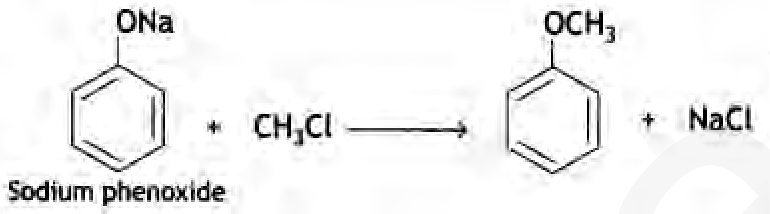
IMPORTANT QUESTIONS CLASS – 12 CHEMISTRY CHAPTER – 7 ALCOHOLS, PHENOLS AND ETHERS

Question 1.
What happens when

(a) Sodium phenoxide is treated with CH_3Cl?

Answer:

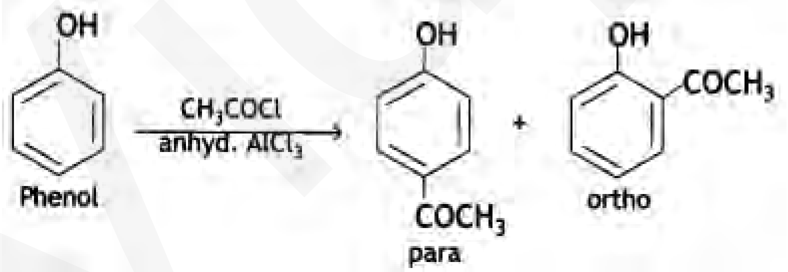


(b) $CH_2 = CH - CH_2 - OH$ is oxidised by PCC?

Answer:
$$CH_2 = CH - CH_2 - OH \xrightarrow{PCC} CH_2 = CH - CHO$$

(c) Phenol is treated with
CH_3COCI/anhydrous $AlCl_3$?
Write chemical equations in support of your answer.

Answer:



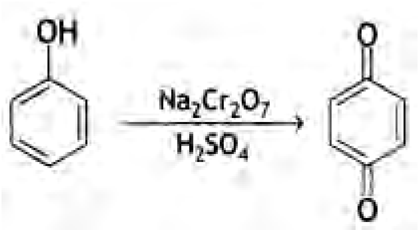
Question 2.
(a) How will you convert the following:

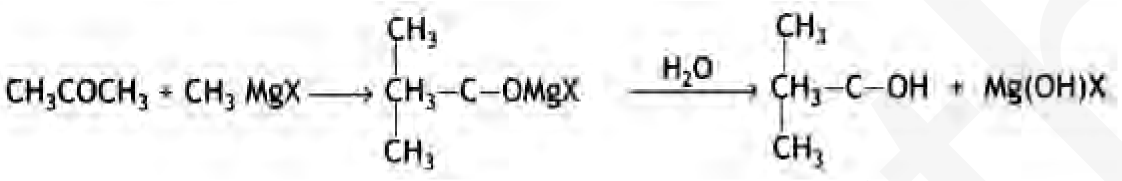
(i) Phenol to benzoquinone

Answer:

(ii) Propanone to 2-methyl propane-2-ol

Answer:



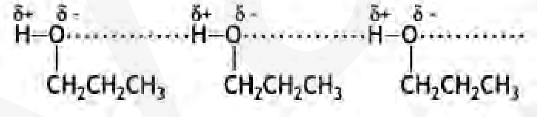


$$CH_3COCH_3 + CH_3MgX \longrightarrow \overset{CH_3}{\underset{CH_3}{CH_3-C-OMgX}} \xrightarrow{H_2O} \overset{CH_3}{\underset{CH_3}{CH_3-C-OH}} + Mg(OH)X$$

(b) Why does propanol have a higher boiling point than that butane? (CBSE 2019C)

Answer:

The molecules of propanol are held together by intermolecular hydrogen bonding while butane molecules have only weak van der Waals forces of attraction. Since hydrogen bonds are stronger than van der Waals forces, therefore, propanol has a higher boiling point than butane.



