EXAM DRILL
CARBON AND ITS COMPOUNDS

(i) The question paper comprises four sections A, B, C and D. There are 36 questions in the question paper. All questions are compulsory.
(ii) Section-A – question no. 1 to 20 - all questions and parts thereof are of one mark each. These questions contain objective and very short answer type questions. Answers to these should be given in one word or one sentence.
(iii) Section-B – question no. 21 to 26 are short answer type questions, carrying 2 marks each. Answers to these questions should in the range of 30 to 50 words.
(iv) Section-C – question no. 27 to 33 are short answer type questions, carrying 3 marks each. Answers to these questions should in the range of 50 to 80 words.
(v) Section-D – question no. 34 to 36 are long answer type questions carrying 5 marks each. Answer to these questions should be in the range of 80 to 120 words.
(vi) There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
(vii) Wherever necessary, neat and properly labeled diagrams should be drawn.

Time: 3 hrs. Max. Marks: 80

SECTION - A

1. Why conc. H_2SO_4 is added in esterification reaction?

OR

Name the fourth member of alkene series.

2. Mineral acids are stronger acids than carboxylic acids. Why?

3. Most of the carbon compounds
(a) are poor conductors of electricity and have high boiling points
(b) are good conductors of electricity and have high boiling points
(c) are poor conductors of electricity and have low boiling points
(d) are good conductors of electricity and have low boiling points.

4. What is the IUPAC name of $(C_2H_5)_2CHCH_2OH$?

5. 2 mL of acetic acid was added in drops to 5 mL of water and it was noticed that
(a) the acid formed a separate layer on the top of water
(b) water formed a separate layer on the top of the acid
(c) a clear and homogeneous solution was formed
(d) a pink and clear solution was formed.

6. Write the condensed formula for *iso*-pentane.

OR

What type of reactions are shown by unsaturated hydrocarbons?

7. In graphite carbon atoms are arranged in which manner ?

8. The common salt is added to soap
(a) so as complete precipitation of soap takes place
(b) so as to provide Na^+ ion
(c) so as to provide Cl^- ion
(d) so as to reduce melting point of soap.

9. 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 the ethanoic acid in each one of them, in which of the test tube or test tubes the flame gets extinguished?
(a) X and Y (b) Y and Z
(c) X and Z (d) Only Z

OR

A student takes 5 mL acetic acid in test tube X and adds 3 mL distilled water into it. In test tube Y, he takes 5 mL distilled water and adds 3 mL acetic acid into it. After mixing he observes that
(a) colloid is formed in both test tubes
(b) homogeneous mixture is formed in both test tubes
(c) colloid is formed in X and homogeneous mixture in Y
(d) homogeneous mixture is formed in X and colloid in Y.

10. What is glacial acetic acid ?

11. What is the functional group in a carboxylic acid?

OR

Graphite is burned in oxygen. What is the product formed?

12. If water contains dissolved calcium hydrogen carbonate, out of soaps and synthetic detergents, which one will you use for cleaning clothes?

OR

If the pH of water is two, out of soap and detergent, which one will you use for cleaning clothes?

13. Define the term 'isomers'.

For question numbers 14-16, two statements are given- one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below :

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

14. Assertion : *n*-Butane has higher m.pt. than its lower alkane, propane.
Reason : Melting points of alkanes do not show regular variation with increase in molecular size.

15. Assertion : Saturated hydrocarbons are chemically less reactive.
Reason : All isomeric paraffins have same parent name.

16. Assertion : Graphite is a poor conductor of electricity.
Reason : Graphite has no free electrons.

Case Based Questions [4 × 1 Mark]

17. Read the following and answer any four questions from 17(i) to 17(v).

A hydrocarbon (*P*) has the molecular formula $C_{10}H_{22}$. A hydrocarbon (*Q*) has two carbon atoms less than (*P*) and belong to the same homologous series. A hydrocarbon (*R*) has two carbon atoms more than (*P*) and belong to the same homologous series.

(i) What is the molecular formula of (*Q*)?
(a) $C_{12}H_{26}$ (b) C_8H_{16}
(c) C_8H_{18} (d) C_8H_{14}

(ii) To which homologous series do the compound (*P*), (*Q*) and (*R*) belong?
(a) C_nH_{2n} (b) C_2H_{2n-2}
(c) C_nH_{2n+2} (d) C_nH_{2n+1}

(iii) What is the molecular formula of (*R*)?
(a) $C_{12}H_{26}$ (b) $C_{12}H_{24}$
(c) $C_{12}H_{22}$ (d) $C_{12}H_{28}$

(iv) Identify the correct statement about compounds (*P*), (*Q*) and (*R*).
(a) They have same melting and boiling points.
(b) They have same chemical properties.
(c) They have different general formula.
(d) They differ by $—CH_2$ unit.

