Ether

R–O–R → simple ether
R'–O–R → Mixed ether

Ether show functional isomerism with alcohol. It also show chain isomerism & metamerism

Preparation of Ether :→

(Imp 1) Willim ether synthesis :→

$$R'ONa + R{-}X \longrightarrow NaX + R'{-}O{-}R$$

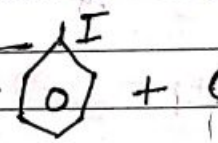
Mechanism → S_N2

$$CH_3CH_2\ddot{O}Na + CH_3{-}\overset{\delta+}{I} \xrightarrow{RDS} \underset{\text{transition state}}{CH_3CH_2O\cdots CH_3\cdots I} \xrightarrow{} NaI + CH_3CH_2O{-}CH_3$$

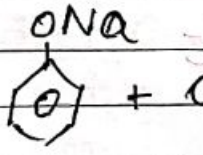
(1° alkyl halide)

→ S_N2 Mechanism (only Primary alkyl halide) Inversion
→ No carbocation should be formed
→ Inversion product should be obtained
→ Best method for preparation of ether because all type of ether symmetrical or unsymmetrical can be formed

Eg



(most stable) + CH_3ONa → No reaction



+ $CH_3{-}CH_2{-}I$ →

ethoxy benzene (IUPAC) (Phenetole)

Ethyl phenyl ether

Imp. Note :→ If tertiary alkyl halide used then alkene should be formed that is no willim son rxn, No S_N2 Mechanism that is elimination Rxn.

