PARISHRAM

2026

ALCOHOL , PHENOL & ETHER

CHEMISTRY LECTURE-1

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. INTRODUCTION
2. CLASSIFICATION OF ALCOHOL
3. IUPAC NOMENCLATURE

MY SHIMMERING STARS

#SHOURYA'SGALAXY


START

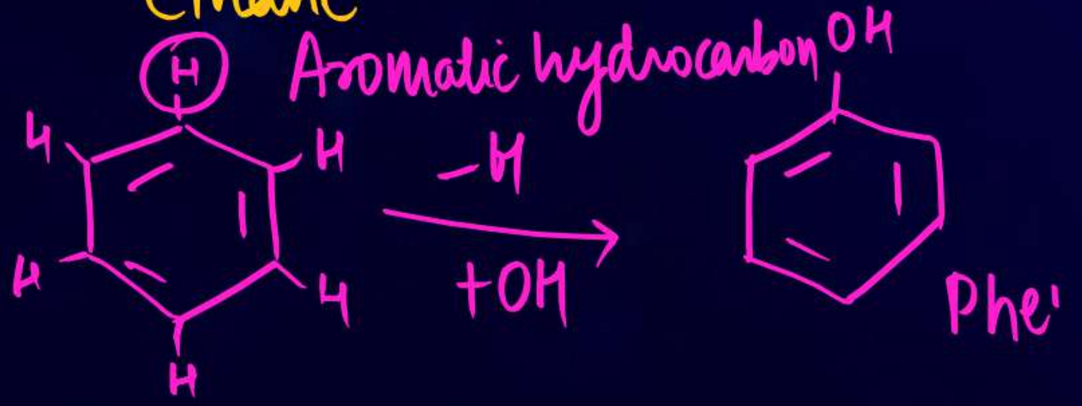
ALCOHOL , PHENOL & ETHER

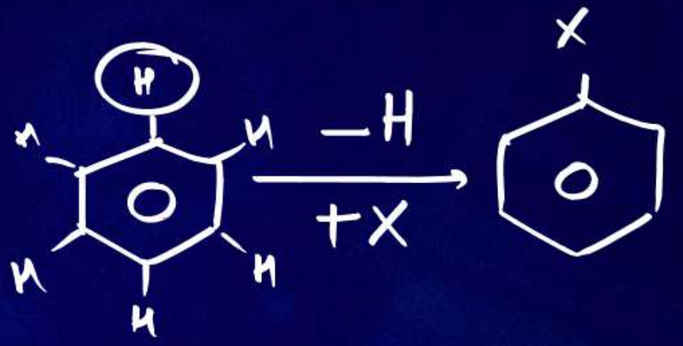
$R-H \xrightarrow[+OH]{-H} R-OH$

Aliphatic hydrocarbon — Alcohol

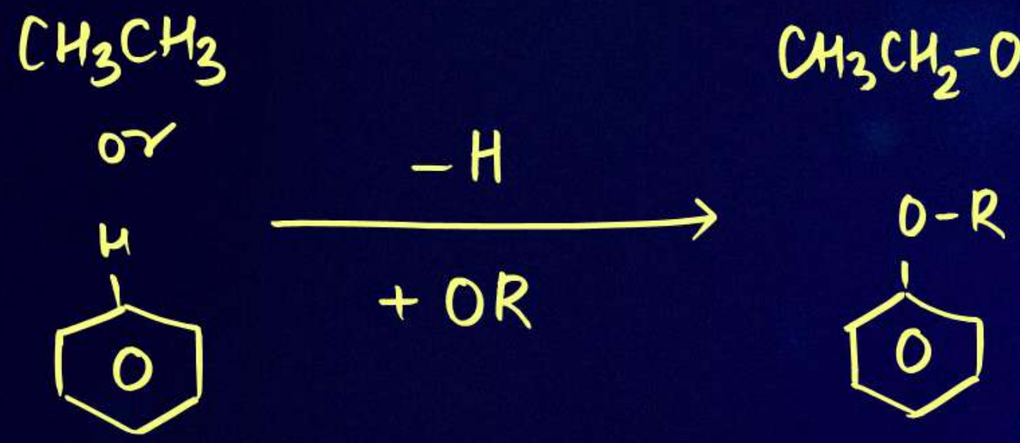
Ex. $CH_3CH_3 \xrightarrow[+OH]{-H} CH_3CH_2OH$

Ethane — ethan-1-ol





$CH_4 \xrightarrow[+X]{-H} CH_3X$



R = alkyl group

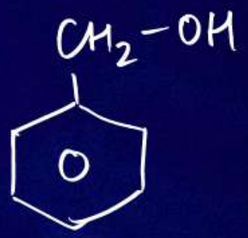
CH_4 , CH_3-O

CH_3CH_3 , CH_3CH_2-

Alcohol

→ When hydrogen atom is replaced by hydroxy group (OH) in aliphatic hydrogen, alcohols are obtained.

Ex. CH_3CH_2OH, $CH_3-\underset{\underset{OH}{|}}{CH}-OH$, $CH_3-CH_2-\underset{\underset{OH}{|}}{CH}-CH_3$,



Phenol

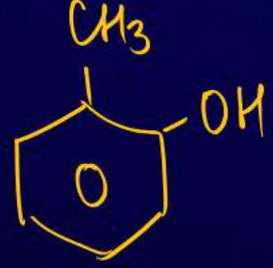
→ When hydrogen atom is replaced by 'OH' group in aromatic hydrocarbon.

or

When OH group is directly attached to Benzene Ring.

Ex.

,



Ether

When hydrogen atom is replaced by 'OR' group in aliphatic or aromatic hydrocarbon.

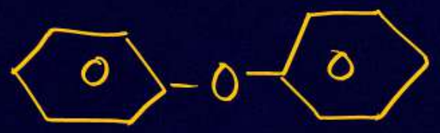
Ether

Symmetrical Ether

R–O–R

Ex. CH_3-O-CH_3

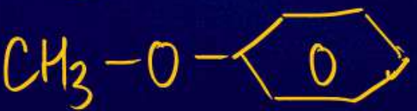
$C_2H_5-O-C_2H_5$



Unsymmetrical Ether

R–O–R'

Ex. $CH_3-O-CH_2-CH_3$



CLASSIFICATION OF ALCOHOL

On the basis of no of OH groups attach

→ **Monohydric Alcohol**

↳ When one OH gp is present

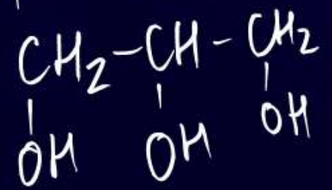
Ex. CH_3CH_2OH

→ **Dihydric Alcohol**

When two OH gp is present

→ **Trihydric Alcohol**

When 3 OH gp →



Degree of C atom which OH gp is attached

→ **Primary Alcohol (1° OH)**

When OH gp is attached to 1°C

Ex. CH_3CH_2OH

→ **Secondary Alcohol (2° OH)**

When OH gp is attached to 2°C

Ex. $CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3$

Hybridisation of C atom to which OH is attached →

→ **Tertiary Alcohol (3° OH)**

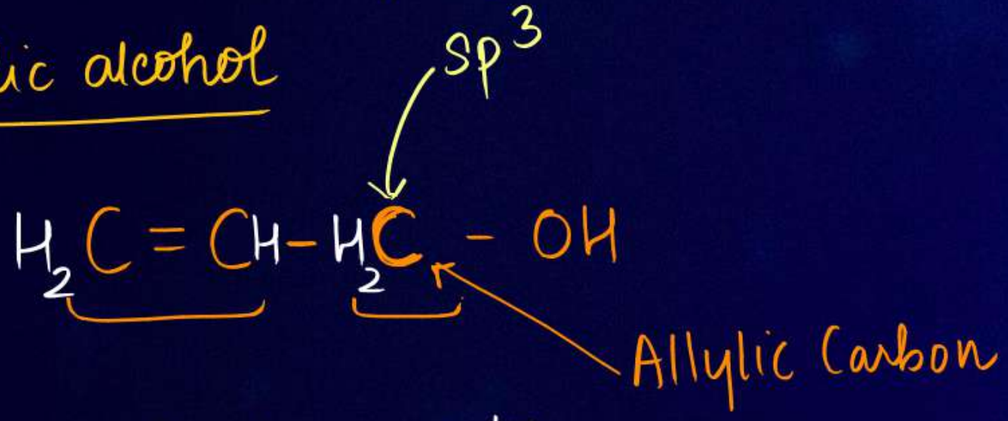
When OH gp is attached to 3°C

Ex. $CH_3-\underset{\displaystyle OH}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C}}}}-CH_3$

→ Hybridisation

1. OH gp is attached to C sp^3 hybridised.

a) Allylic alcohol



When OH group is attached to a carbon atom (sp3 hybridised) which is further attached to carbon having double bond.

Primary allylic Alcohol

$H_2C = CH - \underset{1^\circ C}{CH_2} - OH$

Secondary allylic alcohol

$H_2C = CH - \underset{2^\circ C}{\overset{CH_3}{\underset{|}{C}}H} - OH$

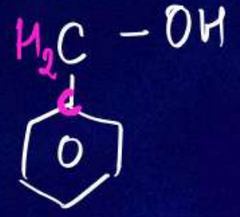
Tertiary Allylic alcohol

$H_2C = CH - \underset{3^\circ C}{\overset{CH_3}{\underset{|}{C}}} - OH$

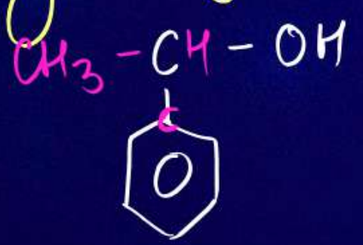
b) Benzylic Alcohol

When OH group is attached to a carbon atom which is linked to a Benzene Ring.

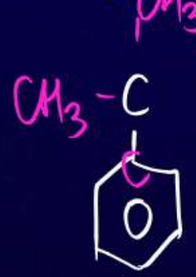
Primary Benzylic Alcohol



Secondary Benzylic Alcohol



Tertiary Benzylic Alcohol



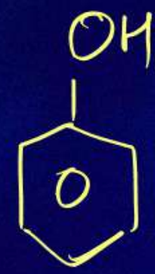
2) OH group is attached to C-sp^2-hybridised

a) Vinylic Alcohol

$H_2C = CH-OH$

If OH group is attached to a carbon (sp^2) which itself is creating a double bond.

b) Phenol



QUESTIONS

Which of the following compounds is a trihydric alcohol?

(A) C_2H_6O

(B) $C_4H_9O_6$

(C) $C_3H_8O_3$

(D) $C_4H_{10}O$

NOMENCLATURE OF ALCOHOL

al ✕ aldehyde

2° PREFIX + 1° PREFIX + WORD ROOT + 1° SUFFIX + 2° SUFFIX

2° PREFIX → extra gp/ chain/ juniormost → alcohol → hydroxy

1° PREFIX → cyclic → cyclo

WORD ROOT → Total no of C atoms present in Main chain

C_1 = meth C_5 = pent C_9 = non
C_2 = eth C_6 = hex C_{10} = dec
C_3 = prop C_7 = hept C_{11} = undec
C_4 = but C_8 = oct C_{12} = dodec

1° SUFFIX → C-C → ane
C=C → ene
C≡C → yne

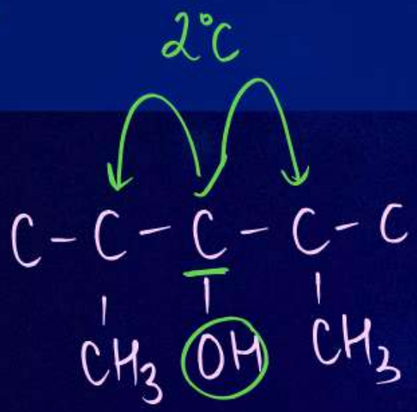
2° SUFFIX → Alcohol → ol

QUESTIONS

QUESTIONS

2.

2,4-Dimethyl-3-pentanol is a:



A. Primary alcohol

B. Secondary alcohol

C. Tertiary alcohol

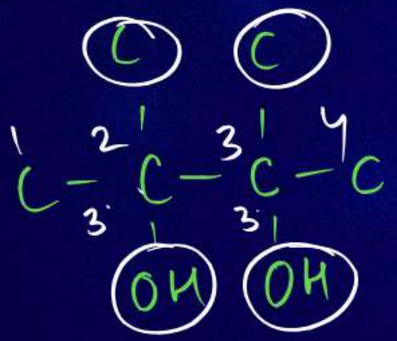
D. Dihydric alcohol

QUESTIONS

3

A compound $C_6H_{14}O_2$ has two tertiary alcoholic groups. The IUPAC name of this compound is

3 OH



(A) 2,3-Dimethyl-1, 2-butanediol

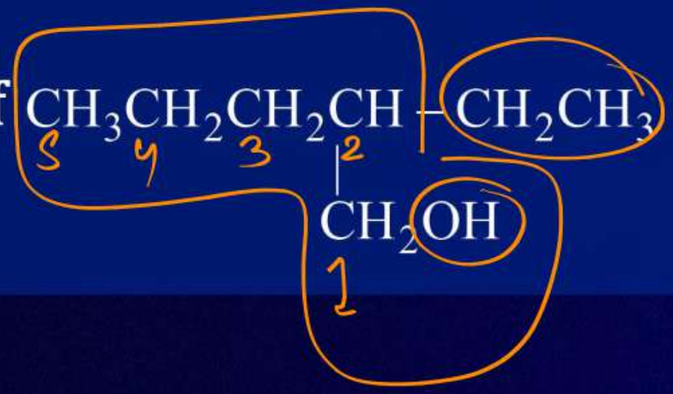
(B) 4, 6-Diethyl-5, 2-hexanediol

(C) 2, 3-Dimethyl-2, 3-butanediol ✓

2,3-dimethyl butan-2,3-diol

(D) 2, 3-Dimethyl-1,3-butanediol

QUESTIONS

The IUPAC name of  **is**

(A) 3-Propylbutan-1-ol

(B) 2-ethylpentan-1-ol

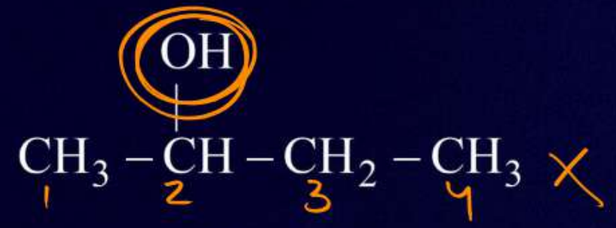
(C) 3-methyl hydroxyhexane

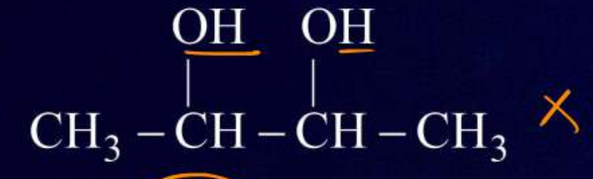
(D) 2-ethyl-2-propyl ethanol

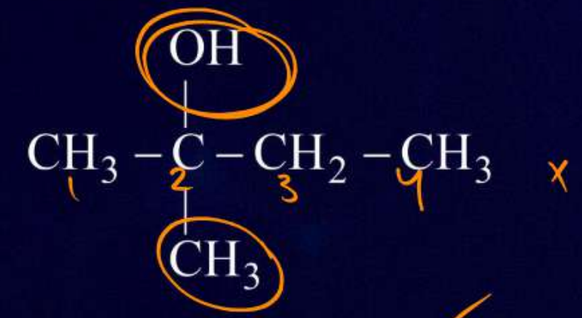
QUESTIONS

5

The structure of 3-Methyl butan-2-ol is:

(A) 

(B) 

(C) 

(D) None of these

QUESTIONS

Which of the following statement regarding IUPAC nomenclature is incorrect?

(6)

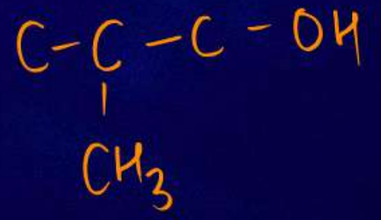
CH_3OH

(A) The IUPAC name of methyl alcohol is methanol.

C-C-C-OH

(B) The IUPAC name of n-propyl alcohol is Propan-1-ol.

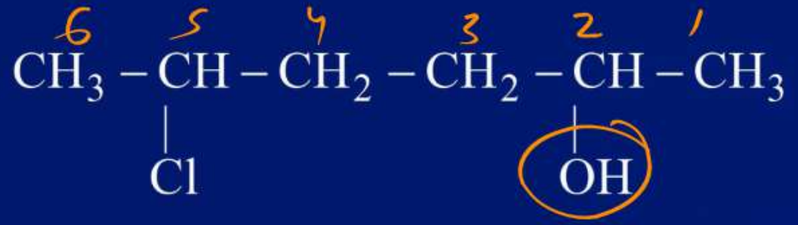
(C) The IUPAC name of isobutyl alcohol 2-Methylpropan-2-ol.



(D) The IUPAC name of n-butyl alcohol is Butan-1-ol

QUESTIONS

Give IUPAC name of the compound given below:



(A) 2-chloro-5-hydroxyhexane

(B) 2-hydroxy-5-chlorohexane

(C) 5-chlorohexan-2-ol

(D) 2-chlorohexan-5-ol

Homework

1) Revise Notes
2) Complete notes
3) S.Q lec 2 watch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@CHEMISTRYBY
SHOURYAMAM


Thank
You

PARISHRAM

2026

ALCOHOL , PHENOL & ETHER

CHEMISTRY LECTURE-2

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. NOMENCLATURE OF ALCOHOLS , PHENOL & ETHER
2. METHODS OF PREPARATION OF ALCOHOL (Part - 01)

MY SHIMMERING STARS

#SHOURYA'SGALAXY

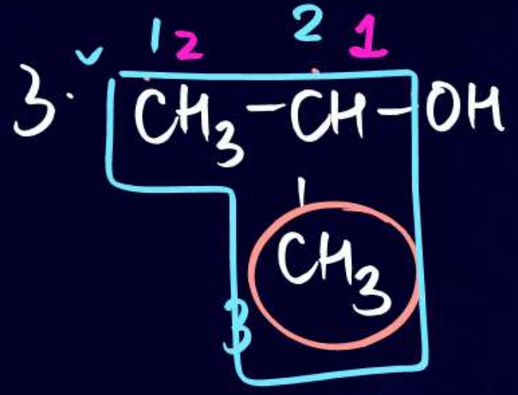

START

NOMENCLATURE OF ALCOHOLS

STRUCTURE	COMMON NAME	IUPAC NAME
1. CH_3OH	methyl alcohol	methane + ol 2 vowels can't come together methanol or methan-1-ol
2. $CH_3CH_2CH_2OH$	n-propyl alcohol	propane + ol propanol

QUESTION

Q.

3. 

Total C

isopropyl alcohol

2nd C पर CH_3 ग्रुप.

propane-2-ol

propan-2-ol

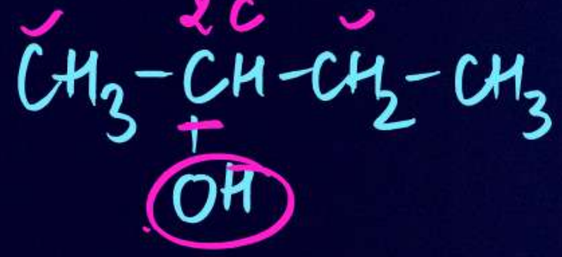
4. $\overset{4}{C}H_3\overset{3}{C}H_2\overset{2}{C}H_2\overset{1}{C}H_2OH$

n-butyl alcohol

Straight chain

butane-1-ol

butan-1-ol

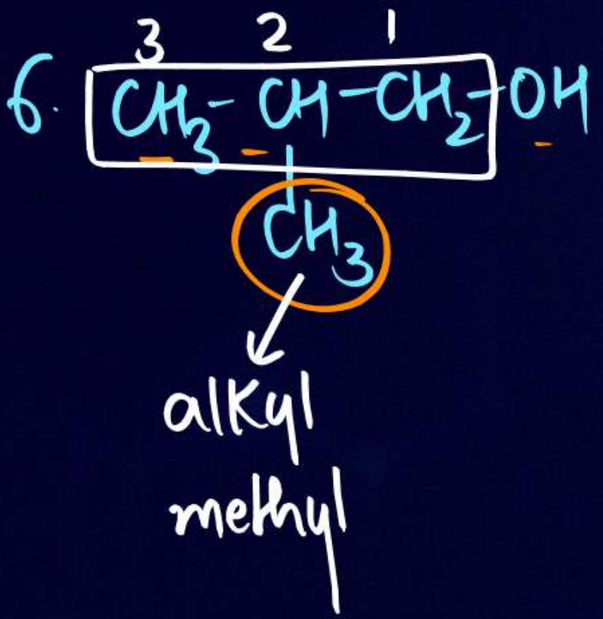
5. 

sec-butyl alcohol

↓

Secondary

OH- 2°C से attached

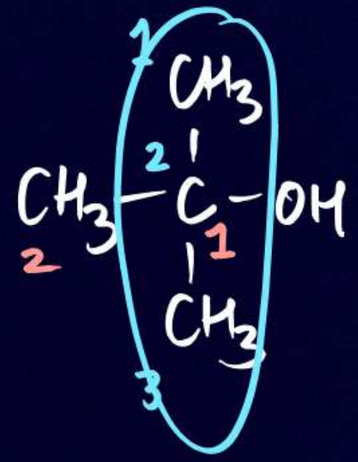
6. 

isobutyl alcohol

↓

2nd C पर CH_3

2-methyl propan-1-ol

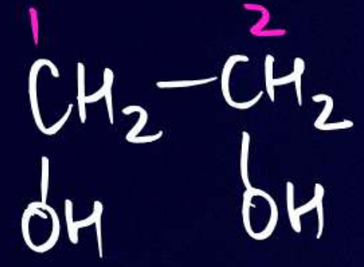
7. 

tert butylalcohol

3°

OH → 3° C

2-methyl propan-2-ol

8. 

ethylene glycol

ethane-1,2-diol

9. 

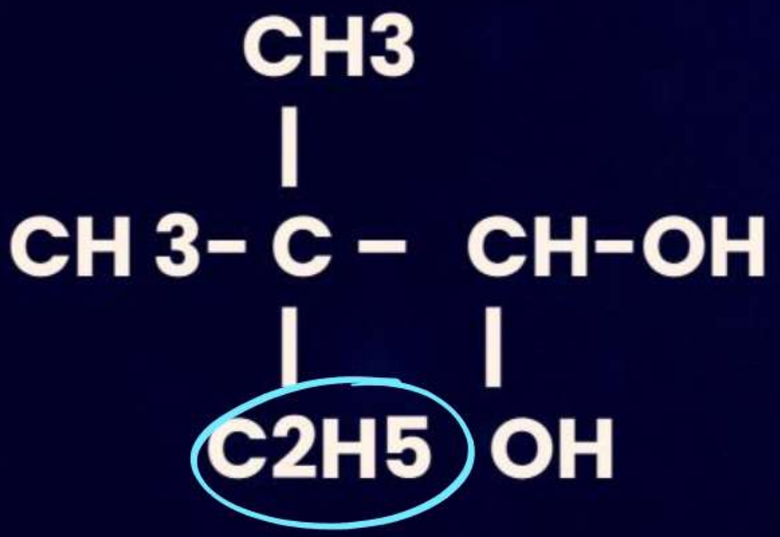
glycerol

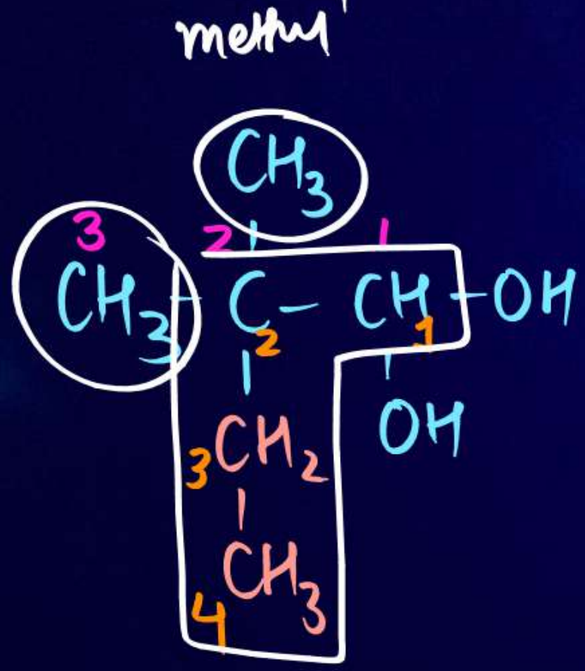
propane-1,2,3-triol

QUESTION (PYQ)

Q. 10

Write IUPAC Nomenclature of the following :





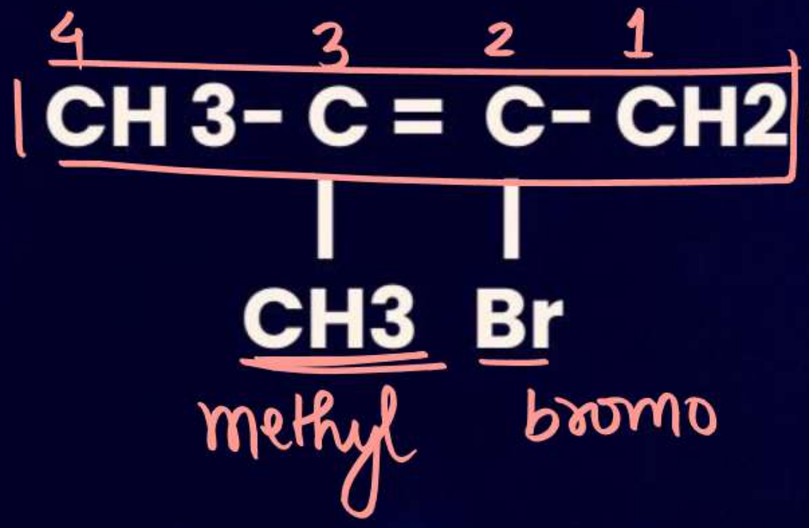
CBSE 2018

2,2-dimethylbutane-1,1-diol

QUESTION (PYQ)

Q. 11

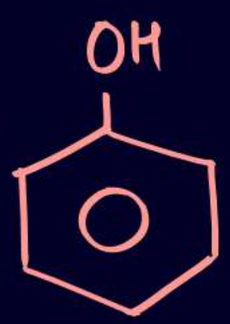
Write IUPAC Nomenclature of the following :



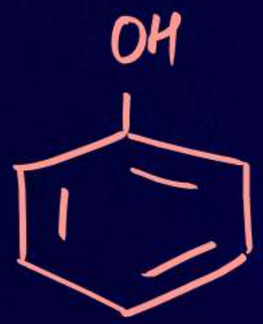
1 MARK

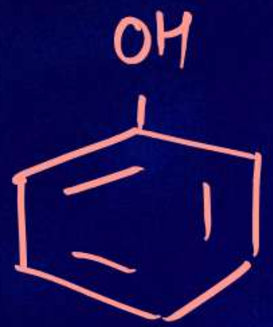
2-bromo-3-methylbut-2-en-1-ol

NOMENCLATURE OF PHENOL

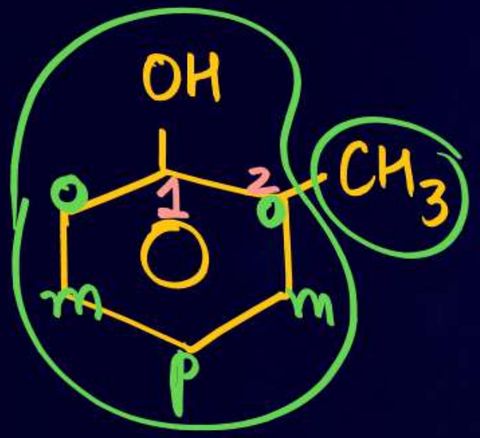
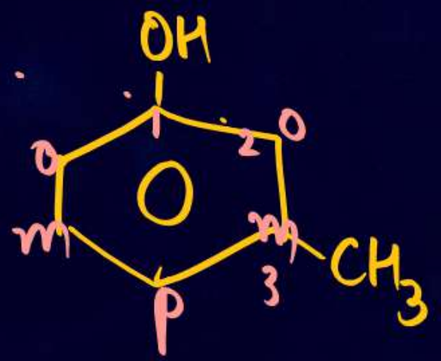


= Phenol





PHENOLS

	STRUCTURE	COMMON NAME	IUPAC
12.		o-cresol	2-methylphenol
13.		m-cresol	3-methylphenol

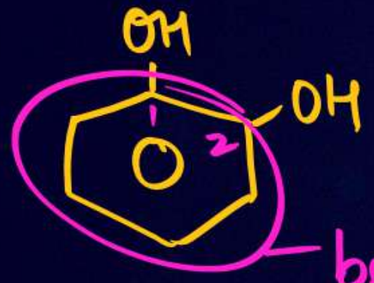
14. 

p-cresol

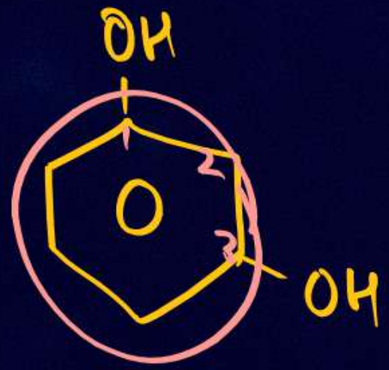
4-methylphenol

1° prefix + Word + 1° suffix

benzene-1,2-diol

15. 

Catechol

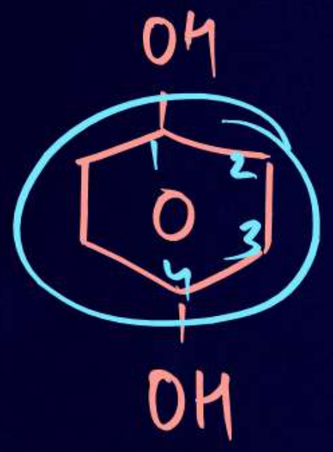
16. 

Resorcinol

benzene-1,3-diol

PHENOL

17.



Hydroquinone
or
quinol

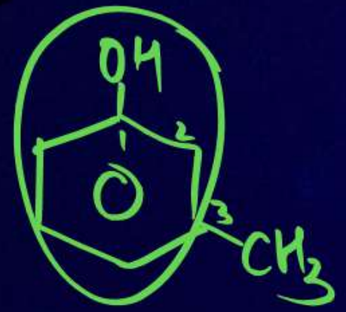
benzene-1,4-diol

QUESTION

Q. 18

IUPAC name of m-cresol is

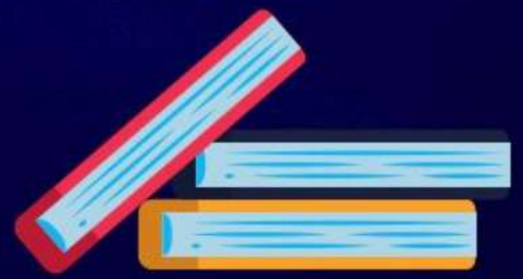
A 3-methylphenol



B 3-chlorophenol

C 3-methoxyphenol

D benzene-1, 3-diol



NOMENCLATURE OF ETHER

R-O-R

Symmetrical Ether

R → alkoxy

R-O-R

Common Name- dialkylether

IUPAC- alkoxy alkane

Ex. CH_3-O-CH_3

C|N- dimethylether

IUPAC- methoxymethane

Unsymmetrical Ether

R-O-R' → alphabetical order

Common Name- alkylalkylether

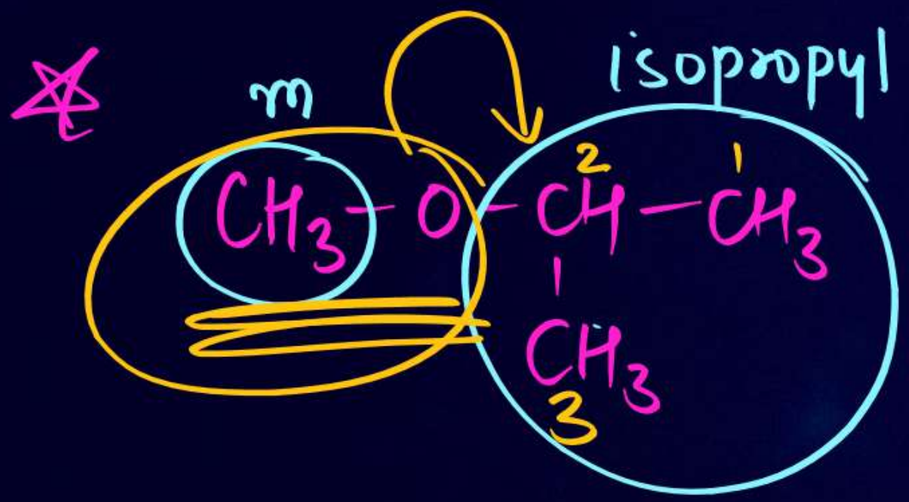
IUPAC- alkoxyalkane

Ex. $\overset{m}{CH_3}-O-\overset{e}{CH_2CH_3}$

C|N- ethylmethylether

IUPAC- methoxyethane

Ether



CN

methyl isopropyl ether

Q19

2-methoxy propane

Q20.

anisole

methoxybenzene

QUESTION

Q.21

The molecular formula of an unsymmetrical ether is $C_4H_{10}O$, its IUPAC name is:

C-C-O-C-C ×

C-O-C-C-C

methoxy propane

(A) Ethoxypropane

(B) Ethoxypentane

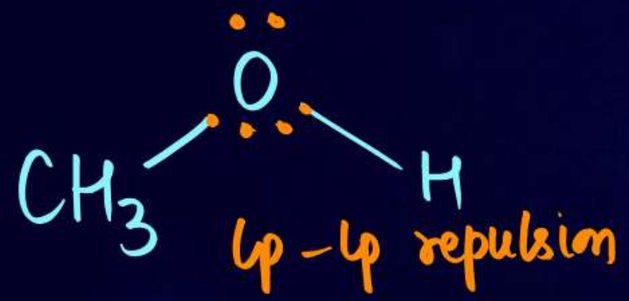
(C) Methoxybutane

(D) Methoxypropane

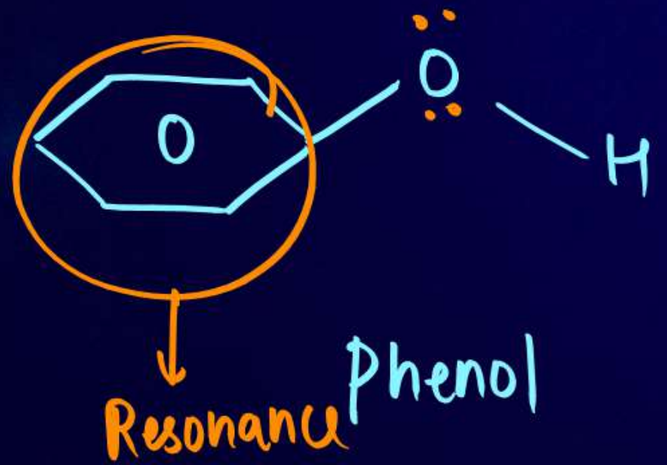
STRUCTURE OF FUNCTIONAL GROUP

Q. Bond angle in Ether

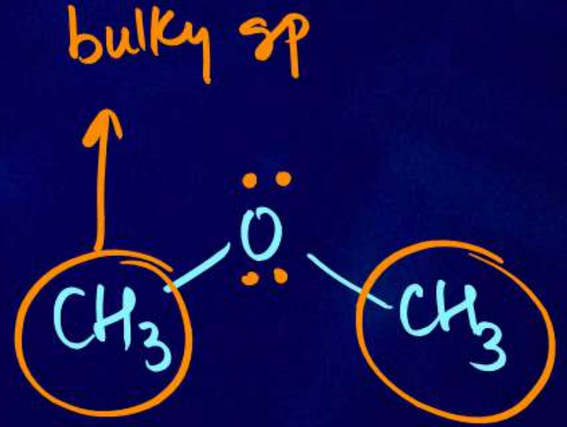
Q statement



Alcohol



Phenol



Ether

NCERT CORNER

STRUCTURE OF FUNCTIONAL GROUP

NCERT

7.3 Structures of Functional Groups

In alcohols, the oxygen of the –OH group is attached to carbon by a sigma (σ) bond formed by the overlap of a sp^3 hybridised orbital of carbon with a sp^3 hybridised orbital of oxygen. Fig. 7.1 depicts structural aspects of methanol, phenol and methoxymethane.

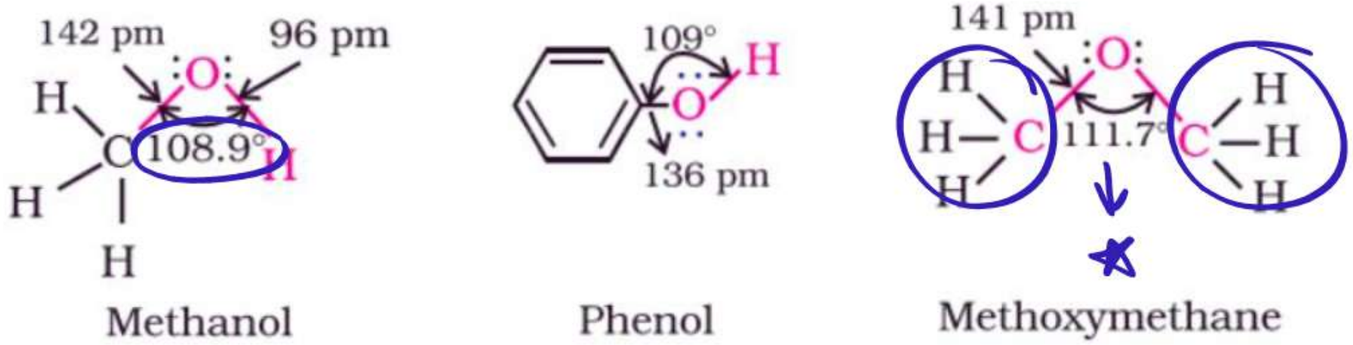
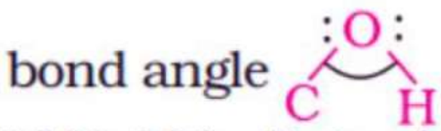


Fig. 7.1: Structures of methanol, phenol and methoxymethane

STRUCTURE OF FUNCTIONAL GROUP

NCERT

The bond angle  in alcohols is slightly less than the tetrahedral angle (109°-28′). It is due to the repulsion between the unshared electron pairs of oxygen. In phenols, the –OH group is attached to sp^2 hybridised carbon of an aromatic ring. The carbon– oxygen bond length (136 pm) in phenol is slightly less than that in methanol. This is due to (i) partial double bond character on account of the conjugation of unshared electron pair of oxygen with the aromatic ring (Section 7.4.4) and (ii) sp^2 hybridised state of carbon to which oxygen is attached.