(v) Compounds (*P*), (*Q*) and (*R*) are
(a) alkanes (b) alkenes
(c) alkynes (d) none of these.

18. Read the following and answer any four questions from 18(i) to 18(v).

Study the table related to three hydrocarbons *P*, *Q*, *R* and answer the questions that follow.

Organic compound	Molecular formula
P	C_3H_8
Q	C_5H_{10}
R	C_4H_6

(i) *P*, *Q* and *R* are classified as hydrocarbons because
(a) they contain hydrogen
(b) they contain carbon
(c) they contain both carbon and hydrogen
(d) none of these.

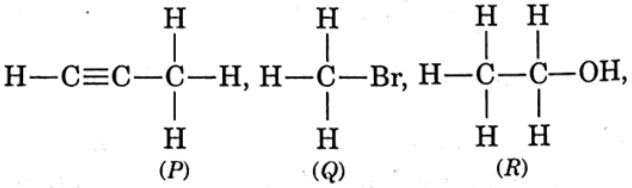
(ii) Which of these organic compounds is an alkyne?
(a) *P* (b) *Q*
(c) *R* (d) All of these

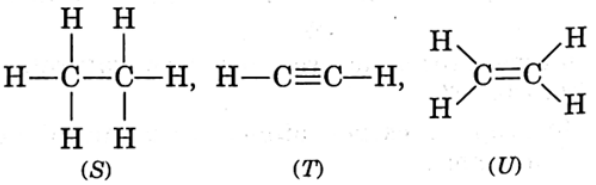
(iii) C_5H_{10} belongs to
(a) C_nH_{2n+2} series
(b) C_nH_{2n} series
(c) C_nH_{2n-2} series
(d) none of these.

(iv) Identify the incorrect statement about these three hydrocarbons.
(a) All have different general formula.
(b) *P* and *Q* differ by $–CH_2$ unit.
(c) *R* is an alkyne.
(d) *Q* is an alkene.

(v) General formula for alkane is
(a) C_nH_{2n} (b) C_nH_{2n+2}
(c) C_nH_{2n-2} (d) C_nH_n

19. Read the following and answer any four questions from 19(i) to 19(v).


(*P*) (*Q*) (*R*)


(*S*) (*T*) (*U*)

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(i) Which of the following compounds belong to same homologous series?
(a) S and T (b) T and U
(c) P and U (d) P and T.

(ii) The functional group of compound (R) is
(a) alcohol (b) aldehyde
(c) ketone (d) carboxylic acid.

(iii) Compound (T) belongs to homologous series of
(a) alkynes (b) alkenes
(c) alkanes (d) none of these.

(iv) Which of the following compounds is unsaturated hydrocarbon?
(a) S (b) Q
(c) U (d) R

(v) Which of the following compounds belongs to alkane series?
(a) P (b) S
(c) T (d) U

20. Read the following and answer any four questions from 20(i) to 20(v).
As neutral atom carbon has electronic configuration $\underset{2,\,4}{K\ L}$. To gain inert gas configuration carbon can either donate 4 valence electrons (helium gas configuration) or gain 4 electrons (neon gas configuration), but it cannot do so. To acquire inert gas configuration carbon can only share its 4 valence electrons with other atoms forming covalent bonds. A covalent bond can be defined as a chemical bond formed between two atoms by mutual sharing of valence electrons so that each atom acquires the stable electronic configuration of the nearest noble gas. The concept of covalent bonds was given by Langmuir and Lewis to explain bonding in non-ionic compounds. The covalent bonds are of three types. If each atom contributes one electron, the covalent bond formed is called a single covalent bond and is represented by a single line (–) and if each atom contributes two electrons, the covalent bond formed is called a double bond and is represented by a double line (=) and if each atom contributes three electrons, the covalent bond formed is called a triple bond and is represented by a triple line (≡).

