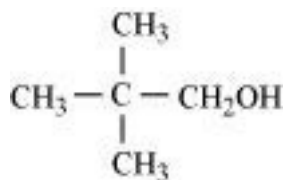


**CBSE Class 12 physics**  
**Important Questions**  
**Chapter 11**  
**Alcohols Phenols and Ethers**

**5 Mark Questions**

1. Classify the following as primary, secondary and tertiary alcohols:

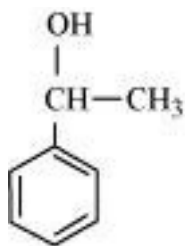
(i)



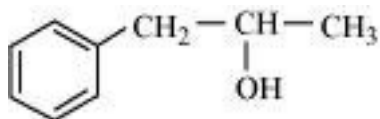
(ii)  $\text{H}_2\text{C} = \text{CH} - \text{CH}_2\text{OH}$

(iii)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{OH}$

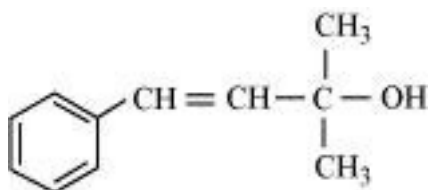
(iv)



(v)



(vi)



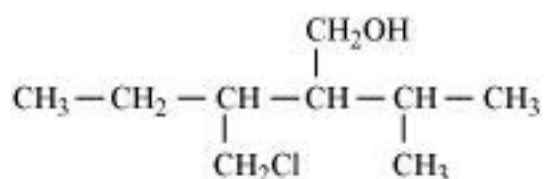
**Ans.** Primary alcohol → (i), (ii), (iii)

Secondary alcohol → (iv), (v)

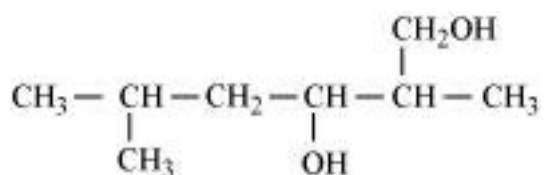
Tertiary alcohol → (vi)

**2. Name the following compounds according to IUPAC system.**

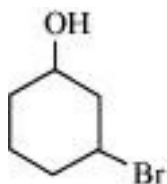
**(i)**



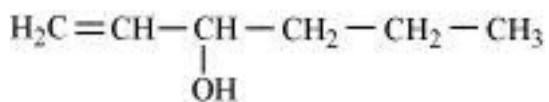
**(ii)**



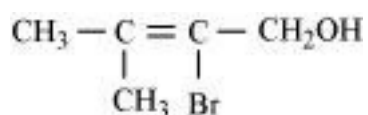
**(iii)**



**(iv)**



**(v)**



**Ans. (i)** 3-Chloromethyl-2-isopropylpentan-1-ol

**(ii)** 2, 5-Dimethylhexane-1, 3-diol

(iii) 3-Bromocyclohexanol

(iv) Hex-1-en-3-ol

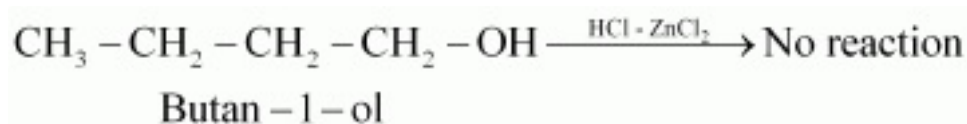
(v) 2-Bromo-3-methylbut-2-en-1-ol

**3. Give structures of the products you would expect when each of the following alcohol reacts with (a)  $HCl - ZnCl_2$  (b)  $HBr$  and (c)  $SOCl_2$ .**

(i) Butan-1-ol

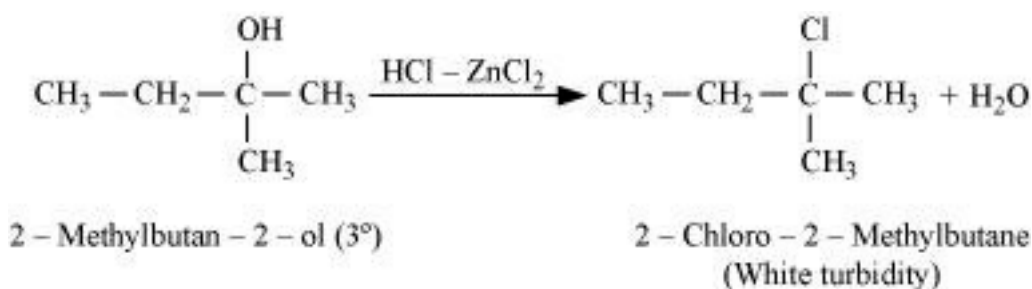
(ii) 2-Methylbutan-2-ol

**Ans. (a)(i)**



Primary alcohols do not react appreciably with Lucas' reagent ( $HCl - ZnCl_2$ ) at room temperature.

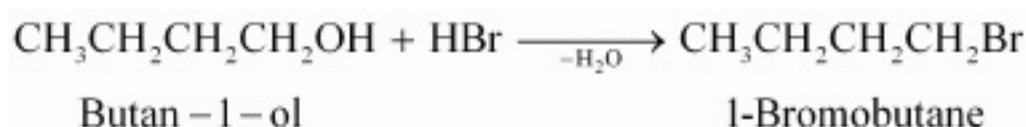
(ii)



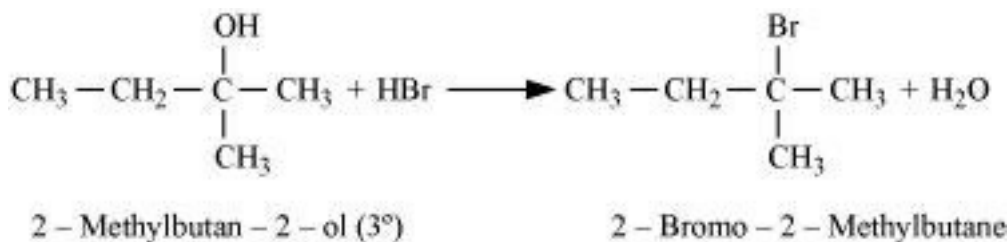
Tertiary alcohols react immediately with Lucas' reagent.

(b)

(i)

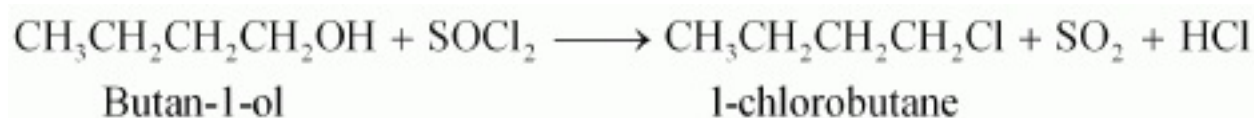


(ii)

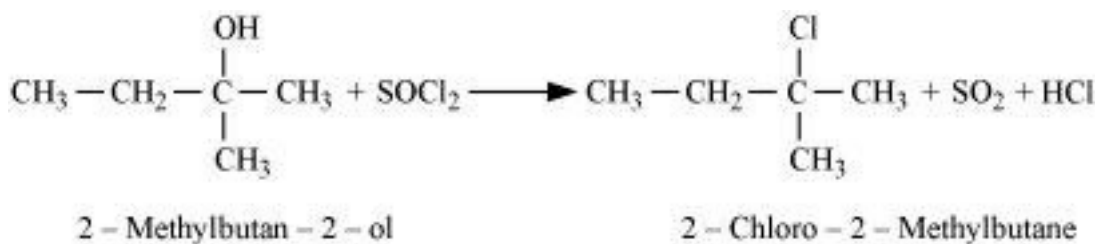


(c)

(i)

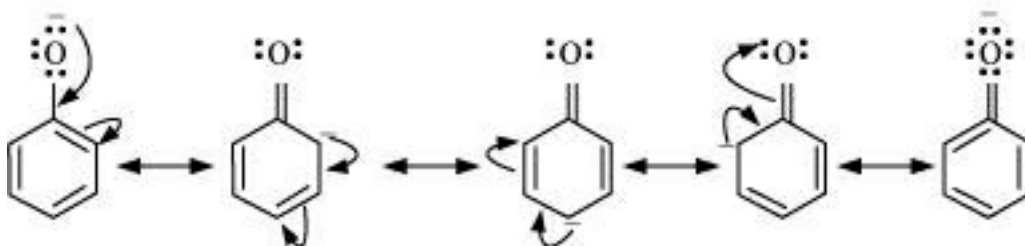


(ii)

