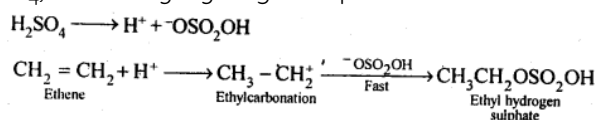
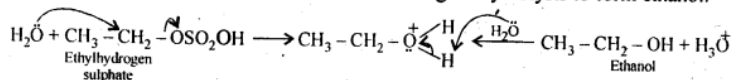




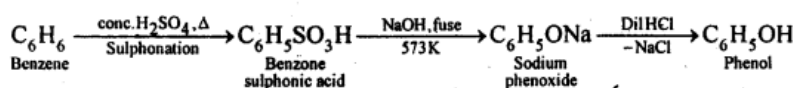
11.11. Write the mechanism of hydration of ethene to yield ethanol.  
 Ans: Direct addition of  $\text{H}_2\text{O}$  to ethene in presence of an acid does not occur. Indirectly, ethene is first passed through concentrated  $\text{H}_2\text{SO}_4$ , when ethyl hydrogen sulphate is formed.



Ethylhydrogen sulphate is then boiled with water undergoes hydrolysis to form ethanol.



11.12. You are given benzene, cone.  $\text{H}_2\text{SO}_4$  and  $\text{NaOH}$ . Write the equations for the preparation of phenol using these reagents.  
 Ans:

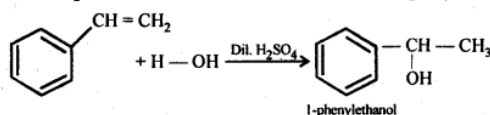


11.13. Show how will you synthesise

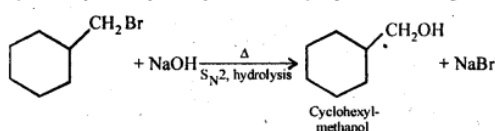
- 1-phenylethanol from a suitable alkene.
- cyclohexylmethanol using an alkyl halide by an  $\text{S}_{\text{N}}2$  reaction.
- Pentan-1-ol using a suitable alkyl halide?

Ans:

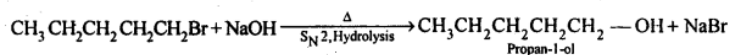
(i) Addition of  $\text{H}_2\text{O}$  to ethenylbenzene in presence of dil  $\text{H}_2\text{SO}_4$ .



(ii) Hydrolysis of cyclohexylmethyl bromide by aqueous  $\text{NaOH}$  gives cyclohexylmethanol.



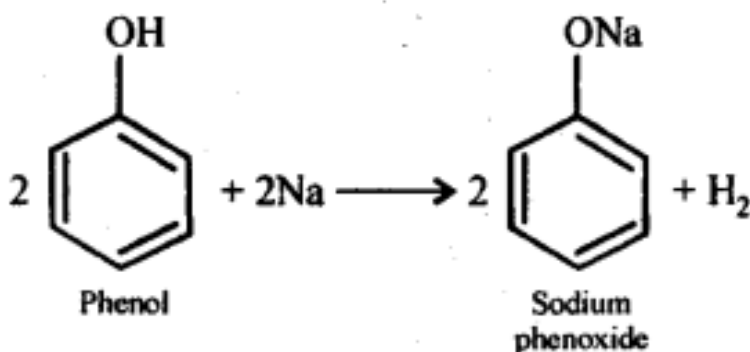
(iii) Hydrolysis of 1-bromopentane by aqueous  $\text{NaOH}$  gives pentan-1-ol.



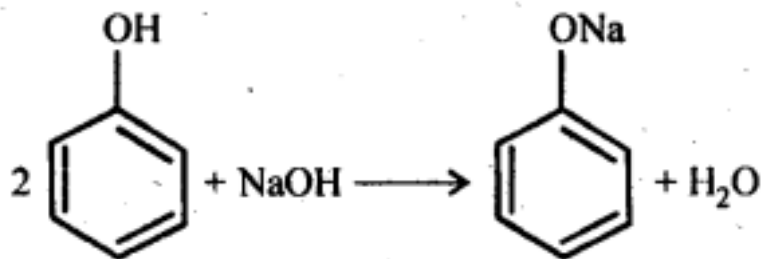
11.14. Give two reactions that show the acidic nature of phenol. Compare its acidity with that of ethanol.

Ans: The reactions showing acidic nature of phenol are:

(a) Reaction with sodium: Phenol reacts with active metals like sodium to liberate  $\text{H}_2$  gas.



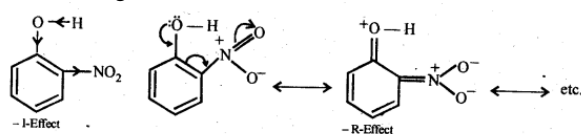
(b) Reaction with NaOH: Phenol dissolves in NaOH to form sodium phenoxide and water.



