

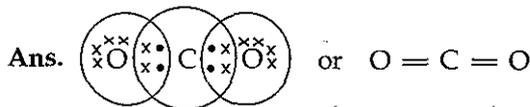
# Carbon and Its Compounds

[NCERT CHAPTER 4]

## TEXTBOOK QUESTIONS

[A] QUESTIONS GIVEN ON PAGE NUMBER 61 OF THE TEXTBOOK

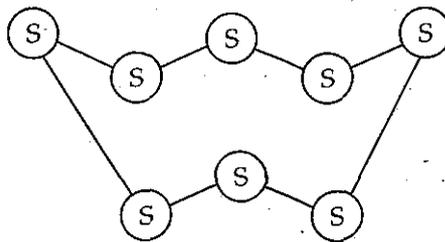
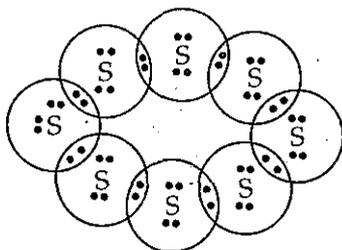
Q.1. What would be the electron dot structure of carbon dioxide which has the formula  $\text{CO}_2$  ?



Q.2. What would be the electron dot structure of a molecule of sulphur which is made up of eight atoms of sulphur ?

[Hint : The eight atoms of sulphur are joined together in the form of a ring.]

Ans.

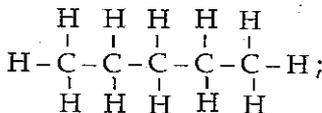


$\text{S}_8$  molecule

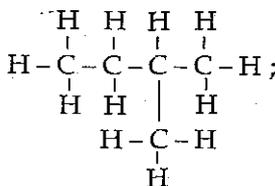
[B] QUESTIONS GIVEN ON PAGE NUMBER 68 OF THE TEXTBOOK

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

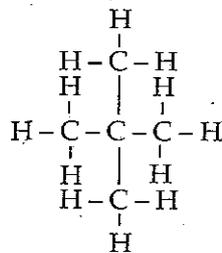
Ans. The isomers are as under :



(i) *n*-pentane



(ii) *iso*-pentane



(iii) *neo*-pentane

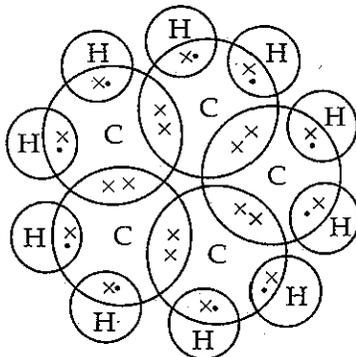
Q.2. What are the two properties of carbon which lead to the huge number of carbon compounds we see around us ?

Ans. The two properties are :

- (a) Catenation, the ability to form bonds with other atoms of carbon.
- (b) Tetravalency of carbon.

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

Ans. Formula of cyclopentane is  $C_5H_{10}$ . The electron dot structure of cyclopentane is :

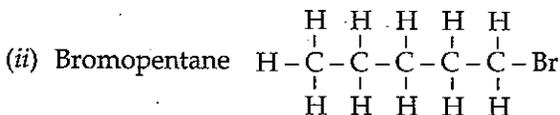
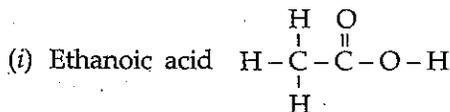


Q.4. Draw the structures for the following compounds :

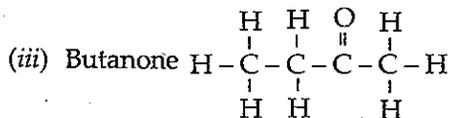
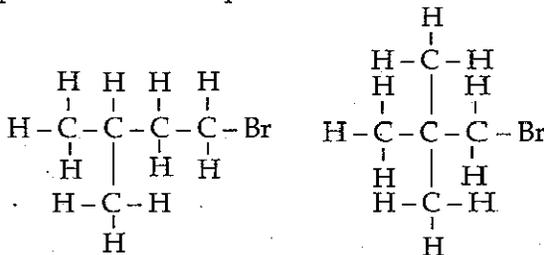
- (i) Ethanoic acid
- (ii) Bromopentane
- (iii) Butanone
- (iv) Hexanal.

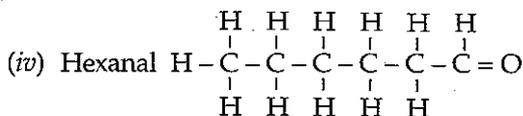
Are structural isomers possible for bromopentane ?

Ans. Structures of compounds are given as under :

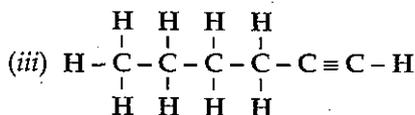


Structural isomers are possible for bromopentane. The other two isomers are :





**Q.5. How would you name the following compounds ?**



**Ans. (i) Bromoethane**

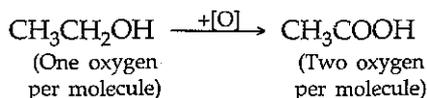
**(ii) Methanal**

**(iii) Hexyne**

**[C] QUESTIONS GIVEN ON PAGE NUMBER 71 OF THE TEXTBOOK**

**Q.1. Why is the conversion of ethanol to ethanoic acid an oxidation reaction ?**

**Ans.** Oxygen has been added to the molecule of ethanol in the conversion to ethanoic acid.



Therefore, it is an oxidation reaction.

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

**Ans.** Combustion of ethyne with oxygen is an exothermic reaction. A lot of heat is evolved which is used in welding.

Air contains a mixture of oxygen + nitrogen. Nitrogen does not help in combustion. Therefore, heat evolved when ethyne burns in air will be much less than when it burns in oxygen.

**[D] QUESTIONS GIVEN ON PAGE NUMBER 74 OF THE TEXTBOOK**

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

**Ans.** Take the samples in two test tubes. Add 5 mL of saturated solution of sodium bicarbonate solution to the two test tubes separately.

The tube in which a brisk effervescence, due to the evolution of carbon dioxide, takes place contains the carboxylic acid.

Thus, the other tube contains the alcohol.

**Q.2. What are oxidising agents ?**

**Ans.** Substances which bring about oxidation of a substance (addition of oxygen) are called oxidising agents. For example, alkaline  $\text{KMnO}_4$  or acidified  $\text{K}_2\text{Cr}_2\text{O}_7$  solution is an oxidising agent for the conversion of ethanol to ethanoic acid.

