Scheme, 2015] 1+1+1

R **Q. 23. What are esters ? How they are prepared ? List two uses of esters.**

[Board Term II, Delhi Set-III, 2014]

Ans. Esters are the derivatives of carboxylic acids which contain —COOR group. The –OH group in an acid is replaced by —O— alkyl or aryl group to form an ester. Esters are represented by the formula R_1COOR_2 where R_1 and R_2 represent an alkyl or aryl group.

Preparation of esters : When carboxylic acids are heated with alcohols in the presence of an acid catalyst, esters are produced.



Uses of esters :

(i) Esters are used in food as flavours and fragrances.

(ii) In making of soaps

(iii) Esters are used as solvents

(iv) Esters are used in medicines.

(v) Esters are used as emulsifying agents. **(Any two)**

1 + 1 + 1

R **Q. 24. What is the difference between the molecules of soaps and detergents, chemically ? Explain the cleansing action of soaps.**

[Board Term II, Delhi Set I, 2015]

Ans. Detergents are sodium salt of long chain benzene sulphonic acids.

Soaps are sodium or potassium salt of long chain fatty acids that have cleaning action in water. *e.g.*, Sodium stearate.

Cleansing Action of Soap : A soap molecule consists of two dissimilar parts :

(i) A short ionic part comprising the carboxylate salt--COO^-Na^+ which is water soluble.

(ii) A long hydrocarbon chain which is hydrophobic.

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. **3**

[CBSE Marking Scheme, 2015]

R **Q. 25. Complete the following equations :**

(i) $CH_3COOC_2H_5 \xrightarrow{NaOH}$

(ii) $CH_3COOH + NaHCO_3 \longrightarrow$

(iii) $CH_4 + Cl_2 \xrightarrow{Sunlight}$ **[Board Term II, SQP, 2013]**

Ans. (i) $CH_3COOC_2H_5 \xrightarrow{NaOH} C_2H_5OH + CH_3COONa$

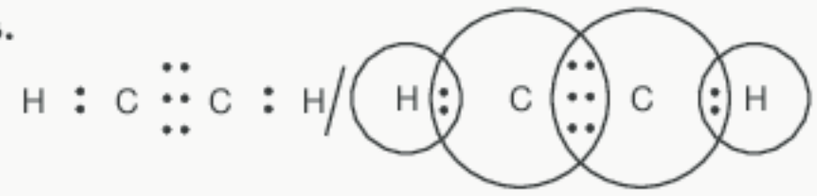
(ii) $CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + H_2O + CO_2$

(iii) $CH_4 + Cl_2 \xrightarrow{Sunlight} CH_3Cl + HCl$ **1+1+1**

U **Q. 26. Draw the electron dot structure of ethyne. A mixture of ethyne and oxygen is burnt for welding. In your opinion, why cannot we use a mixture of ethyne and air for this purpose.**

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

Ans.



1

In pure oxygen, ethyne undergoes complete combustion and high temperature suitable for welding is attained. **1**

Whereas air contains less percentage/amount of oxygen which results in incomplete combustion of ethyne and the temperature required for welding is not attained. **1**

[CBSE Marking Scheme, 2015]

Detailed Answer :

Electron dot structure of ethyne —

No, the mixture of ethyne and air cannot be used for welding because when ethyne is burnt in air, it gives a sooty flame. This is due to incomplete combustion caused by limited supply of air. However, if ethyne is burnt with oxygen, it gives a clean flame with temperature 3000°C because of complete combustion. This oxy-acetylene flame is used for welding. It is not possible to attain such a high temperature without mixing oxygen. **1 + 2**

A **Q. 27. Write the chemical equations for the following chemical reactions and name the carbonic compound obtained.**

(i) Reaction of acidified potassium dichromate solution with ethanol on heating.

(ii) Reaction of sodium metal with ethanol.

(iii) Reaction of concentrated sulphuric acid with ethanol at 443 K.

[Board Term II, Set-8XSVHLC, QNA4XWT, 2014]

Ans. (i) Ethanol is oxidised to ethanoic acid with the help of acidified $K_2Cr_2O_7$.

$CH_3CH_2OH + 2[O] \longrightarrow CH_3COOH + H_2O$

(ii) Ethanol reacts with sodium metal to form sodium ethoxide and hydrogen gas.

$2C_2H_5OH + 2Na \longrightarrow 2C_2H_5ONa + H_2$

(iii) Ethene is formed when ethanol is heated at 443 K with concentrated sulphuric acid. Concentrated sulphuric acid acts as a dehydrating agent in this reaction and removes a molecule of water.

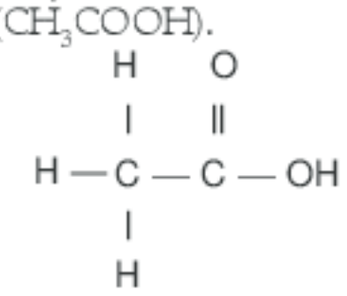
$$CH_3CH_2OH \xrightarrow[443\,K]{H_2SO_4} CH_2 = CH_2 + H_2O \quad 1+1+1$$

[CBSE Marking Scheme, 2014]

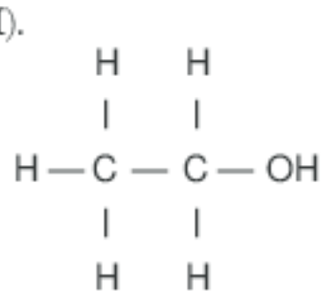
A **Q. 28. A carboxylic acid (molecular formula $C_2H_4O_2$) reacts with an alcohol in the presence of an acid catalyst to form a compound 'X'. The alcohol on oxidation with alkaline $KMnO_4$ followed by acidification gives the same carboxylic acid $C_2H_4O_2$. Write the name and structure of (i) carboxylic acid, (ii) alcohol and (iii) the compound 'X'.**

[NCERT] [Board Term II, Outside Delhi Set-I, II, III, 2014] [O.D. Set-I, 2013]

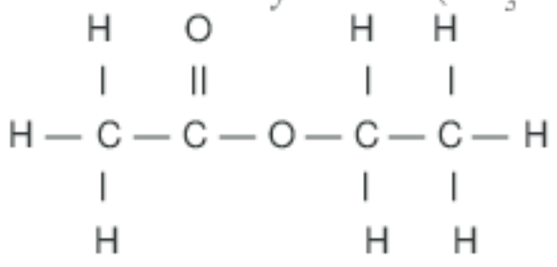
Ans. (i) The carboxylic acid involved in the reaction is acetic acid (CH_3COOH).