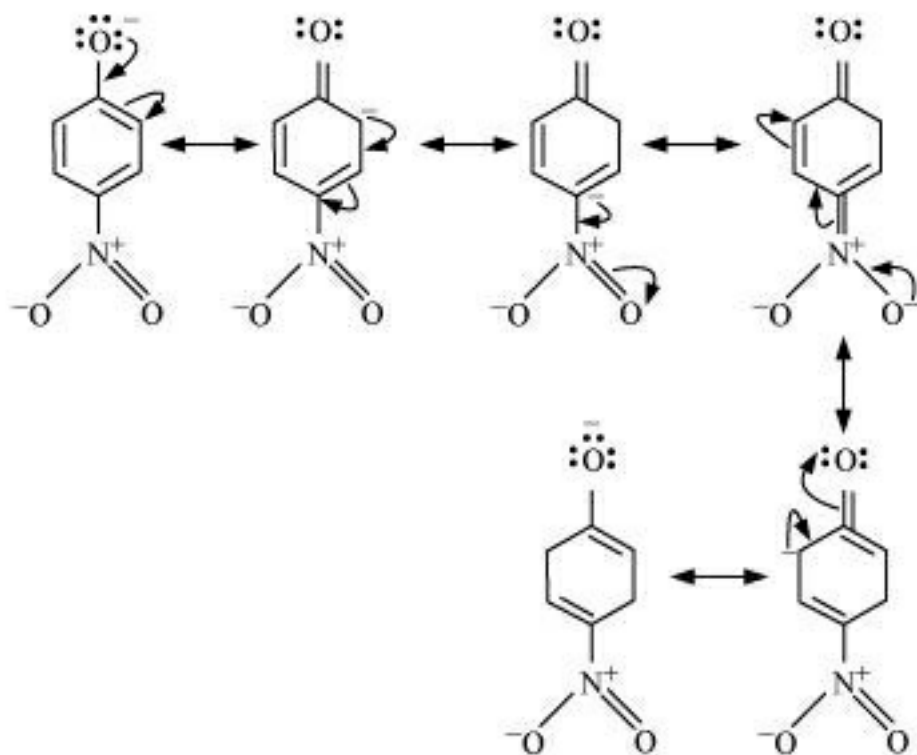


4. *Ortho* and *para* nitrophenols are more acidic than phenol. Draw the resonance structures of the corresponding phenoxide ions.

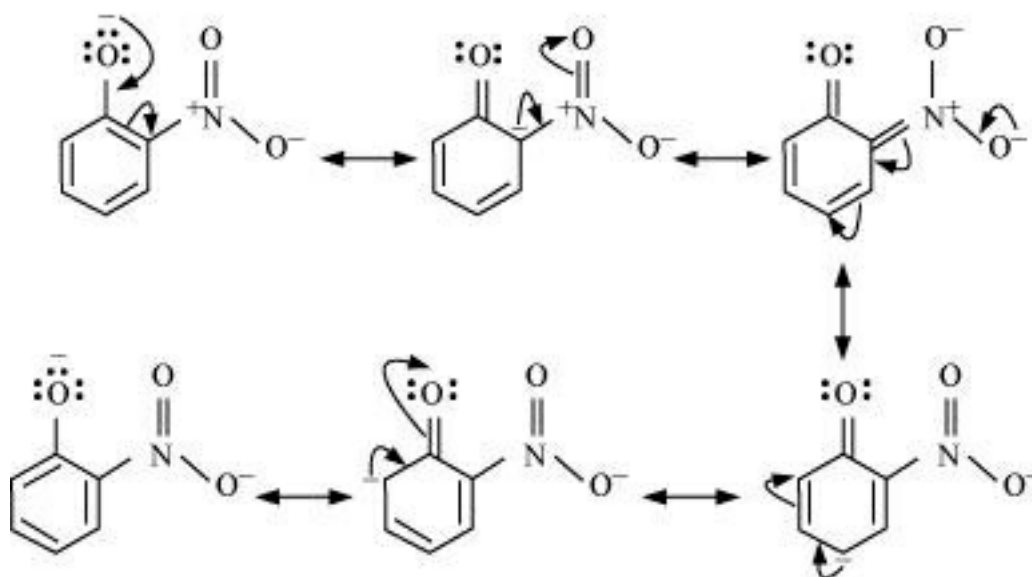
Ans.



Resonance structure of the phenoxide ion



Resonance structures of *p*-nitrophenoxide ion

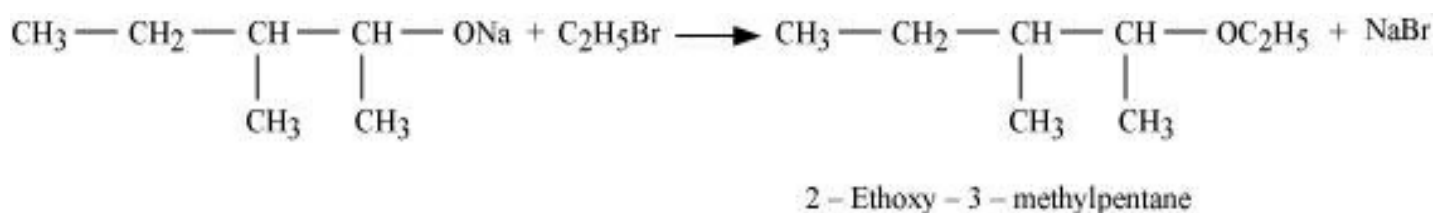
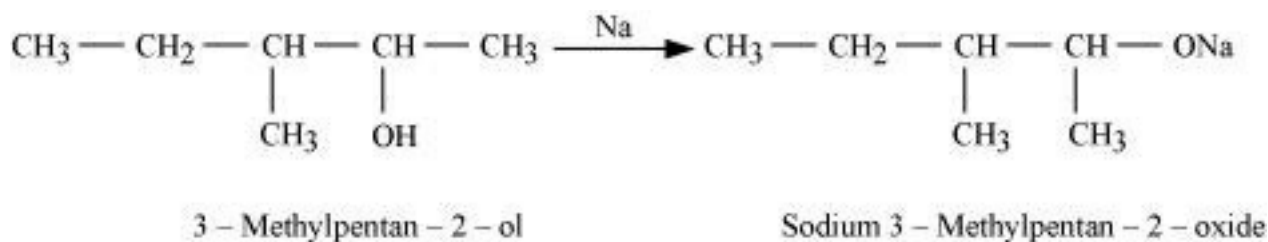


Resonance structures of *o*-nitrophenoxide ion

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

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

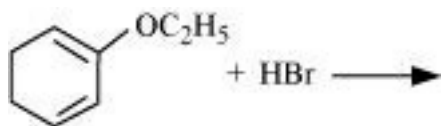
**Ans.** In Williamson synthesis, an alkyl halide reacts with an alkoxide ion. Also, it is an  $S_N^2$  reaction. In the reaction, alkyl halides should be primary having the least steric hindrance. Hence, an alkyl halide is obtained from ethanol and alkoxide ion from 3-methylpentan-2-ol.



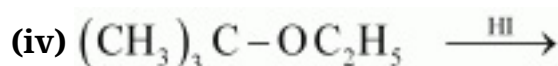
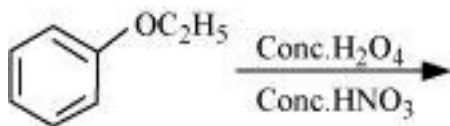
**6. Predict the products of the following reactions:**



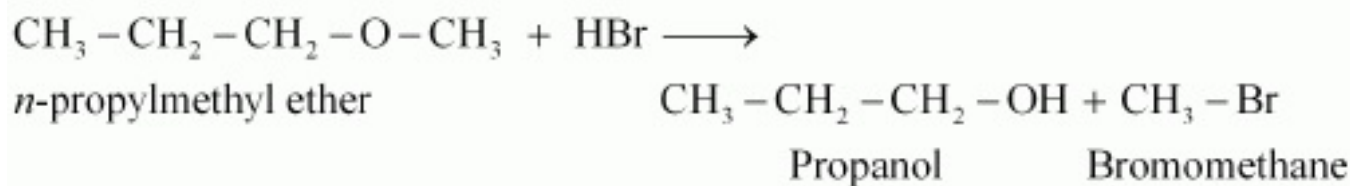
(ii)



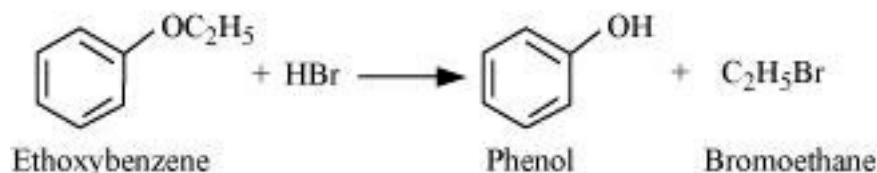
(iii)



**Ans. (i)**



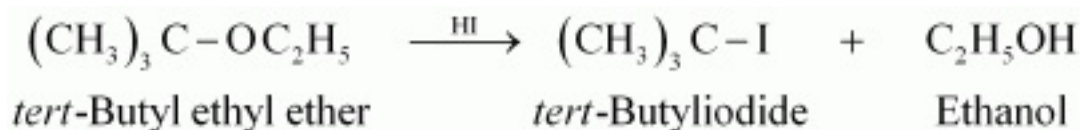
(ii)



(iii)

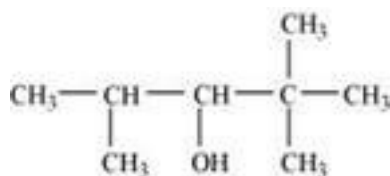


(iv)

