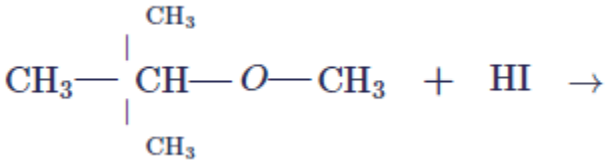
# Short Answer Questions-II

## Short Answer Questions-II (PYQ)

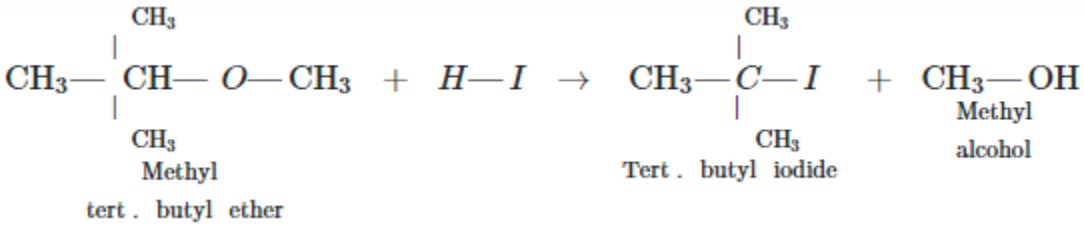
**Q.1. Write the main product(s) in each of the following reactions:**

**[*CBSE Delhi 2016*]**

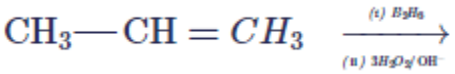
**Q.**



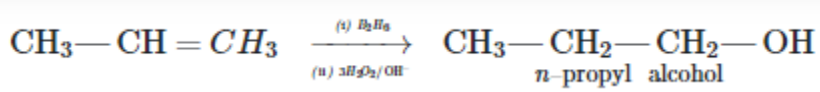
**Ans.**



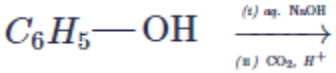

**Q.**



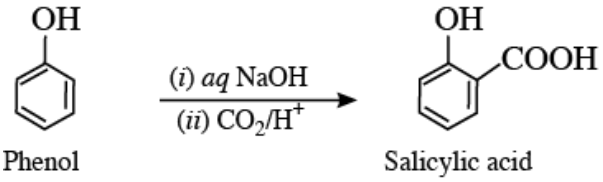
**Ans.**




**Q.**



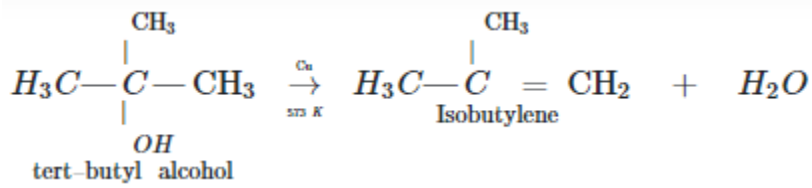
**Ans.**




**Q.2. What happens when**

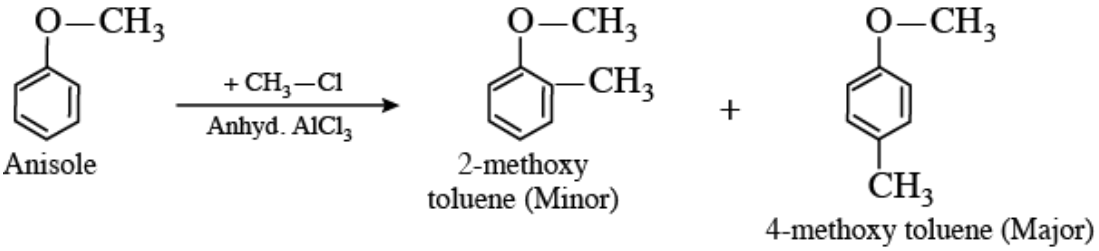
**Q. $(CH_3)_3C—OH$ is treated with Cu at 573 K,**

