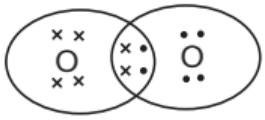
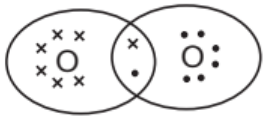
Carbon and its Compound

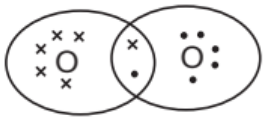
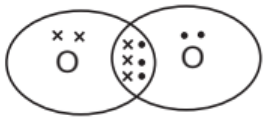
Previous Years' CBSE Board Questions

4.1 Bonding in Carbon - The Covalent Bond

MCQ

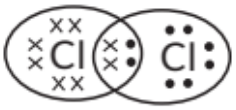
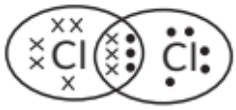
1. The correct representation of covalent bonding in an oxygen molecule is

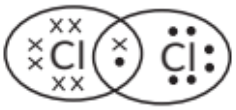
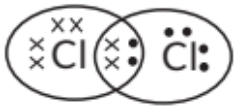
(a)  (b) 

(c)  (d) 

(2023) U

2. The electron dot structure of chlorine molecule is

(a)  (b) 

(c)  (d) 

(2023)

3. Assertion (A): Carbon has a strong tendency to either lose or gain electrons to attain noble gas configuration.
Reason (R) Carbon has four electrons in its outermost shell and has the tendency to share electrons with carbon or other elements.
(a) Both (A) and (R) are true and (R) is the correct explanation of the assertion (A).
(b) Both (A) and (R) are true, but (R) is not the correct explanation of the assertion (A).
(c) (A) is true, but (R) is false.
(d) (A) is false, but (R) is true. (2020)

VSA (1 mark)

4. Covalent compounds have low melting and boiling (Term II, 2021-22, 2020) points. Why? Write the name of an allotrope of carbon. (2021C)

6. How are covalent bonds formed? (2020)

7. Covalent compounds are generally poor conductors of electricity. Why? (2020)

8. Draw the electron dot structure of the following: (Term II, 2021-22)

(a) Cyclohexane
(b) Butane

9. "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. (Term II, 2021-22)

10. Draw the electron dot structure of the molecules of (a) Oxygen, and (b) Nitrogen. The atomic numbers of oxygen and nitrogen are 8 and 7 respectively. (Term II, 2021-22 C)

11. Carbon forms compounds mainly by covalent bonding. Why? (Term II, 2021-22 C)

12. Write the molecular formula of ethene and draw its electron dot structure. (2019)

SA II (3 marks)

13. State the reason why
(i) carbon compounds have low melting and boiling points.
(ii) carbon compounds do not conduct electricity.
(iii) carbon can form only covalent compounds. (Term II, 2021-22)

14. (a) Draw the electron dot structure for ethyne.
(b) List two differences between the properties exhibited by covalent compounds and ionic compounds. (Term II, 2021-22) (Cr)

15. What are covalent compounds? Why are they different from ionic compounds? List their three characteristic properties. (Delhi 2016)

LA (5 marks)

16. Elements forming ionic compounds attain noble gas electronic configuration by either gaining or losing electrons from their valence shells. Explain giving reason why carbon cannot attain such a configuration in this manner to form its compounds. Name the type of bonds formed in ionic compounds and in the compounds formed by carbon. Also explain with reason why carbon compounds are generally poor conductors of electricity. (Foreign 2015, AI 2014)

17. State the reason why carbon can neither form C4+ cations nor C4 anions, but forms covalent compounds. Also state reasons to explain why covalent compounds:
(i) are bad conductors of electricity?
(ii) have low melting and boiling points? (Delhi 2014)

4.2 Versatile Nature of Carbon

MCQ

18. Assertion (A): Following are the members of a homologous series:
CH_3OH, CH_3CH_2OH, $CH_3CH_2CH_2OH$
Reason (R): A series of compounds with same functional group but differing by $-CH_2$ unit is called homologous series.
(a) Both (A) and (R) are true and (R) is the correct explanation of the assertion (A).
(b) Both (A) and (R) are true, but (R) is not the correct explanation of the assertion (A).
(c) (A) is true, but (R) is false.
(d) (A) is false, but (R) is true. (2020)

VSA (1 mark)

19. Name a cylic unsaturated carbon compound. (2020)

20. Write the molecular formula of first two members of homologous series having functional group -CI. (Delhi 2017)

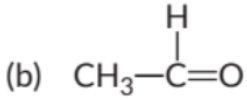
21. Write the molecular formula of first two members of homologous series having functional group —OH. (Delhi 2017)

22. Write the molecular formula of the 2nd and 3rd member of the homologous series whose first member is ethene. (AI 2017)

23. Write the molecular formula of the 2^{nd} and 3_{rd} member of the homologous series whose first member is methane. (AI 2017)

24. Write the next homologue of each of the following: (Delhi 2016)
(i) C_2H_4
(ii) C_4H_6

25. Name the following compounds : (Delhi 2016)
(a) CH_3-CH_2-OH

(b) 

26. Select saturated hydrocarbons from the following:
C_3H_6; $C5H_{10}$; C_4H_{10}; C_6H_{14}; C_2H_4 (Delhi 2016)

27. Write the name and structure of an alcohol with three carbon atoms in its molecule. (Al 2016)

28. Write the name and structure of an alcohol with four carbon atoms in its molecule. (AI 2016)

29. Write the name and structure of an aldehyde with four carbon atoms in its molecule. (AI 2016)

30. Which element exhibits the property of catenation to maximum extent and why? (Foreign 2016)

31. Write the name and molecular formula of the fourth member of alkane series. (Foreign 2016)

32. What is homologous series of carbon compounds? (Foreign 2016)

33. Write the name and formula of the 2nd member of homologous series having general formula C_nH_{2n}- (Delhi 2015) Cr

34. Write the name and formula of the 2nd member of homologous series having general formula C_nH2_{n+2}. (Delhi 2015)

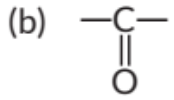
35. Write the name and formula of the 2nd member of homologous series having general formula C_nH_{2n-2}- (Delhi 2015)

36. Write the number of covalent bonds in the molecule of ethane. (AI 2015, Delhi 2014)

37. Write the number of covalent bonds in the molecule of butane, C4H10- (AI 2015)

38. Write the name of each of the following functional

(a) – OH

(b) 

(Foreign 2015)

39. Write the name and molecular formula of the first member of the homologous series of alkynes. (Foreign 2015)

SAI (2 marks)

40. (a) Write the molecular formula of the following carbon compounds :
(i) Methane
(ii) Propane
(b) Carbon compounds have low melting and boiling points. Why? (Term II, 2021-22)

41. Consider the carbon compounds having following molecular formula:
(i) C_3H_6 (ii) C_3H_8 (iii) C_4H_6 (iv) C_6H_6 (v) C_6H_{12}
(a) State the number of double covalent bonds present in C_3H_6.
(b) Write the formula of first member of the homologous series to which the carbon compound C_4H_6 belongs.
(c) Which one of the above compounds forms ring structure of carbon atoms?
(d) Identify, which of the above compounds, is a member of alkane series.
(Term II, 2021-22)

42. The molecular formulae of two alkynes, A and B are CH_2 and C3H, respectively.
(a) Find the values of x and y.
(b) Write the names of A and B. (Term II, 2021-22)

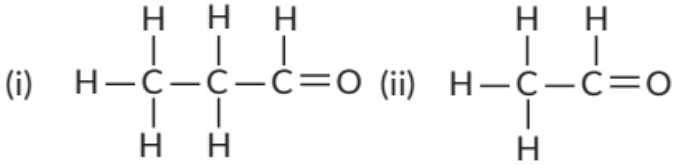
SA II (3 marks)

43. What is a homologous series ? Find the difference in molecular mass between the two consecutive members of a homologous series. State how in a homologous series of carbon compounds the following properties vary with increase in molecular mass:
(i) Melting and boiling points
(ii) Chemical properties (Term II, 2021-22)

44. Draw two different possible structures of a saturated hydrocarbon having four carbon atoms in its molecule. What are these two structures of the hydrocarbon having same molecular formula called? Write the molecular formula and the common name of this compound. Also write the molecular formula of its alkyne.
(Term II, 2021-22)

45. (i) Write the molecular formula of benzene and draw its structure.
(ii) Write the number of single and double covalent bonds present in a molecule of benzene.
(iii) Which compounds are called alkynes? (Term II, 2021-22)

46. Consider the following organic compounds :



(a) Name the functional group present in these compounds.
(b) Write the general formula for the compounds of this functional group.
(c) State the relationship between these compounds and draw the structure of any other compound having similar functional group (Term II, 2021-22)

47. Carbon, a member of group 14, forms a large number of carbon compounds estimated to be about three million. Why is this property not exhibited by other elements of this group? Explain. (2020)

48. What is a homologous series of carbon compounds? Give an example and list its three characteristics. (2019)

49. (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. (2018)

50. An aldehyde as well as a ketone can be represented by the same molecular formula, say C_3H_{60}. Write their structures and name them. State the relation between the two in the language of science. (AI 2016)

51. What is meant by isomers? Draw the structures of two isomers of butane, C_4H_{10}. Explain why we cannot have isomers of first three members of alkane series. (Delhi 2015, Foreign 2014)

OR

Define the term 'structural isomerism'. Explain why propane cannot exhibit this property. Draw the structures of possible isomers of butane, C4H10- (AI 2014)

52. Write the molecular formula of the following compounds and draw their electron-dot structures:
(i) Ethane (ii) Ethene (iii) Ethyne (Foreign 2015)

53. What is meant by functional group in carbon compounds? Write in tabular form the structural formula and the functional group present in the following compounds : (Foreign 2015)
(i) Ethanol
(ii) Ethanoic acid

OR

State the meaning of functional group in a carbon compound. Write the functional group present in (i) ethanol and (ii) ethanoic acid and also draw their structures. (Delhi 2014)

54. Why is homologous series of carbon compounds so called? Write the chemical formula of two consecutive members of any homologous series and state the part of these compounds that determines their (i) physical and (ii) chemical properties. (Foreign 2015, AI 2014)

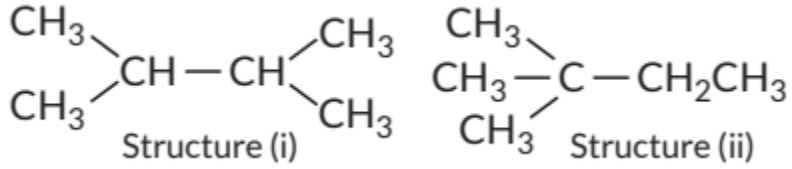
55. State the meaning of the functional group in an organic compound. Write the formula of the functional group present in alcohols, aldehydes, ketones and carboxylic acids. (Delhi 2014)

56. What is meant by homologous series of carbon compounds? Write Write the general formula of
(i) alkenes, and (ii) alkynes. Draw the structures of the first member of each series to show the bonding between the two carbon atoms. (AI 2014)

LA (5 marks)

57. Explain why carbon forms compounds mainly by covalent bonds. Explain in brief two main reasons for carbon forming a large number of compounds. Why does carbon form strong bonds with most other elements? (2023)

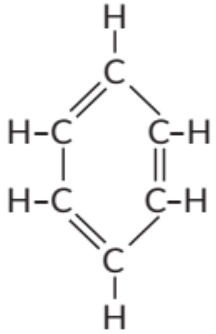
58. (i) Draw the structure of the following compounds :
(a) Butanoic acid (b) Chloropentane
(ii) How are structure (i) and structure (ii) given below related to one another? Give reason to justify your answer.



Draw one more possible structure for above case.
(iii) Differentiate between saturated and unsaturated carbon compounds on the basis of their general formula.

59. (i) Draw two structural isomers of butane. (2023)
(ii) Draw the structures of propanol and propanone.
(iii) Name the third homologue of :
(a) alcohols
(b) aldehydes
(iv) Name the following:

(a)



(b) $CH_3—CH_2CH = CH_2$

(v) Show the covalent bond formation in nitrogen molecule. (2023)

60. (a) State the reason why carbon can neither form C^{4+} cations nor C^{4-} anions, but forms covalent bonds. Also state reasons to explain why covalent compounds
(i) are bad conductors of electricity
(ii) have low melting and boiling points.
(b) Write the structural formula of benzene, C_6H_6. (AI 2019)

61. Explain why carbon forms compounds mainly by covalent bond. Explain in brief two main reasons for carbon forming a large number of compounds. Why does carbon form strong bond with most other elements? (Delhi 2015)

62. What are hydrocarbons? Distinguish alkanes from alkenes and each of them from alkynes, giving one example of each. Draw the structure of each compound cited as example to justify your answer. (Foreign 2014)

4.3 Chemical Properties of Carbon Compounds

VSA (1 mark)

63. Name the process by which unsaturated fats are changed to saturated fats. (Foreign 2015)

64. Write the chemical equation to show what happens when methane is treated with chlorine in the presence of sunlight? (1/3, Foreign 2014)

OR

Write one chemical equation to represent the following type of reaction of organic substances : substitution. (1/3, Foreign 2014)

65. Write the respective chemical reaction to show what happens when methane is burnt in presence of oxygen? (1/3, Foreign 2014)

SAI (2 marks)

66. What happens when 5% alkaline $KMnO_4$ solution is added drop by drop to warm ethanol taken in a test tube? State the role of alkaline $KMnO_4$ solution in this reaction. (2/3, Foreign 2016)

SA II (3 marks)

67. 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.
(i) How is 5% solution of $KMnO_4$ prepared?
(ii) State the role of alkaline potassium permanganate in this reaction. What happens on adding it in excess?
(iii) Write chemical equation of this reaction. (2020)

68. Two carbon compounds X and Y have the molecular formula C_4H_8 and C_5H_{12} respectively. Which one of these is most likely to show addition reaction? Justify your answer. Also give the chemical equation to explain the process of addition reaction in this (Delhi 2017)

