

# Carbon and its Compounds

## TOPICS COVERED

### Bonding in Carbon, Covalent Compounds, Nomenclature, Homologous Series, Properties of Compounds of Carbon



#### Multiple Choice Questions

1 Mark



- CHO represents the functional group  
(a) esters (b) carboxylic acid  
(c) alcohols (d) aldehydes
- A functional group mainly determines the  
(a) physical properties  
(b) chemical properties  
(c) both (d) none of these
- Solubility of alcohol in water is due to  
(a) low density of alcohol  
(b) volatile nature of alcohol  
(c) ionisation  
(d) hydrogen bonding
- Artificial flavour for orange is obtained from  
(a) amyl acetate (b) isoamyl valerate  
(c) methyl butyrate (d) octyl acetate
- Drinking alcohol is very harmful and it ruins the health. "Drinking alcohol" stands for  
(a) drinking methyl alcohol  
(b) drinking ethyl alcohol  
(c) drinking propyl alcohol  
(d) drinking isopropyl alcohol
- The difference in the formula and molecular masses of  $\text{CH}_3\text{OH}$  and  $\text{C}_2\text{H}_5\text{OH}$  is  
(a)  $\text{CH}_3$  and 16u (b)  $\text{CH}_2$  and 14u  
(c)  $\text{CH}_4$  and 18u (d)  $\text{CH}_3$  and 16u
- Which of the following statements about graphite and diamond is true?  
(a) They have the same crystal structure  
(b) They have the same degree of hardness  
(c) They have the same electrical conductivity  
(d) They can undergo the same chemical reactions
- Which of the following is ethanol?  
(a)  $\text{CH}_3\text{CHO}$  (b)  $\text{CH}_3\text{COOH}$   
(c)  $\text{CH}_3\text{CH}_2\text{OH}$  (d)  $\text{CH}_3\text{COOCH}_3$
- Which of the following contains covalent bond?  
(a)  $\text{MgCl}_2$  (b)  $\text{CaF}_2$   
(c)  $\text{Al}_2\text{O}_3$  (d)  $\text{HCl}$
- The number of covalent bonds in  $\text{C}_4\text{H}_{10}$  is  
(a) 10 (b) 8  
(c) 13 (d) 12
- Which amongst the following will conduct electricity?  
(a)  $\text{C}_6\text{H}_{12}\text{O}_6$  (b)  $\text{KCl}(s)$   
(c)  $\text{C}_2\text{H}_5\text{OH}$  (d)  $\text{NaCl}(aq)$
- The self linkage property (catenation) is maximum in  
(a) carbon (b) silicon  
(c) sulphur (d) phosphorus
- Ethane and ethene can be distinguished by  
(a)  $\text{Br}_2(l)$  (b)  $\text{Br}_2(aq)$  water  
(c)  $\text{Cl}_2$  (d)  $\text{I}_2$
- $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow[\text{KMnO}_4]{\text{alkaline}}$   $\text{CH}_3\text{COOH}$ , alkaline  $\text{KMnO}_4$  acts as  
(a) oxidising agent  
(b) reducing agent  
(c) dehydrating agent  
(d) catalyst
- The blindness and death is caused by consuming adulterated liquor contains.  
(a)  $\text{CH}_3\text{OH}$  (b)  $\text{CH}_3\text{COOH}$   
(c)  $\text{CH}_3\text{COCH}_3$  (d)  $\text{CH}_3\text{CHO}$
- Ethanol, on heating at 443 K with conc  $\text{H}_2\text{SO}_4$  gives  
(a)  $\text{CH}_2=\text{CH}_2$  (b)  $\text{HC}\equiv\text{CH}$   
(c)  $\text{CH}_4$  (d)  $\text{C}_2\text{H}_6$
- When sodium hydrogen carbonate is added to ethanoic acid a gas evolves. Consider the following statements about the gas evolved?  
(A) It turns lime water milky.  
(B) It is evolved with a brisk effervescence.  
(C) It has a smell of burning sulphur.  
(D) It is also by-product of respiration.  
The correct statements are: [CBSE 2020]  
(a) (A) and (B) only  
(b) (B) and (D) only  
(c) (A), (C) and (D)  
(d) (A), (B) and (D)
- The IUPAC name of the following structure is  
$$\begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & \text{O} & & \\ & | & | & | & || & & \\ \text{H} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{O} & -\text{H} \\ & | & | & | & & & \\ & \text{H} & \text{H} & \text{H} & & & \end{array}$$
  
(a) Pentanone (b) Butyric acid  
(c) Butanoic acid (d) Butanone

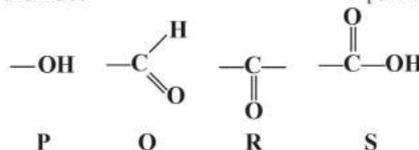
19. On undergoing complete combustion in an adequate supply of oxygen, an organic compound produces only carbon dioxide and water vapour as the products.

Based on this information, which of the following homologous series could the compound belong to?

(P) Alkanes (Q) Alcohols (R) Aldehydes  
[CFPQ, CBSE]

- (a) only P (b) only P or Q  
(c) only Q or R (d) any - P, Q or R

20. A compound with which of the following functional groups is MOST LIKELY to cause the decomposition of baking soda to produce carbon dioxide?  
[CFPQ, CBSE]



- (a) P (b) Q  
(c) R (d) S

21. 1 mole of ethene and 1 mole of ethyne are separately made to completely undergo addition reaction to form the respective saturated compound.

Which of the following will be DIFFERENT for the two reactions?

(P) The number of moles of the saturated compound formed.

(Q) The number of moles of the hydrogen consumed.  
[CFPQ, CBSE]

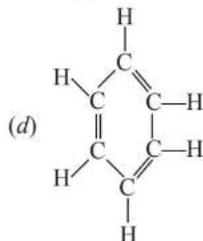
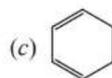
- (a) only P (b) only Q  
(c) both P and Q (d) neither P nor Q

22. In the compound  $\begin{array}{c} \text{O} \\ \parallel \\ \text{C} \\ \diagup \quad \diagdown \\ \text{CH}_3 \quad \text{CH}_3 \end{array}$  which of the following functional group is present?  
[CBSE T.E.R.M.\*]

- (a) Alcohol (b) Aldehyde  
(c) Carboxylic acid (d) Ketone

23. Which of the following represents benzene?

- (a)  $\text{H—C}\equiv\text{C—H}$  (b) 



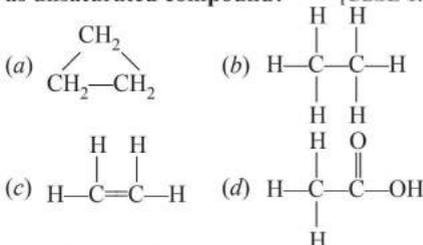
24. There are some organic compounds in the list below:



Now choose the correct option [DoE Pre-Board 2023]

- (a) They are only alkenes in the list.  
(b) All the compounds in the list are alkanes.  
(c) There is no alkyne in the list.  
(d) There are saturated and unsaturated hydrocarbons in the list.

25. Which of the following compounds can be classified as unsaturated compound?  
[CBSE T.E.R.M.\*]



26. A student studies that vinegar, which is diluted solution of ethanoic acid freezes during winter.

What does this suggest about physical properties of acetic acid?  
[CBSE T.E.R.M.\*]

- (a) It has low boiling point.  
(b) It has low melting point.  
(c) It has very high boiling point.  
(d) It has a very high melting point.

27.  $\text{CHCl}_3 + \text{Cl}_2 \xrightarrow{\text{Sunlight}} \text{CCl}_4 + \text{HCl}$ . How does chlorine react to hydrocarbon in presence of sunlight?  
[CBSE T.E.R.M.\*]

- (a) It adds hydrogen into the compound.  
(b) It adds an oxygen atom into the compound.  
(c) It substitutes hydrogen atom from the compound.  
(d) It breaks double and triple bonds into single bonds.

28. A student burns naphthalene. He observed it gives yellow flame with lots of smoke and sooty deposits around it. What type of hydrocarbon naphthalene contains?  
[CBSE T.E.R.M.\*]

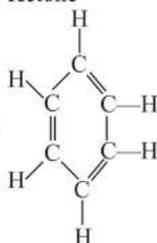
- (a) Unsaturated, as black smoke represents complete combustion.  
(b) Unsaturated, as sooty deposit represents unburnt hydrocarbons.  
(c) Saturated, as it gives yellow flame which represents complete combustion.  
(d) Saturated, as burning of any substance represents complete combustion.

29. Which of these series can be classified as homologous series?  
[CBSE T.E.R.M.\*]

- (a)  $\text{CHCl}_3$ ,  $\text{C}_2\text{H}_5\text{OH}$ ,  $\text{C}_2\text{H}_7\text{OH}$   
(b)  $\text{CH}_3\text{OH}$ ,  $\text{C}_2\text{H}_5\text{OH}$ ,  $\text{C}_3\text{H}_7\text{OH}$   
(c)  $\text{CHCl}_3$ ,  $\text{C}_4\text{H}_9\text{OH}$ ,  $\text{CH}_3\text{COOH}$   
(d)  $\text{CH}_3\text{COOH}$ ,  $\text{C}_4\text{H}_9\text{OH}$ ,  $\text{C}_2\text{H}_5\text{OH}$

### Answers

1. (d)    2. (b)    3. (d)    4. (d)  
 5. (b)    6. (b)    7. (d)    8. (c)  
 9. (d)    10. (c)    11. (d)    12. (a)
13. (b) Ethene will decolourise bromine water.  
 14. (a)  
 15. (a) Methanol causes blindness and even death.  
 16. (a)  $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow[443\text{ K}]{\text{Conc H}_2\text{SO}_4} \text{CH}_2=\text{CH}_2 + \text{H}_2\text{O}$   
 17. (d)  $\text{CO}_2$  gas is evolved with brisk effervescence, is also by-product of respiration and turns lime water milky.  
 18. (c) Butanoic acid  
 19. (d) All of them produce  $\text{CO}_2$  and  $\text{H}_2\text{O}$  on combustion.  
 20. (d) Acid reacts with  $\text{NaHCO}_3$  and liberate  $\text{CO}_2$  gas.  
 21. (b)  $\text{CH}_2=\text{CH}_2 + \text{H}_2 \longrightarrow \text{CH}_3-\text{CH}_3$   
 $\text{HC}\equiv\text{CH} + 2\text{H}_2 \longrightarrow \text{CH}_3-\text{CH}_3$   
 22. (d) Ketone



23. (d)
24. (d) There are saturated and unsaturated hydrocarbons in the list.
25. (c)  $\text{H}-\text{C}=\text{C}-\text{H}$
26. (b) It has low melting point.  
 27. (c) It substitutes hydrogen atom from the compound.  
 28. (b) Unsaturated, as sooty deposit represents unburnt hydrocarbons.  
 29. (b)  $\text{CH}_3\text{OH}$ ,  $\text{C}_2\text{H}_5\text{OH}$ ,  $\text{C}_3\text{H}_7\text{OH}$

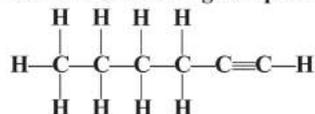


### Very Short Answer Type Questions 2 Marks

30. “Carbon prefers to share its valence electrons with other atoms of carbon or with atoms of other elements rather than gaining or losing the valence electrons in order to attain noble gas configuration.” Give reasons to justify this statement.

Ans. Carbon (2, 4) has four valence electrons. It cannot lose 4 electrons because large amount of energy is needed to remove four electrons. Carbon cannot gain four electrons because 6 protons cannot hold 10 electrons. Carbon can share four electrons easily to form covalent bonds with other carbon atoms and atoms of other elements.

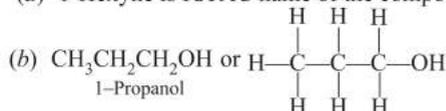
31. (a) Name the following compound:



- (b) Write the name and structure of an alcohol with three carbon atoms units molecule.