* Lewis base → Alcohol (ethanol) & Ether

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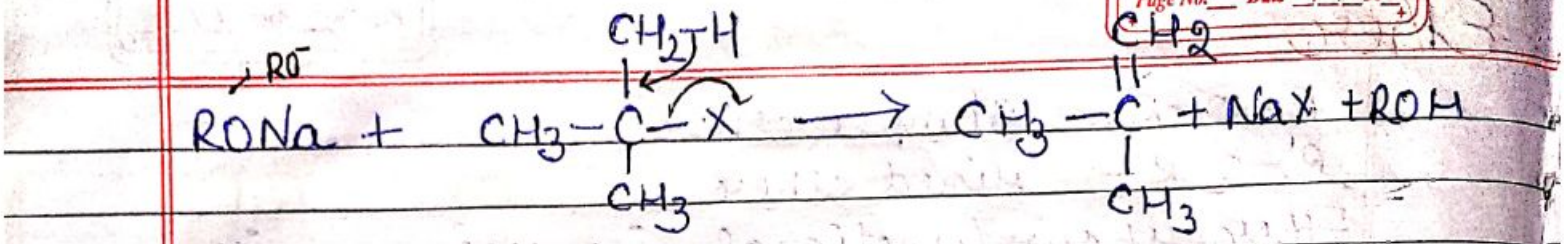
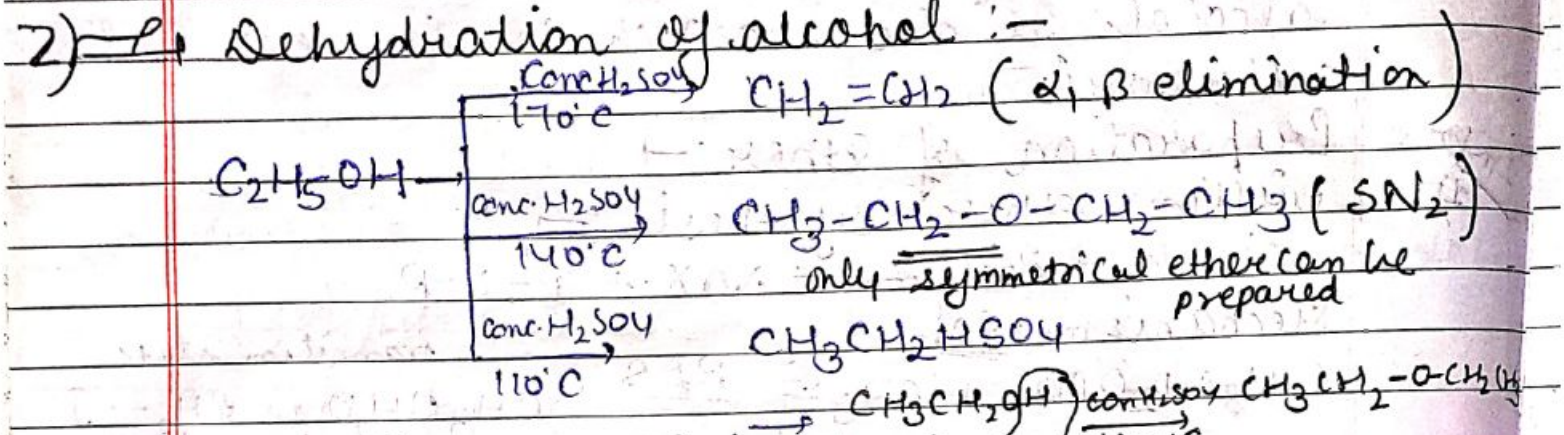
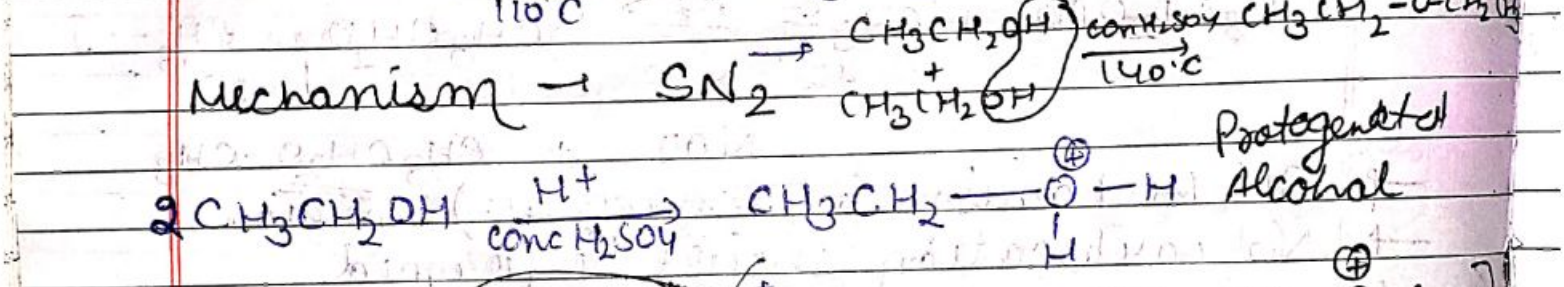
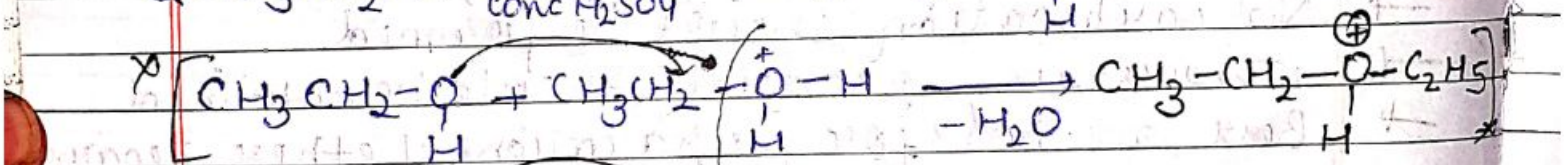