OR

The molecular formula of two carbon compounds are C4H8 and C3Hg. Which one of the two is most likely to show addition reaction? Justify your answer. Also give the chemical equation to explain the process of addition reaction in this case. (Delhi 2017)

69. 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)

70. Draw the electron-dot structure for ethyne. A mixture of ethyne and oxygen is burnt for welding. In your opinion, why cannot we use a mixture of ethyne and air for this purpose? (AI 2015)

71. Write the name and general formula of a chain of hydrocarbons in which an addition reaction with hydrogen is possible. State the essential condition for an addition reaction. Stating this condition, write a chemical equation giving the name of the reactant and the product of the reaction. (AI 2015, Delhi 2014)

LA (5 marks)

72. (i) Write the name and general formula of a chain of hydrocarbons in which an addition reaction with hydrogen can take place. Stating the essential condition required for an addition reaction to occur, write the chemical equation giving the name of the reactant and product of such a reaction. How is an addition reaction different from a substitution reaction?
(ii) Write the structure of benzene. (2023)

73. What is methane? Draw its electron dot structure. Name the type of bonds formed in this compound. Why are such compounds
(i) poor conductors of electricity and
(ii) have low melting and boiling points? What happens when this compound burns in oxygen? (Delhi 2019)

74. (a) Draw electron dot structure of methane molecule.
(b) Identify the functional groups present in the following compounds:
(i) C_2H_6O (ii) $C2H_4O$
(c) A mixture of oxygen and ethyne is burnt for welding. Why do you think a mixture of ethyne and air is not used for welding? (2019 C)

75. Why are certain compounds called hydrocarbons? Write the general formula for homologous series of alkanes, alkenes and alkynes and also draw the structure of the first member of each series. Write the name of the reaction that converts alkenes into alkanes and also write a chemical equation to show the necessary conditions for the reaction to occur. (AI 2017)

76. With the help of a suitable example, explain the process of hydrogenation mentioning the conditions of the reaction and any one change in physical property with the formation of the product. (Delhi 2015)

4.4 Some Important Carbon Compounds - Ethanol and Ethanoic acid

MCQ

77. Assertion (A): Esterification is a process in which a sweet smelling substance is produced. Reason (R): When esters react with sodium hydroxide, an alcohol and sodium salt of carboxylic acid are obtained.
(a) Both (A) and (R) are true and (R) is the correct explanation of the assertion (A).
(b) Both (A) and (R) are true, but (R) is not the correct explanation of the assertion (A).
(c) (A) is true, but (R) is false.
(d) (A) is false, but (R) is true. (2020)

78. Assertion (A) : Ethanoic acid is also known as glacial acetic acid.
Reason (R): The melting point of pure ethanoic acid is 290 K and hence it often freezes during winters in cold climates.
(a) Both (A) and (R) are true and (R) is the correct explanation of the

assertion (A).
(b) Both (A) and (R) are true, but (R) is not the correct explanation of the assertion (A).
(c) (A) is true, but (R) is false.
(d) (A) is false, but (R) is true. (2020)

SAI (2 marks)

79. A compound 'X' on heating with excess conc. sulphuric acid at 443 K gives an unsaturated compound 'Y. 'X' also reacts with sodium metal to evolve a colourless gas 'Z. Identify 'X', 'Y' and 'Z. Write the equation of the chemical reaction of formation of 'Y' and also write the role of sulphuric acid in the reaction. (2018)

80. Write the chemical equations to show what happens when
(i) an ester reacts with a base?
(ii) ethanol reacts with ethanoic acid in the presence of sulphuric acid?
(2/3, Foreign 2014)

81. Write the respective chemical equations to show what happens when
(i) ethanol is heated with concentrated sulphuric acid at 443 K ?
(ii) ethanol reacts with ethanoic acid in the presence of an acid acting as a catalyst? (2/3, Foreign 2014) Ap

SA II (3 marks)

82. Complete the following chemical equations:

(i) $CH_3COOC_2H_5 + NaOH \longrightarrow$

(ii) $CH_3COOH + NaOH \longrightarrow$

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

(Delhi 2017)

83. Complete the following chemical equations:

(i) $C_2H_5OH + O_2 \longrightarrow$

(ii) $C_2H_5OH \xrightarrow[443K]{Conc.H_2SO_4}$

(iii) $CH_3COOH + NaHCO_3 \longrightarrow$ *(Delhi 2017)* U

84. Write the structural formula of ethanol. What happens when it is heated with excess of conc. H_2SO_4 at 443 K? Write the chemical equation for the reaction stating the role of conc. H_2SO_4 in this reaction. (AI 2017, Delhi 2015)

85. What happens when (write chemical equation in each case)
(a) ethanol is burnt in air?
(b) ethanol is heated with excess conc. H_2SO_4 at 443 K?
(c) a piece of sodium is dropped into ethanol? (AI 2017)

86. Distinguish between esterification and saponifica- tion reaction with the help of the chemical equations for each. State one use of each (i) esters, and (ii) saponification process. (Al 2017)

87. Explain esterification reaction with the help of a chemical equation. Describe an activity to show esterification. (AI 2017)

88. When ethanol reacts with ethanoic acid in the presence of conc. H_2SO_4, a substance with fruity smell is produced. Answer the following:
(i) State the class of compounds to which the fruity smelling compounds belong. Write the chemical equation for the reaction and write the chemical name of the product formed.
(ii) State the role of conc. H_2SO_4 in this reaction. (Delhi 2016)

89. Name the compound formed when ethanol is heated in excess of conc. sulphuric acid at 443 K. Also write the chemical equation of the reaction stating the role of conc. sulphuric acid in it. What would happen if hydrogen is added to the product of this reaction in the presence of catalyst such as palladium or nickel? (Delhi 2016, Foreign 2015)

90. Write chemical equation of the reaction of ethanoic acid with the following:
(a) Sodium;
(b) Sodium hydroxide;
(c) Ethanol
Write the name of one main product of each reaction. (AI 2016)

91. On dropping a small piece of sodium in a test tube containing carbon compound 'X' with molecular formula C_2H_6O, a brisk effervescence is observed and a gas 'Y' is produced. On bringing a burning splinter at the mouth of the test tube the gas evolved burns with a pop sound. Identify 'X' and 'Y'. Also

write the chemical equation for the reaction. Write the name and structure of the product formed, when you heat 'X' with excess conc. sulphuric acid. (Al 2016)

92. Write three different chemical reactions showing the conversion of ethanoic acid to sodium ethanoate. Write balanced chemical equation in each case. Write the name of the reactants and the products other than ethanoic acid and sodium ethanoate in each case. (AI 2016)

93. Write the name and molecular formula of an organic compound having its name suffixed with 'ol' and having two carbon atoms in its molecule. Write balanced chemical equation to indicate what happens when this compound is heated with excess conc. H_2SO_4 and the name of main product formed. Also state the role of conc. H_2SO_4 in the reaction. (Foreign 2016) An

94. An organic compound 'P' is a constituent of wine. 'P' on reacting with acidified K2Cr2O7 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)

95. List two tests for experimentally distinguishing between an alcohol and a carboxylic acid and describe how these tests are performed. (AI 2015)

96. What are esters? How are they prepared? List two uses of esters. (Delhi 2014)

97. A carboxylic acid (molecular formula $C_2H_4O_2$) reacts with an alcohol in the presence of an acid catalyst to form a compound 'X'. The alcohol on oxidation with alkaline $KMnO_4$ followed by acidification gives the same carboxylic acid $C_2H_4O_2$. Write the name and structure of (i) carboxylic acid, (ii) alcohol and (iii) the compound 'X'. (AI 2014)

98. 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 2014)

99. Write chemical equations to describe two examples of different oxidations of ethanol. List two uses of ethanol. (Foreign 2014)

100. Write the chemical equations to show what happens when
(i) sodium hydroxide is added to ethanoic acid?

(ii) solid sodium hydrogen carbonate is added to ethanoic acid?
(iii) ethanol reacts with sodium? (Foreign 2014)

LA (5 marks)

101. Write the chemical equation for the following:
(i) Combustion of methane
(ii) Oxidation of ethanol
(iii) Hydrogenation of ethene
(iv) Esterification reaction
(v) Saponification reaction (2023)

102. (i) What happens when a small piece of sodium is dropped in ethanol? Write the equation for this reaction.
(ii) Why is glacial acetic called so?
(iii) What happens when ethanol is heated at 443 K in the presence of conc. H_2SO_4? Write the role of conc. H_2SO_4 in this case.
(iv) Write an equation showing saponification. (2023)

103. (a) Define isomerism. Draw all possible isomers of butane.
(b) "A compound 'X' on combustion gives a yellow flame with lots of smoke." What inference would you draw from this statement?
(c) State the role of alkaline $KMnO_4$ in the reaction involving conversion of an alcohol to corresponding carboxylic acid. (2020)

104. (a) What is a homologous series? Explain with an example.
(b) Define the following terms giving one example of each.
(i) Esterification
(ii) Addition reaction (2020)

105. (a) Carry out following conversions :
(i) Ethanol to ethene
(ii) Ethanol to ethanoic acid
(b) Differentiate between addition reaction and substitution reaction. Give one example of each. (2020)

106. Write the chemical formula and name of the compound which is the active ingredient of all alcoholic drinks. List its two uses. Write chemical equation and name of the product formed when this compound reacts with

(i) sodium metal
(ii) hot concentrated sulphuric acid. (Delhi 2019)

107. (a) Define the term isomer.
(b) Two compounds have same molecular formula C_3H_6O. Write the name of these compounds and their structural formula.
(c) How would you bring the following conversions:
(i) Ethanol to ethene
(ii) Propanol to propanoic acid? (AI 2019)

108. A carbon compound 'P' on heating with excess conc. H_2SO_4 forms another carbon compound 'Q' which on addition of hydrogen in the presence of nickel catalyst forms a saturated carbon compound 'R'. One molecule of 'R' on combustion forms two molecules of carbon dioxide and three molecules of water. Identify P, Q and R and write chemical equations for the reactions involved. (AI 2016)

4.5 Soaps and Detergents

MCQ

109. Several factories were pouring their wastes in rivers A and B. Water samples were collected from these two rivers. It was observed that sample collected from river A was acidic while that of river B was basic. The factories located near A and B are
(a) Soaps and detergents factories near A and alcohol distillery near B.
(b) Soaps and detergents factories near B and alcohol distillery near A.
(c) Lead storage battery manufacturing factories near A and soaps and detergents factories near B.
(d) Lead storage battery manufacturing factories near B and soaps and detergents factories near A. (2020)

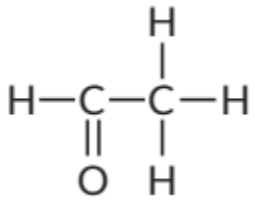
LA (5 marks)

110. (a) A compound 'X' undergoes addition reaction with H2 to form a compound 'Y' having molecular mass 30 g mol^{-1}. 'X' decolorises bromine water and burns with a smoky flame. Identify 'X' and 'Y' and write chemical equations of the reactions involved.
(b) Write the structural formulae of (i) Butanone, and (ii) Pentanoic acid.

(c) Would you be able to check if water is hard by using a detergent ? Give reason to justify your answer. (2020 C)

111. (a) Carry out the following conversions giving complete conditions for the reaction to take place in each case:
(i) Ethanoic acid from Ethanol
(ii) Ethane from Ethene
(iii) Ester from Ethanoic acid and ethanol Also state the names given to all the above conversions.
(b) Detergents are preferred over soaps. Why? (Give one reason)
(2019 C)

112. (a) Compare soaps and detergents on the basis of their composition and cleansing action in hard water.
(b) What happens when ethanol is treated with sodium metal? State about the behaviour of ethanol in this reaction.
(c) Draw the structure of cyclohexane.
(d) Name the following compound.



113.Soaps and detergents are both, types of salts. State the difference between the two. Write the mechanism of the cleansing action of soaps. Why do soaps not form lather (foam) with hard water? Mention any two problems that arise due to the use of detergents instead of soaps. (Delhi 2017, Al 2015)

OR

What is the difference between the molecules of soaps and detergents, chemically? Explain the cleansing action of soaps. (Delhi 2015)

114. 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. (Foreign 2016)

115. (a) You have three unlabelled test tubes containing thanol, ethanoic acid and soap solution. Explain the method you would use to identify the compounds in different test tubes by chemical tests using litmus paper and sodium metal.
(b) Give the reason of formation of scum when soaps are used with hard water. (Foreign 2016)

CBSE Sample Questions

4.2 Versatile Nature of Carbon

MCQ

Which of the following is not observed in a homologous series? Give reason for your choice.
(a) Change in chemical properties
(b) Difference in $-CH_2$ and 14 u molecular mass
(c) Gradation in physical properties
(d) Same functional group (2020-21)

SAI (2 marks)

2. 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. (Term II, 2021-22)

3. The number of carbon compounds is more than those formed by all other elements put together. Justify the statement by giving two reasons. (2020-21)

SA II (3 marks)

4. (a) How many isomers are possible for the compound with the molecular formula C_4Hg? Draw the electron dot structure of branched chain isomer.
(b) How will you prove that C_4H and C_5H_{10} are homologues? (Term II, 2021-22)

5. A carbon compound 'A' having melting point 156 K and boiling point 351 K, with molecular formula C_2H_6O is soluble in water in all proportions.
(a) Identify 'A' and draw its electron dot structure.
(b) Give the molecular formula of any two homologues of 'A'. (Term II, 2021-22)

4.3 Chemical Properties of Carbon Compounds

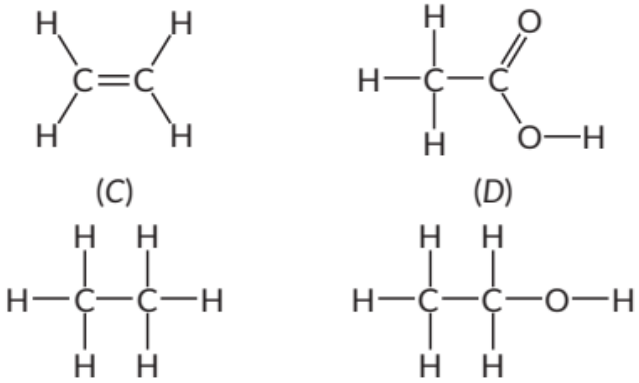
SAI (2 marks)

6. Give a test that can be used to confirm the presence of carbon in a compound. With a valency of 4, how is carbon able to attain noble gas configuration in its compounds? (2020-21)

4.4 Some Important Carbon Compounds - Ethanol and Ethanoic acid

VSA (1 mark)

The formulae of four organic compounds are shown below. Choose the correct option



(a) A and B are unsaturated hydrocarbons
(b) C and D are saturated hydrocarbons
(c) Addition of hydrogen in presence of catalyst changes A to C
(d) Addition of potassium permanganate changes B to D (2022-23)

LA (5 marks)

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.