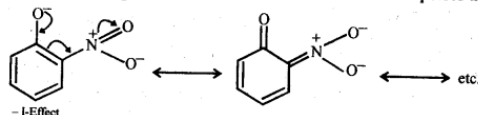
Phenol is more acidic than ethanol. This is due to the reason that phenoxide ion left after the loss of a proton from phenol is stabilized by resonance, while ethoxide ion left after loss of a proton from ethanol, is not.

11.15. Explain why is ortho-nitrophenol more acidic than ortho-methoxyphenol?

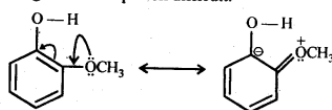
Ans: Due to strong -R and -I-effect of the  $\text{-NO}_2$  group, electron density of the O - H bond decreases and hence the loss of a proton becomes easy.



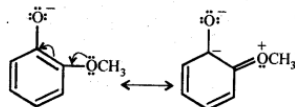
Further, after the loss of a proton, the *o*-nitrophenoxide ion left behind is stabilized by resonance and electron withdrawing  $\text{-NO}_2$  group which withdraws electrons and disperses the negative charge.



In contrast, due to +R effect of the  $\text{-OCH}_3$  group, it increases the electron density of the O - H bond thereby making the loss of proton difficult.



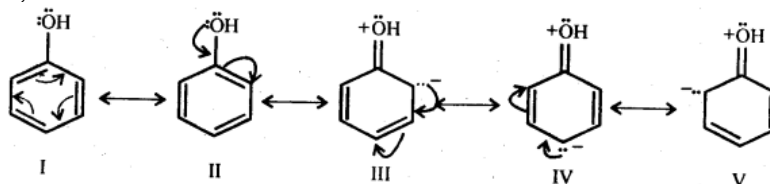
Further more, the *o*-methoxyphenoxide ion left after the loss of a proton is destabilized by resonance. The two negative charges repel each other thereby destabilizing the *o*-methoxy phenoxide ion.



Further the presence of electron donating  $\text{-OCH}_3$  group intensifies the negative charge thereby destabilising the phenoxide ion. Thus, *o*-nitrophenol is more acidic than *o*-methoxyphenol.

11.16. Explain how does the -OH group attached to a carbon of benzene ring activate it towards electrophilic substitution?

Ans: Phenol may be regarded as a resonance hybrid of structures I - V, shown below.



As a result of +R effect of the  $\text{-OH}$  group, the electron density in the benzene ring increases thereby facilitating the attack of an electrophile. In other words, presence of  $\text{-OH}$  group, activates the benzene ring towards electrophilic substitution reactions. Further, since the electron density is relatively higher at the two *o*- and one *p*-position, therefore electrophilic substitution occurs mainly at *o*- and *p*-positions.

11.17. Give equations of the following reactions:

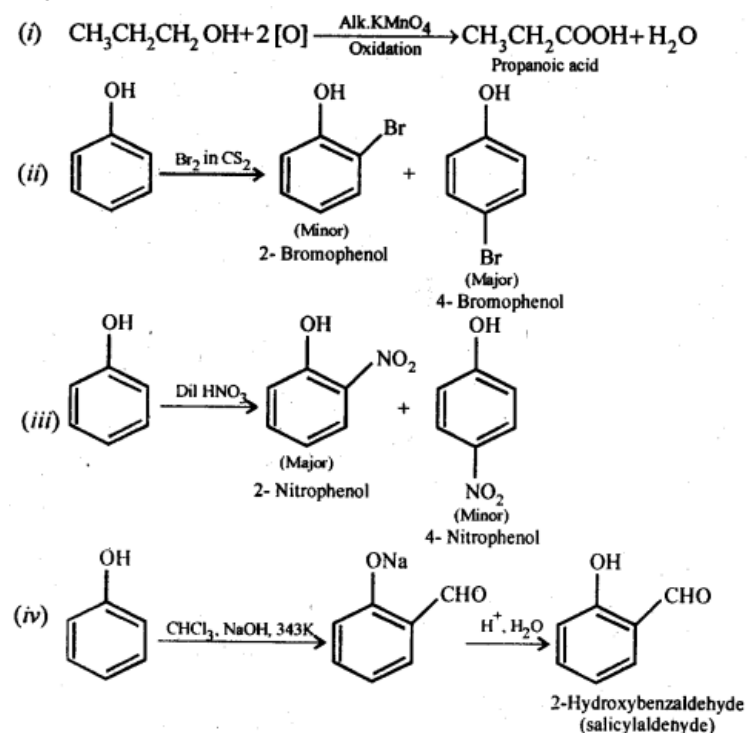
(i) Oxidation of propan-1-ol with alkaline  $\text{KMnO}_4$  solution.

(ii) Bromine in  $\text{CS}_2$  with phenol.

(iii) Dilute  $\text{HNO}_3$  acid with phenol

(iv) Treating phenol with chloroform in presence of aqueous NaOH.