**[E] QUESTIONS GIVEN ON PAGE NUMBER 76 OF THE TEXTBOOK**

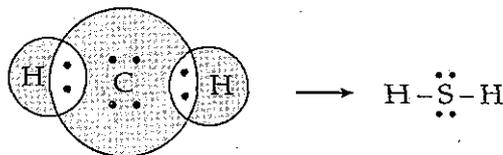
**Q.1. Would you be able to check if water is hard by using a detergent ?**

**Ans.** No, we would not be able to check if water is hard by using a detergent.

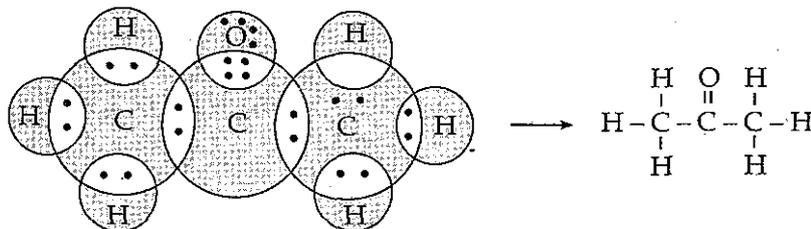
**Q.2. People use a variety of methods to wash clothes. Usually after adding the soap, they 'beat' the clothes on a stone, or beat it with a paddle, scrub with a brush or the mixture is agitated in a washing machine. Why is agitation necessary to get clean clothes ?**



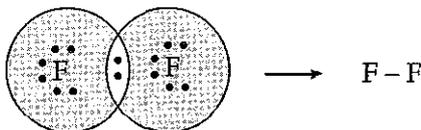
(b) H<sub>2</sub>S



(c) Propanone



(d) F<sub>2</sub>



**Q.6. What is an homologous series ? Explain with an example.**

**Ans.** Series of compounds in which the same functional group substitutes for hydrogen in a carbon chain is called a homologous series. CH<sub>3</sub>OH, C<sub>2</sub>H<sub>5</sub>OH and C<sub>3</sub>H<sub>7</sub>OH is an example of homologous series. The difference between the formulae of any two successive members is -CH<sub>2</sub> while the difference between the molecular masses is 14 u.

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

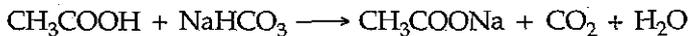
**Ans.** On the basis of physical properties.

Melting and boiling points of the two compounds are different. By determining their m.p. and b.p., the two compounds can be differentiated. The values are given as under :

Compound	Melting Point (K)	Boiling Point (K)
Ethanol	156	351
Ethanoic acid	290	391

**On the basis of chemical properties.**

Ethanoic acid reacts with sodium hydrogencarbonate liberating carbon dioxide while ethanol does not.



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

**Ans.** Soap is sodium salt of long chain fatty acid. Two ends of soap molecule have differing properties. The ionic end is hydrophilic *i.e.*, it dissolves in water while the hydrocarbon chain is hydrophobic *i.e.*, it dissolves in hydrocarbon. The hydrocarbon chains are oriented towards the oil droplet while the ionic ends are oriented towards water.

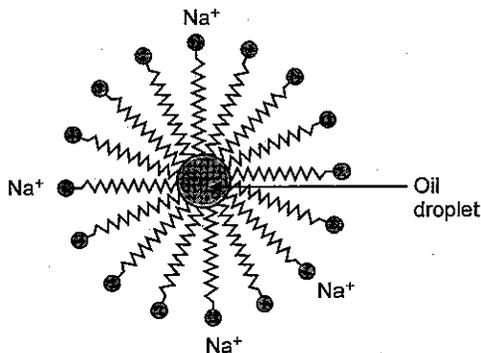


Fig. 4.7 Formation of micelles

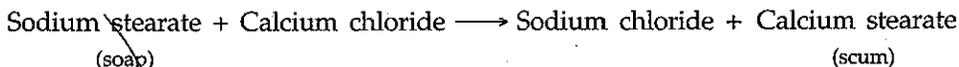
Micelle formation will not take place in ethanol.

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

**Ans.** Carbon on combustion gives carbon dioxide and water. This reaction is accompanied by evolution of heat and light. The same is true for compounds of carbon. That is why carbon and its compounds are used as fuels for most applications.

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

**Ans.** Hard water contains hydrogencarbonates, chlorides and sulphates of calcium and magnesium which react with soap to form scum. For example, calcium chloride reacts with soap to form scum.



Formation of scum hinders the formation of foam. Soap is thus unable to clean in hard water.

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

**Ans.** Soap is sodium salt of fatty acid (like stearic acid). It is obtained by treatment of oil with caustic soda. Sodium stearate (soap) is thus a salt of weak acid and strong base. Its water solution will be slightly alkaline and will turn red litmus blue.

**Q.12. What is hydrogenation ? What is its industrial application ?**

**Ans.** Unsaturated hydrocarbons add hydrogen in the presence of catalysts such as palladium or nickel to give saturated hydrocarbons. This process is called hydrogenation. It is commonly used in the hydrogenation of vegetable oils using nickel as catalyst, to produce 'vanaspati ghee'.

**Q.13. Which of the following hydrocarbons undergo addition reactions.**



**Ans.** Unsaturated hydrocarbons undergo addition reactions.

Thus  $\text{C}_3\text{H}_6$  and  $\text{C}_2\text{H}_2$  will undergo addition reactions.

**Q.14. Give a test that can be used to differentiate chemically between butter and cooking oil.**

**Ans.** Butter and cooking oil can be differentiated with the help of bromine water test. Cooking oil will decolourise the red colour of bromine water on shaking while butter will not.

**Q.15. Explain the mechanism of the cleaning action of soaps.**

**Ans.** Soaps are sodium salts of fatty acids. The two ends of molecule of soap behave differently. The ionic end is hydrophilic and it is oriented towards water. The other hydrocarbon end is hydrophobic and it is oriented towards dirt which is only in nature. A micelle formation

around the oily dirt takes place. When flushed with excess water, the micelle containing the dirt is removed, thus cleaning the clothes, etc.

## MULTIPLE CHOICE TYPE QUESTIONS

### Q.1. Most carbon compounds

- (a) are poor conductors of electricity and have high boiling points.
- (b) are good conductors of electricity and have high boiling points.
- (c) are poor conductors of electricity and have low boiling points.
- (d) are good conductors of electricity and have low boiling points.