In ethers, the four electron pairs, i.e., the two bond pairs and two lone pairs of electrons on oxygen are arranged approximately in a tetrahedral arrangement. The bond angle is slightly greater than the tetrahedral angle due to the repulsive interaction between the two bulky (–R) groups. The C–O bond length (141 pm) is almost the same as in alcohols.

METHODS OF PREPARATION OF ALCOHOL

1. By Haloalkanes (Alkyl halide)

Alcohol is obtained by Nucleophilic Substitution Reaction of Haloalkane

Nucleophilic → Nucleus (+) loving → Nu^-

→ $R\overset{+s}{-}X\overset{-s}{}$ $\xrightarrow[SN_2]{aq\ NaOH}$ $R-OH + NaX$

Alcohol

→ $R-X \xrightarrow[SN_1]{H_2O} R^{\oplus} + X^{\ominus} \xrightarrow{on^-} R-OH$

Carbocation

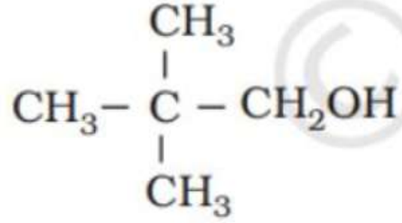
NCERT CORNER

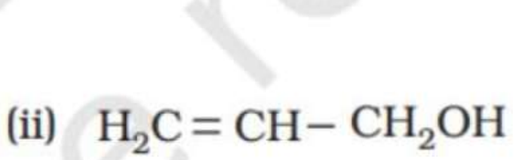
QUESTION

Q. 22

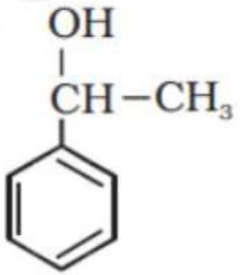
Intext Questions

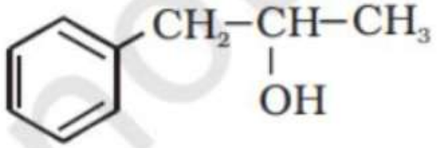
7.1 Classify the following as primary, secondary and tertiary alcohols:

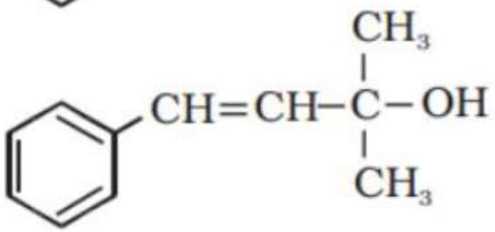
(i) 

(ii) 

(iii)

(iv) 

(v) 

(vi) 

7.2 Identify allylic alcohols in the above examples.

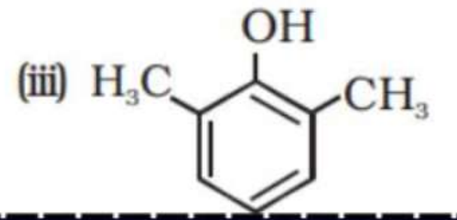
QUESTION

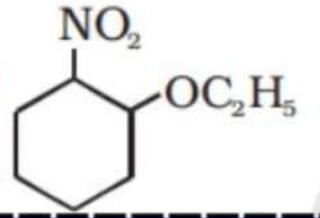
Q. 23

Example 7.1 Give IUPAC names of the following compounds:

(i) $CH_3-\underset{\underset{Cl}{|}}{CH}-\underset{\underset{CH_3}{|}}{CH}-\underset{\underset{CH_3}{|}}{CH}-CH_2OH$

(ii) $CH_3-\underset{\underset{CH_3}{|}}{CH}-O-CH_2CH_3$

(iii) 

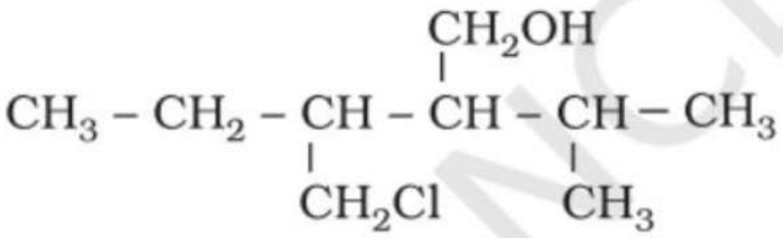
(iv) 

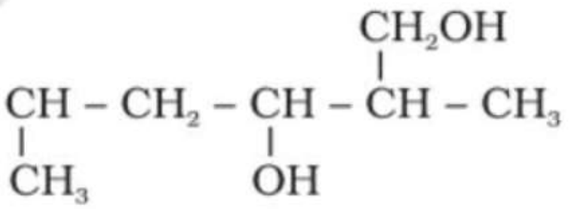
QUESTION

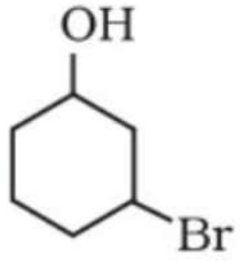
Q. 24

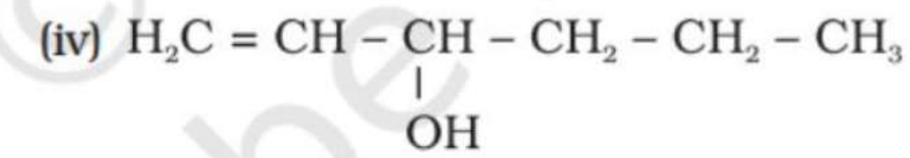
Intext Question

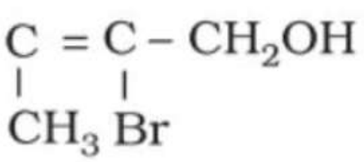
7.3 Name the following compounds according to IUPAC system.

(i) 

(ii) 

(iii) 

(iv) 

(v) 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HOMEWORK

1. 3 Que solve as HW
2. DPP solve except MOP que

PARISHRAM

2026

ALCOHOL , PHENOL & ETHER

CHEMISTRY LECTURE-3

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1.METHODS OF PREPARATION OF ALCOHOL
(Part - 02)

2. METHODS OF PREPARATION OF PHENOL

MY SHIMMERING STARS

#SHOURYA'SGALAXY

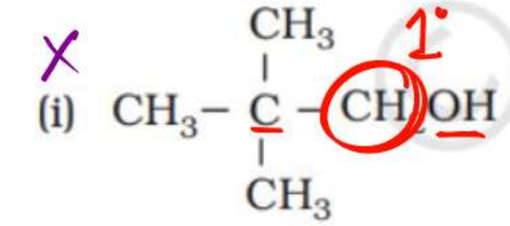

START

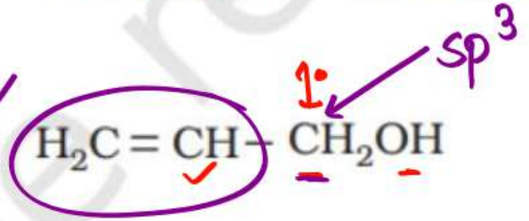
QUESTION

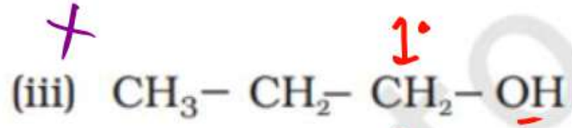
Q.

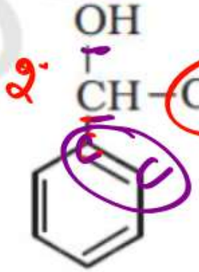
Intext Questions

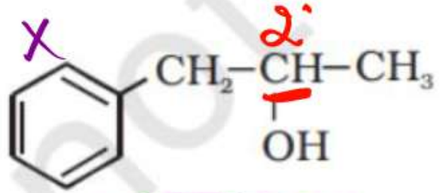
7.1 Classify the following as primary, secondary and tertiary alcohols:

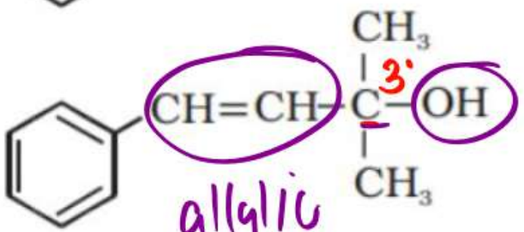
(i) 

(ii) 

(iii) 

(iv) 

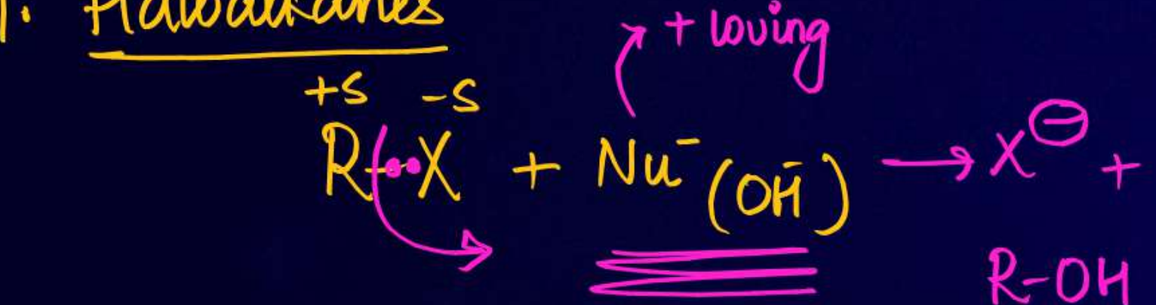
(v) 

(vi) 

7.2 Identify allylic alcohols in the above examples.

METHODS OF PREPARATION OF ALCOHOL

1. Haloalkanes



Class 11th Inorganic

$EN \propto \frac{1}{size}$

$EN \propto$ nuclear charge

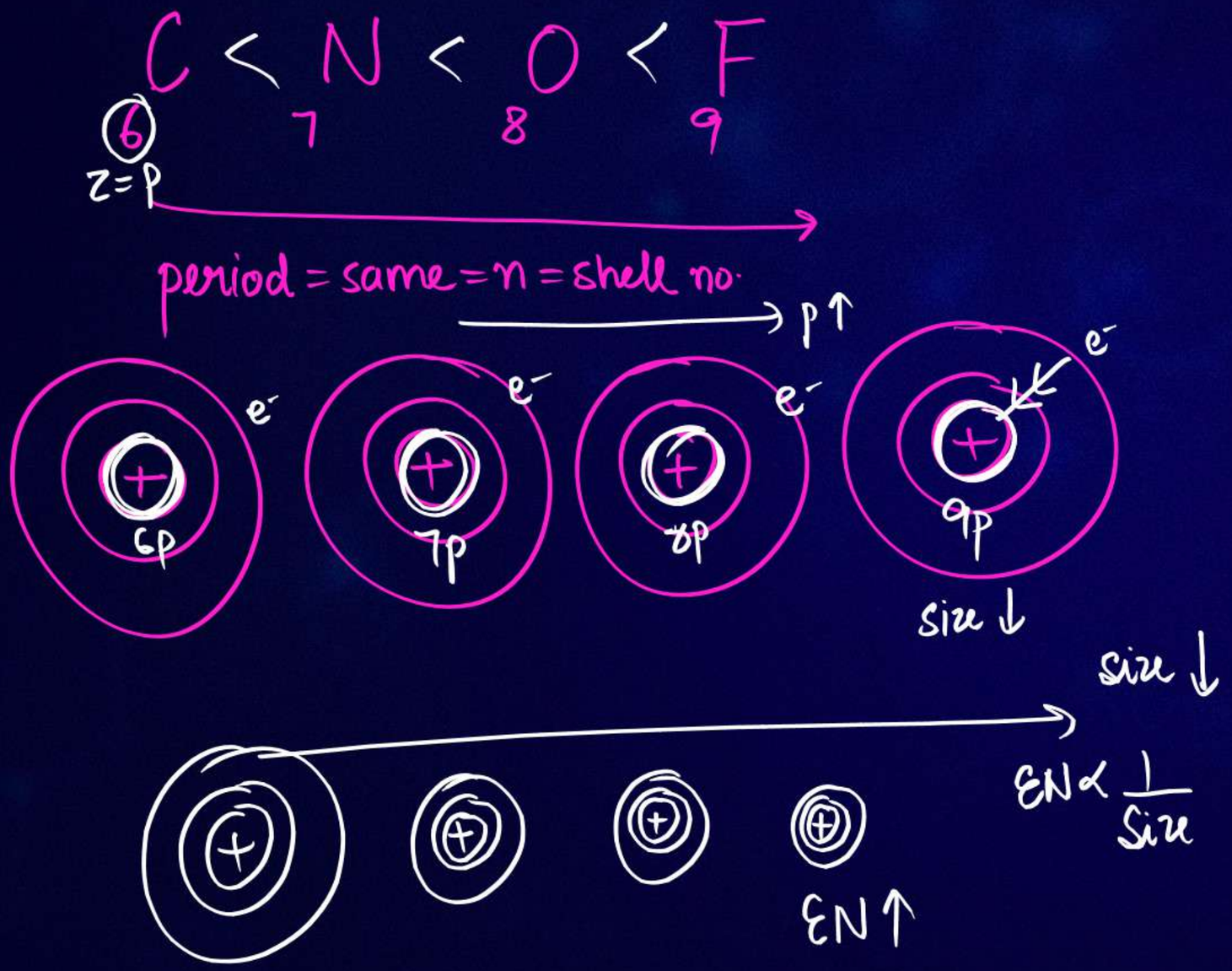
$\underset{6}{C} < \underset{7}{N} < \underset{8}{O} < \underset{9}{F}$ → $z\uparrow\uparrow, p\uparrow$ } period = same, n = same

$z = p$

nuclear charge ↑

size ↓

EN ↑


C < N < O < F
6 7 8 9
Z = P
period = same = n = shell no.
P↑
e⁻
6p
7p
8p
9p
size ↓
size ↓
EN ∝ 1/Size
EN ↑

Q1. $CH_3CH_2CH_2Cl \xrightarrow[SN_2]{aq\ NaOH} OH-CH_2CH_2CH_3 + NaCl$

propan-1-ol (propan-1-ol or propanol)

Q2. $CH_3-CH(Br)-CH_3 \xrightarrow[SN_1]{H_2O} Br^{\ominus} + CH_3-\overset{\oplus}{C}H-CH_3 \xrightarrow{OH^-} CH_3-CH(OH)-CH_3$

carbocation

propan-2-ol (inversion & Retention both)

Q3. $CH_3-C(CH_3)(CH_3)-Cl \xrightarrow[H_2O]{SN1} Cl^{\ominus} + CH_3-\overset{\oplus}{C}(CH_3)(CH_3) \xrightarrow{OH^-} CH_3-C(CH_3)(CH_3)-OH$ (3°)

carbocation

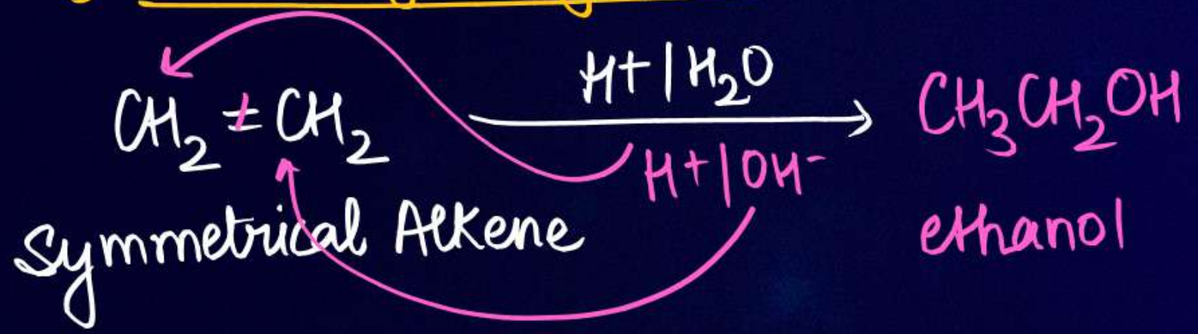
2-methylpropan-2-ol

2. Hydration of Alkenes

Addition of H_2O in alkenes by direct Method or Indirect Method.

A. Direct Method

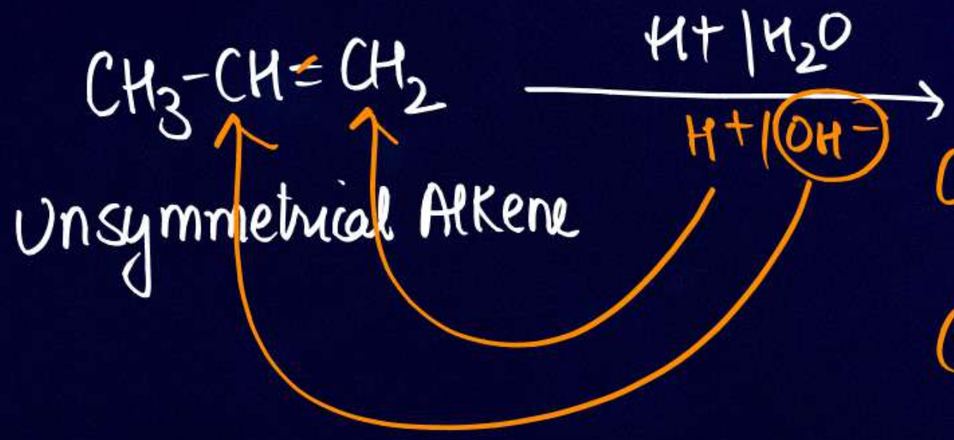
a) Acid Catalysed Hydration



acid catalysed

Markovnikov Rule to add H_2O directly to alkene

-ve part of the addendum will go to that double bond C atom which has less no of H atom.



Q4. $CH_3-CH=CH-CH_3$ $\xrightarrow[H^+/OH^-]{H^+/H_2O}$ $CH_3-CH_2-\underset{OH}{CH}-CH_3$

symmetrical alkene

butan-2-ol

Q5. $CH_3-\underset{CH_3}{C}=CH-CH_3$ $\xrightarrow[\text{Markovnikov Rule}]{H^+/H_2O}$ $CH_3-\underset{CH_3}{\overset{OH}{C}}-CH_2-CH_3$

Unsymmetrical alkene

2-methylbutan-2-ol (Major)

+

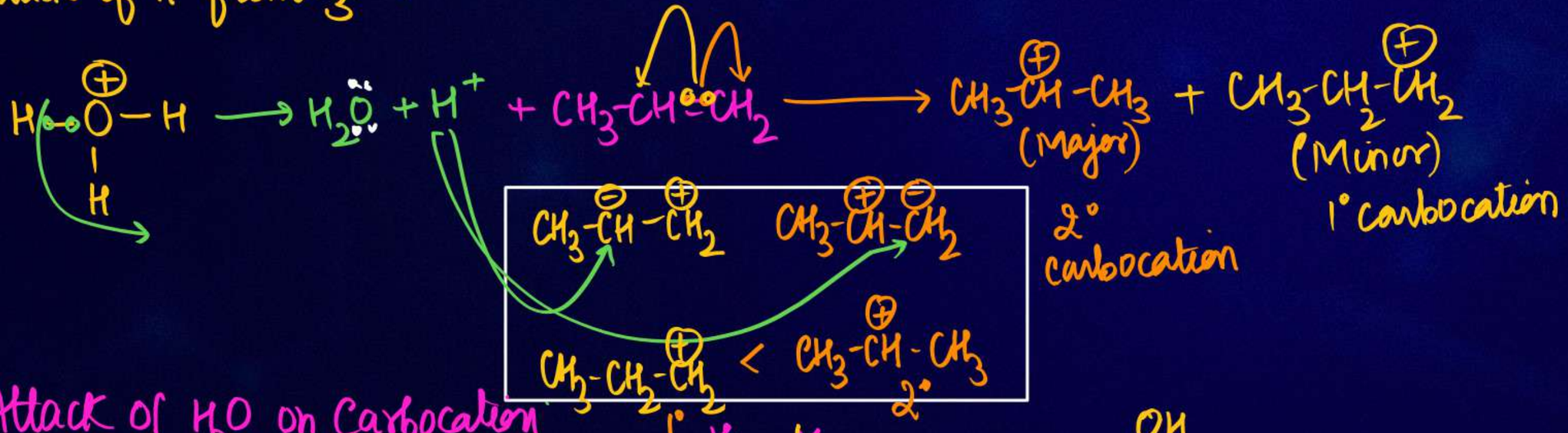
$CH_3-\underset{CH_3}{CH}-\underset{OH}{CH}-CH_3$ (Minor)

3-methylbutan-2-ol

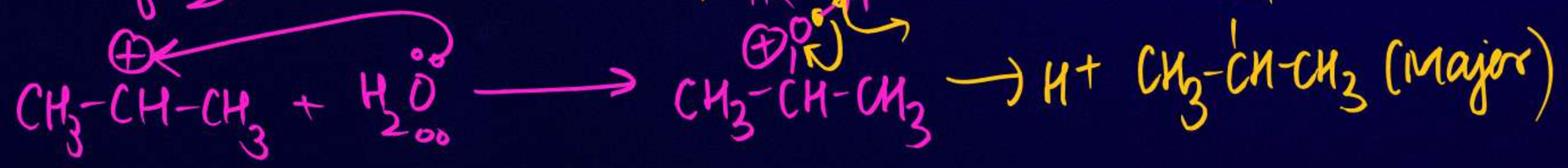
Mechanism

1. Formation of Hydronium ion

2. Attack of H^+ from $H_3O^{\oplus}$.



3. Attack of H_2O on Carbocation



(b) Indirect Method of hydration of alkene

(i) Hydroboration - oxidation

Anti Markovnikov Rule
↓
-ve part = More no of H

BH_3 or $(BH_3)_2$ (diborane)

$CH_2 = CH_2$ ⟶ (H_2O_2, THF (tetrahydrofuran)) ⟶ (indirect add of H_2O, $H^+|OH^-$) ⟶ CH_3-CH_2-OH

Symmetrical alkene

↓ hydrogen peroxide

ethanol

$CH_3-CH=CH_2$ ⟶ (BH_3 or $(BH_3)_2$ or B_2H_6; H_2O_2; H_2O; anti $OH^-|H^+$)

Unsymmetrical Alkene

propan-1-ol (Major) + propan-2-ol (Minor)

$CH_3-CH_2-CH_2-OH$ + $CH_3-\underset{OH}{CH}-CH_3$

1 page leave for Mechanism

(ii) Oxemercuration - demercuration

Ncert ✗ Conversion que ✓

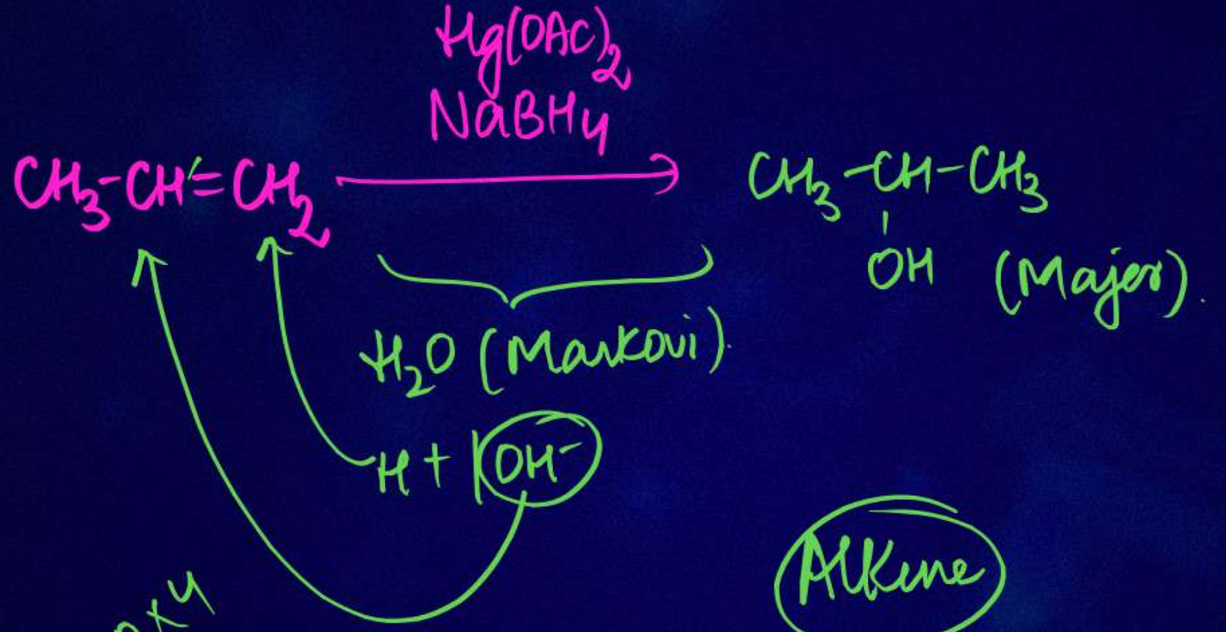
$Hg(OAc)_2$

→ Mercuric acetate is taken

→ Markovnikov Rule is used

→ Indirect add of H_2O

→ occurs in presence of $NaBH_4$



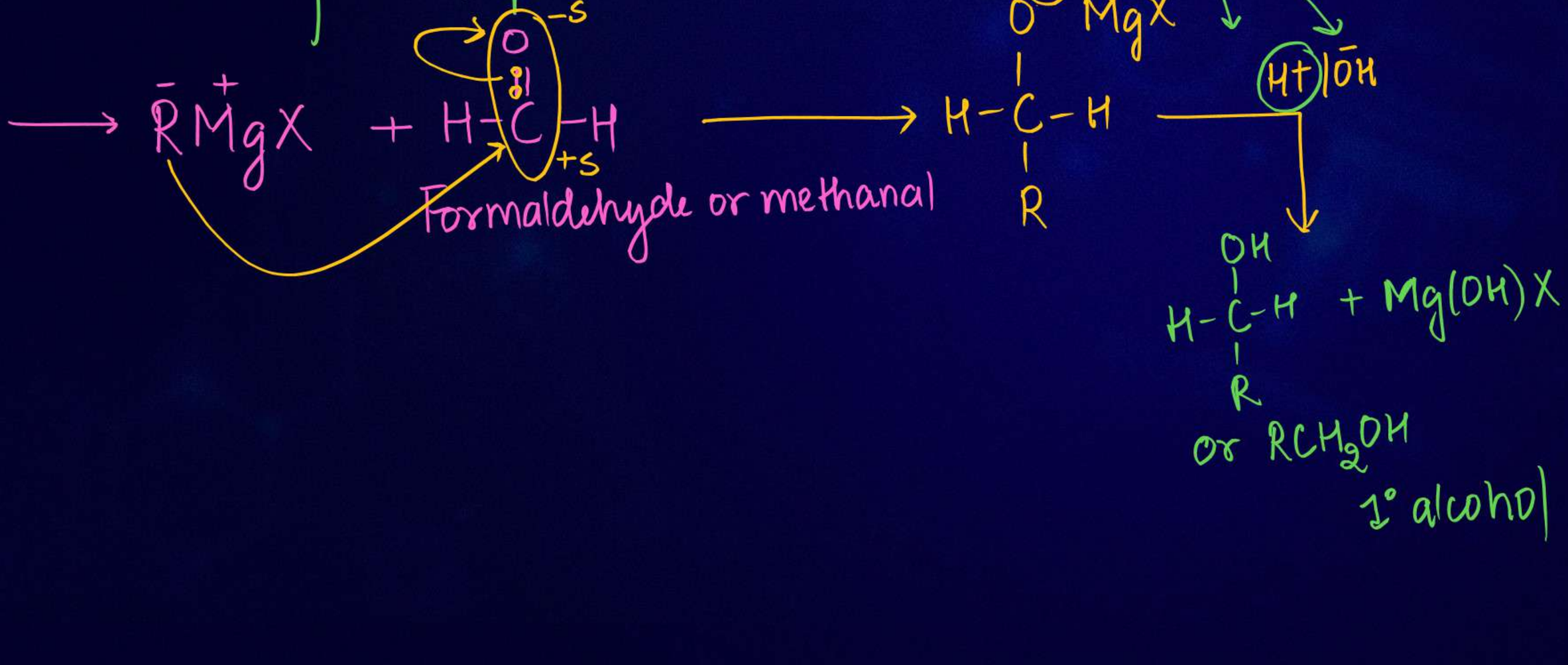
GALAXY TRICK

Alkene

$H^+ \mid H_2O$	⟶ Marko
BH_3 or $B_2H_6 \mid H_2O_2$	⟶ A.M
$Hg(OAc)_2, NaBH_4$	⟶ M

(C) From Grignard Reagent

$\overset{-}{R}\overset{+}{M}gX$ } organometallic compound



Q6 $CH_3MgBr + CH_3-\overset{\overset{O}{\|}}{C}-H \longrightarrow CH_3-\underset{CH_3}{\overset{O^-Mg^+Br}{\underset{|}{\overset{|}{C}}}}-H \xrightarrow{H^+|OH^-} CH_3-\underset{CH_3}{\overset{OH}{\underset{|}{\overset{|}{C}}}}-H$

2° alcohol $+ Mg(OH)Br$

Q7 $CH_3MgCl + H-\overset{\overset{O}{\|}}{C}-H \longrightarrow H-\underset{CH_3}{\overset{O^-MgCl}{\underset{|}{\overset{|}{C}}}}-H \xrightarrow{H^+|OH^-} CH_3-CH_2-OH + Mg(OH)Cl$

1°

Q8 $CH_3CH_2MgBr + CH_3-\overset{\overset{O}{\|}}{C}-CH_3 \longrightarrow CH_3-\underset{CH_2CH_3}{\overset{O^-MgBr}{\underset{|}{\overset{|}{C}}}}-CH_3 \xrightarrow{H^+|OH^-} CH_3CH_2-\underset{CH_3}{\overset{OH}{\underset{|}{\overset{|}{C}}}}-CH_3 + Mg(OH)Br$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HOMEWORK

1. Revise notes
2. Complete notes

PARISHRAM

2026

Alcohol, phenol & Ethers

CHEMISTRY LECTURE-4

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1.METHODS OF PREPARATION OF ALCOHOL PART 2

2. METHODS OF PREPARATION OF PHENOL

Physical Properties
Chemical Properties of Alcohol (Part - 01)

MY SHIMMERING STARS

#SHOURYA'SGALAXY

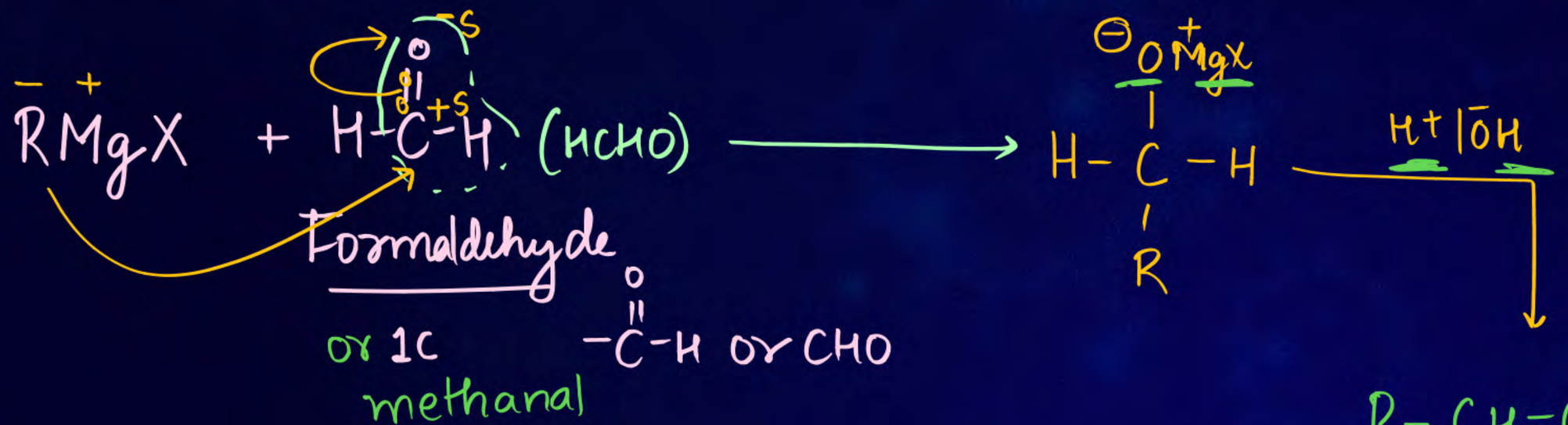

START

METHODS OF PREPARATION OF ALCOHOL

FROM GRIGNARD REAGENT

$\bar{R}\overset{+}{M}gX$

Grignard Reagent (organometallic compound) on rxn with Formaldehyde aldehyde other than formaldehyde, ketone will lead to hydrolysis producing 1°, 2° & 3° alcohol respectively.



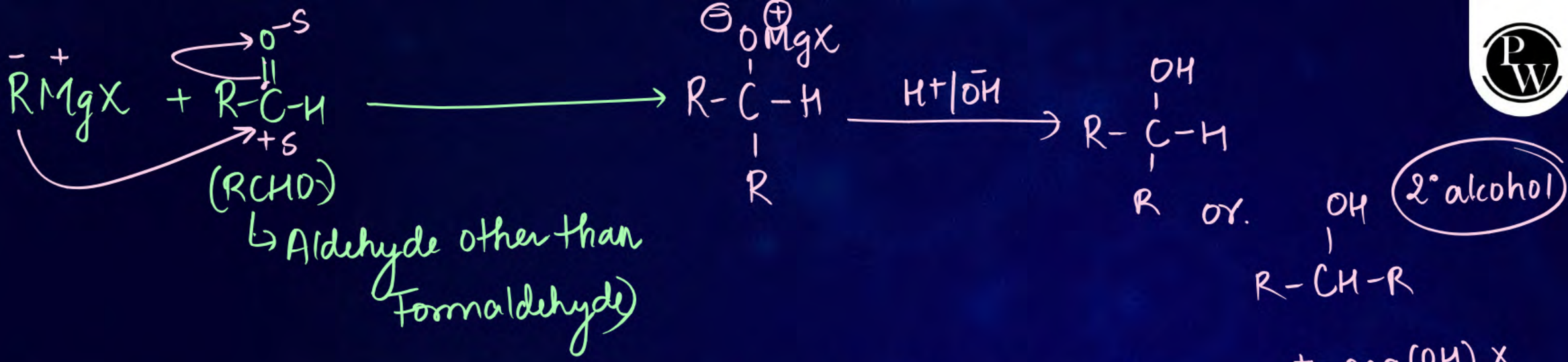
Formaldehyde or Rx with Grignard reagent followed by hydrolysis will always produce primary alcohol.