(ii) The alcohol involved in the reaction is ethanol (CH_3CH_2OH).



(iii) X is the ester formed by the condensation of acetic acid and ethanol is ethyl acetate ($CH_3COOC_2H_5$).



1+1+1

U **Q. 29. Name the oxidising agents used for the conversion of ethanol to ethanoic acid. Distinguish between ethanol and ethanoic acid on the basis of (i) litmus test, (ii) reaction with sodium carbonate.**

[Board Term II, Delhi Set-II, 2013]

Ans. The oxidizing agents used for the conversion of ethanol to ethanoic acid are alkaline potassium permanganate ($KMnO_4$) and acidified potassium dichromate ($K_2Cr_2O_7$). **1**

S. No.	Test	Ethanol	Ethanoic Acid
(i)	Litmus Test	No change in colour of litmus solution.	Blue litmus solution turns red.
(ii)	Reaction with sodium carbonate	No brisk effervescence.	Brisk effervescence due to evolution of CO_2.

1+1

U **Q. 30. How are the following products obtained from ethanol ?**

(i) Ethyl ethanoate

(ii) Sodium ethoxide. **[Board Term II, SQP, 2013]**

Ans. (i) Ethanol reacts with ethanoic acid in the presence of acid catalyst to give ethyl ethanoate.

$$CH_3COOH + CH_3CH_2OH \xrightarrow[\text{catalyst}]{\text{Acid}} CH_3COOCH_2CH_3 + H_2O$$

(ii) When ethanol reacts with sodium, sodium ethoxide is produced along with the liberation of hydrogen.

$$2CH_3CH_2OH + 2Na \longrightarrow 2CH_3CH_2ONa + H_2$$

1½+1½

A **Q. 31. 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 C_2H_5Cl.**

(i) Name the compounds A, B and C.

(ii) Write the chemical equation for the conversion of A to B and name the type of reactions.

[Board Term II, Set (2020), 2012]

Ans. (i) A : $CH_2 = CH_2$ Ethene

B : $CH_3 - CH_3$ Ethane

C : $CH_3 - CH_2 - Cl$ Chloroethane **1½**

(ii) $CH_2 = CH_2 \xrightarrow[\text{nickel}]{\text{hydrogen}} CH_3 - CH_3$ **1**

(A) (B)

Type of reaction : Addition reaction. ½

[CBSE Marking Scheme, 2012]

A **Q. 32. Two compounds 'A' and 'B' have the molecular formula C_3H_8 and C_3H_6 respectively. Which one of the two is most likely to show addition reactions? Justify your answer. Explain with the help of a chemical equation, how an addition reaction is useful in vegetable ghee industry.**

[Board Term II, 2012]

Ans. 'A' is saturated hydrocarbon, propane.

'B' is unsaturated hydrocarbon $CH_2 = CH - CH_3$ which will undergo addition reaction. ½+½

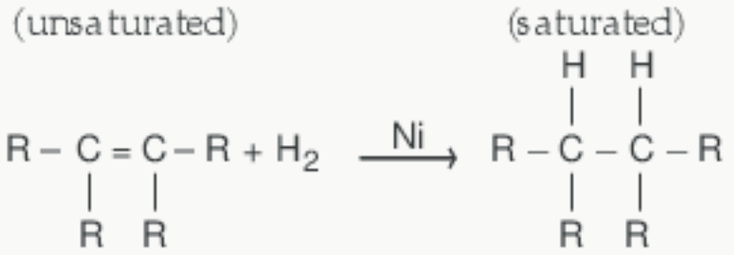
e.g.

$CH_2 = CH - CH_3 + Br_2 \rightarrow CH_2Br - CHBr - CH_3$ **1**

(1, 2 - dibromo-propane)

Vegetable oil + $H_2 \rightarrow$ Vegetable ghee

(unsaturated) (saturated) **1**



[CBSE Marking Scheme, 2012] 1

A **Q. 33. (i) Write chemical name and formula of Vinegar.**

(ii) Describe with a chemical equations what happens when sodium reacts with ethanol.

[Board Term II, Set-2013, 2012]

Ans. (i) Chemically, vinegar is 5-8% of acetic acid solution in water. **1**

Formula : CH_3COOH. **1**

(ii) When ethanol reacts with sodium, it gives sodium ethoxide and hydrogen gas.

$$CH_3CH_2OH + Na \rightarrow CH_3CH_2ONa + H_2\uparrow$$

Ethanol Sodium Sodium ethoxide Hydrogen gas.

metal 1

A **Q. 34. (i) Write the chemical names of CH_3COCH_3, C_2H_5COOH.**

(ii) What happens when acetic acid and ethanol react in presence of concentrated H_2SO_4 ? Write the reactions there in. [Board Term-II, 2012, 2015]

Ans. (i) CH_3COCH_3 : Propanone ½

C_2H_5COOH : Propanoic acid ½

(ii) Esterification takes place

$$CH_3COOH + C_2H_5OH \xrightarrow{\text{Conc. } H_2SO_4} CH_3-\underset{\underset{O}{\|}}{C}-O-CH_2-CH_3 + H_2O \quad 1$$

[CBSE Marking Scheme, 2012]

A **Q. 35. An organic compound 'A' of molecular formula C_2H_6O on oxidation with dilute alkaline $KMnO_4$ solution gives an acid 'B' with the same number of carbon atoms. Compound 'A' is often used for sterilization of skin by doctors.**

(i) Name the compounds 'A' and 'B'.

