

CHAPTER 11

ALCOHOLS, PHENOLS AND ETHERS

MULTIPLE CHOICE QUESTIONS

- Williamsons synthesis is used for the synthesis of:**
(a) Phenol (b) Alcohol
(c) Ether (d) Aldehyde
- Aldehydes after catalytic reduction change to:**
(a) P° alcohol (b) S° alcohol
(c) T° alcohol (d) P° and S° alcohol
- When ether is protonated, the conjugate acid formed is called:**
(a) An oxonium ion (b) Carbanion
(c) An oxide ion (d) A hydration ion
- Which of the following alcohol is commonly used as anti-freeze:**
(a) Methanol (b) Ethanol
(c) Ethylene glycol (d) All of the above
- Which of the following will have the highest boiling point:**
(a) Methanal (b) Ethanal
(c) Propanal (d) 2-hexanone
- 95% ethanol is called:**
(a) Absolute alcohol (b) Rectified spirit
(c) Methylated spirit (d) Wood spirit
- Which of the following alcohol is used in the perfumes and for flavouring:**
(a) Methanol (b) Ethanol
(c) 1-propanol (d) 1-butanol

8. According to Lewis concept ethers behaves as:
- (a) Acid (b) Base
(c) Acid as well as base (d) None of above
9. Which enzyme is not involved in fermentation of starch:
- (a) Diastase (b) Zymase
(c) Urease (d) Maltase
10. The hydrolysis of sugar is called:
- (a) Condensation (b) Polymerization
(c) Inversion (d) Reduction
11. Which compound shows maximum hydrogen bonding with water:
- (a) C_6H_5OH (b) C_2H_5OH
(c) $CH_3 - O - CH_3$ (d) n-hexanol
12. Which statement is incorrect about phenol:
- (a) It is colourless, crystalline poisonous solid
(b) It does not turn blue litmus paper red
(c) It liberates CO_2 gas from carbonate
(d) Above $65.9^\circ C$ it is miscible with water
13. Which of the following is the weakest acid:
- (a) Phenol (b) Alcohol
(c) Carboxylic acid (d) Water
14. Which inorganic reagent may be used to distinguish between phenol and methanol:
- (a) Alkaline aqueous I_2 (b) Aqueous $NaHCO_3$
(c) $K_2Cr_2O_7$ in dil. H_2SO_4 (d) Na
15. Phenol is also called:
- (a) Carbonic acid (b) Carbolic acid
(c) Carboxylic acid (d) Fatty acid
16. Which of the following give iodoform test:
- (a) CH_3OH (b) C_2H_5OH
(c) Methanal (d) 1-propanol

17. Which of the following is more reactive where O – H bonds break:
- (a) P° alcohol (b) S° alcohol
(c) T° alcohol (d) Cannot be predicted
18. Which of the following alcohol is least soluble in water:
- (a) CH₃OH (b) C₂H₅OH
(c) C₃H₇OH (d) C₄H₉OH
19. 100% pure alcohol is called:
- (a) Methylated spirit (b) Rectified spirit
(c) Power alcohol (d) Absolute alcohol
20. The correct name of H₂C = CH – CH₂ – CH₂ – OH is:
- (a) 1-butene-4-ol (b) 2-butene-1-ol
(c) 3-butene-1-ol (d) None of these
21. Which of the following is more reactive:
- (a) Benzene (b) Phenol
(c) Nitrobenzene (d) Benzoic acid
22. Bakelite is thermosetting plastic, it is formed by the polymerization of:
- (a) Ethanol and formaldehyde (b) Phenol and ethanol
(c) Phenol and formaldehyde (d) Phenol and acetaldehyde
23. Which of the following compound should have lowest boiling point:
- (a) C₂H₆ (b) C₂H₅Cl
(c) CH₃ – O – CH₃ (d) C₂H₅OH
24. Ethanol can be converted into ethanoic acid by:
- (a) Hydrogenation (b) Fermentation
(c) Oxidation (d) Hydration
25. When 2-pentanol undergoes oxidation the product is:
- (a) Pentanol (b) 3-pentanone
(c) 2-pentanone (d) Pentanoic acid
26. When ethyl bromide (C₂H₅Br) is heated with Ag₂O in the absence of moisture the product formed is:
- (a) Ethanol (b) Diethyl ether
(c) Ethanal (d) Ethene