**Ans.**




**Q. Anisole is treated with $CH_3Cl$/anhydrous $AlCl_3$,**

**Ans.**

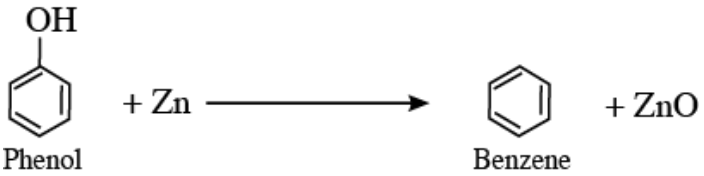



**Q. Phenol is treated with Zn dust?**

**Write chemical equations in support of your answer.**

**[*CBSE (F) 2017*]**

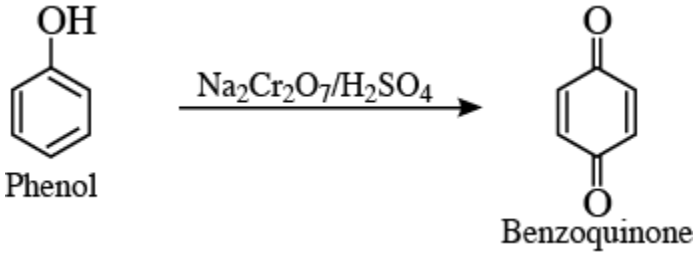
**Ans.**




**Q.3. How would you obtain the following?**

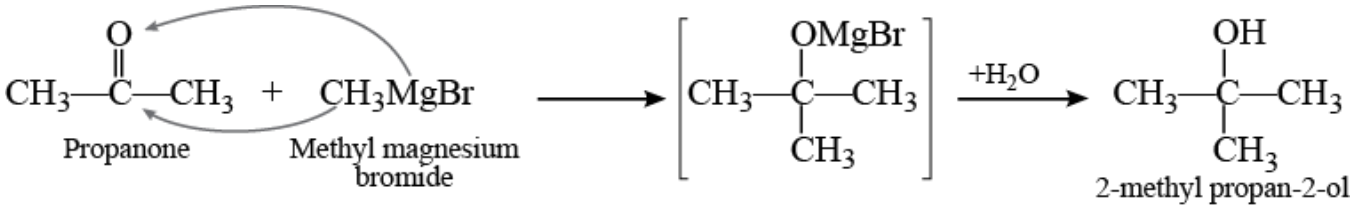
**Q. Benzoquinone from phenol**

**Ans.**




**Q. 2-Methylpropan-2-ol from methylmagnesium bromide**

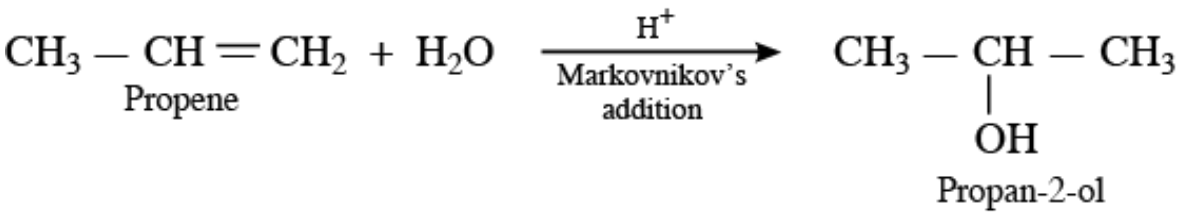
**Ans.**




**Q. Propan-2-ol from propene**

**[*CBSE (AI) 2011, (F) 2011*]**

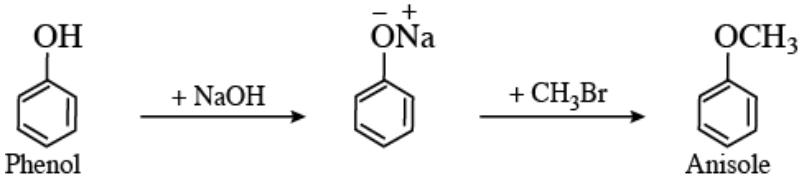
**Ans.**




**Q.4. How do you convert the following:**

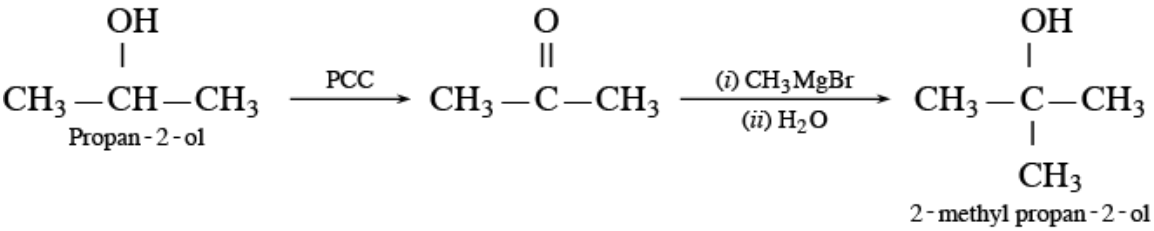
**Q. Phenol to anisole**

**Ans.**



**Q. Propan-2-ol to 2-methylpropan-2-ol**

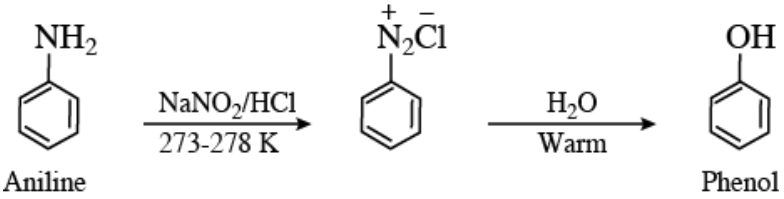
**Ans.**




**Q. Aniline to phenol**

**[*CBSE Delhi 2015*]**

**Ans.**

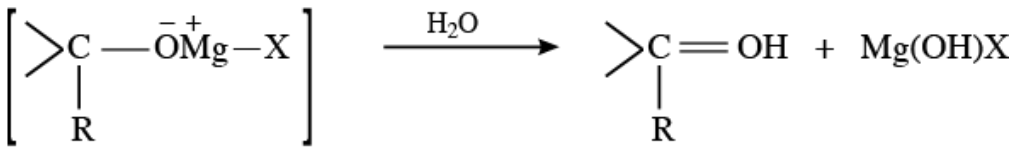