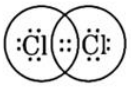
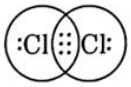
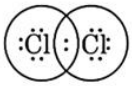
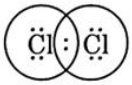
(i) Which of the following do not contain a double bond?
I. SO_2 II. NH_3
III. HCl IV. O_2
(a) I and II only (b) II and III only
(c) III and IV only (d) I and IV only

(ii) Which of the following contains a triple bond?
(a) N_2 (b) O_2
(c) CO_2 (d) H_2

(iii) The shared pair of electrons is said to constitute a _____ bond between two hydrogen atoms.
(a) single (b) double
(c) triple (d) ionic

(iv) Which of the following molecules has all its atoms joined together by double covalent bonds?
(a) Methane
(b) Water
(c) Carbon dioxide
(d) Nitrogen trichloride

(v) Chlorine forms a diatomic molecule, Cl_2. The electron dot structure for this molecule is

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

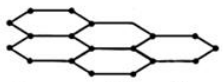
SECTION - B

21. Explain why unsaturated compounds undergo addition reactions and saturated compounds undergo substitution reactions. Give one example in each case.

OR

Showing all the covalent bonds, write the structure of ethanoic acid. How many single and double bonds does it have?

22. The diagram shows one layer of carbon atoms in the structure of graphite :



(a) Identify the types of bonding in graphite.
(b) Which property of graphite makes it suitable for use as a dry lubricant? Explain your answer.

23. Identify the following organic compounds, X and Y.

(i) $X + Br_2 \xrightarrow{\text{UV light}} CH_3CH_2Br + HBr$

(ii) $Y + Br_2 \longrightarrow CH_2BrCH_2Br$

OR

How would you convert ethanol into ethene? Name the process and write the reaction involved.

24. A compound X has molecular formula, C_3H_6. One mole of X reacts with one mole of bromine to yield a compound Y. Deduce the structures of X and Y.

25. A hydrocarbon X reacts with hydrogen to form hydrocarbon Y with the molecular formula C_3H_8. Draw the full structural formulae of X and Y.

26. Write a chemical equation to represent the following :

(i) combustion of alcohol

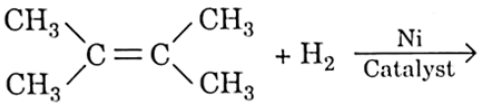
(ii) dehydration of alcohol

SECTION - C

27. Complete the following reaction and name the main products formed in each case.

(i) $CH_3COOH + NaOH \rightarrow$

(ii) $C_2H_5OH + 2[O] \rightarrow$

(iii) 

OR

An organic compound X on heating with concentrated sulphuric acid forms a compound Y which on addition to one mole of hydrogen in presence of Ni forms a compound Z. One mole of compound Z on combustion forms two moles of CO_2 and three moles of H_2O. Identify the compounds X, Y and Z and write the chemical equations of the reactions involved.

28. Write three different chemical reactions showing the conversion of ethanoic acid to sodium ethanoate. Write balanced chemical equation in each case.

29. Define the term 'structural isomerism'. Explain why propane cannot exhibit this property. Draw the structures of possible isomers of butane, C_4H_{10}.

30. (a) Name the compound CH_3COOH and identify its functional group.

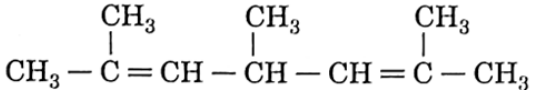
(b) Give a chemical test to identify this compound.

(c) Name the gas evolved when this compound reacts with sodium carbonate. How would you identify this gas?

31. Predict two alkenes that can be obtained when 2-butanol undergoes dehydration. Write the chemical equations for the reactions.

32. (a) What is meant by denatured alcohol? What is the need to denature alcohol?

(b) Give IUPAC name of the following hydrocarbon.



33. What is homologous series of compounds? List any two characteristics of homologous series.

SECTION - D

34. Explain the given reactions with one example of each :

(a) Hydrogenation reaction

(b) Oxidation reaction

(c) Substitution reaction

(d) Saponification reaction

(e) Combustion reaction

OR

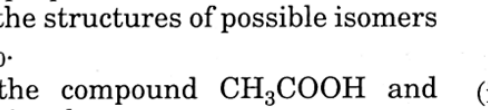
An organic compound 'A' is a constituent of wine and beer and is also used as fuel in spirit lamp. Compound 'A' on heating with alkaline potassium permanganate gives another compound 'B' which turns blue litmus to red. Compounds 'A' and 'B' combine in the presence of conc. H_2SO_4 to give a sweet smelling compound 'C'. Identify the compounds 'A', 'B' and 'C'. Also, write the reactions involved.