(ii) Write the chemical equation involved in the formation of 'B' from 'A'.

[Board Term II, Set 2017, 2012]

Ans. (i) Compound A : Ethanol (ethyl alcohol) 1

Compound B : Ethanoic acid (acetic acid) 1

(ii) $C_2H_5OH \xrightarrow[KMnO_4]{\text{Alkaline}} CH_3COOH$ 1

(A) (B)

[CBSE Marking Scheme, 2012]

U **Q. 36. (i) Give a chemical test to distinguish between saturated and unsaturated hydrocarbons.**

(ii) Name the products formed when ethanol burns in air. List two forms of energy that are liberated on burning ethanol.

(iii) Why is the reaction between methane and chlorine considered a substitution reaction ?

[Board Term II, Set-2023, 2012]

Ans. (i) Saturated hydrocarbons burn with clean flame and do not decolourise brown colour of bromine. Unsaturated hydrocarbons burn with sooty flame and decolourise brown colour of bromine. 1

(ii) Ethanol burns in air to form carbon dioxide and water. The two forms of energy that are liberated are in form of light and heat.

$$CH_3CH_2OH + 3O_2 \rightarrow 2CO_2 + 3H_2O \quad 1$$

(iii) Reaction between methane and chlorine is considered a substitution reaction because one atom of hydrogen from methane is replaced by one atom of chlorine and forms chloromethane.

[CBSE Marking Scheme, 2012] 1

U **Q. 37. Complete the following reactions :**

(i) $CH_3CH_2OH \xrightarrow[KMnO_4 + \text{Heat}]{\text{Alkaline}} ?$

(ii) $2Na + 2CH_3CH_2OH \rightarrow ? + ?$

(iii) $CH_3COOH + CH_3CH_2OH \xrightarrow{\text{acid}} ?$

Ans. (i) $CH_3CH_2OH \xrightarrow[KMnO_4 + \text{Heat}]{\text{Alkaline}} CH_3COOH$ 1

(ii) $2Na + 2CH_3CH_2OH \rightarrow 2CH_3CH_2ONa + H_2$ ½+½

(iii) $CH_3COOH + CH_3CH_2OH \xrightarrow{\text{acid}} CH_3COOCH_2CH_3 + H_2O$ 1+1+1

R **Q. 38. With the help of a diagram, explain cleansing action of soap.**

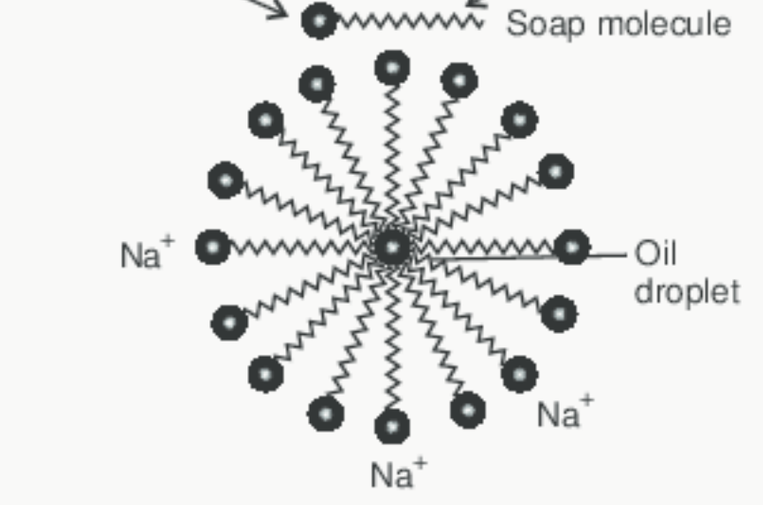
[Board Term II, Set 2012, 2007] [DDE 2017]

OR

Explain the mechanism of cleaning action of soap. [NCERT]

Ans. Soap molecules form micelles where one end 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



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[CBSE Marking Scheme, 2007]

Long Answer Type Questions

(5 marks each)

U **Q. 1. Soaps and detergents are both 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.**

[Delhi 31/1/11 2017]

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

• 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 :**
  (i) Non-biodegradable
  (ii) Water pollution / soil pollution
  (Note : 1 mark to be awarded for any one of the problems.)

S.No.	Soap	Detergents
(i)	They are sodium salts of long chain fatty acids.	These are sodium or potassium salts of sulphonic acids of hydro-carbons.
(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-bi-odegradable.
(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 nonpolar 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 aries 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 tends toward serious health issues. **(Any two)** 5

R **Q. 2. 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.**

[Board Term II Foreign Set-III, 2016]

OR

Why does micelle formation takes place when soap is added to water ? Will a micelle be formed in other solvents such as ethanol also ?

[NCERT]

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 which it 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**

[CBSE Marking Scheme, 2016]

A **Q. 3. (i) Covalent compounds have low melting and boiling points". Justify this statement.**

(ii) What is an ester ? Describe an activity to form an ester in a school laboratory.