[AI 2016]

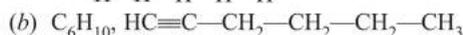
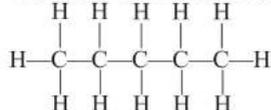
Ans. (a) 1-Hexyne is IUPAC name of the compound.



32. (a) How many covalent bonds are present in pentane  $\text{C}_5\text{H}_{12}$ ? [DoE]

- (b) Write molecular formula of an alkyne containing 10 atoms of hydrogen. [DoE]

Ans. (a) There are 16 covalent bonds present in  $\text{C}_5\text{H}_{12}$ .



33. Write the next homologue of each of the following.

[Delhi 2016]



Ans. (a)  $\text{C}_3\text{H}_6$                       (b)  $\text{C}_5\text{H}_8$

34. Which type of hydrocarbons burn with yellow smoky flame? Why?

Ans. Unsaturated hydrocarbons. Due to presence of higher percentage of carbon.

35. The table shows the electronic structures of four elements.

Element	Electronic Structure
P	2,6
Q	2,8,1
R	2,8,7
S	2,8,8

- (a) Identify which element(s) will form covalent bonds with carbon.

(b) “Carbon reacts with an element in the above table to form several compounds.” Give suitable reason. [CBSE Sample Question Paper 2022]

Ans. (a) P and R                      ( $\frac{1}{2} + \frac{1}{2}$  Mark)

(b) Carbon has a valency four or tetravalency and catenation are responsible. ( $\frac{1}{2} + \frac{1}{2}$  Mark)

[CBSE Marking Scheme]

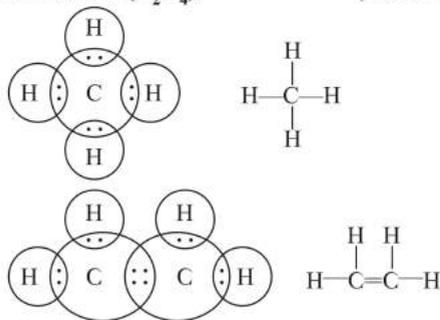
36. “Carbon forms strong bonds with most other element making the compounds exceptionally stable”. Give reason to justify this statement.

[CBSE 2021 (C)]

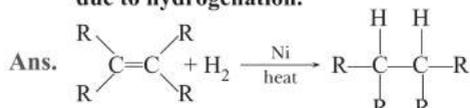
Ans. Carbon has small atomic size and four valence electrons. It shares 4 electrons with other elements to form covalent bonds which are very strong and stable because octet of carbon become complete.

37. Write the electron dot structure of methane (CH<sub>4</sub>) and ethene (C<sub>2</sub>H<sub>4</sub>). [CBSE 2021 (C)]

Ans.

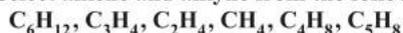


38. With the help of a suitable example explain in brief the process of hydrogenation mentioning the conditions for the reaction and also state any one physical property of substances which changes due to hydrogenation.



When unsaturated hydrocarbons are heated with hydrogen in presence of nickel as catalyst, saturated hydrocarbons are formed. If the starting unsaturated hydrocarbons are liquids, they will change into solids. Vegetable oils are hydrogenated to form vegetable ghee by hydrogenation process.

39. Select alkene and alkyne from the following:



Ans. Alkenes: C<sub>6</sub>H<sub>12</sub>, C<sub>2</sub>H<sub>4</sub>, C<sub>4</sub>H<sub>8</sub>

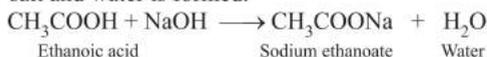
Alkynes: C<sub>3</sub>H<sub>4</sub>, C<sub>5</sub>H<sub>8</sub>

40. Write the names and molecular formula of two organic compounds having functional group suffixed as '-oic acid'. With the help of a balanced chemical equation and explain what happens when any one of them reacts with sodium hydroxide.

Ans. HCOOH (Methanoic acid), its molecular formula is CH<sub>2</sub>O<sub>2</sub>.

CH<sub>3</sub>COOH (Ethanoic acid), its molecular formula is C<sub>2</sub>H<sub>4</sub>O<sub>2</sub>.

When acid reacts with sodium hydroxide, its sodium salt and water is formed.



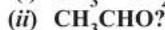
41. What is a homologous series? Which two of the following organic compounds belong to the same homologous?



Ans. Homologous series is a series of organic compounds which have same functional group and similar chemical properties. Each member of this series is differ by —CH<sub>2</sub>— in its molecular formula and 14 u in its molecular mass.

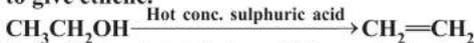
C<sub>2</sub>H<sub>6</sub>O (C<sub>2</sub>H<sub>5</sub>OH) and CH<sub>4</sub>O (CH<sub>3</sub>OH) belong to same homologous series.

42. What is the IUPAC name of

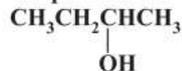


Ans. (i) But-1-ene (ii) Ethanal

43. Heating an alcohol with concentrated sulphuric acid results in the dehydration of the alcohol to give the alkene as shown by the reaction of ethanol to give ethene.



Pramila heated 2-butanol (shown below) with concentrated sulphuric acid.



Write the structural formulae of all the possible products of the reaction. [CFPQ, CBSE]

Ans. CH<sub>3</sub>CH=CHCH<sub>3</sub>, But-2-ene

CH<sub>3</sub>CH<sub>2</sub>CH=CH<sub>2</sub>, But-1-ene

44. Organic compounds belonging to different homologous series can be isomers. For example, propanal and propanone are isomers.

Can an alkane and an alcohol be isomers? Why or why not? [CFPQ, CBSE]

Ans. — No, they cannot be isomers because isomers must have same molecular formula.

— Alkanes have only carbon and hydrogen atoms, while alcohols have oxygen atoms too.

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

[CBSE Sample Paper 2021]

Ans. • Due to self linking ability of carbon/catenation.  
• Since carbon has a valency of four it can form bonds with four other atoms of carbon or atoms of some other mono-valent element. (1+1 mark)  
• Due to small size of carbon it forms very strong and (or) stable bonds with other elements. (any two)

[CBSE Marking Scheme]

### Short Answer Type Questions 3 Marks

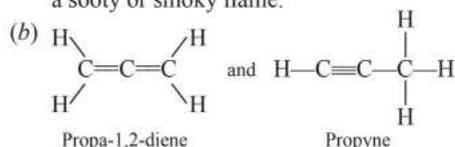
46. Alkanes are saturated compounds of carbon and hydrogen that can be represented by the general formula C<sub>n</sub>H<sub>2n+2</sub> where 'n' is the number of carbon atoms. An example of such a compound is ethane C<sub>2</sub>H<sub>6</sub>.

Maya has a compound of carbon and hydrogen whose formula is  $C_3H_4$ .

(a) What is true about the type of flame this compound will give on combustion?

(b) Draw all the possible straight chain structures of this compound. [CFPQ, CBSE]

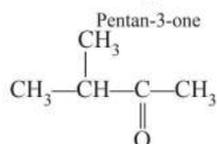
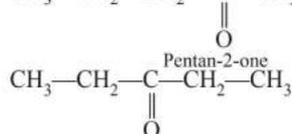
Ans. (a) The compound being unsaturated will burn with a sooty or smoky flame.



47. A carbon compound of molecular formula  $C_5H_{10}O$  contains a ketone functional group.

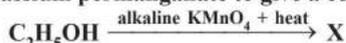
Draw the structures of three isomers of this compound having a ketone group. [CFPQ, CBSE]

Ans.  $CH_3-CH_2-CH_2-C(=O)-CH_3$



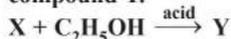
3-Methyl butan-2-one

48. Ethanol ( $C_2H_5OH$ ) is heated with alkaline potassium permanganate to give a compound X.



(a) How many carbon atoms will compound X contain?

(b) Compound X is now reacted with ethanol in the presence of an acid catalyst to give a compound Y.



(i) Name the type of compound formed in the above reaction with respect to the functional group it contains.

(ii) State one characteristic property of compounds of the type of compound Y.

(iii) State one use of compounds of this type. [CFPQ, CBSE]

Ans. (a) Two  
 $C_2H_5OH + 2[O] \xrightarrow{\text{alkaline } KMnO_4} CH_3COOH$   
 'X'

(b) (i) ester  
 $CH_3COOH + C_2H_5OH \xrightarrow{\text{acid}} CH_3COOC_2H_5 + H_2O$   
 'X'

(ii) Esters are pleasant fruity smelling compounds in ice creams, cold drinks etc.

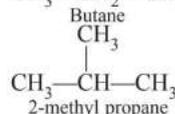
(iii) – perfumes  
 – flavouring agents in ice creams, cold drinks, etc.) (any one)

49. Compounds with identical molecular formula but different structures are called structural isomers.

(a) In the case of saturated hydrocarbons, what is the MINIMUM number of carbon atoms needed in a molecule for it to have a structural isomer?

(b) Draw the structural isomers of the saturated hydrocarbon having the minimum number of carbon atoms mentioned in (a). [CFPQ, CBSE]

Ans. (a) Four  
 $C_4H_{10}$  will show isomerism  
 (b)  $CH_3-CH_2-CH_2-CH_3$  and



50. An open-chain hydrocarbon X having the general formula of  $C_nH_{2n-2}$  is hydrogenated in the presence of a catalyst.

(a) State the number of moles of hydrogen required to completely saturate 1 mole of compound X.

(b) The hydrocarbon X contains carbon-carbon single bonds. Apart from the single bonds, state the number and the type of other carbon-carbon bonds that could possibly be present in the compound X. [CFPQ, CBSE]

Ans. (a) 2 moles  
 $R-C\equiv CH + 2H \longrightarrow R-CH_2-CH_3$   
 where 'R' is alkyl group.

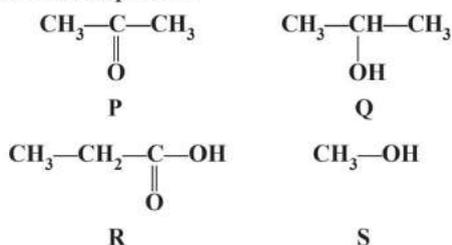
(b) – two C–C double bonds

$$\begin{array}{c} \text{H} & & \text{H} & & \text{H} \\ | & & | & & | \\ \text{H} - \text{C} = \text{C} = \text{C} - \text{C} - \text{H} \end{array}$$

– one C–C triple bond

$$\begin{array}{c} \text{H} & & \text{H} & & \text{H} \\ | & & | & & | \\ \text{H} - \text{C} - \text{C} \equiv \text{C} - \text{C} - \text{C} - \text{H} \\ | & & | & & | \\ \text{H} & & \text{H} & & \text{H} \end{array}$$

51. Shown below are the structural formulae of four carbon compounds.



(a) Two of these compounds are more likely to have similar chemical properties. Identify these two compounds. Give a reason for your answer.

(b) Identify which of these compounds are likely to have the same boiling point. Justify your answer. [CFPQ, CBSE]

Ans. (a) – Q and S because both belong to same family of alcohols.

– They have the same functional group.

(b) – none of them because different compounds differ in physical properties like boiling point.

– They are all different chemical substances.

52. Manasi wrote the names of four compounds as the first members of their respective homologous series.

– Methanol – Methanal

– Methanone – Methanoic acid

(a) Which name has she written incorrectly? Justify your answer.

(b) What name should she have written instead? [CFPQ, CBSE]

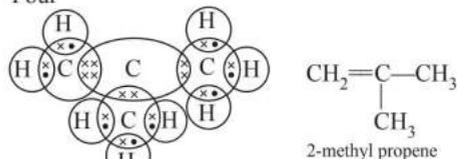
Ans. (a) – Methanone is not possible  
– The smallest ketone has three carbon atoms.

(b) Propanone

53. (a) How many isomers are possible for the compound with the molecular formula  $C_4H_8$ ? Draw the electron dot structure of branched chain isomer.

