## Chapter - 11

## ALCOHOLS, PHENOLS AND ETHERS

1. Write IUPAC names of the following compounds :





- (ix)  $C_6H_5OC_3H_7$
- (x)  $CH_3CH_2OCH_2CH_2CH_2CI$
- 2. Write the structures of the compounds whose names are given below :
  - (i) 3, 5-dimethoxyhexane-1, 3, 5-triol
  - (ii) cyclohexylmethanol
  - (iii) 2-ethoxy-3-methylpentane
  - (iv) 3-chloromethylpentan-2-ol
  - (v) p-nitroanisole
- 3. Describe the following reactions with example :
  - (i) Hydroboration oxidation of alkenes
  - (ii) Acid catalysed dehydration of alcohols at 443K.
  - (iii) Williamson synthesis
  - (iv) Reimer-Tiemann reaction.
  - (v) Kolbe's reaction
  - (vi) Friedel-Crafts acylation of Anisole.
- 4. Complete the following reactions :
  - (i)  $CH_3CH_2CH_2CHO \longrightarrow Pd/H_2 \longrightarrow$
  - (ii)  $CH_3CHO \xrightarrow{(i) CH_3MgBr}{(ii) H^+/H_2O}$



(iii) CH<sub>3</sub>CH<sub>2</sub>OH \_\_\_\_\_Cu/573K

(iv)  $C_6H_5OH + Br_2 \xrightarrow{H_2O} \rightarrow$ 

.COOH

+

(v )

CH₃CO

CH₃CO

H +

- 5. What happens when :
  - (i) aluminium reacts with tert-butyl alcohol
  - (ii) phenol is oxidised with chromic acid

(iii) cumene is oxidised in the presence of air and the product formed is treated with dilute acid.

- (iv) phenol is treated with conc. HNO<sub>3</sub>.
- (v) phenol is treated with chloroform in presence of dilute NaOH.
- 6. How will you convert
  - (i) propene to propan-l-ol.
  - (ii) anisole to phenol
  - (iii) butan-2-one to butan-2-ol
  - (iv) ethanal to ethanol
  - (v) phenol to ethoxybenzene
  - (vi) 1-phenylethene to 1-phenylethanol
  - (vii) formaldehyde to cyclohexylmethanol
  - (viii) butyl bromide to pentan-1-ol.
  - (ix) toluene to benzyl alcohol
  - (x) 1-propoxypropane to propyl iodide
  - (xi) ethyl bromide to 1-ethoxyethane
  - (xii) methyl bromide to 2-methoxy-2-methylpropane
  - (xiii) ethyl bromide to ethoxybenzene
  - (xiv) ethanol to benzyl ethyl ether.

7. Identify the missing reactant or product A to D in the following equations:



8. Identify X, Y and Z in the following sequence of reactions :

(i) Phenol  $\xrightarrow{\text{Zn dust}} X \xrightarrow{\text{CH}_3\text{Cl}} \text{Anhyd. AlCl}_3 Y \xrightarrow{\text{KMnO}_4} Z$ 

(ii) Ethanol 
$$\xrightarrow{\text{PBr}_3} X \xrightarrow{\text{alc. KOH}} Y \xrightarrow{\text{dil.H}_2\text{SO}_4} Z$$

(iii) 
$$(H_3 \rightarrow H) \rightarrow X + CH_3$$

X + conc.  $HNO_3 \longrightarrow Y$  (a dinitro compound)

- X + Br<sub>2</sub>(aq)  $\longrightarrow$  Z (a tribromo product)
- 10. Write the mechanism for following reactions :

(i) 
$$c = c + H_2 O +$$

(acid catalysed hydration of alkenes)

(ii)  $CH_3 - CH_2 - OH \xrightarrow{H^+} CH_2 = CH_2$ (acid catalysed dehydration of alcohols)

. . .

(iii) 
$$2CH_3CH_2OH \xrightarrow{H^{\tau}}{413 \text{ K}} CH_3CH_2OCH_2CH_3$$
  
(acid catalysed nucleophilic substitution reaction)

- (iv)  $CH_3OCH_3 + HI \longrightarrow CH_3OH + CH_3I$
- (v)  $(CH_3)_3C O CH_3 + HI \longrightarrow CH_3OH + (CH_3)_3 CI$
- 11. Give reason for the following :
  - (i) The C-O-C bond angle in dimethyl ether is (111.7°)
  - (ii) Alcohols have higher boiling points than ethers of comparable molecular masses.
  - (iii) Phenols are more acidic than alcohols.
  - (iv) Nitrophenol is more acidic than o-methoxyphenol.
  - (v) Phenol is more reactive towards electrophilic substitution reaction than benzene.
  - (vii) The following is not an appropriate method for the preparation of t-butyl ethyl ether :

$$C_{2}H_{5}ONa + CH_{3} \xrightarrow[]{} C - CI \xrightarrow[]{} -NaCI \xrightarrow{} CH_{3} \xrightarrow{} CH_{3}$$