Ans:



11.18 Explain the following with an example

(i) Kolbe's reaction

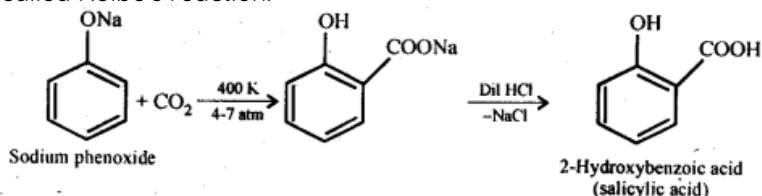
(ii) Reimer - Tiemann reaction -

(iii) Williamson ether synthesis

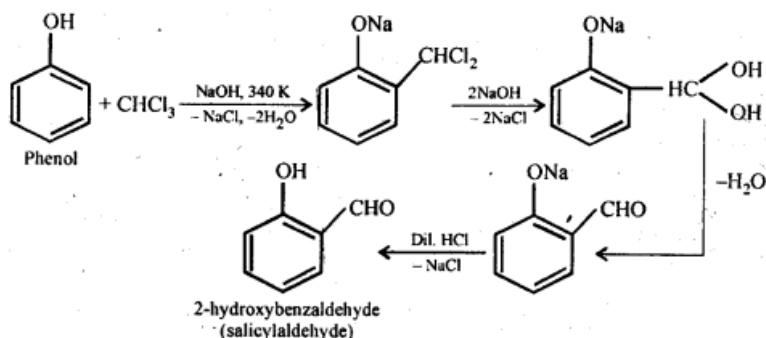
(iv) Unsymmetrical ether

Ans:

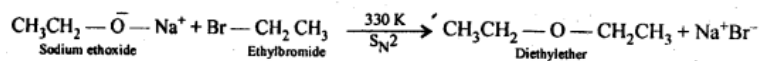
(i) Kolbe's reaction: Sodium phenoxide when heated with  $\text{CO}_2$  at 400K under a pressure of 4-7 atmospheres followed by acidification gives 2-hydroxybenzoic acid (salicylic acid) as the major product along with a small amount of 4-hydroxybenzoic acid. This reaction is called Kolbe's reaction.



(ii) Reimer-Tiemann reaction: Treatment of phenol with  $\text{CHCl}_3$  in presence of aqueous sodium or potassium hydroxide at 340 K followed by hydrolysis of the resulting product gives 2-hydroxybenzaldehyde (salicylaldehyde) as the major product. This reaction is called Reimer-Tiemann reaction.



(iii) Williamson's ether synthesis: It involves the treatment of an alkyl halide with a suitable sodium alkoxide to obtain ethers. The sodium alkoxide needed for the purpose is prepared by the action of sodium on a suitable alcohol. In this reaction alkyl halide should be primary. Secondary and tertiary halides will predominantly give an alkene.

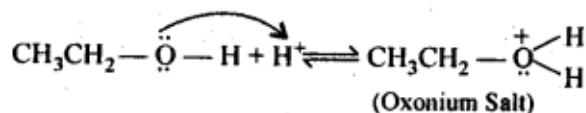


(iv) Unsymmetrical ether: If the alkyl or aryl groups attached to the oxygen atom are different, ethers are called unsymmetrical ethers. For example, ethylmethylether, methylphenylether, 4-chlorophenyl-4-nitrophenyl ether, etc.

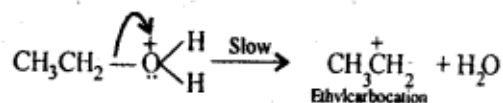
11.19. Write the mechanism of acid dehydration of ethanol to yield ethene.

Ans: The mechanism of dehydration of alcohols to form alkenes occur by the following three steps:

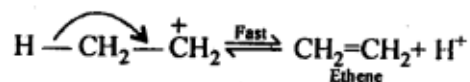
**(a) Formation of protonated alcohol:**



**(b) Formation of carbocation :**



**(c) Elimination of a proton to form ethene:**



11.20. How are the following conversions carried out?

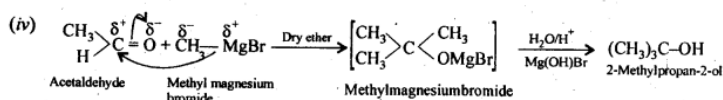
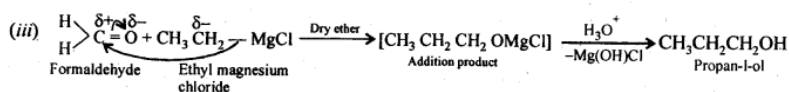
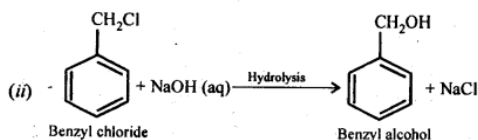
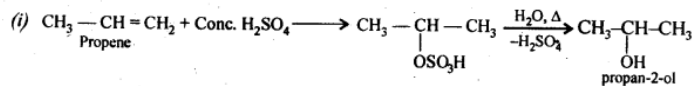
(i) Propene → Propan-2-ol

(ii) Benzyl chloride → Benzyl alcohol

(iii) Ethyl magnesium chloride → Propan-1-ol

(iv) Methyl magnesium bromide → 2-Methylpropan-2-ol

Ans:



\*\*\*\*\* END \*\*\*\*\*