Q1. $CH_3MgCl + H-\overset{\overset{O}{\|}}{C}-H \longrightarrow H-\underset{\underset{CH_3}{|}}{\overset{\overset{OMgCl}{|}}{C}}-H \xrightarrow{H^+|\bar{O}H}$ ethanol $CH_3CH_2OH + Mg(OH)Cl$

1° alcohol

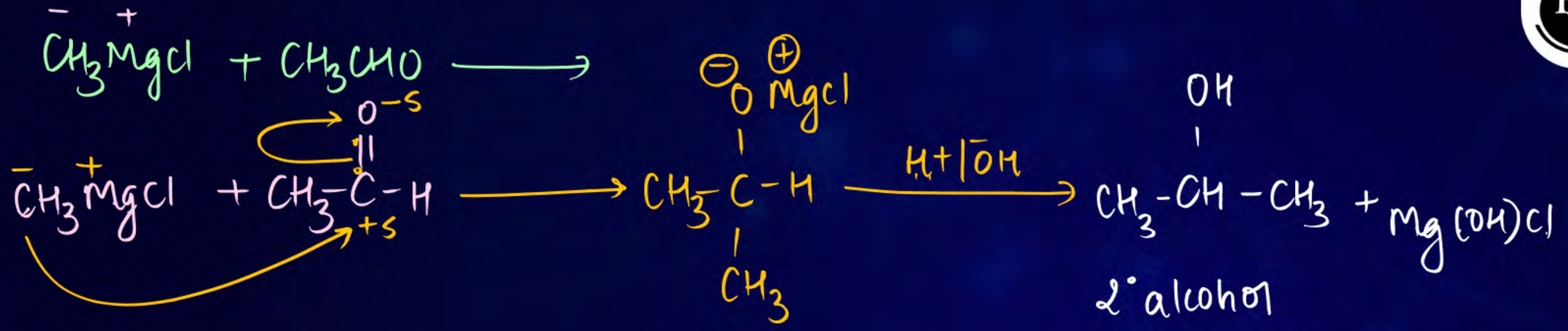
Q2. $CH_3CH_2MgBr + H-\overset{\overset{O}{\|}}{C}-H \longrightarrow H-\underset{\underset{CH_2-CH_3}{|}}{\overset{\overset{OMgBr}{|}}{C}}-H \xrightarrow{H^+|\bar{O}H}$ propanol $CH_3CH_2CH_2OH + Mg(OH)Br$

1° alcohol

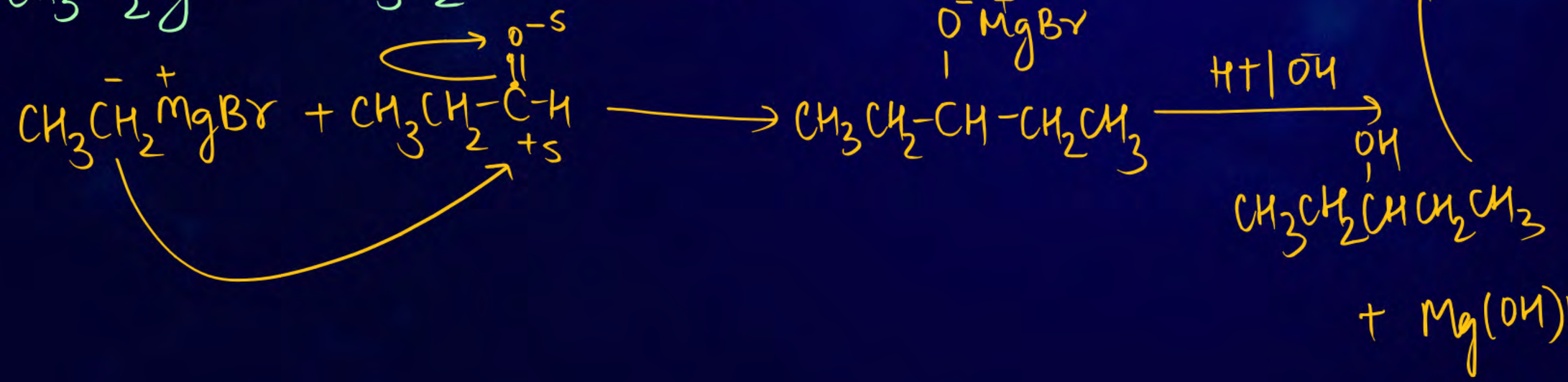


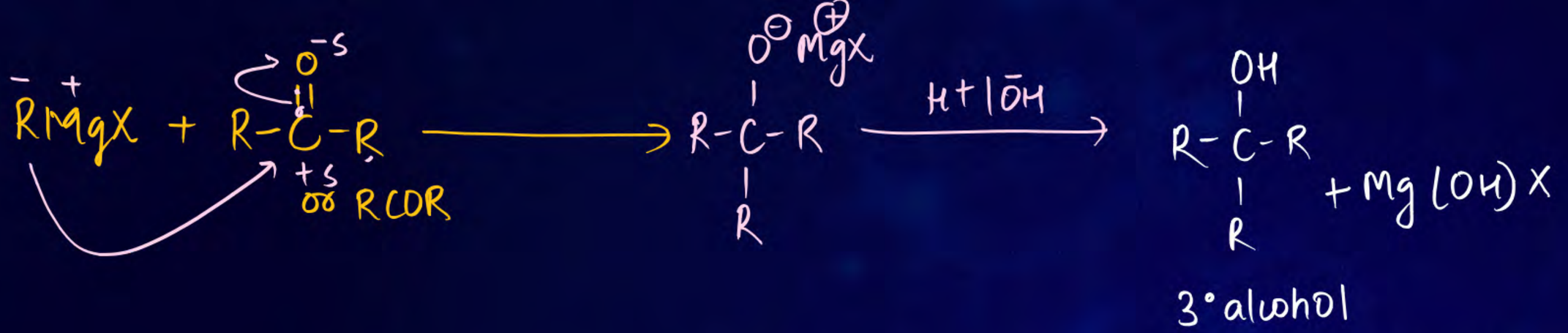
When Aldehyde other than formaldehyde react with Grignard Reagent & on further hydrolysis will always produce 2° alcohol.

Q3. $CH_3MgCl + CH_3CHO \longrightarrow$



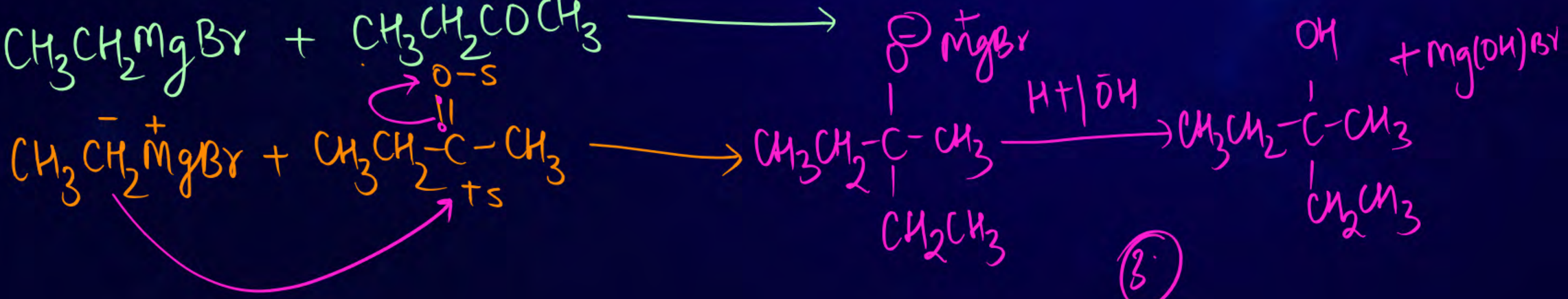
Q4. $CH_3CH_2MgBr + CH_3CH_2CHO \longrightarrow$





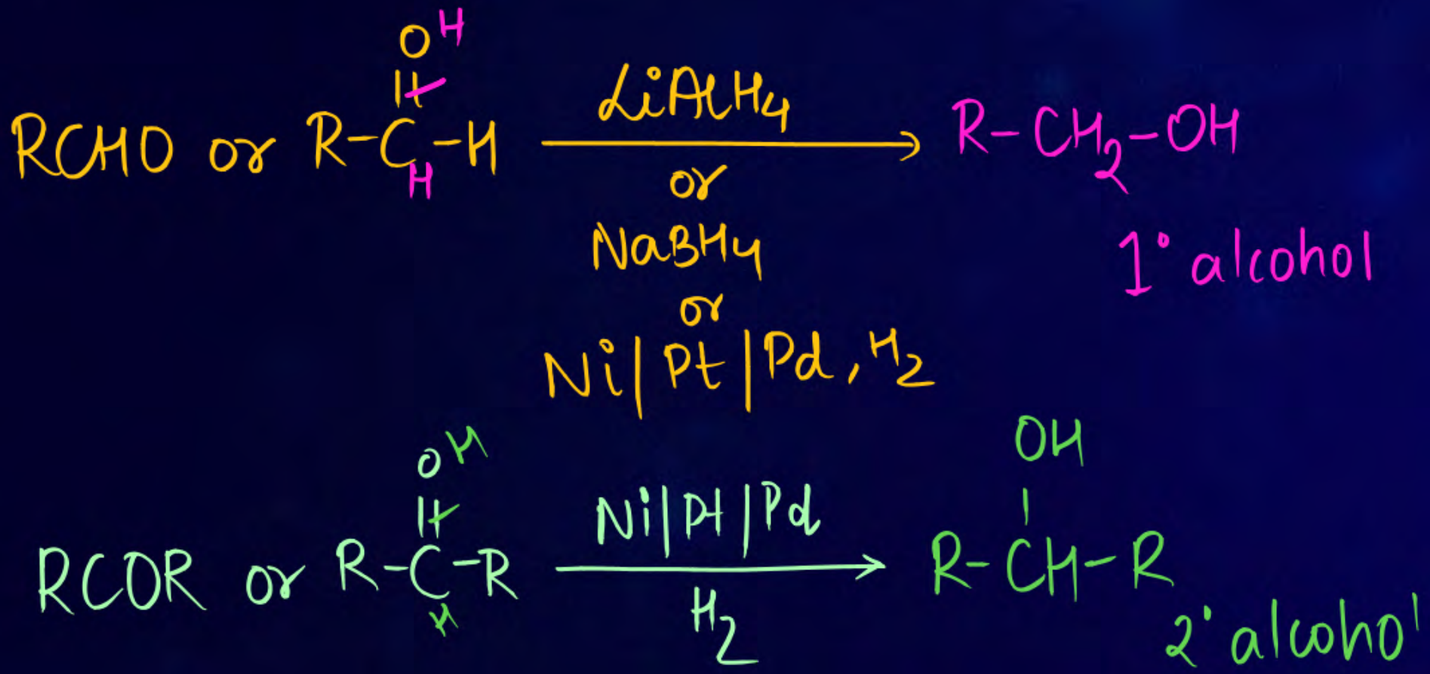
When Ketone React with Grignard Reagent, on further hydrolysis will always produce tertiary alcohol.

Q5. $CH_3CH_2MgBr + CH_3CH_2COCH_3 \longrightarrow$



(B)

FROM ALDEHYDE & KETONES



LiAlH4 | NaBH4 | Ni | Pt | Pd

Aldehyde ⟶ 1° alcohol

Ketone ⟶ 2° alcohol

QUESTION

Q.

Q6. $CH_3CHO \xrightarrow{LiAlH_4} CH_3CH_2OH$

ethanol

Q7. $CH_3-CH_2-\underset{\underset{H}{|}}{\overset{\overset{O}{\|}}{C}}-H \xrightarrow[H_2]{Ni} CH_3CH_2CH_2OH$

propanol

Q8. $CH_3COCH_3 \xrightarrow{LiAlH_4} CH_3\underset{\underset{H}{|}}{\overset{\overset{OH}{|}}{C}}HCH_3$

propan-2-ol

Q9. $CH_3-\underset{\underset{H}{|}}{\overset{\overset{OH}{\|}}{C}}-CH_2CH_3 \xrightarrow[H_2]{Pt}$

$CH_3\underset{OH}{\underset{|}{C}}HCH_2CH_3$

butan-2-ol

Aldehydes & Ketones React with Lithium aluminium hydride ($LiAlH_4$), or $NaBH_4$ or by catalytic hydrogenation with catalyst like Nickel, platinum, palladium.

Q10. Among $LiAlH_4$ and $NaBH_4$, which is preferable? ☆

→ $LiAlH_4$ ✓

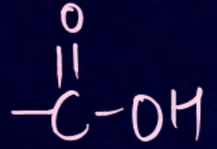
Reason : Aluminium size is more than B

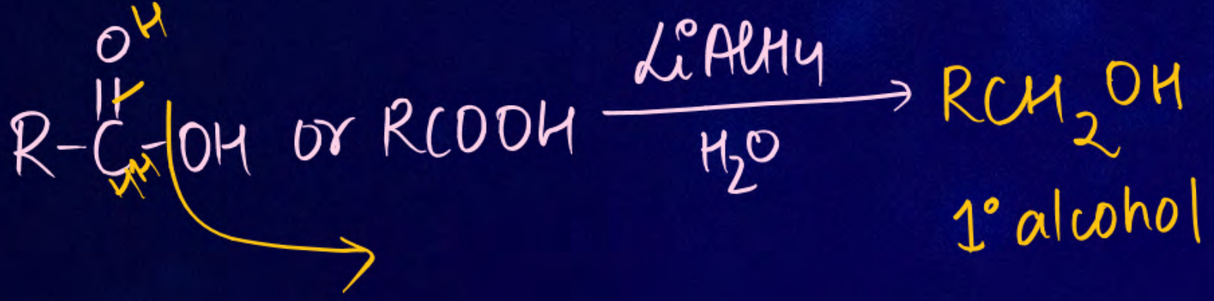
Bond length increases

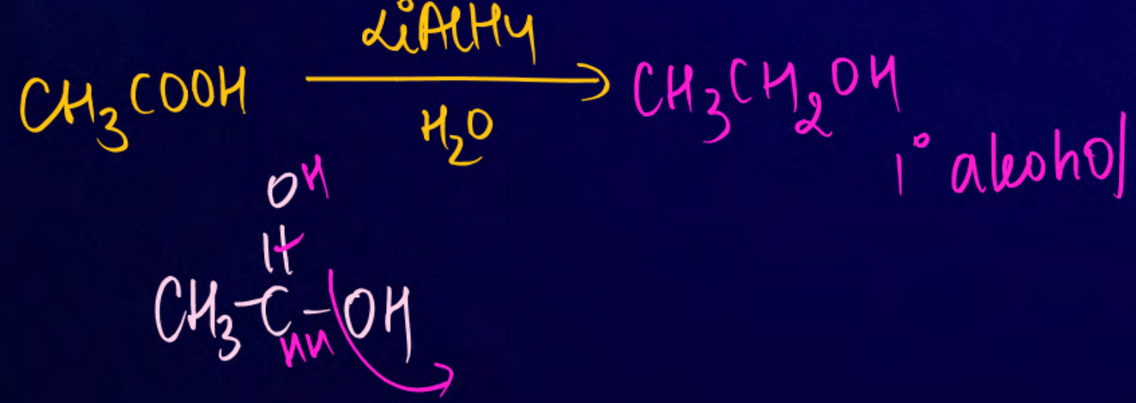
Bond easely broken up.

FROM CARBOXYLIC ACID | ESTER -

CARBOXYLIC ACID





Q.11. 

Ester

↓

$RCOOR$ or $R-\overset{O}{\overset{\|}{C}}-OR$

$$R-\overset{O}{\overset{\|}{C}}-OR \xrightarrow[H_2O]{LiAlH_4} RCH_2OH$$

1 alcohol

Ester	Ether
$R-COOR$ or $R-\overset{O}{\overset{\|}{C}}-OR$	$R-O-R$

Q12: $$CH_3-\overset{O}{\overset{\|}{C}}-OCH_3 \xrightarrow[H_2O]{LiAlH_4} CH_3CH_2OH$$

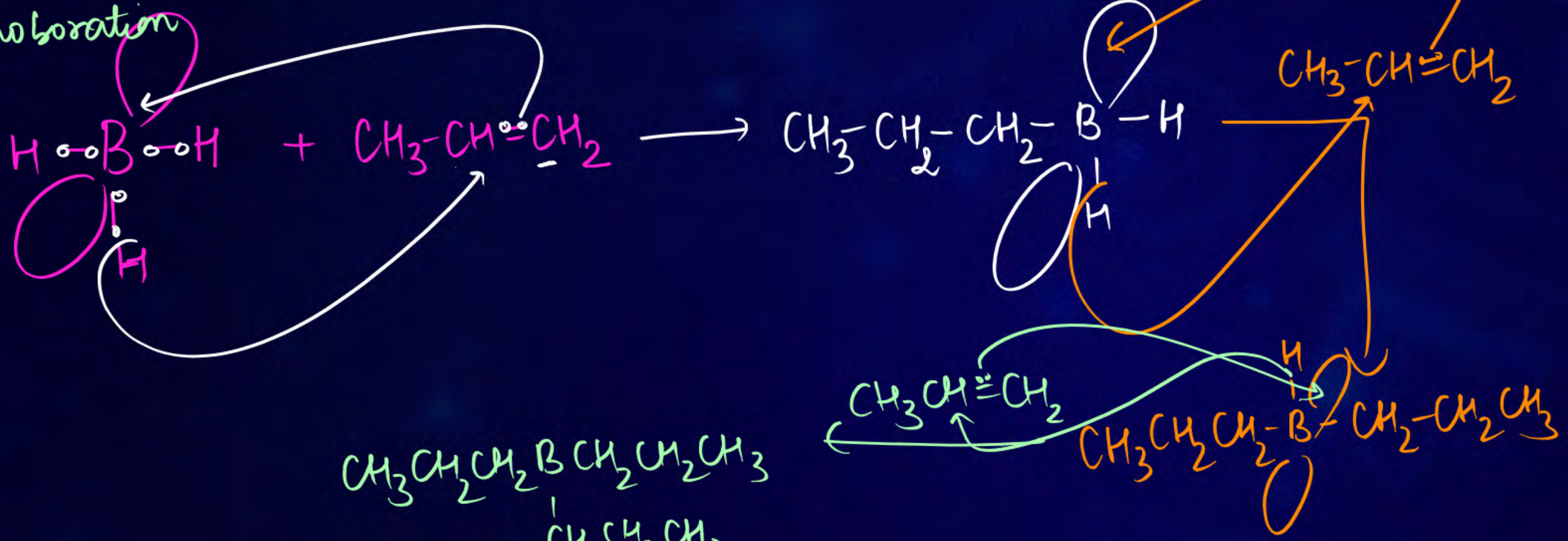
Acyl chloride

↓

acid chloride

Mechanism of Hydroboration - oxidation

1. Hydroboration



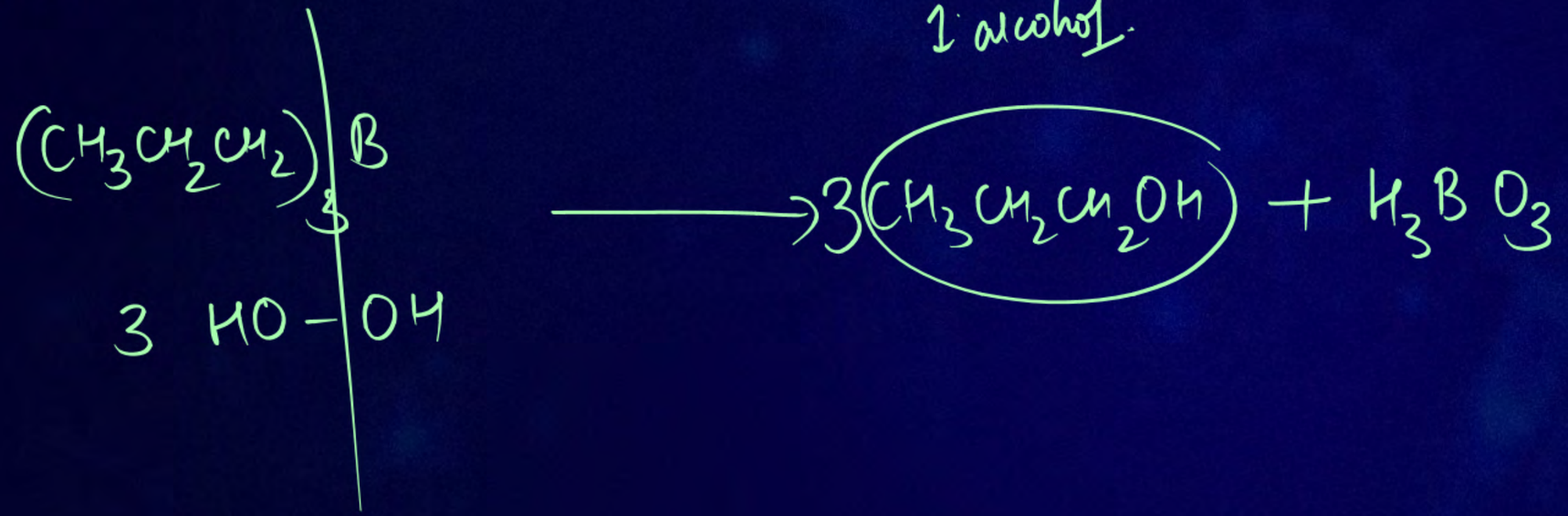
$CH_3CH_2CH_2B(CH_2CH_2CH_3)CH_2CH_2CH_3$

or

$(CH_3CH_2CH_2)_3B$

2. oxidation

H_2O_2



QUESTION

HW

Q.

Example 7.2

Give the structures and IUPAC names of the products expected from the following reactions:

(a) Catalytic reduction of butanal.

(b) Hydration of propene in the presence of dilute sulphuric acid.

(c) Reaction of propanone with methylmagnesium bromide followed by hydrolysis.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HOMEWORK

1. Flowchart of MOP of Alcohol
2. Que solve
3. Notes complete

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2026

ALCOHOL , PHENOL & ETHER

CHEMISTRY LECTURE-5

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. METHODS OF PREPARATION OF PHENOL

2. PHYSICAL PROPERTIES OF ALCOHOL

MY SHIMMERING STARS

#SHOURYA'SGALAXY

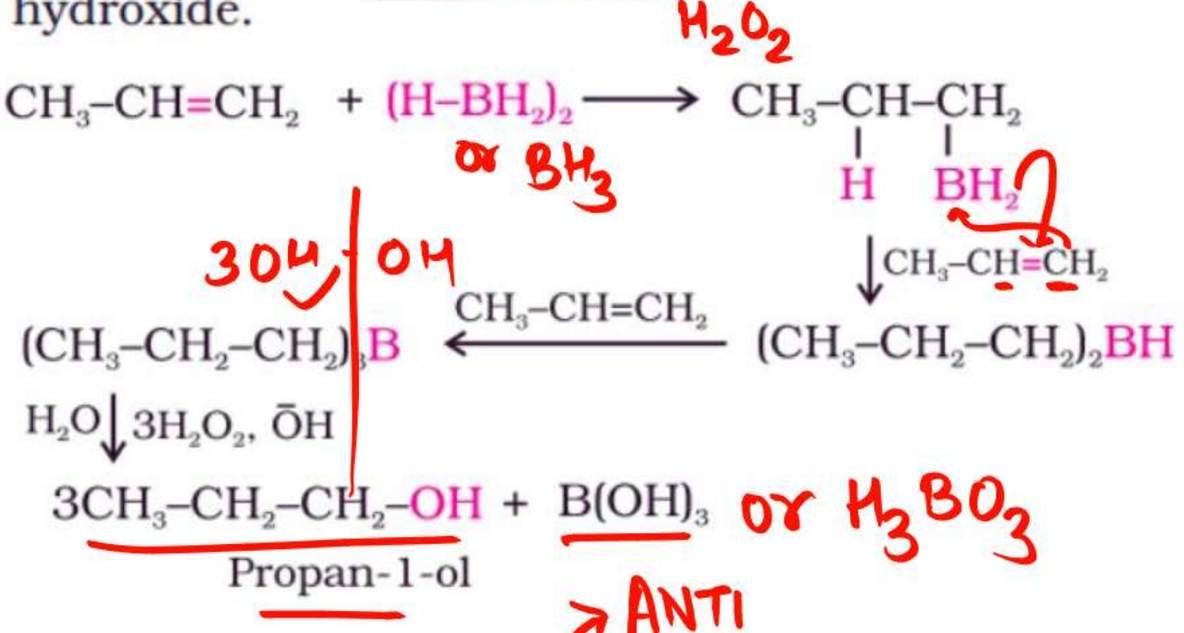

START

NCERT CORNER

HIGHLIGHT

NCERT

(ii) *By hydroboration–oxidation*: Diborane $(BH_3)_2$ reacts with alkenes to give trialkyl boranes as addition product. This is oxidised to alcohol by hydrogen peroxide in the presence of aqueous sodium hydroxide.



ANTI

The addition of borane to the double bond takes place in such a manner that the boron atom gets attached to the sp^2 carbon carrying greater number of hydrogen atoms. The alcohol so formed looks as if it has been formed by the addition of water to the alkene in a way opposite to the Markovnikov's rule. In this reaction, alcohol is obtained in excellent yield.

HIGHLIGHT

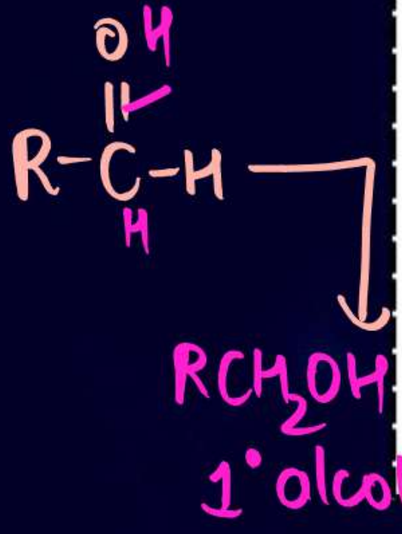
NCERT

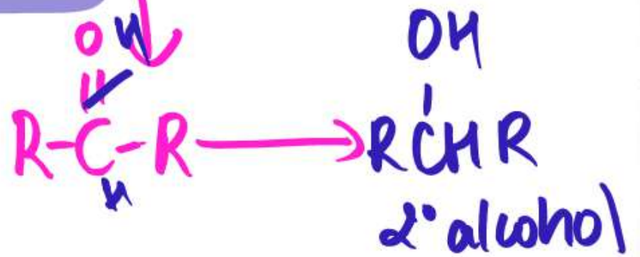
2. *From carbonyl compounds*

(i) *By reduction of aldehydes and ketones*: Aldehydes and ketones are reduced to the corresponding alcohols by addition of hydrogen in the presence of catalysts (catalytic hydrogenation). The usual catalyst is a finely divided metal such as platinum, palladium or nickel. It is also prepared by treating aldehydes and ketones with sodium borohydride ($NaBH_4$) or lithium aluminium hydride ($LiAlH_4$). Aldehydes yield primary alcohols whereas ketones give secondary alcohols.

$$RCHO + H_2 \xrightarrow{Pd} RCH_2OH$$

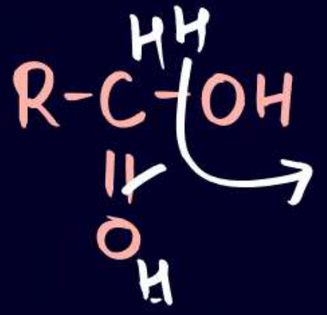
$$RCOR' \xrightarrow{NaBH_4} R-\underset{\displaystyle OH}{\underset{|}{CH}}-R'$$





HIGHLIGHT

NCERT



(ii) *By reduction of carboxylic acids and esters*: Carboxylic acids are reduced to primary alcohols in excellent yields by lithium aluminium hydride, a strong reducing agent.

$$RCOOH \xrightarrow[(ii)\ H_2O]{(i)\ LiAlH_4} RCH_2OH$$

However, $LiAlH_4$ is an expensive reagent, and therefore, used for preparing special chemicals only. Commercially, acids are reduced to alcohols by converting them to the esters (Section 7.4.4), followed by their reduction using hydrogen in the presence of catalyst (catalytic hydrogenation).

$$RCOOH \xrightarrow[H^+]{R'OH} RCOOR' \xrightarrow[Catalyst]{H_2} RCH_2OH + R'OH$$

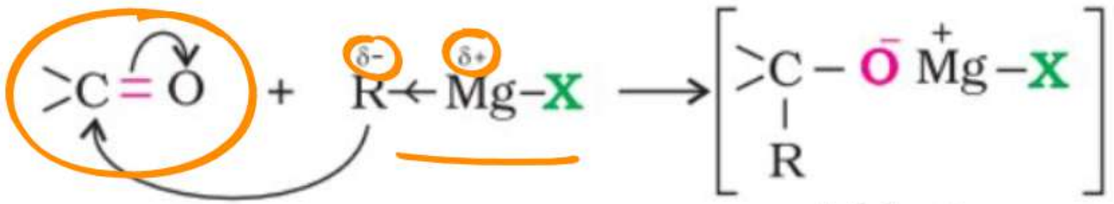
HIGHLIGHT

NCERT

3. *From Grignard reagents*

Alcohols are produced by the reaction of Grignard reagents (Unit 6, Class XII) with aldehydes and ketones.

The first step of the reaction is the nucleophilic addition of Grignard reagent to the carbonyl group to form an adduct. Hydrolysis of the adduct yields an alcohol.



... (i)

...(ii)

HIGHLIGHT

NCERT

The overall reactions using different aldehydes and ketones are as follows:

Formaldehyde → 1° alcohol

$$HCHO + RMgX \rightarrow RCH_2OMgX \xrightarrow{H_2O} RCH_2OH + Mg(OH)X$$

Other than HCHO → 2° alcohol

$$RCHO + R'MgX \longrightarrow R\text{–}\underset{\displaystyle R'}{\underset{|}{CH}}\text{–}OMgX \xrightarrow{H_2O} R\text{–}\underset{\displaystyle R'}{\underset{|}{CH}}\text{–}OH + Mg(OH)X$$

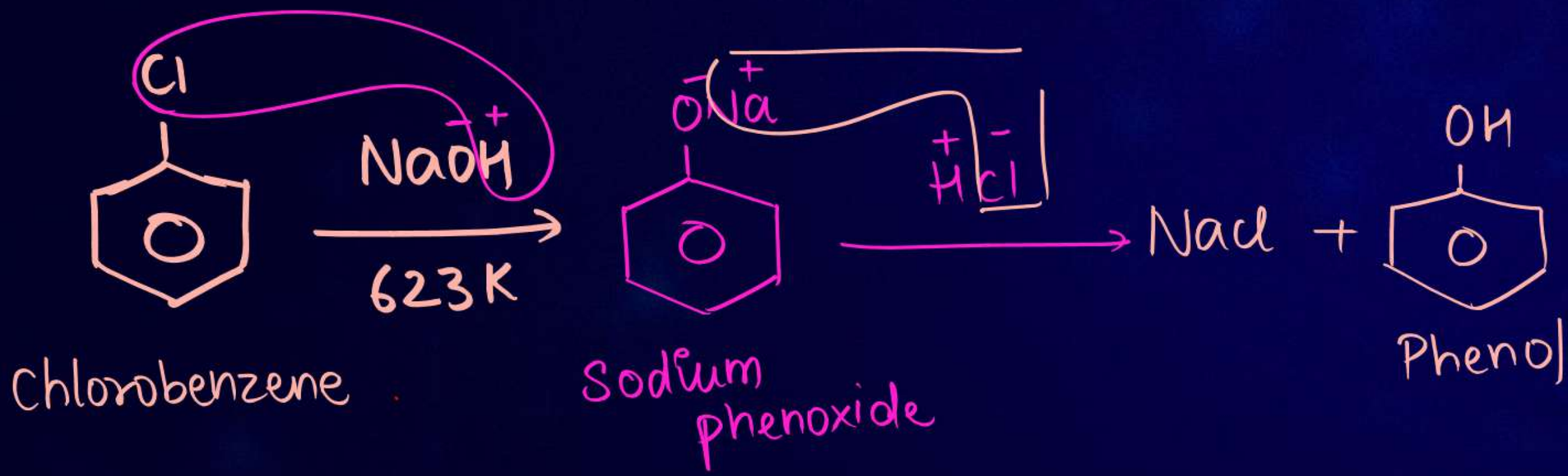
Ketone → 3° alcohol

$$RCOR + R'MgX \longrightarrow R\text{–}\underset{\displaystyle R}{\overset{\displaystyle R'}{\overset{|}{\underset{|}{C}}}}\text{–}OMgX \xrightarrow{H_2O} R\text{–}\underset{\displaystyle R}{\overset{\displaystyle R'}{\overset{|}{\underset{|}{C}}}}\text{–}OH + Mg(OH)X$$

You will notice that the reaction produces a primary alcohol with methanal, a secondary alcohol with other aldehydes and tertiary alcohol with ketones.

METHODS OF PREPARATION OF PHENOL

1. FROM HALOARENE



Chlorobenzene

Sodium phenoxide

Phenol

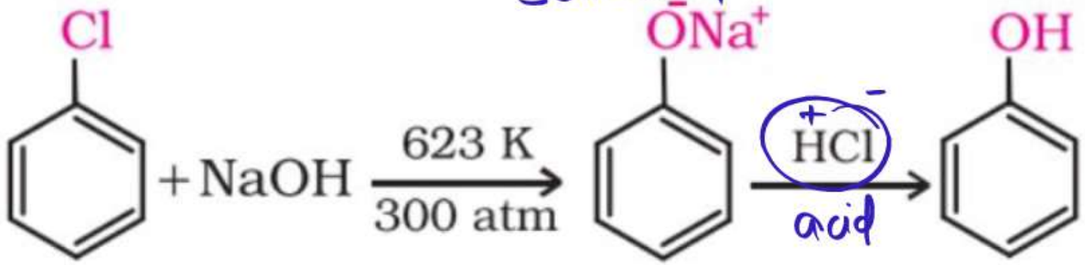
HIGHLIGHT

NCERT

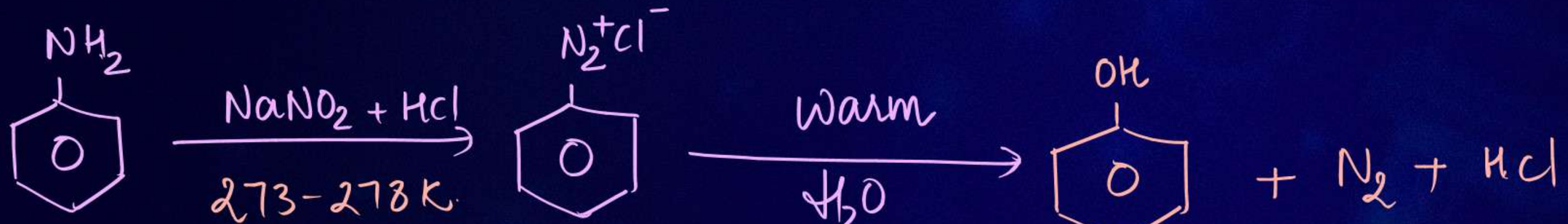
1. *From haloarenes*

Chlorobenzene is fused with NaOH at 623K and 320 atmospheric pressure. Phenol is obtained by acidification of sodium phenoxide so produced (Unit 6, Class XII).

Sodium phenoxide



2. From diazonium salt



Aniline or primary aromatic amine

benzene diazonium salt

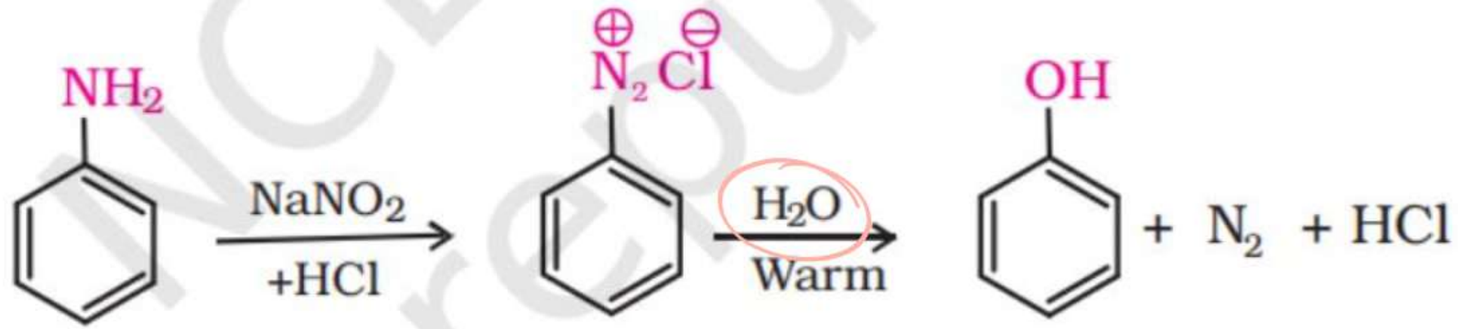
phenol

HIGHLIGHT

NCERT

3. *From diazonium salts*

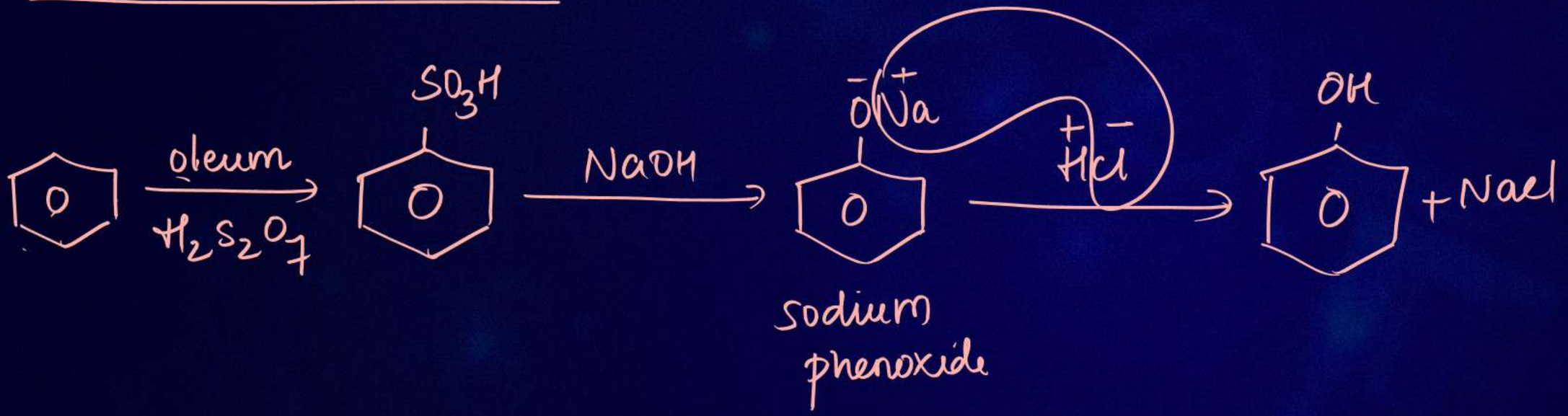
A diazonium salt is formed by treating an aromatic primary amine with nitrous acid ($NaNO_2$ + HCl) at 273-278 K. Diazonium salts are hydrolysed to phenols by warming with water or by treating with dilute acids (Unit 9, Class XII).