### Q.2. Ethane with the molecular formula $C_2H_6$ has

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

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

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

### Q.4. Butanone is a four-carbon compound with the functional group

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

### Q.5. Carbon forms bonds with other atoms

- (a) by gaining electrons.
- (b) by losing electrons.
- (c) by sharing electrons.
- (d) none of the above.

### Q.6. In the formation of nitrogen molecule,

- (a) one pair of electrons are shared.
- (b) two pairs of electrons are shared.
- (c) three pairs of electrons are shared.
- (d) four pairs of electrons are shared.

### Q.7. Which of the following are allotropes of carbon ?

- (a) Graphite
- (b) Diamond
- (c) Fullerene
- (d) All of the above

Q.8. The number of carbon compounds whose formulae are known to the chemists is approximately

- (a) one million
- (b) two million
- (c) three million
- (d) four million

### Q.9. Which of the following compounds of carbon are studied under organic chemistry ?

- (a) Oxides of carbon
- (b) Hydrocarbons
- (c) Carbonates
- (d) Hydrogencarbonates

### Q.10. The following features of carbon give rise to a large number of carbon compounds

- (a) allotropy and tetravalency
- (b) allotropy and catenation
- (c) allotropy and small size
- (d) tetravalency and catenation

### Q.11. The number of carbon-carbon bonds and carbon-hydrogen bonds in propane are

- (a) 2 and 8 respectively
- (b) 8 and 2 respectively
- (c) 3 and 8 respectively
- (d) 8 and 3 respectively

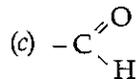
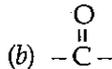
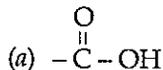
### Q.12. Benzene is

- (a) a straight chain hydrocarbon having the formula  $C_6H_{14}$ .
- (b) an unsaturated compound having the formula  $C_6H_{12}$ .

(c) a branched chain hydrocarbon having the formula  $C_6H_{14}$ .

(d) a ring compound having the formula  $C_6H_6$ .

**Q.13. A carboxy group has the structure**



(d) None of the above

**Q.14. The difference in the molecular mass of the successive members of a homologous series of organic compounds is**

(a) 12 u

(b) 14 u

(c) 16 u

(d) 18 u

**Q.15. The combustion of a hydrocarbon is accompanied by**

(a) heat

(b) light

(c) heat and light both

(d) neither of them

**Q.16. Tick the wrong statement.**

(a) Saturated hydrocarbons burn with a clean flame.

(b) Unsaturated hydrocarbons burn with a yellow colour.

(c) Greater the unsaturation in the hydrocarbon, more will be the soot produced.

(d) There is no relation between unsaturation and the soot produced.

**Q.17. A flame is produced when**

(a) a gaseous substance is burnt.

(b) a liquid substance is burnt.

(c) a solid substance is burnt.

(d) a semi-solid substance is burnt.

**Q.18. On addition of alkaline  $KMnO_4$  to warm ethanol, the pink colour**

(a) changes to green.

(b) changes to blue

(c) disappears

(d) deepens

**Q.19. Tick the wrong statement :**

**Drinking alcohol results in**

(a) lack of coordination

(b) mental confusion

(c) drowsiness

(d) gaining energy

**Q.20. Sweet-smelling substances are provided by**

(a) alcohols

(b) esters

(c) phenols

(d) carboxy acids

**Q.21. In which of the following compounds,  $-\text{OH}$  is the functional group ?**

(a) Butanone

(b) Butanol

(c) Butanoic acid

(d) Butanal

**Q.22. The soap molecule has a**

(a) hydrophilic head and a hydrophobic tail.

(b) hydrophobic head and a hydrophilic tail.

(c) hydrophobic head and a hydrophobic tail.

(d) hydrophilic head and a hydrophilic tail.

**Q.23. Carbon exists in the atmosphere in the form of**

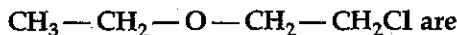
(a) carbon monoxide only.

(b) carbon monoxide in traces and carbon dioxide.

(c) carbon dioxide only.

(d) coal.

- Q.24. Oils on treating with hydrogen in the presence of palladium or nickel catalyst form fats. This is an example of**
- (a) addition reaction (b) substitution reaction  
(c) displacement reaction (d) oxidation reaction
- Q.25. A molecule of ammonia (NH<sub>3</sub>) has**
- (a) only single bonds. (b) only double bonds.  
(c) only triple bonds. (d) two double bonds and a single bond.
- Q.26. Buckminsterfullerene is an allotropic form of**
- (a) phosphorus (b) sulphur  
(c) carbon (d) tin
- Q.27. Chlorine reacts with unsaturated hydrocarbons at room temperature in the**
- (a) absence of sunlight. (b) presence of sunlight.  
(c) presence of water. (d) presence of hydrochloric acid.
- Q.28. Ethanol reacts with sodium and forms two products. These are**
- (a) sodium ethanoate and hydrogen (b) sodium ethanoate and oxygen  
(c) sodium ethoxide and hydrogen (d) sodium ethoxide and oxygen
- Q.29. Vinegar is a solution of**
- (a) 50 – 60% acetic acid in alcohol (b) 5 – 8% acetic acid in alcohol  
(c) 5 – 8% acetic acid in water (d) 50 – 60% acetic acid in water
- Q.30. The heteroatoms present in**

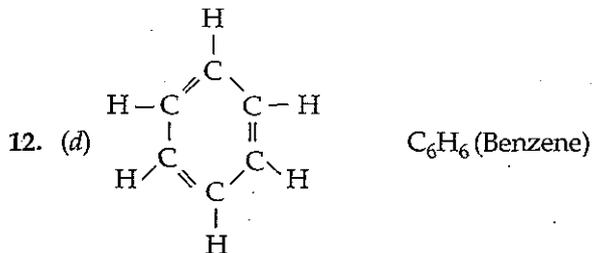
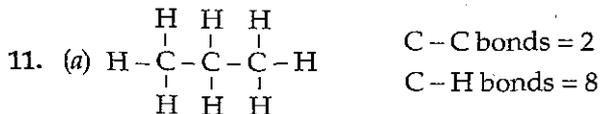


- (i) oxygen (ii) carbon  
(iii) hydrogen (iv) chlorine  
(a) (i) and (ii) (b) (ii) and (iii)  
(c) (iii) and (iv) (d) (i) and (iv)

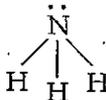
### ANSWERS AND EXPLANATIONS

- (c) Organic compounds have covalent bonding in their molecules. Such compounds are poor conductors of electricity and have low boiling points.
- (b) 
$$\begin{array}{c} \text{H} \quad \text{H} \\ | \quad | \\ \text{H} - \text{C} - \text{C} - \text{H} \\ | \quad | \\ \text{H} \quad \text{H} \end{array}$$
 There are 7 covalent bonds in the compound.
- (b) Because of insufficient air, the fuel is not burning completely.
- (c)  $\text{CH}_3\text{COCH}_2\text{CH}_3$   
Butanone  
It contains a ketonic group.
- (c) Carbon forms bonds with other atoms by sharing electrons because it requires lot of energy to remove four electrons. Adding four electrons to carbon destabilises it. Therefore, it completes its octet by sharing electrons.
- (c)  $\text{N}::\text{N}$ , Three pairs of electrons are shared.
- (d) All the three are allotropes of carbon.
- (c) Three million is the correct answer.
- (b) Out of the given compounds, hydrocarbons are studied under organic chemistry.

