# (Chapter 11)(Alcohols Phenols and Ethers) XII

## **Intext Questions**

## Question 11.1:

Classify the following as primary, secondary and tertiary alcohols:

(i)

$$\begin{array}{c} \text{CH}_{3} \\ \text{CH}_{3} - \text{C} - \text{CH}_{2} \text{OH} \\ \text{I} \\ \text{CH}_{3} \end{array}$$

(ii) 
$$H_2C = CH - CH_2OH$$

(iv)

(v)

(wi)

$$CH = CH - CH_3$$

$$CH_3$$

$$CH_3$$

$$CH_3$$

Answer

Primary alcohol  $\rightarrow$  (i), (ii), (iii)

Secondary alcohol  $\rightarrow$  (iv), (v)

Tertiary alcohol  $\rightarrow$  (vi)

## Question 11.2:

Identify allylic alcohols in the above examples.

#### Answer

The alcohols given in (ii) and (vi) are allylic alcohols.

## Question 11.3:

Name the following compounds according to IUPAC system.

(i)

(ii)

(iii)

(iv)

$$H_2C = CH - CH - CH_2 - CH_2 - CH_3$$
  
OH

(v)

$$CH_3 - C = C - CH_2OH$$

$$CH_3 B_F$$

#### Answer

- (i) 3-Chloromethyl-2-isopropylpentan-1-ol
- (ii) 2, 5-Dimethylhexane-1, 3-diol
- (iii) 3-Bromocyclohexanol
- (iv) Hex-1-en-3-ol
- (v) 2-Bromo-3-methylbut-2-en-1-ol

## Question 11.4:

Show how are the following alcohols prepared by the reaction of a suitable Grignard reagent on methanal?

(i) CH<sub>3</sub>-CH-CH<sub>2</sub>OH | CH<sub>3</sub>

(ii) Сн<sub>2</sub>он

Answer

(i)

$$\begin{array}{c} OMgBr \\ I \\ I \\ CH_{3} \end{array} \longrightarrow \begin{array}{c} CH - MgBr \\ I \\ CH_{3} \end{array} \longrightarrow \begin{array}{c} CH_{3} - CH - CH_{2} \\ I \\ CH_{3} \end{array}$$

$$\begin{array}{c} H^{+} \downarrow H_{2}O \\ Mg(OH)Br + CH_{3} - CH - CH_{2} - OH \\ I \\ CH_{3} \end{array}$$

(ii)

## Question 11.5:

Write structures of the products of the following reactions:

(i)

$$CH_3 - CH = CH_2 \xrightarrow{H_2O/H^+}$$

(ii)

(iii)

Answer

(i)

$$CH_3 - CH = CH_2 \xrightarrow{H_2O/H^+} CH_3 - CH - CH$$
Propene OH

Propene-2-ol

(ii)

$$\bigcup_{0}^{O} CH_2 - C - OCH_3 \xrightarrow{NaBH_4} \bigcup_{0}^{OH} CH_2 - C - OCH_3$$

Methyl (2 – oxocyclohexyl) ethanoate Methyl (2 – hydroxycyclohexyl) ethanoate

(iii)

$$\begin{array}{c} \text{CH}_{3} - \text{CH}_{2} - \text{CH} - \text{CHO} \xrightarrow{\text{NaBH}_{4}} \begin{array}{c} \text{CH}_{3} - \text{CH}_{2} - \text{CH} - \text{CH}_{2} \text{OH} \\ \text{CH}_{3} \end{array}$$

2 - Methylbutanal

2 - Methylbutan - 1 - ol

## Question 11.6:

Give structures of the products you would expect when each of the following alcohol reacts with (a)  $HCI-ZnCI_2$  (b) HBr and (c)  $SOCI_2$ .

- (i) Butan-1-ol
- (ii) 2-Methylbutan-2-ol

Answer

(a)

(i)

$$CH_3 - CH_2 - CH_2 - CH_2 - OH \xrightarrow{HCI - ZnCI_2} No reaction$$
  
Butan -1 - ol

Primary alcohols do not react appreciably with Lucas' reagent (HCl-ZnCl<sub>2</sub>) at room temperature.

(ii)

2 - Methylbutan - 2 - ol (3°) 2 - Chloro - 2 - Methylbutane (White turbidity)

Tertiary alcohols react immediately with Lucas' reagent.