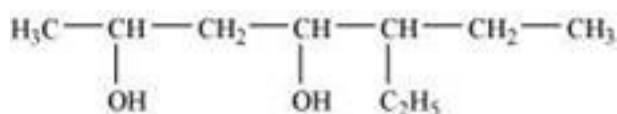


7. Write IUPAC names of the following compounds:

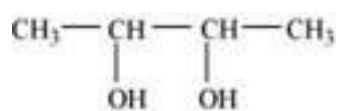
(i)



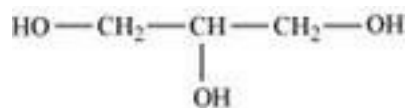
(ii)



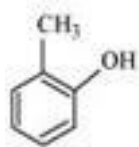
(iii)



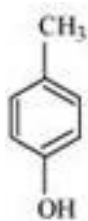
(iv)



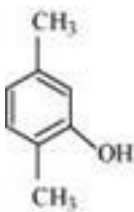
(v)



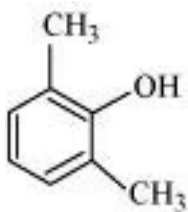
(vi)



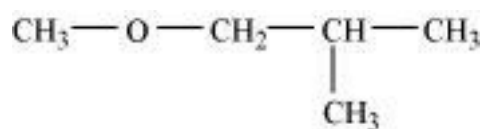
(vii)



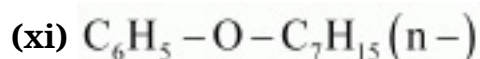
(viii)



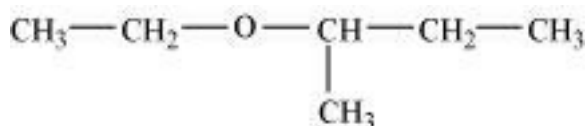
(ix)







(xii)



Ans. (i) 2, 2, 4-Trimethylpentan-3-ol

(ii) 5-Ethylheptane-2, 4-diol

(iii) Butane-2, 3-diol

(iv) Propane-1, 2, 3-triol

(v) 2-Methylphenol

(vi) 4-Methylphenol

(vii) 2, 5-Dimethylphenol

(viii) 2, 6-Dimethylphenol

(ix) 1-Methoxy-2-methylpropane

(x) Ethoxybenzene

(xi) 1-Phenoxyheptane

(xii) 2-Ethoxybutane

**8. Write structures of the compounds whose IUPAC names are as follows:**

(i) 2-Methylbutan-2-ol

(ii) 1-Phenylpropan-2-ol

(iii) 3,5-Dimethylhexane -1, 3, 5-triol

(iv) 2,3 - Diethylphenol

(v) 1 - Ethoxypropane

(vi) 2-Ethoxy-3-methylpentane

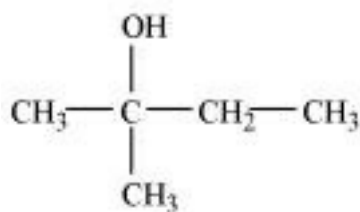
(vii) Cyclohexylmethanol

(viii) 3-Cyclohexylpentan-3-ol

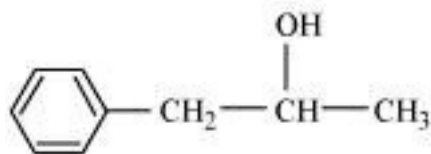
(ix) Cyclopent-3-en-1-ol

(x) 3-Chloromethylpentan-1-ol.

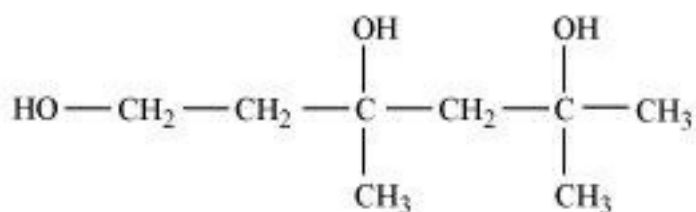
Ans. (i)



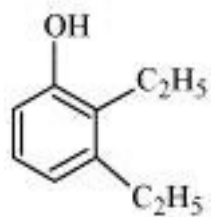
(ii)



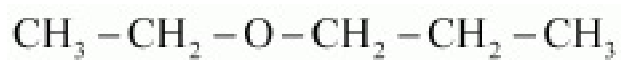
(iii)



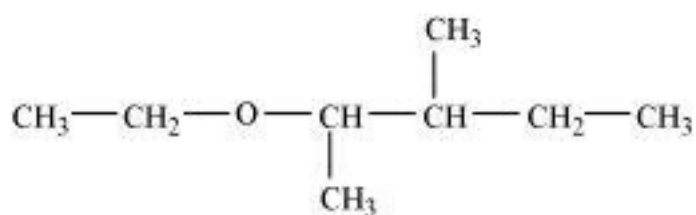
(iv)



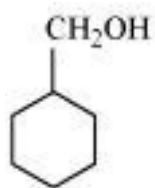
(v)



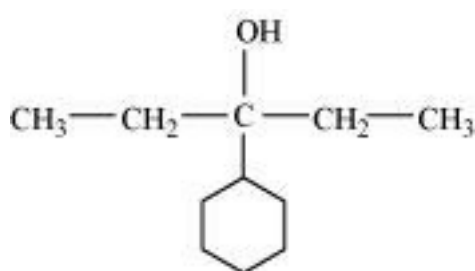
(vi)



(vii)



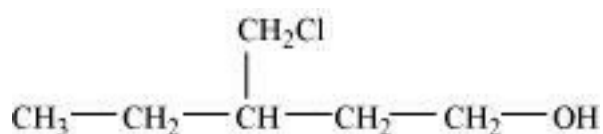
(viii)



(ix)



(x)



9. (i) Draw the structures of all isomeric alcohols of molecular formula  $\text{C}_5\text{H}_{12}\text{O}$  and give their IUPAC names.

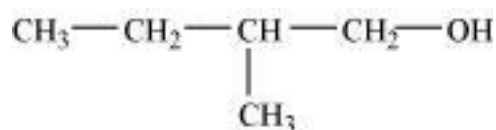
(ii) Classify the isomers of alcohols in question 11.3 (i) as primary, secondary and tertiary alcohols.

**Ans. (i)** The structures of all isomeric alcohols of molecular formula,  $\text{C}_5\text{H}_{12}\text{O}$  are shown below:



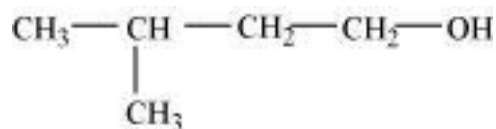
Pentan-1-ol ( $1^\circ$ )

(b)



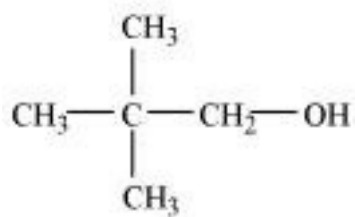
2-Methylbutan-1-ol ( $1^\circ$ )

(c)



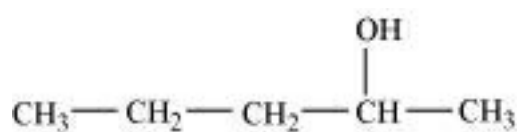
3-Methylbutan-1-ol ( $1^\circ$ )

(d)



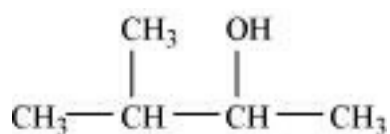
2, 2-Dimethylpropan-1-ol ( $1^\circ$ )

(e)



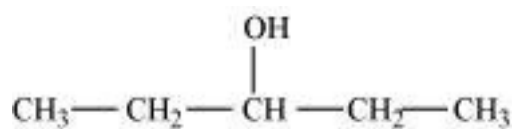
Pentan-2-ol ( $2^\circ$ )

(f)



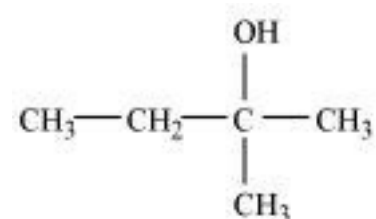
3-Methylbutan-2-ol ( $2^\circ$ )

(g)



Pentan-3-ol ( $2^\circ$ )

(h)



2-Methylbutan-2-ol ( $3^\circ$ )

(ii) Primary alcohol: Pentan-1-ol; 2-Methylbutan-1-ol;

3-Methylbutan-1-ol; 2, 2 - Dimethylpropan-1-ol

Secondary alcohol: Pentan-2-ol; 3-Methylbutan-2-ol;