10. (d) Tetravalency and catenation both give rise to a large number of carbon.

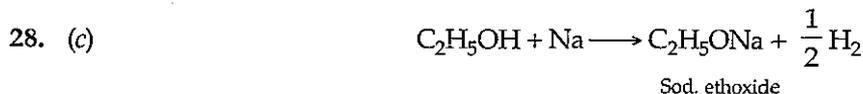


13. (a) Carboxy group has the structure  $-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$ .
14. (b) The successive members of a series differ by CH<sub>2</sub>, i.e., 14 u.
15. (c) Both heat and light emitted when a hydrocarbon burns.
16. (d) Greater the unsaturation, greater is the soot produced.
17. (a) A flame is produced when a gaseous substance is burnt.
18. (c) The pink colour of KMnO<sub>4</sub> disappears when it is added to warm alcohol. Alcohol changes to acid and KMnO<sub>4</sub> is reduced.
19. (d) This is the wrong statement.
20. (b) Esters are sweet smelling compounds.
21. (b) Formula of butanol is CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OH, which contains an -OH group.
22. (a) The soap molecule has a hydrophilic head which is directed towards water and a hydrophobic tail which is directed towards dirt (oil).
23. (b) We have traces of carbon monoxide in the atmosphere due to incomplete burning of fuels and carbon dioxide due to complete burning of fuels and respiration of animals.
24. (a) There are double bonds in oils. Addition of hydrogen takes place to give saturated fats.
25. (a) The structure of ammonia (NH<sub>3</sub>) is



It contains single bonds only.

26. (c) Buckminsterfullerene is an allotropic form of carbon. It resembles the geodesic dome designed by Buckminster.
27. (b) Addition of chlorine with unsaturated hydrocarbons at room temperature takes place in the presence of light.



29. (c) Vinegar is a solution of 5 - 8% acetic acid in water.
30. (d) Oxygen and chlorine are heteroatoms in the compound.

## OTHER IMPORTANT QUESTIONS

### (A) Very Short Answer Type Questions (One Mark Each)

Q.1. Give the names of the functional groups :

(i) - CHO

(ii)  $\overset{\text{O}}{\parallel}{\text{C}}$

[Delhi 2007]

Ans. (i) Aldehydic group

(ii) Ketonic group.

Q.2. Give the names of the following functional groups :

(i) - OH

(ii) - COOH

[Delhi 2007]

Ans. (i) Alcoholic group

(ii) Carboxylic acid group.

Q.3. Name the product other than water formed on burning ethanol in air. [A.I. 2006]

Ans. Carbon dioxide.

Q.4. Name the functional group present in propanone (acetone). [Delhi 2006 C]

Ans. Ketonic group  $\overset{\text{O}}{\parallel}{\text{C}}$ .

Q.5. Name the organic compound which can be produced by fermentation of sugar and is a constituent of beer. [Delhi 2005 C]

Ans. Ethanol (C<sub>2</sub>H<sub>5</sub>OH).

Q.6. Write the formulation for the functional groups of alcohols and carboxylic acids. [Delhi 2004]

Ans. Alcohols - OH, carboxylic acids - COOH.

Q.7. Write the (i) name and (ii) formula of the functional group present in the compound, CH<sub>3</sub>COOH. [Delhi 2004]

Ans. Carboxylic acid (- COOH).

Q.8. Name the main product formed when ethanol is oxidised by an alkaline solution of KMnO<sub>4</sub>. [Delhi 2004]

Ans. Ethanoic acid (CH<sub>3</sub>COOH).

Q.9. Complete the following equation :



Ans.  $2\text{CH}_3\text{CH}_2\text{OH} + 2\text{Na} \longrightarrow 2\text{CH}_3\text{CH}_2\text{ONa} + \text{H}_2$   
Sodium ethoxide

Q.10. Name the organic compound classes associated with the following functional groups :

(i) - CHO

(ii) - OH

[Foreign 2004]

Ans. (i) Aldehydes

(ii) Alcohols.

Q.11. What is denatured alcohol ? [Delhi 2004 C]

Ans. Alcohol which has been made unfit for drinking either by mixing a small amount of methanol or by the addition of a dye, is called denatured alcohol.

Q.12. Which gas will be evolved if sodium bicarbonate is added to a solution of tartaric acid ? [Delhi 2002 C]

Ans. Carbon dioxide.

Q.13. What happens when soap solution in a test tube is shaken with

(i) soft water

(ii) hard water ? [CBSE Sample Paper 2002]

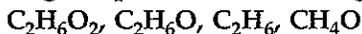
Ans. (i) We obtain lot of foam with soft water.

(ii) We obtain a curdy precipitate (scum) with hard water.

Q.14. What is observed when bromine water is added to ethene ?

Ans. Colour of bromine is discharged.

Q.15. Which two of the following compounds could belong to the same homologous series ?



Ans.  $C_2H_6O$  and  $CH_4O$  having difference in molecular formula equal to  $-CH_2$  belong to the same homologous series of alcohols ( $C_2H_5OH$  and  $CH_3OH$ ).

Q.16. Write the names of two alkenes, one having three carbon atoms and the other having four carbon atoms.

Ans. Propene and butene.

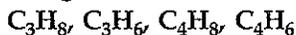
Q.17. A test tube contains a brown liquid in it. The colour of the liquid remains the same when methane is passed through it but it disappears when ethene is passed. Suggest the name of the substance giving brown colour to the liquid.

Ans. Bromine.

Q.18. Name the process by which unsaturated oils are converted into saturated fats.

Ans. Hydrogenation in the presence of nickel.

Q.19. Which of the following belong to the same homologous series ?