**Q.5. Explain the mechanism of the following reactions:**

**Q. Addition of Grignard's reagent to the carbonyl group of a compound forming an adduct followed by hydrolysis.**

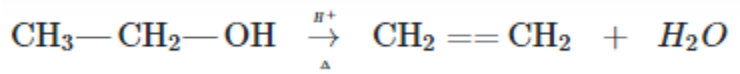
**Ans. Step I:** Nucleophilic addition of Grignard reagent to carbonyl group.


**Step II:** Hydrolysis



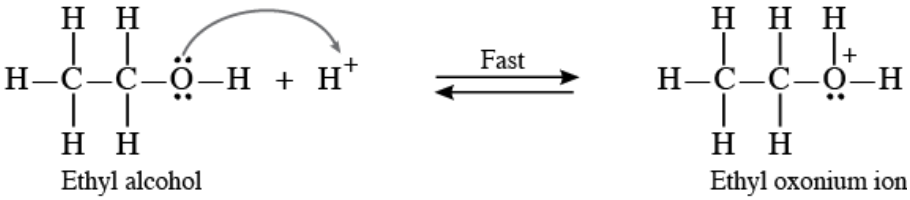

**Q. Acid catalysed dehydration of an alcohol forming an alkene.**

**Ans.**

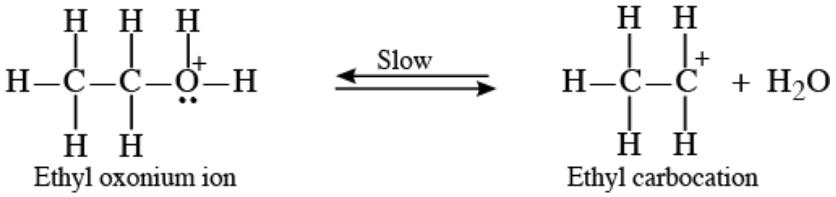


**Mechanism:**

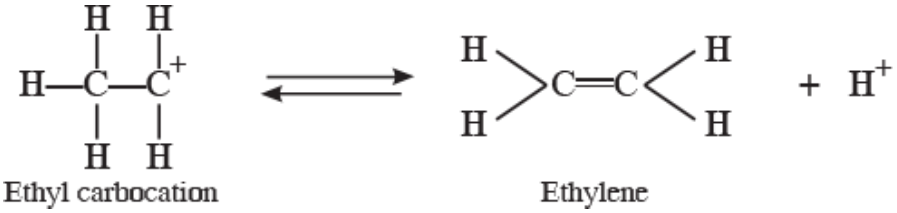
**Step I:** Formation of protonated alcohol




**Step II:** Formation of carbocation: It is the slowest step and hence, the rate determining step.




**Step III:** Formation of ethylene by elimination of a proton

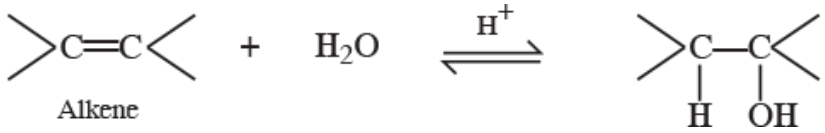



To drive the equilibrium to the right, ethylene is removed as it is formed.