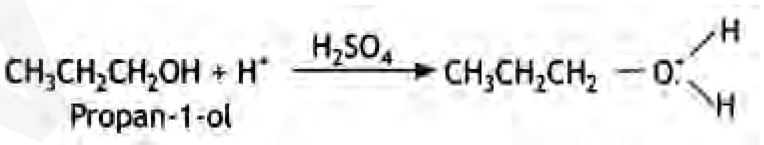
Question 3.
Identify the product formed when propan-1 -ol is treated with a cone. H_2So_4 at 413 K. Write the mechanism involved for the above reaction.

Answer:

(a) 1-Propoxypropane is formed.

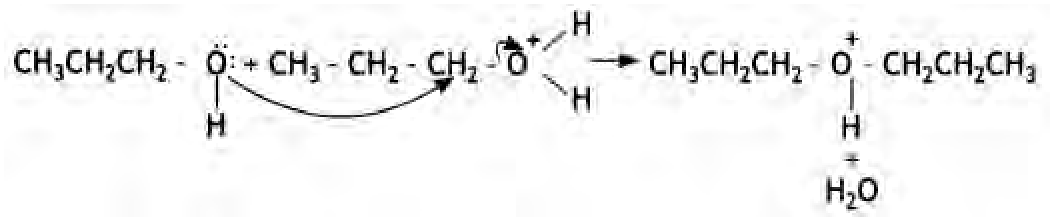
Mechanism involved:

Step 1: Formation of protonated alcohol. Propanol gets protonated in the presence of H^+.

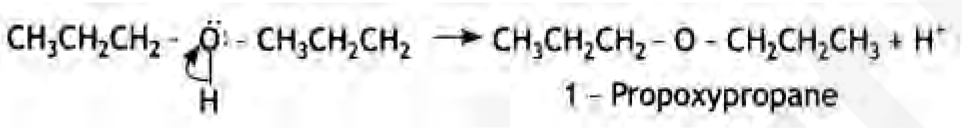


$$\underset{\text{Propan-1-ol}}{CH_3CH_2CH_2OH} + H^+ \xrightarrow{H_2SO_4} CH_3CH_2CH_2-\ddot{O}{<}^{H}_{H}$$

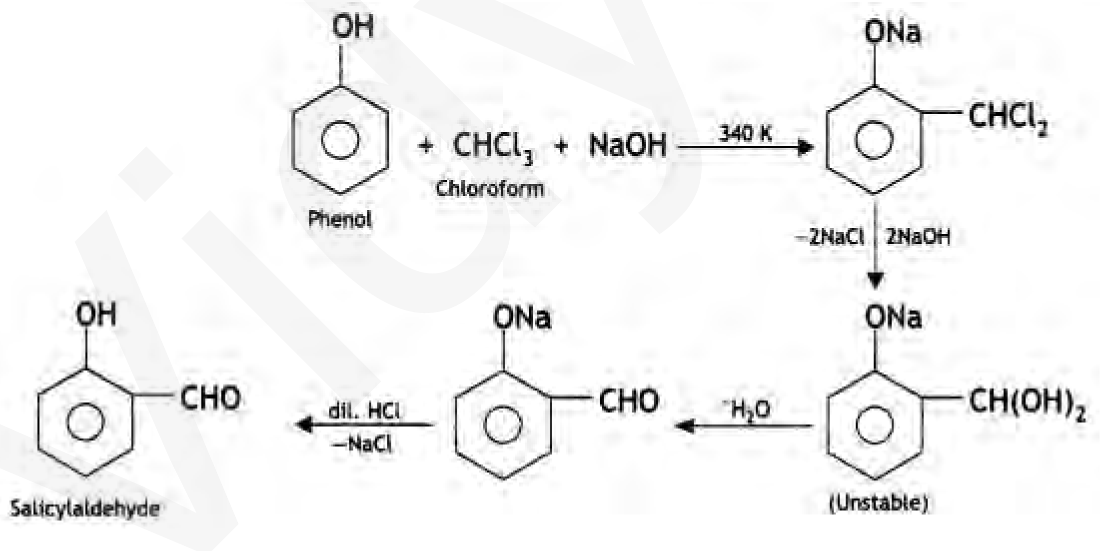
Step 2: Nucleophilic attack. Due to the presence of a +ve charge on the oxygen atom, the carbon of the CH_2 part becomes electron deficient. As a result, a nucleophilic attack by another alcohol molecule (unprotonated) occurs on the protonated alcohol with the elimination of a molecule of water.