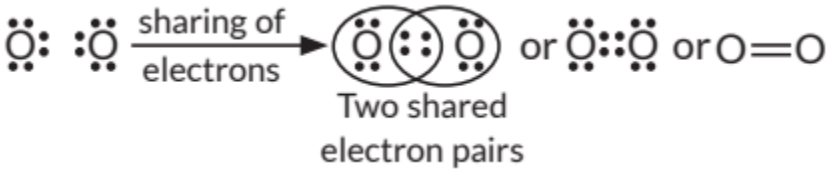
OR

(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. (2022-23)

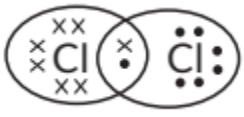
SOLUTIONS

Previous Years' CBSE Board Questions

1. (a) In an oxygen molecule, both oxygen atoms contribute two electrons each and thus share two electron pairs to form two covalent bonds. As shared pairs are shared by both oxygen atoms, they acquire inert gas configuration of neon atom in valence shell. Such bonds are called double bonds.



2. (c) The correct electron dot structure of chlorine molecule is



3. (d): (A) is false, but (R) is true. Carbon can neither gain nor lose four electrons to acquire the nearest noble gas configuration. Carbon can share its valence electrons with carbon or other elements.

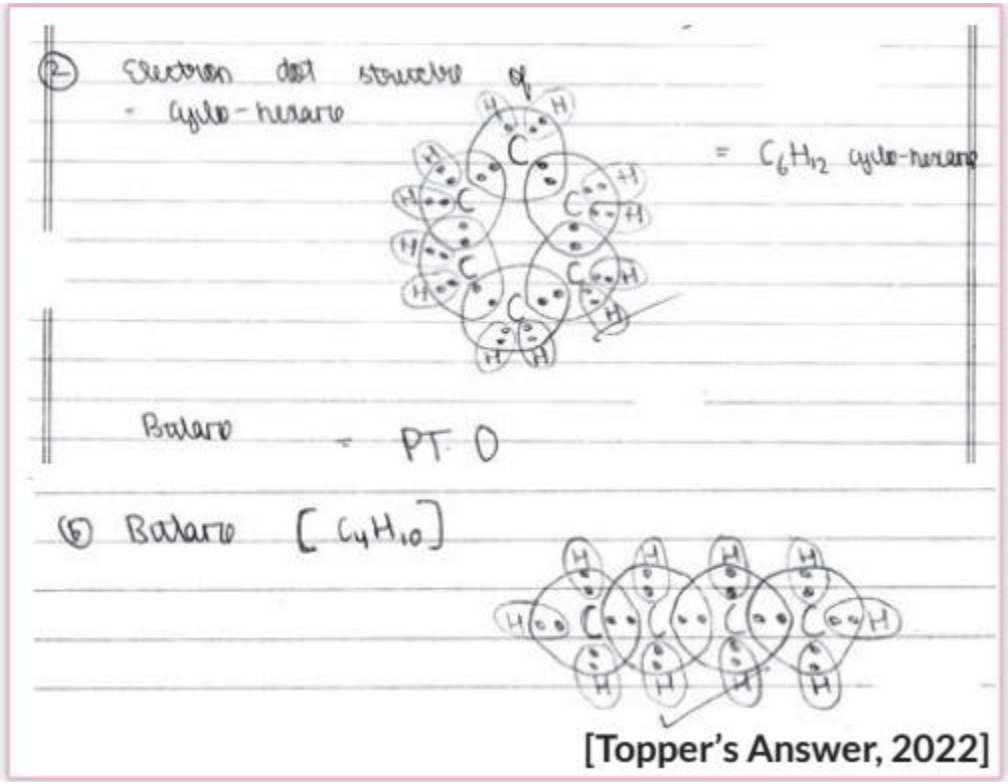
4. Covalent compounds have low melting and boiling points because the forces of attraction between molecules of covalent compounds are very weak. On applying a small amount of heat these molecular forces break.

5. Diamond

6. Covalent bonds are formed by sharing of electron pair between two atoms. Covalently bonded molecules are observed to have stronger bonds within the molecule but intermolecular forces are weak.

7. Covalent compounds do not contain ions and hence, are generally poor conductors of electricity.

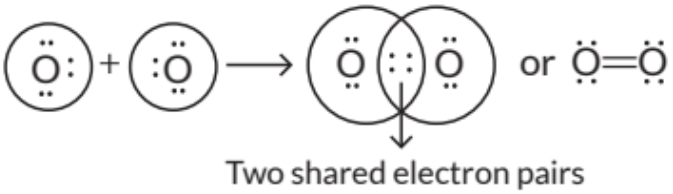
8.



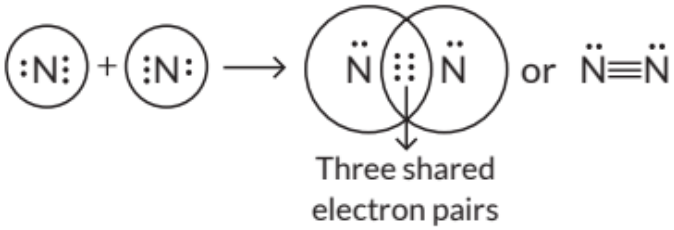
9. Carbon has atomic number 6 with four electrons in the valence shell. If it gains four electrons in order to complete its octet, it will lead to the formation of C4- anion. The addition of four electrons in valence shell will result in strong electronic repulsions between eight electrons now present in valence shell. Hence, it will be difficult for the nucleus to hold on to ten electrons. On the other hand, if it loses four electrons, it forms C4+ cation. It would require a large amount of energy to remove four electrons. Hence, carbon prefers to

share its valence electrons with other atoms of carbon to attain noble gas configuration. The bond formed is known as covalent bond.

10. (a) Formation of oxygen molecule :

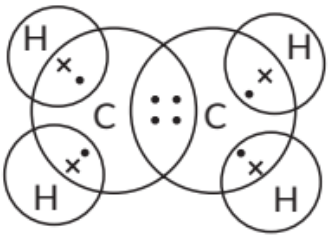


(b) Formation of nitrogen molecule :

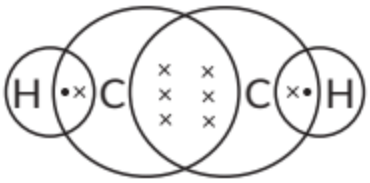


11. Carbon can form only covalent compounds because carbon can neither gain nor lose four electrons to acquire stable octet. The only way by which it can acquire the nearest noble gas configuration is by sharing its valence electrons with other C-atoms or atoms of other elements. Hence, carbon forms compounds mainly by covalent bonding.

12. Molecular formula of ethene is C_2H_4. Its electron dot structure is :



13. (i) Due to weak intermolecular forces of attraction, carbon compounds generally have low melting and boiling points.
(ii) Carbon compounds do not contain ions and hence, are generally poor conductors of electricity.
(iii) Carbon can form only covalent compounds because carbon can neither gain nor lose four electrons to acquire stable octet. The only way by which it can acquire the nearest noble gas configuration is by sharing its valence electrons with other C-atoms or atoms of other elements.

14. (a)  or H—C≡C—H

(b)

	Covalent compounds	Ionic compounds
(i)	They have low melting and boiling points.	They have high melting and boiling points.
(ii)	They do not conduct electricity in molten and aqueous state.	They are good conductors of electricity in molten and aqueous state.

15. Covalent compounds are those compounds which are formed by sharing of valence electrons between the atoms e.g., hydrogen molecule is formed by mutual sharing of electrons between two hydrogen atoms. They are different from ionic compounds as ionic
compounds are formed by the complete transfer of electrons from one atom to another e.g., NaCl is formed when one valence electron of sodium gets completely transferred to outer shell of chlorine atom. The characteristic properties of covalent compounds are:
(i) They are generally insoluble or less soluble in water but soluble in organic solvents.
(ii) They have low melting and boiling points.
(iii) They do not conduct electricity as they do not contain ions.

16. Ionic compounds are formed either by gaining or losing electrons from the outermost shells, but carbon which has four electrons in its outermost shell cannot form ionic bonds because If carbon forms ionic bonds by gaining four electrons to attain a noble gas configuration then it would be difficult for six protons in the nucleus to hold ten electrons.
- If carbon forms ionic bonds by loss of four electrons then it would require a lot of energy to remove these electrons from outermost shell. Due to these reasons, carbon forms covalent bonds by sharing the valence electrons. Type of bonds formed in ionic compounds are called electrovalent bonds and the type of bonds formed in carbon compounds are called covalent bonds.
Covalent bonds are those bonds which are formed by sharing of the valence

electrons between two atoms. Covalent compounds are generally poor conductors of electricity because they do not have free electrons or ions.

17. Ionic compounds are formed either by gaining or losing electrons from the outermost shells, but carbon which has four electrons in its outermost shell cannot form ionic bonds because If carbon forms ionic bonds by gaining four electrons to attain a noble gas configuration then it would be difficult for six protons in the nucleus to hold ten electrons.
- If carbon forms ionic bonds by loss of four electrons then it would require a lot of energy to remove these electrons from outermost shell. Due to these reasons carbon forms covalent bonds by sharing the valence electrons.
(i) Covalent compounds are generally poor conductors of electricity because they do not have free electrons or ions.
(ii) Covalent compounds have low melting and boiling points because the forces of attraction between molecules of covalent compounds are very weak. On applying a small amount of heat these molecular forces break.

18. (a): The given compounds are members of homologous series of alcohol.

19. Benzene,  jis a cyclic unsaturated carbon compound.

20. The molecular formula of first two members of homologous series having –Cl functional group are CH_3CI and CH_3CH_2CI.

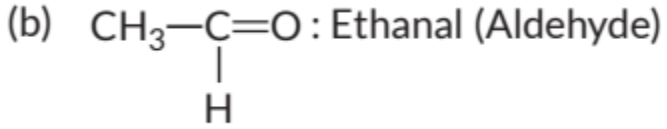
21. The molecular formula of first two members of homologous series having -OH functional group are CH_3OH and CH_3CH_2OH.

22. Homologous series of alkenes have general formula, CnH_2n whose first member is ethene. 2^{nd} member of homologous series of alkenes is C_3H_6 i.e., propene. 3^{rd} member of homologous series of alkenes is C_4Hg i.e., butene.

23. Methane, CH_4 is an alkane. Alkanes have general formula, CnH_2n+2- 2^{nd} member of homologous series of alkanes is C_2H_6 i.e., ethane. 3rd member of homologous series of alkanes is C_3Hg i.e., propane.

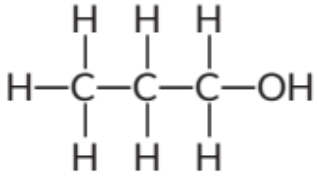
24. (i) C_2H_4 belongs to alkene series having general formula, C_nH_{2n} Thus, next homologue will be $C_3H_2x3 = C_3H_6$
(ii) C_4H_6 belongs to alkyne series having general formula, C_nH_{2n}-2- Thus, next homologue will be $C_5H_2x5\text{-}2 = C_5Hg$

25. (a) CH_3-CH_2- OH: Ethanol (Alcohol)

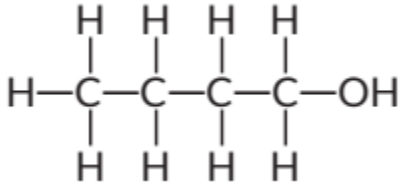
(b)  : Ethanal (Aldehyde)

26. Saturated hydrocarbons (alkanes) have general formula, $C_nH_{2n}+2$. Among the given compounds, only C_4H_{10} and C_6H_{14} satisfy the above formula. Thus, these are saturated hydrocarbons.
Unsaturated hydrocarbons have the general formula CnH_{2n} (alkene) and CnH_{2n}-2 (alkyne).

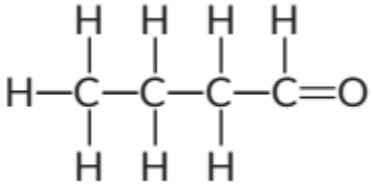
27. An alcohol with three carbon atoms in its molecule is propanol. The structure of propanol is



28. An alcohol with four carbon atoms is butanol and its structure is :



29. An aldehyde with four carbon atoms is butanal and its structure is:



30. Carbon has the unique ability to form bonds with other atoms of carbon, giving rise to large molecules. This property is called catenation. Carbon shows catenation due to its small size and stronger carbon-carbon bond strength.

31. The general formula of the alkane series is $C_nH_{2n}+2$. For fourth member of alkane series, n = 4 $C_4H_2x4+2 = C_4H_{10}$ i.e., butane.

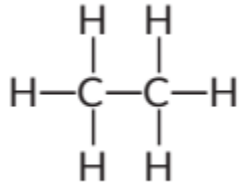
32. A homologous series is the family of organic compounds having the same functional group, similar chemical properties but the successive (adjacent) members of the series differ by a $-CH_2$ unit or 14 mass units.

33. Homologous series of alkenes have general formula, C_nH_{2n} whose first member is ethene. 2nd member of homologous series of alkenes is C_3H_6 i.e., propene.

34. Alkanes have general formula, $CnH_{2n}+2$- 2nd member of homologous series of alkanes is C_2H_6 i.e., ethane.

35. General formula, $C_nH_{2n}-2$ belongs to alkyne series. The second member of this series is propyne i.e., (C_3H_4) or $CH_3-C{=}CH$.