Pentan-3-ol

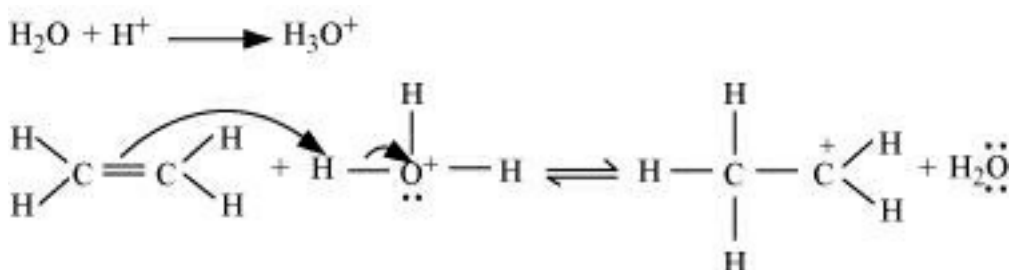
Tertiary alcohol: 2-methylbutan-2-ol

**10. Write the mechanism of hydration of ethene to yield ethanol.**

**Ans.** The mechanism of hydration of ethene to form ethanol involves three steps.

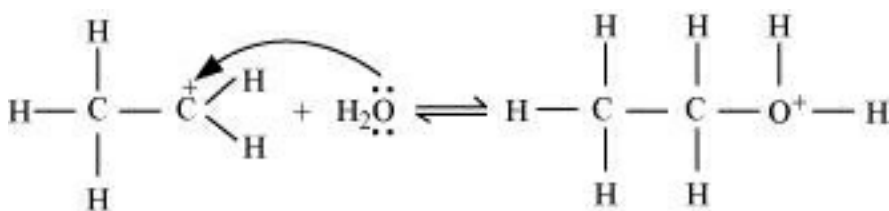
**Step 1:**

Protonation of ethene to form carbocation by electrophilic attack of  $H_3O^+$  + :



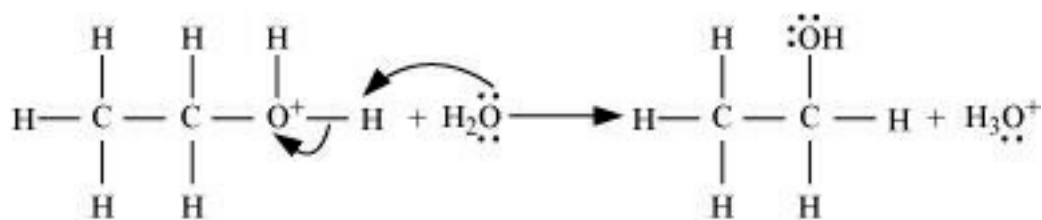
**Step 2:**

Nucleophilic attack of water on carbocation:



**Step 3:**

Deprotonation to form ethanol:



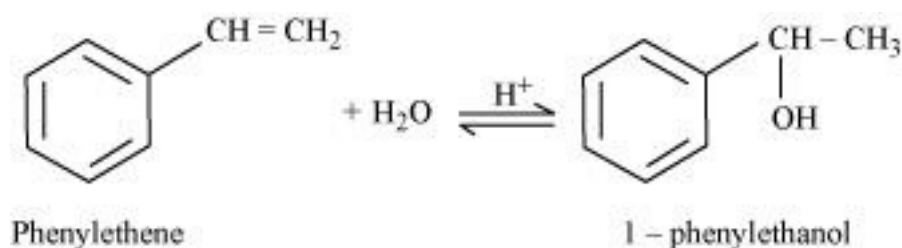
11. Show how will you synthesize:

(i) 1-phenylethanol from a suitable alkene.

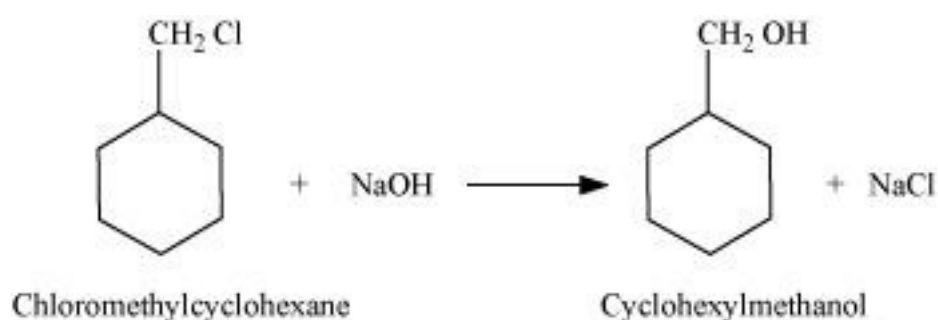
(ii) cyclohexylmethanol using an alkyl halide by an  $S_N2$  reaction.

(iii) pentan-1-ol using a suitable alkyl halide?

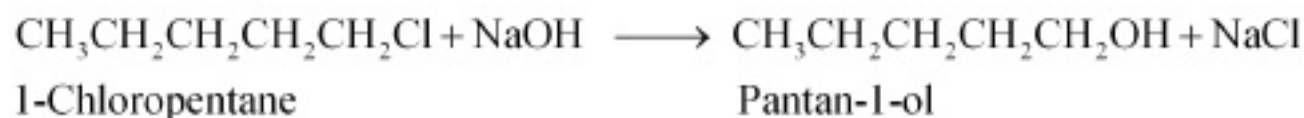
**Ans. (i)** By acid-catalyzed hydration of ethylbenzene (styrene), 1-phenylethanol can be synthesized.



**(ii)** When chloromethylcyclohexane is treated with sodium hydroxide, cyclohexylmethanol is obtained.



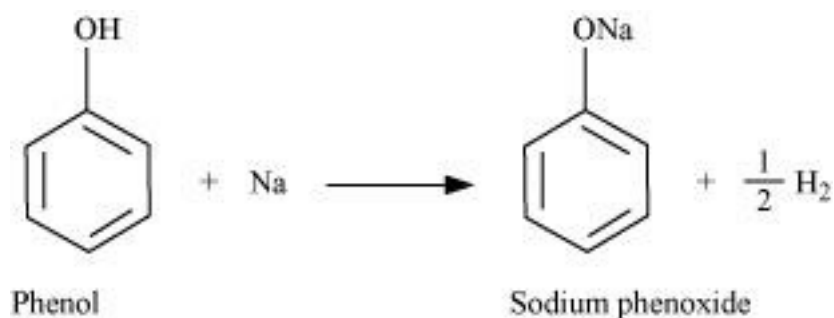
**(iii)** When 1-chloropentane is treated with NaOH, pentan-1-ol is produced.



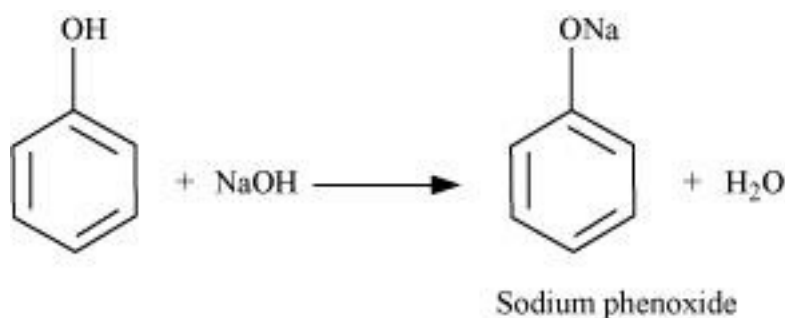
12. Give two reactions that show the acidic nature of phenol. Compare acidity of phenol with that of ethanol.

**Ans.** The acidic nature of phenol can be represented by the following two reactions:

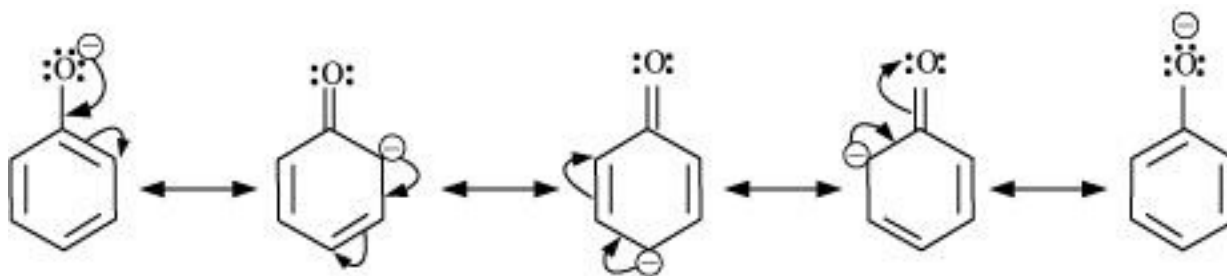
(i) Phenol reacts with sodium to give sodium phenoxide, liberating  $H_2$ .



(ii) Phenol reacts with sodium hydroxide to give sodium phenoxide and water as by-products.



The acidity of phenol is more than that of ethanol. This is because after losing a proton, the phenoxide ion undergoes resonance and gets stabilized whereas ethoxide ion does not.