**Q. Acid catalysed hydration of an alkene forming an alkene.**

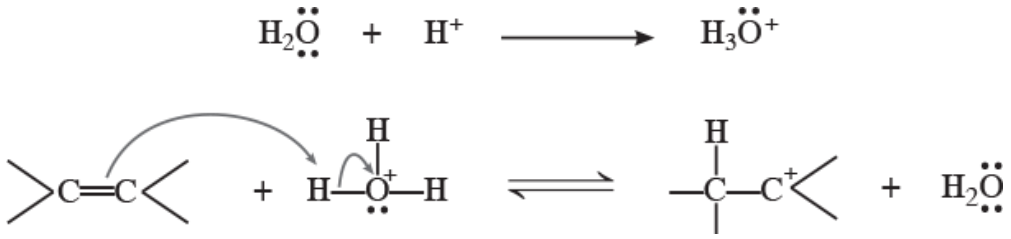
**[*CBSE Delhi 2009; (AI) 2012*] [*HOTS*]**

**Ans.**

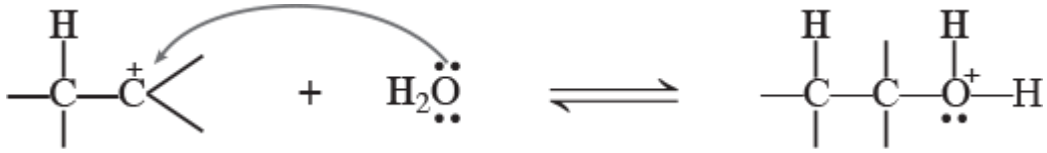


**Mechanism:**

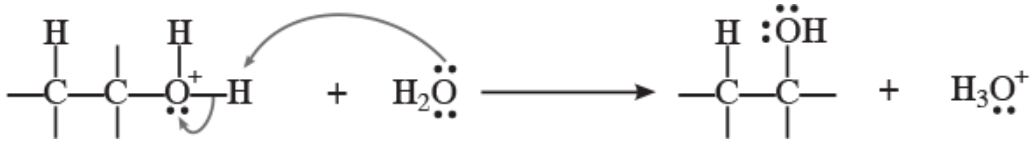
**Step I:** Protonation of alkene to form carbocation by electrophilic attack of $H_3O^+$.



**Step II:** Nucleophilic attack of water on carbocation.



**Step III:** Deprotonation to form an alcohol



**Q.6. Give reasons for the following:**

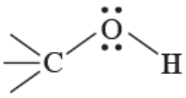
**Q. Phenol is more acidic than methanol.**

**Ans.** In phenol, the phenoxide ion obtained after the removal of a proton is stabilised by resonance whereas there is no resonance in the alkoxide ion of methanol.

Moreover, due to +*I* effect of $CH_3$ group the electron density in O—H bond increases which makes release of H+ difficult.

**Q. The C—O—H bond angle in alcohols is slightly less than the tetrahedral angle (109°28´).**

**Ans.** It is due to the repulsion between the lone pair of electrons on oxygen atoms,



**Q. $(CH_3)_3C—O—CH_3$ on reaction with HI gives $(CH_3)_3C—I$ and $CH_3—OH$ as the main products and not $(CH_3)_3C—OH$ and $CH_3—I$.**

**[*CBSE Allahabad 2015*] [*HOTS*]**

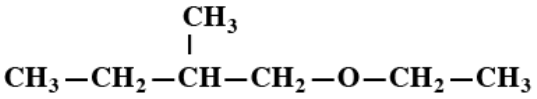
**Ans.**

The reaction between $(CH_3)_3COCH_3$ and HI follows $SN_1$ mechanism. For an $SN_1$ reaction, the formation of product is controlled by stability of the carbocation formed in the slowest step. Since tert.butyl carbonium ion $(CH_3)_3\overset{\oplus}{C})$ formed after the cleavage of C—O bond in the slowest step is more stable than methyl carbonium ion $(\overset{\oplus}{C}H_3)$ therefore $(CH_3)_3C—I)$ and $CH_3OH$ are the main products.

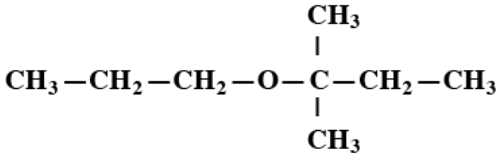
## Short Answer Questions-II (OIQ)

**Q.1. Give the major products that are formed by heating each of the following ethers with HI.**

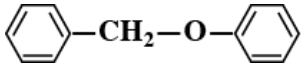
**i.**



**ii.**



**iii.**



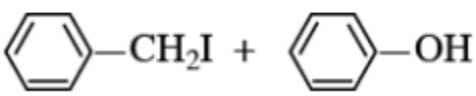
**[*HOTS*]**

**Ans.**

i. $CH_3—CH_2—\underset{\underset{CH_3}{|}}{CH}—CH_2OH + CH_3CH_2I$

ii. $CH_3CH_2CH_2OH + CH_3CH_2—\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}—I$

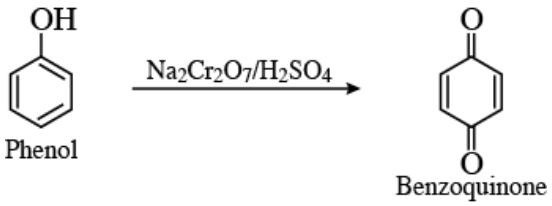
iii.