(b) How will you prove that  $C_4H_8$  and  $C_5H_{10}$  are homologues? [CBSE Sample Question Paper 2022]

Ans. (a) Four

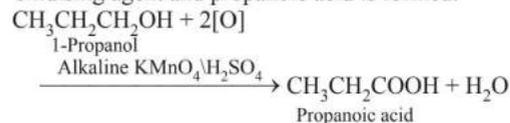


(b)  $C_4H_8$  and  $C_5H_{10}$  are homologues as they differ in

- “ $-\text{CH}_2-$ ”
- differ in 14u molecular mass
- Same functional group
- Same general formula (Any two reasons)

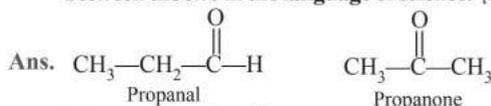
54. What is an oxidising agent? What happens when an oxidising agent is added to propanol? Explain with the help of a chemical equation. [Delhi 2016]

Ans. Those substances which add oxygen are called oxidising agent and propanoic acid is formed.



Propanol will get oxidised to propanoic acid by acidified  $\text{KMnO}_4$ .

55. An aldehyde as well as 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. [AI 2016]



They are functional isomers.

56.  $C_3H_6$ ,  $C_4H_8$  and  $C_5H_{10}$  belong to the same homologous series.

(a) Define homologous series.

(b) Why the melting and boiling points of  $C_5H_{10}$  is higher than  $C_4H_8$ ?

(c) Arrange these hydrocarbons in order of increasing boiling points. [CBSE 2016]

Ans. (a) The series of organic compounds which have similar chemical properties, same functional group is called homologous series.

(b) It is because  $C_5H_{10}$  has higher molecular weight, more Van der Waal's force of attraction and higher boiling points and melting points.

(c)  $C_3H_6 < C_4H_8 < C_5H_{10}$  is increasing order of boiling point.

57. What are covalent compounds? Why are they different from ionic compounds? List their three characteristic properties. [Delhi 2016]

Ans. Those compounds which are formed by sharing of electrons are called covalent compounds. They differ from ionic compounds because they do not have ions. Ionic compounds are formed by transfer of electrons.

**Properties**

- (i) They have low melting and boiling points.
- (ii) They do not conduct electricity in molten state or in aqueous solution.
- (iii) They are mostly insoluble in water but soluble in organic solvents.

58. Complete the following chemical equations:

(a)  $\text{CH}_3\text{COOC}_2\text{H}_5 + \text{NaOH} \longrightarrow$  [CBSE 2020(C)]

(b)  $\text{CH}_3\text{COOH} + \text{NaOH} \xrightarrow{\text{Conc. H}_2\text{SO}_4} \longrightarrow$

(c)  $\text{C}_2\text{H}_5\text{OH} + \text{CH}_3\text{COOH} \xrightarrow{\text{Conc. H}_2\text{SO}_4} \longrightarrow$  [Delhi 2017]

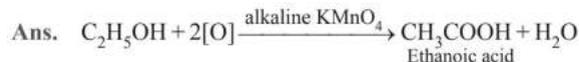
Ans. (a)  $\text{CH}_3\text{COOC}_2\text{H}_5 + \text{NaOH} \longrightarrow \text{CH}_3\text{COONa} + \text{C}_2\text{H}_5\text{OH}$

(b)  $\text{CH}_3\text{COOH} + \text{NaOH} \xrightarrow{\text{Conc. H}_2\text{SO}_4} \text{CH}_3\text{COONa} + \text{H}_2\text{O}$

(c)  $\text{C}_2\text{H}_5\text{OH} + \text{CH}_3\text{COOH} \xrightarrow{\text{Conc. H}_2\text{SO}_4} \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$

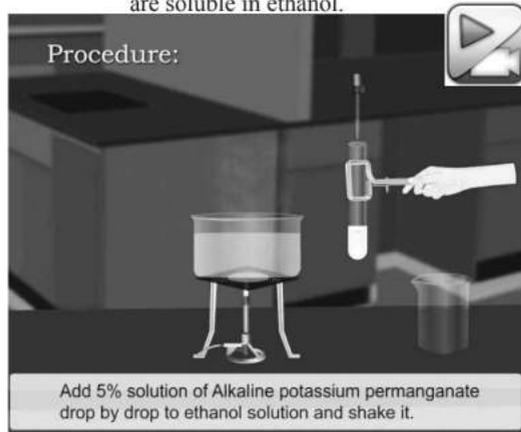
59. Write the chemical equation to explain what happens when ethanol is heated with alkaline solution of potassium permanganate. Mention two physical properties and two uses of ethanol.

[Foreign 2015]



Alkaline  $KMnO_4$  is dark pink in colour. So when it is added to ethanol and heated, the pink colour of the solution disappears. When excess of  $KMnO_4$  is added, the pink colour does not disappear, indicating that all the ethanol has been converted to ethanoic acid.

- Physical properties of ethanol:
  - (a) It is a colourless liquid with pleasant smell and burning taste.
  - (b) It is a volatile liquid with low boiling point.
- Uses of ethanol:
  - (a) It is used in the manufacture of medicines, varnished, paints, dyes, soap, etc.
  - (b) It is a good solvent. Many organic compounds which are insoluble in water are soluble in ethanol.

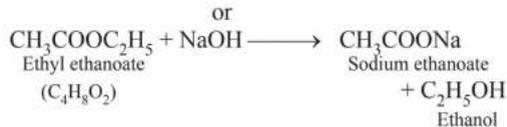
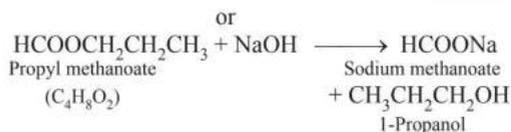
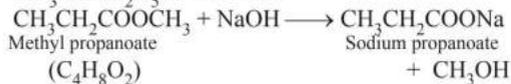


60. An ester has the molecular formula  $C_4H_8O_2$ . Write its structural formula. What happens when this ester is heated in the presence of sodium hydroxide solution? Write the balanced chemical equation for the reaction and name the products. What is a saponification reaction? [HOTS]

Ans. There are three possible structural formulae of esters with molecular formula  $C_4H_8O_2$ .



$CH_3COOC_2H_5$  are isomers.

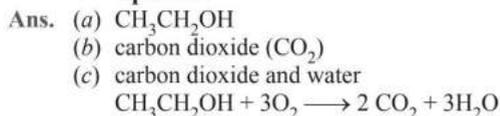


Saponification is the process in which an ester is treated with sodium hydroxide to form sodium salt of acid and alcohol is formed.

61. Study the following information given and answer the questions that follow.

Ethanol is a renewable biofuel because it is made from biomass. Ethanol is a clear, colourless alcohol made from a variety of biomass materials. Ethanol producers mostly use food grains and crops with high starch and sugar content such as corn, sorghum, barley, sugar cane, and sugar beets. The most common ethanol production processes today use yeast to ferment the starch and sugars in corn, sugar cane, and sugar beets.

- (a) What is the chemical formula for ethanol?
- (b) What other compound is obtained as a by-product when ethanol is obtained from a sugar?
- (c) What would be the products formed when ethanol undergoes complete combustion? Support your answer with a balanced chemical equation.



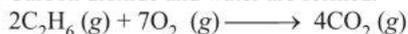
**Long Answer Type Questions 5 Marks**

62. Give reasons for the following:
- (a) Element carbon forms compounds mainly by covalent bonding.
  - (b) Diamond has a high melting point.
  - (c) Graphite is a good conductor of electricity.
  - (d) Acetylene burns with a sooty flame.
  - (e) Kerosene does not decolourise bromine water while cooking oils do.
- Ans. (a) It is because carbon has four valence electrons, it cannot gain or lose four electrons because high energy is needed. It can only share four electrons.  
 (b) It is due to strong covalent bonds and compact structure of diamond.  
 (c) It is due to presence of free electrons in graphite because each carbon is linked to three more carbon atoms.  
 (d) It is due to high percentage of carbon, it burns with sooty or smoky flame.  
 (e) Kerosene oil is mixture of saturated hydrocarbons therefore does not decolourise bromine water.

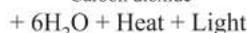
63. (a) Give a chemical test to distinguish between saturated and unsaturated hydrocarbon.  
 (b) Name the products formed when ethane burns in air. Write the balanced chemical equation for the reaction showing the types of energies liberated.  
 (c) Why is reaction between methane and chlorine in the presence of sunlight considered a substitution reaction? [Delhi 2016]

Ans. (a) Add bromine water. Unsaturated hydrocarbon will decolourise bromine water whereas saturated hydrocarbon will not react.

(b) Carbon dioxide and water are formed.



Carbon dioxide



Water



It is because hydrogen atom of methane gets substituted by chlorine atom to form chloromethane, therefore, it is called substitution reaction.

64. List in tabular form three physical and two chemical properties on the basis of which ethanol and ethanoic acid can be differentiated.

Ans. Physical properties:

Ethanol	Ethanoic acid
(i) It has specific smell.	(i) It has vinegar like smell.
(ii) It has burning taste.	(ii) It is sour in taste.
(iii) It does not freeze in winters.	(iii) It freezes in winters.

Chemical properties:

Ethanol	Ethanoic acid
(i) It does not react with $\text{NaHCO}_3$ .	(i) It gives $\text{CO}_2$ with $\text{NaHCO}_3$ .
(ii) It burns with blue flame.	(ii) It does not burn with blue flame.
(iii) It does not affect blue litmus.	(iii) It turns blue litmus red.

65. Shristi heated Ethanol with a compound A in presence of a few drops of concentrated sulphuric acid and observed a sweet smelling compound B is formed. When B is treated with sodium hydroxide it gives back Ethanol and a compound C.

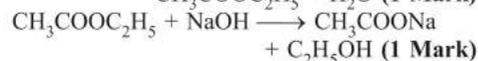
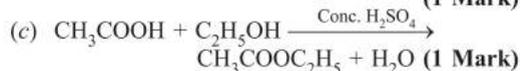
(a) Identify A and C

(b) Give one use each of compounds A and B.

(c) Write the chemical reactions involved and name the reactions. [CBSE Sample Paper 2023]

Ans. (a) A – Ethanoic acid/ Or any other carboxylic acid, C- Sodium salt of ethanoic acid/ any other carboxylic acid/ sodium ethanoate (½ + ½ Mark)

- (b) Use of A- dil solution used as vinegar in cooking/ preservative in pickles (1 Mark)  
 Use of B – making perfumes, flavoring agent (1 Mark)



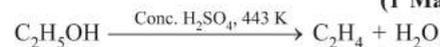
[CBSE Marking Scheme]

66. (a) What is the role of concentrated sulphuric acid when it is heated with ethanol at 443 K? Give the reaction involved.  
 (b) Reshu by mistake forgot to label the two test tubes containing ethanol and ethanoic acid. Suggest an experiment to identify the substances correctly. Illustrate the reactions with the help of chemical equations.

[CBSE Sample Paper 2023]

Ans. (a) Sulphuric acid acts as dehydrating agent.

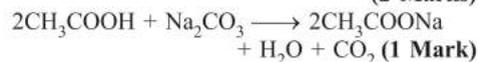
(1 Mark)



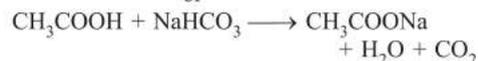
(1 Mark)

- (b) By reaction with sodium carbonate/ bicarbonate with the samples, ethanol will not react whereas ethanoic acid gives brisk effervescence

(2 Marks)



or



[CBSE Marking Scheme]

67. The formulae of four organic compounds are given below:



(a) Which one of these compounds A, B, C or D is a saturated hydrocarbon?

(b) Identify the organic acid and give its structural formula.

(c) Which of the above compounds when heated at 443K in the presence of concentrated  $\text{H}_2\text{SO}_4$  forms ethene as the major product? What is the role played by concentrated  $\text{H}_2\text{SO}_4$  in this reaction? Also write the chemical equation involved.