Aniline

Benzene diazonium chloride

3. From Benzenesulphonic Acid



NCERT CORNER

HIGHLIGHT

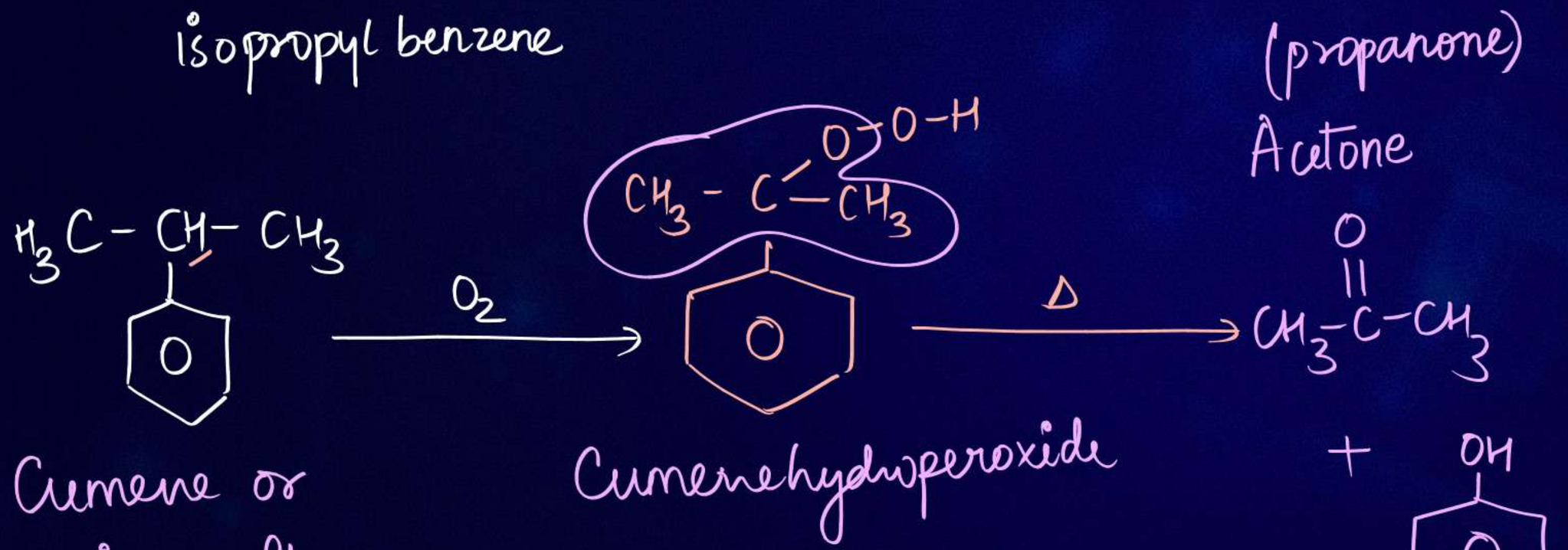
NCERT

2. *From benzenesulphonic acid*

Benzene is sulphonated with oleum and benzene sulphonic acid so formed is converted to sodium phenoxide on heating with molten sodium hydroxide. Acidification of the sodium salt gives phenol.

From Cumene

isopropyl benzene



Cumene or isopropylbenzene

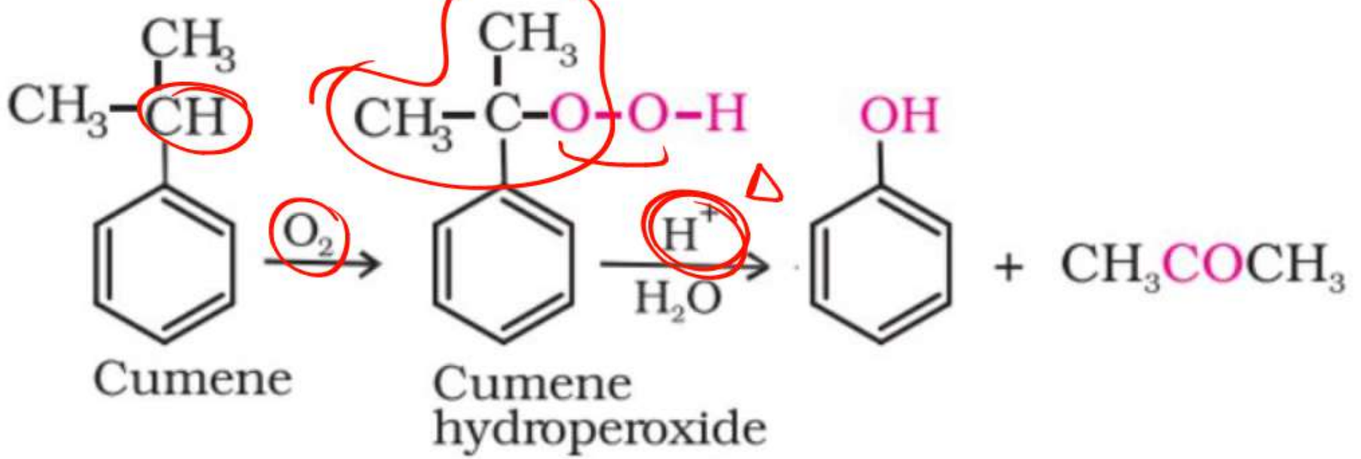
Cumenehydroperoxide

HIGHLIGHT

NCERT

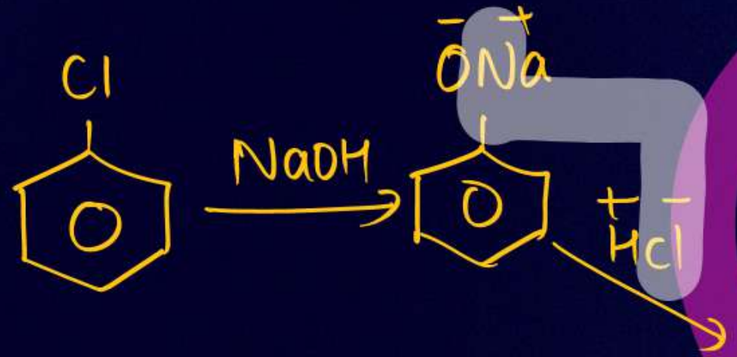
4. *From cumene*

Phenol is manufactured from the hydrocarbon, cumene. Cumene (isopropylbenzene) is oxidised in the presence of air to cumene hydroperoxide. It is converted to phenol and acetone by treating it with dilute acid. Acetone, a by-product of this reaction, is also obtained in large quantities by this method.

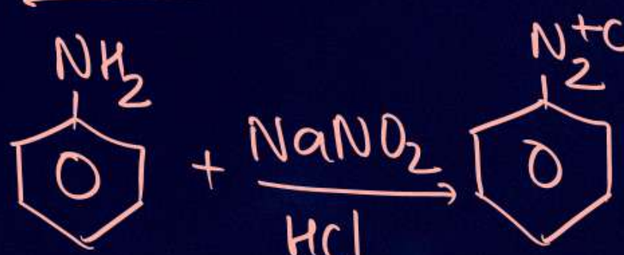


MOP OF PHENOL

1. From Haloarene

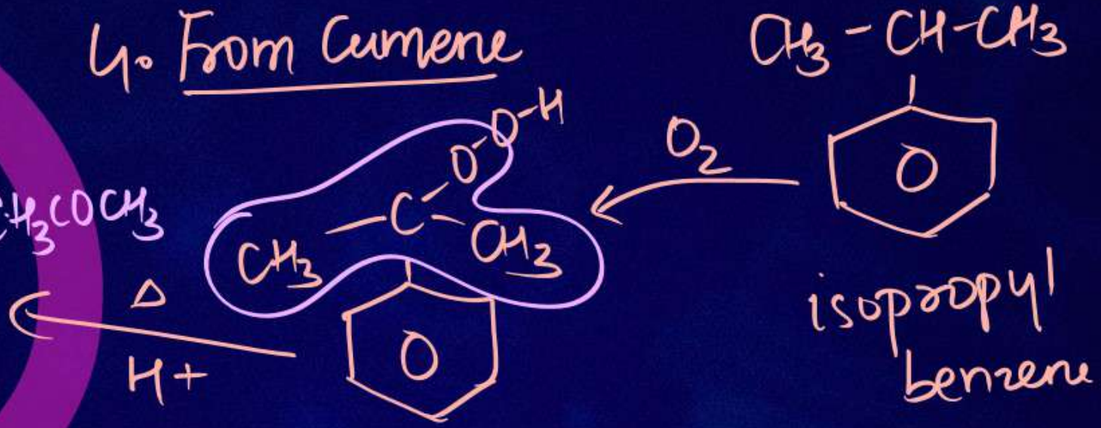


2. From Diazonium salt



3. From Benzenesulphonic acid

4. From Cumene



PHYSICAL PROPERTIES OF ALCOHOL

1. BOILING POINT ⟶ $\propto$ Molecular Mass $\propto$ Forces

$\propto \frac{1}{\text{Branching}}$

Vanderwaal forces

Order ☆

CARBOXYLIC ACID (RCOOH) > ALCOHOL (ROH) > ALDEHYDES (RCHO) / KETONE (RCOR) > ETHER (ROR) > HYDROCARBON

- CARBOXYLIC ACID ⟶ Dimer (MM ↑)
- CARBOXYLIC ACID ⟶ H-Bond
- ALCOHOL → H bond
- ALDEHYDES / KETONE → DIPOLE-DIPOLE INTERACTION
- ALDEHYDES / KETONE → INDUCED DIPOLE
- ETHER → POLAR

Q.

CH_3CH_2COOH > CH_3CH_2OH > $CH_3CH_2CH_3$

(a) (b) (c)

What is the order of Boiling point ?

Q $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH$ < $CH_3\underset{\underset{CH_2-CH_3}{|}}{CH}-OH$ < $CH_3CH_2CH_2CH_2OH$

d e f

2. Solubility

Lower Alcohols are soluble in water due to H-bond but as no of C atom increases, hydrophobic part increases hence solubility decreases.

CHEMICAL PROPERTIES OF ALCOHOL

R–O–H

Alcohol can behave as both

(O–H)

Behave as Nucleophile

- Acidity
- Esterification
- Rx with Metals

R–OH

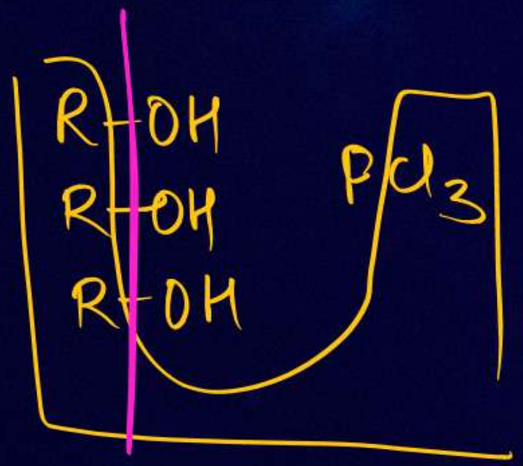
Behave as Electrophile

- Rx with HX
- Rx with PX_3, PX_5
- Rx with $SOCl_2$
- oxidation
- dehydration
- HIO_4

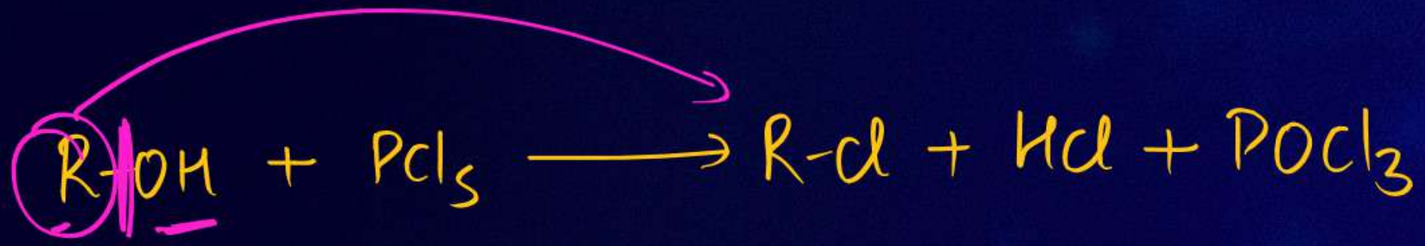
Alcohol as Electrophile

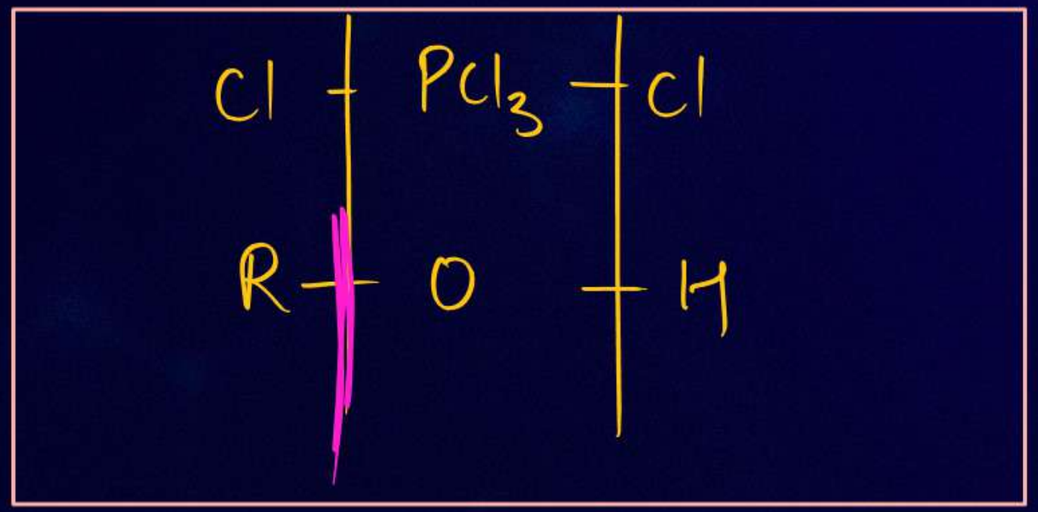
a) Rx with PX_3

$$3\,R\text{-}OH + PX_3 \longrightarrow 3RCl + H_3PO_3$$



b) Rx with PCl_5





3. Rx with $SOCl_2$

(Thionyl chloride)

$$R\text{-}OH + SOCl_2 \longrightarrow \underset{\text{pure}}{R\text{-}Cl} + SO_2 + HCl$$

Darzen's process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HOMEWORK

1. Revise
2. Complete Notes

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2026

ALCOHOL , PHENOL & ETHER

CHEMISTRY LECTURE- 6

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. METHODS OF PREPARATION OF ~~PHENOL~~ Ether

2. Physical & Chemical Properties of Ether

MY SHIMMERING STARS

#SHOURYA'SGALAXY


START

QUESTION

Q. HW

Example 7.2

Give the structures and IUPAC names of the products expected from the following reactions:

(a) Catalytic reduction of butanal.

(b) Hydration of propene in the presence of dilute sulphuric acid.

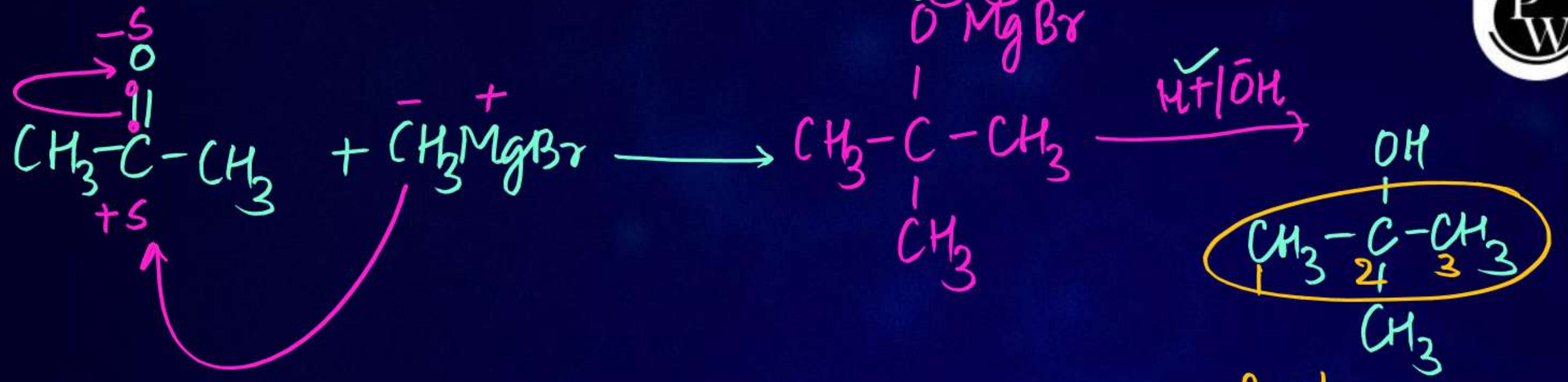
(c) Reaction of propanone with methylmagnesium bromide followed by hydrolysis.

(a) $CH_3-CH_2-CH_2-\underset{OH}{\overset{H}{C}}-H \xrightarrow[Ni|Pt|Pd]{H_2} CH_3CH_2CH_2\underset{OH}{CH_2}$ butan-1-ol

(b) $CH_3-CH=CH_2 \xrightarrow[H_2O]{H^+} CH_3-\underset{OH}{CH}-CH_3 + CH_3CH_2CH_2OH$

(H^+ adds to the CH$_2$ end; OH^- attacks the CH)

OH (Major) (Minor)

(iii) 

2-methylpropan-2-ol

+ Mg(OH)Br

NCERT CORNER

HIGHLIGHT

NCERT

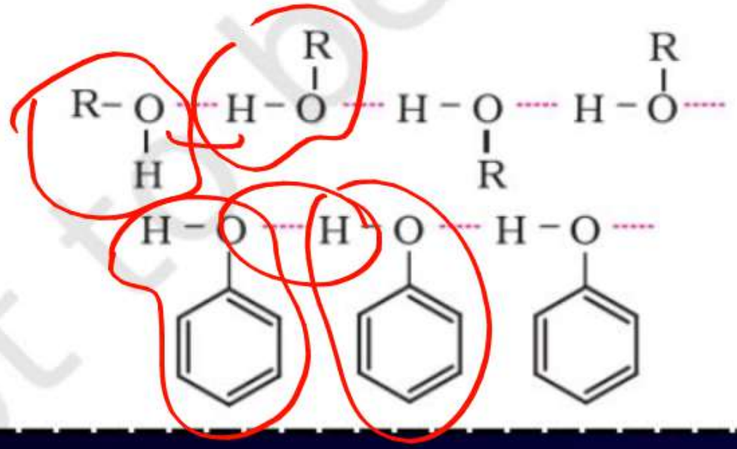
Physical Properties

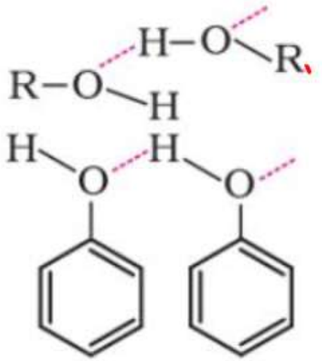
Alcohols and phenols consist of two parts, an alkyl/aryl group and a hydroxyl group. The properties of alcohols and phenols are chiefly due to the hydroxyl group. The nature of alkyl and aryl groups simply modify these properties.

Boiling Points

The boiling points of alcohols and phenols increase with increase in the number of carbon atoms (increase in van der Waals forces). In alcohols, the boiling points decrease with increase of branching in carbon chain (because of decrease in van der Waals forces with decrease in surface area).

The –OH group in alcohols and phenols is involved in intermolecular hydrogen bonding as shown below:





HIGHLIGHT

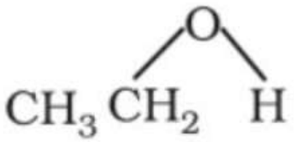
NCERT

It is interesting to note that boiling points of alcohols and phenols are higher in comparison to other classes of compounds, namely hydrocarbons, ethers, haloalkanes and haloarenes of comparable molecular masses. For example, ethanol and propane have comparable molecular masses but their boiling points differ widely. The boiling point of methoxymethane is intermediate of the two boiling points.

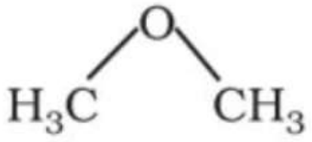
Alcohol > ether > Hydrocarbon.

HIGHLIGHT

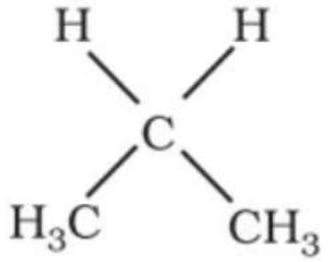
NCERT



Ethanol
Molecular mass/b.p.
46/ 351 K



Methoxymethane
Molecular mass/b.p.
46/248 K



Propane
Molecular mass/b.p.
44/231 K

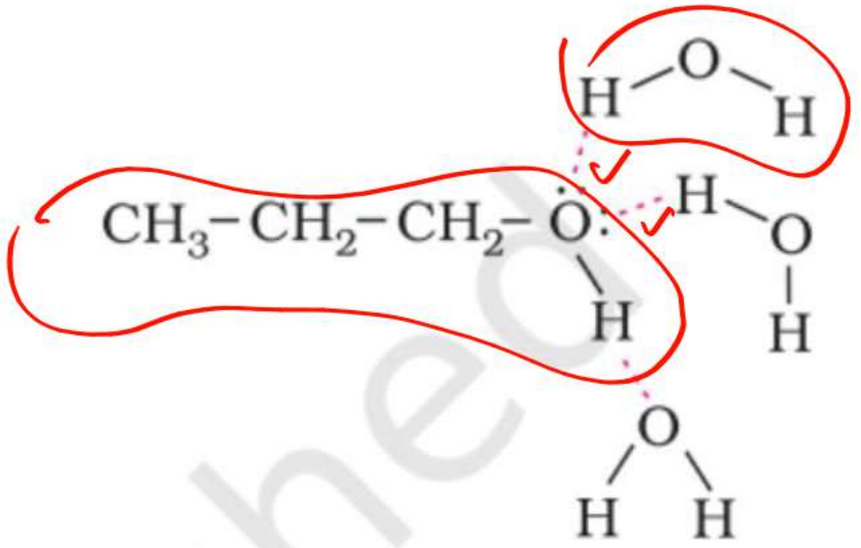
The high boiling points of alcohols are mainly due to the presence of intermolecular hydrogen bonding in them which is lacking in ethers and hydrocarbons.

HIGHLIGHT

NCERT

Solubility

Solubility of alcohols and phenols in water is due to their ability to form hydrogen bonds with water molecules as shown. The solubility decreases with increase in size of alkyl/aryl (hydrophobic) groups. Several of the lower molecular mass alcohols are miscible with water in all proportions.



HIGHLIGHT

NCERT

(a) C-C-C-C-C-OH (A) C-C-OH (D)

C-C-C-C-OH (B) C-C-C-OH (E)

C-C-C-C (C) C-OH (F)

OH

F < D < E < C < B < A

Example 7.3 Arrange the following sets of compounds in order of their increasing boiling points:

A B C D E F

(a) Pentan-1-ol, butan-1-ol, butan-2-ol, ethanol, propan-1-ol, methanol.

(b) Pentan-1-ol, n-butane, pentanal, ethoxyethane.

G H I J

Solution (a) Methanol, ethanol, propan-1-ol, butan-2-ol, butan-1-ol, pentan-1-ol.

(b) n-Butane, ethoxyethane, pentanal and pentan-1-ol.

(b) C-C-C-C-C-OH (G) C-C-C-C (H) C-C-C-C-CHO (I) C-C-O-C-C (J)

H < J < I < G

CHEMICAL PROPERTIES OF ALCOHOL

Alcohol behaves as

Nucleophile ($R-O\overset{}{\underset{}{}}H$)

Electrophile ($R\overset{}{\underset{}{}}OH$)

- ✓ PCl_3
- ✓ PCl_5
- ✓ $SOCl_2$

NCERT CORNER

HIGHLIGHT

7.4.4 Chemical Reactions

Alcohols are versatile compounds. They react both as nucleophiles and electrophiles. The bond between O–H is broken when alcohols react as nucleophiles.

Alcohols as nucleophiles

(i) $R-\ddot{O}-H + \overset{+}{C}- \longrightarrow R-\overset{+}{\underset{\cdot\cdot}{O}}(H)-C- \longrightarrow R-O-C- + H^+$

nucleus loving (+)
Nu⁻

(ii) The bond between C–O is broken when they react as electrophiles. Protonated alcohols react in this manner.

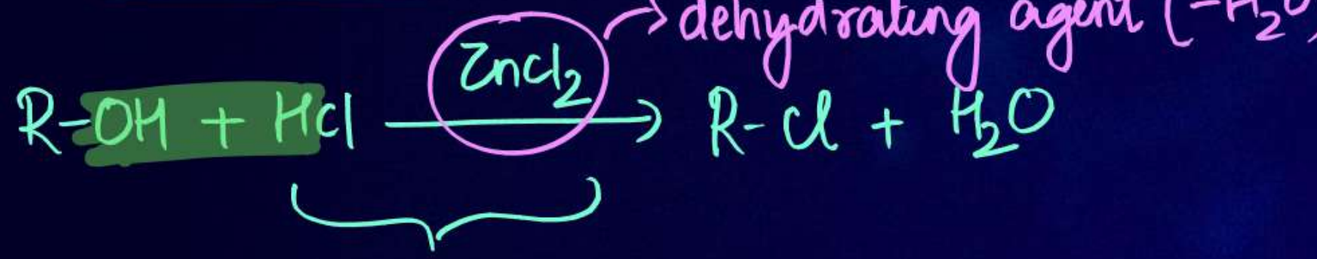
Protonated alcohols as electrophiles

$R-CH_2-\ddot{O}H + \overset{+}{H} \rightarrow R-CH_2-\overset{+}{O}H_2$

$Br^- + CH_2(R)-\overset{+}{O}H_2 \longrightarrow Br-CH_2(R) + H_2O$

Based on the cleavage of O–H and C–O bonds, the reactions of alcohols and phenols may be divided into two groups:

(4) Reaction with HX (Hydrogen Halide)



Lucas Test → Distinction test for 1° (primary), 2° (Secondary), 3° (Tertiary) Alcohols.

- 3° alcohols ⟶ Immediate Turbidity
- 2° ⟶ 5-10 min
- 1° ⟶ room temp X

(5) Dehydration

Removal of water occurs in the presence of protic Acid ex. H_2SO_4, H_3PO_4 etc it will form alkene.

Alkene

$$C_2H_5OH \xrightarrow[443\,K]{H_2SO_4} CH_2=CH_2 + H_2O$$

H_3C-CH_2-OH

$$\xrightarrow[413\,K]{H_2SO_4} \text{Ether } (CH_3CH_2OCH_2CH_3)$$

$CH_3CH_2OH \quad HOCH_2CH_3$

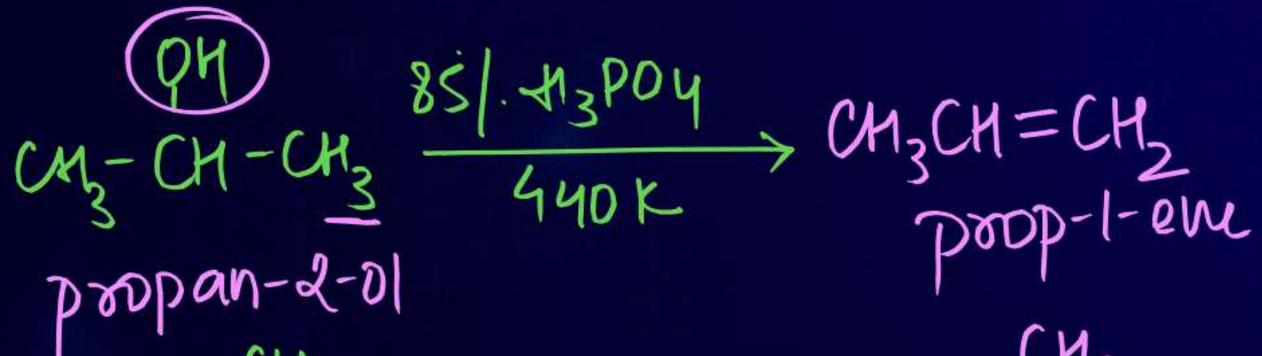
1° alcohol

$$C_2H_5OH \xrightarrow[443K]{H_2SO_4} CH_2=CH_2$$

ethene

2° & 3° alcohol

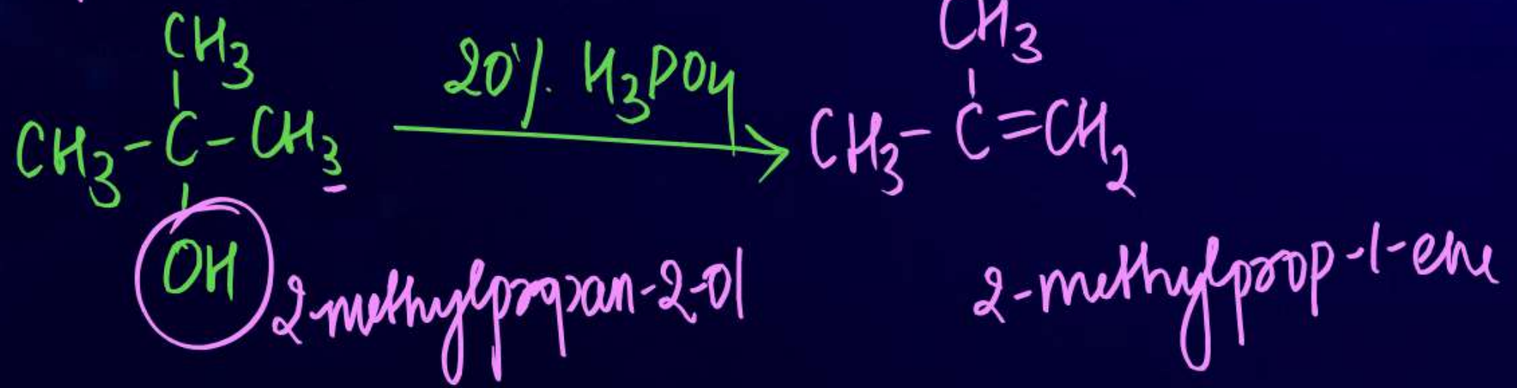
→ Mild conditions



propan-2-ol

$CH_3CH=CH_2$

prop-1-ene

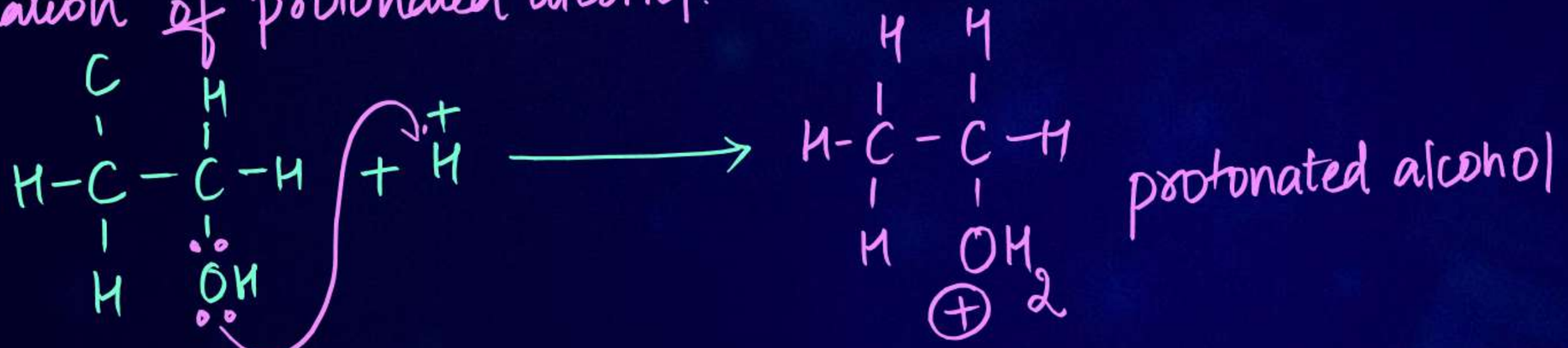


2-methylpropan-2-ol

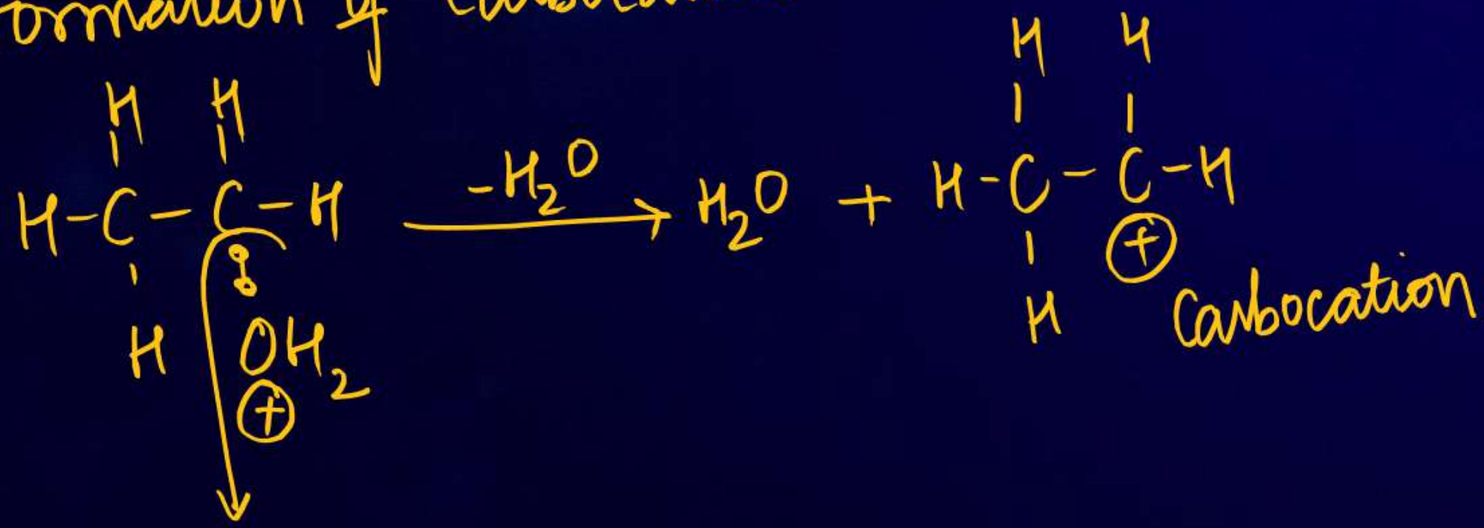
2-methylprop-1-ene

Mechanism of dehydration

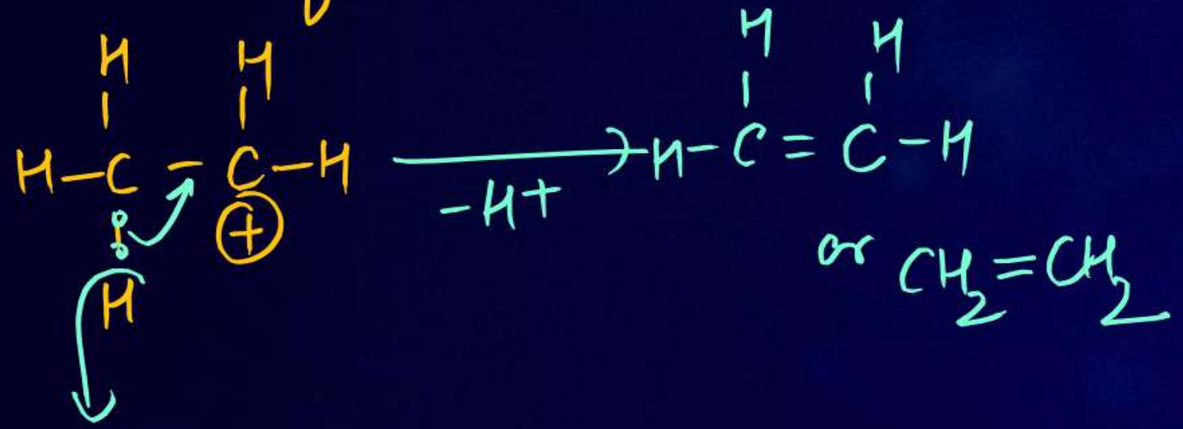
1. Formation of protonated alcohol.



2. Formation of Carbocation.



3. Formation of Alkene



or $CH_2=CH_2$

(6) OXIDATION

1° alcohol $K_2Cr_2O_7$ or $KMnO_4$

$RCH_2OH \longrightarrow RCHO \longrightarrow RCOOH$

CrO_3

PCC (good yield)

Pyridinium chlorochromate

1° alcohol → Aldehyde or RCOOH

2° alcohol → Ketone ★

ex. $CH_3CH_2CH_2OH$ (RCH_2OH) — PCC → $RCHO$ (CH_3CH_2CHO)

ex. $CH_3CH_2CH_2CH_2OH$ (RCH_2OH) — $K_2Cr_2O_7$ → $RCOOH$ ($CH_3CH_2CH_2COOH$)

via $CH_3CH_2CH_2CHO$

(7) oxidation

$RCH_2OH \xrightarrow[573K \text{ or } 300^\circ C]{Cu}$ Aldehyde

1° alcohol

$R-\underset{\underset{R}{|}}{CH}-OH \xrightarrow[573K \text{ or } 300^\circ C]{Cu}$ Ketone

2° alcohol

$R-\underset{\underset{R}{|}}{\overset{\overset{R}{|}}{C}}-OH \xrightarrow[573K \text{ or } 300^\circ C]{Cu}$ Alkene

3° alcohol

ex. $CH_3CH_2OH \xrightarrow[300^\circ C]{Cu} RCHO$ (CH_3CHO)

RCH_2OH

ex. $CH_3-\underset{\underset{CH_3}{|}}{CH}-OH \xrightarrow[Cu]{300^\circ C} R-\overset{\overset{O}{||}}{C}-R$

$CH_3-\overset{\overset{O}{||}}{C}-CH_3$

ex. $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH \xrightarrow[300^\circ C]{Cu} CH_3-\overset{\overset{CH_3}{|}}{C}=CH_2$

ALCOHOL AS NUCLEOPHILE

→ Bond Breakage of R-O-H

- ✓ Rx with Metals
- ✓ Esterification
- ✓ Acidity

* Rx with Metals

$R-\bar{O}\overset{+}{H} + \overset{+}{N}a \longrightarrow R-\bar{O}\overset{+}{N}a + H_2$ (sodium alkoxide)

$R-\bar{O}\overset{+}{H} + \overset{+}{N}a\bar{O}H \longrightarrow R-\bar{O}\overset{+}{N}a + H_2O$] X

Is this Rx possible?
NaOH = SB (strong base)
X

Can phenol React ?