27. Which of the following compound has no unsaturation:
- (a) Methanal (b) Methoxy methane
(c) Phenol (d) Benzoic acid
28. The conversion of ethanol to ethene is an example of:
- (a) Dehydration (b) Hydration
(c) Hydrogenation (d) Fermentation
29. Ethanol reacts with sodium metal to liberate:
- (a) CO₂ gas (b) H₂ gas
(c) CO gas (d) Steam
30. Diethyl ether can be decomposed by heating with:
- (a) HI (b) NaOH
(c) Water (d) KMnO₄

answers

1.	(c)	2.	(a)	3.	(a)	4.	(c)	5.	(d)
6.	(b)	7.	(d)	8.	(b)	9.	(c)	10.	(c)
11.	(b)	12.	(c)	13.	(b)	14.	(c)	15.	(b)
16.	(b)	17.	(a)	18.	(d)	19.	(d)	20.	(c)
21.	(b)	22.	(c)	23.	(a)	24.	(c)	25.	(c)
26.	(b)	27.	(b)	28.	(a)	29.	(b)	30.	(a)

SOLVED EXERCISE

Q.1 Fill in the blanks:

- (i) Primary, secondary and tertiary alcohols can be identified by _____ test.
- (ii) Oxidation of _____ alcohols give ketones.
- (iii) Alcohols on heating with _____ give alkenes at high temperature.
- (iv) Alcohols have _____ boiling points than ethers due to stronger hydrogen bonding.
- (v) Williamson's synthesis is used to prepare _____.
- (vi) _____ is also called wood spirit.
- (vii) Carbolic acid is the other name of _____.
- (viii) Primary, secondary and tertiary alcohols can be prepared by reacting Grignard reagent with _____.
- (ix) Alcohols and _____ react to produce esters.
- (x) _____ is used as anti-freezing agent in automobile radiator.
- (xi) The process of conversion of starch into alcohol with the help of microorganisms is called _____.
- (xii) Ketones on reduction give _____ alcohols.

answers

(i)	Lucas	(ii)	secondary	(iii)	H ₂ SO ₄
(iv)	high	(v)	ether	(vi)	methanol
(vii)	phenol	(viii)	carbonyl compound	(ix)	carboxylic acids
(x)	glycol	(xi)	fermentation	(xii)	secondary

Q.2 Indicate True or False:

- (i) Methylated spirit contains 95% methyl alcohol and 5% ethyl alcohol.
- (ii) Ethyl alcohol is a very good anti-freezing agent.
- (iii) Methanol is also called wood spirit.

- (iv) Only 14% ethyl alcohol can be prepared by fermentation.
- (v) Ethers do not show hydrogen bonding.
- (vi) Alcohols are more acidic than phenols.
- (vii) Phenol is more soluble in water than lower alcohols.
- (viii) Alcohols are more basic than ethers.
- (ix) Ethers have higher boiling points than alcohols and phenols.
- (x) Methanol and ethanol can be distinguished by iodoform test.

answers

(i)	False	(ii)	False	(iii)	True	(iv)	True	(v)	True
(vi)	False	(vii)	False	(viii)	False	(ix)	False	(x)	True

Q.3 Multiple choice questions. Encircle the correct answer:

- (i) Which compound shows hydrogen bonding:
 - (a) C_2H_6
 - (b) C_2H_5Cl
 - (c) CH_3-O-CH_3
 - (d) C_2H_5OH
- (ii) Which compound shows maximum hydrogen bonding with water:
 - (a) CH_3OH
 - (b) C_2H_5OH
 - (c) CH_3-O-CH_3
 - (d) C_6H_5OH
- (iii) Which compound is more soluble in water:
 - (a) C_2H_5OH
 - (b) C_6H_5OH
 - (c) CH_3COCH_3
 - (d) n-Hexanol
- (iv) Which compound will have the maximum repulsion with H_2O :
 - (a) C_6H_6
 - (b) C_2H_5OH
 - (c) $CH_3CH_2CH_2OH$
 - (d) CH_3-O-CH_3
- (v) Ethanol can be converted into ethanoic acid by:
 - (a) Hydrogenation
 - (b) Hydration
 - (c) Oxidation
 - (d) Fermentation
- (vi) Which enzyme is not involved in fermentation:
 - (a) Diastase
 - (b) Zymase