(d) Give a chemical equation when B and C react with each other in presence of concentrated  $\text{H}_2\text{SO}_4$ . Name the major product formed and mention one of its important use.

[CBSE Sample Paper 2020]

Ans. (a) D is a saturated hydrocarbon (½ Mark)

(b) B is an organic acid. (½ Mark)

Structural formula



11. (a) Draw the structure of butanone molecule,  $\text{CH}_3\text{COC}_2\text{H}_5$ .  
 (b) Draw the structure of the hexanal molecule,  $\text{C}_5\text{H}_{11}\text{CHO}$ .
12. An organic compound burns with blue flame. It is saturated or unsaturated compound. Give reason. [DoE]
13. Explain why carbon generally forms compounds by covalent bonds.
14. Write the name and molecular formula of an organic compound having its name suffixed with '-ol' and having two carbon atoms in the molecule. With the help of a balanced chemical equation indicate what happens when it is heated with excess of conc.  $\text{H}_2\text{SO}_4$ .

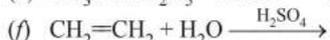
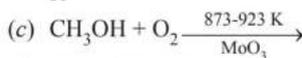
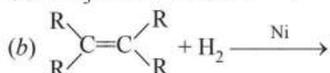
15.	Column I	Column II
	(i) $\text{CH}\equiv\text{CH} + \text{Br}_2 \longrightarrow \begin{array}{c} \text{CHBr}_2 \\   \\ \text{CHBr}_2 \end{array}$	A. Combustion reaction
	(ii) $\text{CH}_3\text{COOH} + \text{NaHCO}_3 \longrightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O} + \text{CO}_2$	B. Test for carboxylic acid
	(iii) $\text{CH}_2=\text{CH}_2 + \text{H}_2\text{O} \xrightarrow{\text{H}_2\text{SO}_4} \text{CH}_3\text{CH}_2\text{OH}$	C. Bromine water test
	(iv) $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \longrightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}$	D. Hydration

16. Write the molecular formula of an alkene and an alkane with twenty carbon atoms.
17. Select alkene and alkyne from the following:  $\text{C}_6\text{H}_{12}$ ,  $\text{C}_3\text{H}_4$ ,  $\text{C}_2\text{H}_4$ ,  $\text{CH}_4$ ,  $\text{C}_4\text{H}_8$ ,  $\text{C}_5\text{H}_8$
18. What is the IUPAC name of  
 (a)  $\text{CH}_3-\text{CH}_2-\text{CH}=\text{CH}_2$   
 (b)  $\text{CH}_3\text{CHO}$
19. Write IUPAC names of  
 (a)  $\text{CH}_3\text{COCH}_2\text{CH}_3$   
 (b)  $\text{CH}_3-\underset{\text{OH}}{\text{CH}}-\text{CH}_3$   
 (c)  $\text{HCOOH}$   
 (d)  $\text{CH}_3\text{COOCH}_3$
20. What is the function of conc.  $\text{H}_2\text{SO}_4$  in the formation of ethene from ethanol?
21. A carbon compound 'A' having melting point 156K and boiling point 351K, with molecular formula  $\text{C}_2\text{H}_6\text{O}$  is soluble in water in all proportions.  
 (a) Identify 'A' and draw its electron dot structure. [CBSE 2023]  
 (b) Give the molecular formulae of any two homologues of 'A'. [CBSE Sample Paper 2022]
22. What happens when hydrogen is added to a vegetable oil in the presence of nickel? Name the reaction and write one difference between the physical property of the vegetable oil and the product obtained in this reaction. Write the role of nickel in this reaction. [CBSE 2018C]
23. (a) Define the term functional group. Identify the functional group present in  
 (i)  $\text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$       (ii)  $\text{H}-\overset{\text{H}}{\underset{\text{H}}{\text{C}}}-\overset{\text{OH}}{\text{C}}=\text{O}$
24. (b) What happens when 5% alkaline  $\text{KMnO}_4$  solution is added drop by drop to warm ethanol taken in a test tube? State the role of alkaline  $\text{KMnO}_4$  solution in this reaction. [Foreign 2016]
24. Two carbon compounds X and Y have the molecular formula  $\text{C}_4\text{H}_8$  and  $\text{C}_5\text{H}_{12}$  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 2017]
25. (a) Why are most carbon compounds poor conductors of electricity?  
 (b) Write the name and structure of a saturated compound in which the carbon atoms are arranged in a ring. Give the number of single bonds present in this compound. [CBSE 2023, 18]
26. Write the molecular formula of the following compounds and draw their electron-dot structures:  
 (a) Ethane      (b) Ethene  
 (c) Ethyne [Foreign 2015, KVS]
27. Write the structural formula of ethanol and list its two physical properties. What happens when it is heated with excess of conc.  $\text{H}_2\text{SO}_4$  at 443 K? State the role of conc.  $\text{H}_2\text{SO}_4$  in this reaction. [DoE, AI 2017, Foreign 2013]
28. An organic compound 'P' is a constituent of wine. 'P' on reacting with acidified  $\text{K}_2\text{Cr}_2\text{O}_7$  forms another compound 'Q'. When a piece of sodium is added to 'Q' a gas 'R' evolves which burns with a pop sound. Identify P, Q and R and write the chemical equations of the reactions involved. [Foreign 2016]
29. Write IUPAC names of  
 (a)  $\text{HC}\equiv\text{CH}$       (b)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$   
 (c)  $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$  [DoE, CBSE 2020]

30. 3 mL of ethanol is taken in a test tube and warmed gently in a water bath. A 5% solution of alkaline potassium permanganate is added first drop by drop to this solution, then in excess. [CBSE 2020]

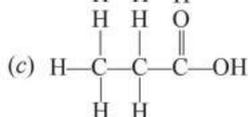
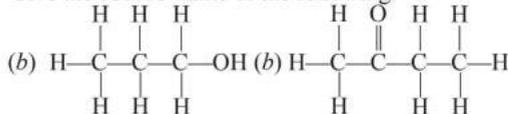
- (a) How is 5% solution of  $\text{KMnO}_4$  prepared?  
 (b) State the role of alkaline potassium permanganate in this reaction. What happens on adding it in excess?  
 (c) Write chemical equation of this reaction.

31. Complete the following reactions:



32. (a) Why do we add ethanol to petrol in these days?  
 (b) Give one use of ethanol in medicines.  
 (c) Why is vinegar used in pickles?

33. Give the IUPAC name of the following:



34. (a) Write two characteristics of homologous series.  
 (b) Name the functional present in the following compounds.  
 (i)  $\text{HCHO}$   
 (ii)  $\text{CH}_3\text{CHO}$   
 (iii)  $\text{CH}_3\text{COOH}$   
 (iv)  $\text{CH}_3\text{OH}$

35. You are provided with an organic compound having the molecular formula,  $\text{C}_2\text{H}_6$ . Give the name and formula of the compound formed when:

- (a) One H atom of  $\text{C}_2\text{H}_6$  is replaced by a OH group.  
 (b) One H atom of  $\text{C}_2\text{H}_6$  is replaced by a CHO group.  
 (c) One H atom of  $\text{C}_2\text{H}_6$  is replaced by a COOH group.

36. An organic compound 'X' on heating with conc.  $\text{H}_2\text{SO}_4$  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

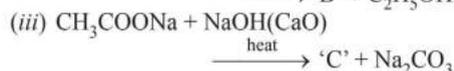
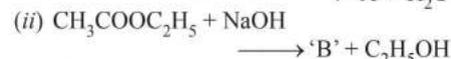
'Z' on combustion forms two molecules of  $\text{CO}_2$  and three molecules of  $\text{H}_2\text{O}$ . Identify giving reasons the compounds 'X', 'Y' and 'Z'. Write the chemical equations for all the chemical reactions involved.

[AI 2013]

37. A compound (A)  $\text{C}_2\text{H}_4\text{O}_2$  reacts with sodium metal to form a compound 'B' and evolves a gas which burns with a 'pop' sound. Compound 'A' on treatment with alcohol 'C' in the presence of acid forms a sweet smelling compound 'D' ( $\text{C}_4\text{H}_8\text{O}_2$ ). On addition of NaOH to D gives back 'B' and 'C'. Identify A, B, C and D and write the reactions involve.

[CBSE 2023, CBSE Sample Paper 2018]

38. (a) Identify the compounds 'A', 'B' and 'C' in the following reactions:

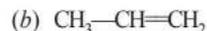
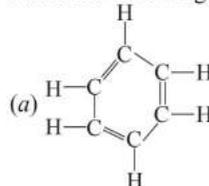


(b) A cyclic compound 'X' has molecular formula  $\text{C}_6\text{H}_6$ . It is unsaturated and burns with sooty flame. Identify 'X' and write its structural formula. Will it decolourise bromine water or not and why? [HOTS]

39. An organic compound with molecular formula  $\text{C}_2\text{H}_4\text{O}_2$  produces brisk effervescence on addition of sodium carbonate /bicarbonate.

- (a) Identify the organic compound.  
 (b) Name the gas evolved.  
 (c) How will you test the gas evolved?  
 (d) Write the chemical equation for the above reaction.  
 (e) List two important uses of the above compound. [KVS]

40. (i) Draw two structural isomers of butane.  
 (ii) Draw the structures of propanol and propanone.  
 (iii) Name the third homologue of (a) alcohols  
 (b) aldehyde  
 (iv) Name the following:



[CBSE 2023]

## TOPICS COVERED

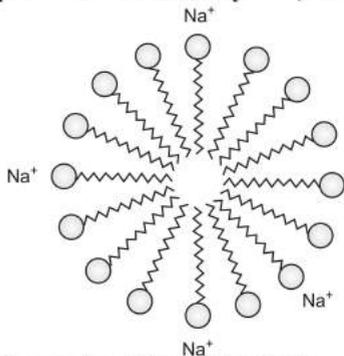
### Soaps and Detergents and their Cleaning Action



**Multiple Choice Questions**

**1 Mark**

- The ionic part of synthetic detergent is
  - $-\text{OSO}_3^- \text{Na}^+$
  - $-\text{COO}^- \text{Na}^+$
  - $-\text{COO}^- \text{H}^+$
  - $-\text{COO}^- \text{CH}_3^+$
- Soaps are sodium or potassium salts of
  - alcohol
  - fatty acids
  - sulphonic acid
  - esters
- Which of the following is correct about detergents?
  - They are 100% biodegradable.
  - They work well with hard water.
  - They do not create pollution.
  - They do not work with hard water.
- A student studies that soap solution results in micelle formation which helps to remove dirt. It has unique orientation which helps in keeping the dirt out of the water as shown in the image. Which helps the dirt to rise again? [CBSE T.E.R.M.\*]



- Suspension of the dirt in micelle.
- A collection of water molecules in the centre of micelles.
- Attraction between ionic part and dirt to remove it.
- Mixing of soap molecules along with dirt so as to make it heavier.

#### Answers

- (a)      2. (b)      3. (b)
- (a) Suspension of the dirt in micelle.



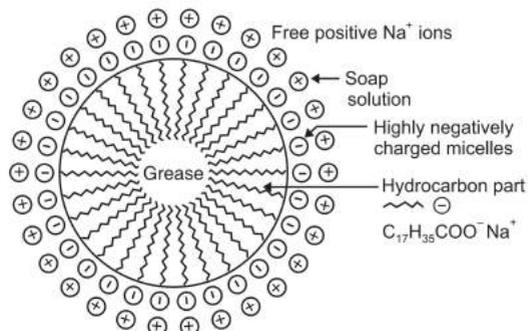
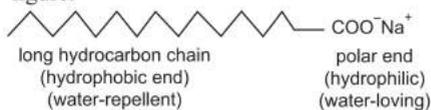
**Long Answer Type Questions 5 Marks**

- Soaps and detergents are both types of salts. State the difference between the two. Write the mechanism of the cleaning 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.

[CBSE 2023; Delhi 2017]

**Ans.** Soaps are sodium or potassium salts of fatty acids having  $-\text{COONa}$  group. Detergents are sodium or potassium salts of sulphonic acids having  $-\text{SO}_3\text{Na}$  and  $-\text{SO}_4\text{Na}$  group.