**12. Give equations of the following reactions:**

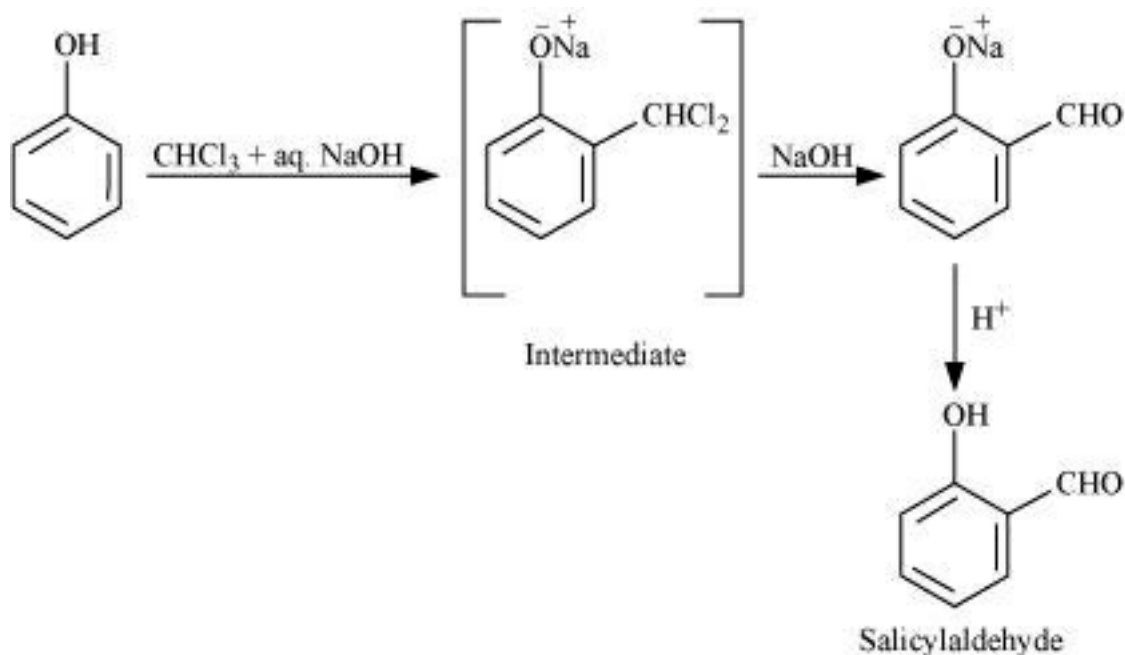
(i) Oxidation of propan-1-ol with alkaline  $KMnO_4$  solution.

(ii) Bromine in  $CS_2$  with phenol.

(iii) Dilute  $HNO_3$  with phenol.



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13. Explain the following with an example.

(i) Kolbe's reaction.

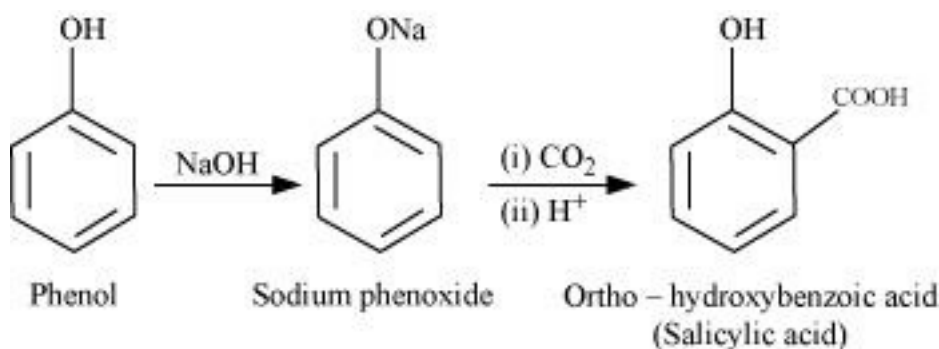
(ii) Reimer-Tiemann reaction.

(iii) Williamson ether synthesis.

(iv) Unsymmetrical ether.

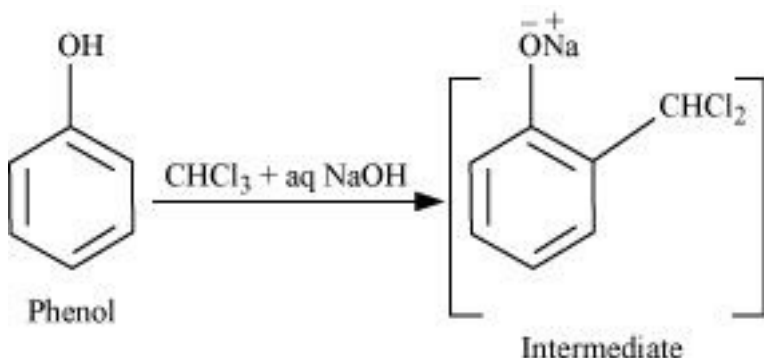
Ans. (i) Kolbe's reaction:

When phenol is treated with sodium hydroxide, sodium phenoxide is produced. This sodium phenoxide when treated with carbon dioxide, followed by acidification, undergoes electrophilic substitution to give ortho-hydroxybenzoic acid as the main product. This reaction is known as Kolbe's reaction.



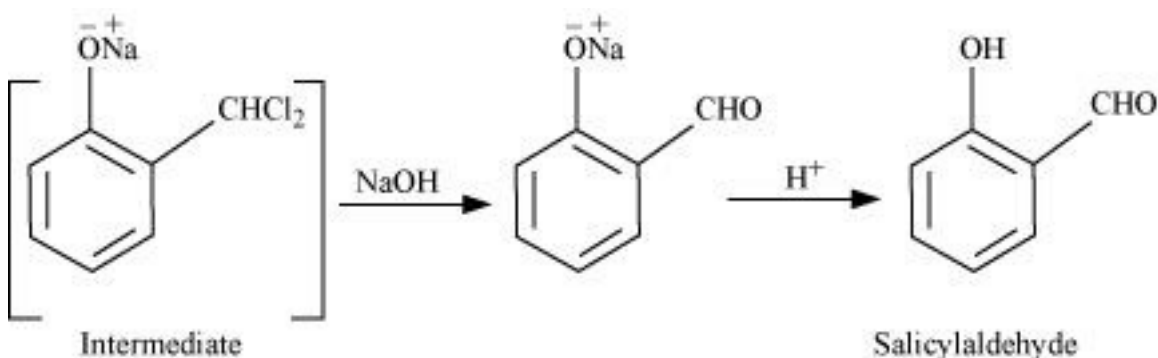
### (ii) Reimer-Tiemann reaction:

When phenol is treated with chloroform ( $\text{CHCl}_3$ ) in the presence of sodium hydroxide, a -CHO group is introduced at the ortho position of the benzene ring.



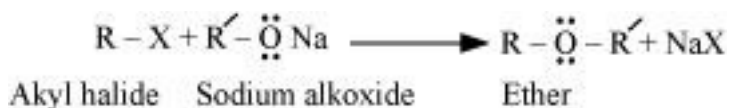
This reaction is known as the Reimer-Tiemann reaction.

The intermediate is hydrolyzed in the presence of alkalis to produce salicylaldehyde.



### (iii) Williamson ether synthesis:

Williamson ether synthesis is a laboratory method to prepare symmetrical and unsymmetrical ethers by allowing alkyl halides to react with sodium alkoxides.



This reaction involves  $\text{S}_{\text{N}}^2$  attack of the alkoxide ion on the alkyl halide. Better results are obtained in case of primary alkyl halides.



If the alkyl halide is secondary or tertiary, then elimination competes over substitution.

#### (iv) Unsymmetrical ether:

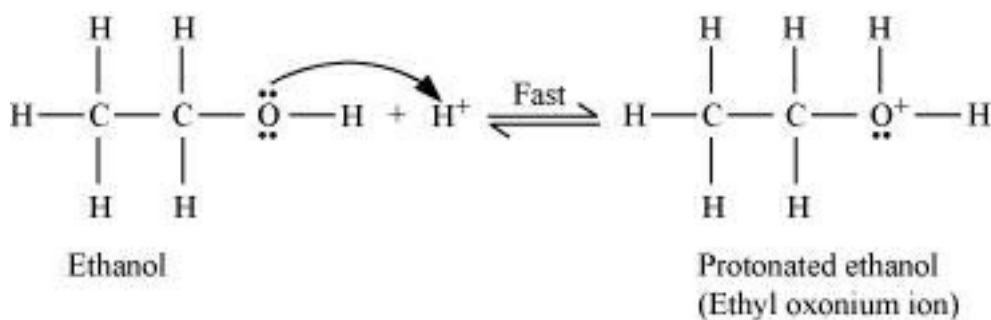
An unsymmetrical ether is an ether where two groups on the two sides of an oxygen atom differ (i.e., have an unequal number of carbon atoms). For example: ethyl methyl ether ( $\text{CH}_3 - \text{O} - \text{CH}_2\text{CH}_3$ ).