**Q.2. Carry out the following conversions:**

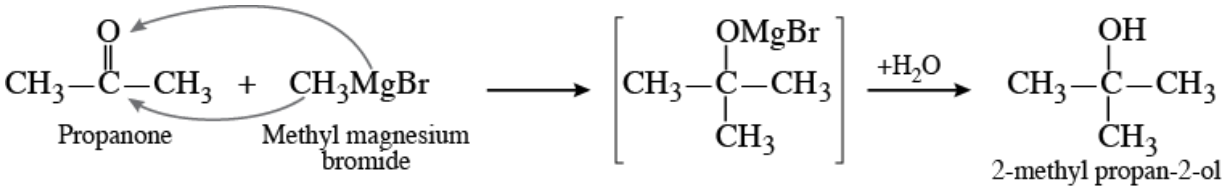
**Q. Phenol to benzoquinone**

**Ans.**



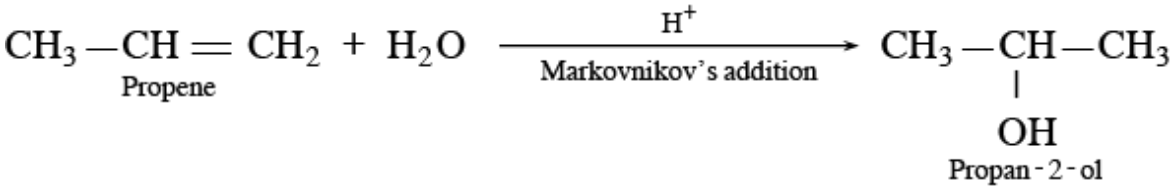

**Q. Propanone to 2-Methylpropan-2-ol.**

**Ans.**




**Q. Propene to propan-2-ol.**

**Ans.**



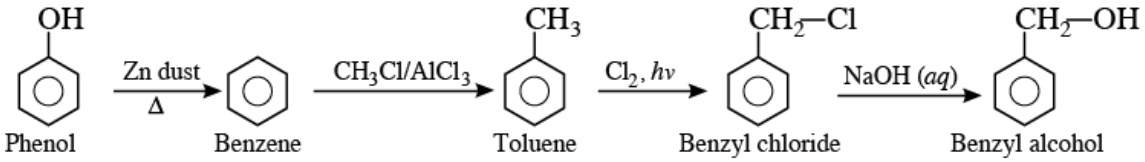

**Q.3. How will you bring the following conversions?**

i. **Phenol to benzyl alcohol**
ii. **Phenol to m-bromophenol**
iii. **Phenol to aspirin.**