35. What are detergents? List two merits and two demerits of using detergents for cleansing. State the reason for the suitability of detergents for washing, even in the case of water having calcium and magnesium ions.

36. (a) Name the three fatty acid whose sodium or potassium salts are present in soaps.

(b) What is scum ? How is it formed?

(c) Label the hydrophilic and hydrophobic parts in the following compounds :

(i) 

(ii) $CH_3(CH_2)_{14}CH_2—N^+(CH_3)_3Br^-$

OR

Give an example of each of the following :

(a) A carbon compound containing two double bonds.

(b) A molecule in which central atom is linked to four other atoms.

(c) A compound containing both ionic and covalent bonds.

(d) An organic compound which is soluble in water.

(e) A carbon compound which burns with a sooty flame.

EXAM DRILL
CARBON AND ITS COMPOUNDS

ANSWERS

1. Because (i) it acts as catalyst and (ii) it removes water which is necessary to proceed the reaction in forward direction.

OR

The fourth member of alkene series is pentene

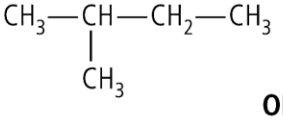
2. Mineral acids are stronger acids than carboxylic acids because mineral acids are completely ionised while carboxylic acids are partially ionised.

3. **(c) :** Because most of the carbon compounds are covalent.

4. 2-Ethylbutan-1-ol

5. **(c) :** When acetic acid and water are mixed, a clear and homogeneous solution was formed.

6.



OR

Unsaturated hydrocarbons show addition reactions.

7. A lattice of graphite appears as hexagonal rings, which are arranged in layers.

8. **(a) :** The common salt is added to soap due to which all the soap precipitates out from the solution.

9. **(d) :** In test tube *Z*, sodium carbonate reacts with ethanoic acid and liberates CO_2 gas, which can extinguish the burning splinter.

OR

(b) : In both cases homogeneous mixture is formed.

10. 100% pure ethanoic acid is called glacial acetic acid.

11. —COOH is the functional group in a carboxylic acid.

OR

Chemically graphite is carbon which combines with oxygen to form carbon dioxide.

12. Water containing calcium hydrogen carbonate is hard water. Detergents are preferred over soaps for cleaning clothes in hard water because calcium salts of detergents are soluble in water while calcium salts of soaps are insoluble. Therefore, if washing is done with soap, lot of soap will be wasted.

OR

Soaps cannot be used in acidic medium for washing purposes because in acidic medium soaps are converted into free fatty acids which are insoluble in water. As a result, they stick to the surface of the fabric and the cleaning ability of soaps is blocked. However, detergents can be used in acidic medium. The reason being that in acidic medium, detergents are converted into free sulphonic acids which are also soluble in water. As a result, the cleaning ability of detergents is not blocked.

13. Isomers are those compounds which have the same molecular formula but different structural formula *i.e.*, show different properties.

14. **(b)**

15. **(c) :** Less reactivity of saturated hydrocarbons is due to presence of single bonds between carbon atoms. Paraffins (alkanes) may have straight chain or branched chain isomers which have different parent names.

16. **(d) :** Graphite is a good conductor of electricity as it has one free valence electron.

17. **(i) (c) :** Molecular formula of (*Q*) is C_8H_{18} as it has two carbon atoms less than (*P*).

(ii) (c) : Compounds (*P*), (*Q*) and (*R*) are alkanes having general formula C_nH_{2n+2}.

(iii) (a) : Molecular formula of (*R*) is $C_{12}H_{26}$ as it has two carbon atoms more than (*P*).

(iv) (b) : Compound (*P*), (*Q*) and (*R*) belong to same homologous series so they have different physical properties but similar chemical properties. They have same general formula C_nH_{2n+2}. They differ by 2 carbon atoms and 4 hydrogen atoms.

(v) (a)

18. **(i) (c) :** *P*, *Q* and *R* are classified as hydrocarbons because these compounds are made up of carbon and hydrogen only.

(ii) (c) : *R* is an alkyne.

(iii) (b) : C_5H_{10} is an alkene having a general formula C_nH_{2n}.

(iv) (b) : *P* and *Q* do not belong to same homologous series. *P* is an alkane while *Q* is an alkene.