#### 14. Write the mechanism of acid-catalysed dehydration of ethanol to yield ethene.

**Ans.** The mechanism of acid dehydration of ethanol to yield ethene involves the following three steps:

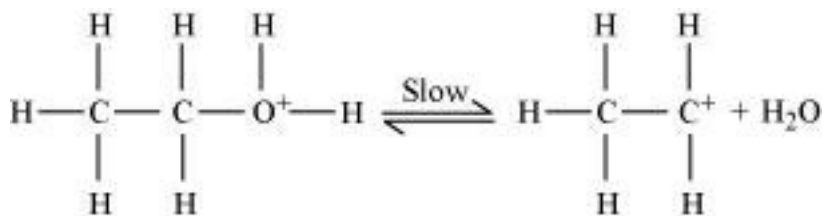
##### Step 1:

Protonation of ethanol to form ethyl oxonium ion:



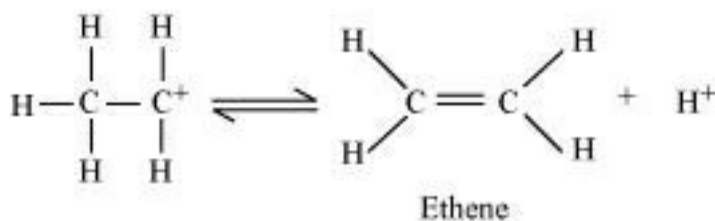
##### Step 2:

Formation of carbocation (rate determining step):



##### Step 3:

Elimination of a proton to form ethene:



The acid consumed in step 1 is released in Step 3. After the formation of ethene, it is removed to shift the equilibrium in a forward direction.

**15. How are the following conversions carried out?**

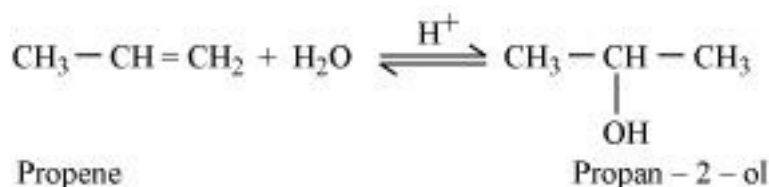
**(i) Propene → Propan-2-ol**

**(ii) Benzyl chloride → Benzyl alcohol**

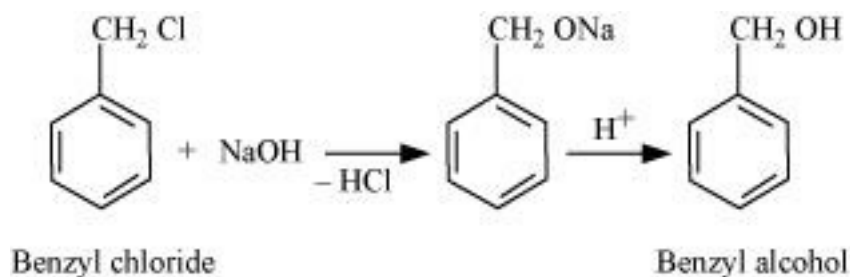
**(iii) Ethyl magnesium chloride → Propan-1-ol.**

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

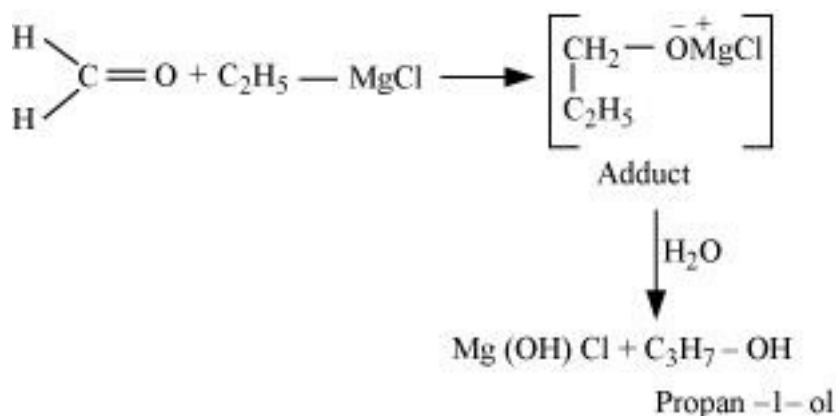
**Ans. (i)** If propene is allowed to react with water in the presence of an acid as a catalyst, then propan-2-ol is obtained.



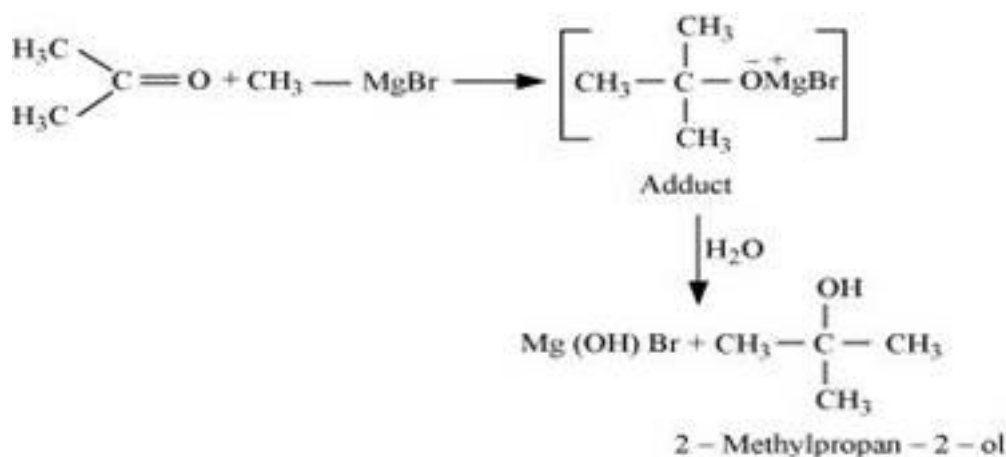
**(ii)** If benzyl chloride is treated with NaOH (followed by acidification) then benzyl alcohol is produced.



**(iii)** When ethyl magnesium chloride is treated with methanal, an adduct is the produced which gives propan-1-ol on hydrolysis.



(iv) When methyl magnesium bromide is treated with propanone, an adduct is the product which gives 2-methylpropan-2-ol on hydrolysis.



16. Name the reagents used in the following reactions:

(i) Oxidation of a primary alcohol to carboxylic acid.

(ii) Oxidation of a primary alcohol to aldehyde.

(iii) Bromination of phenol to 2,4,6-tribromophenol.

(iv) Benzyl alcohol to benzoic acid.

(v) Dehydration of propan-2-ol to propene.

(vi) Butan-2-one to butan-2-ol.

**Ans.** (i) Acidified potassium permanganate

(ii) Pyridinium chlorochromate (PCC)

(iii) Bromine water

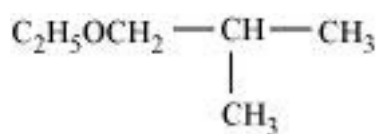
(iv) Acidified potassium permanganate

(v) 85% phosphoric acid

(vi)  $\text{NaBH}_4$  or  $\text{LiAlH}_4$

**18. Give IUPAC names of the following ethers:**

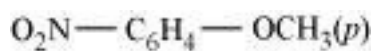
(i)



(ii)



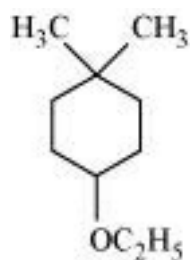
(iii)



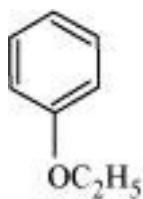
(iv)



(v)



(vi)



Ans. (i) 1-Ethoxy-2-methylpropane

(ii) 2-Chloro-1-methoxyethane

(iii) 4-Nitroanisole

(iv) 1-Methoxypropane

(v) 4-Ethoxy-1, 1-dimethylcyclohexane

(vi) Ethoxybenzene

19. Write the names of reagents and equations for the preparation of the following ethers by Williamson's synthesis:

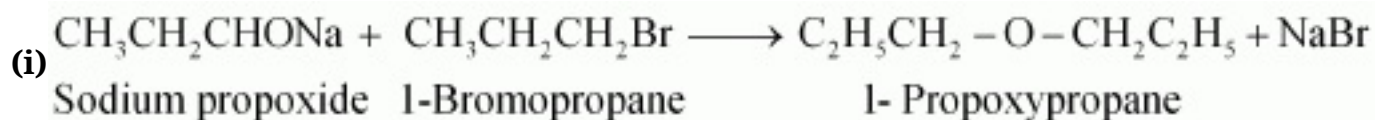
(i) 1-Propoxypropane

(ii) Ethoxybenzene

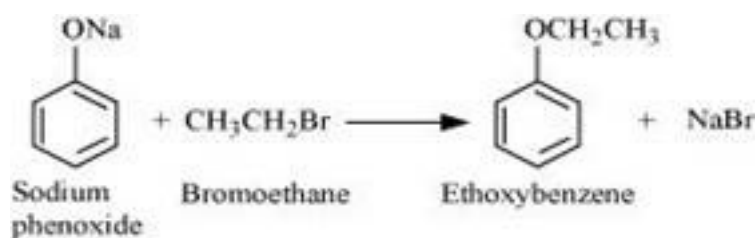
(iii) 2-Methoxy-2-methylpropane

(iv) 1-Methoxyethane

Ans.