Step 3: Deprotonation. Oxonium ion loses a proton to form an ether.



Question 4.
Write the equations involved in the following reactions:
(i) Reimer-Tiemann reaction
Answer:
Reimer-Tiemann reaction: When phenol is refluxed with chloroform in the presence of aqueous caustic alkali at 340 K, an aldehydic group (CHO) gets introduced in the ring at a position ortho to the phenolic group. Ortho hydroxy benzaldehyde or salicylaldehyde is formed as the product of the reaction.



(ii) Williamson's ether synthesis
Answer:
Williamson's ether synthesis. This is used to prepare symmetrical and unsymmetrical ethers by treating alkyl halide with either sodium alkoxide or sodium phenoxide.

$$\underset{\text{Bromomethane}}{CH_3Br} + \underset{\text{Sod. ethoxide}}{C_2H_5O^-Na^+} \longrightarrow \underset{\text{Methoxy ethane}}{CH_3OC_2H_5} + NaBr$$

$$\underset{\text{Bromoethane}}{C_2H_5Br} + \underset{\text{Sod. ethoxide}}{C_2H_5O^-Na^+} \longrightarrow \underset{\text{Ethoxy ethane}}{C_2H_5OC_2H_5} + NaBr$$

$$\underset{\text{Chloroethane}}{C_2H_5Cl} + \underset{\text{Sod. phenoxide}}{C_6H_5O^-Na^+} \longrightarrow \underset{\text{Ethoxy benezene}}{C_6H_5OC_2H_5} + NaBr$$

Aryl halides cannot be used for the preparation of alkyl-aryl ethers because of their low reactivity.

Question 5.

Draw the structure and name the product formed if the following alcohols are oxidised. Assume that an excess of the oxidising agent is used.

(i) CH3CH2CH2CH2OH

Answer:

$$CH_3CH_2CH_2CH_2OH \xrightarrow[KMnO_4]{Alkaline} \underset{\text{Butan-1-oic acid}}{CH_3CH_2CH_2COOH}$$

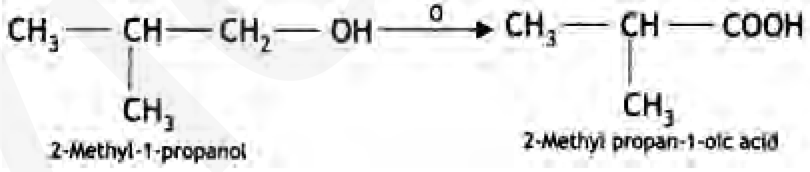
(ii) 2-butenol

Answer:

$$CH_3-CH=CH-CH_2-OH \xrightarrow{O} \underset{\text{But-2-en-1-oic acid}}{CH_3-CH=CH-COOH}$$

(iii) 2-methyl-1-propanol

Answer:

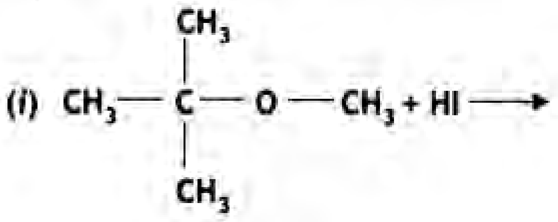


$$\underset{\text{2-Methyl-1-propanol}}{CH_3-\underset{CH_3}{\underset{|}{CH}}-CH_2-OH} \xrightarrow{O} \underset{\text{2-Methyl propan-1-oic acid}}{CH_3-\underset{CH_3}{\underset{|}{CH}}-COOH}$$

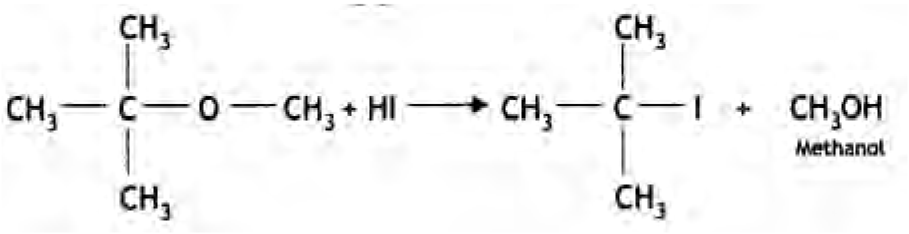
Question 6.

Write the main product(s) in each of the following reactions:

Answer:



$$(i)\ CH_3-\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}-O-CH_3 + HI \longrightarrow$$



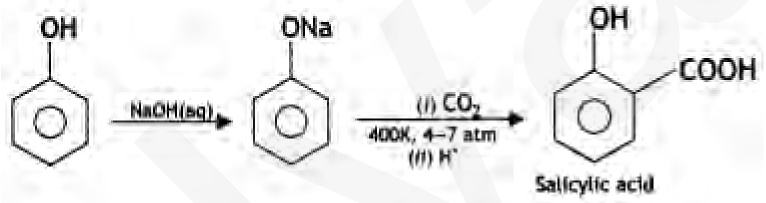
$$CH_3-\overset{\overset{\large CH_3}{|}}{\underset{\underset{\large CH_3}{|}}{C}}-O-CH_3 + HI \longrightarrow CH_3-\overset{\overset{\large CH_3}{|}}{\underset{\underset{\large CH_3}{|}}{C}}-I + \underset{\text{Methanol}}{CH_3OH}$$

Answer: (ii) $CH_3-CH=CH_2 \xrightarrow[(ii)\ 3H_2O_2/OH^-]{(i)\ B_2H_6}$

Answer:

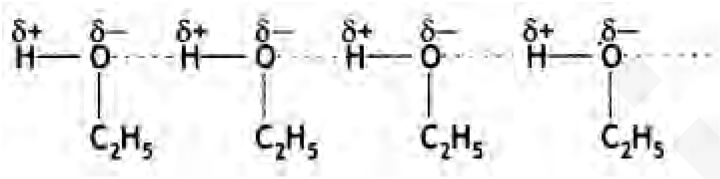
$$CH_3-CH=CH_2 \xrightarrow[(ii)\ 3H_2O_2/OH^-]{(i)\ B_2H_6} \underset{\text{Propan-1-ol}}{CH_3CH_2CH_2OH}$$

(iii) $C_6H_5-OH \xrightarrow[(ii)\ CO_2,\ H^+]{(i)\ aq.\ NaOH}$



Question 7.
Give reasons for the following:
(i) Protonation of phenols Is difficult whereas ethanol easily undergoes protonation.
Answer:
In phenols, the oxygen atom acquires a partial positive charge due to resonance and therefore, it is not easily protonated. On the other hand, in ethanol, the alkyl group is an electron-releasing group and increases the electron density on 0 atoms. Therefore, ethanol is easily protonated.