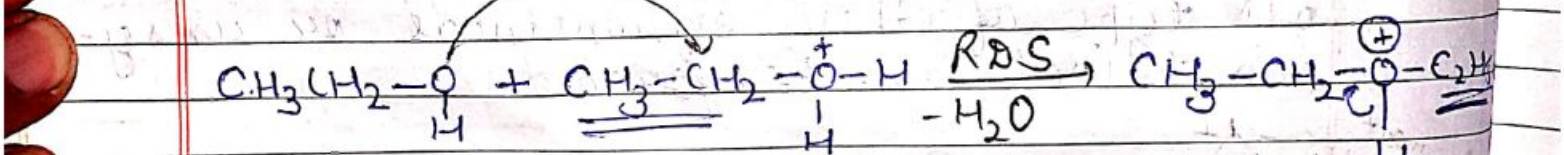
2) → Dehydration of alcohol :-

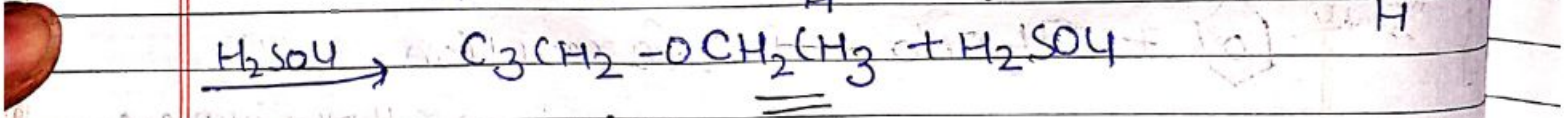


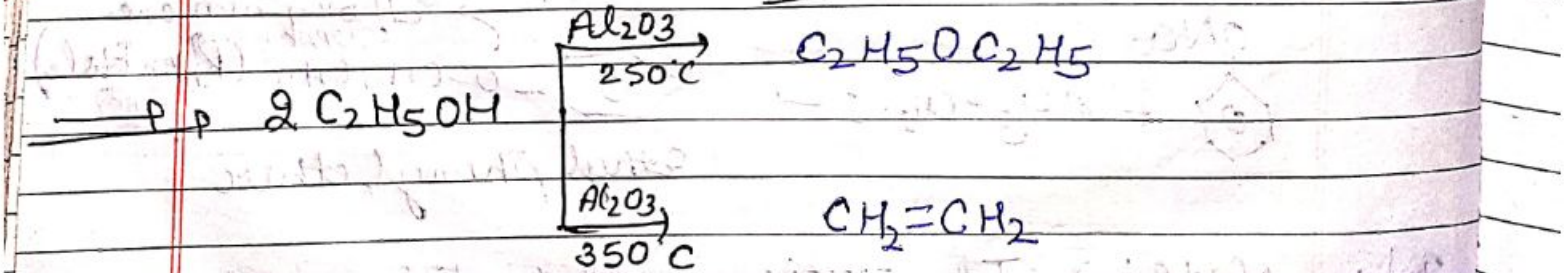
Mechanism → S_N2











$CH_3OH > C_2H_5OH > C_3H_7OH$

Reactivity of different 1° alcohol for dehydration of alcohol at 140°C in presence of conc. H_2SO_4

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3) From silver oxide :→

$$R-X + \text{dry } Ag_2O \longrightarrow R-O-R + 2AgX$$

Note :→ $R-X + \text{Moist } Ag_2O \longrightarrow R-OH$

Physical properties :→

1) solubility → Initially 3ethers are soluble in water due to H-bond. Higher ethers are soluble in organic solvent.

2) Boiling point → $C_2H_5OH > CH_3-O-CH_3$
It is due to ethanol having stronger intermolecular H-bond as compare to ethers.

chemical Properties :→

1) Reaction with HI (Highly reducing agent)

$$CH_3-O-CH_3 + HI \xrightarrow[\text{cold}]{\text{Normal}} CH_3I + CH_3OH$$
(limited supply)

I^- :

$$CH_3-\overset{+}{O}(H)-CH_3 + HI \xrightarrow{SN2} CH_3OH + CH_3I$$

$$CH_3-O-C_2H_5 + HI \xrightarrow{SN_2} CH_3I + C_2H_5OH$$

$$CH_3-\underset{CH_3}{\overset{CH_3}{C}}-O-CH_3 + HI \xrightarrow{SN_1} CH_3-\underset{CH_3}{\overset{CH_3}{C}}-I + CH_3OH$$

case-1 If both alkyl group (1°) in ether molecule is same then reaction carried out according to SN_2 Mechanism

case-2

If any one alkyl group is tertiary then reaction Mechanism should be S_N1

cas-3 →

If any alkyle group is secondary then reaction mechanism depends on nature of solvent.

polar protic solvent → SN^1
(water, ethanol etc)

Polar aprotic solvent → SN^2
(CH_3COCH_3, ether, DMO

cas-1.

$$CH_3-O-C_2H_5 + HI \xrightarrow{SN^2} CH_3-\overset{+}{\underset{H}{O}}-C_2H_5$$