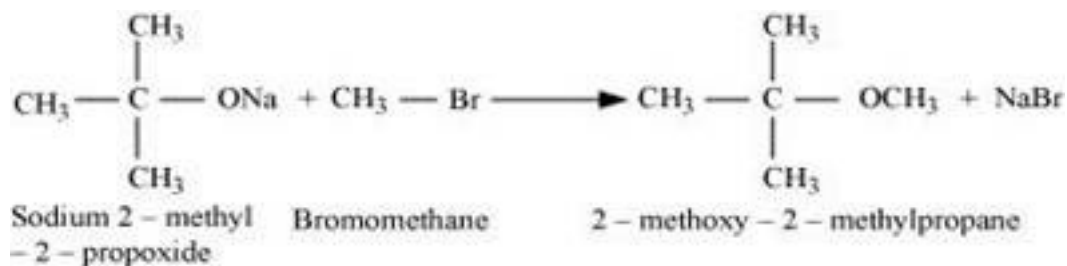


(ii)





(iii)



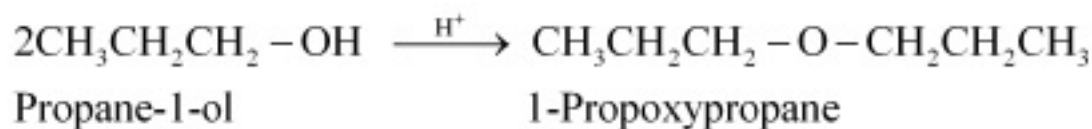
(iv)



**20. How is 1-propoxypropane synthesised from propan-1-ol? Write mechanism of this reaction.**

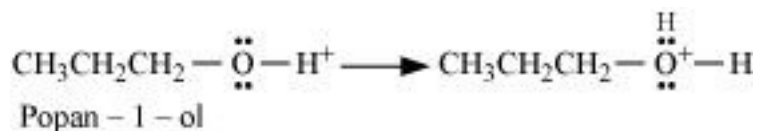
**Ans.** 1-propoxypropane can be synthesized from propan-1-ol by dehydration.

Propan-1-ol undergoes dehydration in the presence of protic acids (such as H<sub>2</sub>SO<sub>4</sub>, H<sub>3</sub>PO<sub>4</sub>) to give 1-propoxypropane.

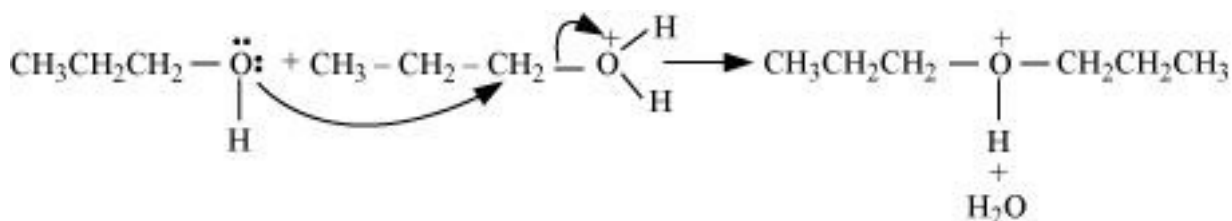


The mechanism of this reaction involves the following three steps:

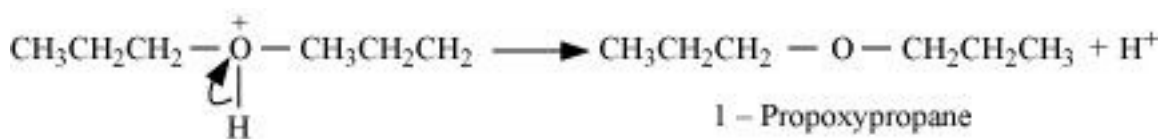
**Step 1: Protonation**



**Step 2: Nucleophilic attack**



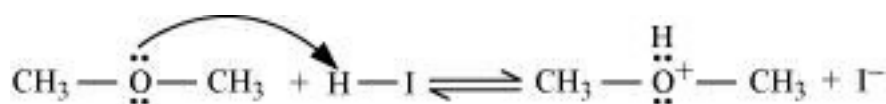
### Step 3: Deprotonation



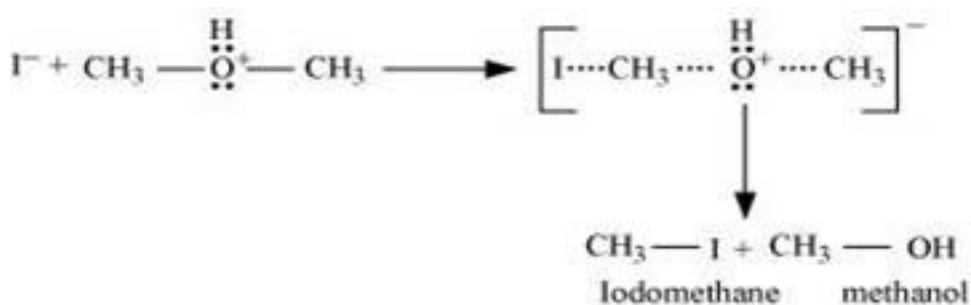
### 21. Write the mechanism of the reaction of HI with methoxymethane.

**Ans.** The mechanism of the reaction of HI with methoxymethane involves the following steps:

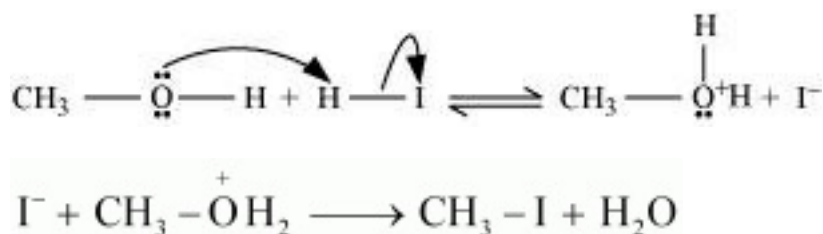
#### Step1: Protonation of methoxymethane:



#### Step2: Nucleophilic attack of I<sup>-</sup>:



**Step3:** When HI is in excess and the reaction is carried out at a high temperature, the methanol formed in the second step reacts with another HI molecule and gets converted to methyl iodide



### 22. Write equations of the following reactions:

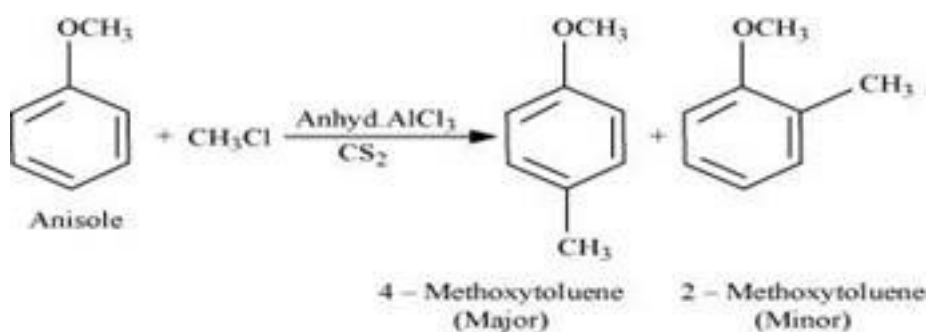
(i) Friedel-Crafts reaction-alkylation of anisole.

(ii) Nitration of anisole.

(iii) Bromination of anisole in ethanoic acid medium.

(iv) Friedel-Craft's acetylation of anisole.

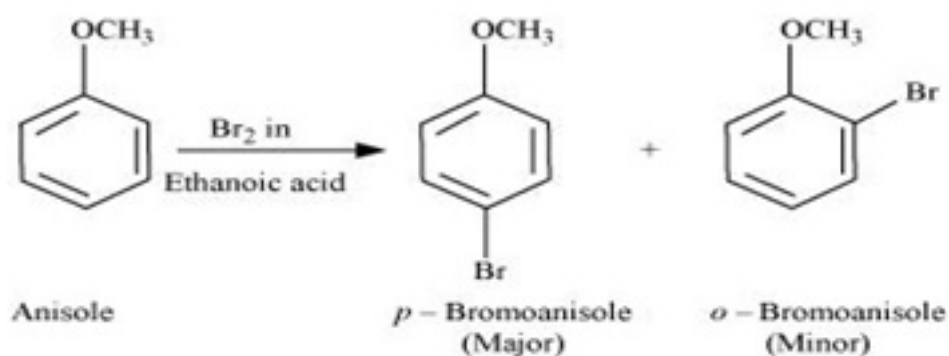
Ans. (i)