36. The structural formula of ethane (C_2H_6) is

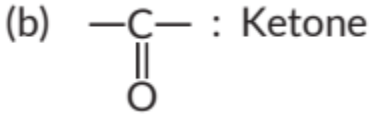


There are total 7 covalent bonds. Six C-H covalent bonds and one C - C covalent bond.

37. Butane (C_4H_{10}) has the following structural formula as:

Total number of covalent bonds is 13 in which there are 10 C – H and 3 C - C covalent bonds.

38. (a) -OH : Alcohol

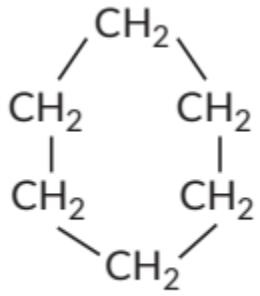
(b)  : Ketone

39. General formula for alkynes is $CnH_{2n}-2$- First member of homologous series of alkyne has the formula, $C_2H_2 \times 2-2 = C_2H_2$ i.e., ethyne.

40. (a) (i) Methane (CH4)
(ii) Propane ($CH_3CH_2CH_3$) or C_3H_8

(b) Due to weak intermolecular forces of attraction, covalent compounds generally have low melting and boiling points.

41. (a) C3H6(or CnH2n, n = 3) i.e, alkene series thus,has one double covalent bond.
(b) C4H6 (or CnH2n-2, n = 4) i.e., alkyne series. The first member of alkyne series is ethyne (C2H2); HC=CH.
(c) C6H12 can form ring structure of C-atoms.



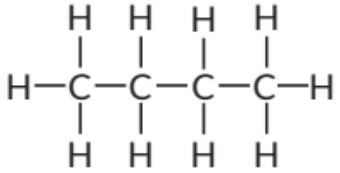
Cyclohexane

(d) Alkane series; C_nH_{2n+2} Only C_3Hg is a member of alkane series.
CH_3-CH_2-CH_3 Propane

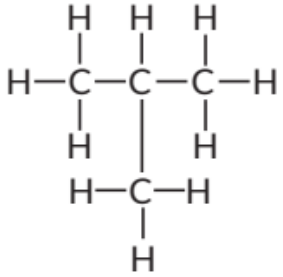
42. (a) General formula of alkyne = C_nH_{2n} - 2
For C_xH_2, 2n - 2 = 2 ⇒n=2.. x = 2.
For C_3H_y, n = 3, y = 2n-2=2x3-2=4
Hence, x = 2, y = 4
(b) A is ethyne (C_2H_2) and B is propyne (C_3H_4).

43. A homologous series is the family of organic compounds having the same functional group, similar chemical properties but the successive (adjacent) members of the series differ by a -CH_2 unit or 14 mass units.
(i) As the molecular mass increases in a homologous series, melting and boiling points also increases.
(ii) Chemical properties remains same for the members of homologous series because they all have same functional group.

44.

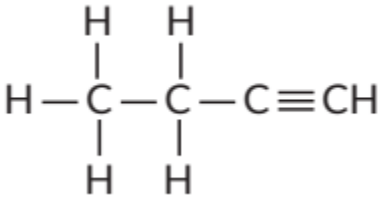


n-butane



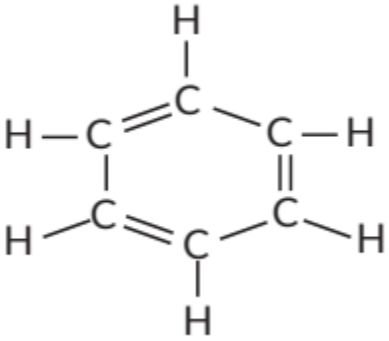
iso-butane

These are called structural isomers as they have the same molecular formula i.e., C_4H_{10} but different structures. As the molecular formula is C_4H_{10}, common name of this compound is butane. The alkyne of four carbon atoms is butyne. Its structure is as follows:

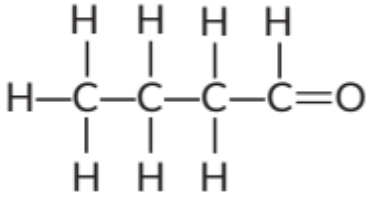


The molecular formula of butyne is C_4H_6.

45. (i) Molecular formula of benzene is C_6H_6.



46. (a) Aldehyde (-CHO) group.
(b) $C_nH_{2n}O$
(c) Compound (i) is propanal, and compound (ii) is ethanal. They belong to the same homologous series where each successive compound differs from each other by a $-CH_2$ unit. Other member of same homologous series:



Butanal

47. Carbon has the unique ability to form bonds with other atoms of carbon, giving rise to large molecules. This property is called catenation. Carbon shows catenation due to its small size and stronger carbon-carbon bond strength. As we move down the group, the element-element bond energies decrease rapidly. For this reason, other elements of this group show little or no catenation property.

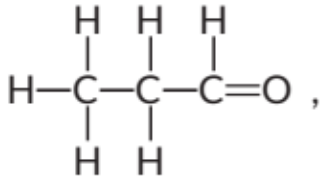
48. A homologous series is defined as a group of compounds having the same functional group, similar chemical properties in which the successive members differ by a $-CH_2$ group or 14 mass unit. For example, in alkane homologous series, the general formula is $C_nH_{2n}+2$ i.e.; first three members are CH_4, C_2H_6 and C_3H_8 where two successive members differ by $-CH_2$ group. Characteristics of homologous series: All compounds in the series can be represented by a general formula, e.g., for alcohol it is $C_nH_{2n}+1OH$, for alkane $C_nH_{2n}+2$, for alkene C_nH_{2n}, and for alkynes $C_nH_{2n}-2$, where, n = 1, 2, 3..... All compounds in the series have similar chemical properties. All members of the series, show a gradual change in their physical properties.
- Physical properties generally increase as the molecular mass increases.

49. (a) Due to catenation, carbon forms covalent bonds with the constituent elements in the carbon compounds, hence it does not have mobile electrons and carbon compounds do not dissociate themselves into ions and hence, they are poor conductor of electricity.

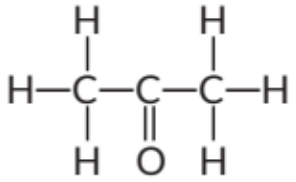
(b) Structure : 

Name : Cyclopentane
Number of single bonds : 15

50. The aldehyde and ketone represented by the molecular formula, C_3H_6O are:



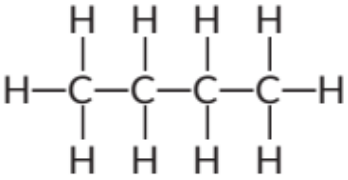
Aldehyde (Propanal)



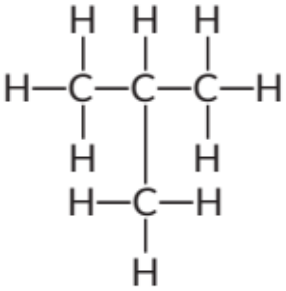
Ketone (Propanone)

In the language of science, they are called as isomers because both have same molecular formula but different structural formulae (having different functional groups.)

51. Isomers are those molecules which have the same molecular formula but different structural formula i.e., show different arrangement of atoms. The structures of possible isomers of butane (C_4H_{10}) are:



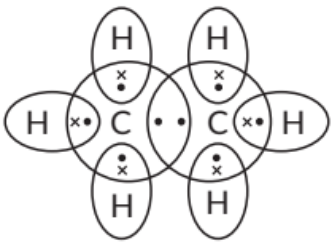
n-Butane
(I)



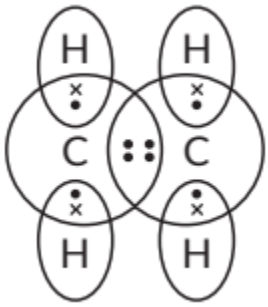
2-Methylpropane
or isobutane
(II)

The first three members of alkane series are:
(i) CH_4 (methane)
(iii) C_3Hg (propane)
(ii) C_2H_6 (ethane)
In the above members of alkane series, it is not possible to have different arrangements of carbon atoms. Thus, we cannot have isomers of first three members of alkane series.

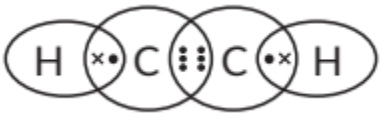
52. (i) Molecular formula of ethane is C2H6. Its electron dot structure is :



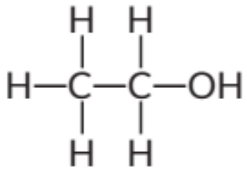
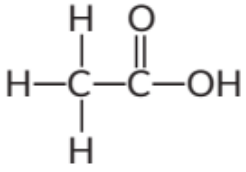
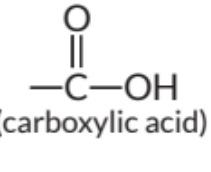
(ii) Molecular formula of ethene is C_2H_4. Its electron dot structure is :



(iii) Molecular formula of ethyne is C_2H_2. Its electron dot structure is :



53. An atom or a group of atoms present in a molecule which largely determines its chemical properties, is called functional group.

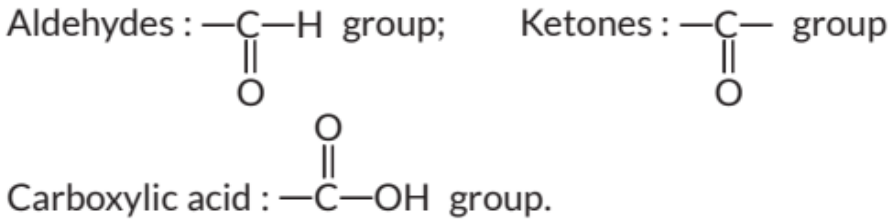
Compound		Structural formula	Functional group
(i)	Ethanol (C_2H_5OH)		—OH (alcoholic)
(ii)	Ethanoic acid (CH_3COOH)		 (carboxylic acid)

54. A homologous series is the family of organic compounds having the same functional group, similar chemical properties but the successive (adjacent) members of the series differ by a -CH_2 unit or 14 mass units. Consecutive members of the homologous series of alcohols are:

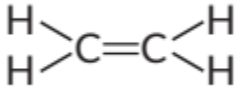
$$\left.\begin{matrix} CH_3OH \\ C_2H_5OH \end{matrix}\right] \text{They differ by } -CH_2 \text{ unit.}$$

The physical properties are determined by alkyl group/ hydrocarbon part/part other than the functional group. The chemical properties are determined by functional group such as -OH group.

55. An atom or a group of atoms present in a molecule which largely determines its chemical properties, is called functional group. The formulae for different functional groups are: Alcohols : -OH group

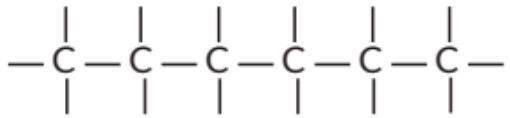


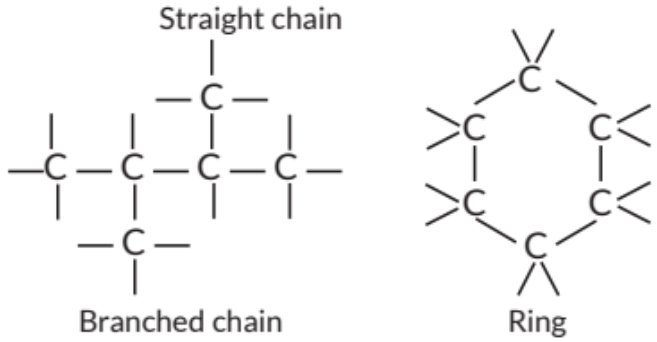
56. A homologous series is the family of organic compounds having the same functional group, similar chemical properties but the successive (adjacent) members of the series differ by a $-CH_2$ unit or 14 mass units. The general formula for alkenes is CnH_2, and for alkynes is $CnH2_n$-2 First member of alkene is ethene, C_2H_4 and its structure is



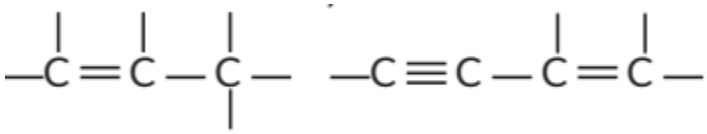
First member of alkyne is ethyne, C_2H_2 and its structure is H-C=C-H.

57. As carbon has four valence electrons and it can neither loose nor gain four electrons thus, it attains noble gas configuration only by sharing of electrons. Thus, it forms covalent compounds. The existence of large number of compounds is due to some unique properties of carbon which are:
(i) Carbon atoms possess an unique property to link together to form very long chains. This property is referred to as catenation. A large number of carbon atoms can join together to form straight chains, branched chains and rings as shown below:



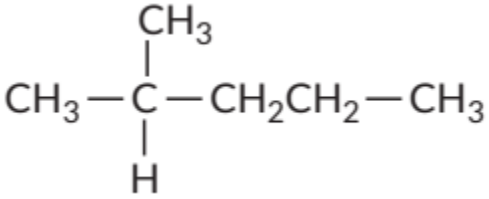


(ii) Due to small size and presence of four valence electrons, a carbon atom can form multiple bonds with some other carbon atoms as well as with other atoms like oxygen, nitrogen etc., This increases the variety of compounds formed by it and hence the number of compounds is tremendously increased.



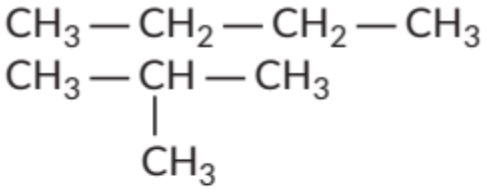
Due to small size, the nucleus of carbon atom can hold its shared pairs of electrons strongly. As a result, the bonds that carbon forms with most of the other elements such as hydrogen, oxygen, nitrogen, etc. are very strong there by making these compounds exceptionally stable.