+ Na →

+ H_2

↳ sodium phenoxide

HIGHLIGHT

NCERT

(a) Reactions involving cleavage of O–H bond

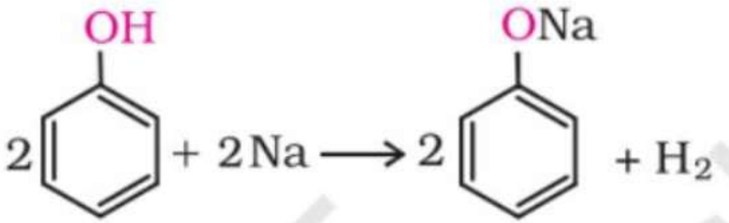
1. *Acidity of alcohols and phenols*

(i) *Reaction with metals*: Alcohols and phenols react with active metals such as sodium, potassium and aluminium to yield corresponding alkoxides/phenoxides and hydrogen.

$$2R{-}O{-}H + 2Na \longrightarrow \underset{\text{Sodium alkoxide}}{2R{-}O{-}Na} + H_2$$

$$6\,CH_3{-}\overset{\displaystyle CH_3}{\underset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}{-}OH + 2Al \longrightarrow 2\left(CH_3{-}\overset{\displaystyle CH_3}{\underset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}{-}O\right)_3Al + 3H_2$$

tert- Butyl alcohol — Aluminium *tert*- butoxide

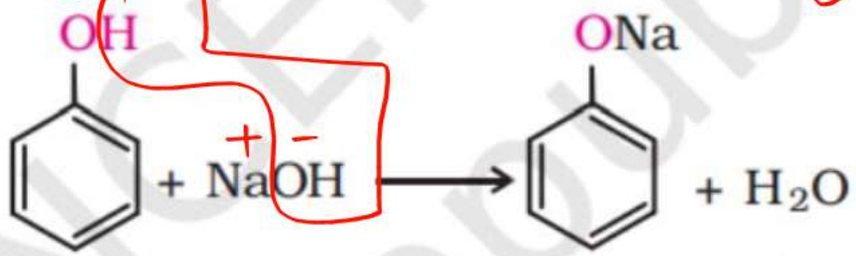


Phenol — Sodium phenoxide

HIGHLIGHT

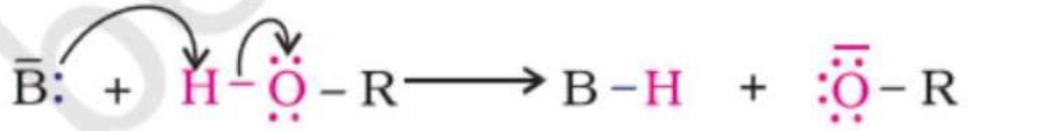
NCERT

In addition to this, phenols react with aqueous sodium hydroxide to form sodium phenoxides.



Sodium phenoxide

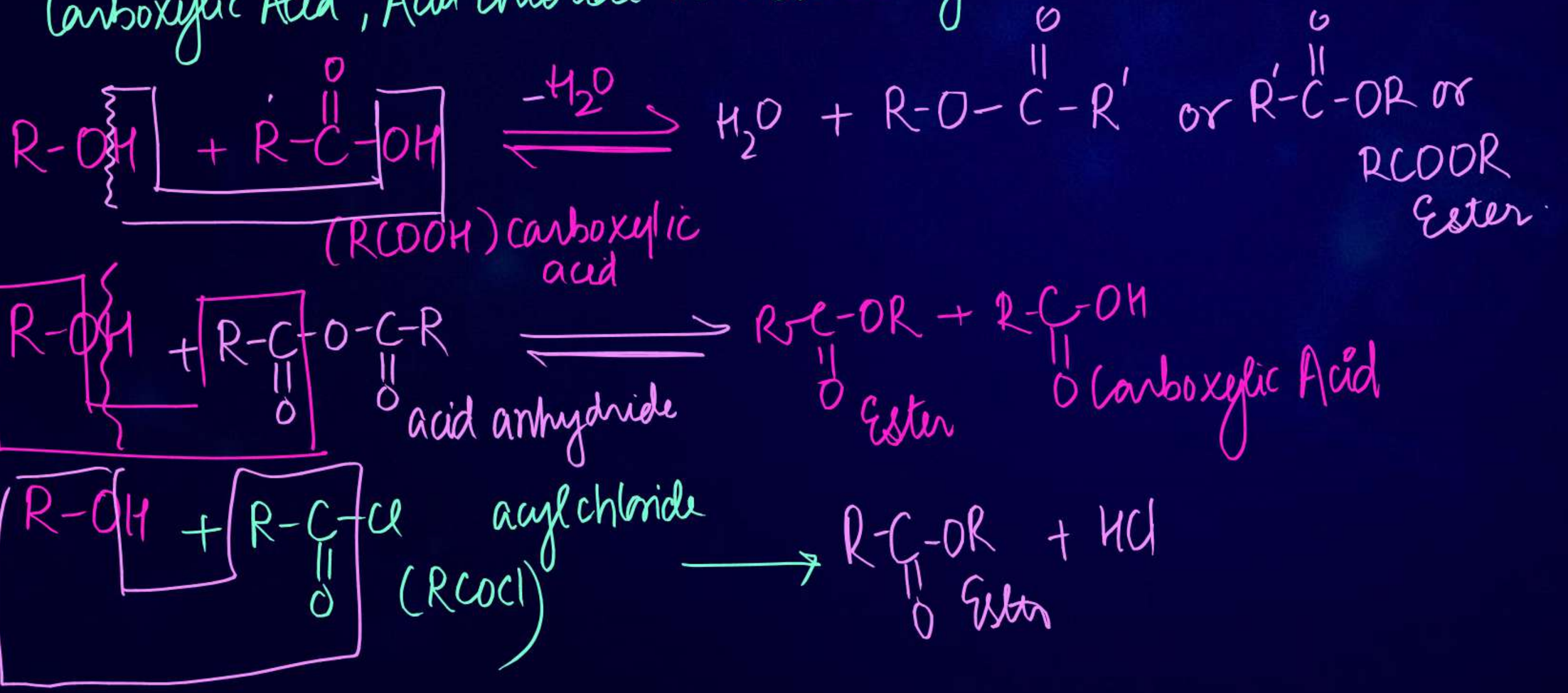
The above reactions show that alcohols and phenols are acidic in nature. In fact, alcohols and phenols are Brönsted acids i.e., they can donate a proton to a stronger base (B:).

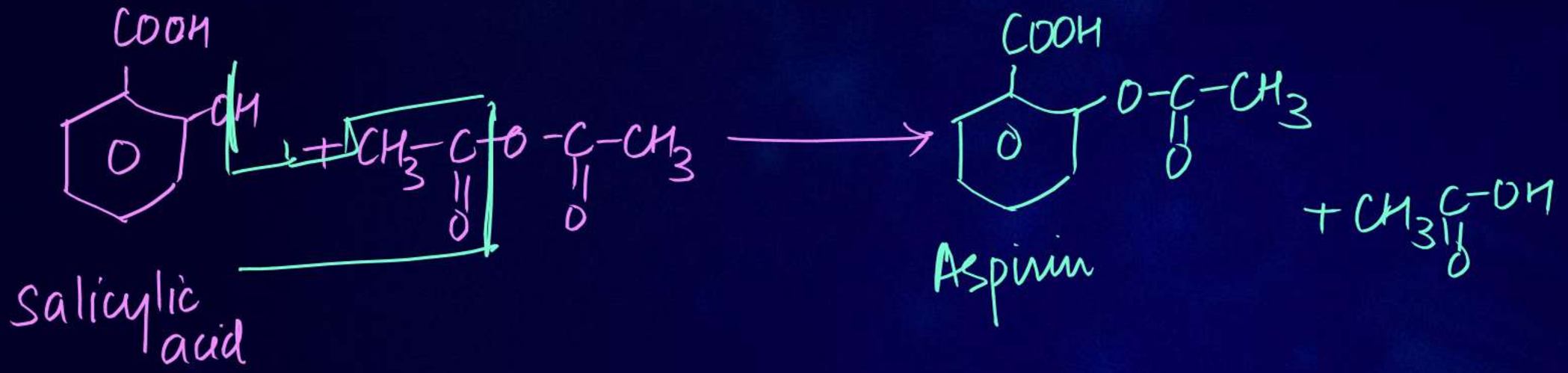


Base Acid Conjugate acid Conjugate base

(2) Esterification

Formation of Ester occurs when alcohol Reacts with Carboxylic Acid, Acid chloride or acid anhydride.




COOH
OH
O
+ CH3–C(=O)–O–C(=O)–CH3
Salicylic acid
COOH
O–C(=O)–CH3
O
Aspirin
+ CH3C(=O)–OH

(3) Acidity

Acid $\longrightarrow$ donate H^+

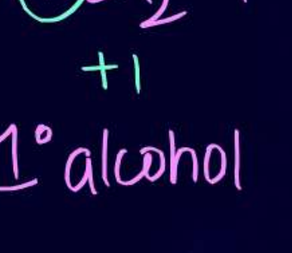
$+I \Rightarrow$ Carbon group (R).

$$R\text{-}OH \xrightarrow{-H^+} H^+ + RO^{\ominus}$$

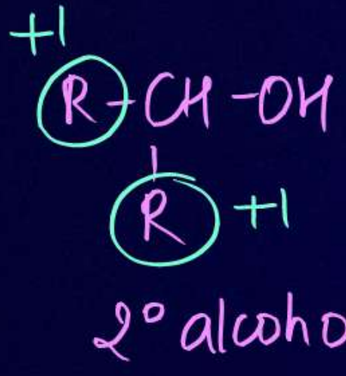
anion ✓

$$\text{Acidity} \propto \frac{\text{stability of anion} \propto -I \propto -M}{+I \propto M}$$

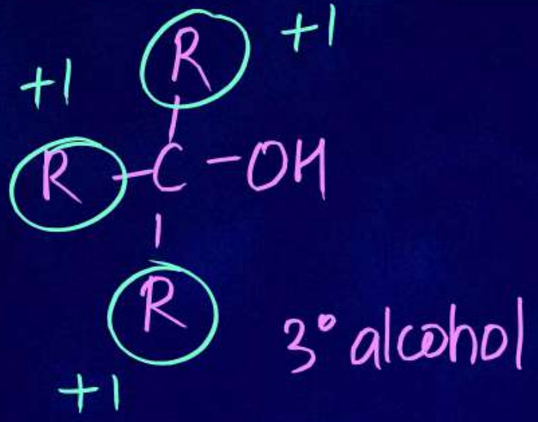
Que. what is the order of acidity in 1°, 2°, 3° alcohol



1° alcohol



2° alcohol



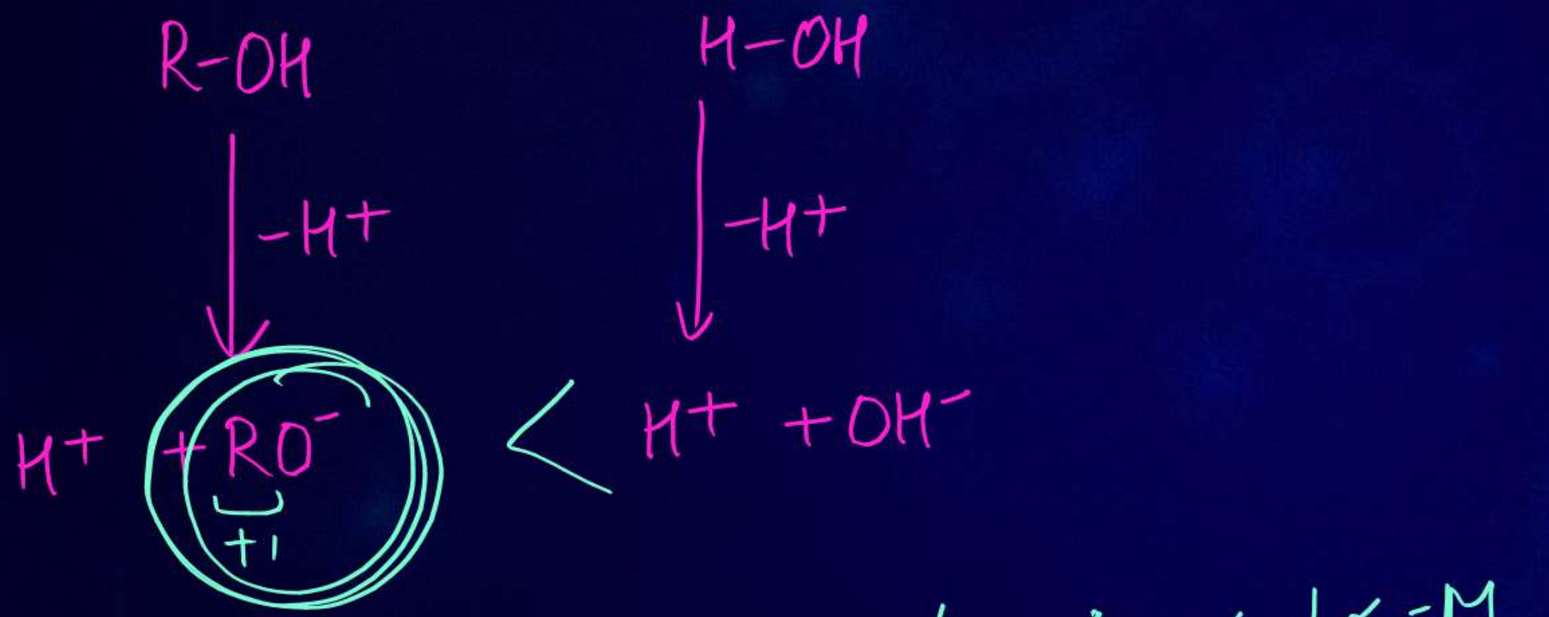
3° alcohol

Acidity $\propto -I \propto -M$ / $\propto +I \propto +M$

$1° > 2° > 3°$

Most Imp

Que. Which is more acidic :- Alcohol or H_2O.

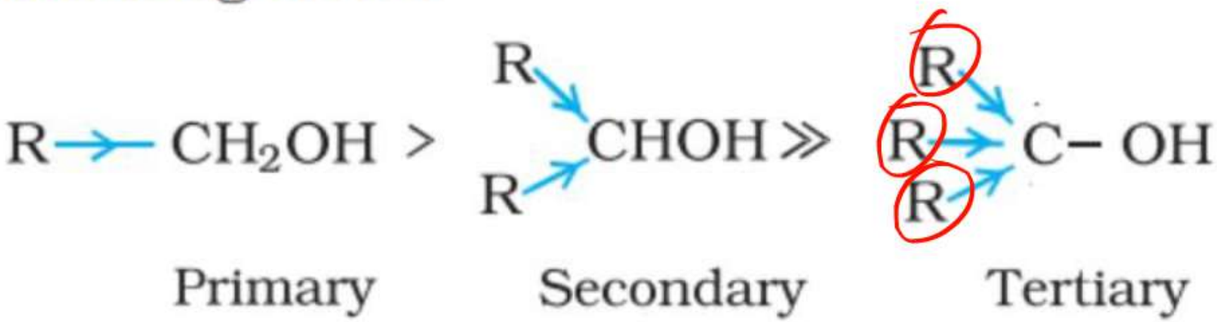


Acidity $\propto$ Stability of anion $\propto \frac{-I \propto -M}{+I \propto +M}$

HIGHLIGHT

NCERT

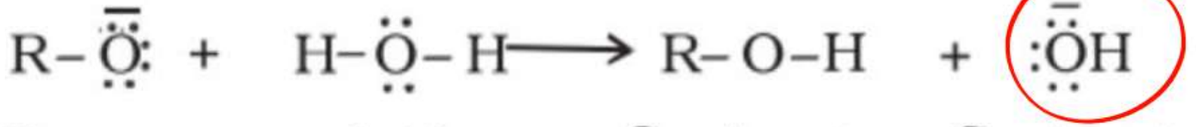
(ii) Acidity of alcohols: The acidic character of alcohols is due to the polar nature of O–H bond. An electron-releasing group ($-CH_3$, $-C_2H_5$) increases electron density on oxygen tending to decrease the polarity of O-H bond. This decreases the acid strength. For this reason, the acid strength of alcohols decreases in the following order:



HIGHLIGHT

NCERT

Alcohols are, however, weaker acids than water. This can be illustrated by the reaction of water with an alkoxide.



Base	Acid	Conjugate acid	Conjugate base

This reaction shows that water is a better proton donor (i.e., stronger acid) than alcohol. Also, in the above reaction, we note that an alkoxide ion is a better proton acceptor than hydroxide ion, which suggests that alkoxides are stronger bases (sodium ethoxide is a stronger base than sodium hydroxide).

Alcohols act as Bronsted bases as well. It is due to the presence of unshared electron pairs on oxygen, which makes them proton acceptors.

Chemical property

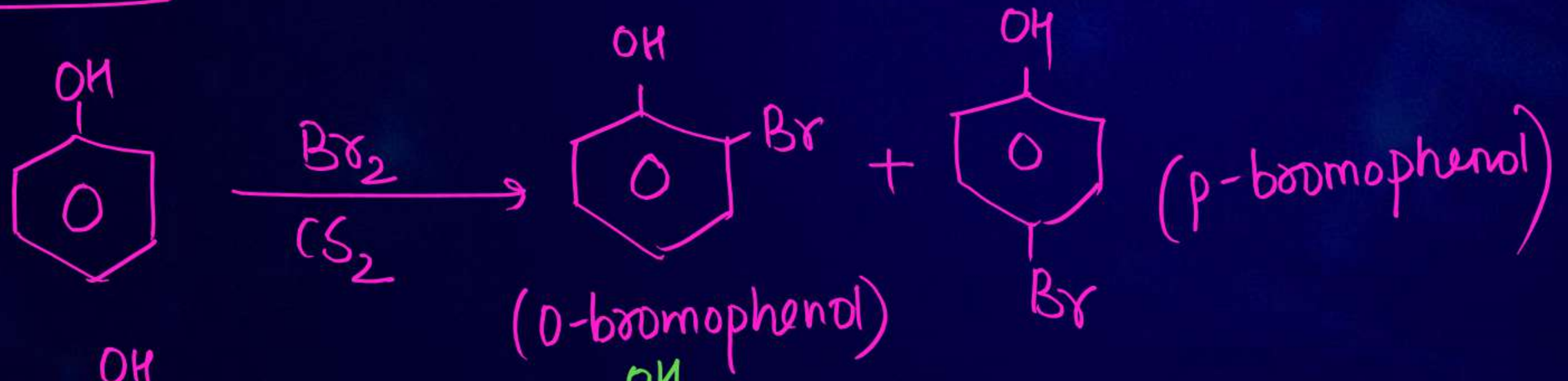
R-OH

HW

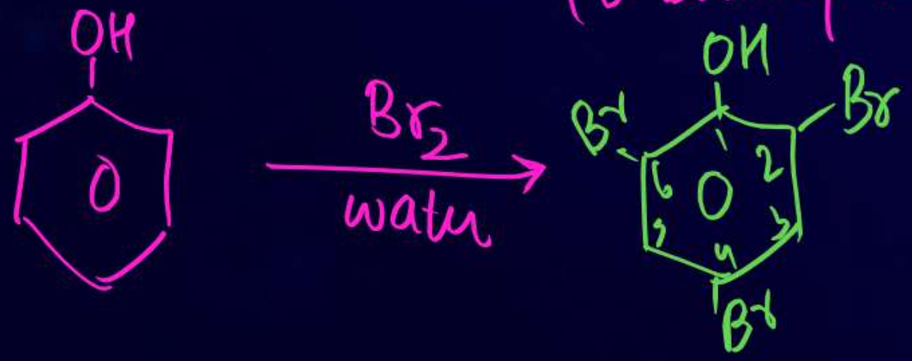
CHEMICAL PROPERTIES OF PHENOL

It undergoes electrophilic substitution Rx.

1. Halogenation

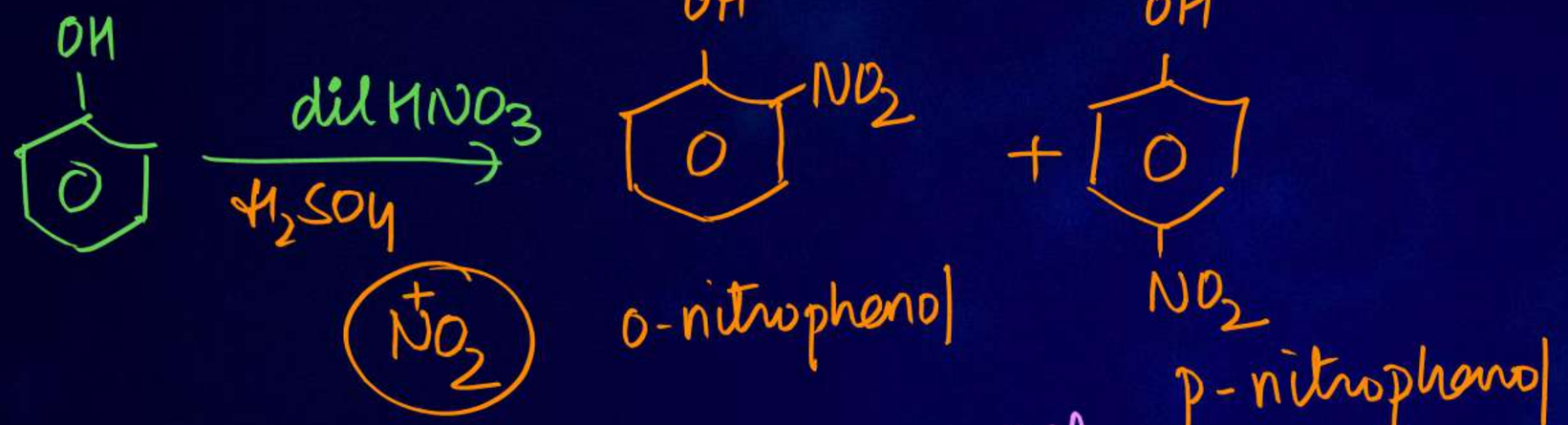


★



white ppt 2,4,6-tribromophenol

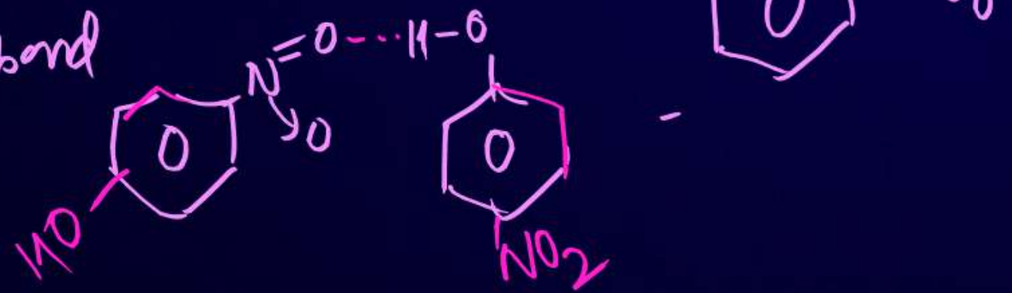
② Nitration

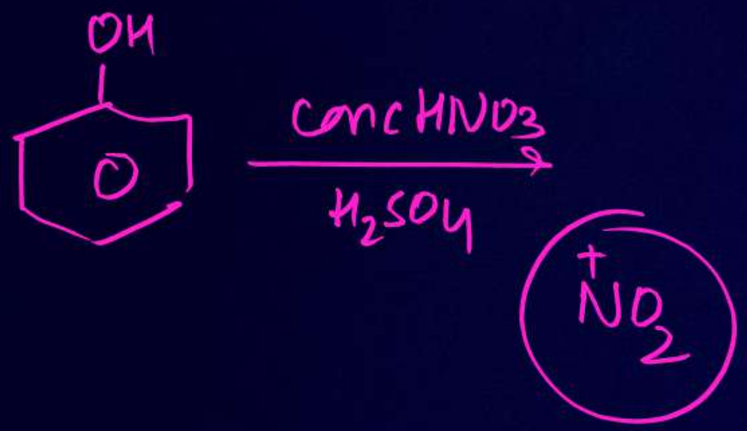


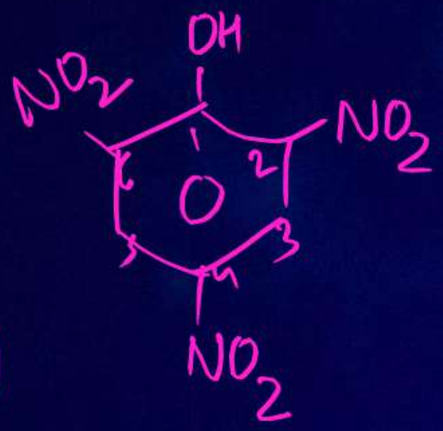
o-nitrophenol & p-nitrophenol can be separated by steam distillation

o-nitrophenol → More steam volatile → intramolecular H-bond

p → less steam volatile
intermolecular H bond





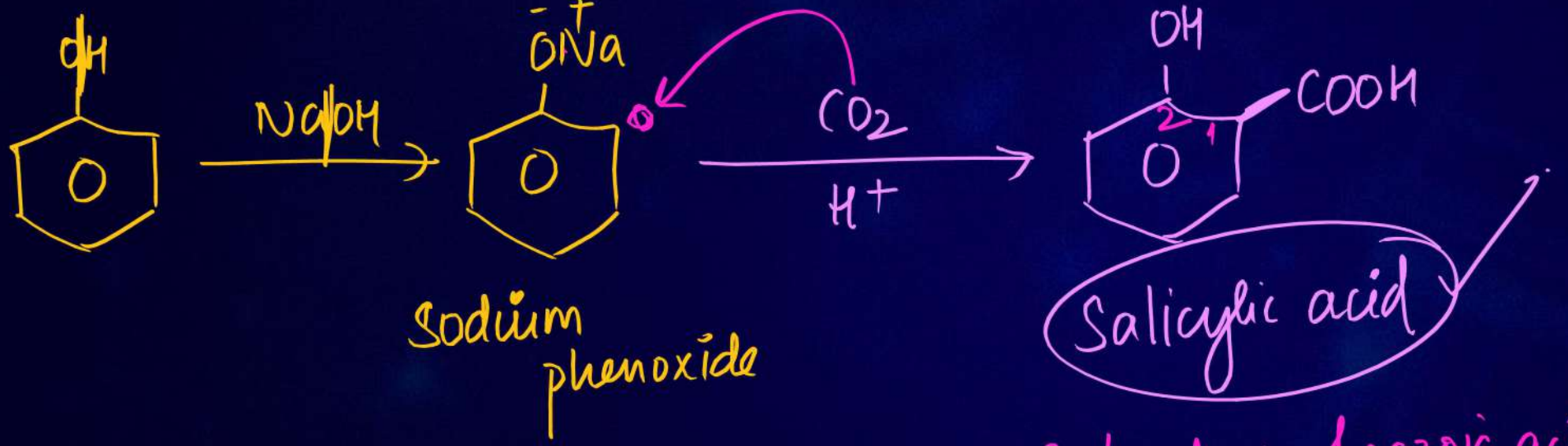


(PICRIC ACID)

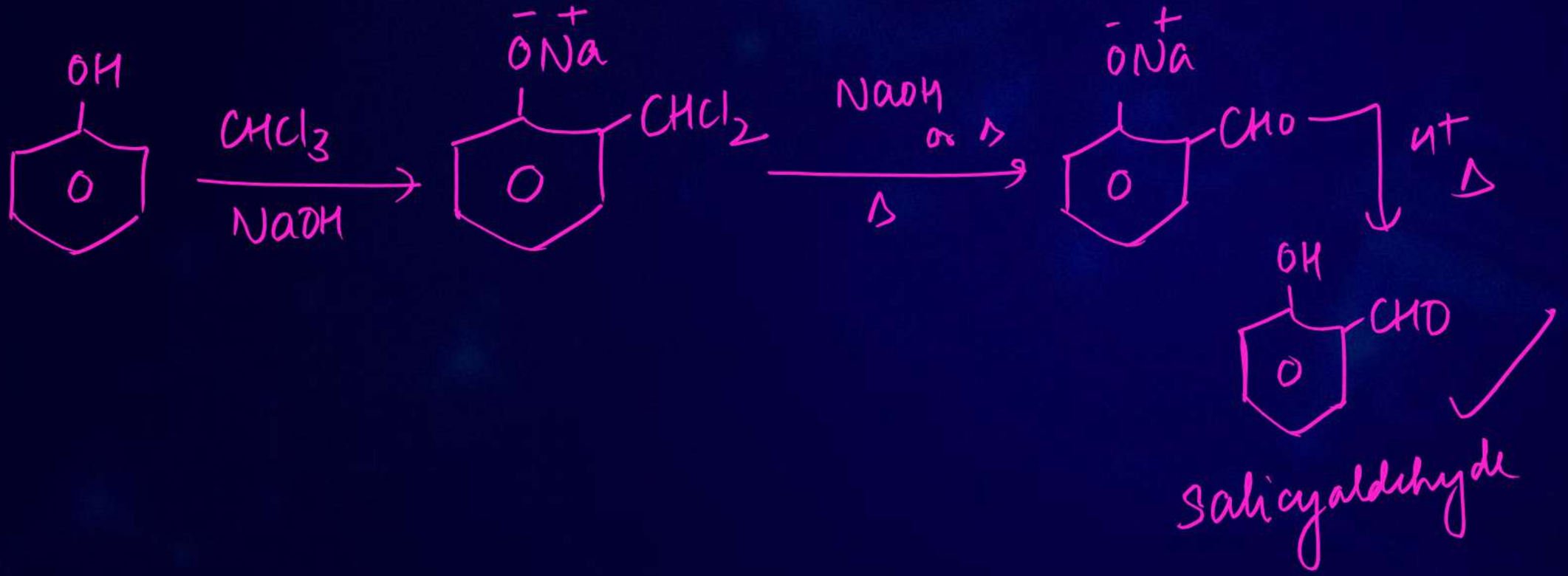
or

2,4,6- trinitrophenol

(3) KOLBE RX


OH
NaOH
$\bar{O}\overset{+}{N}a$
CO_2
H^+
OH
COOH
Sodium phenoxide
Salicylic acid
2-hydroxybenzoic acid

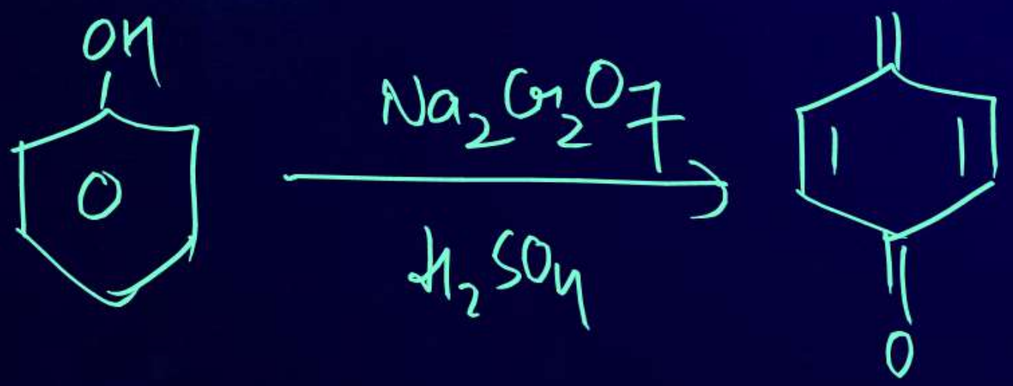
(4) REIMER – TIEMENN RX



(5) Rx with Zinc dust

benzene

(6) Oxidation



diketone or benzoquinone

HIGHLIGHT

7.5 Some Commercially Important Alcohols

Methanol and ethanol are among the two commercially important alcohols.

1. Methanol

Methanol, CH_3OH, also known as 'wood spirit', was produced by destructive distillation of wood. Today, most of the methanol is produced by catalytic hydrogenation of carbon monoxide at high pressure and temperature and in the presence of $ZnO - Cr_2O_3$ catalyst.

$$CO + 2H_2 \xrightarrow[200\text{-}300\ atm,\ 573\text{-}673\ K]{ZnO\text{-}Cr_2O_3} CH_3OH$$

Methanol is a colourless liquid and boils at 337 K. It is highly poisonous in nature. Ingestion of even small quantities of methanol can cause blindness and large quantities causes even death. Methanol is used as a solvent in paints, varnishes and chiefly for making formaldehyde.

HIGHLIGHT

2. Ethanol

Ethanol, C_2H_5OH, is obtained commercially by fermentation, the oldest method is from sugars. The sugar in molasses, sugarcane or fruits such as grapes is converted to glucose and fructose, (both of which have the formula $C_6H_{12}O_6$), in the presence of an enzyme, invertase. Glucose and fructose undergo fermentation in the presence of another enzyme, zymase, which is found in yeast.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Invertase}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

$$C_6H_{12}O_6 \xrightarrow{\text{Zymase}} 2C_2H_5OH + 2CO_2$$

In wine making, grapes are the source of sugars and yeast. As grapes ripen, the quantity of sugar increases and yeast grows on the outer skin. When grapes are crushed, sugar and the enzyme come in contact and fermentation starts. Fermentation takes place in anaerobic conditions i.e. in absence of air. Carbon dioxide is released during fermentation.

HIGHLIGHT

The action of zymase is inhibited once the percentage of alcohol formed exceeds 14 percent. If air gets into fermentation mixture, the oxygen of air oxidises ethanol to ethanoic acid which in turn destroys the taste of alcoholic drinks.

Ethanol is a colourless liquid with boiling point 351 K. It is used as a solvent in paint industry and in the preparation of a number of carbon compounds. The commercial alcohol is made unfit for drinking by mixing in it some copper sulphate (to give it a colour) and pyridine (a foul smelling liquid). It is known as **denaturation** of alcohol.

ETHER

MOP

1. Dehydration of Alcohol

$C_2H_5OH \xrightarrow[443K]{H_2SO_4}$ Alkene

$\xrightarrow[413K]{H_2SO_4}$ Ether

$C_2H_5OH \quad HOC_2H_5$

$\downarrow$

$C_2H_5-O-C_2H_5$

(2) Williamson synthesis

$+ R-X \longrightarrow$

$R-\bar{O}\overset{+}{N}a + \overset{+}{R}\bar{X} \longrightarrow NaX + R-O-R$

Ether

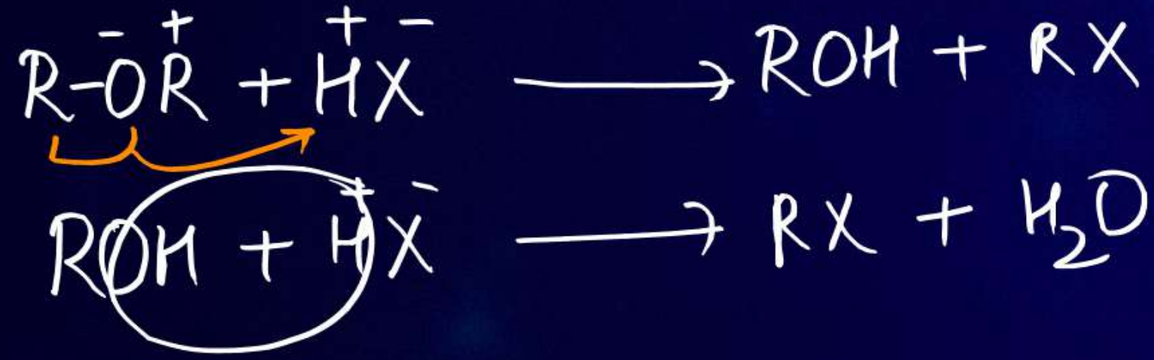
It follows SN_2 Rx. That's why 1° primary halide undergo, if 2° or 3° R-X is taken, alkene is formed. (elimination)

$R-\bar{O}-\dot{R}$

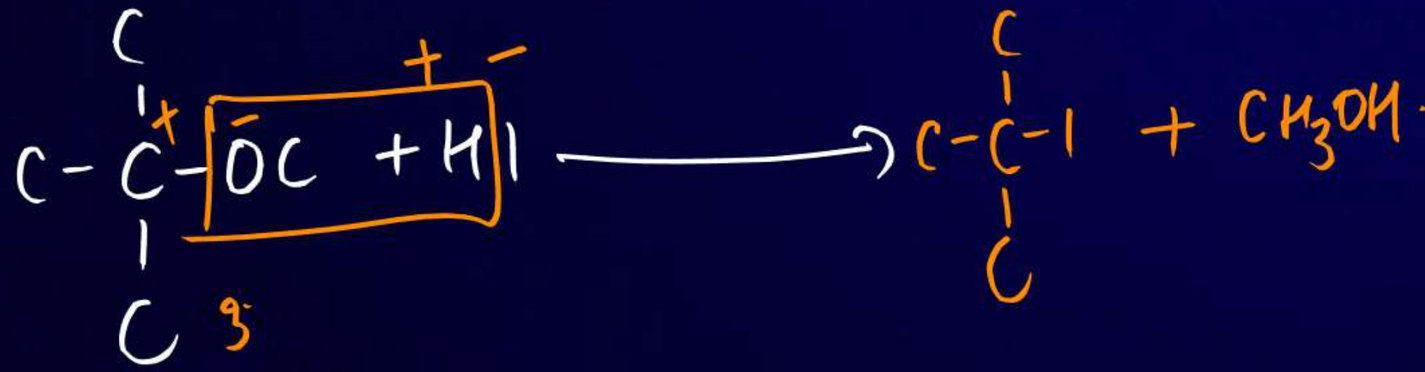
poles :- EN diff

CHEMICAL PROPERTIES OF ETHER.