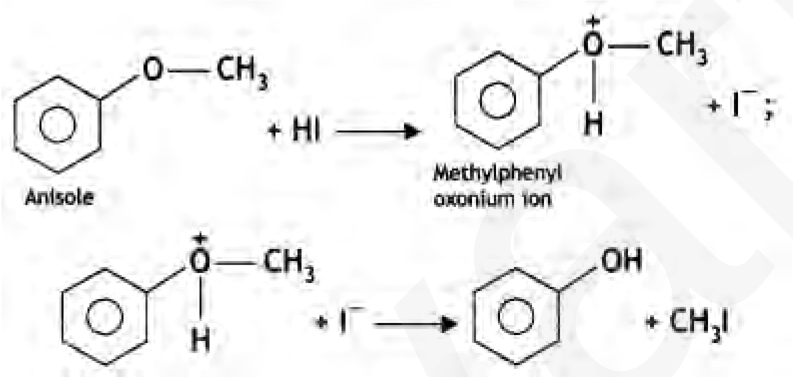
(ii) Bolting point of ethanol is higher than that of dimethyl ether.
Answer:
The molecules of ethanol are held together by intermolecular hydrogen bonding while dimethyl molecules have only weak van der Waals forces of attractions. Since hydrogen bonds are stronger than van der Waals forces, ethanol has a higher boiling point than dimethyl ether.



(iii) Anisole on reaction with Hl gives phenol and CH_3-I as main products and not iodobenzene and CH_3OH.

Answer:

This is because, during the reaction, the attack of halide ion occurs to the protonated anisole, i.e. methyl phenyl oxonium ion, which is formed during the protonation of anisole. Due to steric hindrance of the bulky phenyl group, the attack preferably occurs to the alkyl group forming methyl iodide and phenol.



Question 8.

How do you convert the following: (CBSE Delhi 2015, Delhi)

(i) Phenol to anisole

(ii) Propan-2-ol to 2-methylpropan-2-ol

(iii) Aniline to phenol?

OR

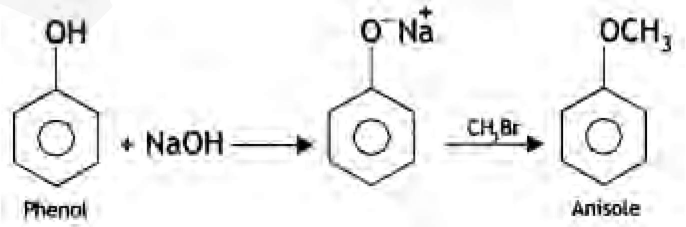
(i) Write the mechanism of the following reaction:

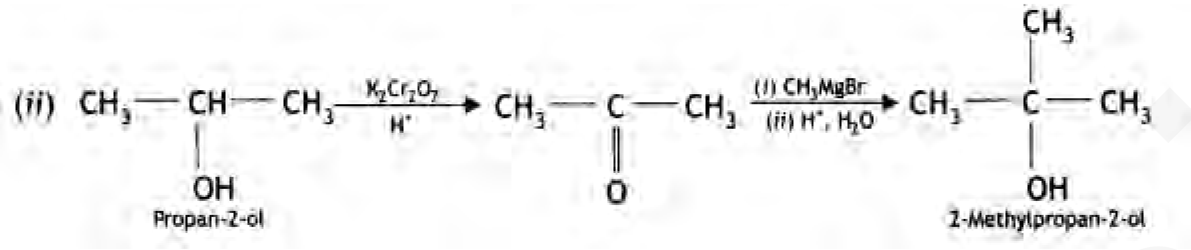
$2CH_3CH_2OH \xrightarrow{H^+} CH_3CH_2{-}O{-}CH_2CH_3$

(ii) Write the equation involved In the acetylation of salicylic acid.