**Cleaning Action of Soap.** Soaps consist of a large hydrocarbon tail which is hydrophobic (water-hating or water repelling) with a negatively charged head which is hydrophilic (water-loving) as shown in figure.

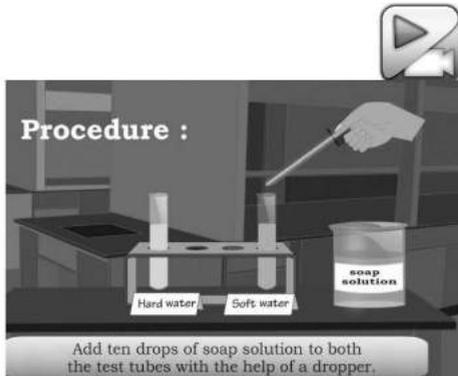


When a soap is dissolved in water, the molecules associate together as clusters called micelles in which, water molecules being polar in nature, surround the ions and the hydrocarbon part of the molecule attracts grease, oil and dirt.

Hard water has  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions that react with soap to form insoluble compound and soap goes waste.

#### Disadvantages of Detergents

- Detergents are expensive.
- Many detergents are branched chain hydrocarbon which are not biodegradable and create water pollution.



6. What are micelles? Why does it form when soap is added to water? Will a micelle be formed in other solvents such as ethanol also? State briefly how the formation of micelles help to clean the clothes having oily spots. [CBSE 2023; Foreign 2016]

**Ans.** Micelles: When molecular ions in soaps and detergents aggregate, they form micelles.

It is because large number of molecular ions of soaps get aggregated and form colloidal solution. Soap has hydrophobic tail (hydrocarbon) which dissolves in hydrocarbon part and hydrophilic part dissolves in water. Ethanol is non-polar solvent therefore micelles are not formed because hydrocarbon part get attracted towards ethanol and ionic end will not dissolve in alcohol.

## PRACTICE QUESTIONS

- With the help of diagram show the formation of micelles, when soap is applied to oily dirt.
  - Take two test tubes 'X' and 'Y' with 10 mL of hard water in each. In test tube 'X' add few drops of soap solution and in test tube 'Y' add a few drops of detergent solution. Shake both the test tubes for the same period.
    - In which test tube the formation of foam will be more? Why?
    - In which test tube curdy solid will be formed? Why? [CBSE 2023]
- What are soaps? Explain the mechanism of cleaning action of soaps with the help of labelled diagram.
  - Detergents are better than soaps. Justify. [CBSE 2023]



## INTEGRATED (MIXED) QUESTIONS

- Write three difference between soaps and detergents.
  - Give two uses of ethanoic acid.
  - Name the products formed when ethanol reacts with sodium metal. (5 Marks)
- What are isomers? Write the structures of two compounds having molecular formula  $C_3H_6O$  and give their names. [CBSE 2023] (5 Marks)
  - What are soaps? How are they chemically different from detergents? Why do soaps do not work effectively in hard water? [CBSE 2023]
- Write chemical equations for the following:
  - Combustion of methane
  - Oxidation of alcohol
  - Hydrogenation of ethene
  - Esterification
  - Saponification reaction. [CBSE 2023] (5 Marks)



## ASSERTION AND REASON QUESTIONS

**Direction:** The questions given below consist of an assertion and the reason. Use the following key to choose the appropriate answer.

- Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion.
- The Assertion and the Reason are correct but the Reason is not the correct explanation of the Assertion.
- Assertion is true but the Reason is false.
- The statement of the Assertion is false but the Reason is true.

1. **Assertion:** Vegetable oils are healthier than animal fats.

**Reason:** Vegetable oils generally have long unsaturated carbon chains while animal fats have saturated carbon chains.

2. **Assertion:** Ammonia is an ionic compound.

**Reason:** Covalent compounds are formed by sharing of electrons. [DoE 2023]

3. **Assertion:** Methane is simplest saturated hydrocarbon which is a major component of natural gas.  
**Reason:** Methane belongs to alkene.
4. **Assertion:** Ethanol is present in alcoholic drinks.  
**Reason:** Ethanol has formula  $\text{CH}_3\text{OH}$ .
5. **Assertion:** Ethanoic acid reacts with ethyl alcohol in presence of conc  $\text{H}_2\text{SO}_4$  to form ethyl ethanoate.  
**Reason:** Esters are used in ice creams and cold drinks.
6. **Assertion:** Vegetable oils are unsaturated, react with hydrogen in presence of nickel to form vegetable ghee.  
**Reason:** This reaction is saponification.
7. **Assertion:** In a homologous series of alcohols, the formula for the second member is  $\text{C}_2\text{H}_5\text{OH}$  and the third member is  $\text{C}_3\text{H}_7\text{OH}$ .  
**Reason:** The difference between the molecular masses of the two consecutive members of a homologous series is 144. [CBSE 2020]
8. **Assertion:** Soaps are 100% biodegradable but do not work well with hard water.  
**Reason:** Some detergents are not bio-degradable but work well with hard water.
9. **Assertion:** Esterification is a process in which a sweet smelling substance is produced.  
**Reason:** When esters react with sodium hydroxide an alcohol and sodium salt of carboxylic acid are obtained. [CBSE 2020]
10. **Assertion:** Butane exhibits isomerism.  
**Reason:** Butane is a saturated hydrocarbon.
11. **Assertion:** Carbon forms strong and stable covalent bonds.  
**Reason:** Carbon is tetravalent and the Carbon atom is small in size.
12. **Assertion:** Following are the members of a homologous series:  
 $\text{CH}_3\text{OH}$ ,  $\text{CH}_3\text{CH}_2\text{OH}$ ,  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$   
**Reason:** A series of compounds with same functional group but differing by  $-\text{CH}_2-$  in unit is called homologous series. [CBSE 2020]
13. **Assertion:** Ethanoic acid is also known as glacial acetic acid.  
**Reason:** The melting point of pure ethanoic acid is 290 K and hence it often freezes during winters in cold climates. [CBSE 2023, 20]
14. **Assertion:** Carbon has a strong tendency to either lose or gain electrons to attain noble gas configuration.  
**Reason:** Carbon has four valence electrons in outermost shell and has the tendency to share electrons with carbon or other elements. [CBSE 2020]



## CASE-BASED QUESTIONS

1. **Read the given passage and answer the questions based on passage and related studied concepts.**  
Carbon has four valence electrons. It cannot lose or gain four electrons. It can share four electrons easily. It forms large number of covalent compounds due to property of catenation and tetra valency. Carbon has three crystalline allotropes-diamond, graphite and fullerene which differ in physical properties. Alkanes are saturated hydrocarbons, undergo combustion and substitution reactions. Alkenes and alkynes are unsaturated hydrocarbons undergo addition reactions. Ethanol on dehydration with conc.  $\text{H}_2\text{SO}_4$  at 443K gives ethene. Hydrogenation of vegetable oils in presence of nickel forms vegetable ghee. Alcohol react with carboxylic acid in presence of conc.  $\text{H}_2\text{SO}_4$  to form esters, pleasant fruity smelling compounds. Alcohol and carboxylic acids react with Na metal to liberate hydrogen. Acetic acid reacts with  $\text{NaHCO}_3$  and  $\text{Na}_2\text{CO}_3$  to give  $\text{CO}_2$  which turns lime water milky. Esters on heating with NaOH to give sodium salt of acid and alcohol. Soaps are prepared by saponification of fat or oil with NaOH. Detergents are more effective and work well with hard water but some of them are non-biodegradable.
- (a) 'X' on combustion gives yellow sooty flame. 'X' is saturated or unsaturated?  
(b) Which types of fatty acids are good for health?  
(c) Give two properties of covalent compounds.
- Or**
- (c) What happens when propanol reacts with sodium metal?
2. **Read the given passage and answer the questions based on passage and related studied concepts.**  
Alcohols form a homologous series with general formula  $\text{C}_n\text{H}_{2n+1}-\text{OH}$  and hydroxyl ( $-\text{OH}$ ) group as functional group. Alcohols are colourless liquids, boiling points higher than hydrocarbons, soluble in water. Lower alcohols have specific smell and burning taste. Their boiling point increases with increase in molecular weight but solubility in water decrease. Methanol is called wood spirit used as disinfectant. Ethanol is commonly called alcohol and is used in alcoholic drinks. It is good solvent, used in medicines, cough syrups, tonics. Consumption of alcohol leads to loss of muscular and nervous control. Intake of small amount of pure alcohol can be fatal and long term consumption of

alcoholic drinks cause many health problems and ruin family life. Drinking methanol may lead to blindness and even death.

- Write structural formula of 5th member of alcohol homologous series.
- What happens when 1-propanol is heated with conc  $\text{H}_2\text{SO}_4$ ? Write chemical reaction.
- What happens when ethanoic acid reacts with 1-propanol in presence of conc  $\text{H}_2\text{SO}_4$ ? What is name of reaction?

**Or**

- What happens when ethyl ethanoate reacts with  $\text{NaOH}$ ? What is name of the reaction?

3. Hydrocarbons are the organic compounds of carbon and hydrogen, which are obtained from coal, petroleum and natural gas. Hydrocarbons and their derivatives may be saturated, unsaturated, cyclic and aromatic. Due to their large number, in order to correlate and have a systematic study of organic compounds they have been further classified into a number of series or families known as homologous series.

- Out of ethane, ethanol and ethanoic acid, which has lowest boiling point?
- What is formula for cyclohexane?
- What is general formula of ketone? Write formula of ketone with four carbon atoms.

**Or**

- What is general formula of alkyl group? Give formula for *n*-pentyl group.

4. Observe the table of boiling points of alcohols and carboxylic acids. Study this table and answer the questions related to studied concepts.

Compound	Boiling point
1. Methanol	64°C
2. Ethanol	78°C
3. Propanol	97°C
4. Butanol	117°C
5. Methanoic acid	101°C
6. Ethanoic acid	118°C
7. Propanoic acid	141°C
8. Butanoic acid	164°C

- Why do acids have higher boiling points than alcohol?
- Why does ethanol have higher boiling point than  $\text{CH}_3\text{OH}$ ?
- (i) What is vinegar?  
(ii) What is glacial acetic acid?

**Or**

- (i) Which acid is present in Rancid butter?  
(ii) What happens when 5% alkaline  $\text{KMnO}_4$  is added to butanol?

5. Read the given passage and answer the questions based on passage and related studied concepts.

Soaps and detergents are cleansing agents. Soaps are sodium or potassium salts of higher fatty acids. Detergents are sodium or potassium salts of sulphonic acids. Soaps do not work well with hard water where as detergents work well with hard water. Soaps are biodegradable and do not create water pollution. Some detergents create water pollution.

- Write functional group present in detergent.
- Name the useful product obtained in saponification of oil or fat to form soap.
- Give two examples of soaps.

**Or**

- Give two examples of detergents.

6. Read the given passage and answer the questions based on passage and related studied concepts.

The element carbon occurs in different forms in nature with widely varying physical properties. Both diamond and graphite are formed by carbon atoms, the difference lies in the manner in which the carbon atoms are bonded to one another. Diamond is hard whereas graphite is soft and slippery. Graphite is conductor of electricity whereas diamond is not conductor. Fullerenes form another class of carbon in which carbon atoms (C-60) arranged in shape of football.

- What is name given to forms of same element which differ in physical properties? Which form of carbon is purest?
- Why is diamond hard?
- How are diamonds synthesised? Why do they not conduct electricity?

**Or**

- Why is graphite soft and slippery and how valency of carbon satisfied?

7. Read the given passage and answer the questions based on passage and related studied concepts.

Covalent bonds are formed by sharing electrons. Not just carbon, but many other elements form molecules by sharing electrons in this manner. The shared electrons belong to outer shells of both the atoms and lead to both atoms attaining the noble gas configuration. Hydrogen is simplest molecule formed in this manner. Single bond is formed between two hydrogen atoms by sharing one electron each. Double bond is formed by sharing two electrons each. Triple bond is formed by sharing three electrons each. Ammonia, water, methane also have covalent bonds. Covalently bonded molecules are seen to have strong bonds within the molecule but intermolecular forces are small.

