

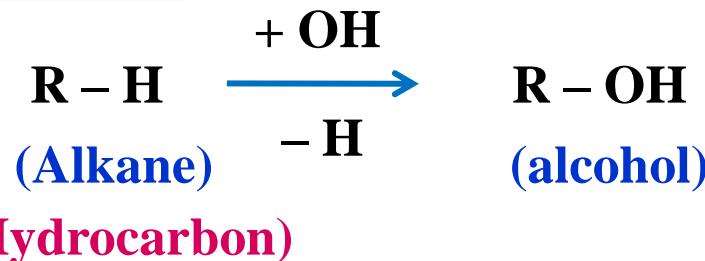
# **ALCOHOLS, PHENOLS AND ETHERS**

ALCOHOLS, PHENOLS AND ETHERS

# INTRODUCTION TO ALCOHOLS

## ALCOHOLS, PHENOLS AND ETHERS

### Alcohols



Now, replace hydrogen of alkane **with hydroxyl group**

Alcohols are the hydroxyl derivatives of hydrocarbons **in which one or more hydrogen atoms are replaced by corresponding number of hydroxyl ( $- \text{OH}$ ) group(s).**

For e.g.  $\text{H}_3\text{C} - \text{OH}$  (Methyl alcohol),

$\text{H}_5\text{C}_2 - \text{OH}$  (Ethyl alcohol), etc.

1. R – H means...

a)  Alkane

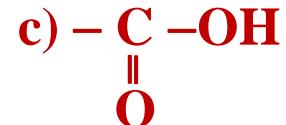
b) Alkynes

c) Alkene

d) Both a & b

## ALCOHOLS, PHENOLS AND ETHERS

2. Functional group of an alcohol is...



### 3. Alcohols are ... derivatives of hydrocarbons

- a) keto
- b)  hydroxyl
- c) aldehyde
- d) halogen

## ALCOHOLS, PHENOLS AND ETHERS

4.  $C_2H_5OH$  (Name of this compound is \_\_\_\_\_)

a) methyl alcohol

b) butyl alcohol

c)  ethyl alcohol

d) isopropyl alcohol

# CLASSIFICATION OF ALCOHOL (PART-I)

# ALCOHOLS, PHENOLS AND ETHERS

## Classification of alcohols

### Alcohols

- 1. Monohydric alcohols
- 2. Dihydric alcohols
- 3. Trihydric alcohols
- 4. Polyhydric alcohols

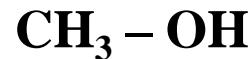
## ALCOHOLS, PHENOLS AND ETHERS

### Classification of alcohols

#### 1. Monohydric alcohols

(Contains only one – OH group)

For eg.



(Methyl alcohol)

How many hydroxyl groups  
does it contain?

# ALCOHOLS, PHENOLS AND ETHERS

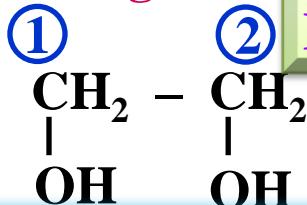
## Classification of alcohols

### 2. Dihydric alcohols

(Contain two – OH groups)

What is the IUPAC name of this compound ?

For eg.



Common name:

Ethylene glycol

IUPAC name:

Ethane – 1, 2 – diol)

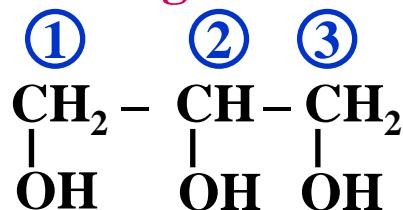
# ALCOHOLS, PHENOLS AND ETHERS

## Classification of alcohols

### 3. Trihydric alcohols

(Contain three – OH groups)

For eg.



Common Name:  
Glycerol / Glycerin

IUPAC Name:  
Propane – 1, 2 ,3 – triol)

What is the IUPAC name of this compound ?