[Board Term II SQP 2013]

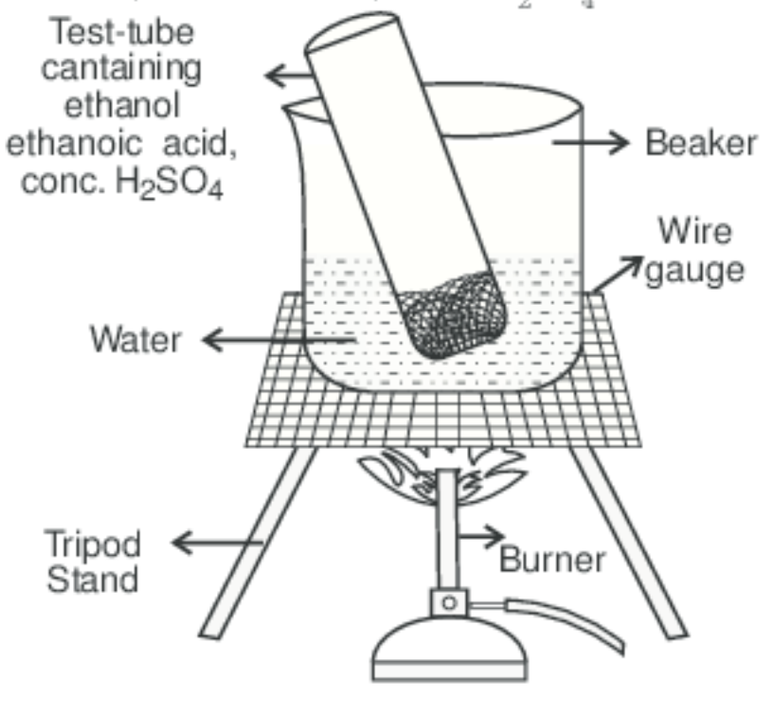
Ans. (i) The force of attraction between the molecules of covalent compounds are not strong as ionic compounds. So, they have low melting and low boiling points. **1**

(ii) Esters are organic compounds which have sweet smell.

Activity :

Aim : To demonstrate esterification process using ethanol and acetic acid. **1**

Materials Required : Beakers, water, test-tube, ethanol, ethanoic acid, conc. H_2SO_4.



Procedure :

(a) Take 2 ml of ethanol in a test-tube. **1**

(b) Add 2 ml of ethanoic acid into it.
(c) Add few drops of conc. H_2SO_4.
(d) Warm it in a beaker containing water.
(e) Observe the smell of the products formed.

Observation : Pleasant fruity smelling compound (called ester) is formed. **1**

Chemical Reaction :

$$\underset{\text{Ethanoic acid}}{CH_3COOH_{(l)}} + \underset{\text{Ethanol}}{C_2H_5OH_{(l)}} \xrightarrow{\text{Conc.}H_2SO_4} \underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} + \underset{\text{Water}}{H_2O}$$

1

Conclusion : Carboxylic acid reacts with alcohol in presence of conc. H_2SO_4 which act as a dehydrating agent to from esters.

U **Q. 4. 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?**

[Board Term II, Delhi Set-FF7NBE6, 2015]

Ans. When any molecule like H_2 adds to unsaturated hydrocarbon because of double and triple bond it is called addition reaction.

$$CH_2 = CH_2 + H_2 \xrightarrow{Ni} C_2H_6$$

Use — Hydrogenation of vegetable oils. **2**

Catalyst — Increase the rate of reaction.

Substitution reaction — $CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$ one atom is replaced by another ; two products only, one product in addition reaction. **3**

[CBSE Marking Scheme, 2015]

U **Q. 5. (a) How will you bring about following reactions? Write the concerned chemical equations**
(i) Ethanol to Ethene
(ii) Ethanol to Ethanoic acid
(b) Give one example with chemical equation for the following reactions :
(i) Substitution reaction
(ii) Saponification reaction
(iii) Combustion reaction

Ans. (a) (i) $CH_3CH_2OH \xrightarrow[443\,K]{\text{Conc.}H_2SO_4} CH_2 = CH_2 + H_2O$ **1**

(ii) $CH_3CH_2OH \xrightarrow{\text{Alkaline } KMnO_4} CH_3COOH$ **1**

(b) (i) $CH_4 + Cl_2 \xrightarrow{\text{Sunlight}} CH_3Cl + HCl$ **1**

(ii) $CH_3COOC_2H_5 \xrightarrow[H_2O]{NaOH} C_2H_5OH + CH_3COOH$ **1**

(iii) $CH_4 + O_2 \rightarrow CO_2 + H_2O + \text{light} + \text{energy}$ **1**

U **Q. 6. Write balanced chemical equation for the following :**
(i) Methane is burned in sufficient air
(ii) Ethanol is treated with sodium
(iii) Ethanoic acid is reacted with sodium hydroxide
(iv) Ethanoic acid is treated with sodium carbonate.
(v) Ethanol is mixed with ethanoic acid in the presence of an acid. [Board Term II, Foreign Set-II, III, 2014]

[Board Term II, Set 2013, 2012]

Ans. (i) $CH_4 + 5O_2 \longrightarrow CO_2 + H_2O + \text{heat} + \text{light}$ **1**

(ii) $2CH_3CH_2OH + 2Na \longrightarrow 2CH_3CH_2ONa + H_2$ **1**

(iii) $CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$ **1**

(iv) $CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + H_2O + CO_2$ **1**

(v) $C_2H_5OH + CH_3COOH \xrightarrow{\text{Acid}} CH_3COOC_2H_5 + H_2O$ **1**

[CBSE Marking Scheme, 2012]

U **Q. 7. (a) Complete the following equations :**

(i) $CH_3CH_2OH \xrightarrow[\text{Heat}]{\text{Conc.}H_2SO_4}$

(ii) $CH_3COOH + KHCO_3 \xrightarrow{\text{Sunlight}}$

(iii) $CH_4 + Cl_2 \rightarrow$

(b) Write the name of the following :
(i) CH_3CH_2COOH,
(ii) $CH_3CH_2CH_2Br$.
(c) Draw the electron dot structure of ethene (C_2H_4).