Ans.  $C_3H_6$  and  $C_4H_8$  differing in molecular formula by  $-CH_2$  belong to the same homologous series.

Q.20. What is catenation ?

Ans. The property of carbon to link with other carbon atom forming straight chain, branched chain or ring compounds is called catenation.

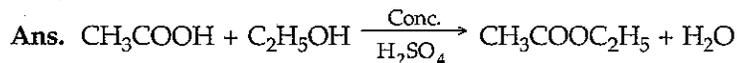
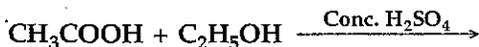
Q.21. Why is oxy-acetylene flame used for welding purposes ?

Ans. Combustion of acetylene with oxygen is an exothermic process. A lot of heat is evolved in the reaction which is used for welding.

Q.22. Which alcohol is used in cough syrups and tonics ?

Ans. Ethanol ( $C_2H_5OH$ ).

Q.23. Complete the reaction :



Q.24. A vegetable oil contains two double bonds in its molecule. How many moles of hydrogen gas are required for complete hydrogenation of one mole of oil ?

Ans. 2 moles.

Q.25. When methane burns, \_\_\_\_\_ and \_\_\_\_\_ are formed.

Ans. Carbon dioxide and water.

Q.26. Write the molecular formula of the third member of the homologous series of carbon compounds with general formula  $C_n H_{2n+1} OH$ .

Ans.  $C_3H_{2 \times 3 + 1} OH$  i.e.,  $C_3H_7OH$ .

Q.27. Which of the following are carboxylic acids ?



Ans. Carboxylic acids contain two oxygen atoms in their molecules. Therefore,  $\text{C}_2\text{H}_4\text{O}_2$  and  $\text{C}_3\text{H}_6\text{O}_2$  are carboxylic acids.

Q.28. What is meant by saponification ?

Ans. Hydrolysis of an ester to produce an alcohol and a carboxylic acid in the presence of an acid or base is called saponification.

Q.29. Give one advantage of detergent over soap.

Ans. Detergent can work with hard water whereas soap cannot.

Q.30. What is vinegar ?

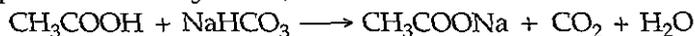
Ans. 5-8% solution of acetic acid in water is called vinegar.

Q.31. What is the effect of drinking methanol ?

Ans. It causes the protoplasm to be coagulated causing death. It also affects the optic nerve causing blindness.

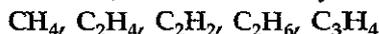
Q.32. An organic compound A of the formula  $\text{C}_2\text{H}_4\text{O}_2$  turns blue litmus red and gives brisk effervescence with  $\text{NaHCO}_3$ . Identify and give chemical reaction.

Ans. The compound A is  $\text{CH}_3\text{COOH}$ , ethanoic acid.



### (B-I) Short Answer Type Questions (Two Marks Each)

Q.1. Classify the following as alkane, alkene and alkyne :



Ans. Alkane :  $\text{CH}_4, \text{C}_2\text{H}_6$

Alkene :  $\text{C}_2\text{H}_4$

Alkyne :  $\text{C}_2\text{H}_2, \text{C}_3\text{H}_4$

Q.2. What is meant by denatured alcohol ? What is the need to denature alcohol ?

Ans. Potable alcohol (alcoholic beverages) is costly. Government levies high excise duty on the sale of drinking alcohol. But alcohol meant to be used in industries is cheap. To prevent the misuse of industrial alcohol for drinking purposes, alcohol is denatured. That is it made unfit for drinking. This can be done either by mixing methanol to ethanol or adding some dye to it.

Q.3. Explain why carbon generally forms compounds by covalent bonds.

Ans. Carbon has 4 electrons in the valency shell. To complete its octet, it either needs to gain 4 electrons or lose 4 electrons to the other atom. Both these processes are improbable. It requires a lot of energy to remove four electrons from an atom. Similarly, it becomes difficult for the nucleus to hold 4 extra electrons added. Therefore, carbon completes its octet by sharing four electrons with other atoms. Thus, carbon generally forms compounds by covalent bonds.

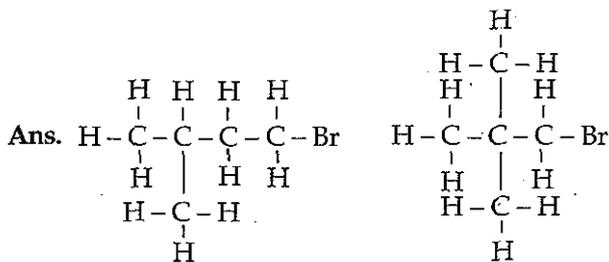
Q.4. Give reason for the formation of large number of carbon compounds.

Ans. There are two reasons for the existence of large number of carbon compounds.

(i) Catenation *i.e.*, ability to form bonds with other carbon atoms to give straight chain, branched chain and ring compounds.

(ii) Tetravalency, *i.e.*, ability of carbon to link with four other monovalent atoms. Also, it has the ability to link with oxygen, sulphur and halogens to form a wide variety of compounds.

Q.5. Write the structural formula of two isomers of  $n$ -pentane  $C_5H_{12}$ .



Q.6. What happens when hydrogen gas is passed through mustard oil in presence of nickel? Mention one difference between physical property of mustard oil and the product so obtained.

Ans. Mustard oil changes into solid fat upon hydrogenation in presence of nickel.

Physical difference between mustard oil and the product fat is while the former is a liquid and the latter is a solid.

Q.7. Acetic acid reacts with ethyl alcohol in the presence of conc.  $H_2SO_4$  producing a sweet smelling compound. For the reaction

(i) Name the main product

(ii) Write the chemical equation.

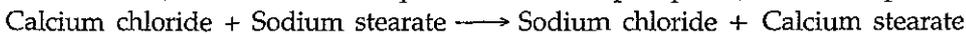
Ans. (i) The main product in the reaction is ethyl acetate or ethyl ethanoate.

(ii) The chemical reaction involved is :



Q.8. Explain why soaps are not effective cleansing agents in hard water.

Ans. Hard water contains hydrogencarbonates, chlorides and sulphates of calcium and magnesium. These salts react with soap to form scum (precipitate). For example



(Soap)

(Scum)

The scum formed hinders the cleansing action of soap.

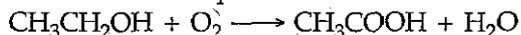
Q.9. Allotropy is a property shown by which class of substances : elements, compounds or mixtures? Give one example of allotropy. [Delhi 2005]

Ans. Allotropy is shown by elements. Carbon exists in the allotropic forms : Diamond, graphite, fullerene, etc.