58. (i) (a) Butanoic acid : $CH_3CH_2CH_2COOH$
(b) Chloropentane : $CH_3CH_2CH_2CH_2CH_2Cl$
(ii) Structures (i) and (ii) are chain isomers.
Chain isomers have the same molecular formula but differ in the order in which the carbon atoms are bonded to each other. One more structure for the given case is shown below:

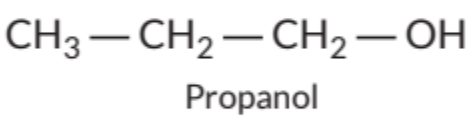


(iii) The general formula of saturated carbon compounds: C_nH_{2n+2} (Alkane)
The general formula of unsaturated carbon compounds : C_nH_2n(Alkene), C_nH_{2n} - 2 (Alkyne)

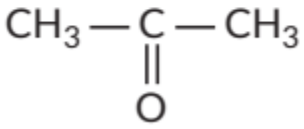
59. (i) Structural isomers of butane are the following:



(ii)



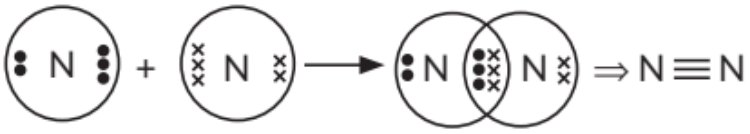
Propanol



Propanone

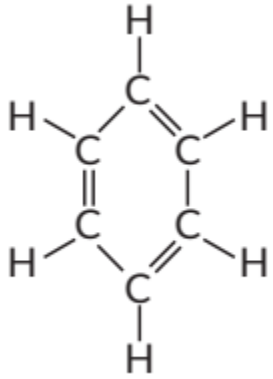
(iii) (a) Three homologue of alcohol are the following: CH_3OH, CH_3CH_2OH, $CH_3CH_2CH_2OH$
Third homologue of alcohol is $CH_3CH_2CH_2OH$
(b) Three homologue of aldehyde are the following: HCHO, CH_3CHO, CH_3CH_2CHO Third homologue of aldehyde is CH_3CH_2CHO.
(iv) (a) Benzene
(b) But-1-ene

(v) $Z = 7$, K 2, L 5



60. (a) lonic compounds are formed either by gaining or losing electrons from the outermost shells, but carbon which has four electrons in its outermost shell cannot form ionic bonds because If carbon forms ionic bonds by gaining four electrons to attain a noble gas configuration then it would be difficult for six protons in the nucleus to hold ten electrons.
- If carbon forms ionic bonds by loss of four electrons then it would require a lot of energy to remove these electrons from outermost shell. Due to these reasons carbon forms covalent bonds by sharing the valence electrons.

(i) Covalent compounds are generally poor conductors of electricity because they do not have free electrons or ions.
(ii) Covalent compounds have low melting and boiling points because the forces of attraction between molecules of covalent compounds are very weak. On applying a small amount of heat, these molecular forces break.

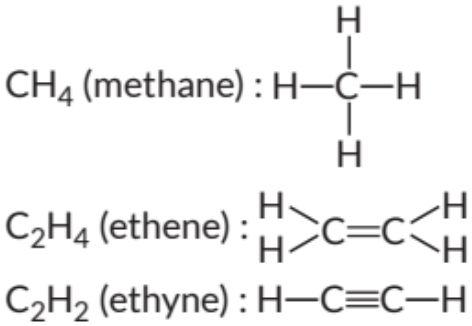
(b) 

61. Ionic compounds are formed either by gaining or losing electrons from the outermost shells, but carbon which has four electrons in its outermost shell cannot form ionic bonds because If carbon forms ionic bonds by gaining four electrons to attain a noble gas configuration then it would be difficult for six protons in the nucleus to hold ten electrons.
- If carbon forms ionic bonds by loss of four electrons then it would require a lot of energy to remove these electrons from outermost shell. Due to these reasons carbon forms covalent bonds by sharing the valence electrons. Carbon forms a large number of carbon compounds like long chains which may be straight or branched chains or ring of different sizes due to its tetravalency and unique property of catenation. Carbon due to its small size forms exceptionally stable compounds by forming strong bonds. Due to the small size of carbon atom, its nucleus holds the shared pair of electrons between atoms strongly. Thus, carbon forms strong covalent bonds with elements such as hydrogen, oxygen, nitrogen, sulphur, chlorine and other elements.

62. Hydrocarbons are the compounds of carbon and hydrogen atoms. Those hydrocarbons which contain only single carbon-carbon bonds are called alkanes (saturated hydrocarbons) while those having double and triple bonds are called alkenes and alkynes respectively (unsaturated hydrocarbons).

	Alkanes	Alkenes	Alkynes
1.	General formula $= C_nH_{2n+2}$	General formula $= C_nH_{2n}$	General formula $= C_nH_{2n-2}$
2.	Contain C—C single bonds	Contain C=C double bonds	Contain C≡C triple bonds
3.	*e.g.*, methane (CH_4)	*e.g.*, ethene (C_2H_4)	*e.g.*, ethyne (C_2H_2)

Structures of the above examples are:



63. Hydrogenation is the process in which unsaturated fats are changed to saturated fats.

64. When methane is treated with chlorine in the presence of sunlight, then substitution reaction takes place. In this, chlorine replaces the hydrogen atom of methane.

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

65. When methane is burnt in presence of oxygen then carbon dioxide will be produced.

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O + \text{heat} + \text{light}$$

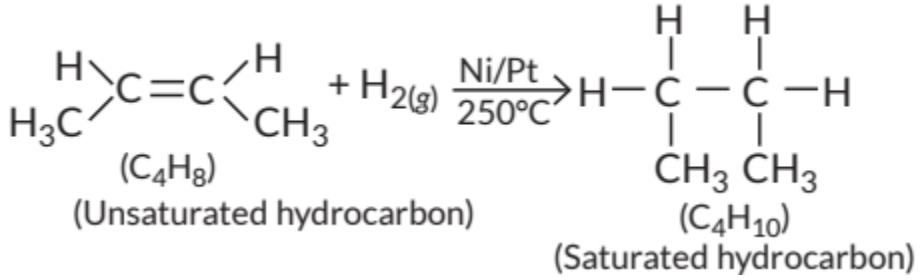
66. When 5% alkaline KMnO4 solution is added drop by drop to warm ethanol then it gets oxidised to ethanoic acid.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[KMnO_4]{\text{alkaline}} \underset{\text{Ethanoic acid}}{CH_3COOH}$$

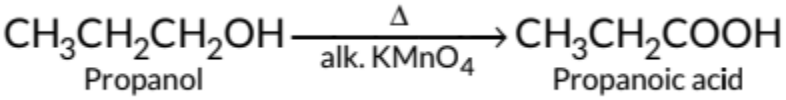
Here, alkaline $KMnO_4$ acts as an oxidising agent i.e., the substance which is capable of adding oxygen to others. Thus, alkaline $KMnO_4$ provides oxygen to ethanol to form ethanoic acid.

67. (i) 5% solution of $KMnO_4$ is prepared by adding 5 g of $KMnO_4$ in 95 g of water.
(ii) Here alkaline $KMnO_4$ acts as an oxidising agent. It oxidises ethanol to ethanoic acid by donating nascent oxygen. If excess of $KMnO_4$ is added the purple colour will persist indicating no more alcohol is left and reaction stops.

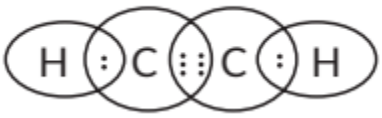
68. All unsaturated hydrocarbons (containing double or triple bonds) have tendency to get converted to saturated hydrocarbons (single bonds) by adding small molecules such as hydrogen (H_2), halogens (X_2), etc. Such reactions are called addition reactions. Compound with the molecular formula C_4Hg belongs to alkene series (C_nH_{2n}). Hence, it will undergo addition reaction.



69. The substance that supply oxygen in a reaction for oxidation is called oxidising agent e.g., potassium permanganate, potassium dichromate, etc. When propanol is heated with alkaline $KMnO_4$, it gets oxidised to propanoic acid and the purple colour of $KMnO_4$ disappears..



70. The formula for ethyne is C_2H_2 and its electron dot structure is :



A mixture of ethyne and oxygen is burnt for welding so that complete oxidation of ethyne takes place. If in place of oxygen, air is taken which

contains less amount of oxygen then incomplete combustion of ethyne takes place and temperature required for welding will not be attained.

71. Alkenes, having general formula as C_nH_2 and alkynes, having general formula as C_nH_{2n-2} are the class of hydrocarbons in which addition reaction is possible. The essential conditions for addition reaction are:
(i) Presence of unsaturated hydrocarbon.
(ii) Presence of catalyst such as Ni/Pt/Pd. Let us take an example of ethene. It undergoes addition reaction with hydrogen when it is heated in the presence of nickel catalyst to form ethane. The reaction is known as hydrogenation.

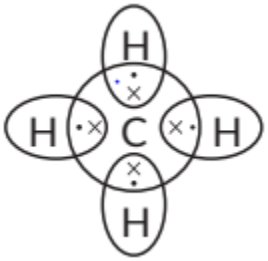
$$\underset{\text{Ethene}}{CH_2=CH_2} + H_2 \xrightarrow[\text{Catalyst}]{\text{Ni}} \underset{\text{Ethane}}{CH_3-CH_3}$$

72. (i) In addition reactions, an unsaturated hydrocarbon combines with other molecules to give a single product. Addition reactions are characteristic reactions of unsaturated hydrocarbons as other molecules are added reactions are given by all unsaturated hydrocarbons (alkenes, C_nH_{2n} and alkynes, C_nH_{2n-2}). The essential conditions for addition reaction are:
(i) Presence of unsaturated hydrocarbon.
(ii) Presence of catalyst such as Ni/Pt/Pd. Addition reaction of ethene with hydrogen: Ethene combines with hydrogen when heated in presence of nickel catalyst to give ethane.

$$\underset{\substack{\text{Ethene}\\\text{(Unsaturated)}}}{H_2C=CH_2} + \underset{\text{Hydrogen}}{H_2} \xrightarrow[\text{Heat}]{\text{Ni catalyst}} \underset{\substack{\text{Ethane}\\\text{(Saturated)}}}{H_3C-CH_3}$$

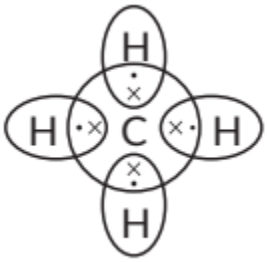
The addition of hydrogen molecule to an unsaturated hydrocarbon to obtain a saturated hydrocarbon is called hydrogenation. The process requires the presence of nickel or palladium metals as catalyst. Substitution reactions involve the direct replacement (displacement or substitution) of an atom or a group of atoms in an organic molecule by another atom or group of atoms without any change in the rest of the molecule. Whereas addition reactions involve addition of a reagent to unsaturated hydrocarbons to form a single product.
(ii) The structure of benzene (C_6H_6) is

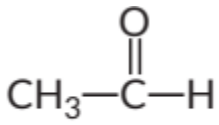
73. Methane is the first member of alkane series having formula CH_4. In this compound the bond formed are covalent bonds.
(i) Covalent compounds are generally poor conductors of electricity because they do not have free electrons or ions.
(ii) Covalent compounds have low melting and boiling points because the forces of attraction between molecules of covalent compounds are very weak. On applying a small amount of heat, these molecular forces break. When methane is burnt in presence of oxygen then carbon dioxide will be produced.



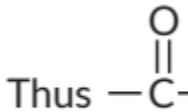
$$CH_4 + O_2 \longrightarrow CO_2 + H_2O + \text{heat} + \text{light}$$

74. (a) Electron dot structure of methane is shown in the figure.
(b) (i) C_2H_6O i.e., $C_nH_{2n}+20$
or $CnH_{2n}+1OH$ where, n = 2
Thus, OH (alcohol) is the functional group present in it.
(ii) C_2H_4O i.e; C_nH_{2n}





Ethanol (acetaldehyde)



Thus (aldehyde) functional group is present in this compound.

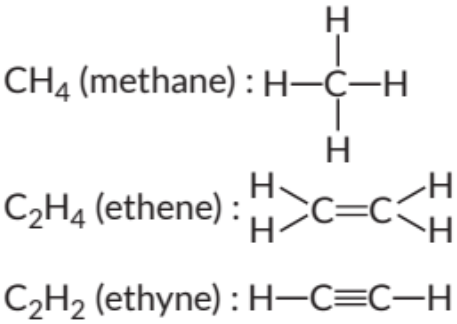
(c) When ethyne is burnt in air, incomplete combustion takes place due to limited supply of oxygen in air which produces sooty flame. Instead ethyne is

burnt with oxygen at high temperature to produce clean flame which is used for welding.

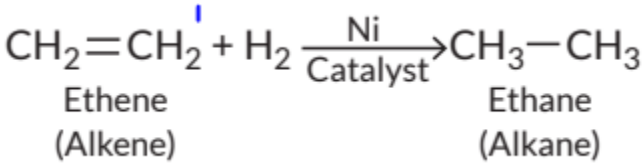
75. Hydrocarbons are the compounds of carbon and hydrogen atoms. Those hydrocarbons which contain only single carbon-carbon bonds are called alkanes (saturated hydrocarbons) while those having double and triple bonds are called alkenes and alkynes respectively (unsaturated hydrocarbon).

Alkanes	Alkenes	Alkynes
General formula $= C_nH_{2n+2}$	General formula $= C_nH_{2n}$	General formula $= C_nH_{2n-2}$

Structures of the first member of these series are:

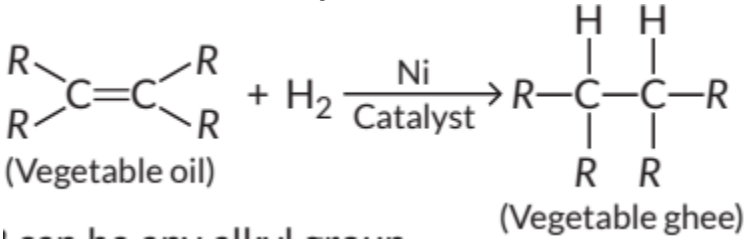


The essential conditions for addition reaction (hydrogenation) are:
(i) Presence of unsaturated hydrocarbon.
(ii) Presence of catalyst such as Ni/Pt/Pd. The reaction is known as hydrogenation.