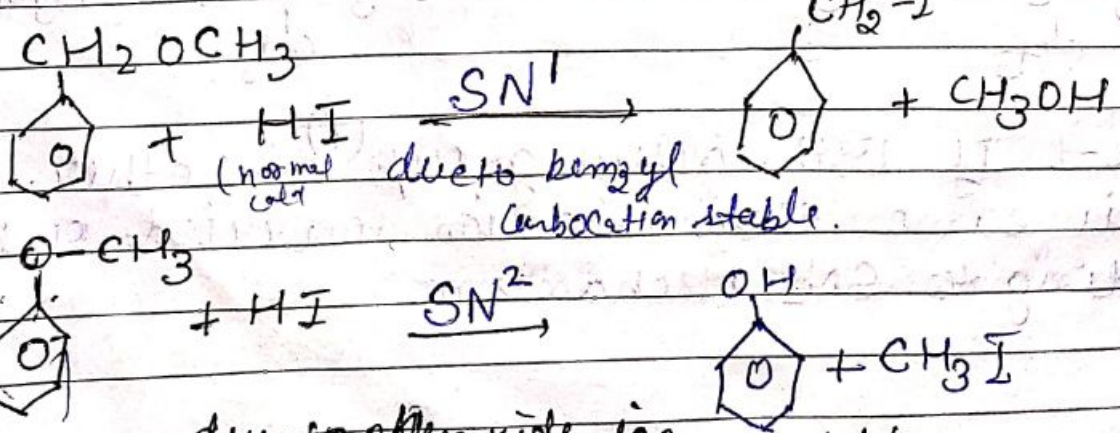
$$I^- + CH_3-\overset{+}{O}-C_2H_5 \longrightarrow CH_3CH_2OH + CH_3I$$

Case-2

$$CH_3-O-\underset{CH_3}{\underset{|}{CH}}-CH_3$$

Polar protic, SN^1: $CH_3-\underset{CH_3}{\underset{|}{CH}}-I + CH_3OH$

Polar aprotic, SN^2: $CH_3I + CH_3-\underset{CH_3}{\underset{|}{CH}}-OH$



2) Reaction with excess HI (hot, excess)

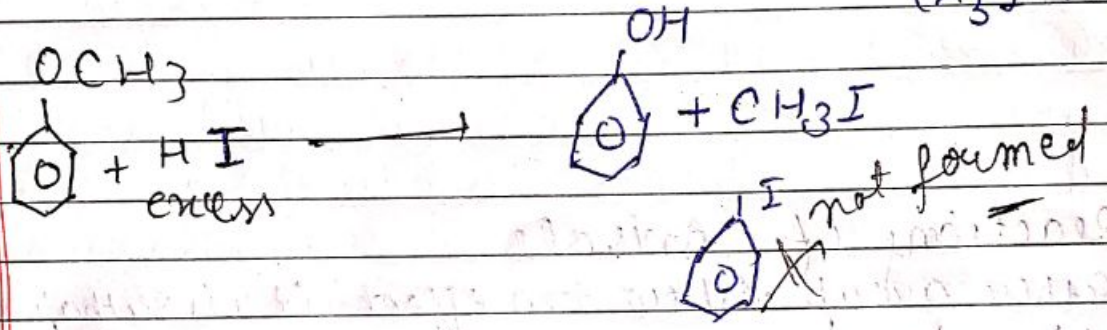
$CH_3OCH_3 + HI \longrightarrow CH_3I + CH_3OH$

$CH_3OH + HI \longrightarrow CH_3I + H_2O$

Overall net Rxn

$CH_3OCH_3 + 2HI \xrightarrow{\text{excess.}} 2CH_3I + H_2O$

Eg: $CH_3-\underset{CH_3}{CH}-O-CH_3 + HI_{excess} \longrightarrow CH_3-\underset{CH_3}{CH}-I + CH_3I + H_2O$



3) Reaction with PCl_5

$C_2H_5-O-C_2H_5 + PCl_5 \longrightarrow POCl_3 + 2C_2H_5Cl$

4) Reaction with Conc. HCl & Conc. H_2SO_4

$C_2H_5-O-C_2H_5 + HCl \longrightarrow [C_2H_5-\overset{+}{O}(H)-C_2H_5]Cl^-$

Diethyl oxonium chloride salt

$C_2H_5-O-C_2H_5 + H_2SO_4 \longrightarrow [C_2H_5-\overset{+}{O}(H)-C_2H_5]HSO_4^-$

Diethyl oxonium Hydrogen sulphate

This reaction show ether act as lewis base

5) Reaction with BF_3

Ethrate should be formed

$C_2H_5-O-C_2H_5 + BF_3 \longrightarrow C_2H_5-\overset{+}{O}(-B^-F_3)-C_2H_5$

Diethyl boron trifluoride ethrate

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6) Reaction with atmospheric oxygen or ozonic oxygen (nascent)