Q.10. An organic compound A is a constituent of antifreeze. The compound on heating with oxygen forms another compound B which has a molecular formula  $C_2H_4O_2$ . Identify the compounds A and B. Write the chemical equation of the reaction that takes place to form the compound B. [A.I. 2000 C]

Ans. The compound that is used as an antifreeze is ethanol,  $C_2H_5OH$ .

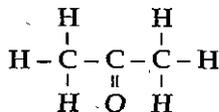
On heating with oxygen, it forms ethanoic acid  $CH_3COOH$ . Thus compound A is ethanol and compound B is ethanoic acid. Chemical equation of the reaction is as follows :



**(B-II) Short Answer Type Questions (Three Marks Each)**

**Q.1. (a) Why are covalent compounds generally poor conductors of electricity ?**

**(b) Name the compound :**



**(c) Name the gas evolved when ethanoic acid is added to sodium carbonate. How would you prove the presence of this gas ?** [A.I. 2008]

**Ans. (a)** Covalent compounds involve covalent bonding. There are no ions in the covalent compounds, hence they are poor conductors of electricity.

**(b)** Propanone.

**(c)** Carbon dioxide gas is evolved which turns lime water milky.

**Q.2. (a) What is a functional group in a carbon compound ? Identify the functional group present in  $\text{CH}_3\text{COOH}$  and  $\text{C}_2\text{H}_5\text{OH}$ .**

**(b) State the principle on which the cleansing action of a soap is based.**

[Foreign 2008]

**Ans. (a)** An atom or a group of atoms which determine the chemical properties of a compound is called functional group. Functional groups present in  $\text{CH}_3\text{COOH}$  and  $\text{C}_2\text{H}_5\text{OH}$  are carboxylic group and alcoholic group.

**(b)** Soap forms a micelle which traps the oily dirt. The micelle containing the dirt is washed away with water.

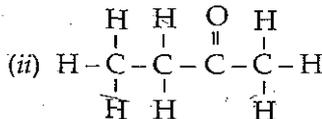
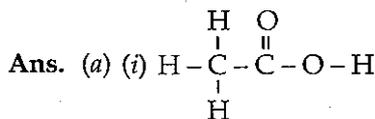
**Q.3. (a) Draw the structures of the following compounds :**

**(i) Ethanoic acid**

**(ii) Butanone**

**(b) Why is conversion of ethanol to ethanoic acid an oxidation reaction ?**

[Foreign 2008]



**(b)  $\text{CH}_3\text{CH}_2\text{OH} \longrightarrow \text{CH}_3\text{COOH}$**

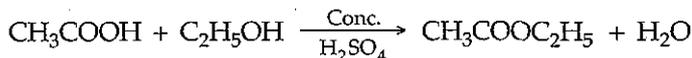
Ethanol adds an atom of oxygen per molecule to change into ethanoic acid.

**Q.4. (a) What are esters ? How are they formed ?**

**(b) Write two uses of esters.**

[Foreign 2008]

**Ans. (a)** Compounds having the formula  $\text{RCOOR}'$  are called esters. Esters are formed by the combination of a carboxylic acid and an alcohol in the presence of concentrated sulphuric acid. For example,



Ethyl ethanoate  
(ester)

**(b) Uses of esters**

**(i)** In making perfumes.

**(ii)** As flavouring agents.

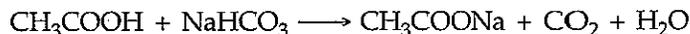
Q.5. (a) Name the compound  $\text{CH}_3\text{CH}_2\text{OH}$  and identify its functional group.

(b) Give a chemical test to distinguish between ethanol and ethanoic acid.

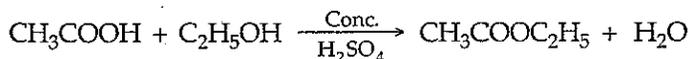
(c) Name the product formed when an organic acid reacts with an alcohol in the presence of an acid catalyst. What is the name assigned to this type of reaction ? [A.I. 2008 C]

Ans. (a)  $\text{CH}_3\text{CH}_2\text{OH}$  – Ethanol. Its functional group is – OH (alcohol group).

(b) Ethanoic acid produces a brisk effervescence of carbon dioxide on adding sodium hydrogencarbonate while ethanol does not.



(c) Ester is formed when an organic acid reacts with an alcohol in the presence of an acid catalyst.



Ester

This type of reaction is called esterification.

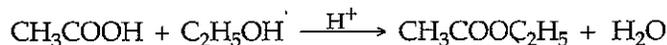
Q.6. (a) Name the compound  $\text{CH}_3\text{COOH}$  and identify its functional group.

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

(c) Name the gas evolved when this compound acts on solid sodium carbonate. How would you identify this gas ? [A.I. 2008 C]

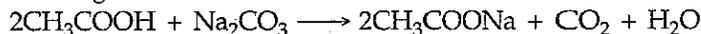
Ans. (a)  $\text{CH}_3\text{COOH}$  is ethanoic acid. It contains the functional group carboxylic acid.

(b) Ethanoic acid reacts with ethanol in the presence of conc.  $\text{H}_2\text{SO}_4$ , an ester is formed which has a fruity smell.

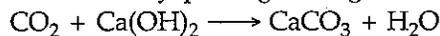


Ester

(c) Carbon dioxide gas is evolved when ethanoic acid acts on solid sodium carbonate.



Carbon dioxide can be identified by passing through lime water which turns milky.



milky

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

(b) (i) Name the products formed when ethanol burns in air.

(ii) What two forms of energy are liberated on burning alcohol ?

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

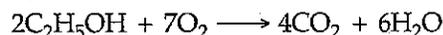
[A.I. 2008 C]

Ans. (a) Saturated and unsaturated hydrocarbons can be distinguished by adding bromine water.

Brown colour of bromine disappears with unsaturated hydrocarbon because of addition reaction.

There is no change in the colour of bromine water when it acts on saturated hydrocarbon.

(b) (i) Carbon dioxide and water are formed when ethanol burns in air.



(ii) Heat and light are evolved in the above reaction.

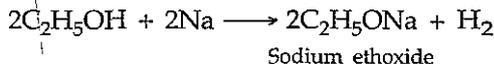
(c)  $\text{CH}_4 + \text{Cl}_2 \longrightarrow \text{CH}_3\text{Cl} + \text{HCl}$

Chlorine substitutes for hydrogen in methane forming chloromethane. Therefore, it is a substitution reaction.