- (c) Urease (d) Invertase
- (vii) Which compound is called a universal solvent:
 (a) H_2O (b) CH_3OH
 (c) $\text{C}_2\text{H}_5\text{OH}$ (d) $\text{CH}_3\text{—O—CH}_3$
- (viii) Methyl alcohol is not used:
 (a) As a solvent (b) As an anti-freezing agent
 (c) As a substitute for petrol (d) For denaturing of ethyl alcohol
- (ix) Rectified spirit contains alcohol about:
 (a) 80% (b) 85%
 (c) 90% (d) 95%
- (x) According to Lewis concept ethers behave as:
 (a) Acid (b) Base
 (c) Acid as well as a base (d) None of these

answers

(i)	(d)	(ii)	(a)	(iii)	(a)	(iv)	(a)	(v)	(c)
(vi)	(c)	(vii)	(a)	(viii)	(c)	(ix)	(d)	(x)	(b)

Q.4 What are alcohols? How are they classified? How will you distinguish between primary, secondary and tertiary alcohols?

Ans. The organic compounds having formula ROH are called alcohols. They are of three types:

- (i) Primary alcohols (ii) Secondary alcohols (iii) Tertiary alcohols

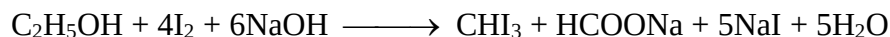
They can be distinguished by the Lucas test.

(See Answer of Q.8)

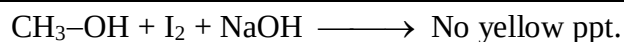
Q.5 How is methyl alcohol obtained on large scale? How it may be distinguished from ethyl alcohol?

Ans. First part is detailed question. Consult text book for answer.

Ethanol gives iodoform with iodine in the presence of NaOH. Formation of yellow crystals indicate the presence of ethanol or ethyl alcohol.



While methyl alcohol does not give this reaction.



Q.6 What is fermentation? Which compound may be obtained on industrial scale by fermentation?

Ans. **Fermentation:** It is a biochemical process which occurs in the presence of certain enzymes secreted by microorganisms such as yeast.

More detail see in the text book.

Ethanol ($\text{C}_2\text{H}_5\text{OH}$) is obtained by fermentation at industrial scale.

Q.7 Explain the following terms:

- | | |
|-------------------------------|------------------------------------|
| (i) Absolute alcohol | (ii) Methylated spirit |
| (iii) Rectified spirit | (iv) Denaturing of alcohols |

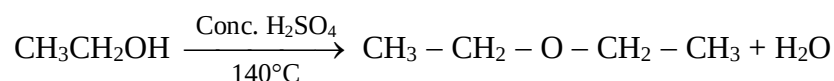
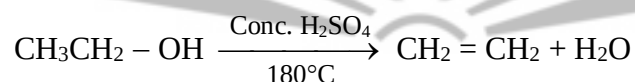
Ans.

- (i) **Absolute Alcohol:** 100% ethyl alcohol is called absolute alcohol. It is obtained by redistillation of rectified spirit with CaO which absorbs moisture.
- (ii) **Methylated Spirit:** Ethyl alcohol containing small amount of methyl alcohol is called methylated spirit.
- (iii) **Rectified Spirit:** Alcohol obtained by fermentation is 12 – 14%. It is distilled again and again to obtain 95% alcohol which is called rectified spirit.
- (iv) **Denaturing of Alcohol:** The addition of methanol (poisonous) into ethanol to render it unfit for the drinking purpose is called denaturing of alcohol.