- Hydrogen molecule acquires stable electronic configuration of which noble gas after forming covalent bonds?

- (b) Draw the electron dot diagram of nitrogen.  
[CBSE 2023]
- (c) Draw the electron dot diagram of ammonia. Does it conduct electricity? Give reason.

**Or**

- (c) Draw electron dot diagram of water molecule. Which has higher boiling point-H<sub>2</sub>O or NaCl? Give reason.
8. Read the given passage and answer the questions based on passage and related studied concepts.  
Have you ever observed either a coal or a wood fire? If not, the next time you get a chance, take a note of what happens when wood or coal starts to burn. You must have seen above the candle or the LPG in gas stove burns with a flame. However, you will observe that coal or charcoal in an 'angithi' sometimes just glows red and gives out heat without a flame. There are two types of flames, luminous flame and non luminous flame. The colour produced by each element is characteristic property of that

element. Try and heat a copper wire in flame of a gas stove and observe its colour. Some compounds, on combustion give sooty (smoky) flame. Heat common salt in flame and observe the colour of the flame. Coal and petroleum are fossil fuels and create lot of pollution on combustion. Ethanol burns with blue flame and creates less pollution. Hydrogen is best fuel.

- (a) Why do some substances on combustion produce flame, others do not?  
(b) What type of hydrocarbons burn with blue (non-luminous) flame and why?  
(c) Among LPG, ethanol, hydrogen, coal arrange them in increasing order of suitability in order to reduce pollution? Give reason.

**Or**

- (c) Which coloured flame is produced by  
(i) Heating copper wire in flame  
(ii) Sodium chloride in flame  
Why do elements produce specific colour flame?



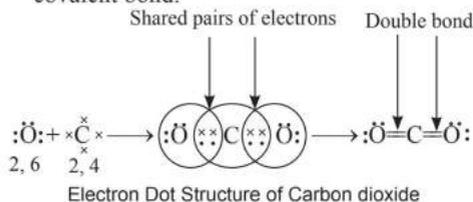
## NCERT ZONE

### NCERT INTEXT QUESTIONS

Page 61

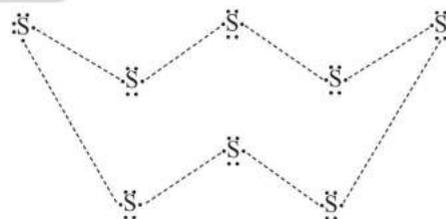
1. What would be the electron dot structure of carbon dioxide which has the formula CO<sub>2</sub>?

Ans. A molecule of CO<sub>2</sub> consists of one atom of carbon and two atoms of oxygen. The electronic configuration of carbon is 2,4 while that of oxygen is 2, 6. Each of the two atoms of oxygen shares two electrons with carbon atom to complete the octet of both the elements, thereby forming a double covalent bond.



2. What would be the electron dot structure of a molecule of sulphur which is made up of eight atoms of sulphur? [Hint: The eight atoms of sulphur are joined together in the form of a ring.]

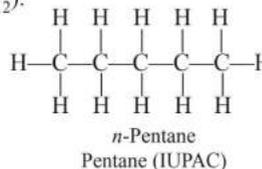
Ans. In S<sub>8</sub>, the atoms are joined together in the form of a ring.

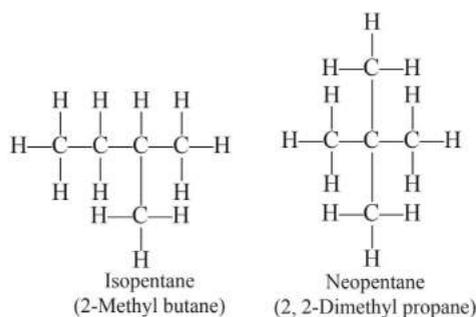


Page 68

1. How many structural isomers can you draw for pentane?

Ans. We can draw three structural isomers of pentane (C<sub>5</sub>H<sub>12</sub>).



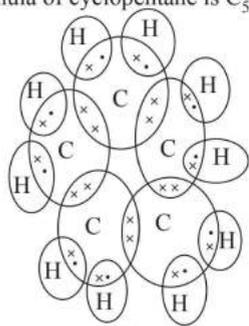


2. What are the two properties of carbon which lead to the huge number of carbon compounds we see around us?

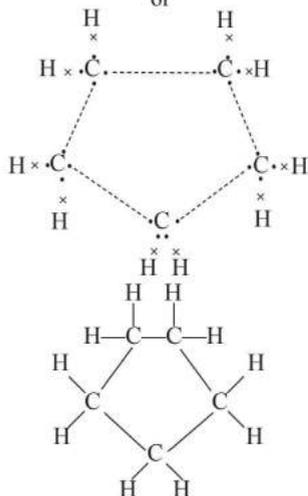
Ans. Catenation and tetravalency.

3. What will be the formula and electron dot structure of cyclopentane?

Ans. The formula of cyclopentane is  $C_5H_{10}$ .



or

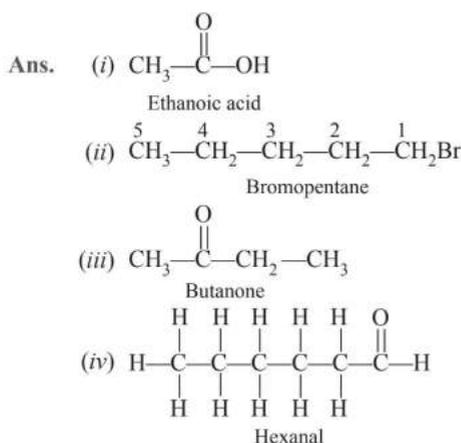


4. Draw the structures for the following compounds:

- (i) Ethanoic acid      (ii) Bromopentane\*  
(iii) Butanone      (iv) Hexanal

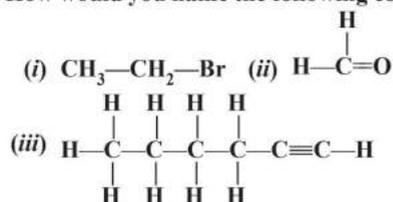
[CBSE 2020 (C)]

\*Are structural isomers possible for bromopentane?



Yes, structural isomers are possible for bromopentane.

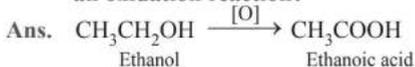
5. How would you name the following compounds?



Ans. (i) Bromoethane (ii) Methanal (iii) 1-Hexyne

#### Page 71

1. Why is the conversion of ethanol to ethanoic acid an oxidation reaction? [KVS]



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

2. A mixture of oxygen and ethyne is burnt for welding. Can you tell why a mixture of ethyne and air is not used?

Ans.  $2HC\equiv CH + 5O_2 \longrightarrow 4CO_2 + 2H_2O + \text{Heat}$   
When ethyne is burnt in air, it gives a sooty flame due to incomplete combustion caused by limited supply of oxygen (in air). However, if ethyne is burnt with oxygen (at 3000 °C), it gives a clean flame 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.

#### Page 74

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

Ans. We can distinguish between an alcohol and a carboxylic acid on the basis of their reaction with carbonates and hydrogen carbonates. Carboxylic acid reacts with carbonate and hydrogen carbonate

to evolve carbon dioxide gas which turns lime water milky. On the other hand, alcohols do not react with carbonates and hydrogen carbonates.

Metal carbonate/Metal hydrogen carbonate + Carboxylic acid  $\longrightarrow$  Salt + Water + Carbon dioxide

**2. What are oxidising agents? Give an example.**

[DoE]

**Ans.** Those substances which give oxygen or replace hydrogen on reaction with other compounds are known as oxidising agents. For example, potassium permanganate ( $\text{KMnO}_4$ ).

**Page 76**

**1. Would you be able to check if water is hard by using a detergent?**

[CBSE 2020 (C)]

**Ans.** No. Detergents are sodium or potassium salts of sulphonic acids of hydrocarbons of alkene type. Unlike soap, they do not react with calcium and magnesium ions present in hard water to form scum. They give a good amount of lather with both soft water and hard water. Hence, it cannot be used to check whether the water is hard or not.

**2. People use a variety of methods to wash clothes. Usually after adding the soap, they 'beat' the clothes on a stone, or beat it with a paddle, scrub with a brush or the mixture is agitated in a washing machine. Why is agitation necessary to get clean clothes?**

**Ans.** A soap molecule has two parts namely hydrophobic and hydrophilic. With the help of these, it attaches to the grease or dirt particles and forms a cluster called micelle. These micelles remain suspended in solution as a colloid.

When water is agitated, the oily dirt tends to lift off from the dirty surface and dissociates into fragments. This gives an opportunity to other tails to stick to oil. This results in the formation of an emulsion in water. This emulsion now contains small globules of oil surrounded by soap or detergent molecules. The negatively charged heads present in water prevent the small globules from coming together and form clusters. Thus, the oily dirt is removed from the object.

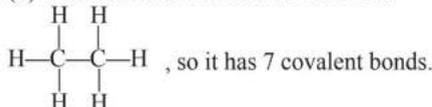
**NCERT EXERCISES**

**1. Ethane, with the molecular formula  $\text{C}_2\text{H}_6$  has**

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

[AI 2015]

**Ans.** (b) The structural formula for ethane is



**2. Butanone is a four-carbon compound with the functional group**

- (a) carboxylic acid.      (b) aldehyde.  
(c) ketone.      (d) alcohol.

**Ans.** (c) Butanone has ketone functional group.

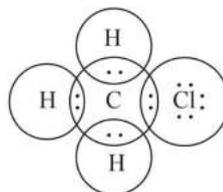
**3. While cooking, if the bottom of the vessel is getting blackened on the outside, it means that**

- (a) the food is not cooked completely.  
(b) the fuel is not burning completely.  
(c) the fuel is wet.  
(d) the fuel is burning completely.

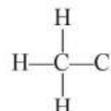
**Ans.** (b) This means that the fuel is not burning completely and unburnt carbon particles get deposited on the bottom of the vessel, making it black.

**4. Explain the nature of the covalent bond using the bond formation in  $\text{CH}_3\text{Cl}$ .**

**Ans.** Carbon has four valence electrons. It shares one electron with chlorine and one electron each with three hydrogen atoms.



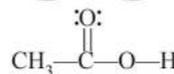
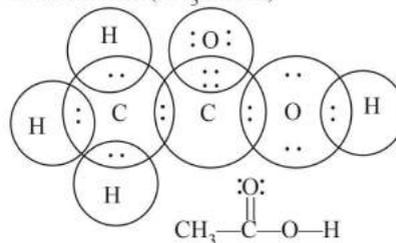
Electron dot structure for Chloromethane ( $\text{CH}_3\text{Cl}$ )



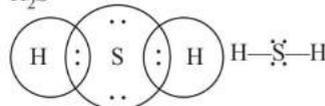
Structural formula for Chloromethane

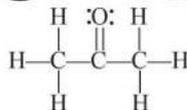
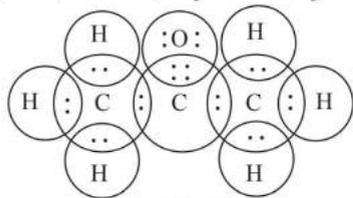
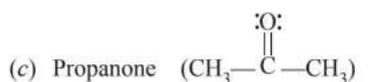
**5. Draw the electron dot structures for**  
(a) ethanoic acid.      (b)  $\text{H}_2\text{S}$ .  
(c) propanone.      (d)  $\text{F}_2$ .