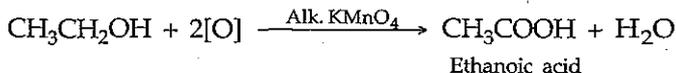
Q.8. What happens when ethanol reacts with (i) sodium (ii) alkaline potassium permanganate solution? Write the necessary chemical equations for the reactions involved in the above cases.

[A.I. 2005 C]

Ans. (i) Reaction with sodium



(ii) Reaction with alkaline potassium permanganate

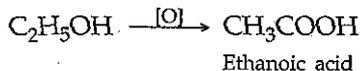


Q.9. An organic compound X is an essential constituent of wine and beer. X is responsible for intoxication caused by these drinks. Oxidation of X yields an organic acid Y which is present in vinegar. Name the compounds X and Y and write their structural formulae.

[A.I. 2003]

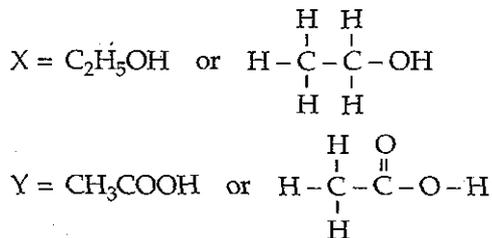
Ans. Compound  $\text{C}_2\text{H}_5\text{OH}$  ethanol is an essential constituent of wine and beer. It causes intoxication.

Oxidation of X yields ethanoic acid.



Vinegar is 5-8% solution of ethanoic acid in water.

Thus,



Q.10. Describe along with chemical equations, what happens when

(i) Ethene reacts with bromine water.

(ii) Ethanol burns in air.

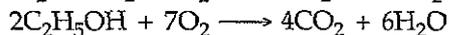
(iii) Ethanoic acid reacts with ethanol in presence of sulphuric acid.

[CBSE Sample Paper 2002]

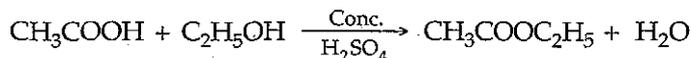
Ans. (i) The brown colour of bromine disappears



(ii)



(iii)



### (C) Long Answer Type Questions (Five Marks Each)

Q.1. (a) Why does carbon form compounds mainly by covalent bonding?

(b) List any two reasons for carbon forming a very large number of compounds.

(c) An organic acid X is a liquid which often freezes during winter time in cold countries, has the formula,  $C_2H_4O_2$ . On warming with ethanol in the presence of a few drops of concentrated sulphuric acid, a compound Y with a sweet smell is formed.

(i) Identify X and Y.

(ii) Write a chemical equation for the reaction involved. [Delhi 2008]

**Ans.** (a) Carbon has 4 electrons in its valence shell. To attain stability, it should either gain 4 electrons or lose 4 electrons. It cannot lose 4 electrons as it involves a lot of energy. Also, it cannot gain 4 electrons because the nucleus cannot hold on to the extra electrons added. Therefore to complete the octet, it shares four electrons with other atoms. That is why carbon forms compounds mainly by covalent bonding.

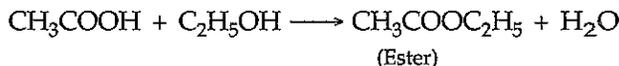
(b) Two reasons for forming a large number of compounds by carbon are :

**Catenation :** It is the property of carbon to link to other carbon atoms forming straight chain, branched chain and ring compounds.

**Tetravalency :** Carbon has a valency of four. Also it can link to atoms other than hydrogen, like oxygen, nitrogen and halogens to form a wide variety of compounds.

(c) Compound X is ethanoic acid  $CH_3COOH$ . It freezes at 290 K ( $17^\circ C$ ), the temperature during winter season. It has the molecular formula  $C_2H_4O_2$ . On warming with ethanol, it forms ethyl ethanoate having a sweet smell. Thus, Y is ethyl ethanoate ( $CH_3COOC_2H_5$ ).

Chemical equation for the reaction is written as under :



**Q.2.** (a) Why does carbon form compounds mainly by covalent bonding ?

(b) Why do covalent compounds have low melting and boiling points ?

(c) What is an ester ? Describe an activity to form an ester.

[A.I. 2008]

**Ans.** (a) See Q.1 (a) above.

(b) Covalent compounds have covalent bonding in them. The bonds are formed by sharing of electrons. There are no ions in such compounds. There are weak forces of attraction between the molecules. So, they have low melting and boiling points.

(c) An ester is a compound having the general formula  $RCOOR'$  where R and R' are alkyl groups. For example, ethyl ethanoate,  $CH_3COOC_2H_5$  which is obtained by the combination of ethanoic acid with ethanol.

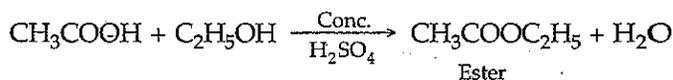
**Activity to form an ester**

**Materials required :** Beaker, test tube, wire gauze, tripod stand, burner, ethanoic acid, ethanol.

**Procedure :**

1. Take 1 mL ethanol, 1 mL glacial acetic acid and a few drops of conc.  $H_2SO_4$  in a clean and dry test tube.
2. Warm in a water bath for about 5 minutes as shown in Fig. 4.8.
3. Pour the contents of the test tube in a beaker containing about 50 mL of water and smell the resulting mixture.

A sweet smell of the ester is noticed.



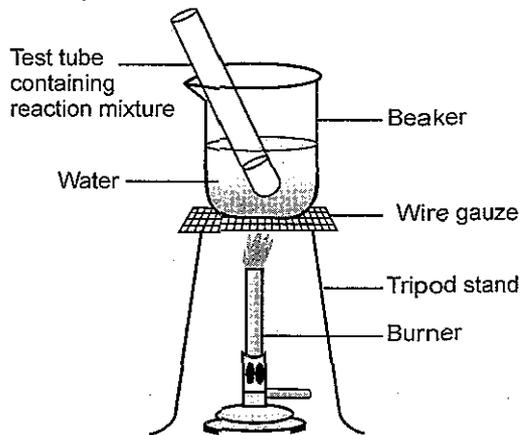


Fig. 4.8

**Q.3. (a)** What is a homologous series of compounds ? List any two characteristics of a homologous series.

(b) (i) What would be observed on adding a 5% solution of alkaline potassium permanganate solution drop by drop to some warm alcohol taken in a test tube ?

(ii) Write the name of the compound formed during the chemical reaction.