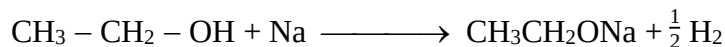
Q.8 How does ethylalcohol react with the following reagents?

Ans.

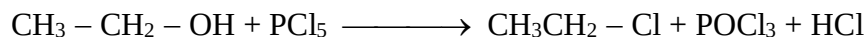
(i) **Conc. H_2SO_4 :**



(ii) **Na:**



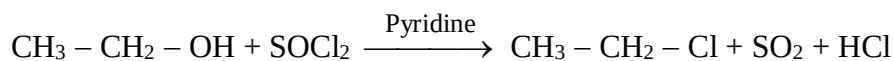
(iii) **PCl_5 :**



(iv) **CH_3COOH :**



(v) SOCl_2 :

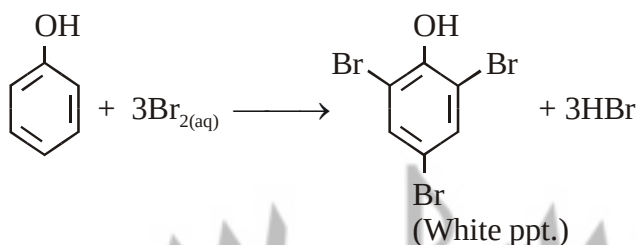


Q.10 How will you distinguish between:

- (i) An alcohol and a phenol (ii) An alcohol and an ether
 (iii) Methanol and ethanol (iv) A tertiary alcohol and a primary alcohol
 (v) 1-propanol and 2-propanol

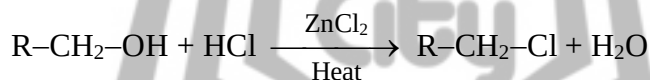
Ans.

(i) Phenol gives white ppt. with bromine water.



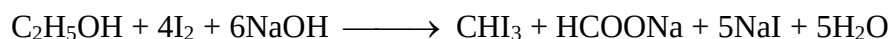
While alcohols do not react with bromine water.

(ii) Alcohols give oily layer of alkyl halides while reacting with conc. HCl in anhydrous ZnCl_2 .

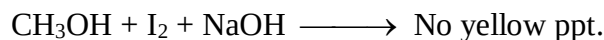


While ethers do not give this reactions.

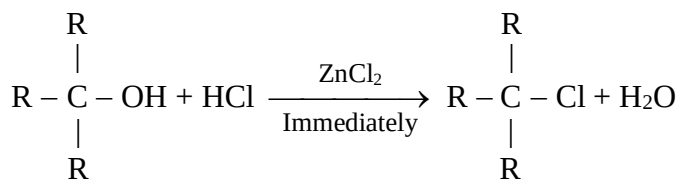
(iii) Ethanol gives iodoform with iodine in the presence of NaOH. Formation of yellow crystals indicate the presence of ethanol.



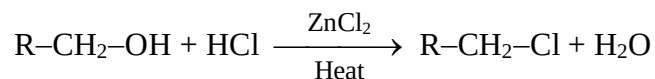
While methanol does not give yellow ppt. of CHI_3 .



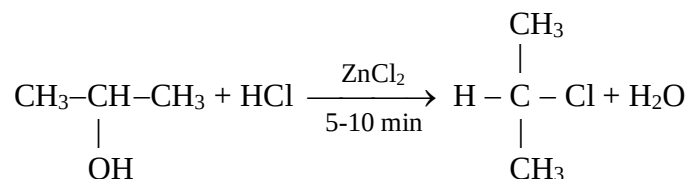
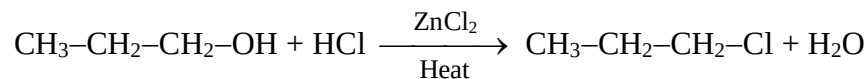
(iv) Tertiary alcohol form an oily layer immediately when react with conc. HCl in anhydrous ZnCl_2 .



While primary alcohol form an oily layer only on heating.