[Board Term II, Set (2022) 2012]

Ans. (a) (i) $CH_3CH_2OH \xrightarrow[\text{Heat}]{\text{Conc.}H_2SO_4} CH_2 = CH_2$ **1**

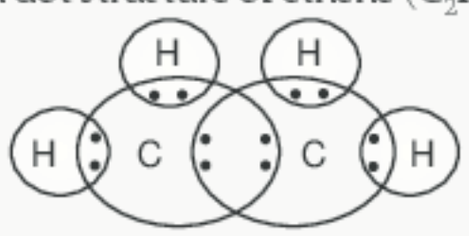
(ii) $CH_3COOH + KHCO_3 \rightarrow CH_3COOK + H_2O + CO_2$ **1**

(iii) $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$ **1**

(b) (i) CH_3CH_2COOH : propanoic acid ½

(ii) $CH_3CH_2CH_2Br$: 1-bromo propane ½

(c) Electron dot structure of ethene (C_2H_4) :



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[CBSE Marking Scheme, 2012]

U **Q. 8. (a) Complete the following equations :**
(i) $n CH_2 = CH_2 \rightarrow$ .....
(ii) $CH_3—COOH + NaHCO_3 \rightarrow$ ..... + ... + ...
(b) What is the cause of hardness of water ? Why soap does not form lather with hard water? Mention the disadvantage of cleaning clothes with soap in hard water? [KVS- 2014]

Ans. (a) (i) $n CH_2 = CH_2 \rightarrow (—CH_2—CH_2—)_n$ **1**

(ii) $CH_3—COOH + NaHCO_3 \rightarrow CH_3—COONa + H_2O + CO_2$ **1**

(b) Presence of Ca^{2+} ions and Mg^{2+} ions. **1**
Formation of insoluble calcium and magnesium salts with soap. **1**
Soap gets wasted simply as it does not form lather with soap. **1**

A **Q. 9. (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.

[Board Term II, 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

A **Q. 10. 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. [Board Term II, O.D. Set-I, 2016]**

Ans. P = Ethanol/C_2H_5OH, Q = Ethene/$CH_2 = CH_2$, R = Ethane/C_2H_6 **3 × ½**

$$\underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow[443k]{\text{Conc } H_2SO_4} \underset{\text{Ethene}}{CH_2 = CH_2} + H_2O \quad \textbf{1½}$$

$$CH_2 = CH_2 \xrightarrow[H_2]{\text{Nickel Catalyst}} \underset{\text{Ethane}}{CH_3 - CH_3/C_2H_6} \quad \textbf{1}$$

$$C_2H_6/CH_3 - CH_3 + \frac{7}{2} O_2 \longrightarrow 2CO_2 + 3H_2O \quad \textbf{[CBSE Marking Scheme, 2016] 1}$$

OR

[Topper Answer, 2016]

A **Q. 11. An organic compound A is widely used as a preservative in pickles and has a molecular formula $C_2H_4O_2$. This compound reacts with ethanol to form a sweet smelling compound B.**

(i) Identify the compound A.

(ii) Write the chemical equation for its reaction with ethanol.

(iii) Name the products formed.

(iv) Name the process involved in the reaction.

(v) How can we get back the compound A from B.

[KVS-2014]

Ans. (i) CH_3COOH (Ethanoic acid). **1**

(ii) $CH_3\text{-}COOH + C_2H_5OH \xrightarrow{\text{Conc. } H_2SO_4}$

$CH_3\text{-}COOC_2H_5 + H_2O$ **1**

(iii) Ethyl ethanoate. **1**

(iv) Esterification . **1**

(v) Through Saponification reaction. **1**

A **Q. 12. An organic compound 'X' on heating with conc. H_2SO_4 forms a compound 'Y' which on addition of one molecule of hydrogen in the presence of nickel forms a compound 'Z'. One molecule of compound 'Z' on combustion forms two**

molecules of CO_2 and three molecules of H_2O. Identify giving reasons the compounds 'X', 'Y' and 'Z'. Write the chemical equations for all the chemical reactions involved. [NCERT Exemplar]

[Board Term II, O.D. Set-I, 2013]

Ans. Compound 'X' is ethanol and compound 'Y' is ethene. **1**

Ethanol, when heated with conc. H_2SO_4 at 443 K undergoes dehydration *i.e.*, loses water molecule to form alkene. **1**

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[443\ K]{\text{Conc.}H_2SO_4} \underset{\text{Ethene}}{CH_2 = CH_2} + H_2O \quad \mathbf{1}$$

Ethene reacts with one molecule of hydrogen in the presence of nickel to form ethane. **1**

$$\underset{\text{Ethene}}{CH_2 = CH_2} + H_2 \xrightarrow{Ni} \underset{\text{Ethane}}{CH_3 - CH_3} \quad \mathbf{1}$$

R **Q. 13. (i) Write the name of the following compounds.**

$$CH_3CH_2COOH, C_6H_6$$

(ii) What is a homologous series ? Write the formula of functional group of ketone and aldehyde.

(iii) What will happen if ethanol reacts with ethanoic acid, in the presence of an acid ? Name the reactions. Write the chemical equation for this reaction.

[Board Term II, Set-2008, 2012]

Ans. (i) Propanoic acid, Benzene. ½+½

(ii) A series of compounds, in which the compounds have similar chemical properties is called homologous series. **1**

Ketone : $-\overset{\overset{O}{\|}}{C}-$, Aldehyde : $-C\begin{matrix}H\\ \diagup\\ \diagdown\\ =O\end{matrix}$ ½+½

(iii) If ethanol reacts with ethanoic acid in presence of any acid, ester is formed. **1**

The reaction is called esterification reaction.