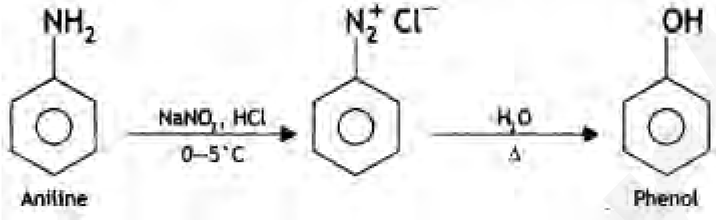
Answer:

(i) Phenol to anisole





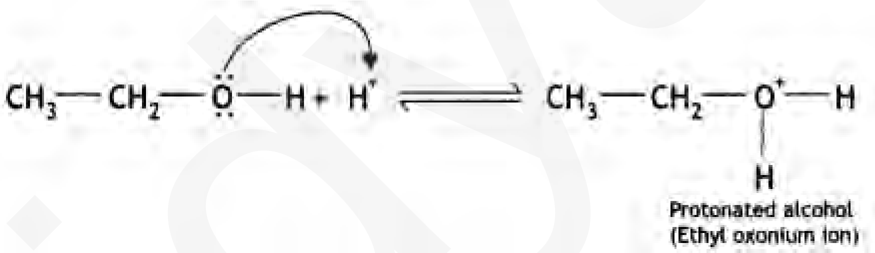
(iii) Aniline to phenol



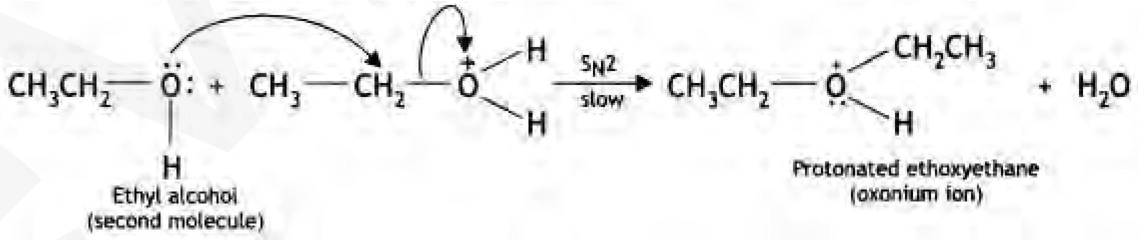
Or

(i) The mechanism for the formation of ether from ethanol at 413 K is a nucleophilic bimolecular reaction as given below:

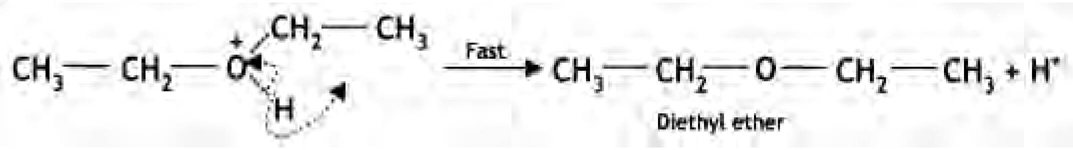
(a) Ethyl alcohol gets protonated in the presence of H^+

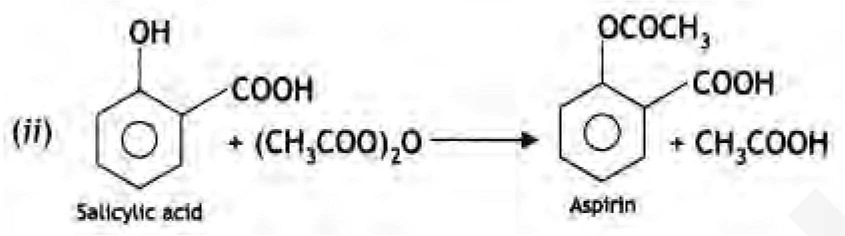


(b) Due to the presence of a +ve charge on the oxygen atom, the carbon of CH_2 part of CH_3CH_2 becomes electron deficient. As a result, nucleophilic attack by another alcohol molecule (unprotonated) occurs on the protonated alcohol with the elimination of a



(c) Oxonium ion loses a proton to form an ether.