**Ans.** (a) Ethanoic acid ( $\text{CH}_3\text{COOH}$ )



(b)  $\text{H}_2\text{S}$





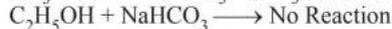
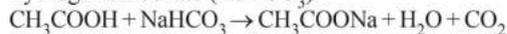
6. What is homologous series? Explain with an example. [CBSE 2023, 20]

Ans. It is a series of organic compounds having same general formula, same functional group, same general methods of preparation, similar chemical properties and gradation in physical properties, e.g. The general formula for the homologous series of alkanes is  $\text{C}_n\text{H}_{2n+2}$ .  $\text{CH}_4$  (Methane),  $\text{C}_2\text{H}_6$  (Ethane),  $\text{C}_3\text{H}_8$  (Propane) and  $\text{C}_4\text{H}_{10}$  (Butane). Every homologous series have general formula. In alkane single bond is functional group, in alkene double bond and in alkyne triple bond.

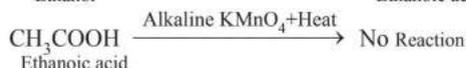
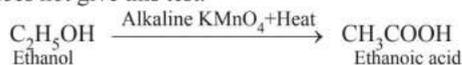
7. How can ethanol and ethanoic acid be differentiated on the basis of their physical and chemical properties?

Ans. **Difference on the physical basis:** Ethanol has pleasant smell, whereas ethanoic acid has vinegar-like smell.

**Difference on the chemical basis:** Ethanol does not react with sodium hydrogen carbonate, whereas ethanoic acid liberates  $\text{CO}_2$  on treatment with sodium hydrogen carbonate ( $\text{NaHCO}_3$ ).



When a few drops of alkaline  $\text{KMnO}_4$  are added to alcohol and the resultant mixture is heated, the pink colour of alkaline  $\text{KMnO}_4$  disappears. Ethanoic acid does not give this test.



8. Why does micelle formation take place when soap is added to water? Will a micelle be formed in other solvents such as ethanol also? [Foreign 2016]

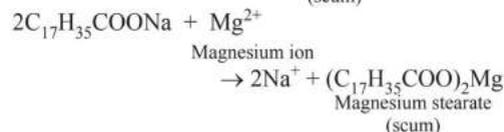
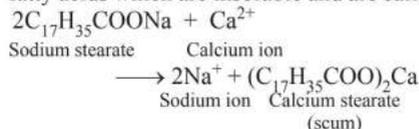
Ans. A soap molecule has both a hydrophilic and a hydrophobic end. The hydrophilic end is soluble in water, whereas the hydrophobic end is insoluble in water. When soap is added in water, the hydrophilic part gets dissolved in water but hydrocarbon tail being hydrophobic part forms clusters called micelles. As soap is soluble in ethanol, micelle formation will not take place in it.

9. Why are carbon and its compounds used as fuels for most applications?

Ans. During the process of combustion of carbon and its compounds, a large amount of heat and light is released. Because of this carbon and its compounds are used as fuels.

10. Explain the formation of scum when hard water is treated with soap.

Ans. Soaps are sodium or potassium salts of fatty acids. Hard water contains  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions, which react with soap to form calcium and magnesium salts of fatty acids which are insoluble and are called scum.



11. What change will you observe if you test soap with litmus paper (red and blue)?

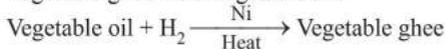
Ans. As soap solution is basic in nature, it will turn red litmus paper into blue but it will not affect blue litmus paper.

12. What is hydrogenation? What is its industrial application? [CBSE 2023]

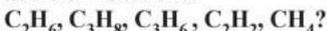
Ans. **Hydrogenation** is a process in which a substance reacts with hydrogen in the presence of nickel or palladium as catalyst.

**Industrial application:**

The process of hydrogenation is used to prepare vegetable ghee from vegetable oil.



13. Which of the following hydrocarbons undergo addition reactions:



Ans.  $\text{C}_3\text{H}_6$  and  $\text{C}_2\text{H}_2$  are unsaturated hydrocarbons, therefore, they will undergo addition reactions.

14. Give a test that can be used to differentiate between saturated and unsaturated hydrocarbons.

Ans. Add bromine water to each of them. Cooking oil will decolourise bromine water showing that it is unsaturated, whereas butter will not decolourise bromine water showing that it is saturated.

15. Explain the mechanism of the cleaning action of soaps. [CBSE 2023]

Ans. A soap molecule has hydrophobic and hydrophilic ends. In water, hydrophobic ends of soap, which consists of hydrocarbon chains, cluster together to form micelles. The oily dirt collects in the centre

of micelle. These micelles stay in solution as a colloid and will not come together to form precipitate because of ion-ion repulsion. Thus the dirt suspended in the micelles can be easily rinsed away and hence, soaps are effective in cleaning.

### SELECT NCERT EXEMPLAR PROBLEMS

1. Carbon exists in the atmosphere in the form of

- (a) carbon monoxide only
- (b) carbon monoxide in traces and carbon dioxide
- (c) carbon dioxide only
- (d) coal

[KVS 2023]

Ans. (c)

2. Which of the following statements are usually correct for carbon compounds? These

- (i) are good conductors of electricity
- (ii) are poor conductors of electricity
- (iii) have strong forces of attraction between their molecules
- (iv) do not have strong forces of attraction between their molecules

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

[KVS 2023]

Ans. (d)

3. A molecule of ammonia (NH<sub>3</sub>) has

- (a) only single bonds
- (b) only double bonds
- (c) only triple bonds
- (d) two double bonds and one single bond

Ans. (a)  $\begin{array}{c} \text{H} \\ | \\ \text{H}-\text{N}-\text{H} \end{array}$

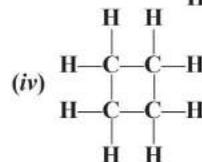
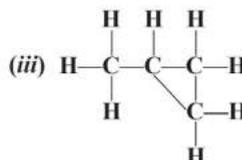
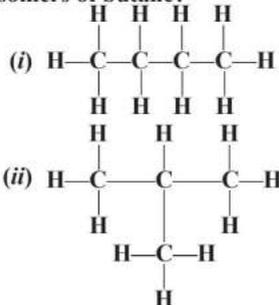
4. Buckminsterfullerene is an allotropic form of

- (a) phosphorus
- (b) sulphur
- (c) carbon
- (d) tin

[KVS 2023]

Ans. (c)

5. Which of the following are correct structural isomers of butane?



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

[KVS 2023]

Ans. (c)

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

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

[KVS 2023]

Ans. (a)

7. Which of the following is the correct representation of electron dot structure of nitrogen?

- (a)  $\cdot\dot{\text{N}}:\dot{\text{N}}:$
- (b)  $\cdot\dot{\text{N}}::\dot{\text{N}}:$
- (c)  $\cdot\dot{\text{N}}:\dot{\text{N}}:$
- (d)  $\cdot\text{N} \text{ N}:$

Ans. (d)  $\cdot\text{N}\equiv\text{N}:$

8. Structural formula of ethyne is

- (a)  $\text{H}-\text{C}\equiv\text{C}-\text{H}$
- (b)  $\text{H}_3\text{C}-\text{C}\equiv\text{C}-\text{H}$
- (c)  $\begin{array}{ccc} \text{H} & & \text{H} \\ & \diagdown & / \\ \text{H}-\text{C} & - & \text{C}-\text{H} \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array}$
- (d)  $\begin{array}{ccc} \text{H} & & \text{H} \\ & \diagdown & / \\ \text{H}-\text{C} & - & \text{C}-\text{H} \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array}$

Ans. (a)

9. Chlorine reacts with saturated hydrocarbons at room temperature in the

- (a) absence of sunlight
- (b) presence of sunlight
- (c) presence of water
- (d) presence of hydrochloric acid

Ans. (b)  $\text{CH}_4(\text{g}) + \text{Cl}_2(\text{g}) \xrightarrow{\text{Sun light}} \text{CH}_3\text{Cl} + \text{HCl}$

10. Pentane has the molecular formula  $C_5H_{12}$ . It has

- (a) 5 covalent bonds
- (b) 12 covalent bonds
- (c) 16 covalent bonds
- (d) 17 covalent bonds

[KVS 2023]

Ans. (c)

11. Ethanol reacts with sodium and forms two products. These are

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

[CBSE 2023; KVS 2023]

Ans. (c)  $2CH_3CH_2OH + 2Na \longrightarrow 2CH_3CH_2ONa + H_2$

12. Vinegar is a solution of

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

Ans. (c)

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

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

Ans. (b)

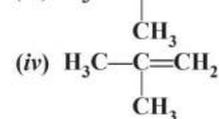
14. The correct electron dot structure of a water molecule is

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

Ans. (c)

15. Which among the following are unsaturated hydrocarbons?

- (i)  $H_3C-CH_2-CH_2-CH_3$
- (ii)  $H_3C-C \equiv C-CH_3$
- (iii)  $H_3C-CH-CH_3$



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

Ans. (c)

16. Which of the following does not belong to the same homologous series?

- (a)  $CH_4$
- (b)  $C_2H_6$
- (c)  $C_3H_8$
- (d)  $C_4H_8$

Ans. (d)

17. The heteroatoms present in  $CH_3-CH_2-O-CH_2-CH_2Cl$  are

- (i) oxygen
- (ii) carbon
- (iii) hydrogen
- (iv) chlorine

(a) (i) and (ii)

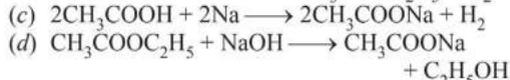
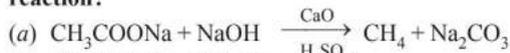
(b) (ii) and (iii)

(c) (iii) and (iv)

(d) (i) and (iv)

Ans. (d)

18. Which of the following represents saponification reaction?



Ans. (d)

19. In which of the following compounds, —OH is the functional group?

(a) Butanone

(b) Butanol

(c) Butanoic acid

(d) Butanal

[KVS 2023]

Ans. (b)  $CH_3CH_2CH_2CH_2OH$  has —OH as functional group.

20. The soap molecule has a

- (a) hydrophilic head and a hydrophobic tail
- (b) hydrophobic head and a hydrophilic tail
- (c) hydrophobic head and a hydrophobic tail
- (d) hydrophilic head and a hydrophilic tail

[DoE Pre-Board 2023]

Ans. (a) —COONa head, hydrophilic, hydrocarbon is hydrophobic tail.

21. Identify the unsaturated compounds from the following

(i) Propane

(ii) Propene

(iii) Propyne

(iv) Chloropropane

(a) (i) and (ii)

(b) (ii) and (iv)

(c) (iii) and (iv)

(d) (ii) and (iii)

[KVS 2023]

Ans. (d) Propene,  $CH_3-CH=CH_2$  and propyne  $HC \equiv C-CH_3$  are unsaturated.

22. In the soap micelles

- (a) the ionic end of soap is on the surface of the cluster while the carbon chain is in the interior of the cluster.
- (b) ionic end of soap is in the interior of the cluster and the carbon chain is out of the cluster.
- (c) both ionic end and carbon chain are in the interior of the cluster.
- (d) both ionic end and carbon chain are on the exterior of the cluster.

Ans. (a) Ionic end of soap is hydrophilic (water loving) whereas carbon chain of soap is hydrophobic (water hating) but attracts oil, dirt and grease.

23. Mineral acids are stronger acids than carboxylic acids because

- (i) mineral acids are completely ionised
- (ii) carboxylic acids are completely ionised
- (iii) mineral acids are partially ionised
- (iv) carboxylic acids are partially ionised





- Ans. (a) Ketone (b) Carboxylic acid  
(c) Aldehyde (d) Alcohol

31. Intake of small quantity of methanol can be lethal. Comment.

- Ans. Methanol is oxidised to methanal in liver. Methanal is highly reactive and good reducing agent. It causes protoplasm to coagulate. It also affects optic nerve and leads to blindness.

32. Carbon, Group (14) element in the Periodic Table, is known to form compounds with many elements. Write an example of a compound formed with:

- (a) chlorine (Group 17 of Periodic Table)  
(b) oxygen (Group 16 of Periodic Table)

- Ans. (a)  $\text{CCl}_4$  (Carbon tetrachloride)  
(b)  $\text{CO}_2$  (Carbon dioxide)

33. In electron dot structure, the valence shell electrons are represented by crosses or dots.

- (a) The atomic number of chlorine is 17. Write its electronic configuration.  
(b) Draw the electron dot structure of chlorine molecule.