76. C=C and C=C– are functional groups that
can be hydrogenated.
Hydrogenation is the addition of hydrogen to an unsaturated hydrocarbon to

obtain a saturated hydrocarbon.



Here, R can be any alkyl group. There is the change of unsaturated compound from the liquid state to saturated compound in the solid state thus, melting point increases.

77. (b): When an ester reacts with the base, saponification reaction occurs.

78. (a): Pure ethanoic acid or acetic acid freezes below room temperature into white crystals that resemble glaciers.

79. As X reacts with conc. H_2SO_4 to give an alkene so it should be an alcohol as conc. H_2SO_4 acts as a dehydrating agent. The reaction of X with Na also confirms that it is an alcohol because alcohols react with Na metal to evolve colourless hydrogen gas.

$$\underset{(X)}{CH_3CH_2OH} \xrightarrow[443\ K]{\text{conc. } H_2SO_4} \underset{(Y)}{CH_2=CH_2} + H_2O$$

Here, conc. H_2SO_4 acts as a dehydrating agent i.e., he in the removal of water.

$$\underset{(X)}{2CH_3CH_2OH} + 2Na \longrightarrow 2CH_3CH_2ONa + \underset{\text{Colourless gas } (Z)}{H_2\uparrow}$$

80. (i) When an ester reacts with the base then it gives sodium salt of carboxylic acid and an alcohol. It is known as saponification reaction.

$$\underset{\text{Ethyl ethanoate (Ester)}}{CH_3COOC_2H_5} \xrightarrow{NaOH} \underset{\text{Ethanol (Alcohol)}}{C_2H_5OH} + \underset{\text{Sodium ethanoate}}{CH_3COONa}$$

(ii) Carboxylic acids react with alcohols in the presence of a little concentrated sulphuric acid to form pleasant smelling esters. This reaction is called

esterification reaction.

$$\underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow[H_2SO_4]{\text{Conc.}} \underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} + H_2O$$

81.

(i) $$\underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow[443\ K]{\text{Conc.}H_2SO_4} \underset{\text{Ethene}}{CH_2=CH_2} + H_2O$$

(ii) Carboxylic acids react with alcohols in the presence of a little concentrated sulphuric acid to form pleasant smelling esters. This reaction is called esterification reaction.

$$\underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow[H_2SO_4]{\text{Conc.}} \underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} + H_2O$$

82.

(i) $$\underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} + NaOH \longrightarrow \underset{\substack{\text{Sodium}\\\text{ethanoate}}}{CH_3COO^-Na^+} + \underset{\text{Ethanol}}{C_2H_5OH}$$

(ii) $$\underset{\substack{\text{Ethanoic}\\\text{acid}}}{CH_3COOH} + \underset{\substack{\text{Sodium}\\\text{hydroxide}}}{NaOH} \longrightarrow \underset{\substack{\text{Sodium}\\\text{ethanoate}}}{CH_3COONa} + H_2O$$

(iii) $$\underset{\text{Ethanol}}{C_2H_5OH} + \underset{\substack{\text{Ethanoic}\\\text{acid}}}{CH_3COOH} \xrightarrow[H_2SO_4]{\text{Conc.}} \underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} + H_2O$$

83.

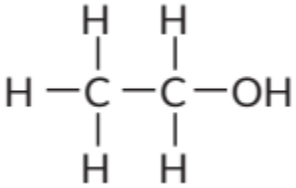
(i) $C_2H_5OH + 3O_2 \xrightarrow[\text{(Burning)}]{\text{Combustion}} 2CO_2 + 3H_2O +$ heat + light

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

(iii) $CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + CO_2 + H_2O$

Ethanoic acid	Sodium bicarbonate	Sodium ethanoate	Carbon dioxide

84. The structural formula of ethanol (C_2H_5OH) is



When ethanol is heated with conc. H_2SO_4 at 443 K then it looses a water molecule to form unsaturated alkene (ethene) as a product.

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

Here conc. H2SO4 acts as a dehydrating agent i.e., helps in the removal of water.

(a) $C_2H_5OH + 3O_2 \xrightarrow[\text{(Burning)}]{\text{Combustion}} 2CO_2 + 3H_2O +$ heat + light

(b) $\underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow[443\ K]{Conc.H_2SO_4} \underset{\text{Ethene}}{CH_2=CH_2} + H_2O$

(c) When a small piece of sodium is dropped into ethanol then hydrogen gas is liberated which burns with a pop sound.

$$2C_2H_5OH + 2Na \longrightarrow 2C_2H_5O^-Na^+ + H_2\uparrow$$

86.

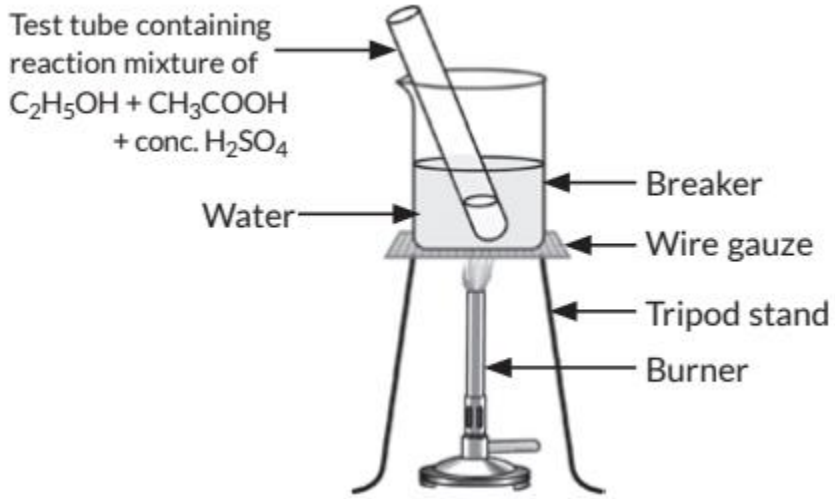
S. No.	Esterification	Saponification
1.	When alcohol is added to carboxylic acid in the presence of acid catalyst then a fruity smelling ester is formed. This process is called esterification.	Oils or fats when treated with sodium hydroxide solution gets converted into sodium salts of fatty acids and glycerol. This reaction is called saponification.
2.	**Chemical reaction :** $CH_3CH_2OH + CH_3COOH \xrightarrow[H_2SO_4]{Conc.} CH_3COOC_2H_5 + H_2O$ (Ester)	**Chemical reaction :** $CH_2OCOC_{17}H_{35}$ / $CHOCOC_{17}H_{35} + 3NaOH \longrightarrow CHOH + 3C_{17}H_{35}COONa$ (Sodium stearate (Soap)) / $CH_2OCOC_{17}H_{35}$ (Oil of fat) ; CH_2OH / CH_2OH (Glycerol)

Use of esters: They are used for making perfumes or used as artificial flavouring substances. Use of saponification process: This process is used in making soaps.

87. When alcohol is added to carboxylic acid in the presence of acid catalyst then a fruity smelling ester is formed. This process is called esterification. Chemical reaction:

$$CH_3CH_2OH + CH_3COOH \xrightarrow[H_2SO_4]{Conc.} \underset{Ester}{CH_3COOC_2H_5} + H_2O$$

Aim: To demonstrate esterification process using ethanol and acetic acid. Materials required: Beaker, water, test tube, ethanol, acetic acid, conc. H_2SO_4, tripod stand, burner, wire gauze, etc.



Procedure:
- Take 2 mL of ethanol in a test tube.
- Take 2 mL of ethanoic acid (acetic acid) into it.
- Add few drops of conc. H2SO4.
- Warm it in a beaker containing water.
- Observe the smell of the products formed.

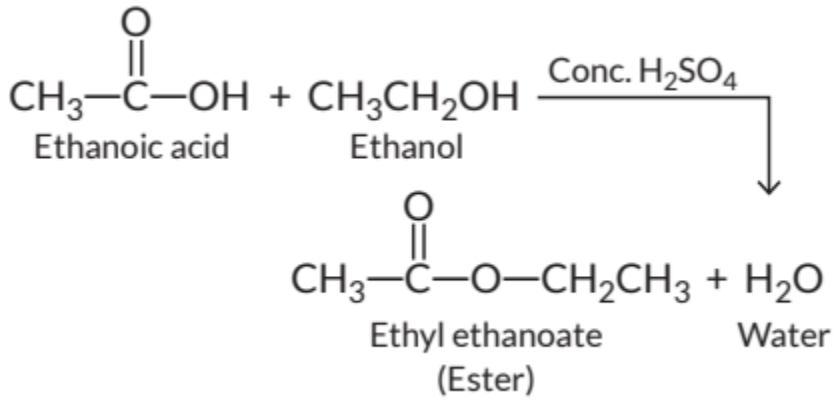
Observations: Pleasant fruity smelling compound (called ester) is formed.

Chemical reaction:

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

Conclusion: Carboxylic acid reacts with alcohol in presence of conc. H2SO4 which acts as a dehydrating agent to form esters.

88. (i) When ethanol reacts with ethanoic acid in presence of conc. H2SO4, ethyl ethanoate is formed which belongs to the class of ester compounds, having fruity smell.



(ii) The above reaction is called esterification which occurs in presence of conc. H_2SO_4 which acts as a dehydrating agent and helps in the removal of water. Conc. H_2SO_4 also acts as a catalyst to speed up the reaction.

89. When ethanol is heated with conc. H_2SO_4 at 443 K then it loses a water molecule to form unsaturated alkene (ethene) as a product.

$$CH_3CH_2OH \xrightarrow[443\ K]{\text{conc. } H_2SO_4} CH_2 = CH_2 + H_2O$$

Here conc. H_2SO_4 acts as a dehydrating agent i.e., helps in the removal of water. If hydrogen is added to ethene in presence of palladium or nickel catalyst then one atom of hydrogen adds to each carbon atom of ethene to form ethane.

$$\underset{\text{Ethene}}{CH_2{=}CH_2} + H_2 \xrightarrow[\text{Catalyst}]{\text{Ni/Pd}} \underset{\text{Ethane}}{CH_3{-}CH_3}$$

90. Ethanoic acid reacts with sodium as well as sodium hydroxide to form sodium ethanoate.

(a) $$\underset{\text{Ethanoic acid}}{2CH_3COOH} + 2Na \longrightarrow \underset{\text{Sodium ethanoate}}{2CH_3COONa} + H_2\uparrow$$

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

(c) $$\underset{\text{Ethanol}}{C_2H_5OH} + \underset{\text{Ethanoic acid}}{CH_3COOH} \xrightarrow[H_2SO_4]{\text{Conc.}} \underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} + H_2O$$

91. Ethanol reacts with sodium to form sodium ethoxide and hydrogen gas is liberated which burns with a pop sound.

$$\underset{\text{Ethanol (X)}}{2C_2H_5OH} + \underset{\text{Sodium}}{2Na} \longrightarrow \underset{\text{Sodium ethoxide}}{2C_2H_5ONa} + \underset{\text{Hydrogen gas (Y)}}{H_2\uparrow}$$

Thus, compound X is ethanol and gas Y is hydrogen gas. When ethanol is heated with excess of concentrated sulphuric acid then it gets dehydrated to form ethene.

$$\underset{\text{Ethanol (X)}}{CH_3CH_2OH} \xrightarrow[\Delta]{\text{Conc. } H_2SO_4} \underset{\text{Ethene}}{CH_2{=}CH_2} + H_2O$$

92. Ethanoic acid reacts with Na_2CO_3 to form sodium ethanoate and CO_2 gas is liberated.

$$2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + CO_2 + H_2O$$

Ethanoic acid | Sodium carbonate | Sodium ethanoate | Carbon dioxide | Water

With sodium hydrogen carbonate it forms sodium ethanoate.

$$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + CO_2 + H_2O$$

Ethanoic acid | Sodium bicarbonate | Sodium ethanoate | Carbon dioxide | Water

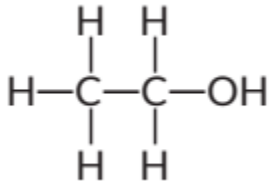
With NaOH it forms sodium ethanoate.

$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$

Ethanoic acid | Sodium hydroxide | Sodium ethanoate | Water

93. Those organic compounds having suffix 'ol' are alcohols. As the alcohol is having two carbon atoms in its molecule so, it is ethanol. The structural formula of ethanol (C_2H_5OH) is

$CH_3—CH_2—OH$ (Ethanol) or



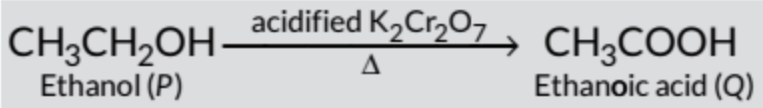
When ethanol is heated with conc. H_2SO_4 at 443 K then it loses a water molecule to form unsaturated alkene (ethene) as a product.

$$CH_3CH_2OH \xrightarrow[443\ K]{\text{conc. } H_2SO_4} CH_2 = CH_2 + H_2O$$

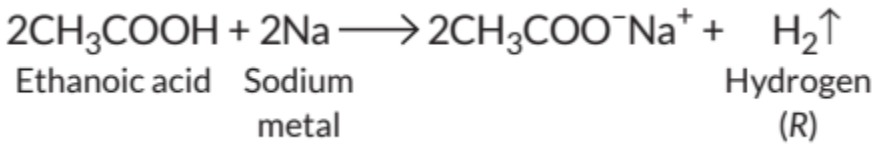
Here conc. H_2SO_4 acts as a dehydrating agent i.e., helps in the removal of water.

94. 'P' is ethanol which is a constituent of wine.

95. Ethanol on reacting with acidified potassium dichromate (K_2Cr2O7) solution gives ethanoic acid 'Q'.



When a piece of sodium is added to ethanoic acid then sodium salt of ethanoic acid is formed with the liberation of hydrogen gas which burns with a pop sound.