- (v) 1-propanol is primary alcohol and 2-propanol is secondary alcohol. We can distinguish them by Lucas test as following:



2-propanol

Q.11 Give reasons for the followings:

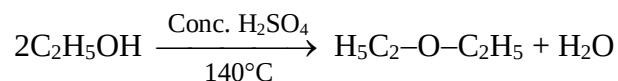
- (i) Ethyl alcohol is a liquid while methyl chloride is a gas.
- (ii) Ethanol has higher boiling point than diethyl ether.
- (iii) Absolute alcohol cannot be prepared by fermentation process.
- (iv) Ethanol gives different products with conc. H_2SO_4 under different conditions.
- (v) Water has higher boiling point than ethanol.

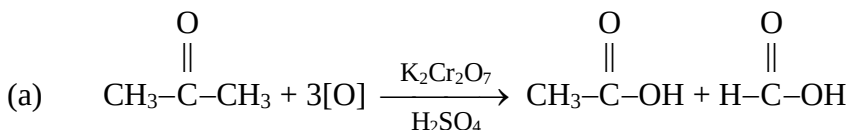
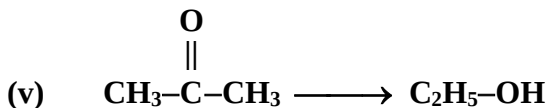
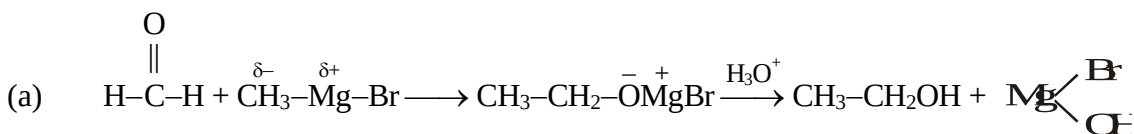
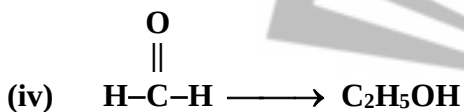
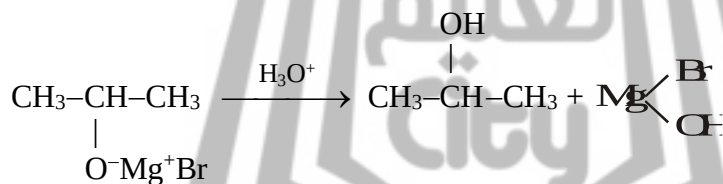
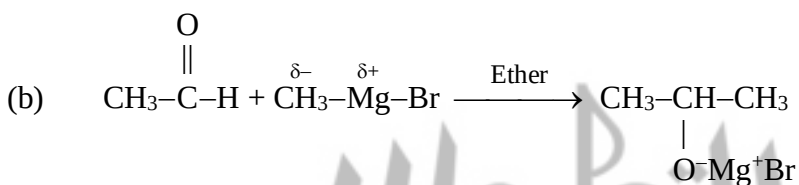
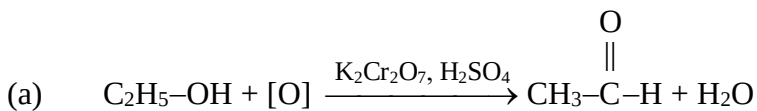
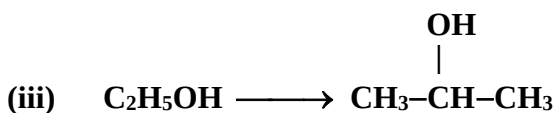
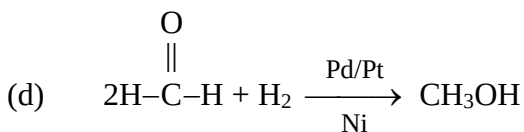
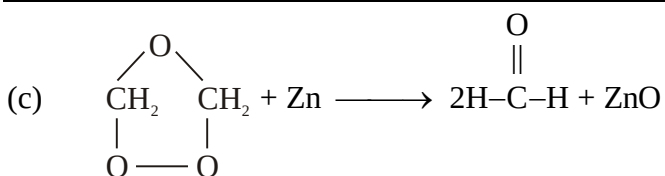
Ans.