Chemical equation :

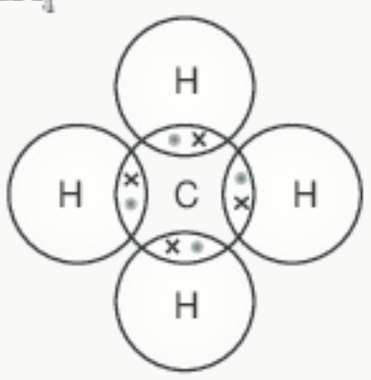
$$CH_3OH + CH_3COOH \xrightarrow{H^+} CH_3COOCH_3 + H_2O$$

[CBSE Marking Scheme, 2012] ½+½

A **Q. 14. Make the structure of methane by showing sharing of electrons between carbon and hydrogen atoms. How could you convert methane into chloroform by substitution reaction? Explain with the help of chemical reactions.**

[Board Term II, Set-8XSVHLC, 2014]

Ans. Methane, CH_4



Hydrogen atoms can form one covalent bond, while carbon atoms can form four covalent bonds. Four pairs of electrons are shared in a methane molecule (CH_4).

When a mixture of methane and chlorine is exposed to ultraviolet light - typically sunlight- a substitution reaction occurs and the organic product formed is chloromethane.

$$CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$$

However, the reaction doesn't stop there, and all the hydrogens in the methane can in turn be replaced by chlorine atoms.

$$CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$$
$$CH_3Cl + Cl_2 \longrightarrow CH_2Cl_2 + HCl$$
$$CH_2Cl_2 + Cl_2 \longrightarrow CHCl_3 + HCl$$
$$CHCl_3 + Cl_2 \longrightarrow CCl_4 + HCl \quad \mathbf{2+3}$$

[CBSE Marking Scheme, 2014]

High Order Thinking Skills (HOTS) Questions

Q. 1. What are the properties of carbon that lead to the formation of fullerenes. Name two other compounds which are allotropes. In which of these compounds, all the four valencies are satisfied? 3

Ans. Tetravalency and catenation are the properties of carbon that gives the formation of fullerenes. Because of these properties, carbon forms two allotropes-diamond and graphite, out of which, all the four valencies of carbon are satisfied in diamond. **3**

Q. 2. Give reasons :

(i) Why is pure ethanoic acid known as glacial acetic acid ?

(ii) Why is ethanol used as antifreeze ?

(iii) Why is ethanol mixed with methanol known as denatured alcohol ?

(iv) Why is oxyacetylene flame used for welding purposes ?

(v) What is gasol ? 5

Ans. (i) Pure ethanoic acid has a low freezing point. It freezes and looks like glaciers. **1**

(ii) Ethanol mixed with water freezes at temperatures lower than water. Thus a mixture of water and ethanol is used in radiators of cars in cold countries. **1**

(iii) When methanol is mixed with ethanol, the latter becomes undrinkable. **1**

(iv) Acetylene mixed with oxygen burns giving large amount of heat which is used for welding purposes. **1**

(v) Gasol is a mixture of petrol and alcohol. **1**

Q. 3. Two compounds 'A' and 'B' have the same molecular formula $C_3H_6O_2$. One of them reacts with sodium metal and $NaHCO_3$ to liberate H_2 gas and a gas 'C', respectively. 'C' turns lime water milky. The other compound does not react with either Na metal or $NaHCO_3$ but undergoes saponification to give sodium salt of a carboxylic acid and wood spirit, 'D'. Identify A, B, C and D. 5

Ans. Two possible compounds with molecular formula $C_3H_6O_2$ are propanoic acid (CH_3CH_2COOH) and methyl acetate (CH_3COOCH_3). Propanoic acid reacts with Na metal to give sodium propanoate and H_2 gas and with $NaHCO_3$, it gives CO_2 gas which turns lime water milky. Methyl acetate on saponification gives sodium acetate and wood spirit *i.e.,* methanol. 3

Thus, A is propanoic acid ½

B is methyl acetate ½

C is carbon dioxide ½

D is methanol. ½

Q. 4. An organic compound 'A' with molecular formula C_2H_6O gives compound 'B' on oxidation with alkaline $KMnO_4$. 'A' an heating with conc. H_2SO_4 gives 'C' which on reaction with phosphoric acid and water gives back 'A'. Compound 'C' gives addition product with Br_2 and H_2. Identify A, B, C and write chemical equations involved. 3

Ans. Since C gives addition reaction with Br_2 and H_2 and so it is unsaturated hydrocarbon. It gives an alcohol with phosphoric acid and water *i.e.,* CH_3CH_2OH. So C is ethene. Thus, A is ethanol which on oxidation with alkaline $KMnO_4$ gives ethanoic acid. So we can conclude that A is ethanol, B is ethanoic acid and C is ethene. 2

$$\underset{\text{(A)}}{CH_3CH_2OH} \xrightarrow[KMnO_4]{\text{alkaline}} \underset{\text{(B)}}{CH_3COOH}$$

$$\underset{\text{(A)}}{CH_3CH_2OH} \xrightarrow[443k]{\text{conc.}H_2SO_4} \underset{\text{(C)}}{C_2H_4}$$

↓ Phosphoric acid and water

$$CH_3CH_2OH$$

(A) 1

Value Based Questions

Q. 1. Ravi read the formation of covalent bonds and came to know the property of carbon.

Carbon has four valence electrons. It cannot lose four electrons since very high amount of energy will be required to lose four electrons to form C^{4+}. Carbon cannot gain four electrons to form C^{4-} ion as six protons cannot hold 10 electrons easily and there will be strong interelectronic repulsion

(i) What is the atomic number and electronic configuration of carbon ? 1

(ii) Explain how covalent bonding is important between carbon compounds. Give any two suggestions.

[Board Term II SQP, 2012] 2

Ans. (i) Atomic number of carbon = 6.

Electronic configuration of carbon = 2, 4. 1

(ii) (a) Carbon forms maximum number of compounds due to covalent bonding. 1

(b) Carbon compounds have covalent bonds due to which they are poor conductors of electricity.