95. Tests for distinguishing between an alcohol and a carboxylic acid are:
(i) Litmus test: When we place a drop of carboxylic acid on blue litmus paper it turns red while alcohol will not change the colour of blue litmus paper.
(ii) Sodium hydrogen carbonate test/sodium carbonate test: If a pinch of $NaHCO_3$ or Na_2CO_3 is added to two test tubes containing alcohol and carboxylic acid respectively, then test tube containing carboxylic acid will show the evolution of colourless gas with brisk effervescence while test tube containing alcohol does not show any reaction.

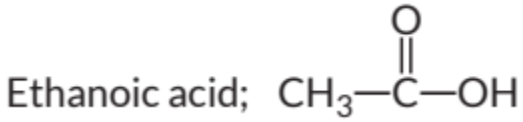
96. Esters are compounds with functional group COOR

pleasant fruity smell. Esters are prepared when a carboxylic acid reacts with an alcohol in the presence of small amount of concentrated H_2SO_4. For example, when ethanoic acid reacts with ethanol it forms an ester (i.e. ethyl ethanoate).

Uses of ester:
1. It is used in making perfumes.

2. It is used in making artificial flavours and essences used in ice-creams, sweets and cold drinks.

97. The molecular formula of carboxylic acid is $C_2H_4O_2$. Thus, it should be acetic acid (ethanoic acid).

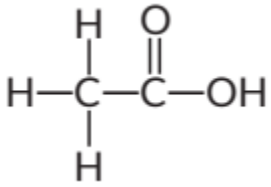


It reacts with alcohol in presence of acid catalyst to give compound 'X'. As alcohol on oxidation with alkaline $KMnO_4$ gives the same acid i.e. ethanoic acid, hence alcohol must contain two carbon atoms. Thus, formula for alcohol is CH_3CH_2OH i.e. ethanol. Reactions involved are:

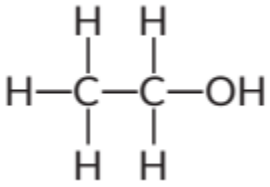
$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[\text{oxidation}]{\text{Alkaline } KMnO_4} \underset{\text{Ethanoic acid}}{CH_3COOH}$$

$$\underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow{H_2SO_4} \underset{\substack{\text{Ethyl ethanoate}\\(X)}}{CH_3COOCH_2CH_3} + H_2O$$

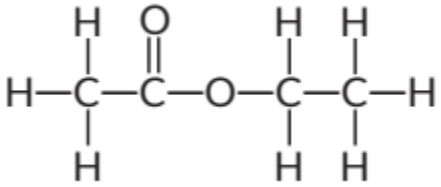
(i) Structure of ethanoic acid:



(ii) Structure of ethanol:



(iii) Structure of ethyl ethanoate (X):



98. When ethanol is heated with alkaline solution of potassium permanganate then oxidation of ethanol takes place to form ethanoic acid.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow{\text{Alkaline } KMnO_4} \underset{\text{Ethanoic acid}}{CH_3COOH}$$

Two physical properties of ethanol are:
1. It is liquid at room temperature.
2. It is soluble in water in all proportions. Two uses of ethanol are:
3. It is used as a liquor for drinking purpose.
4. It is a good solvent and hence, it is used in medicines such as tincture of iodine, cough syrup and many tonics.

99. Addition of oxygen to any substance is called oxidation. Ethanol gets oxidised to ethanoic acid as:

$$\underset{\text{Ethanol}}{CH_3CH_2OH} + 2[O] \xrightarrow[\Delta]{\text{Acidified } K_2Cr_2O_7} \underset{\text{Ethanoic acid}}{CH_3COOH} + H_2O$$

When ethanol is heated with alkaline solution of potassium permanganate then oxidation of ethanol takes place to form ethanoic acid.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} + 2[O] \xrightarrow[\Delta]{\text{Alkaline } KMnO_4} \underset{\text{Ethanoic acid}}{CH_3COOH} + H_2O$$

Two uses of ethanol are : It is used as a liquor for drinking purpose.

2. It is a good solvent and hence, it is used in medicines such as tincture of iodine, cough syrup and many tonics.

100.

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

(ii) $\underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Sodium bicarbonate}}{NaHCO_3} \rightarrow \underset{\text{Sodium ethanoate}}{CH_3COONa} + H_2O + \underset{\text{Carbon dioxide}}{CO_2}$

(iii) $2C_2H_5OH + 2Na \longrightarrow 2C_2H_5O^-Na^+ + H_2\uparrow$

101. The process in which compounds of carbon react with oxygen to give carbon dioxide, water, heat and light, is known as combustion. Alkanes burn in

air and release large amount of heat, therefore can be used as excellent fuels.

$$\underset{\text{Methane (Natural gas)}}{CH_4} + \underset{\text{Oxygen (From air)}}{2O_2} \xrightarrow{\text{Combustion}} \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Water}}{2H_2O} + \text{Heat} + \text{Light}$$

(ii) Oxidation is process in which oxygen is added to a substance.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[\text{or acidified } K_2Cr_2O_7 + \text{Heat}]{\text{alk. } KMnO_4 + \text{Heat}} \underset{\text{Ethanoic acid (Acetic acid)}}{CH_3COOH}$$

(iii) Hydrogenation means addition of hydrogen to an unsaturated compound.

$$CH_2 = CH_2 + H_2 \xrightarrow{Ni} CH_3 - CH_3$$

(iv) When alcohol is added to carboxylic acid in the presence of acid catalyst then, a fruity smelling ester is formed. This process is called esterification.

$$CH_3CH_2OH + CH_3COOH \xrightarrow{\text{conc. } H_2SO_4} \underset{\text{Ester}}{CH_3COOC_2H_5} + H_2O$$

(v) Esters react in the presence of an acid or a base to give the alcohol and carboxylic acid. This reaction is known as saponification because it is used in the preparation of soap.

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

102.(i) Ethanol reacts with sodium to produce sodium ethoxide and hydrogen gas.

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

(ii) Pure acetic acid is known as glacial acetic acid. The melting point of pure ethanoic acid is 290 K and hence it often freezes during winter in cold

climates. This gives rise to its name glacial acetic acid.

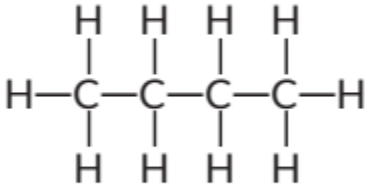
(iii) $CH_3CH_2OH + H_2SO_4(conc.) \xrightarrow{443\ K} CH_2 = CH_2 + H_2O$

Ethanol on heating with excess of concentrated sulphuric acid at 443 K, releases water molecule to form ethene. In this reaction, concentrated sulphuric acid acts as dehydrating agent.

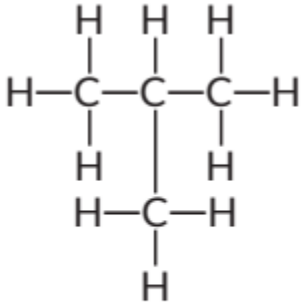
(iv) Esters in the presence of alkali (NaOH) give alcohol and sodium salt of carboxylic acid. This process is known as saponification because it is used in the preparation of soaps.

$CH_3COOC_2H_5 \xrightarrow{NaOH} C_2H_5OH + CH_3COONa$

103. (a) Isomers are those molecules which have the same molecular formula but different structural formulae i.e., show different properties and the phenomenon is called isomerism. The structures of possible isomers of butane (C_4H_{10}) are :



n-Butane
(I)



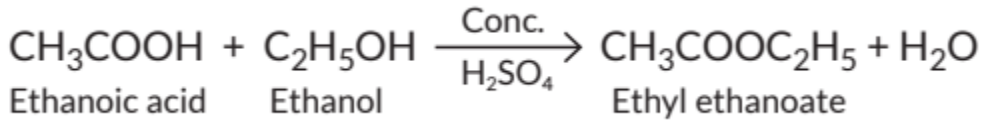
2-Methylpropane
(II)

(b) The compound 'X' is an unsaturated compound (alkene or alkyne) which burn in air with a yellow sooty flame (producing black smoke).

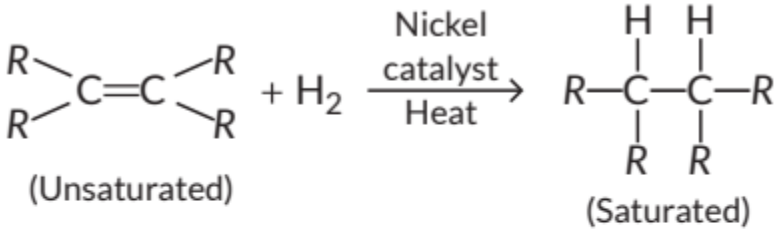
(c) Alkaline $KMnO_4$ acts as an oxidising agent which oxidise alcohol (-OH) to corresponding carboxylic acid (-COOH).

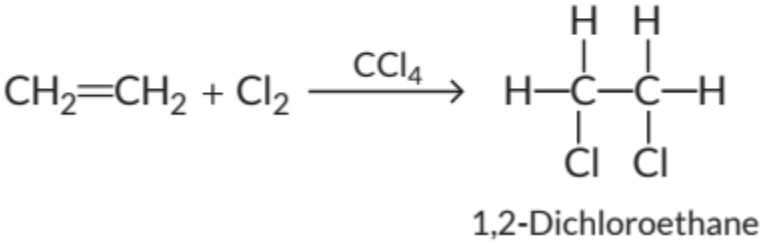
104. (a) A homologous series is the family of organic compounds having the same functional group, similar chemical properties but the successive (adjacent) members of the series differ by a $-CH_2$ unit or 14 mass units. For example, alkane series has general formula C_nH_{2n+2} First member of homologous series of alkane is methane,
i.e., CH_4.
Second member of homologous series of alkane is ethane,

i.e., C_2H_6.
Third member of homologous series of alkane is propane
i.e., C_3Hg.
(b) (i) Carboxylic acids react with alcohols in the presence of a little concentrated sulphuric acid to form pleasant smelling esters. This reaction is called esterification reaction.

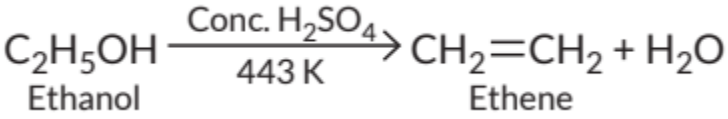


(ii) Those reactions in which atoms or group of atoms are simply added to a double or triple bond without the elimination of any atom or molecule, are known as addition reactions.

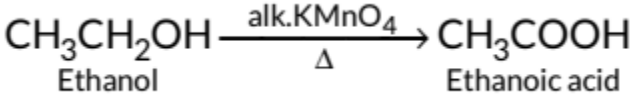




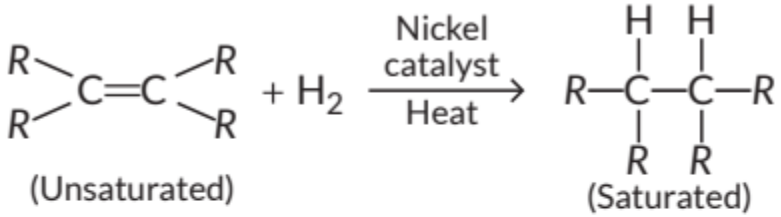
105. (a) (i) When ethanol is heated with conc. H2SO4 at 443 K, ethene is obtained due to dehydration of ethanol.

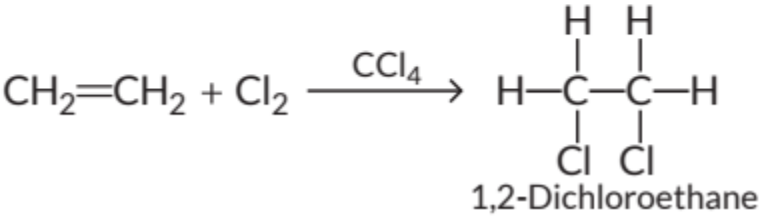


(ii) When 5% alkaline KMnO4 solution is added drop by drop to warm ethanol then it gets oxidised to ethanoic acid.

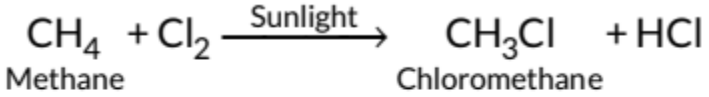


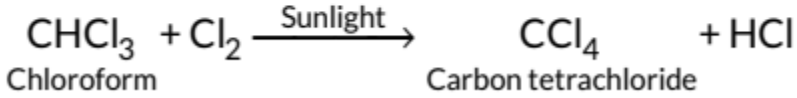
(b) Addition reactions : Those reactions in which atoms or group of atoms are simply added to a double or triple bond without the elimination of any atom or molecule, are known as addition reactions.





Substitution reactions: The reactions which involve the displacement or substitution of an atom or a group of atoms in an organic compound by another atom or group of atoms, are known as substitution reactions. Saturated hydrocarbons are fairly unreactive and inert in the presence of most of the reagents. However, in presence of sunlight, hydrocarbons undergo rapid substitution reactions. e.g.,





106. Ethanol having chemical formula C_2H_5OH is the active ingredient of all alcoholic drinks.

Uses of ethanol:
1. Ethanol is widely used in industry as a solvent.
2. Ethanol is used as an antiseptic for wounds in the form of rectified spirit.

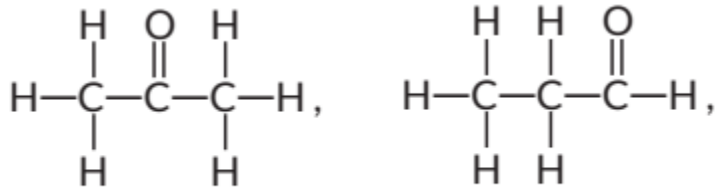
Chemical equations:
(i) When a small piece of sodium is dropped into ethanol then hydrogen gas is liberated which burns with a pop sound.

$$2C_2H_5OH + 2Na \longrightarrow 2C_2H_5O^-Na^+ + H_2\uparrow$$

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

107.(a) Isomers are those molecules which have the same molecular formula but different structural formula i.e., show different properties.