(v) (b)

19. **(i) (d) :** *P* and *T* are alkynes.

(ii) (a) : Alcohol (–OH).

(iii) (a) : *T* is an alkyne having general formula of C_nH_{2n-2}.

(iv) (c) : *U* is an alkene.

(v) (b)

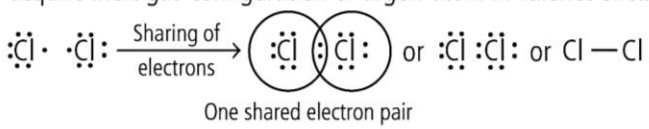
20. (i) (b) : Both NH_3 and HCl have single bonds.

(ii) (a) : $N \equiv N$

(iii) (a)

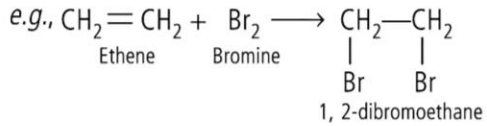
(iv) (c) : $O=C=O$

(v) (c) : In chlorine molecule, both chlorine atoms contribute one electron and thus share single electron pair to form single covalent bond. As shared pair is shared by both atoms, they acquire inert gas configuration of argon atom in valence shell.



One shared electron pair

21. Unsaturated compounds contain double or triple bonds between the two C-atoms and show addition reactions.

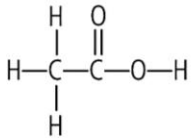


1, 2-dibromoethane

While saturated compounds contain carbon-carbon (C–C) and carbon-hydrogen (C–H) single bonds which are quite unreactive and inert so undergo substitution reactions.

OR

The structure of ethanoic acid is

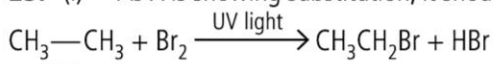


There are 6 single bonds and 1 double bond in it.

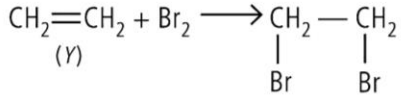
22. (a) Covalent bonds between carbon atoms in each layer and van der Waals' forces between the layers of carbon atoms.

(b) Graphite is soft. The layers of carbon atoms can slide over each other because of the weak van der Waals' forces between them.

23. (i) As *X* is showing substitution, it should be an alkane.

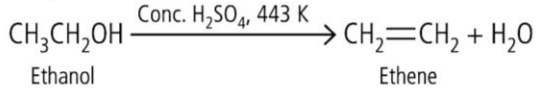


(ii) As *Y* is showing addition of 1 mole of Br_2, it should be an alkene.

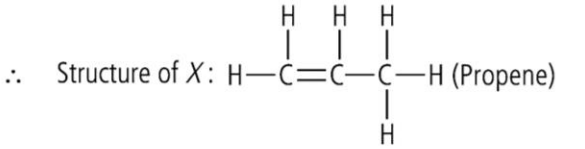


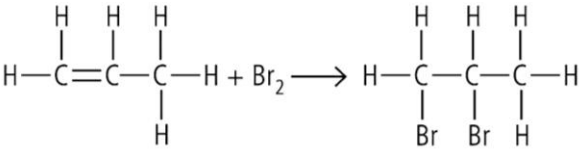
OR

Dehydration :



24. One mole of *X* (C_3H_6) react with one mole of Br_2, thus, *X* contains one double bond.



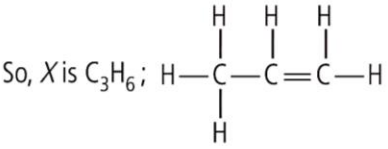


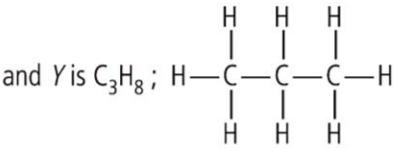
(*X*) (*Y*)

1, 2-Dibromopropane

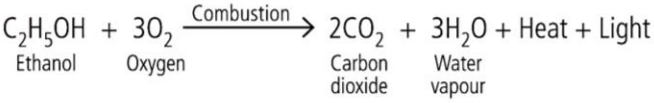
25. $X + H_2 \longrightarrow \underset{(C_3H_8)}{Y}$

As *Y* is an alkane, *X* should be an alkene which on hydrogenation gives alkane.