(c) How would you distinguish experimentally between an alcohol and a carboxylic acid on the basis of a chemical property ? [Delhi 2008]

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

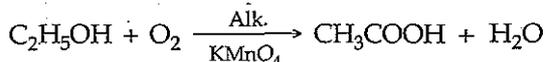
**Characteristics of homologous series.**

(i) The molecular formulae of any two successive members of a homologous series differ by  $-\text{CH}_2$ .

(ii) There is a regular gradation in physical properties of members of a homologous series.

(b) (i) Pink colour of alkaline potassium permanganate disappears when it is added drop by drop to warm alcohol taken in a test tube till the reaction is complete and the whole of alcohol has been oxidised.

(ii) The compound formed is ethanoic acid ( $\text{CH}_3\text{COOH}$ ).



(c) A brisk effervescence is obtained when sodium hydrogencarbonate is added to a carboxylic acid. No such effervescence is obtained with alcohol.

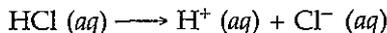
**Q.4. (a)** What is a homologous series ? State any two characteristics of a homologous series.

(b) (i) How are carboxylic acids different from mineral acids from the ionization point of view ?

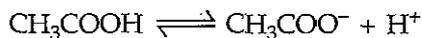
(ii) Describe an activity to find out how ethanoic acid reacts with sodium carbonate. Name the gas evolved. How can it be tested ? [A.I. 2008]

**Ans. (a)** See Q.3 (a) above.

(b) (i) Mineral acids are completely dissociated into  $\text{H}^+$  ions. For example, hydrochloric acid is completely dissociated into  $\text{H}^+$  and  $\text{Cl}^-$  ions.



On the other hand, carboxylic acids are only partially dissociated into  $H^+$  ions. This can be represented as under :



Therefore, carboxylic acids are weaker compared to mineral acids.

(ii) Activity to find out how ethanoic acid reacts with sodium carbonate.

**Materials required :** Two test tubes, thistle funnel, iron stand, cork, delivery tube, lime water  $Ca(OH)_2$ , sodium carbonate, ethanoic acid.

**Procedure :**

1. Set up the apparatus as shown in Fig. 4.9.
2. Take a spatula full of sodium carbonate in a test tube and add 2 mL of dilute ethanoic acid. A brisk effervescence is observed.
3. Pass the gas through freshly prepared lime water. We observe that lime water turns milky indicating that the gas evolved is carbon dioxide.

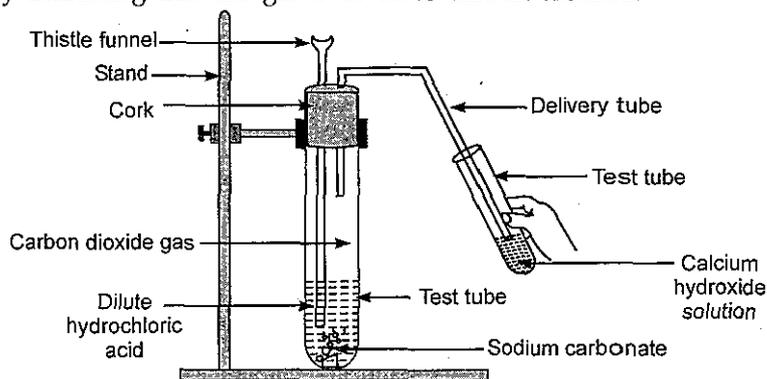


Fig. 4.9

**Q.5. Give schematic representation of the cleansing action of soap in different steps.**

**Ans.** Fig. 4.10 gives the schematic representation of cleansing action of soap in two different ways.

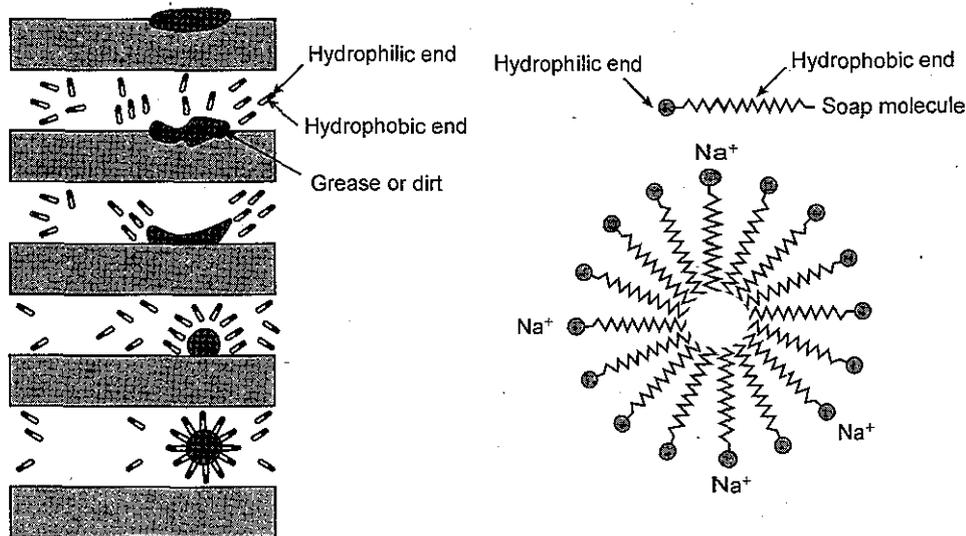
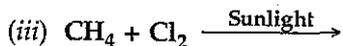
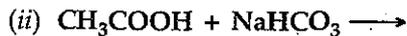
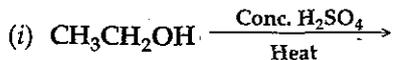


Fig. 4.10

Q.6. (a) Complete the following equations :

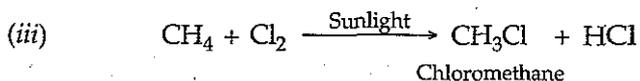
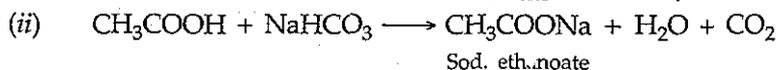
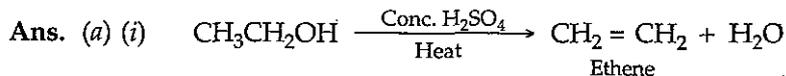


(b) Write the names of the following :



(c) Draw the electron dot structure of ethene ( $\text{C}_2\text{H}_4$ ).

[Delhi 2008 C]



(c) Electron dot structure of ethene ( $\text{C}_2\text{H}_4$ ).