(b) Two possible isomers of the compound, C3H6O are:



Propanone

Propanal

(c) (i) When ethanol is heated with conc. H_2SO_4 at 443 K, ethene is obtained due to dehydration of ethanol.

$$\underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow[443\ K]{Conc.\ H_2SO_4} \underset{\text{Ethene}}{CH_2=CH_2} + H_2O$$

(ii) $$\underset{\text{Propanol}}{CH_3CH_2CH_2OH} \xrightarrow[\Delta]{Alk.\ KMnO_4} \underset{\text{Propanoic acid}}{CH_3CH_2COOH}$$

108. When ethanol is heated with excess of concentrated H_2SO_4 it gets dehydrated to form ethene.

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

When ethene is heated with hydrogen in presence of nickel catalyst it forms ethane.

$$\underset{\substack{\text{Ethene}\\(Q)}}{CH_2=CH_2} + H_2 \xrightarrow[catalyst]{Nickel} \underset{\substack{\text{Ethane}\\(R)}}{CH_3-CH_3}$$

Ethane on oxidation gives two moles of carbon dioxide and three moles of water.

$$CH_3CH_3 + \frac{7}{2}O_2 \longrightarrow 2CO_2 + 3H_2O + \text{Heat} + \text{Light}$$

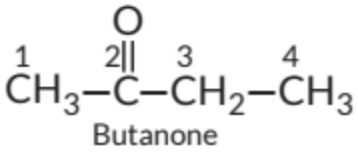
109.(c)

110. (a) As the molecular mass of 'Y' is 30 g mol^1, it is ethane ($C_2H_6 = 12 \times 2 + 6 \times 1 = 30$). 'X' is ethene ($CH_2 = CH_2$) which decolourises Br_2-water and burns with a smoky flame.

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

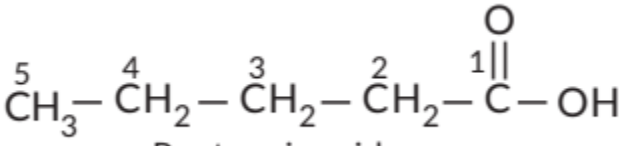
$$\underset{\text{Ethene (X)}}{CH_2{=}CH_2} + \underset{\text{Orange}}{Br_{2(aq)}} \xrightarrow{\text{Water}} \underset{\text{(Colourless)}}{CH_2(Br){-}CH_2(Br)}$$

(b) (i)



Butanone

(ii)



Pentanoic acid

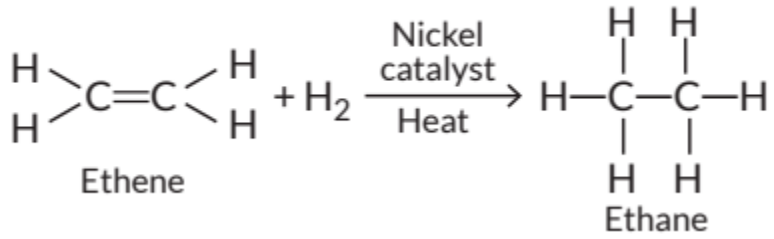
(c) No, we are not able to check if water is hard by using a detergent as detergent works well in hard water as well. This is because calcium and magnesium salts of detergents are soluble in water and hence, detergents can be used for washing even in hard water.

111. (a) (i) Oxidation of ethanol to ethanoic acid :

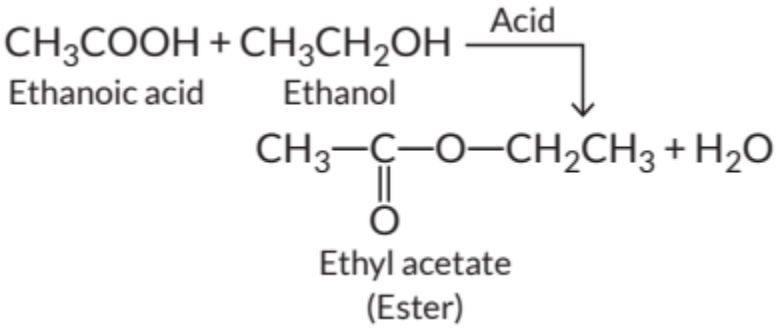
$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[\text{or acidified } K_2Cr_2O_7 \text{ + Heat}]{\text{Alk. } KMnO_4 \text{ + Heat}} \underset{\text{Ethanoic acid}}{CH_3COOH}$$

Here, alkaline $KMnO_4$ or acidified K_2Cr2O7 dichromate are oxidising agents.

(ii) Addition reaction:

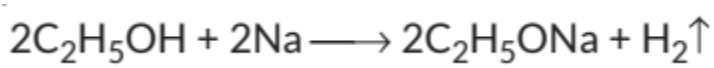


(iii) Esterification:



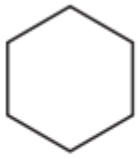
(b) Detergents work well with hard water and are biodegradable.

112. (a) Refer to Quick Recap.
(b) Ethanol reacts with Na metal and forms sodium ethoxide and hydrogen gas is liberated which burns with a pop sound.



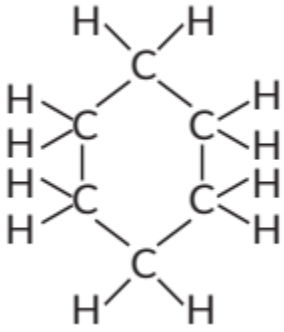
This represents the acidic behaviour of ethanol.

(c)



Cyclohexane (C_6H_{12})

or

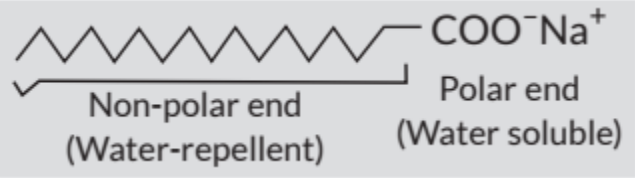


(d) The compound is known as ethanal.

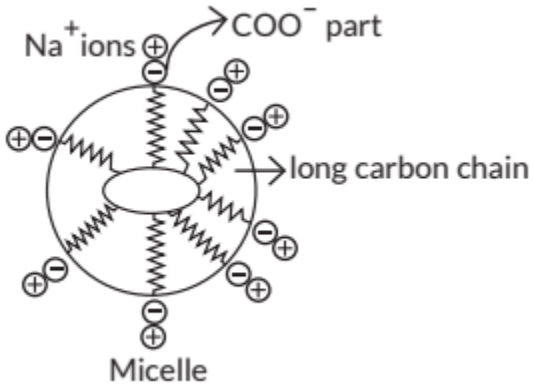
113. Soaps are the sodium or potassium salts of higher fatty acids. The ionic group in soaps is $-COO^-Na^+$.

On the other hand, synthetic detergents are the sodium salts of a long chain alkylbenzenesulphonic acids or long chain alkyl hydrogen sulphates. The ionic group in synthetic detergents is-SO_3 Na+ or -OSO, Na^+

Cleansing action of soap:
A soap molecule contains a polar part (COO^-Na^+) called polar end and a non-polar part consisting of a long chain carbon atoms. This part is called hydrocarbon end. The polar end is water soluble whereas hydrocarbon part is water-repellent and oil soluble.



When an oily (dirty) piece of cloth is put into soap solution, the hydrocarbon part of the molecule attaches itself to the oily drop and the $-COO^-$ end orients itself towards water. Na^+ ions in solution arrange themselves around the $-COO^-$ ions. The negatively charged micelle so formed entraps the oily dirt. The negatively charged micelle repel each other due to the electrostatic repulsion. As a result, the tiny oily dirt particles do not come together and get washed away in water during rinsing.



In hard water, soap does not form lather as hard water contains Ca^{2+} and Mg^{2+} ions. Soap reacts with these ions to form insoluble calcium and magnesium salts of fatty acids.

$$\underset{\text{Soap}}{RCOO^-Na^+} + Ca^{2+}_{(aq)} \rightarrow \underset{\text{Insoluble ppt.}}{(RCOO)_2Ca\downarrow} + 2Na^+$$

Two problems which arise due to the use of detergents instead of soaps are:
(i) Synthetic detergents are non-biodegradable and hence, cause water pollution.
(ii) Synthetic detergents also cause skin related problems.

114. A micelle is a submicroscopic aggregate of molecules with non-polar groups on the inside and hydrophilic groups on the outside. If ethanol is used in place of water, micelle will not be formed as the solution will not have any polar part.

115. (a) The tests may be tabulated as below:

S. No.	Solution	Blue litmus paper	Red litmus paper	Sodium Metal
1.	Ethanol	No change	No change	Hydrogen gas
2.	Ethanoic acid	Turns red	No change	Hydrogen gas
3.	Soap solution	No change	Turns blue	No reaction

(b) Hard water contains hydrogen carbonates, chlorides and sulphates of calcium and magnesium. When soap is added to hard water it reacts with these salts to form scum which is insoluble in water and floats on the top of the water surface. The scum is formed due to the formation of insoluble calcium or magnesium salts of fatty acids.

$$\underset{\text{Sodium stearate (soap)}}{2C_{17}H_{35}COONa} + \underset{\text{(From hard water)}}{Ca^{2+}} \longrightarrow \underset{\text{Calcium stearate (ppt. or scum)}}{(C_{17}H_{35}COO)_2Ca} + 2Na^{+}$$

CBSE Sample Questions

1. (a): In a homologous series, chemical properties of members remain same as they are having same functional group. (1)

2. (a) Elements P and R will form covalent bond as both are non-metals. (1/2 + 1/2)

(b) Carbon forms several compounds because it has valency four (tetravalency) and can form long chains (catenation). (1/2 + 1/2)

3. Carbon forms large number of compounds due to
(i) its unique property of self-linking of carbon atoms, i.e., catenation. (1)
(ii) its small size, it forms very strong and stable bonds with other elements and can also form multiple bonds with C, O, S and N atoms. (1)

4. (a) Four structural isomers of compound C4Hg are possible as follows: (1/2)

(i) $CH_3CH_2CH{=}CH_2$ 1-Butene

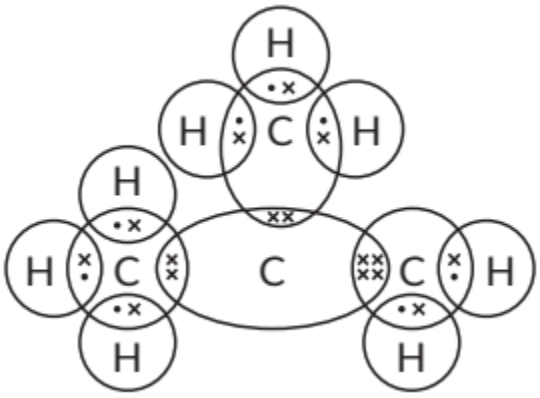
(ii) $CH_3CH{=}CHCH_3$ 2-Butene

(iii) $CH_3{-}C(CH_3){=}CH_2$ 2-Methylpropene

(iv) Cyclobutane

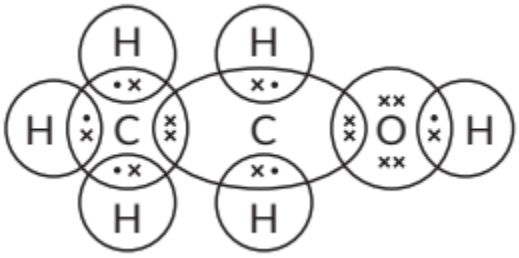
(1/2)

The electron dot structure of 2-methylpropene is



(b) Both C_4Hg and C_5H_{10} are homologues. (1/2) C_4H_8 and C_5H_{10} differ by $-CH_2$ group. They possess the same general formula C_nH_{2n} and show similar chemical properties and gradation in physical properties such as melting point, boiling point, density etc. hence they belong to same homologous series. (1/2 + 1/2)

5. (a) The compound 'A' with melting point 156 K and boiling point 351 K is ethanol i.e. CH_3CH_2OH. The electron dot structure is (1)



(b) The compounds of homologous series have similar chemical properties, but gradually changing physical properties. Thus the molecular formulae of two homologues of A are $CH_3CH_2CH_2OH$ or (CHO) and C_4H100 or $CH_3CH_2CH_2CH_2OH$. (1)

6. On burning a compound containing carbon, CO_2 gas is evolved which when passed through lime water, it turns milky due to formation of $CaCO_3$. (1)
As carbon has four valence electrons and it can neither loose nor gain four electrons thus, it attains noble gas configuration only by sharing of electrons with other elements and forms covalent compounds. (1)

7. (c): Addition of hydrogen in presence of catalyst changes A to C. (1)

8. (a) A- Ethanoic acid/any other carboxylic acid, C - Sodium salt of ethanoic acid (sodium ethanoate)/salt of any other carboxylic acid (1/2 + 1/2)
(b) Use of ethanoic acid- dil solution used as vinegar in cooking/preservative in pickles. Use of ester - making perfumes, flavoring agent

(1/2 + 1/2)

(c) $\underset{(A)}{CH_3COOH} + C_2H_5OH \xrightarrow[H_2SO_4]{\text{Conc.}} \underset{(B)}{CH_3COOC_2H_5} + H_2O$

(Esterification)

(1½)

$\underset{(B)}{CH_3COOC_2H_5} + NaOH \longrightarrow \underset{(C)}{CH_3COONa} + C_2H_5OH$

(Saponification) **(1½)**

OR

(a) Sulphuric acid acts as a dehydrating agent.

$$C_2H_5OH \xrightarrow[443K]{\text{conc. } H_2SO_4,} CH_2{=}CH_2 + H_2O \qquad \textbf{(1)}$$

(b) By reaction with sodium carbonate/ bicarbonate with the samples, ethanol will not react whereas ethanoic acid gives brisk effervescence. (1)

$2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + H_2O + CO_2$ (1)
$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$ (1)