They do not contain ions or free electrons to conduct electricity. 1

Q. 2. Ethanol, commonly called as 'alcohol' is an excellent solvent, it is used in medicines and is an important chemical compound involved in synthesis of many chemical compounds. However is in spite of its benefits to man, its impact on social behaviour has always been questioned. Media has often shown abnormal behaviour of people while drunk. It is considered as a curse in the lives of those who are addicted to alcohol. 'Alcoholic' people are not only lowering their metabolism and affecting central nervous system, they are also a threat to the liver of others. Anger and rude behaviour are some of its ill effects.

(i) Comment on the statement : 'Should production of alcohol be banned'. Give three valid reasons to justify. 2

(ii) As a student, what initiative would you take in the common concern of 'Save Life, Do not Drink'. Give two suggestions. 1

Ans. (i) In favour of negative response :

(a) It is an excellent industrial solvent.

(b) It is used in so many ways such as in medicines and ornamentation.

(c) It is used as a disinfectant.

In favour of positive response :

(a) It is the reason behind deaths of many people.

(b) Many adolescents get affected out of it and become addicted.

(c) It is being misused even where it is of important use. 2

(ii) Initiatives :

(a) Drive to increase awareness among people with the help of skit / role plays / drama / article writing.

(b) Chart preparation and slogan writing. 1

Practical Based Questions

Q. 1. What do you observe when you add a few drops of acetic acid to a test-tube containing :

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

(i) phenolphthalein

(ii) distilled water

(iii) universal indicator

(iv) Sodium hydrogen carbonate powder

Ans. (i) No change/remains colourless

(ii) No change

(iii) Turns pink/orange

(iv) Evolution of colourless gas $4 \times \frac{1}{2} = 2$

Q. 2. A student is studying the properties of acetic acid in his school laboratory. List two physical and two chemical properties which he must observe and note in his record book.

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

Ans. Physical Properties :

(i) Smell like vinegar

(ii) Colourless liquid.

Chemical Properties :

(i) Turns blue litmus red

(ii) Gives brisk effervescence with sodium carbonate

1 + 1

Q. 3. A student adds a spoon full of powdered sodium hydrogen carbonate to a flask containing ethanoic acid. List two main observations, he must note in his notebook, about the reaction that takes place. Also write chemical equation for the reaction.

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

Ans. Brisk effervescence ½

Evolution of colourless/odourless gas ½

$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$ **[CBSE Marking Scheme, 2016]** 1

[Topper Answer, 2016]

Q. 4. Out of the following list of chemicals, select those which are required to study the prescribed four properties of acetic acid in the laboratory. Litmus solutions (blue or red), water, alcohol, sodium chloride, sodium hydrogen carbonate, calcium hydroxide solution.

[Board Term II, Delhi Set FF7NBE6, 2015]

Ans. Blue litmus solution, water, sodium hydrogen carbonate and calcium hydroxide solution. 2

Q. 5. Write the names of apparatus/chemicals required to study the following properties of ethanoic acid in the laboratory.

The properties are : Nature, odour, solubility and action on sodium hydrogen carbonate.

[Board Term II, Delhi Set GFUTB86, 2015]

Ans. Litmus water, blue litmus water, test-tubes, Passing tubes. **(Any four)** 2

Q. 6. A student is studying the properties of acetic acid. List two physical properties of acetic acid he observes. What happens when he adds a pinch of sodium hydrogen carbonate to this acid ? Write any two observations. [Board Term II, Delhi Set-I, 2015]

Ans. Acetic acid is colourless liquid. It is miscible/soluble in water. **(Any or other physical property)**

On adding a pinch of sodium hydrogen carbonate,

Brisk effervescence is observed.

Evolution of a colourless/odourless gas. 2

[CBSE Marking Scheme, 2015]

Q. 7. What precautions should be taken while studying the properties of ethanoic acid ?

Ans. (i) Handle ethanoic acid carefully.

(ii) Add only small amount (0.01 g) of $NaHCO_3$ or Na_2CO_3 to ethanoic acid to control the intensity of CO_2 evolved. 1+1

Q. 8. What type of reaction takes place between CH_3COOH and NaOH solution ? Where do you find the use of ethanoic acid in day to day food products ?

Ans. Neutralization reaction.

It is used in the form of vinegar, which is a dilute solution of ethanoic acid in water. 1+1

Q. 9. A student takes 2 ml acetic acid, in a dry test-tube and add a pinch of sodium hydrogen carbonate to it. Write down the observation made by the students ?

Ans. A colourless and odourless gas is evolved. It turns lime water milky and this gas extinguishes the burning splinter. 2

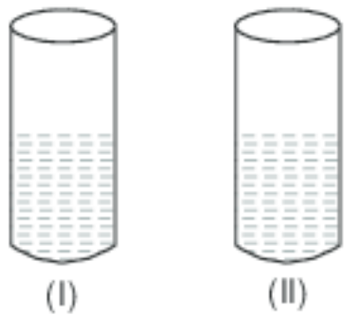
Q. 10. When you add about 2 ml of acetic acid to a test-tube containing an equal amount of distilled water and leave the test-tube to settle after shaking its contents, what will you observe in the test-tube after about 5 minutes ?

Ans. When acetic acid and distilled water are mixed, they form a clear solution because acetic acid is completely miscible with water. 2

Q. 11. A student adds a few drops of ethanoic acid to test tubes X, Y and Z containing aqueous solutions of sodium chloride, sodium hydroxide and sodium carbonate respectively. If he now brings a burning splinter near the mouth of the test-tubes immediately after adding ethanoic acid in each one of them, in which of the test tube or test-tubes the flame will be extinguished?