1. Rx with HX

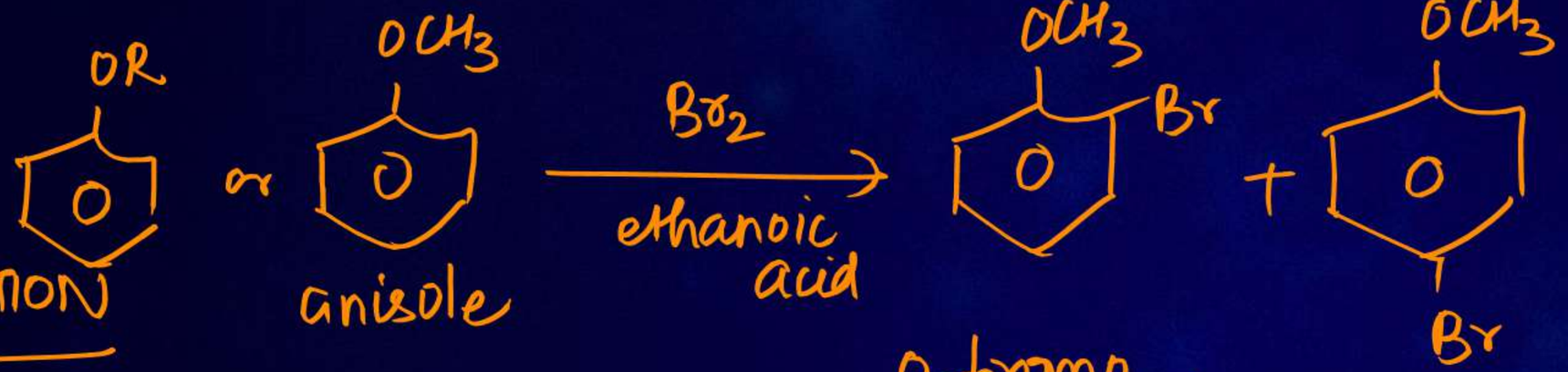


Ex.

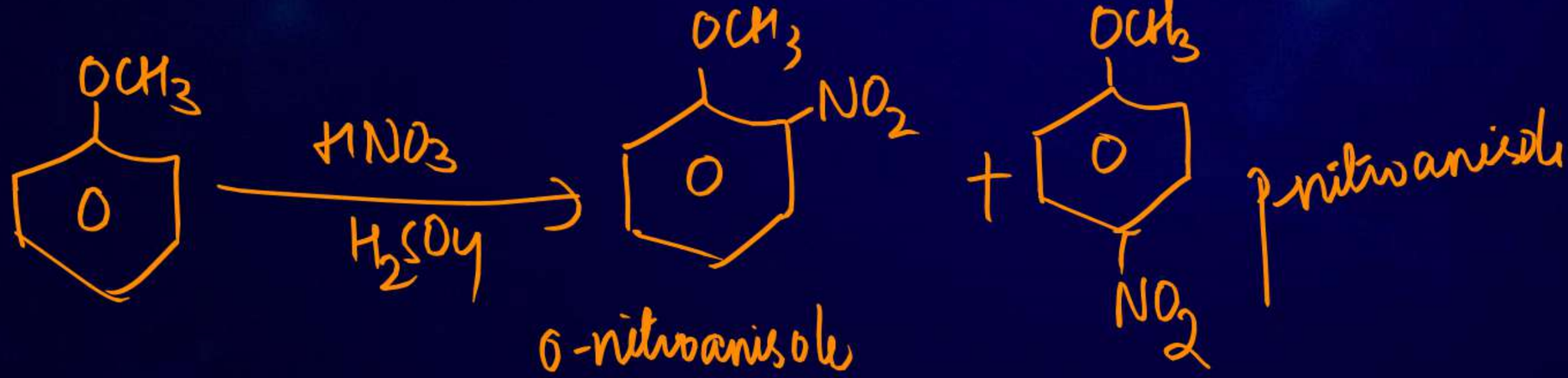


2. Halogenation

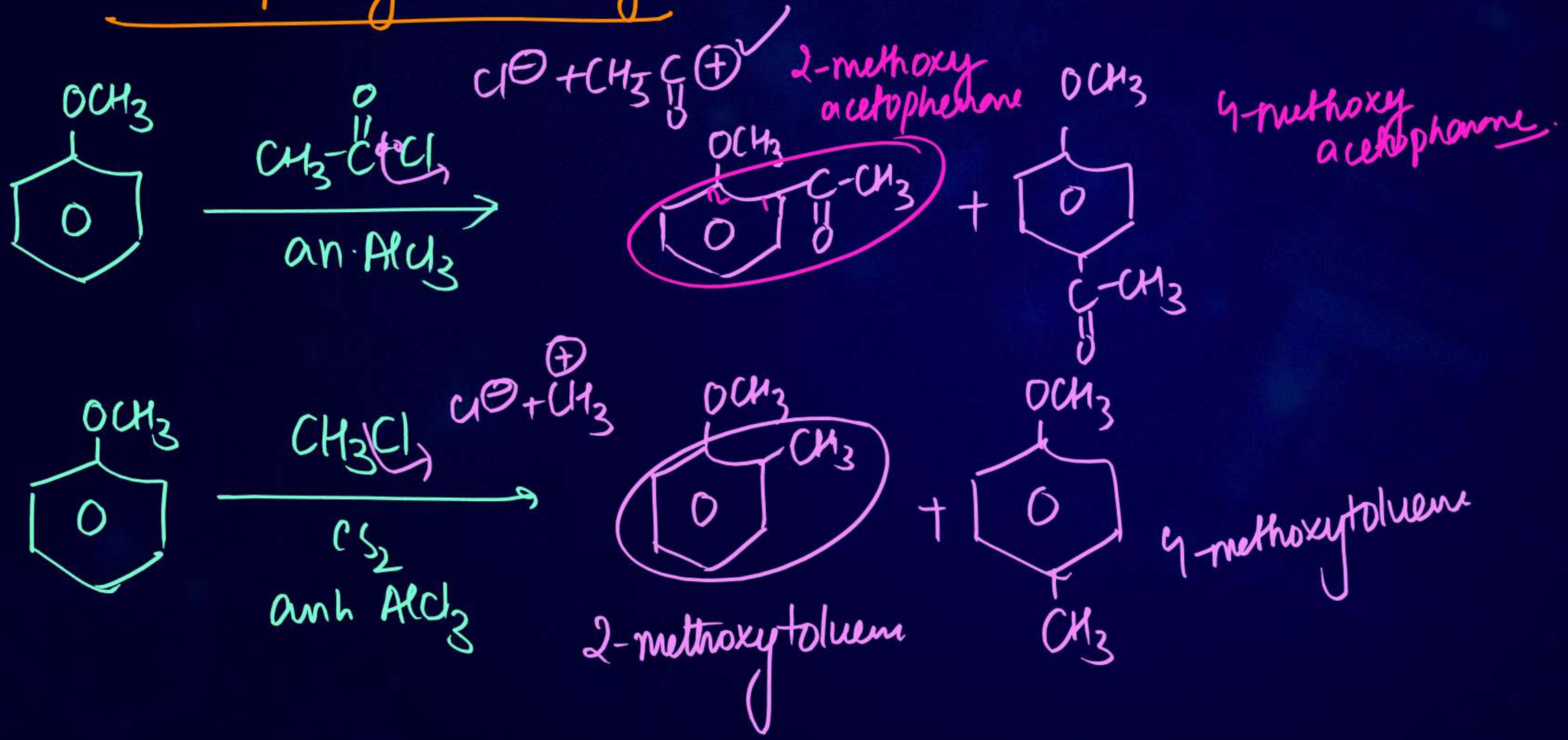
BROMINATION



NITRATION



3. Friedel craft- alkylation & acylation



C·P of Phenol

&

Ether


SHOURYA MAM
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@CHEMISTRYBY
SHOURYAMAM

HOMEWORK

1. Revise Notes
2. Complete notes

PARISHRAM

2026

ALCOHOL , PHENOL & ETHER

CHEMISTRY LECTURE-07

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. **PROPERTIES OF ALCOHOL**
   Chemical Properties
2. **QUESTIONS** Practice

MY SHIMMERING STARS

#SHOURYA'SGALAXY


START

PHYSICAL PROPERTIES

NCERT COVERAGE

PHYSICAL PROPERTY

Alcohol $\longrightarrow$ R-OH

Phenol $\longrightarrow$ Ar-OH or 

} Both of them contains 'OH'-hydroxyl group.

↓

All properties exist because of OH group.

1. Boiling Point →

Boiling point is directly dependent on Molecular Mass i.e. More the no of Carbon atoms. It also increases vanderwaal forces of attraction.

$$B_{pt} \propto \text{Molecular Mass}$$
$$\propto \text{vanderwaal Forces}$$
$$\propto \text{no of Carbon atoms}$$

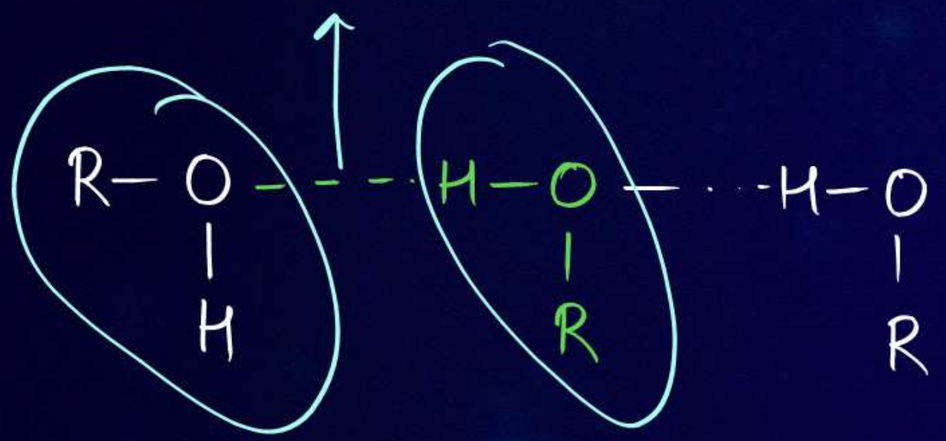
Boiling point is inversly proportional to Branching.

Increase in branching, decrease in surface area, decrease in vanderwaal bpt decreases.

$$\text{Bpt} \propto \frac{1}{\text{Branching}}$$

$\Rightarrow$ OH group present in ALCOHOL shows H-bonding.

F, O, N



→ 2 Molecules

Due to formation of H-bond (intermolecular) alcohol has more boiling point than aldehyde/ketone/ether/hydrocarbon.

QUESTION

Boiling point of ethanol is higher in comparison to methoxymethane .

CH_3OCH_3

C_2H_6O

C_2H_5OH or CH_3CH_2OH

or

C_2H_6O

(Molecular Formula)

H bond

(intermolecular H bond)

QUESTION

Butan-1-ol has a higher boiling point than diethylether.

$CH_3CH_2CH_2CH_2OH$ > $C_2H_5OC_2H_5$

intermolecular H bond

X

QUESTION

Rearrange the following compounds in increasing order of their boiling point.

CH_3CHO , CH_3CH_2OH, $CH_3CH_2CH_3$

aldehyde — 1

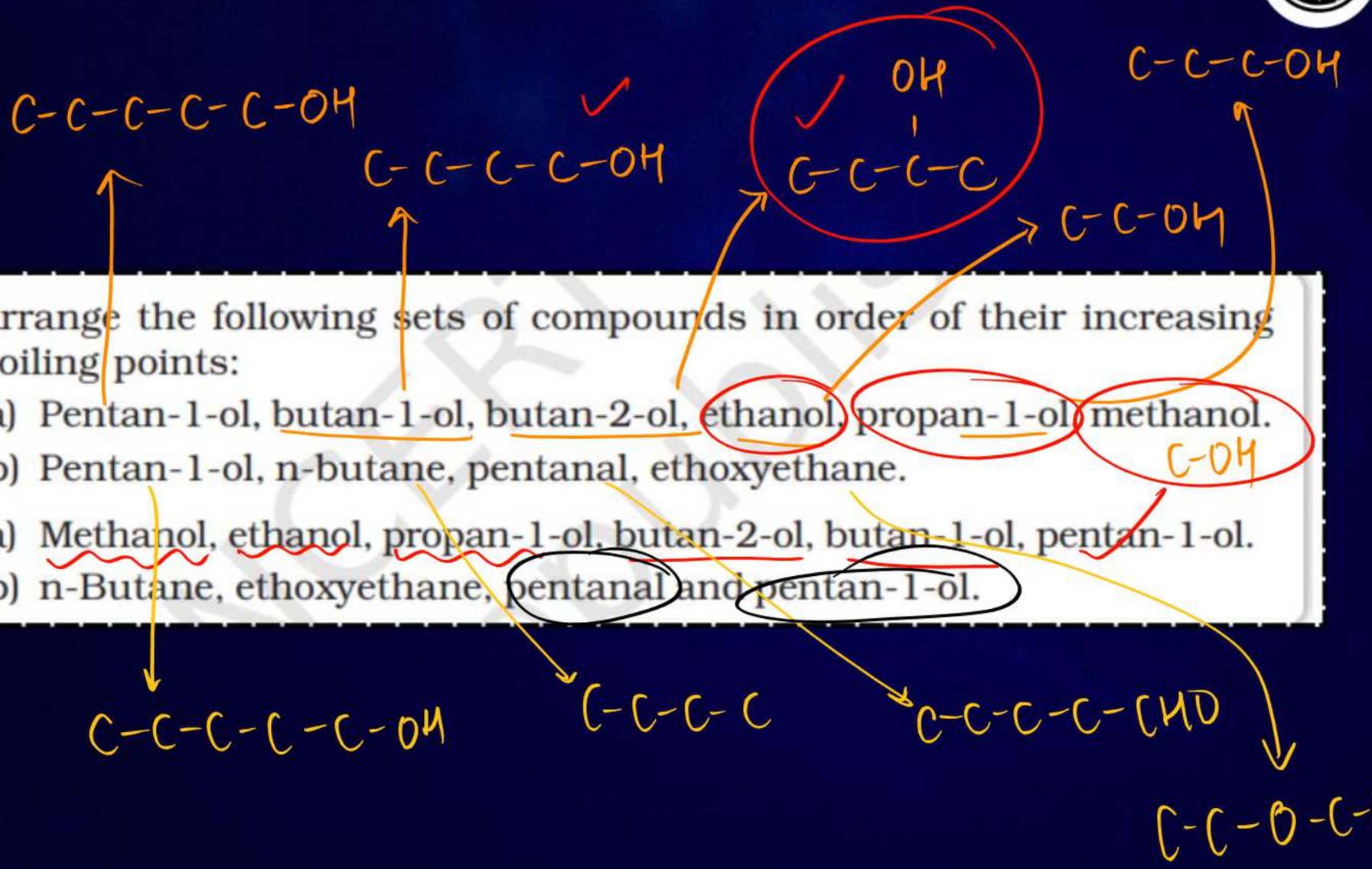
alcohol — 2

hydrocarbon — 3

$3 < 1 < 2$

HIGHLIGHT

NCERT



Example 7.3 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.

Solution (a) Methanol, ethanol, propan-1-ol, butan-2-ol, butan-1-ol, pentan-1-ol.

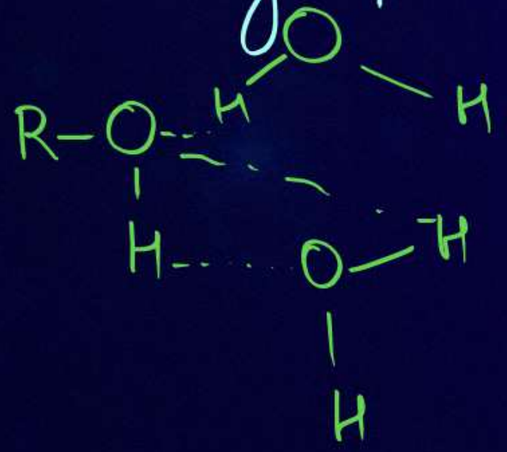
(b) n-Butane, ethoxyethane, pentanal and pentan-1-ol.

2. Solubility

↓

Lower Members of alcohol are soluble in water.

But as size of alkyl chain (no of carbon atom) increases, it increases hydrophobic part; solubility decrease.



QUESTION

Alcohols are more soluble in water than hydrocarbons of comparable molecular masses.

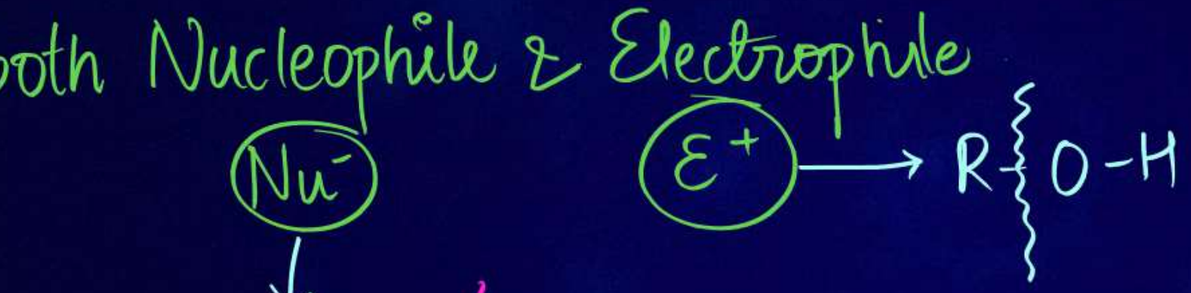
↓ H bond with H_2O.

↓ do not contain any H-bond

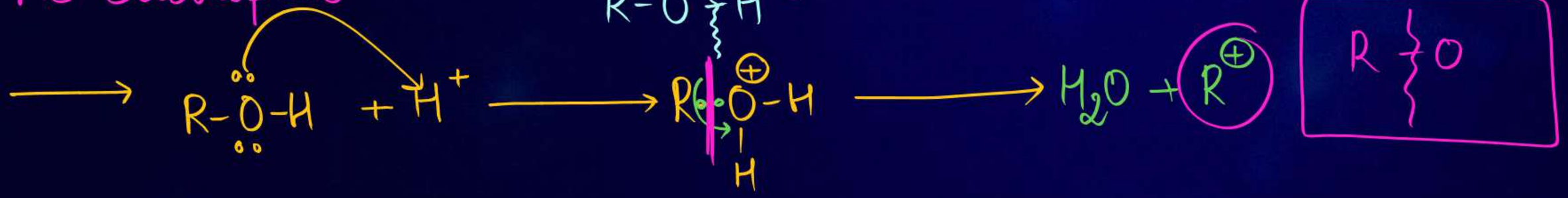
CHEMICAL PROPERTIES

CHEMICAL PROPERTIES OF ALCOHOL

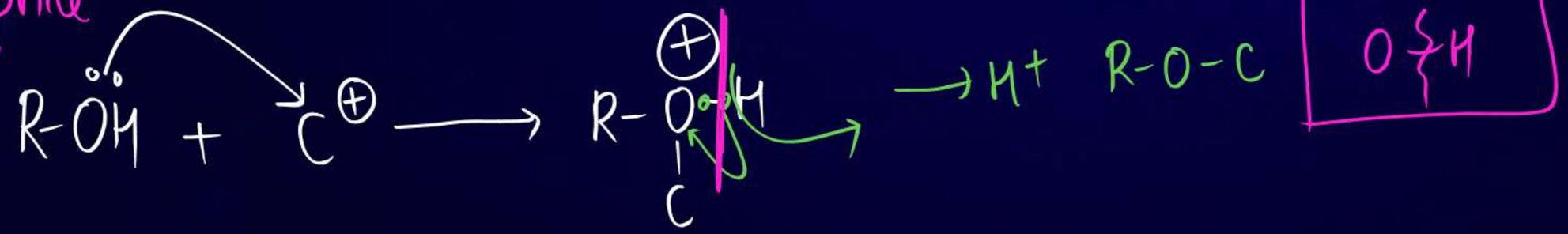
Alcohol act as both Nucleophile & Electrophile



As Electrophile



As Nucleophile



1. Alcohol behaves as Nucleophile

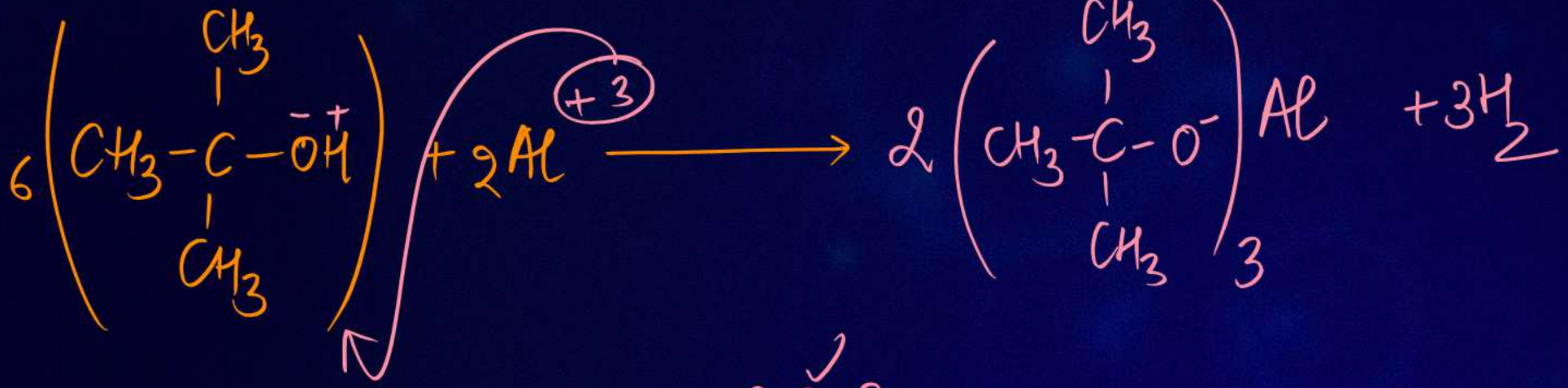
O-H bond will break.

(i) Rx with Metals

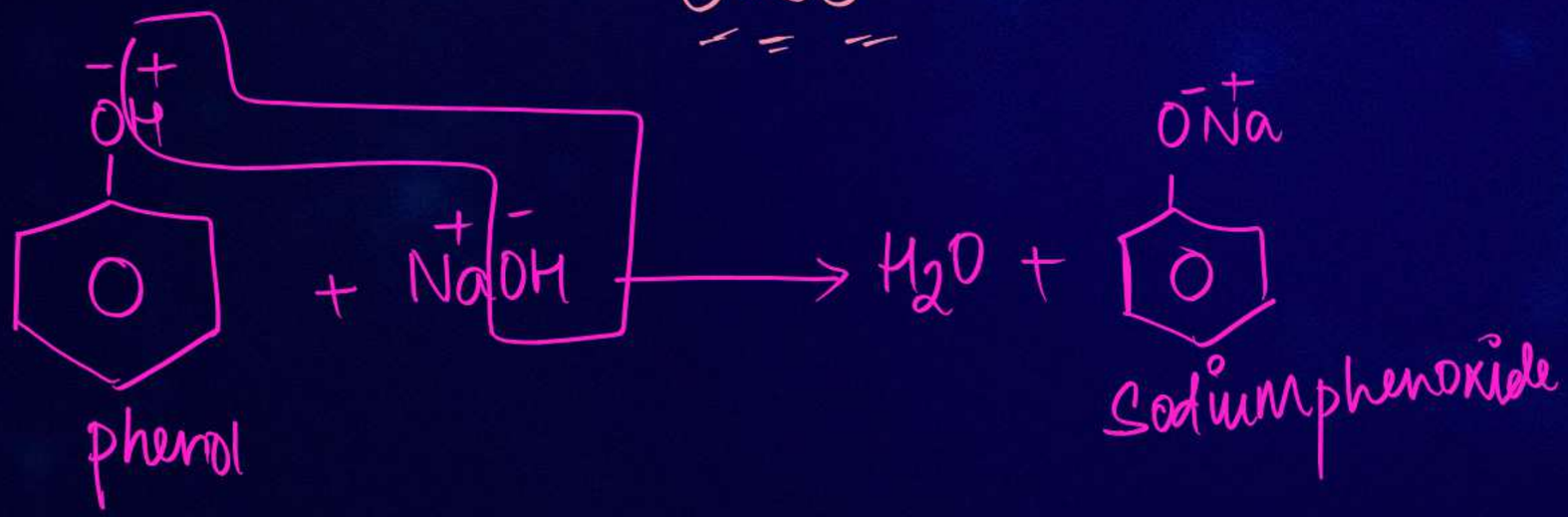
Alcohol & phenol on Rx with Active Metals (Na, K, Al) will produce alkoxide/phenoxide with hydrogen gas

$$R\text{-}\overset{-}{O}\text{-}\overset{+}{H} + Na \longrightarrow R\text{-}\bar{O}\overset{+}{N}a + H_2$$

Sodium alkoxide



6 2 3



* Alcohol behaves as Bronsted Acid.

(ii) Acidity :- donate H^+

$$R-OH \xrightarrow{-H^+} R-O^{\ominus} + H^+$$

Acidity $\propto$ stability of Anion

$\propto -I \propto -M$

$+I \propto +M$

On increasing electron Releasing (+I) group on oxygen atom (Carbon) polarity decreases, acidic strength ↓

R, C⊕I

NO_2 -I

Arrhenius Theory

Acid :- donate H^+

Base :- donate OH^-

Bronsted Lowry concept

Bronsted Acid :- donate H^+

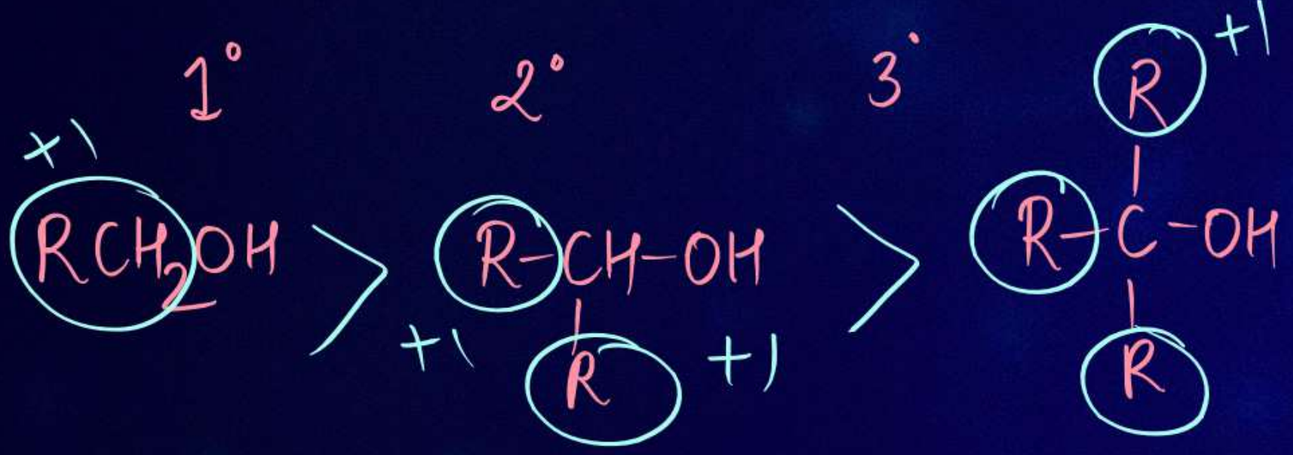
Bronsted Base :- accept H^+

Lewis Acid-Base Theory

↳ e⁻ pair acceptor

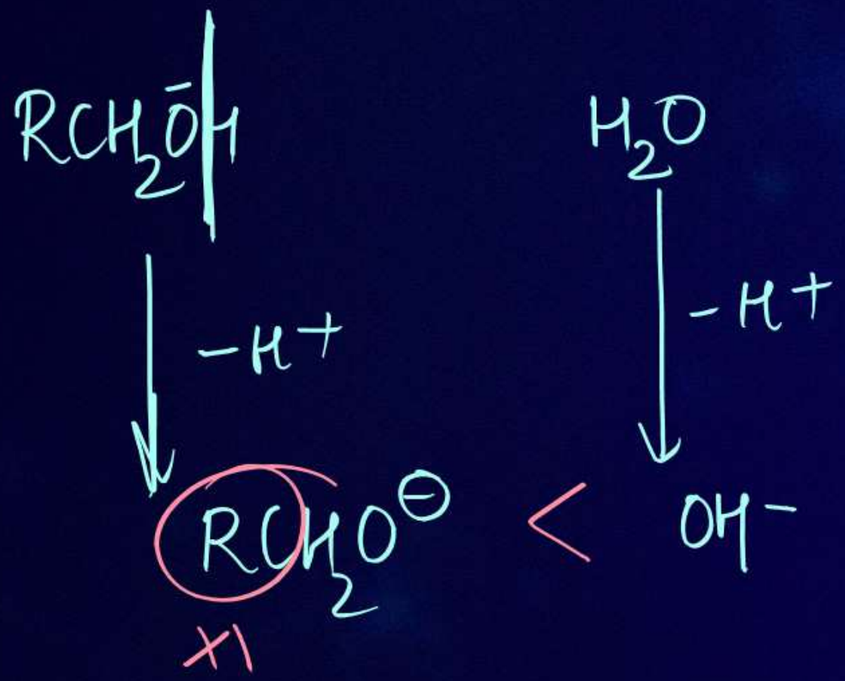
lone-pair donor

Q. Which is More Acidic



Acidity $\propto \frac{-I \propto -M}{+I \propto +M}$

Q. Which is More Acidic



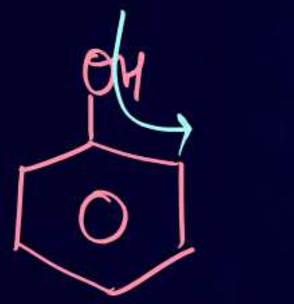
QUESTION

Arrange the following in increasing order of acidic character.

Phenol , ethanol , water.

Phenol > H_2O > Ethanol

Ethanol < H_2O < phenol



CH_3CH_2OH

H_2O

OH^-

QUESTION

Arrange the following in increasing order of acidic character.

p-nitropehnol , ethanol , phenol

1

2

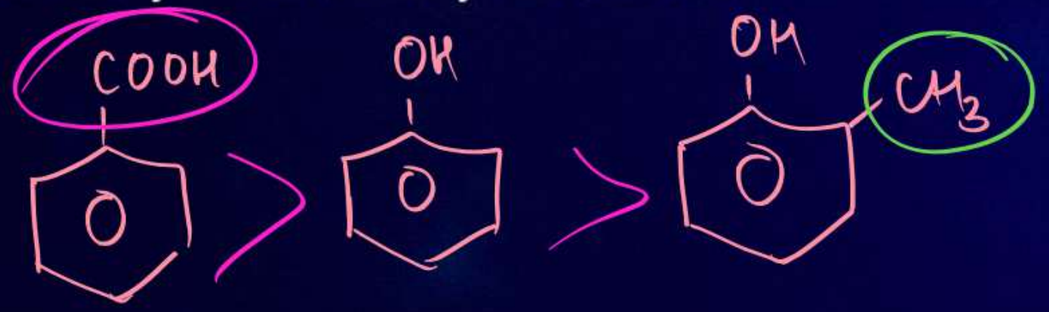
3

2 < 3 < 1

QUESTION

Arrange the following in increasing order of acidic character.

Benzoic acid , Phenol , Cresol



1 2 3

$3 < 2 < 1$

QUESTION

Arrange the following in increasing order of acidic character.

p-nitrophenol , p-methylphenol

+I

>

QUESTION

Arrange the following in increasing order of acidic character.

phenol & ethanol

QUESTION

Arrange the following in increasing order of acidic character.

O-nitrophenol & o-methoxyphenol

HW

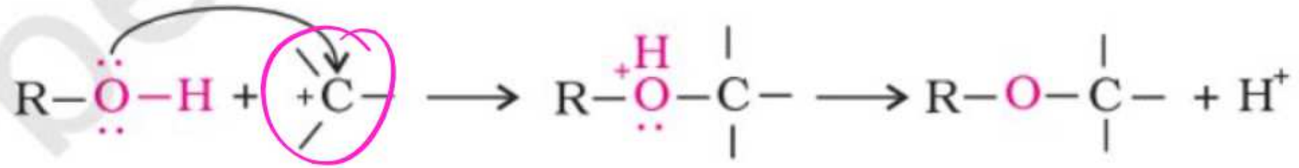
NCERT CORNER

HIGHLIGHT

7.4.4 Chemical Reactions

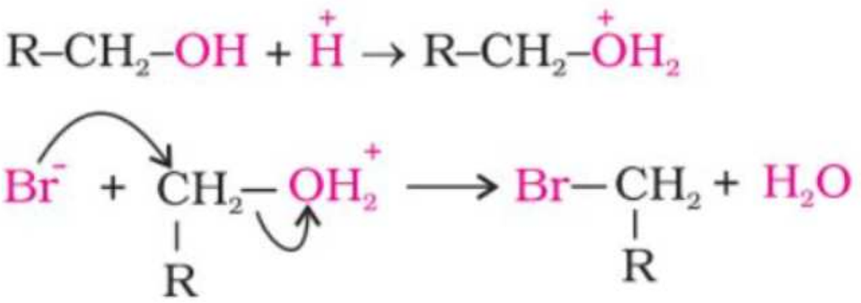
Alcohols are versatile compounds. They react both as nucleophiles and electrophiles. The bond between O–H is broken when alcohols react as nucleophiles.

Alcohols as nucleophiles

(i) 

(ii) The bond between C–O is broken when they react as electrophiles. Protonated alcohols react in this manner.

Protonated alcohols as electrophiles



Based on the cleavage of O–H and C–O bonds, the reactions of alcohols and phenols may be divided into two groups:

HIGHLIGHT

NCERT

(a) Reactions involving cleavage of O–H bond

1. *Acidity of alcohols and phenols*

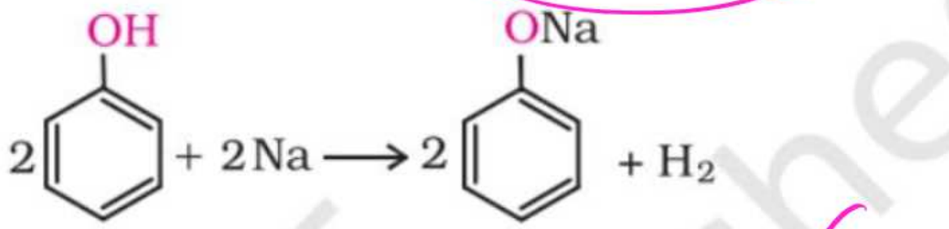
(i) *Reaction with metals:* Alcohols and phenols react with active metals such as sodium, potassium and aluminium to yield corresponding alkoxides/phenoxides and hydrogen.

$$2R\text{–}O\text{–}H + 2Na \longrightarrow \underset{\text{Sodium alkoxide}}{2R\text{–}O\text{–}Na} + H_2$$

$$6\,CH_3\text{–}\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}\text{–}OH + 2\,Al \longrightarrow 2\left(CH_3\text{–}\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}\text{–}O\right)_3 Al + 3H_2$$

tert- Butyl alcohol

Aluminium *tert*- butoxide



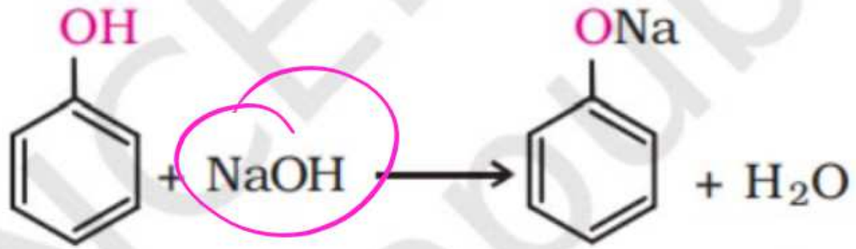
Phenol

Sodium phenoxide

HIGHLIGHT

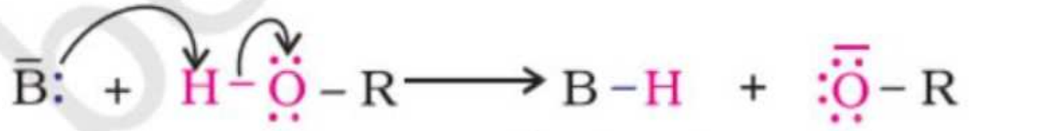
NCERT

In addition to this, phenols react with aqueous sodium hydroxide to form sodium phenoxides.



Sodium phenoxide

The above reactions show that alcohols and phenols are acidic in nature. In fact, alcohols and phenols are Brönsted acids i.e., they can donate a proton to a stronger base (B:).



Base Acid Conjugate acid Conjugate base

HIGHLIGHT

NCERT

(ii) Acidity of alcohols: The acidic character of alcohols is due to the polar nature of O–H bond. An electron-releasing group ($-CH_3$, $-C_2H_5$) increases electron density on oxygen tending to decrease the polarity of O-H bond. This decreases the acid strength. For this reason, the acid strength of alcohols decreases in the following order:

HIGHLIGHT

NCERT

Alcohols are, however, weaker acids than water. This can be illustrated by the reaction of water with an alkoxide.