- (a) What would be the major product of this reaction?
- (b) Write suitable reaction for the preparation of t-butyl ethyl ether.
- (viii) The following is not an appropriate method for the preparation of 1-methoxy-4-nitrobenzene;



- (x) Write the suitable reaction for the preparation of 1-methoxy-4-nitrobenzene
- (ix) o-nitrophenol is steam volatile but p-nitrophenol is not.
- (x) phenol is less polar than ethanol.
- (xi) The phenyl methyl ether reacts with HI fo form phenol and iodomethane and not iodobenzene and methanol.



- (xii) methanol is less acidic than water.
- (xiii) alcohols can act as weak base as well as weak acids.
- (xiv) phenols do not give protonation reaction readily.
- (xvi) absolute ethanol can not be obtained by factional distillation of ethanol and water mixture.
- 12. Arrange the following in the increasing order of property shown :
  - (i) methanol, ethanol, diethylether, ethyleneglycol. (Boiling points)
  - (ii) phenol, o-nitrophenol, m-nitrophenol, p-nitrophenol. (Acid strength)
  - (iii) dimethylether, ethanol, phenol. (Solubility in water)
  - (iv) n-butanol, 2-methylpropan-1-ol, 2-methylpropan-2-ol. (Acid strength)
- 13. Give a chemical test to distinguish between the following pair of compounds.
  - (i) n-propyl alcohol and isopropylalcohol
  - (ii) methanol and ethanol
  - (iii) cyclohexanol and phenol.
  - (iv) propan-2-ol and 2-methylpropan-2-ol.
  - (v) phenol and anisole
  - (vi) ethanol and diethyl ether
- \*14. Which of the following compounds gives fastest reaction with HBr and why?
  - (i)  $(CH_3)_3COH$
  - (ii) CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>OH

- \*15. What is the function of ZnCl<sub>2</sub> (anhyd) in Lucas test for distinction between 1°, 2° and 3° alcohols.
- 16. An alcohol A ( $C_4H_{10}O$ ) on oxidation with acidified potassium dichromate gives carboxylic acid B ( $C_4H_8O_2$ ). Compound A when dehydrated with conc.  $H_2SO_4$  at 443 K gives compound C. Treatment of C with aqueous  $H_2SO_4$  gives compound D ( $C_4H_{10}O$ ) which is an isomer of A. Compound D is resistant to oxidation but compound A can be easily oxidised. Identify A, B, C and D and write their structures.

[Ans. : [A] : 
$$(CH_3)_2CHCH_2OH$$
 [B] :  $CH_3CH(CH_3)COOH$   
[C] :  $(CH_3)_2C = CH_2$  [D] :  $(CH_3)_3C - OH$ 

\*17. An organic compound A having molecular formula C<sub>6</sub>H<sub>6</sub>O gives a characteristic colour with aqueous FeCl<sub>3</sub>. When A is treated with NaOH and CO<sub>2</sub> at 400 K under pressure, compound B is obtained. Compound B on acidification gives compound C which reacts with acetyl chloride to form D which is a popular pain killer. Deduce the structure of A, B, C and D. What is the common name of Drug D?



An ether A (C<sub>5</sub>H<sub>12</sub>O) when heated with excess of hot concentrated HI produced two alkyl halides which on hydrolysis from compounds B and C. Oxidation of B gives an acid D whereas oxidation of C gave a ketone E. Deduce the structures of A, B, C, D and E.

[Ans. : (A) CH<sub>3</sub>CH<sub>2</sub>OCH

- (B) CH<sub>3</sub>CH<sub>2</sub>OH
- (C) CH<sub>3</sub>CHOHCH<sub>3</sub>
- (D) CH<sub>3</sub>COOH
- (E) CH<sub>3</sub>COCH<sub>3</sub>
- Phenol, C<sub>6</sub>H<sub>5</sub>OH when it first reacts with concentrated sulphuric acid, forms Y.Y is reacted with concentrated nitric acid to form Z. Identify Y and Z and explain why phenol is not converted commercially to Z by reacting it with conc. HNO<sub>3</sub>.

[Ans. :



Phenol is not reacted directly with conc.  ${\rm HNO}_{\rm 3}$  because the yield of picric acid is very poor]

21. Synthesise the following alcohols from suitable alkenes.



- 22. How are the following ethers prepared by williumson synthesis?
  - (a) Ethoxybenzene (b) 2-methoxy-2-methylpropane