(b)

(i)

$$CH_3CH_2CH_2CH_2OH + HBr \xrightarrow{-H_2O} CH_3CH_2CH_2CH_2Br$$
  
Butan -1 - ol 1-Bromobutane

(ii)

$$\begin{array}{c} OH & Br \\ | & | \\ CH_3 - CH_2 - CH_3 + HBr & \longrightarrow CH_3 - CH_2 - CH_3 + H_2O \\ | & | & | \\ CH_3 & CH_3 \end{array}$$

2 - Methylbutan - 2 - ol (3°) 2 - Bromo - 2 - Methylbutane

(c)

(i)

$$CH_3CH_2CH_2CH_2OH + SOCl_2 \longrightarrow CH_3CH_2CH_2CH_2CI + SO_2 + HCI$$
  
Butan-1-ol l-chlorobutane

(ii)

$$\begin{array}{c} \text{OH} & \text{CI} \\ \text{CH}_3 - \text{CH}_2 - \overset{\text{I}}{\underset{\text{CH}_3}{\text{CH}_3}} + \text{SOCI}_2 \longrightarrow \text{CH}_3 - \text{CH}_2 - \overset{\text{CI}}{\underset{\text{CH}_3}{\text{CH}_3}} + \text{SO}_2 + \text{HCI} \\ \text{CH}_3 & \text{CH}_3 \end{array}$$

2 - Methylbutan - 2 - ol

2 - Chloro - 2 - Methylbutane

## Question 11.7:

Predict the major product of acid catalysed dehydration of

(i) 1-methylcyclohexanol and

## (ii) butan-1-ol

Answer

i.

OH CH<sub>3</sub>

Dehydration

$$H^+$$
 $H_2O$ 

1 - Methylcyclohexanol

(Major product)

(ii)

## Question 11.8:

*Ortho* and *para* nitrophenols are more acidic than phenol. Draw the resonance structures of the corresponding phenoxide ions.

Answer

Resonance structure of the phenoxide ion

Resonance structures of p-nitrophenoxide ion

Resonance structures of m-nitrophenoxide ion

It can be observed that the presence of nitro groups increases the stability of phenoxide ion.

## Question 11.9:

Write the equations involved in the following reactions:

- (i) Reimer-Tiemann reaction
- (ii) Kolbe's reaction

Answer

#### i. Reimer-Tiemann reaction

#### ii. Kolbe's reaction

## Question 11.10:

Write the reactions of Williamson synthesis of 2-ethoxy-3-methylpentane starting from ethanol and 3-methylpentan-2-ol.

#### Answer

In Williamson synthesis, an alkyl halide reacts with an alkoxide ion. Also, it is an  $S_N2$  reaction. In the reaction, alkyl halides should be primary having the least steric hindrance. Hence, an alkyl halide is obtained from ethanol and alkoxide ion from 3methylpentan-2-ol.

2 - Ethoxy - 3 - methylpentane

## Question 11.11:

Which of the following is an appropriate set of reactants for the preparation of 1methoxy-4-nitrobenzene and why?

(i)

(ii)

## Answer

Set (ii) is an appropriate set of reactants for the preparation of 1-methoxy-4nitrobenzene.

ONa OCH<sub>3</sub>

$$+ CH_3Br \longrightarrow NO_2 + NaBr$$

1 - Methoxy - 4 - nitrobenzene

In set (i), sodium methoxide ( $CH_3ONa$ ) is a strong nucleophile as well as a strong base. Hence, an elimination reaction predominates over a substitution reaction.

## **Question 11.12:**

Predict the products of the following reactions:

(i) 
$$CH_3 - CH_2 - CH_2 - O - CH_3 + HBr \rightarrow$$

(ii)

$$(iii)$$

$$CC_{2}H_{5} \xrightarrow{Conc.H_{2}O_{4}} \underbrace{Conc.H_{2}O_{4}} \underbrace{Conc.H_{NO_{3}}} \underbrace{(CH_{3})_{3}C-OC_{2}H_{5}} \xrightarrow{HI} iv)$$

Answer
$$(i)$$

$$CH_{3}-CH_{2}-CH_{2}-O-CH_{3}+HBr \longrightarrow CH_{3}-CH_{2}-CH_{2}-OH+CH_{3}-Br$$

$$n\text{-propylmethyl ether} \qquad CH_{3}-CH_{2}-CH_{2}-OH+CH_{3}-Br$$

$$Propanol \qquad Bromomethane$$

$$(iii)$$

$$CC_{2}H_{5} + HBr \longrightarrow OH + C_{2}H_{5}Br$$

$$Ethoxybenzene \qquad Phenol \qquad Bromoethane$$

$$(iii)$$

$$CC_{2}H_{5} \xrightarrow{Conc.H_{2}SO_{4}} \xrightarrow{OC_{2}H_{5}} + \cdots \xrightarrow{OC_{2}H_$$

tert-Butyl ethyl ether tert-Butyliodide

C2H5OH

Ethanol