Base Acid Conjugate acid Conjugate base

This reaction shows that water is a better proton donor (i.e., stronger acid) than alcohol. Also, in the above reaction, we note that an alkoxide ion is a better proton acceptor than hydroxide ion, which suggests that alkoxides are stronger bases (sodium ethoxide is a stronger base than sodium hydroxide).

Alcohols act as Bronsted bases as well. It is due to the presence of unshared electron pairs on oxygen, which makes them proton acceptors.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HOMEWORK

1 Que

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2026

ALCOHOL , PHENOL & ETHER

CHEMISTRY LECTURE-08

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. ALCOHOL AS ELECTROPHILE
2. PHENOL PROPERTIES

MY SHIMMERING STARS

#SHOURYA'SGALAXY

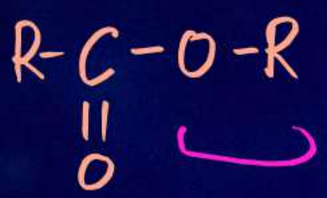

START

CHEMICAL PROPERTIES

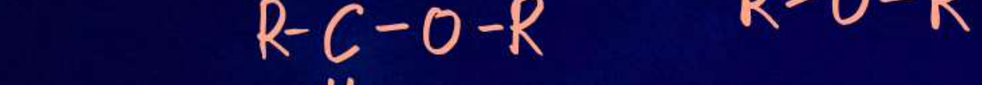
NCERT COVERAGE

CHEMICAL PROPERTY

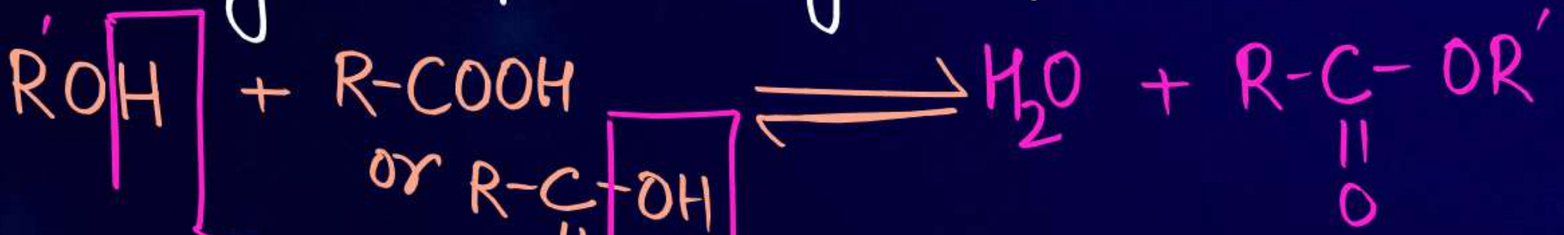
Ester



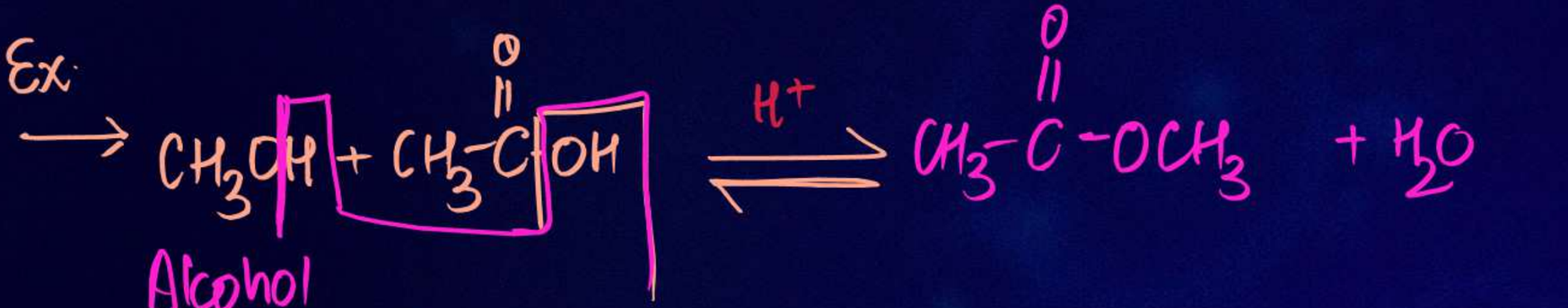
Ether



3. Esterification : Formation of Ester by Alcohol when it reacts with Carboxylic Acid / acid anhydride / acid halide.



Ex.



Alcohol
(Nucleophile)

Ex.

2) $R-OH$ + $R-C(=O)-O-C(=O)-R$ $\rightleftharpoons[]^{H^+}$ $R-C(=O)-OR$ + $R-C(=O)-OH$

Alcohol

acid anhydride or $(R-C(=O))_2O$

Ester

Carboxylic Acid

Ex: CH_3-OH + $CH_3-C(=O)-O-C(=O)-CH_3$ $\rightleftharpoons[]^{H^+}$ $CH_3-C(=O)-OCH_3$ + $CH_3-C(=O)-OH$

3) $R\text{-}OH + R\text{-}\underset{\underset{O}{\|}}{C}\text{-}X \xrightarrow{\text{Pyridine}} R\text{-}\underset{\underset{O}{\|}}{C}\text{-}OR + HCl$

Alcohol as Nucleophile

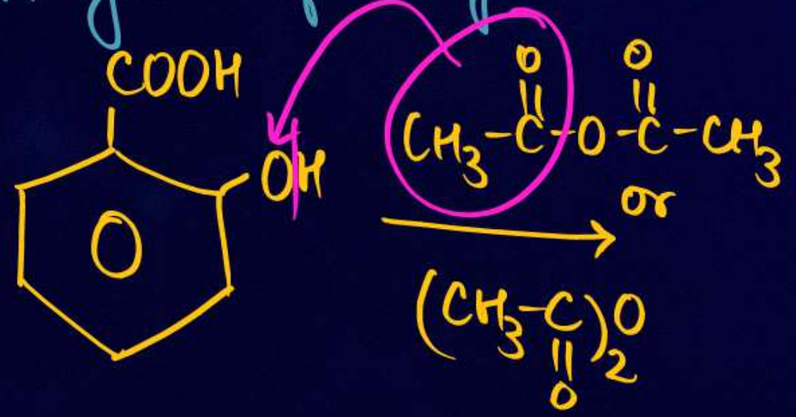
(acid halide)

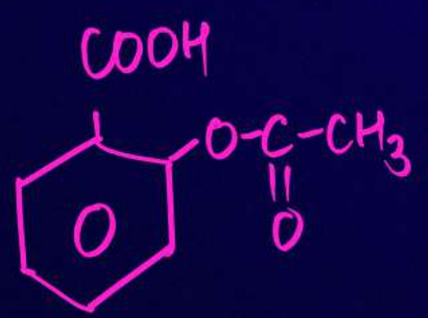
↳ $RCOCl$ or $R\text{-}\underset{\underset{O}{\|}}{C}\text{-}Cl$ (acyl halide)

ACETYLATION

Introduction of acetyl group (CH_3CO) to alcohol & phenol is called Acetylation.

Acetylation of salicylic acid produces aspirin.



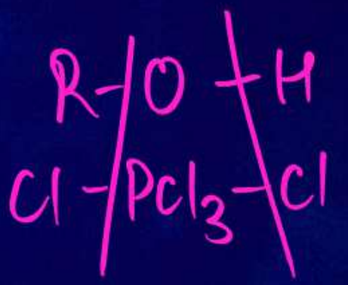


} Aspirin or acetylsalicylic acid + $CH_3\text{-}\underset{\underset{O}{\|}}{C}\text{-}OH$.

CHEMICAL PROPERTIES OF ALCOHOL

Alcohol as Electrophile

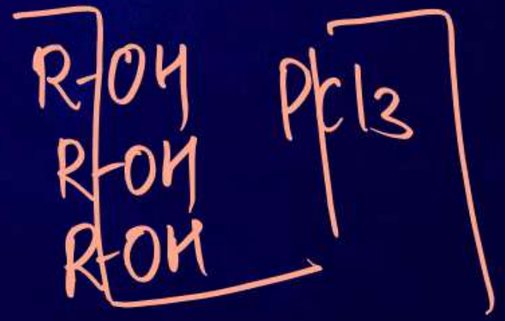
Breakage of -C-O bond takes place.



1) Rx with PCl_5

$$R\text{-}OH + PCl_5 \longrightarrow R\text{-}Cl + HCl + POCl_3$$

Ex. $$CH_3CH_2OH + PCl_5 \longrightarrow CH_3CH_2Cl + HCl + POCl_3$$



2) Rx with PCl_3

$$3\,R\text{-}OH + PCl_3 \longrightarrow 3\,R\text{-}Cl + H_3PO_3$$

Ex. $$3CH_3OH + PCl_3 \longrightarrow 3CH_3Cl + H_3PO_3$$

3) Rx with $SOCl_2$

(Thionyl chloride)

It is also called Darzen's process.

Considered as Best & preferable Method.

Pure Haloalkane is obtained.

$$R\text{-}OH + SOCl_2 \longrightarrow R\text{-}Cl + \underset{\uparrow}{HCl} + SO_2\uparrow$$

Ex. $CH_3CH_2OH + SOCl_2 \longrightarrow CH_3CH_2Cl + SO_2\uparrow + HCl\uparrow$

4) Rx with HX.

$HCl + ZnCl_2 \Rightarrow$ **Lucas Reagent**

Lucas Test

↳ It is used for distinguishing 1°, 2° & 3° alcohols.

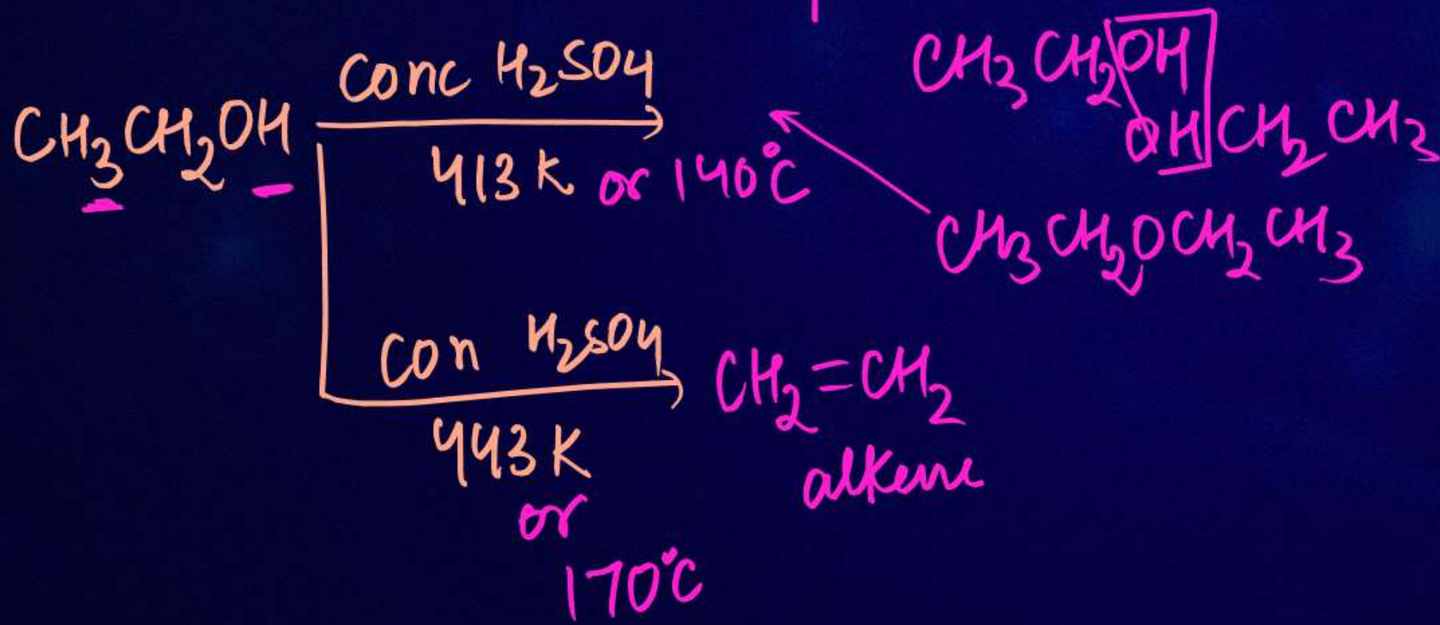
3° alcohol ⟶ Turbidity occurs immediately
2° ⟶ — appear after 5 min
1° ⟶ X

→ $CH_3CH_2OH + HCl \xrightarrow{ZnCl_2} CH_3CH_2Cl + H_2O$ ✓

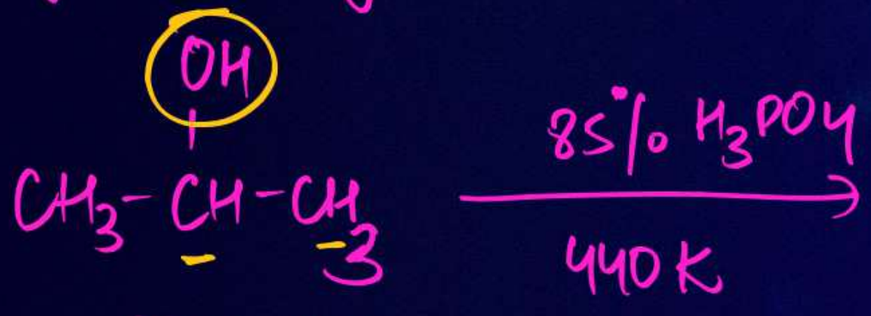
5) Dehydration

Removal of H_2O

In case of alcohol dehydration occurs in a such a way it either produces alkenes or ether are formed



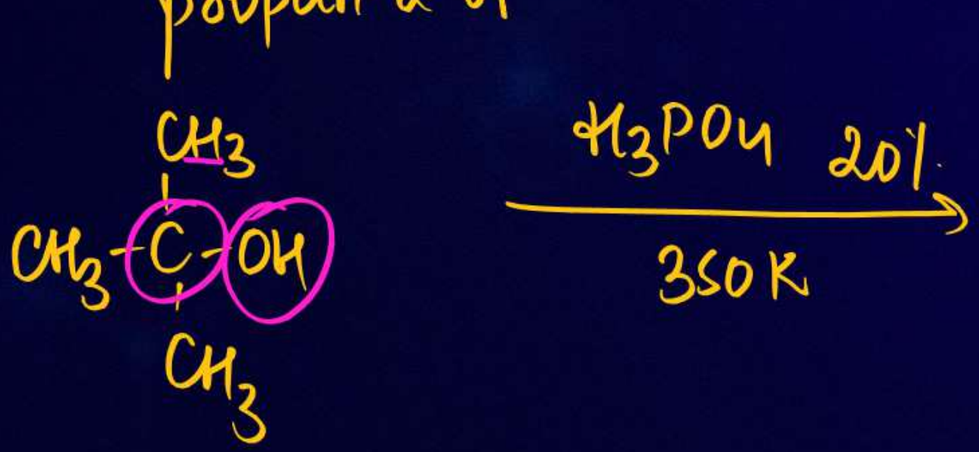
Secondary & Tertiary alcohols shows dehydration under Mild conditions



2° alcohol

propan-2-ol

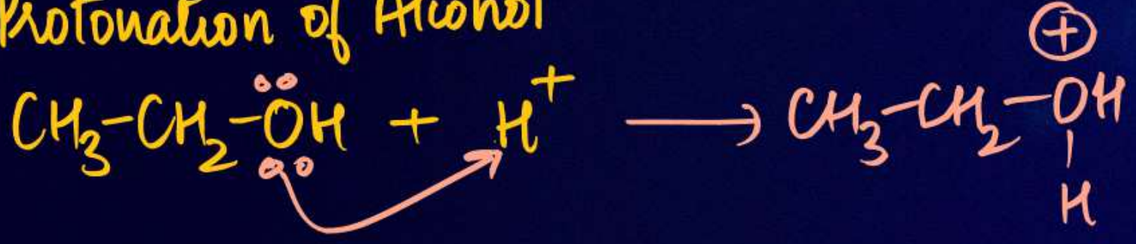
prop-1-ene



2-methylprop-1-ene.

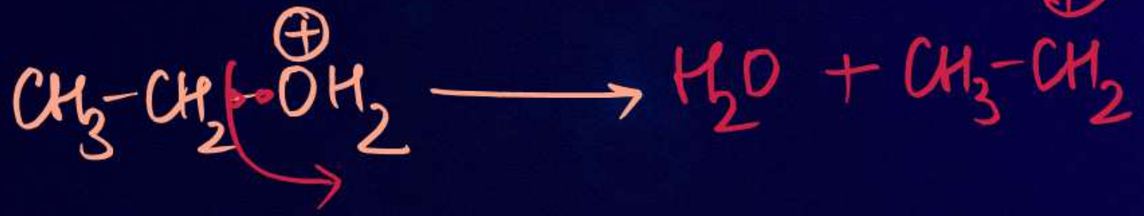
Mechanism of Dehydration

1. Protonation of Alcohol

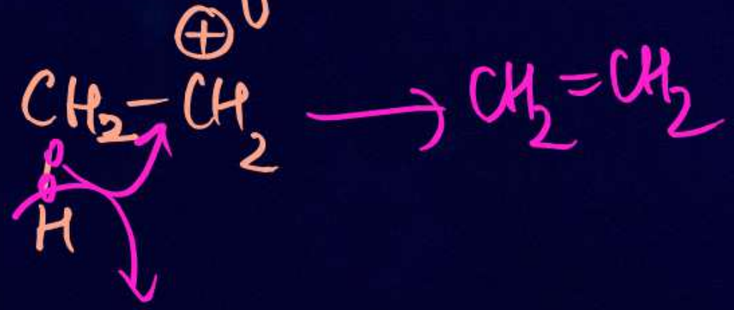


Protonated alcohol.

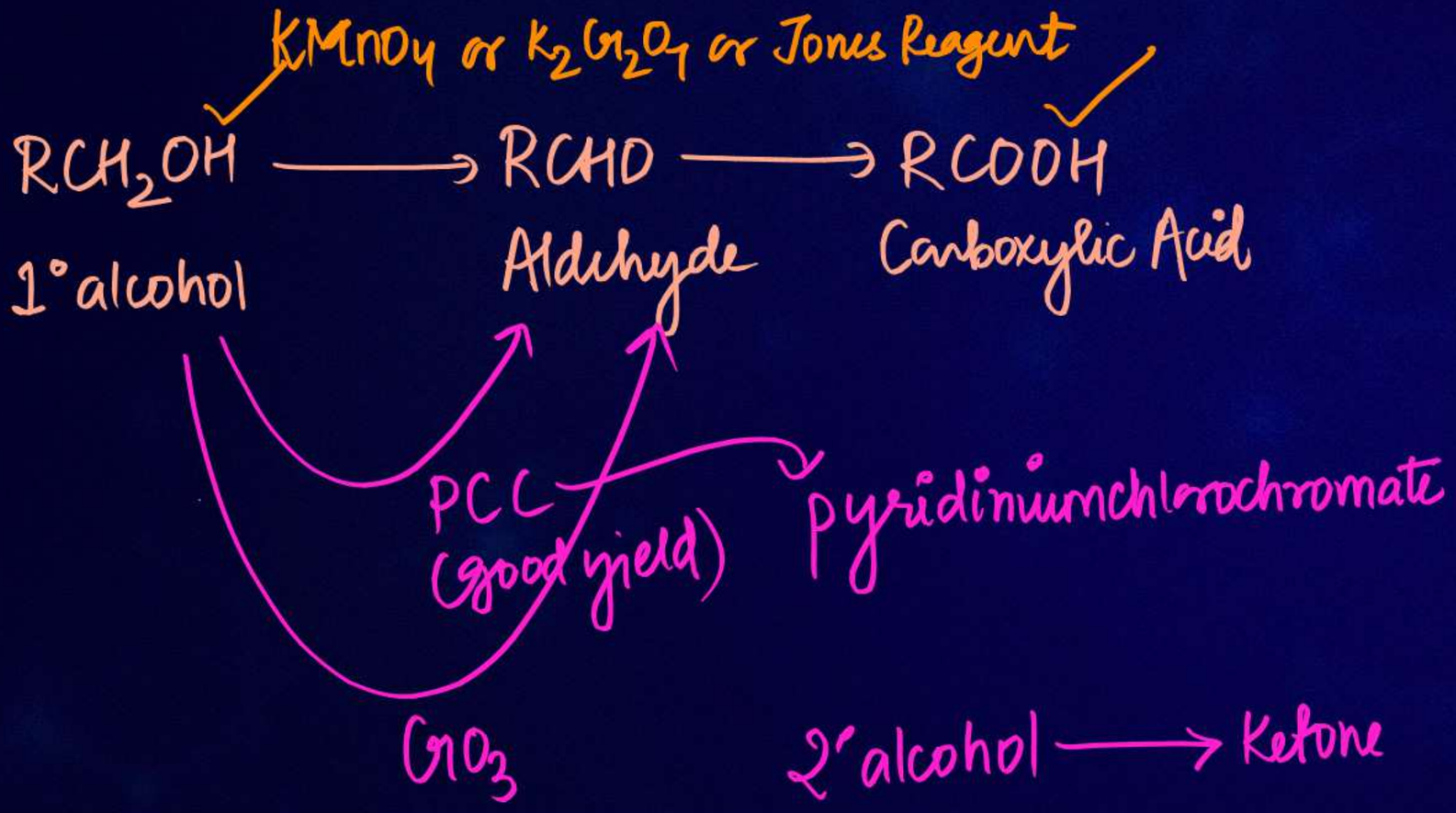
2. Removal of H_2O, Carbocation is formed.

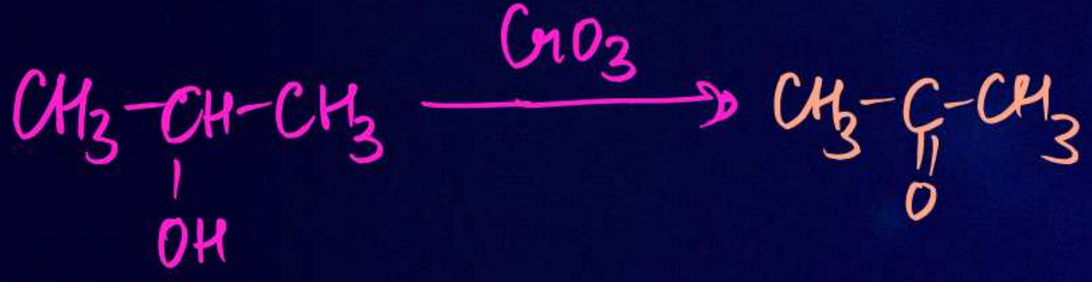


3. Formation of Alkene

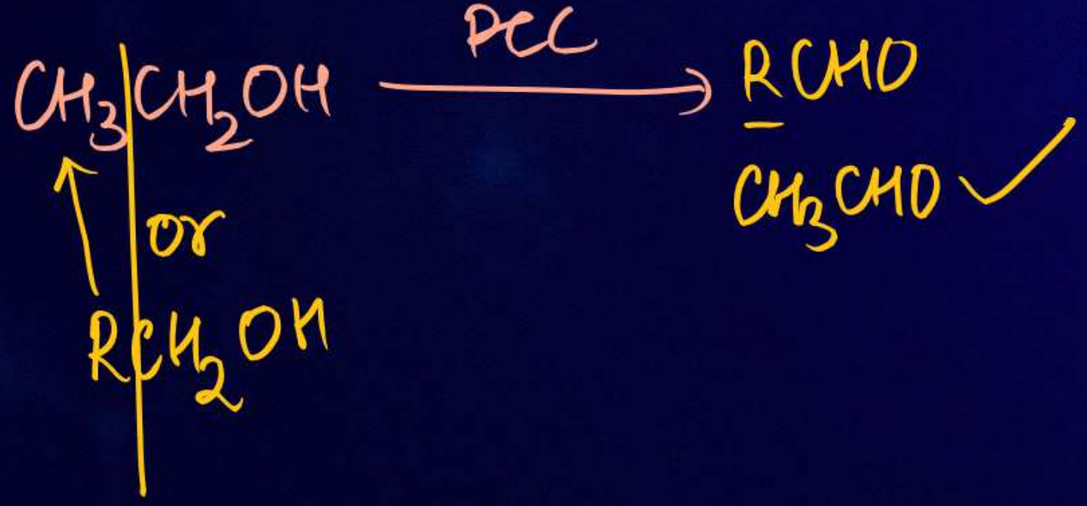


6) Oxidation


KMnO4 or K2Cr2O4 or Jones Reagent
RCH2OH
1° alcohol
RCHO
Aldehyde
RCOOH
Carboxylic Acid
PCC
(good yield)
Pyridiniumchlorochromate
CrO3
2° alcohol → Ketone
3° alcohol → Alkene.


CrO_3
$CH_3-CH-CH_3$
OH
CH_3-C-CH_3
O

2° alcohol


PCC
CH_3CH_2OH
or
RCH_2OH
RCHO
CH_3CHO ✓

RCH_2OH

$CH_3CH_2CH_2OH \xrightarrow{K_2Cr_2O_7} RCHO \longrightarrow RCOOH$

$CH_3CH_2CHO \quad CH_3CH_2COOH$

1° alcohol

$3^\circ \longrightarrow X$

dont undergo oxidation with $KMnO_4$ / $K_2Cr_2O_7$

7. Rx with Cu at 300°C or 573K.

1° alcohol $\xrightarrow[573K]{Cu}$ Aldehyde

2° $\longrightarrow$ Ketone

3° $\longrightarrow$ alkene

} ✓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HOMEWORK

1. Complete notes
2. Revise

PARISHRAM

2026

ALCOHOL , PHENOL & ETHER

CHEMISTRY LECTURE-09

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. PHENOL & ETHER PROPERTIES
2. QUESTIONS


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MY SHIMMERING STARS

#SHOURYA'SGALAXY


START

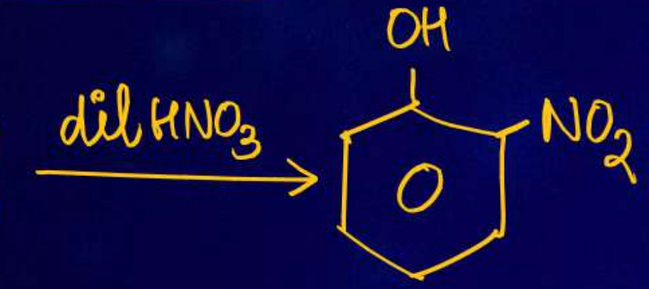
CHEMICAL PROPERTIES

NCERT COVERAGE

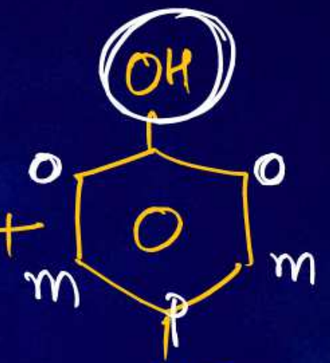
CHEMICAL PROPERTY

→ 1. Nitration

phenol



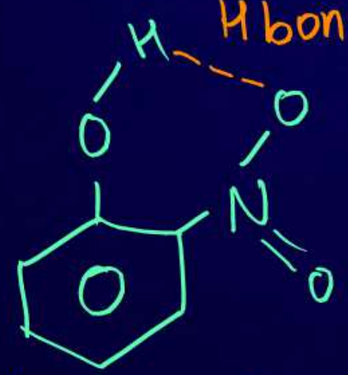
o-nitrophenol



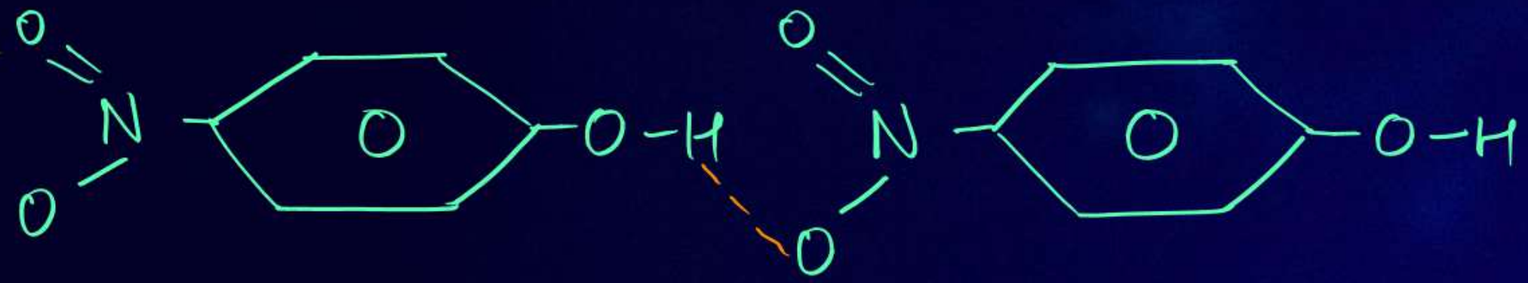
p-nitrophenol

o-nitrophenol and p-nitrophenol can be separated by steam distillation.

→ o-nitrophenol is steam volatile in Nature and exhibits intramolecular H bonding while p nitrophenol is less volatile and exhibit intermolecular H bonding



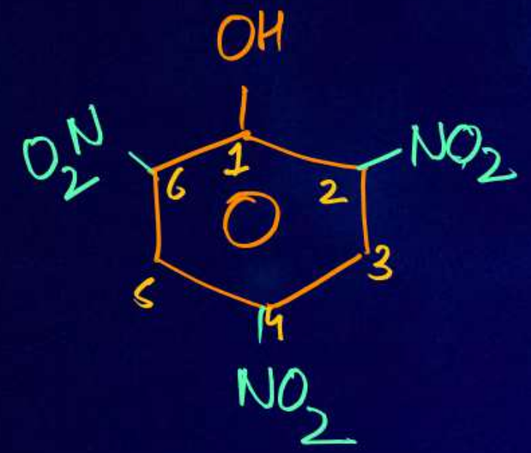
intramolecular H bonding (More volatile)



Intermolecular
H bond
(less volatile)

(ii)

$\xrightarrow{\text{Conc } HNO_3}$



poor yield is obtained.

2,4,6-trinitrophenol

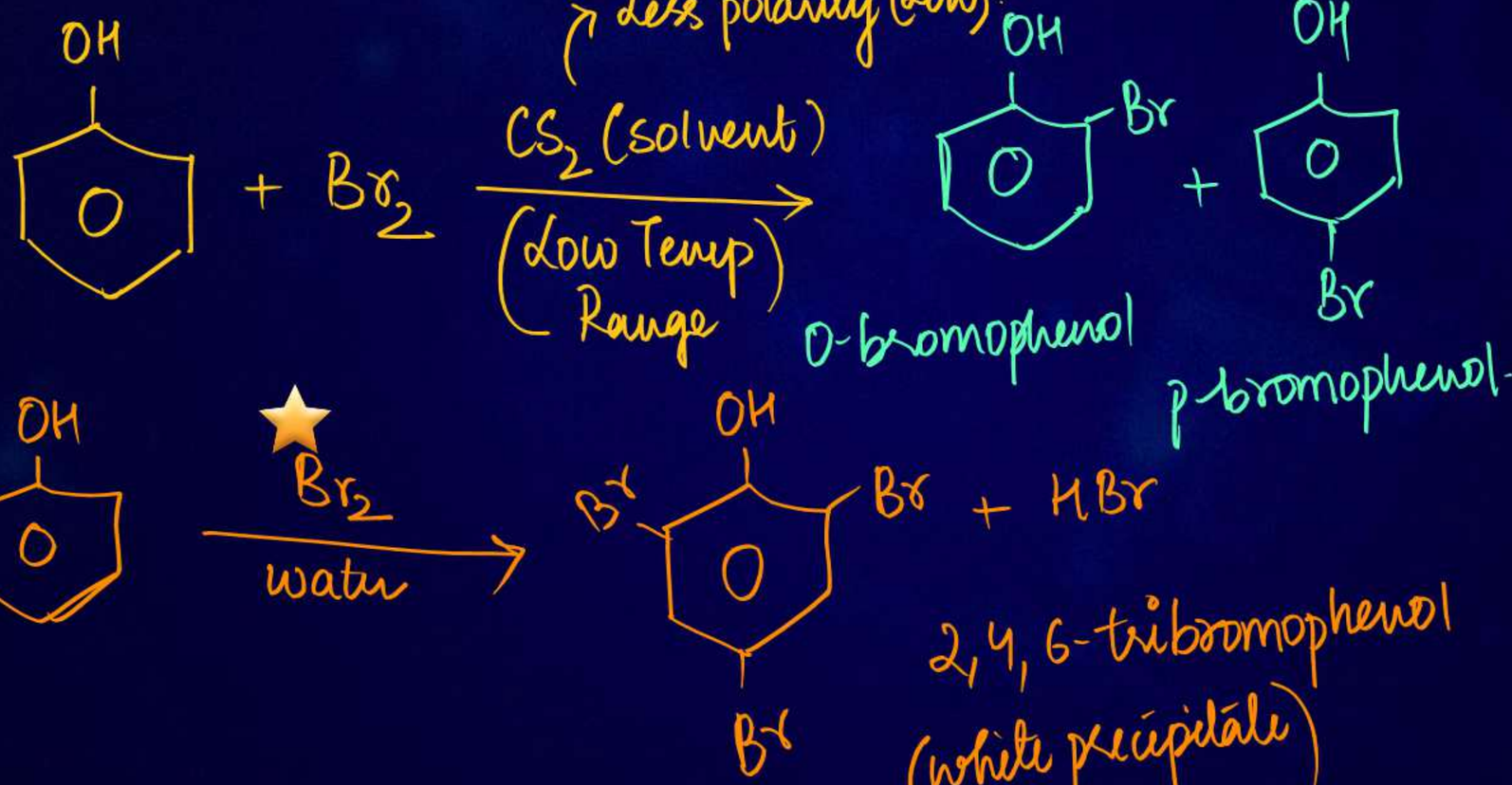
or

'PICRIC ACID'

CHEMICAL PROPERTIES OF PHENOL

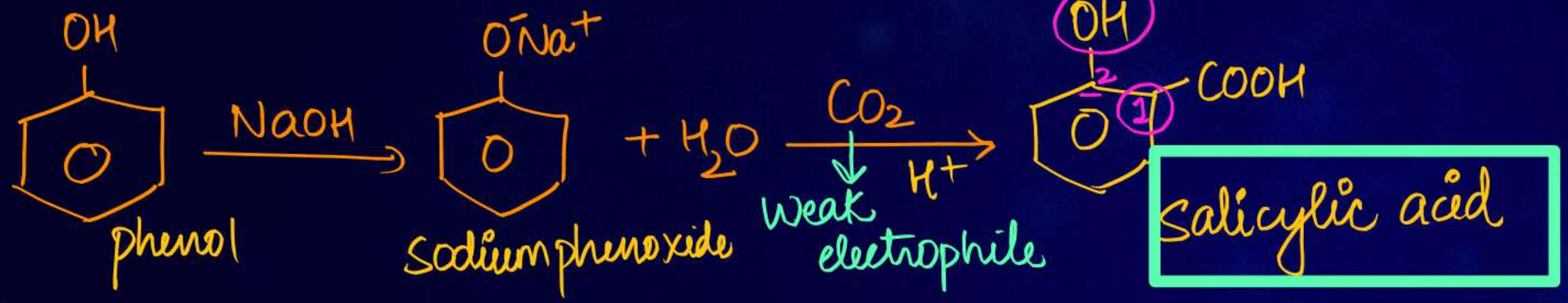
2) Bromination

addition



3) KOLBE RX.

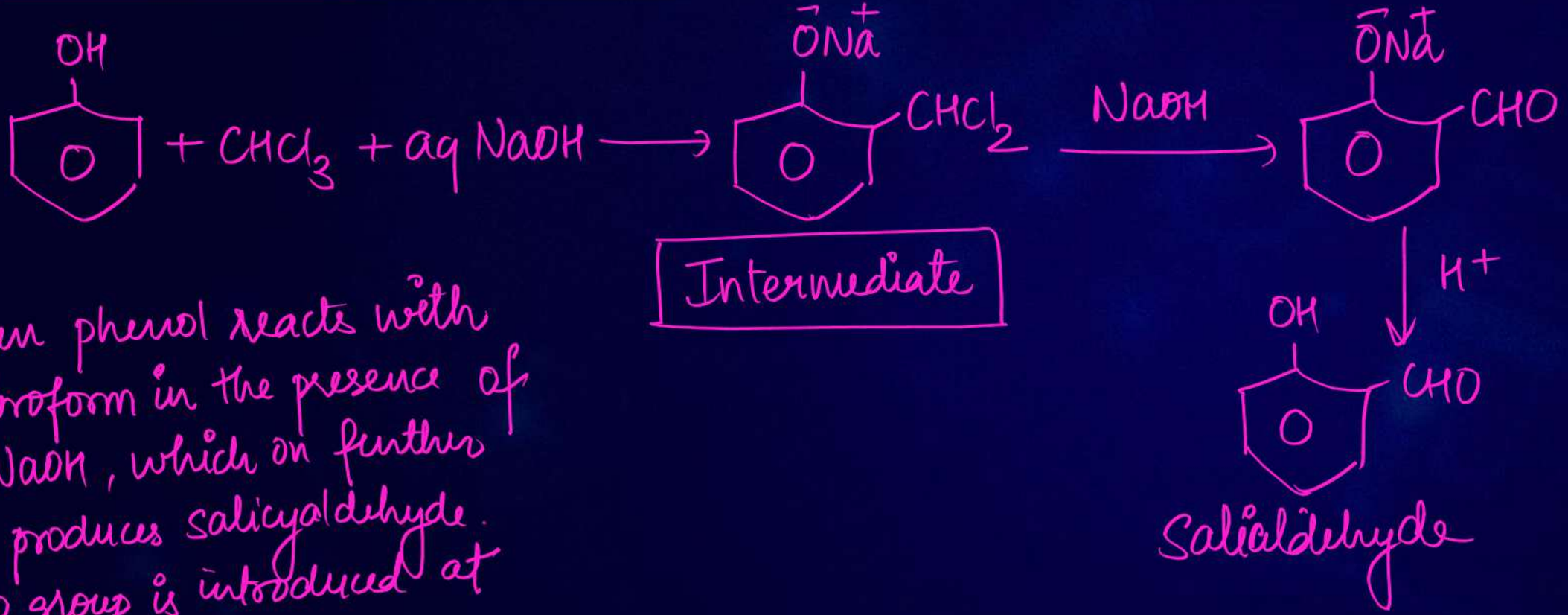
Most Imp Expected Que



Que →
1) Kolbe Rx
2) product name
3) Reagent → (CO_2) → weak E⊕
4) Conversion

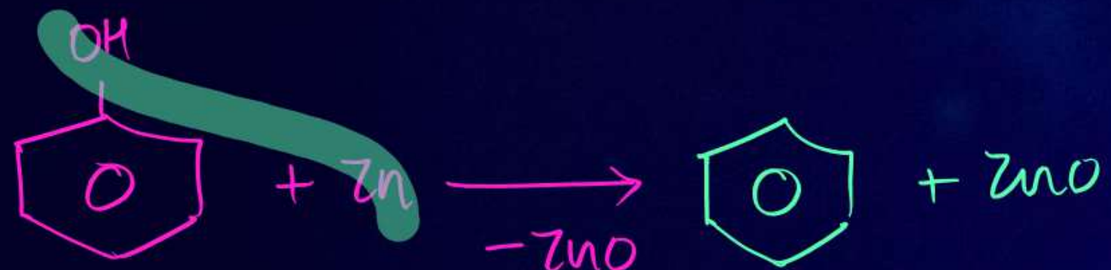
Phenol reacts with sodiumhydroxide to produce Sodiumphenoxide which on further rx with weak electrophile CO_2 will form a ortho directing product called Salicylic acid or 2-hydroxybenzoic acid.