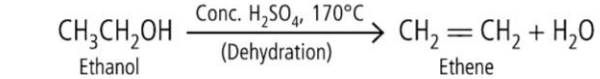




26. (a) (i) **Combustion of alcohol :** Ethanol is a highly inflammable liquid. It catches fire easily and starts burning. Ethanol burns readily in air to form carbon dioxide and water vapour with the evolution of heat and light.



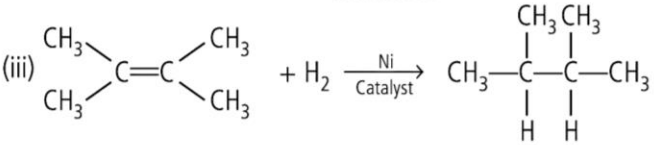
(ii) **Dehydration of alcohol :** When ethanol is heated with excess of concentrated sulphuric acid at 170°C (443 K), it gets dehydrated to form ethene. In this reaction, concentrated sulphuric acid acts as a dehydrating agent (which removes water molecule form ethanol molecule).



27. (i) $CH_3COOH + NaOH \longrightarrow \underset{\text{Sodium ethanoate}}{CH_3COONa} + H_2O$

(ii) $C_2H_5OH + 2[O] \xrightarrow{KMnO_4} \underset{\text{Ethanoic acid}}{CH_3COOH} + H_2O$

(iii)



2, 3-dimethylbutane

OR

Since, compound *Z* on combustion forms two moles of CO_2 and three moles of H_2O, therefore, compound *Z* must contain two carbon atoms and six hydrogen atoms. Thus, compound *Z* must be C_2H_6 (ethane).

$$\underset{\substack{\text{Ethane}\\(Z)}}{C_2H_6} + 7/2O_2 \xrightarrow{\text{Heat}} \underset{\text{Carbon dioxide}}{2CO_2} + \underset{\text{Water}}{3H_2O}$$

Since, compound (*Z*) is obtained by addition of 1 mole of H_2 in presence of Ni to compound (*Y*), therefore (*Y*) must be ethene.

$$\underset{\substack{(Y)\\\text{Ethene}}}{CH_2=CH_2} + H_2 \xrightarrow{\text{Ni, Heat}} \underset{\substack{(Z)\\\text{Ethane}}}{CH_3-CH_3}$$

Since, compound (*Y*) is formed by heating compound (*X*) with conc. H_2SO_4, therefore, compound (*X*) must be ethanol.

$$\underset{\substack{(X)\\\text{Ethanol}}}{CH_3CH_2OH} \xrightarrow[\text{(Dehydration)}]{\text{Conc. } H_2SO_4,\ 443\ K} \underset{\substack{(Y)\\\text{Ethene}}}{CH_2=CH_2} + H_2O$$

28. (i) With Na_2CO_3 :

$$\underset{\text{Ethanoic acid}}{2CH_3COOH} + \underset{\text{Sodium carbonate}}{Na_2CO_3} \longrightarrow \underset{\text{Sodium ethanoate}}{2CH_3COONa} + \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Water}}{H_2O}$$

(ii) With sodium hydrogen carbonate :

$$\underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Sodium bicarbonate}}{NaHCO_3} \longrightarrow \underset{\text{Sodium ethanoate}}{CH_3COONa} + \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Water}}{H_2O}$$

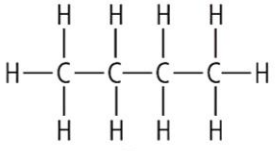
(iii) With NaOH :

$$\underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Sodium hydroxide}}{NaOH} \longrightarrow \underset{\text{Sodium ethanoate}}{CH_3COONa} + \underset{\text{Water}}{H_2O}$$

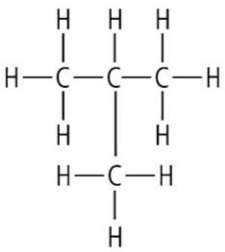
29. Two or more organic compounds having the same molecular formula but different structures, are called structural isomers and the phenomenon is known as structural isomerism.

There is no possible isomers for propane as it contains three carbon atoms and it is not possible to have different arrangements of these carbon atoms.

The structures of possible isomers of butane (C_4H_{10}) are :



n-Butane
(I)



2-Methylpropane
(II)

30. (a) CH_3COOH is ethanoic acid. It has carboxylic acid (—C(=O)—OH) as a functional group.