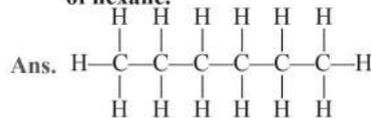
- Ans. (a) Cl(17)  
Electronic configuration: K L M  
2 8 7

36. Match the reactions given in Column (A) with the names given in Column (B).

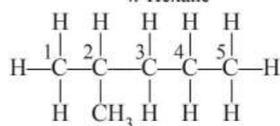
Column (A)	Column (B)
(a) $\text{CH}_3\text{OH} + \text{CH}_3\text{COOH} \xrightarrow{\text{H}^+} \text{CH}_3\text{COOCH}_3 + \text{H}_2\text{O}$	(i) Addition reaction
(b) $\text{CH}_2=\text{CH}_2 + \text{H}_2 \xrightarrow{\text{Ni}} \text{CH}_3-\text{CH}_3$	(ii) Substitution reaction
(c) $\text{CH}_4 + \text{Cl}_2 \xrightarrow{\text{Sunlight}} \text{CH}_3\text{Cl} + \text{HCl}$	(iii) Neutralisation reaction
(d) $\text{CH}_3\text{COOH} + \text{NaOH} \longrightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O}$	(iv) Esterification reaction

- Ans. (a) – (iv) Esterification reaction because ester is being formed from carboxylic acid and alcohol.  
(b) – (i) Addition reaction as hydrogen is being added.  
(c) – (ii) Substitution reaction because hydrogen of methane is being substituted by chlorine atom.  
(d) – (iii) Neutralisation reaction because acetic acid reacts with sodium hydroxide to form salt and water.

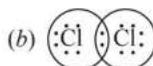
37. Write the structural formulae of all the isomers of hexane.



*n*-Hexane



2-Methylpentane



[CBSE 2023]

34. Catenation is the ability of an atom to form bonds with other atoms of the same element. It is exhibited by both carbon and silicon. Compare the ability of catenation of the two elements. Give reasons.

- Ans. Carbon shows catenation to large extent as compared to silicon as well as any other element due to smaller size of carbon. C—C bond is stronger than Si—Si bond because Si is larger in size, so, it forms weaker bond.

35. Unsaturated hydrocarbons contain multiple bonds between the two C-atoms and show addition reactions. Give the test to distinguish ethane from ethene.

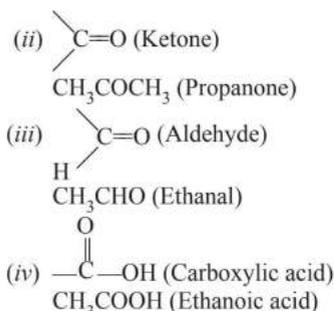
- Ans. Add bromine water. Ethane will not react. Ethene will decolourise bromine water.

*Alternative Method:*

**Combustion test:**

Ethane, a saturated hydrocarbon, will burn with blue flame which is non-smoky, whereas ethene, an unsaturated hydrocarbon, will burn with yellow flame which is smoky due to the presence of unburnt carbon particles.



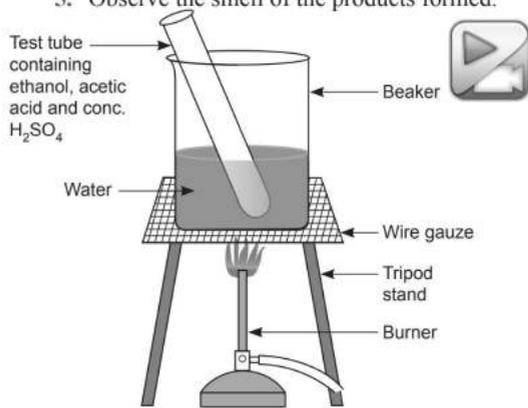


41. Esters are sweet smelling substances and are used in making perfumes. Suggest one activity and the reaction involved for the preparation of ester with well labelled diagram.

Ans. Aim : To demonstrate the preparation of ester.  
Materials Required : Beaker, water, test tube, ethanol, acetic acid, conc.  $\text{H}_2\text{SO}_4$ , tripod stand, burner, wire gauze, etc.

Method :

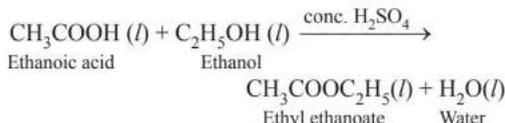
1. Take 2 ml of ethanol in a test tube.
2. Add 2 ml of ethanoic acid (acetic acid) into it.
3. Add few drops of conc.  $\text{H}_2\text{SO}_4$ .
4. Warm it in a beaker containing water.
5. Observe the smell of the products formed.



Formation of ester (ethyl acetate)

Observations : Pleasant fruity smelling compound (called ester) is formed.

Chemical Reaction Involved :

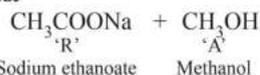
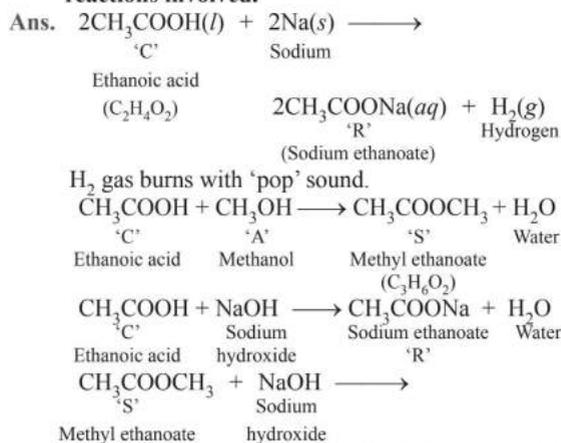


Conclusion : Carboxylic acid reacts with alcohol in presence of conc.  $\text{H}_2\text{SO}_4$ , which acts as a dehydrating agent to form esters.

42. A compound 'C' (molecular formula,  $\text{C}_2\text{H}_4\text{O}_2$ ) reacts with Na metal to form a compound 'R' and evolves a gas which burns with a pop sound.

Compound 'C' on treatment with an alcohol 'A' in presence of an acid forms a sweet smelling compound 'S' (molecular formula  $\text{C}_3\text{H}_6\text{O}_2$ ). On addition of NaOH to 'C', it also gives 'R' and water. 'S' on treatment with NaOH solution gives back 'R' and 'A'.

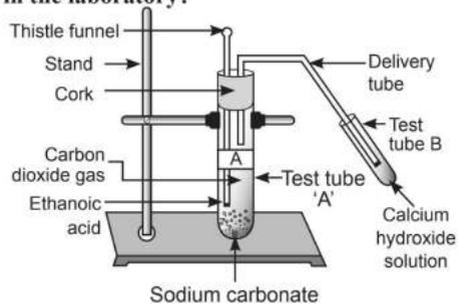
Identify 'C', 'R', 'A', 'S' and write down the reactions involved.



'C' is ethanoic acid, 'R' is sodium ethanoate, 'A' is methanol and 'S' is methyl ethanoate.

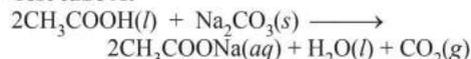
43. Look at figure and answer the following questions:

- (a) What change would you observe in the calcium hydroxide solution taken in tube 'B'?
- (b) Write the reaction involved in test tubes 'A' and 'B' respectively.
- (c) If ethanol is given instead of ethanoic acid, would you expect the same change?
- (d) How can a solution of lime water be prepared in the laboratory?

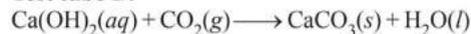


Ans. (a) Lime water will turn milky.

(b) Test tube A:



Test tube B:



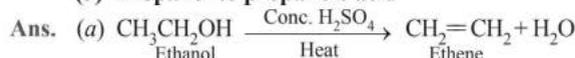
(c) Ethanol will not react with  $\text{Na}_2\text{CO}_3$  and  $\text{CO}_2$  gas will not be formed.

(d) Add  $\text{Ca}(\text{OH})_2$  in water, shake it well. Filter the solution. The filtrate is lime water.

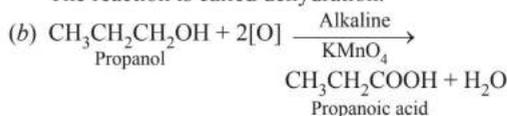
44. How would you bring about the following conversions? Name the process and write the reaction involved.

(a) Ethanol to ethene

(b) Propanol to propanoic acid



The reaction is called dehydration.

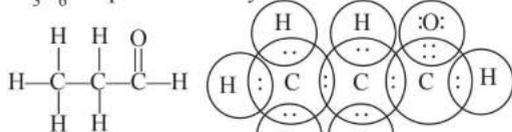


The reaction is called oxidation.

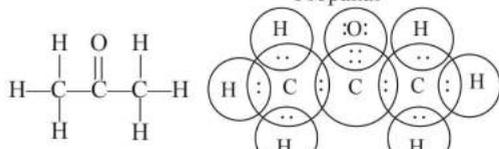
45. Draw the possible isomers of compound with molecular formula  $\text{C}_3\text{H}_6\text{O}$  and also give their electron dot structures.

[CBSE 2023, CBSE Sample Paper 2018]

Ans.  $\text{C}_3\text{H}_6\text{O}$  represents aldehyde as well as ketone.



Propanal



Propanone

46. Explain the given reactions with the examples

(a) Hydrogenation reaction [CBSE 2023]

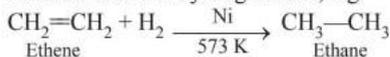
(b) Oxidation reaction

(c) Substitution reaction

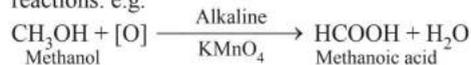
(d) Saponification reaction [CBSE 2023]

(e) Combustion reaction [CBSE 2023]

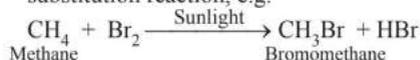
Ans. (a) **Hydrogenation reaction:** When hydrogen is added to unsaturated hydrocarbons having double or triple bond in presence of Ni as catalyst, the reaction is called hydrogenation, e.g.



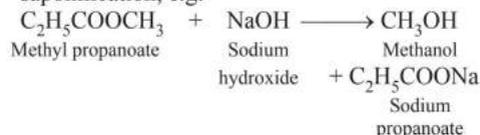
(b) Those reactions in which oxygen is added or hydrogen is removed are called oxidation reactions. e.g.



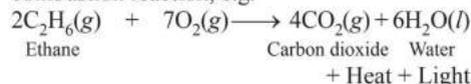
(c) **Substitution reaction:** The reaction in which one or more atoms of compound is replaced by another atom or group of atoms, it is called substitution reaction, e.g.



(d) **Saponification reaction:** When an ester reacts with sodium hydroxide to form sodium salt of carboxylic acid and alcohol, it is called saponification, e.g.



(e) **Combustion reaction:** When an organic compound burns in presence of air to form  $\text{CO}_2$  and  $\text{H}_2\text{O}$  along with heat and light is called combustion reaction, e.g.

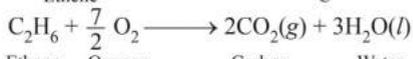
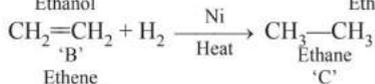
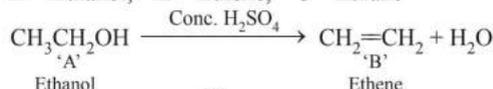


47. An organic compound 'A' on heating with conc.  $\text{H}_2\text{SO}_4$  forms a compound B, which on addition with 1 mole of hydrogen in presence of Ni forms a compound 'C'. One mole of compound 'C' on combustion forms two moles of  $\text{CO}_2$  and 3 moles of  $\text{H}_2\text{O}$ . Identify the compounds A, B and C and write the chemical equation of the reactions involved.

[HOTS]

Ans. The compounds are as follows:

A—Ethanol, B—Ethene, C—Ethane



[CBSE 2023]