4. Reimer-Tiemann Rx.



When phenol reacts with chloroform in the presence of aq NaOH, which on further rx produces salicyaldehyde. -CHO group is introduced at ortho position.

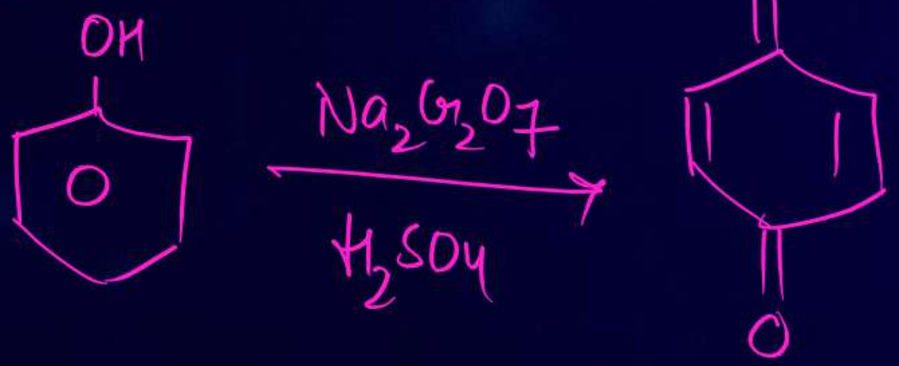
5) Rx with Zinc dust



Phenol

Benzene

6) Oxidation



Benzoquinone
(diketone)
dark coloured compounds.

Doubts

NCERT CORNER

HIGHLIGHT

7.5 Some Commercially Important Alcohols

CUET or 1 mark (MCQ)

Methanol and ethanol are among the two commercially important alcohols.

1. Methanol

Direct que.

Methanol, CH_3OH, also known as 'wood spirit', was produced by destructive distillation of wood. Today, most of the methanol is produced by catalytic hydrogenation of carbon monoxide at high pressure and temperature and in the presence of $ZnO - Cr_2O_3$ catalyst.

Que

$$CO + 2H_2 \xrightarrow[200\text{-}300\ atm,\ 573\text{-}673\ K]{ZnO\text{-}Cr_2O_3} CH_3OH$$

Methanol is a colourless liquid and boils at 337 K. It is highly poisonous in nature. Ingestion of even small quantities of methanol can cause blindness and large quantities causes even death. Methanol is used as a solvent in paints, varnishes and chiefly for making formaldehyde.

HIGHLIGHT

2. *Ethanol*

Ethanol, C_2H_5OH, is obtained commercially by fermentation, the oldest method is from sugars. The sugar in molasses, sugarcane or fruits such as grapes is converted to glucose and fructose, (both of which have the formula $C_6H_{12}O_6$), in the presence of an enzyme, invertase. Glucose and fructose undergo fermentation in the presence of another enzyme, zymase, which is found in yeast.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Invertase}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

$$C_6H_{12}O_6 \xrightarrow{\text{Zymase}} 2C_2H_5OH + 2CO_2$$

In wine making, grapes are the source of sugars and yeast. As grapes ripen, the quantity of sugar increases and yeast grows on the outer skin. When grapes are crushed, sugar and the enzyme come in contact and fermentation starts. Fermentation takes place in anaerobic conditions i.e. in absence of air. Carbon dioxide is released during fermentation.

HIGHLIGHT

The action of zymase is inhibited once the percentage of alcohol formed exceeds 14 percent. If air gets into fermentation mixture, the oxygen of air oxidises ethanol to ethanoic acid which in turn destroys the taste of alcoholic drinks.

Ethanol is a colourless liquid with boiling point 351 K. It is used as a solvent in paint industry and in the preparation of a number of carbon compounds. The commercial alcohol is made unfit for drinking by mixing in it some copper sulphate (to give it a colour) and pyridine (a foul smelling liquid). It is known as **denaturation** of alcohol.

Assertion (A): Ortho and para-nitrophenols can be separated by steam distillation.

Reason (R): Ortho isomer associates through intermolecular hydrogen bonding while Para isomer associates through intramolecular hydrogen bonding.

[CBSE, 2020]

Solution

Due to intermolecular H-bonding in para nitrophenol, para nitrophenol has a more boiling point than ortho nitrophenol. Therefore, they can be separated by steam distillation.

Arrange the following in order of increasing boiling point:
Ethoxyethane, Butanal, Butanol, n-butane

C-C-O-C-C

$CH_3-CH_2-CH_2-CHO$

$CH_3CH_2CH_2CH_3$

$CH_3-CH_2-O-CH_2-CH_3$

$CH_3CH_2CH_2CH_2OH$

Solution

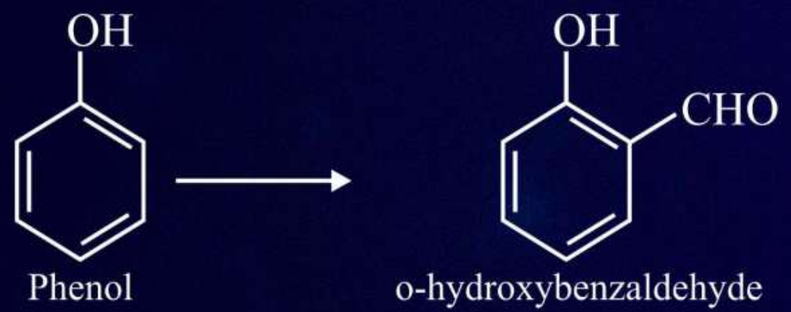
n-butane < ethoxyethane < butanal < butanol

Convert:

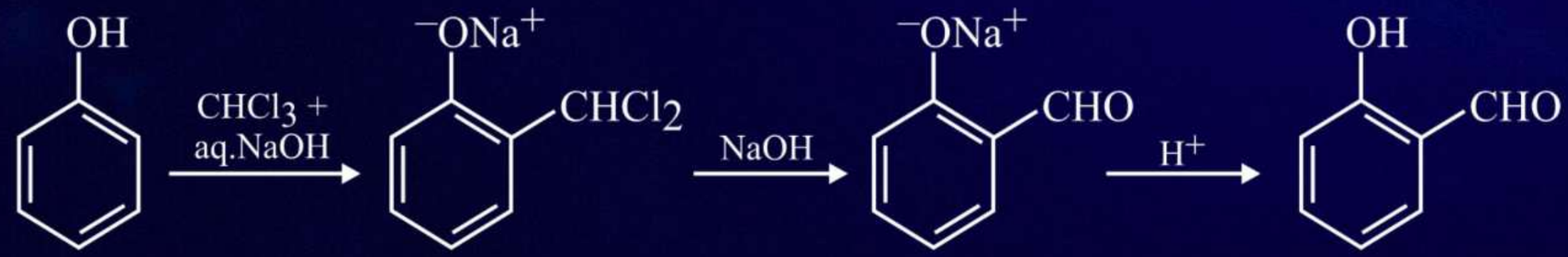
(a) Phenol to o-hydroxybenzaldehyde (Salicyaldehyde) — Reimer-Tiemann

Solution

(a)



Phenol — o-hydroxybenzaldehyde



(Salicyladehyde)

Convert: (Formaldehyde)

(b) Methanal to ethanol

$HCHO$ or $H-\underset{\underset{O}{\|}}{C}-H \longrightarrow CH_3CH_2OH$

1° alcohol.

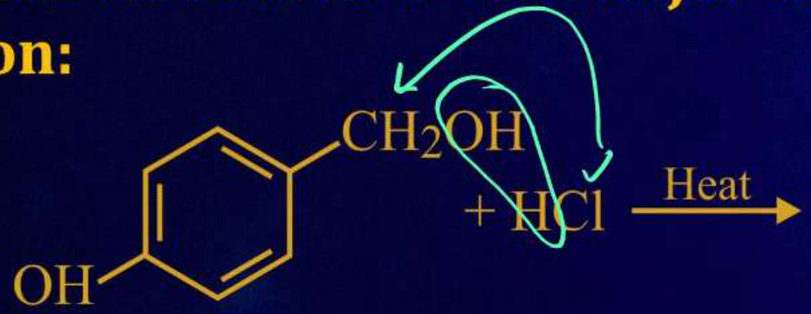
(b) $\underset{\text{Methanal}}{HCHO} \rightarrow \underset{\text{Ethanol}}{CH_3CH_2OH}$

$$H-\overset{\overset{O}{\|}}{C}-H + CH_3MgBr \rightarrow H_3C-CH_2-OMgBr \xrightarrow{H_2O} CH_3CH_2OH + Mg(OH)Br$$

(i) (a) **Ortho-nitrophenol is more acidic than ortho-methoxyphenol. Give reason.**

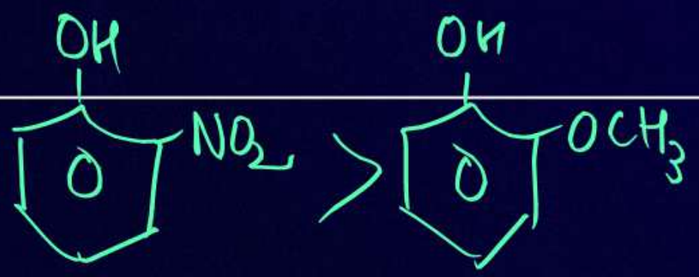
[CBSE, 2019]

(b) **Draw the structure of the major monohalo product in the following reaction:**

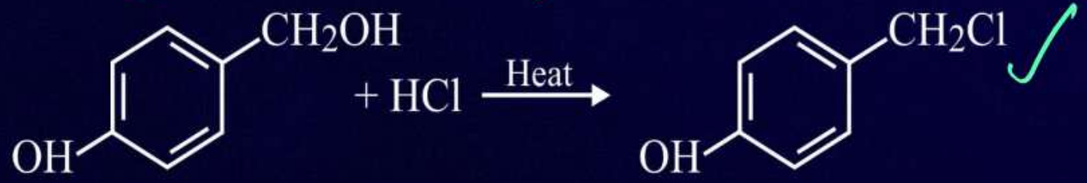


Solution

(i) (a)



(b)



(b) Write the chemical equation involved in the following:
(i) Kolbe's reaction
(ii) Williamson synthesis

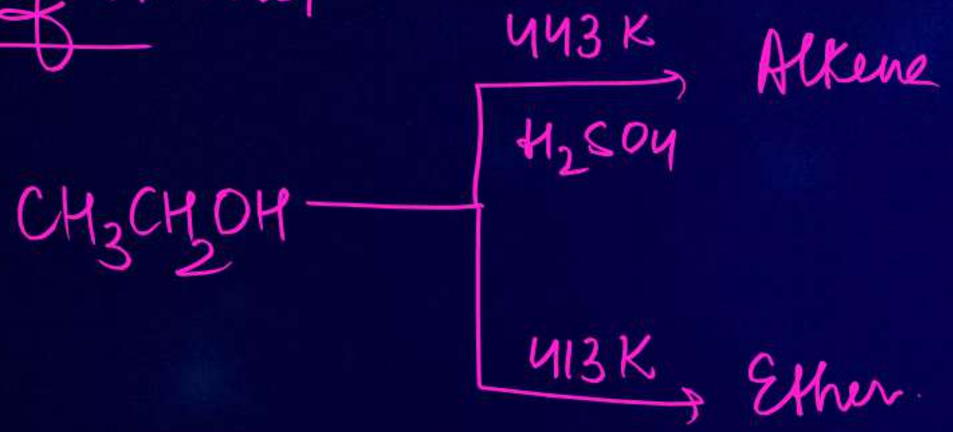
[CBSE 2023]

Solution

(b) (i) Already given
(ii) Already given

METHOD OF PREPARATION OF ETHER-

1. Dehydration of Alcohol



$$2\ CH_3CH_2OH \xrightarrow[H_2SO_4]{413K} CH_3CH_2OCH_2CH_3$$

(protic acid) $\hookrightarrow H^+$

* R group should be less hindered.
otherwise alkene will be formed.

Mechanism

1) Formation of protonated Alcohol.

$$CH_3CH_2\ddot{O}H \xrightarrow{H^+} CH_3CH_2\overset{\oplus}{O}H_2$$

2) Alcohol attacks on protonated alcohol

$$CH_3CH_2\ddot{O}H + CH_3CH_2\overset{\oplus}{O}H_2 \longrightarrow CH_3CH_2\overset{\oplus}{O}(H)CH_2CH_3 \longrightarrow CH_3CH_2OCH_2CH_3$$

ether

2) WILLIAMSON SYNTHESIS RX.

Alkoxides reacts with haloalkane to produce Ether. It follows S_N2 Mechanism alkoxide hue generally reacts with primary haloalkane, in case of secondary, tertiary haloalkane, ethers are not formed and elimination Rx occurs producing alkenes

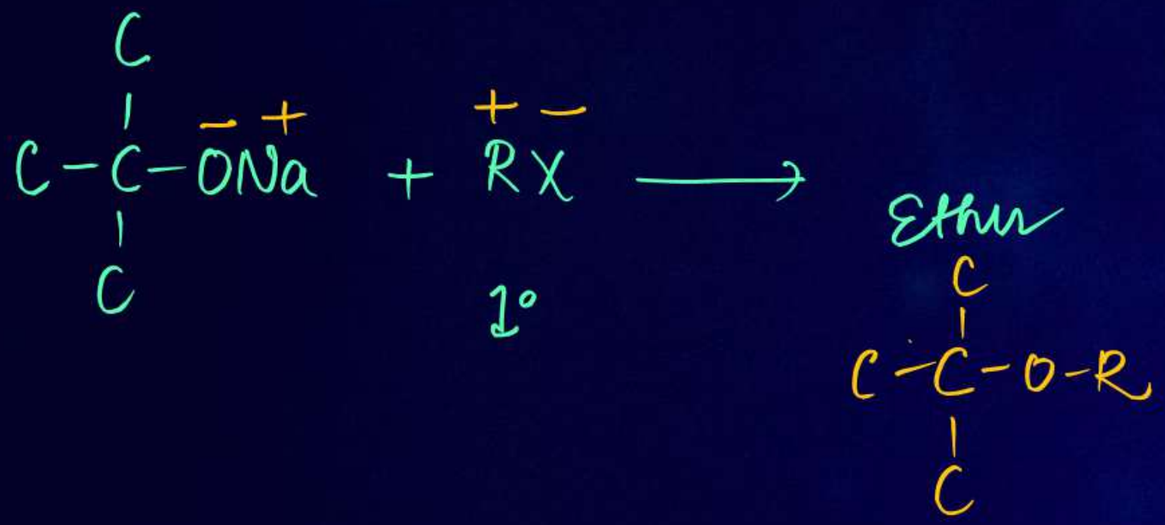
less hindrance (1°)

$$R-\overset{-}{O}\overset{+}{Na} + \overset{+}{R}-\overset{-}{X} \longrightarrow NaX + R-O-R$$

alkoxide — Haloalkane (1°) — ether.

$2° RX \longrightarrow X$ Alkene

$3° RX \longrightarrow X$


1°
Ether

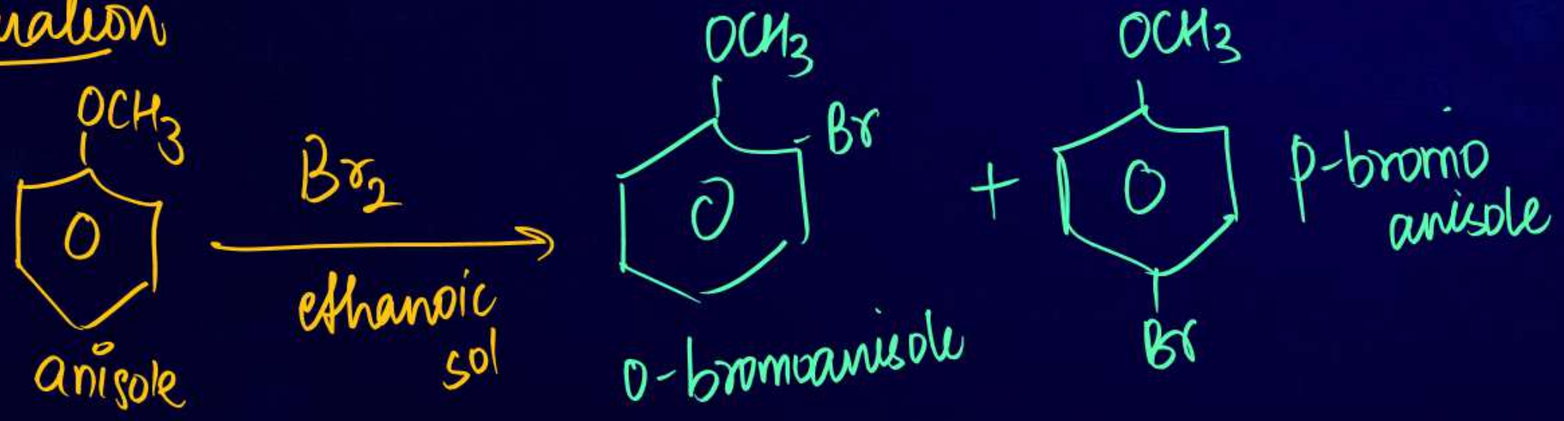
CHEMICAL PROPERTIES OF ETHER

1. Rx with HX

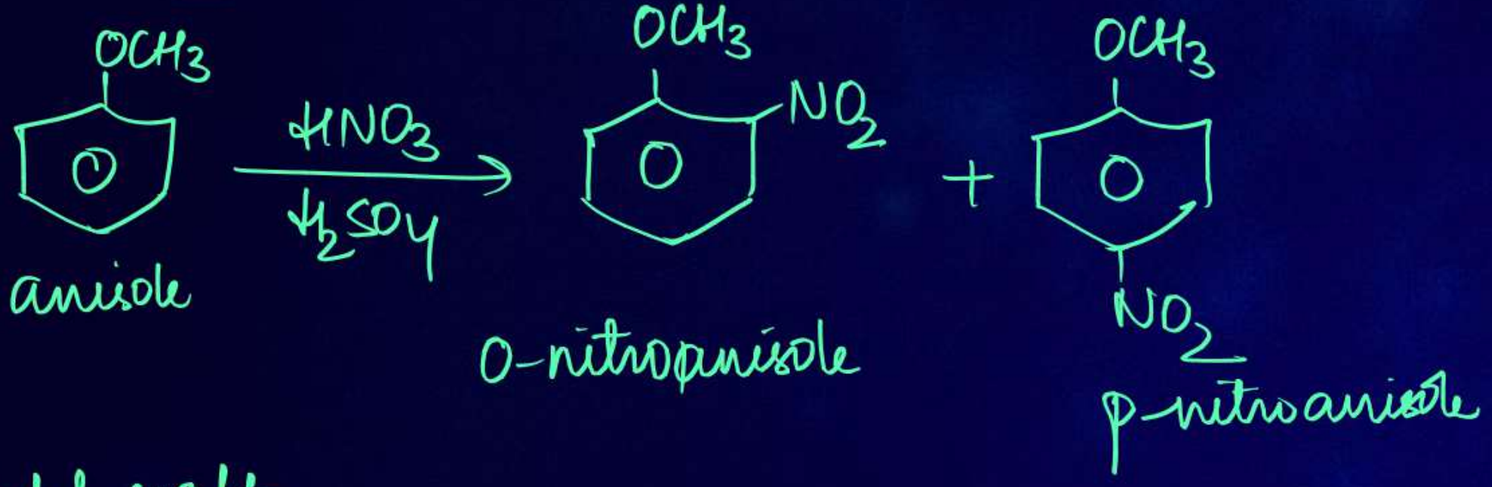
$$R\overset{-}{-}O\overset{+}{R} + \overset{+}{H}\overset{-}{X} \longrightarrow R\text{-}OH + RX$$

$$R\text{-}OH + HX \longrightarrow R\text{-}X + H_2O$$

2. Halogenation

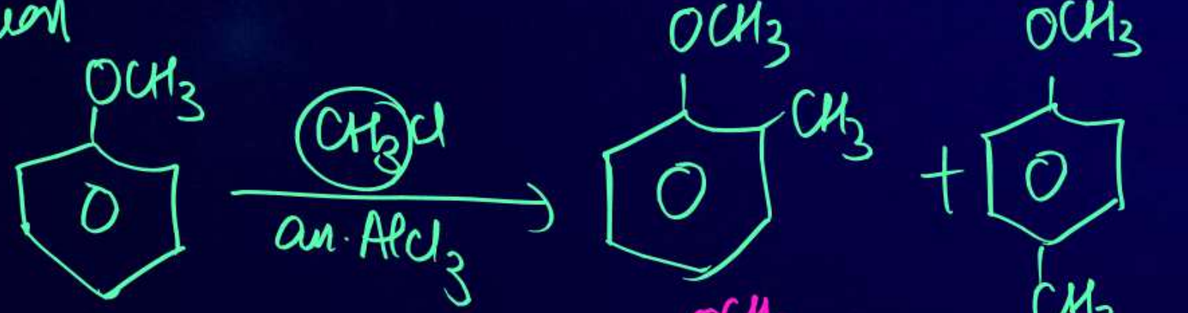


3. Nitration

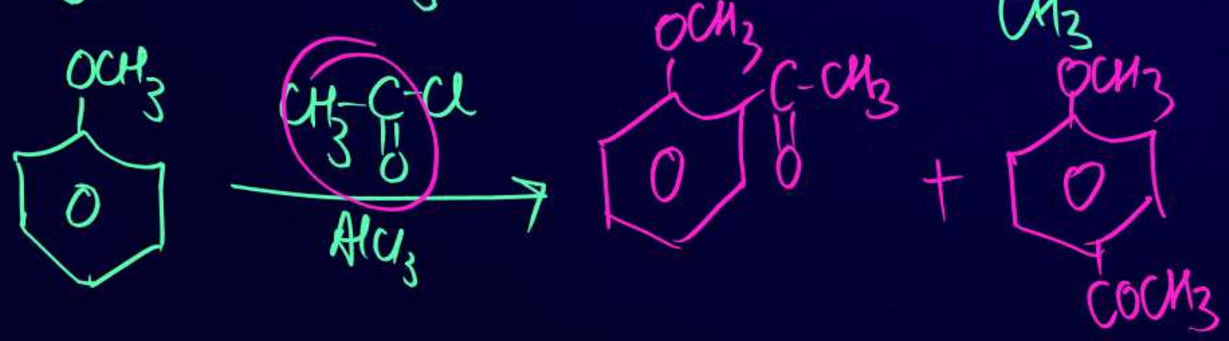


4. Friedel craft

Alkylation



acylation



What happens when

(a) Anisole is treated with CH_3Cl / anhydrous $AlCl_3$?

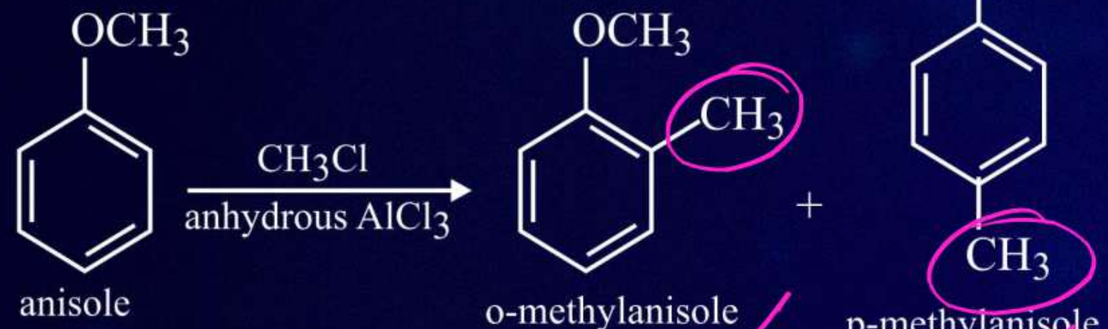
(b) Phenol is oxidised with $Na_2Cr_2O_7/H^+$?

(c) $(CH_3)_3C - OH$ is heated with Cu/573K?

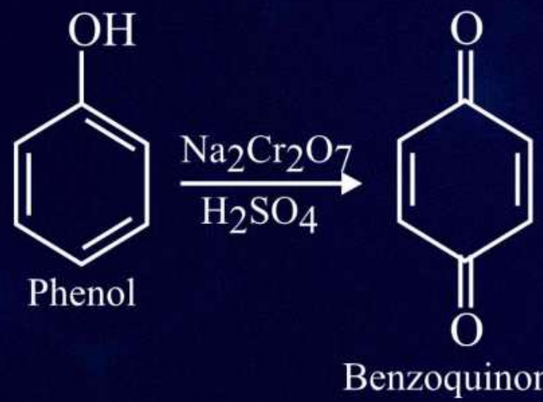
Write a chemical equation in support of your answer.

Solution

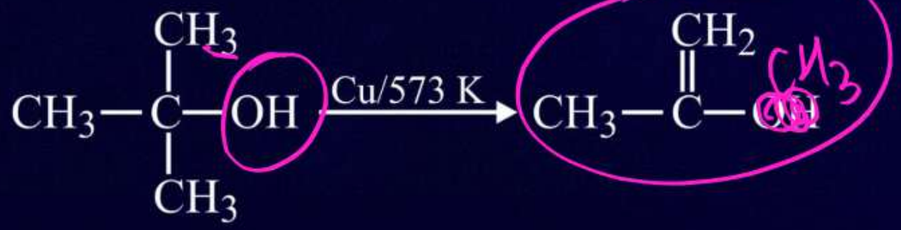
(a)



(b)



(c)



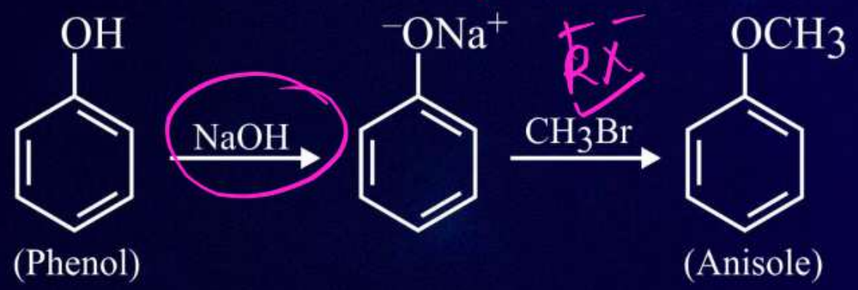
(i) How do you convert the following:

(a) Phenol to Anisole

(b) Ethanol to Propan-2-ol

Solution

(i) (a)



(b) $CH_3CH_2OH \rightarrow CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3$

(Ethanol) (Propan–2–ol)

$$CH_3CH_2OH \xrightarrow{PCC} CH_3CHO \xrightarrow{CH_3MgBr} H_3C-\underset{\displaystyle OMgBr}{\underset{|}{CH}}-CH_3 \xrightarrow{H_2O} H_3C-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3$$

(Ethanol) Propan-2-ol

Case Based Que.

1. Ethers are organic compounds characterized by an oxygen atom linked to two similar or different alkyl or aryl groups. Several methods are available for ether synthesis. With the presence of protic acids like sulphuric acid or phosphoric acid, alcohols can undergo dehydration, producing alkenes and ethers under varying conditions. This method suits the preparation of ethers with primary alkyl groups.

   Williamson's synthesis is a significant technique for creating symmetrical and asymmetrical ethers in labs. In this approach, alkylk halides react with alcoholic sodium alkoxides through heating, yielding the desired ethers. This method can also produce ethers, with substituted alkylk groups, be they secondary or tertiary. The process involves nucleophilic substitution of halides by alkoxides to achieve the desired outcomes.

   Aromatic ethers, containing alkoxy groups, exhibit heightened reactivity in electrophilic substitution reactions. This makes them susceptible to halogenations, nitration, and Friedel-Crafts reactions on their aromatic rings.

Which type of reaction is used in Williamson's synthesis of ethers?

S_N2 types of reaction is occur in Williamson synthesis.

What is the role of protic acid in dehydration of ethers?

Polar acid helps to protonate alcohol, after this, removal of water will take place.

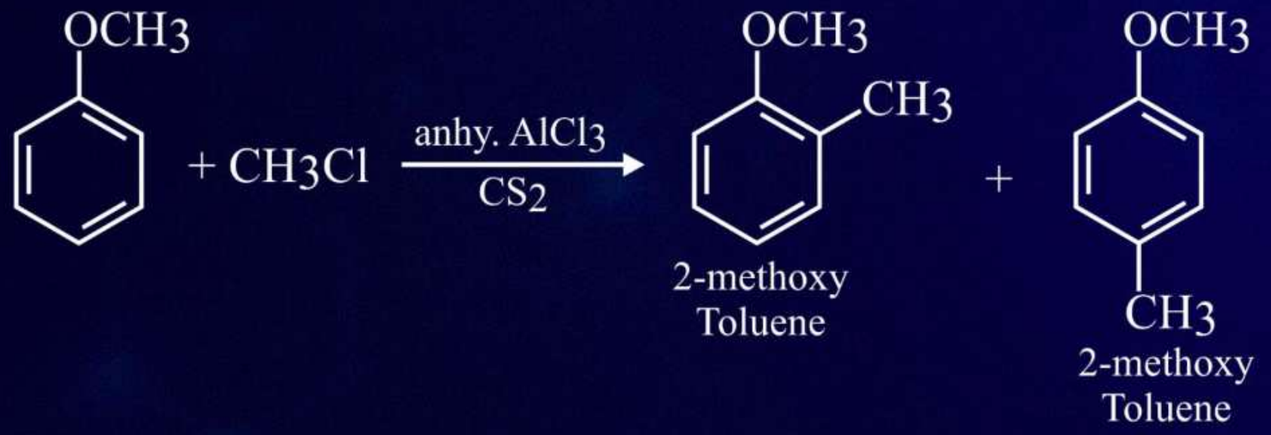
How does the presence of alkoxy groups in aromatic ethers affect their reactivity towards electrophilic substitution reactions?

Solution

Aromatic ether containing alkoxy groups activates their aromatic sings towards Electrophilic substitution reactions. This makes them more susceptible to reaction like halogenation, nitration etc.


OCH3
+ CH3Cl
anhy. AlCl3
CS2

Solution

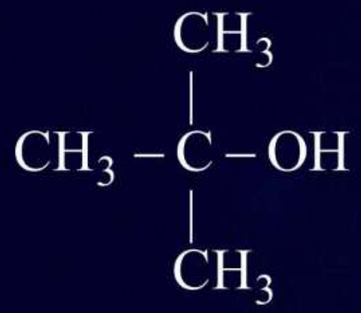

OCH3
+ CH3Cl
anhy. AlCl3
CS2
OCH3
CH3
2-methoxy
Toluene
+
OCH3
CH3
2-methoxy
Toluene

2. **Read the passage givenbelow and answer the following questions:**

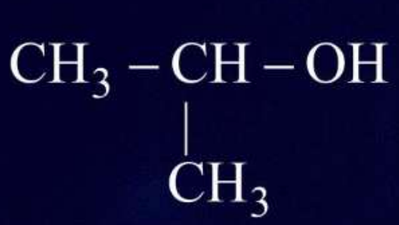
Alcohols and phenols are acidic in nature. Electron withdrawing groups in phenol increase its acidic strength and electron donating groups decrease it. Alcohols undergo nucleophilic substitution with hydrogen halides to give alkyl halides. On oxidation primary alcohols yielding aldehydes with mild oxidizing agents and carboxylic acids with strong oxidizing agents while secondary alcohols yields ketones. The presence of –OH groups in phenols activates the ring towards electrophilic substitution. Various imkportant products are obtained from phenol like salicylaldehyde, salicylic acid, picric acid etc.

Which of the following alcohols is resistant to oxidation?

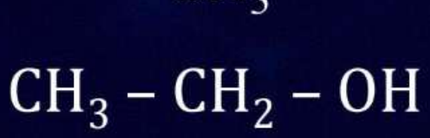
A



B



C



D

Solution

(A)

Tertiary alcohols are resistant to oxidation because the C-atom to which –OH group is attached does not have a hydrogen atom.

Which of the following groups increase the acidic character of phenol?

A CH_3O^-

B CH_3^-

C NO_2^-

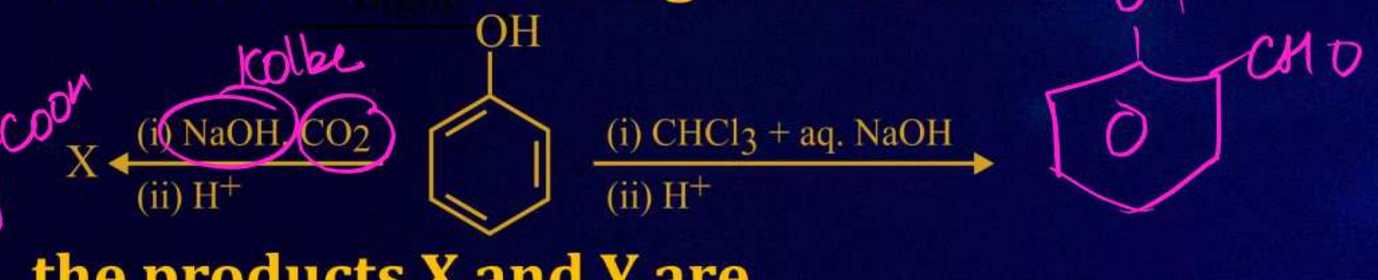
D All of these

Solution

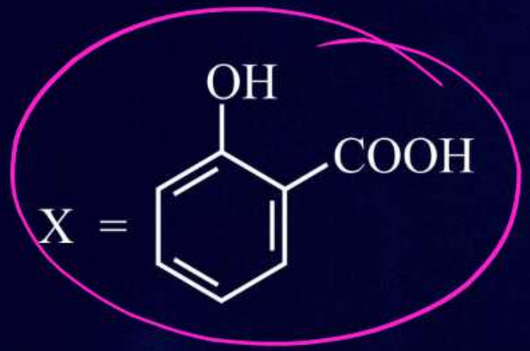
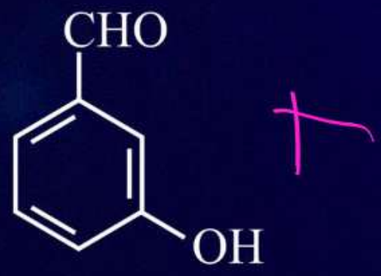
(C)

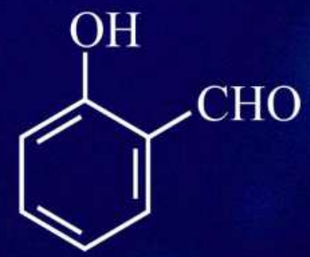
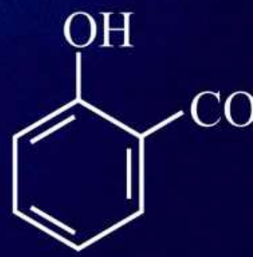
Nitro group is an electron withdrawing group, it increases the acidic strength of phenol.

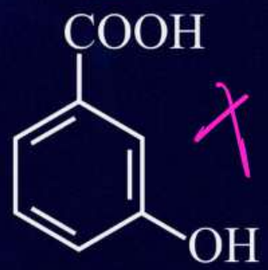
Consider the following reactions:

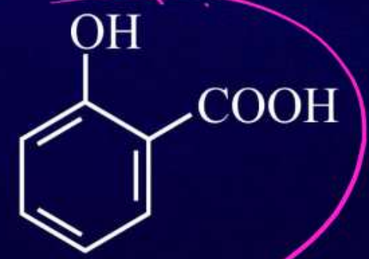
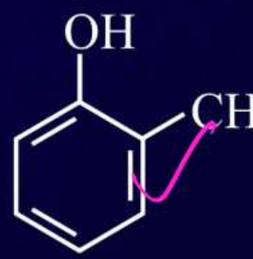


the products X and Y are

A X =  Y = 

B X =  Y = 

C X =  Y = 

D X =  Y = 

Solution

(D)

Product "X" is Salicylic acid and the reaction is Kolbe's reaction.

Thank You