Ans. Only test tube Z will be extinguished. The flame will be extinguished when test tube Z is brought near a burning splinter due to evolution of carbon dioxide gas, which does not support combustion

Q. 12. Among the two test-tubes I and II, one contains acetic acid and another contains water. Which of the given properties of acetic acid can be used to identify acetic acid from it?



(i) Colour change with universal indicator
(ii) Reaction with $NaHCO_3$
(iii) Colour of the solution
(iv) Transparent nature

Ans. The two properties of acetic acid can be used to identify acetic acid in the test tube, containing acetic acid and water are: Acetic acid reacts with $NaHCO_3$ and the colour change with universal indicator. 2

Q. 13. Write the reaction between soap molecules and ions present in hard water.

Ans. $Ca(HCO_3)_2$ (aq) + $2Na^+$—stearate (aq) $\downarrow \longrightarrow$
$Ca(stearate)_2$ (s) + $2NaHCO_3$ (aq)
$CaSO_4$ (aq) + $2Na^+$ – stearate (aq) $\downarrow \longrightarrow Ca(stearate)_2$ (s) + Na_2SO_4 (aq) 1+1

Q. 14. Is a sample containing dil. HCl hard ? Why ?

Ans. Yes. Hydrogen ions provided by HCl makes water hard.
$H^+ + Na^+$ stearate$^- \rightarrow$ Steric acid + Na^+ 1+1

Q. 15. While studying saponification reaction for the preparation of soap, a teacher suggested to a student to add a small quantity of common salt to the reaction mixture. Write down the function of common salt in this reaction?

Ans. Common salt is added in saponification reaction, as it helps in the precipitation of soap by decreasing the solubility of soap. 2

Q. 16. While studying saponification reaction, a student measures the temperature of the reaction mixture and also finds its nature using blue/red litmus paper. What conclusion can be drawn from his observations?

Ans. Saponification reaction is a highly exothermic reaction. The reaction mixture of this reaction is basic in nature and hence, this will turn red litmus blue. 2

Q. 17. On the basis of study of saponification reactions, a group of students noted down the following comments in their notebooks:

(i) The nature of the reaction mixture is basic.
(ii) In saponification reactions, heat is evolved.
(iii) Saponification reaction is not a neutralization reaction.
(iv) Soap is nothing but a salt of fatty acids.
Which of these comments is correct according to you?

Ans. The correct comments are:

(i) In saponification reactions, heat is evolved.
(ii) Saponification reaction is not a neutralization reaction.
(iii) Soap is nothing but a salt of fatty acids. 2

Q. 18. When the red litmus paper and the blue litmus paper are dipped into the soap solution, what colour changes, will you observe?

Ans. Red litmus paper turn blue and blue litmus paper remains colourless, as soap solution is basic in nature. 2

Q. 19. Rupal took a liquid A in a test-tube and added sodium hydroxide solution in it. The mixture was stirred for some time. Glyceride and solid B are formed after the reaction. Identify A and B?

Ans. Olive oil (A) and sodium hydroxide forms soap (B). 1 + 1

Q. 20. For determining the saponification reaction for the preparation of soap, write down the name of any five apparatus that we require?

Ans. Beaker, measuring cylinder, thermometer, test-tube, glass rod. 2

Q. 21. Name any two chemicals used for the preparation of toilet soap?

Ans. Fat and potassium hydroxide are used to prepare toilet soap. 2

Q. 22. We need 20% aqueous solution of sodium hydroxide for the study of saponification reaction. When we open the lid of the bottle containing solid sodium hydroxide we observe it in which form?

Ans. Solid sodium hydroxide is stored in the form of white pellets/flake. 2

Q. 23. Consider the following oils :

(i) Mobile oil
(ii) Castor oil
(iii) Turpentine oil
(iv) Kerosene
(v) Mustard oil
(vi) Coconut oil

Which of these can be used for preparation of soap?

Ans. Castor oil, Turpentine oil, and coconut oil can be used for preparation of soap. 2

Q. 24. In a locality, hard water, required for an experiment, is not available. However, the following salts are available in the school laboratory :

1. Sodium sulphate **2. Calcium sulphate**
3. Magnesium chloride **4. Sodium chloride**
5. Calcium chloride **6. Potassium sulphate**

Which of the above salts may be dissolved in water to obtain hard water for the experiment?

Ans. Water containing calcium and magnesium salts is known as hard water. Among the given salts, calcium sulphate, magnesium chloride and calcium chloride can be dissolved in water to obtain hard water. 2

Q. 25. A student takes about 6 ml of distilled water in each of the four test tubes P, Q, R and S. He then dissolves an equal amount of four different salts namely, sodium chloride in 'P', potassium chloride in 'Q', calcium chloride in 'R' and magnesium chloride in 'S'. Next, he then adds 10 drops of soap solution to each test tube and shakes its contents. In which of these test tubes the scum (insoluble substance) is formed with soap?

Ans. Scum is formed by reaction of soap with calcium and magnesium salts in water. Test-tubes R and S contain calcium chloride and magnesium chloride, respectively. Therefore, scum will be formed in these two test-tubes. 1 + 1

Q. 26. A student puts a drop of reaction mixture of a saponification reaction first on a blue litmus paper and then on a red litmus paper. Write down the observation he will observe?

Ans. There is no change in blue litmus paper as soap solution is alkaline in nature. 2

Q. 27. During saponification reaction, Rupal takes refined oil in a test-tube and adds 20% NaOH solution. She then stirs the reacting mixture. Write down the observation she will observe?

Ans. She will observe that soap settles down in the test-tube. 2

Q. 28. Do soaps create water pollution? Give reason in support of your answer?

Ans. No, because soaps are biodegradable.

Q. 29. Take a test-tube and put soap and water and shake it for 10 times by placing thumb on its mouth. What will you observe?

Ans. When you put soap and water in a test tube and shake it well for 10 times by placing thumb on its mouth, it will form foam. 2

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