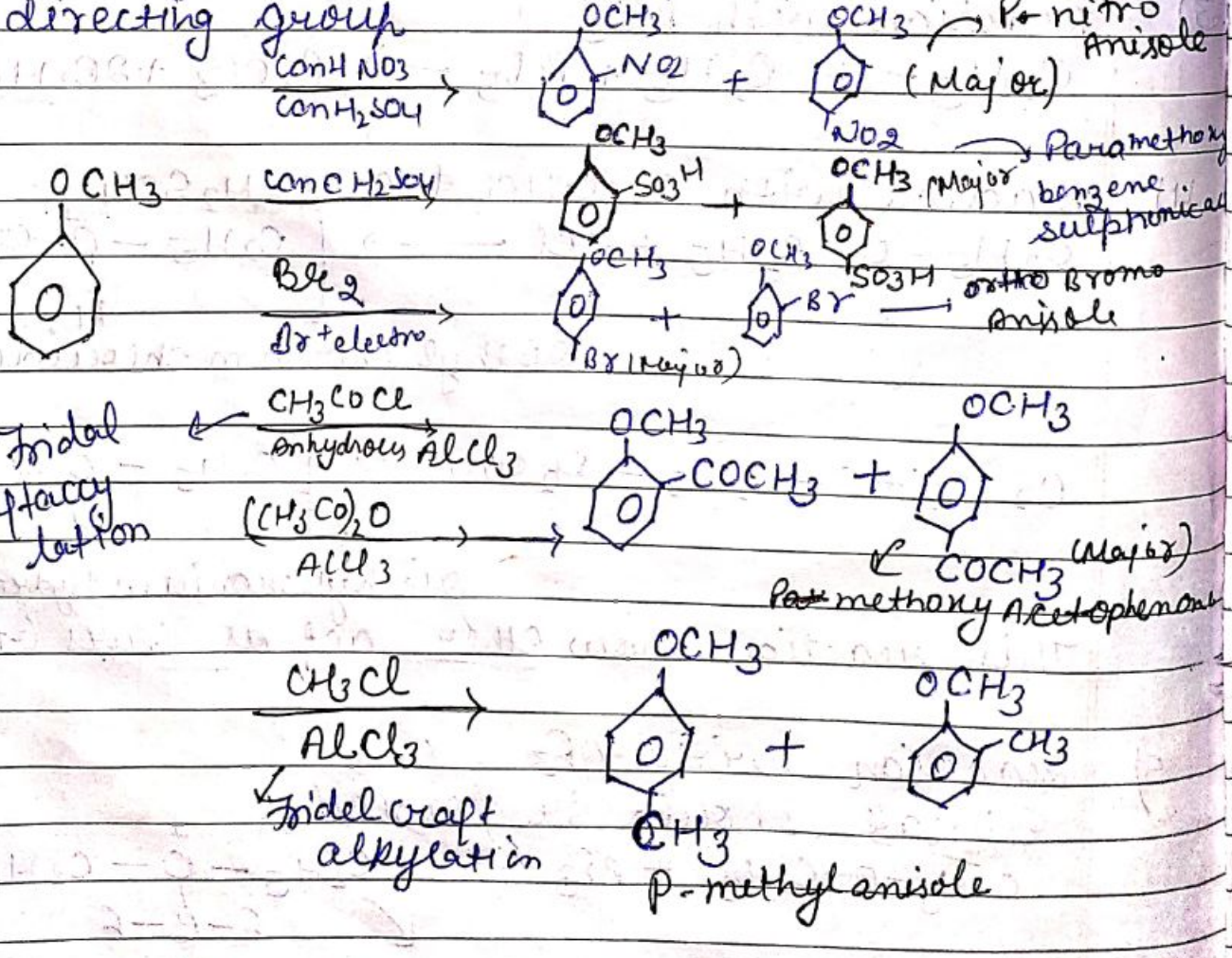
Diethyl peroxide should be formed

peroxide of ether is explosive in nature

$C_2H_5-O-C_2H_5 + [O] \longrightarrow C_2H_5-\overset{+}{O}(\downarrow\ominus)-C_2H_5$ explosive

1 Reaction of Anisole

ether group is also +m effect it is ortho para directing group



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uses of Ether :→

used as anesthia solvent

As refrigrent

use as inert solvent providing moisture free ~~ato~~ atmosphere

Its trade name is natalite (mixture of alcohol & ether)

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