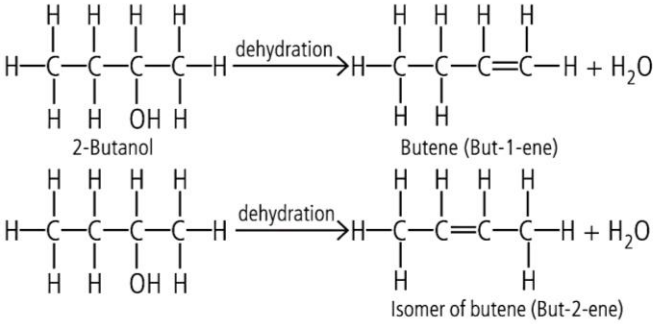
(b) The following tests show the presence of ethanoic acid :

Sodium bicarbonate test – To a small amount of organic compound add a pinch of solid sodium bicarbonate. Evolution of carbon dioxide gas with brisk effervescence shows the presence of ethanoic acid (carboxylic acid).

(c) $$CH_3COOH + Na_2CO_3 \longrightarrow \underset{\text{Sodium ethanoate}}{2CH_3COONa} + CO_2\uparrow + H_2O$$

The gas evolved can be easily identified by passing it through freshly prepared lime water, if it turns lime water milky then carbon dioxide is present.

31. The two alkenes are but-1-ene and but-2-ene.



2-Butanol — Butene (But-1-ene)

Isomer of butene (But-2-ene)

32. (a) Ethanol which has been made unfit for drinking purposes by adding poisonous substances like methanol, pyridine, copper sulphate, etc., is called denatured alcohol.

To supply cheaper alcohol to industries and to refrain from drinking, alcohol is denatured by adding poisonous substances.

(b) 2, 4, 6-Trimethyl-2, 5-heptadiene

33. Homologous series : A family of organic compounds having the same functional group, similar chemical properties and the successive members of which differ by a CH_2 group or 14 mass units.

Characteristics :

(i) All the members of homologous series have similar chemical properties.

(ii) Any two consecutive members differ in their molecular formula by a $-CH_2$ group.

34. (a) **Hydrogenation reaction :** The addition of hydrogen to unsaturated hydrocarbon to obtain a saturated hydrocarbon is called hydrogenation. For example,

$$\underset{\text{Ethene}}{CH_2=CH_2} + H_2 \xrightarrow{\text{Nickel, 473 K}} \underset{\text{Ethane}}{CH_3-CH_3}$$

(b) **Oxidation reaction :** Addition of oxygen to any substance is called oxidation and the substances which are capable of adding oxygen to other substances are called oxidising agent.

$$CH_3CH_2OH + \underset{\substack{\text{From}\\\text{oxidising}\\\text{agent}}}{2[O]} \xrightarrow{KMnO_4/KOH,\ \text{Heat}} CH_3-\overset{\overset{O}{\|}}{C}-OH + H_2O$$

(c) **Substitution reaction :** Reactions which involve the direct replacement (displacement or substitution) of an atom or a group of atoms in an organic molecule by another atom or group of atoms without any change in the rest of the molecule are called substitution reactions.

$$\underset{\text{Methane}}{CH_4} + \underset{\text{Chlorine}}{Cl_2} \xrightarrow{\text{Sunlight}} \underset{\substack{\text{Chloromethane}\\(\text{Substitution}\\\text{product})}}{CH_3Cl} + \underset{\substack{\text{Hydrogen}\\\text{chloride}}}{HCl}$$

(d) **Saponification reaction :** When hydrolysis of an ester is carried out with a base such as sodium hydroxide, sodium salt of the original acid and the original alcohol are formed. Since sodium salts of higher fatty acids are called soaps, therefore, alkaline hydrolysis of an ester to give the salt of the corresponding carboxylic acid and the alcohol is called saponification. It is reverse of esterification.

$$\underset{\text{Ethyl ethanoate}}{CH_3-\overset{\overset{O}{\|}}{C}-OCH_2CH_3} + \underset{\substack{\text{Sodium}\\\text{hydroxide}}}{NaOH} \xrightarrow{\text{Heat}} \underset{\text{Sodium ethanoate}}{CH_3-\overset{\overset{O}{\|}}{C}-ONa} + \underset{\text{Ethanol}}{CH_3CH_2OH}$$

(e) **Combustion reaction :** Combustion means heating a substance strongly in presence of excess of oxygen or air. During combustion, all the allotropic forms of carbon (diamond, graphite, fullerene, coal, etc.) are oxidised to form carbon dioxide and water with release of a large amount of heat and light.