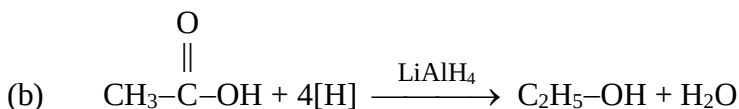
- (i) Ethyl alcohol has strong hydrogen bonding between its molecule whereas methyl chloride does not have, rather its molecules experience weaker dipole-dipole forces. That is why ethyl alcohol is liquid while methyl chloride is gas.
- (ii) Ethanol has higher boiling point than diethyl ether because strong hydrogen bonding is present in ethanol.

Whereas diethyl ether has dipole-dipole forces which are weaker than hydrogen bonding due to this ethanol has higher boiling point than diethyl ether.

- (iii) Alcohol obtained by fermentation is only upto 12% and never exceeds 14% because beyond this limited enzymes become inactive and the process is ceased, that is why absolute (100%) alcohol cannot be prepared from fermentation process.
- (iv) High concentration of ethanol when treated with conc. H_2SO_4 at 140°C produce diethyl ether.



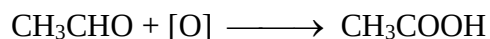
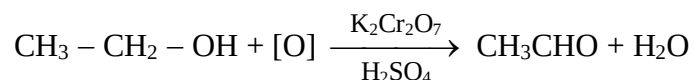




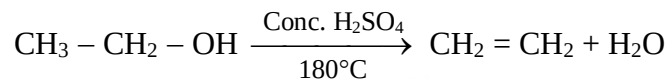
Q.13 Explain the following terms using ethyl alcohol as an example.

Ans.

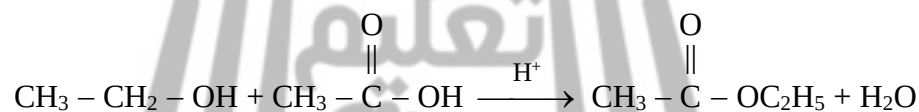
- (i) **Oxidation:** Ethyl alcohol on oxidation changes to acetaldehyde and on further oxidation changes to acetic acid. Mixture of $\text{K}_2\text{Cr}_2\text{O}_7$ and conc. H_2SO_4 is good oxidizing agent.



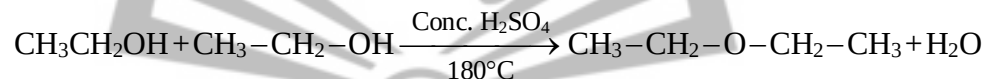
- (ii) **Dehydration:** Ethyl alcohol when reacted with conc. H_2SO_4 at 180°C , dehydration takes place. Removal of water from a substance is called dehydration.



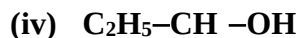
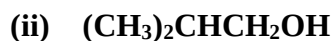
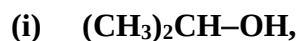
- (iii) **Esterification:** The process in which alcohol and carboxylic acid reacts together to form ester.



- (iv) **Ether Formation:** When excess amount of ethyl alcohol reacts with less amount of conc. H_2SO_4 at 140°C ether is formed.



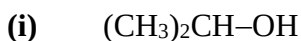
Q.18 (a) Write I.U.P.A.C. names of the following compounds:



(b) Write structure formulas for the following compounds:

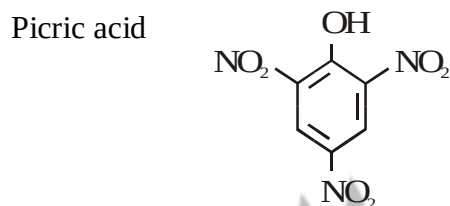
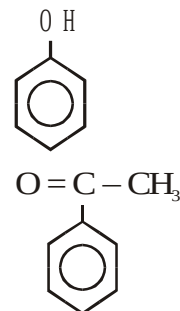
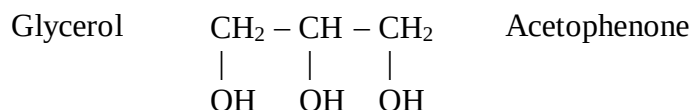
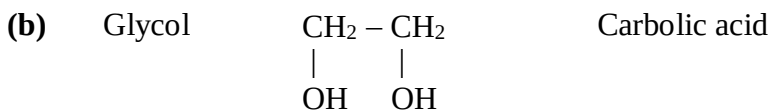
Glycol, Glycerol, Carbolic acid, Acetophenone, Picric acid