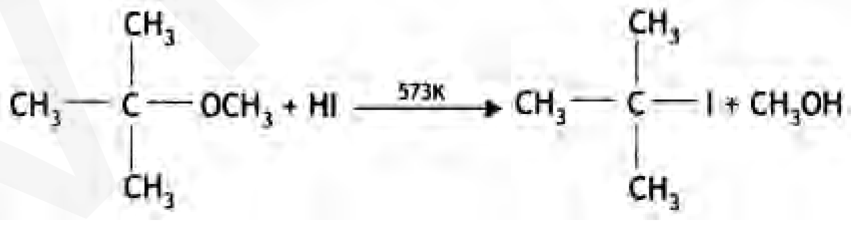




Question 9.
Give reasons for the following:
(i) o-nitrophenol is more acidic than o-methoxyphenyl.
Answer:
This is because —NO_2 (nitro group) is an electron-withdrawing group and will increase the +ve charge on oxygen to make it more acidic. On the other hand, the -OCH_3 group is an electron¬releasing group and will decrease +ve charge on oxygen making it less acidic as O-H bond will not break easily.

(ii) Butan-1-oi has a higher boiling point than diethyl ether.
Answer:
Butan-1 -ol has intermolecular hydrogen bonding between their molecules. Therefore, it exists as associated molecules and large amount of energy is required to break these bonds and hence, its boiling point is high. But diethyl ether does not show any association by intermolecular hydrogen bonding. Hence, its boiling point is low.

(iii) $(CH_3)_3C – O – CH_3$ on reaction with HI gives $(CH_3)_3C – I$ and $CH_3 – OH$ as the main products and not $(CH_3)_3C – OH$ and $CH_3 – I$.
Answer:
The reaction:

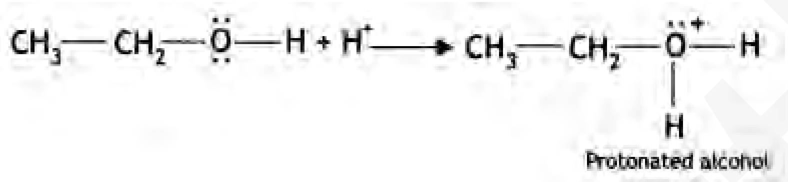


gives $(CH_3)_3C – I$ and CH_3OH as the main products and not $(CH_3)_3COH$ and CH_3I. This is because the reaction occurs by the S_N1 mechanism and the formation of products is governed by the stability of carbocation formed from the cleavage of the C-o bond in the protonated ether. Since tert. butyl carbocation, $(CH_3)_3C^+$ is more stable than methyl carbocation, CH_3, the cleavage of C-o gives a more stable carbocation, $[(CH_3)_3C]^+$ and methanol. Then, iodide ion, I^- attacks this tert. butyl carbocation to form tert. butyl iodide.

Question 10.
(i) Write the mechanism of the following reaction:

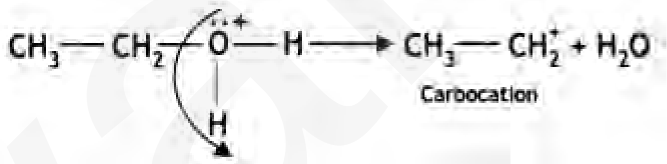
$$CH_3CH_2OH \xrightarrow{HBr} CH_3CH_2Br + H_2O$$

Answer:
$HBr \rightarrow H^+ + Br^-$
(a) H+ attacks oxygen of O-H to form protonated alcohol



$$CH_3-CH_2-\ddot{\underset{\cdot\cdot}{O}}-H + H^+ \longrightarrow CH_3-CH_2-\underset{\underset{H}{|}}{\overset{+}{\ddot{O}}}-H$$

(b) Protonated alcohol Loses a molecule of water to form a carbocation.



(C) Br attacks the carbocation to form bromoatkane
$CH_3CH_2+ + Br^- \rightarrow CH_3CH_2Br$
(Bromoethane)