$$\underset{\text{Methane}}{CH_4} + \underset{\text{Oxygen}}{2O_2} \longrightarrow \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Water}}{H_2O} + \text{heat} + \text{light}$$

OR

Since, compound *A*, on oxidation with alkaline potassium permanganate gives ethanoic acid (acetic acid) which turns blue litmus red, therefore, compound *A* is ethanol and *B* is ethanoic acid.

$$\underset{\substack{(A)\\\text{Ethanol}}}{CH_3CH_2OH} + 2[O] \xrightarrow[\text{or } K_2Cr_2O_7 / H_2SO_4, \text{ Heat}]{KMnO_4 / KOH, \text{ Heat}} \underset{\substack{(B)\\\text{Ethanoic acid}}}{CH_3COOH} + H_2O$$

Ethanol is a constituent of wine and beer and is also used as a fuel.

Since, *B* is an acid which on heating with *A* in presence of a few drops of conc. H_2SO_4 gives a sweet smelling compound *C*, therefore, *C* must be an ester.

$$\underset{\substack{(A)\\\text{Ethanol}}}{CH_3CH_2OH} + \underset{\substack{(B)\\\text{Ethanoic acid}}}{CH_3COOH} \xrightarrow[\text{Warm}]{\text{Conc. } H_2SO_4} \underset{\substack{(C)\\\text{Ethyl ethanoate}}}{CH_3COOCH_2CH_3} + \underset{\text{Water}}{H_2O}$$

35. Detergents are generally ammonium or sulphonate salts of long chain carboxylic acids. *e.g.*, sodium *n*-dodecyl benzene sulphonate which has cleaning property in water.

Merits of using detergents :

(i) Detergents are very strong cleansing agents.

(ii) They can form lather well even in hard water as they do not form insoluble calcium or magnesium salts.

Demerits of using detergents :

(i) As detergents are ammonium or sulphonate salts of long chain carboxylic acids which are very bulky molecules, are not easily degraded by bacteria and hence, they are non-biodegradable and cause water pollution.

(ii) They are highly basic in nature and cause damage to skin.

Synthetic detergents can be used even in hard water because they do not react with Ca^{2+} and Mg^{2+} ions present in hard water. They do not form curdy white precipitates (scum) of calcium and magnesium salts of fatty acids.

36. (a) Palmitic acid ($C_{15}H_{31}COOH$), stearic acid ($C_{17}H_{35}COOH$) and oleic acid ($C_{17}H_{33}COOH$).

(b) The Ca^{2+} and Mg^{2+} ions present in hard water react with soap to form dirty white precipitate. This white precipitate is called scum.

$$\underset{\substack{\text{Sodium stearate}\\(\text{Soap})}}{2C_{17}H_{35}COONa} + \underset{\substack{\text{Calcium ion}\\(\text{from hard water})}}{Ca^{2+}} \longrightarrow \underset{\substack{\text{Calcium stearate}\\(\text{Scum})}}{(C_{17}H_{35}COO)_2Ca} + 2Na^+$$

$$\underset{\text{Sodium stearate}}{2C_{17}H_{35}COONa} + \underset{\substack{\text{Magnesium ion}\\(\text{from hard water})}}{Mg^{2+}} \longrightarrow \underset{\substack{\text{Magnesium stearate}\\(\text{Scum})}}{(C_{17}H_{35}COO)_2Mg} + 2Na^+$$

(c) (i) $\underbrace{CH_3(CH_2)_{15}CH_2}_{\text{Hydrophobic part}}-\underbrace{\overset{\overset{O}{\|}}{C}-O^-Na^+}_{\text{Hydrophilic part}}$

(ii) $\underbrace{CH_3(CH_2)_{14}CH_2}_{\text{Hydrophobic part}}-\underbrace{\overset{+}{N}(CH_3)_3Br^-}_{\text{Hydrophilic part}}$

OR

(a) Carbon dioxide, $:\underset{\cdot\cdot}{O}=C=\underset{\cdot\cdot}{O}:$

(b) Methane, $H-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-H$

(c) Ammonium chloride, $\left[H-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{N}}-H\right]^+ Cl^-$

(d) $\underset{\text{Ethanol}}{CH_3CH_2-OH}$ or $\underset{\text{Ethanoic acid}}{CH_3COOH}$

(e) Unsaturated compounds burn with a sooty flame. For example, ethene, ethyne, etc.

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