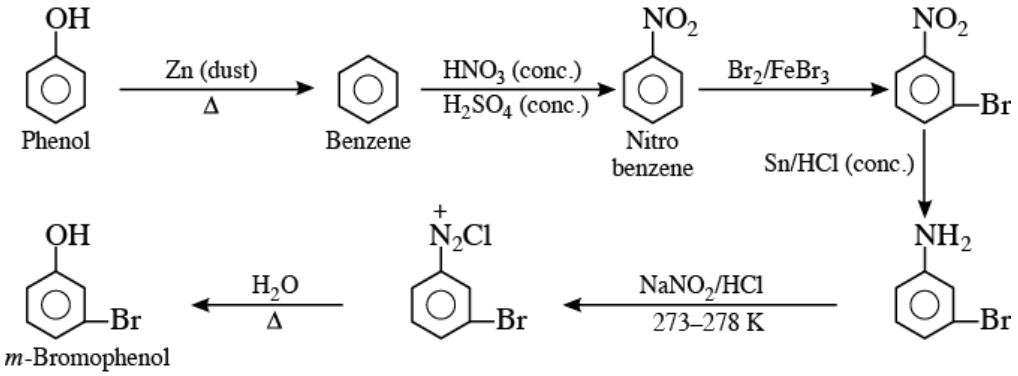
**[*HOTS*]**

**Ans.**

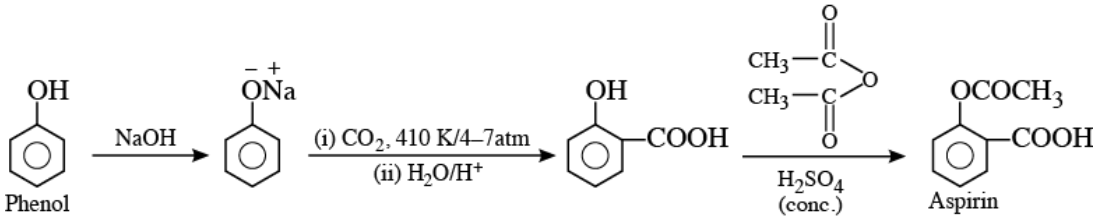
**i.**




**ii.**




**iii.**




**Q.4. The following is not an appropriate reaction for the preparation of tert.-butyl ethyl ether:**

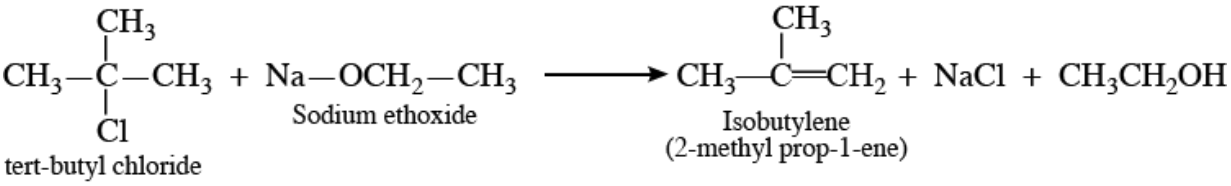
$$C_2H_5ONa + (CH_3)_3C—Cl \rightarrow (CH_3)_3C—OC_2H_5$$

i. **What would be the major product of the given reaction?**
ii. **Write a suitable reaction for the preparation of tert.-butyl ethyl ether, specifying the names of reagents used.**

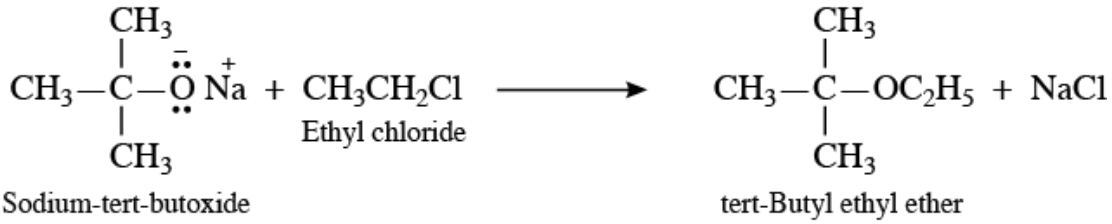
**Justify your answer in both cases.**

**[*CBSE Sample Paper 2016*] [*HOTS*]**

**Ans. (i)** The major product of the given reaction is 2-methylprop-1-ene. It is because sodium ethoxide $(CH_3—CH_2\bar{O}\overset{+}{N}a)$ is a strong nucleophile as well as a strong base. Thus, elimination reaction predominates over substitution reaction.




**(ii).** To prepare tertiary butylethyl ether, the alkyl halide should be primary, *i.e*., ethyl chloride and the nucleophile should be tertiary, *i.e.*, tertiary butoxide ion. It is because the reaction occurs by $S_N2$ mechanism and primary alkyl halides are most reactive in $S_N2$ reactions.

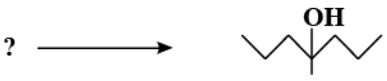



**Q.5. Answer the following questions:**

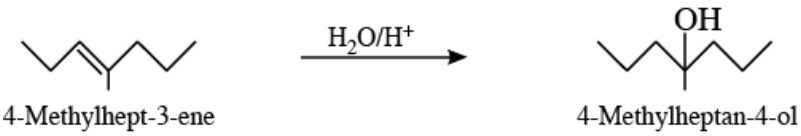
**Q. Why are ethers insoluble in water?**

**Ans.** Ethers are insoluble in water because due to the bigger size of the alkyl groups, the oxygen atom in ethers fails to form intermolecular H-bonds with water.

**Q. Complete the reaction equation:**




**Ans.**




**Q. How will you know whether a given OH group is alcoholic or phenolic in nature?**

**Ans.** Phenolic OH group gives blue or violet colouration with neutral $FeCl_3$, while alcoholic OH group does not.

**Q.6. Account for the following:**

**Q. Rectified spirit cannot be converted into absolute alcohol by simple distillation.**

**Ans.** Rectified spirit containing 95% ethyl alcohol and 5% water forms an azeotropic mixture which distils at a constant temperature of 351.13 K.