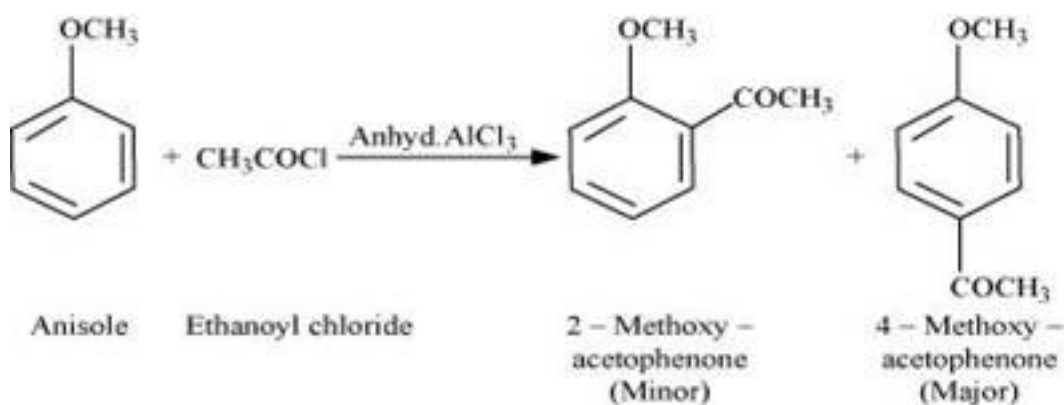
(ii)



(iii)

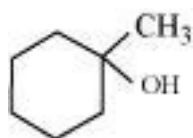


(iv)

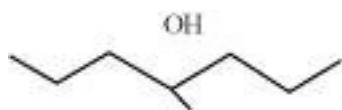


23. Show how would you synthesise the following alcohols from appropriate alkenes?

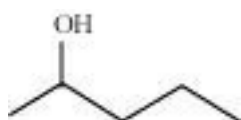
(i)



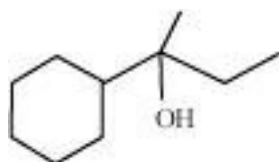
(ii)



(iii)

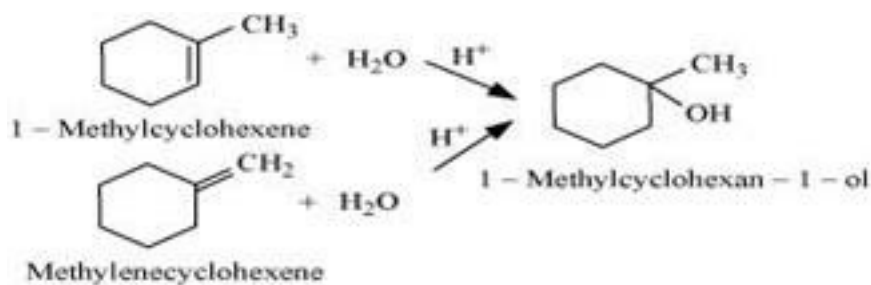


(iv)

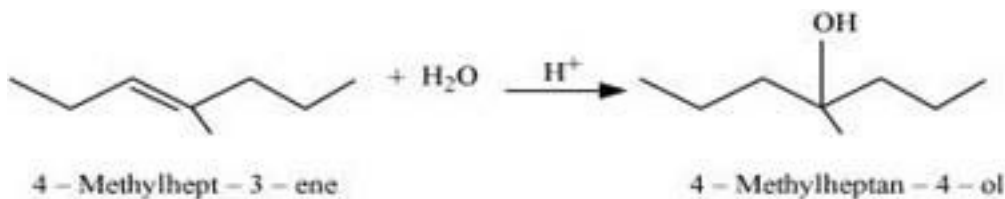


**Ans.** The given alcohols can be synthesized by applying Markovnikov's rule of acid-catalyzed hydration of appropriate alkenes.

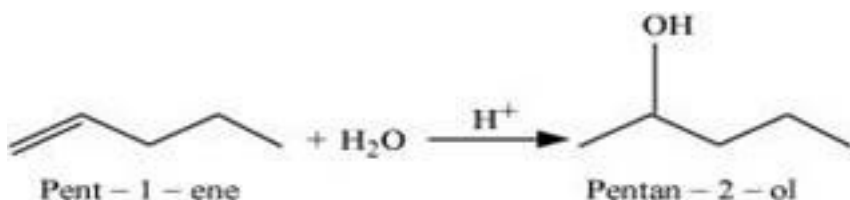
(i)



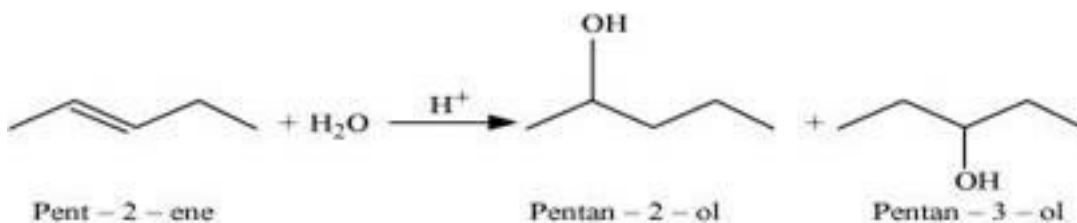
(ii)



(iii)

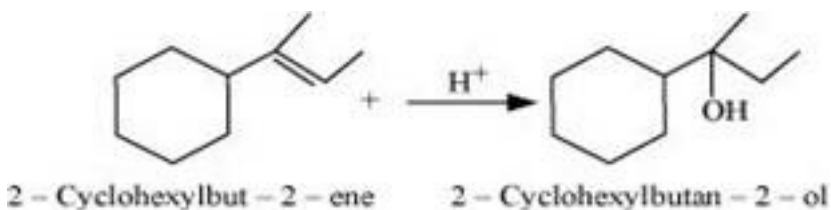


Acid-catalyzed hydration of pent-2-ene also produces pentan-2-ol but along with pentan-3-ol.



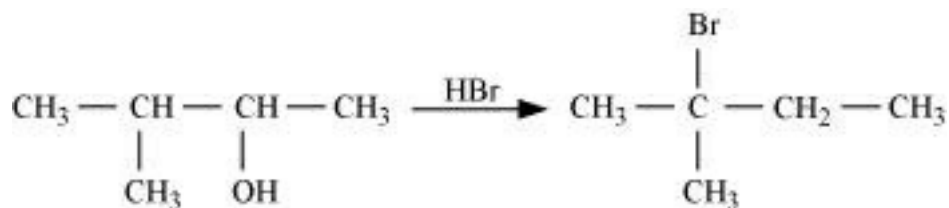
Thus, the first reaction is preferred over the second one to get pentan-2-ol.

(iv)



24. When 3-methylbutan-2-ol is treated with HBr, the following reaction takes

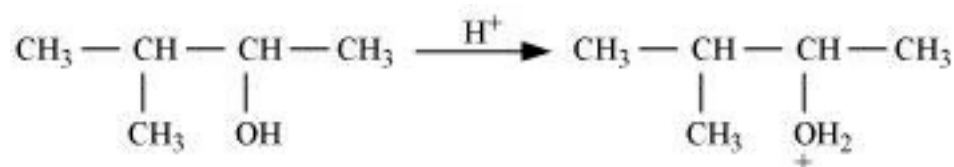
place:



Give a mechanism for this reaction. (Hint : The secondary carbocation formed in step II rearranges to a more stable tertiary carbocation by a hydride ion shift from 3rd carbon atom.

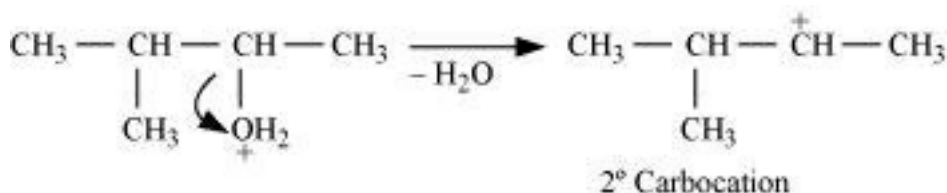
Ans. : The mechanism of the given reaction involves the following steps:

**Step 1: Protonation**

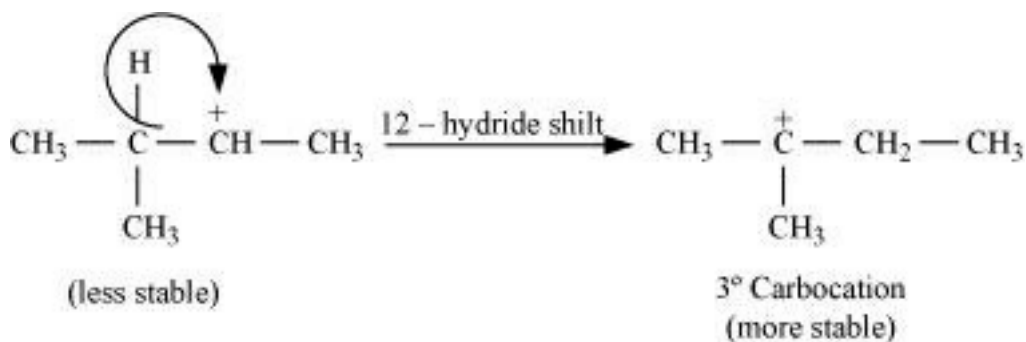


3 - Methylbutan - 2 - ol

**Step 2: Formation of 2° carbocation by the elimination of a water molecule**



**Step 3: Re-arrangement by the hydride-ion shift**



**Step 4: Nucleophilic attack**