## ALCOHOLS, PHENOLS AND ETHERS

### Classification of alcohols

#### 4. Polyhydric alcohols

(Contains four or more than four – OH group)

For eg.



Common Name:  
**Sorbitol**

### Classification of Monohydric alcohols

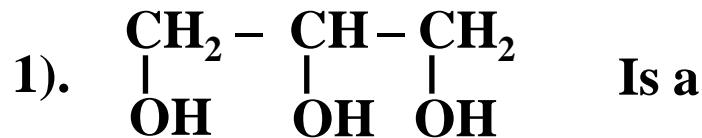
According to the type of **hybridization** of the Carbon atom to which the hydroxyl group is attached :

#### Monohydric alcohols

There are two types of monohydric alcohols

1. Alcohols Containing  $C_{sp^3}$  – OH bond

2. Alcohols Containing  $C_{sp^2}$  – OH bond



- a) mono hydric alcohol
- b) di hydric alcohol
- c) tri hydric alcohol
- d) Tetra hydric alcohol

ALCOHOLS, PHENOLS AND ETHERS

# CLASSIFICATION OF ALCOHOL (PART-II)

# ALCOHOLS, PHENOLS AND ETHERS

## 1. Alcohols Containing $C_{sp^3}$ – OH bond

Alkyl Alcohols

There are three types of  
Alkyl alcohols

- Primary ( $1^0$ ) alcohols
- Secondary ( $2^0$ ) alcohols
- Tertiary ( $3^0$ ) alcohols

## ALCOHOLS, PHENOLS AND ETHERS

### Alkyl Alcohols

#### Primary ( $1^0$ ) alcohols

For eg.  $1^0$



IUPAC Name:  
Ethanol

To what type of carbon  
OH group is attached?

In primary alcohols hydroxyl group is attached to  $1^0$  Carbon atom or Primary carbon.

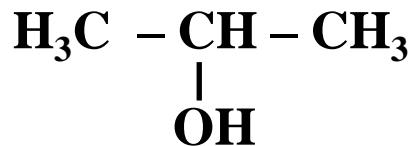
## ALCOHOLS, PHENOLS AND ETHERS

Alkyl Alcohols

Secondary ( $2^0$ ) alcohols

In secondary alcohols hydroxyl group is attached to  $2^0$  Carbon atom.

For eg.  $2^0$  - Carbon



(Iso/sec – propyl alcohol)

IUPAC Name:

Propanol-2 or Propan-2-ol

## ALCOHOLS, PHENOLS AND ETHERS

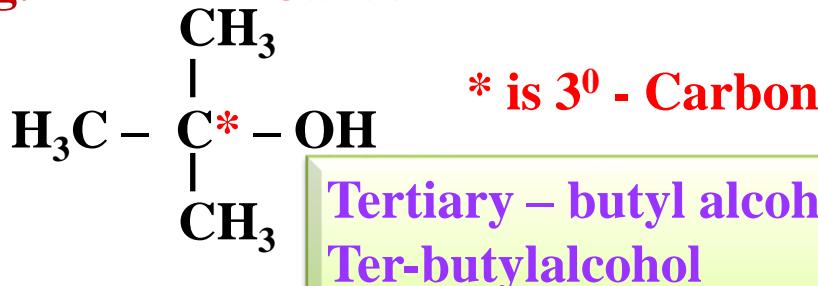
Alkyl Alcohols

Tertiary ( $3^0$ ) alcohols

In tertiary alcohols hydroxyl group is attached to  $3^0$  or Tertiary carbon atom)

For eg.

$1^0$  - Carbon



Tertiary – butyl alcohol (or)  
Ter-butylalcohol

IUPAC Name:

2-methylpropan-2-ol

## ALCOHOLS, PHENOLS AND ETHERS

### 1. Alcohols Containing $C_{sp^3}$ – OH bond

Allylic Alcohols

There are three types of  
Allylic alcohols

(Hydroxyl group is attached to a  $sp^3$   
hybridised carbon atom next to the  $C = C$   
i.e. to an allylic carbon)

## ALCOHOLS, PHENOLS AND ETHERS

### Allylic Alcohols

#### 1<sup>o</sup> allylic alcohols

For eg.