**Q. Diethyl ether does not react with sodium.**

**Ans.** Since diethyl ether does not contain an active hydrogen attached to oxygen like alcohols and phenols, it does not react with sodium.

**Q. Phenols do not undergo substitution of the —OH group like alcohols.**

**Ans.** The C—O bond in phenols has some double bond character due to resonance and hence cannot be easily cleaved by nucleophile. In contrast, the C—O bond in alcohols is a pure single bond and hence can be easily cleaved by nucleophile.

**Q.7.**

i. **Arrange the following sets of compounds in order of their increasing boiling points:**
   **(a) Pentan-1-ol, butan-1-ol, butan-2-ol, ethanol, propan-1-ol, methanol**
   **(b) Pentan-1-ol, n-butane, pentanal, ethoxyethane.**
ii. **Arrange the following compounds in increasing order of acidity and give a suitable explanation.**

**Phenol, *o*-nitrophenol, *o*-cresol**

**[*NCERT Exemplar*]**

**Ans.**

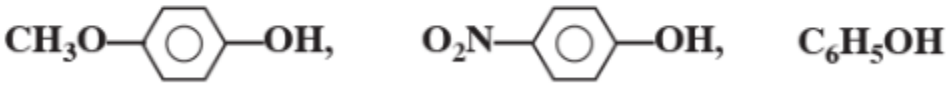
**i.** (a) Methanol < ethanol < propan-1-ol < butan-2-ol < butane-1-ol < pentan-1-ol.
(b) *n*-Butane < ethoxyethane < pentanal < pentan-1-ol.

**ii.** Increasing order of acidity:
*o*-cresol < phenol < *o*-nitrophenol
In substituted phenols, the presence of electron-withdrawing groups enhance the acidic strength of phenol whereas, electron-releasing groups decrease the acidic strength of phenol.

**Q.8. Arrange the following compounds in decreasing order of acidity.**

[*NCERT Exemplar*]

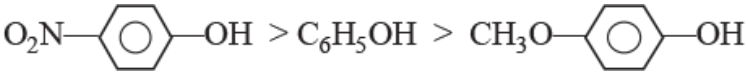
i. $H_2O$, ROH, HC≡CH

ii. 

iii. $CH_3OH$, $H_2O$, $C_6H_5OH$

**Ans.**

**i.** $H_2O > ROH > HC{\equiv}CH$

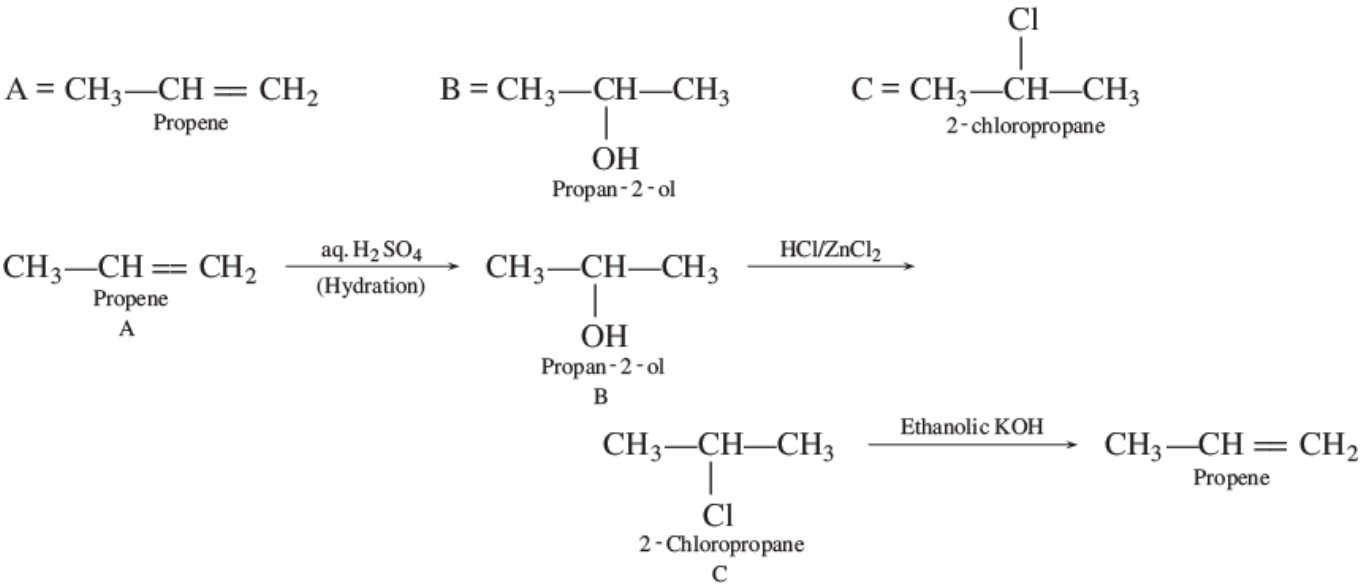
**ii.** 

**iii.** $C_6H_5OH > H_2O > CH_3OH$

**Q.9. An organic compound 'A' having molecular formula $C_3H_6$ on treatment with aqueous $H_2SO_4$ gives 'B' which on treatment with $HCl/ZnCl_2$ gives 'C'. The compound C on treatment with ethanolic KOH gives back the compound 'A'. Identify the compounds A, B, C.**