Ans. (a)

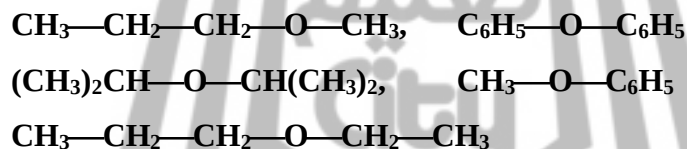


2-propanol

- (ii) $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$ 2-methyl-1-propanol
 (iii) $(\text{CH}_3)_3\text{COH}$ 2-methyl-2-propanol
 (iv) $\text{C}_2\text{H}_5-\underset{\text{CH}_3}{\text{CH}}-\text{OH}$ 2-butanol



Q.19 (a) Name the following compounds:

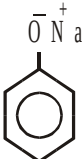


(b) Write down structural formulas of the following compounds:

Methoxy ethane, Ethoxy benzene, Sodium ethoxide, Sodium phenoxide,
 Propoxy propane

Ans.

- (a) (i) $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{O}-\text{CH}_3$ Methoxy propane
 (ii) $\text{C}_6\text{H}_5-\text{O}-\text{C}_6\text{H}_5$ Phenoxy benzene
 (iii) $(\text{CH}_3)_2\text{CH}-\text{O}-\text{CH}(\text{CH}_3)_2$ Isopropoxy iso-propane
 (iv) $\text{CH}_3-\text{O}-\text{C}_6\text{H}_5$ Methoxy benzene
 (v) $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{O}-\text{CH}_2-\text{CH}_3$ Ethoxy propane
 (b) (i) Methoxy ethane $\text{CH}_3-\text{O}-\text{C}_2\text{H}_5$

- | | | |
|-------|------------------|---|
| (ii) | Ethoxy benzene | $\text{C}_2\text{H}_5\text{—O—C}_6\text{H}_5$ |
| (iii) | Sodium ethoxide | $\text{CH}_3\text{—CH}_2\text{—}\overset{+}{\text{O}}\text{Na}^-$ |
| (iv) | Sodium phenoxide |  |
| (v) | Propoxy propane | $\text{CH}_3\text{—CH}_2\text{—CH}_2\text{—O—CH}_2\text{—CH}_2\text{—CH}_3$ |



DO YOU KNOW?

1. Methyl alcohol is called wood spirit or wood naphtha.
2. Ethyl alcohol is called grain alcohol.
3. CH_3OH is poisonous and causes blindness, madness and even death.
4. 95% ethanol is called rectified spirit.
5. The process of conversion of starch or sugars into alcohol in the presence of yeast is called fermentation.
6. Lucas test is used to distinguish between primary, secondary and tertiary alcohols.
7. Primary alcohols on oxidation form aldehydes and secondary alcohols on oxidation form ketones.
8. Ethanol gives iodoform test but methanol does not.
9. Phenol is also called carbolic acid.
10. Williamson's synthesis is used for the preparation of ethers.
11. Phenol was obtained by Runge in 1834.
12. Phenol is partially miscible with water but becomes completely miscible at 65.9°C .
13. K_a for phenol is in the order of 10^{-10} .
14. Relative acidic strength of alcohol, phenol, water and carboxylic acids is:
$$\text{Carboxylic acid} > \text{Phenol} > \text{H}_2\text{O} > \text{Alcohol}$$
15. Dimethyl ether is a gas at ordinary temperature.
16. Phenol was discovered by Runge in 1834 from coal tar.
17. Phenol is deliquescent solid.
18. Ethyl-methyl ether is also a gas at ordinary temperature.