**[*HOTS*]**

**Ans.**

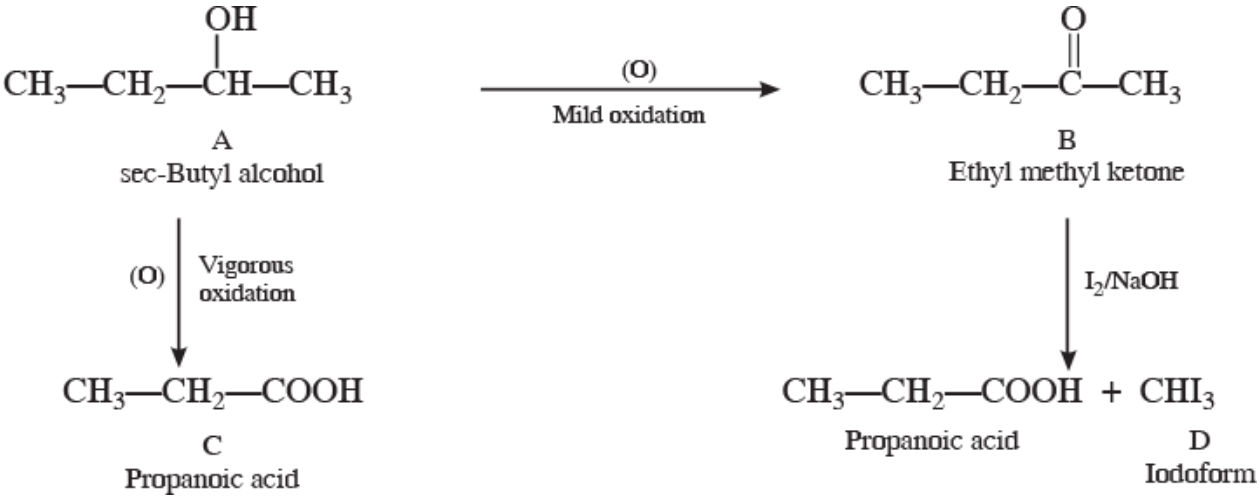



**Q.10. A compound 'A' is optically active. On mild oxidation, it gives a compound 'B' but on vigorous oxidation gives another compound 'C'. C along with D is also**

**formed from B by reaction with iodine and alkali. Deduce the structures of A, B, C, D.**

**[*HOTS*]**

**Ans.**




**Q.11. A compound 'A' having molecular formula $C_4H_{10}O$ is found to be soluble in concentrated sulphuric acid. It does not react with sodium metal or potassium permanganate. On heating with excess of HI, it gives a single alkyl halide. Deduce the structure of compound A and explain all the reactions.**

**[*HOTS*]**

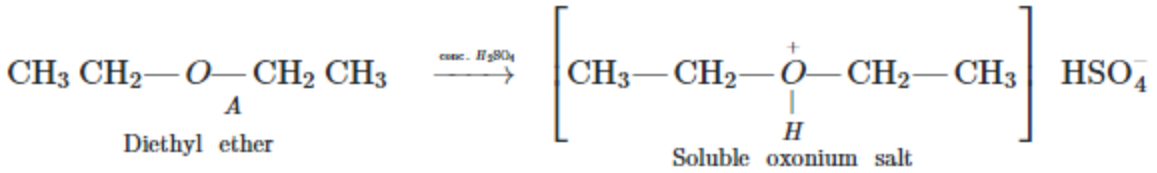
**Ans.**

i. As compound A does not react with sodium metal or potassium permanganate, it cannot be an alcohol.

ii. As compound A dissolves in conc. $H_2SO_4$, it may be an ether.

iii. As compound A on heating with excess of HI gives a single alkyl halide, therefore, compound A must be a symmetrical ether.

iv. The only symmetrical ether having molecular formula $C_4H_{10}O$ is diethyl ether. Thus compound 'A' is diethylether, $CH_3—CH_2—O—CH_2—CH_3$.




A

Diethyl ether

Soluble oxonium salt


A

Diethyl ether

Ethyl iodide