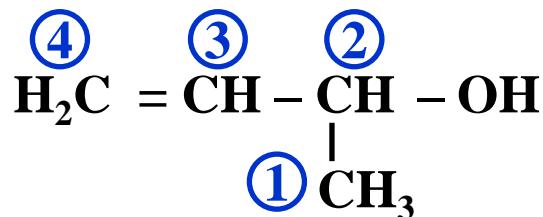
(Prop – 2 – en – 1 – ol)

## ALCOHOLS, PHENOLS AND ETHERS

### Allylic Alcohols

#### 2<sup>0</sup> allylic alcohols

For eg.



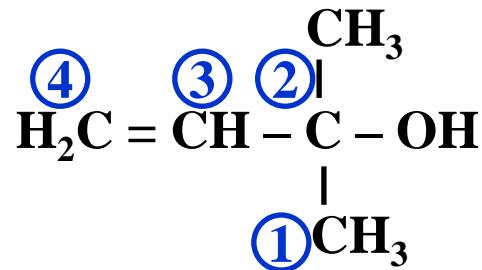
(But – 3 – en – 2 – ol)

## ALCOHOLS, PHENOLS AND ETHERS

### Allylic Alcohols

#### 3<sup>o</sup> allylic alcohols

For eg.



(2 – Methyl but – 3 –en – 2 – ol )

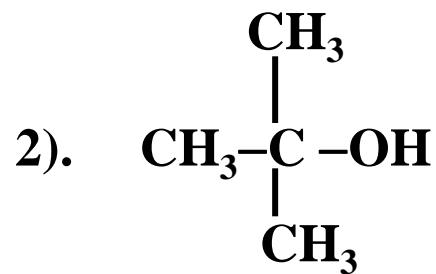
1).  $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{OH}$  is a...

a) Primary alcohols

b) Secondary alcohols

c) Tertiary alcohols

d) Quaternary alcohols



- a) Primary alcohols
- b) Secondary alcohols
- c)  Tertiary alcohols
- d) Quaternary alcohols

## ALCOHOLS, PHENOLS AND ETHERS

3). Which one of the following is a secondary alcohol?

a) 2 – methyl -2- propanol

b) 1- propanol

c) 1- butanol

 2- pentanol

## ALCOHOLS, PHENOLS AND ETHERS

4). 2 - methyl pentanol -1 is a...

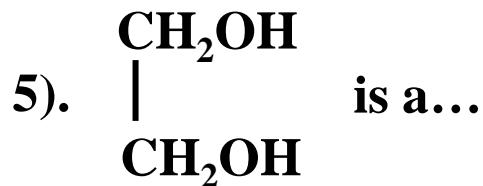
a)   $1^0$  alcohol

b)  $2^0$  alcohol

c)  $3^0$  alcohol

d) enol

## ALCOHOLS, PHENOLS AND ETHERS



a)   $1^0$  alcohols

b)  $2^0$  alcohols

c)  $3^0$  alcohols

d) Carbinol

# **CLASSIFICATION OF ALCOHOL (PART-II)**

## ALCOHOLS, PHENOLS AND ETHERS

### 1. Alcohols Containing $C_{sp^3}$ – OH bond

Benzyllic alcohols

There are three types of  
Benzyllic alcohols

$1^0$  benzyllic alcohols

$2^0$  benzyllic alcohols

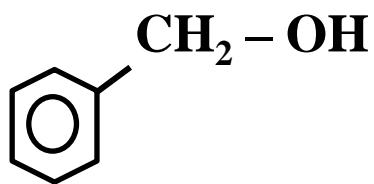
$3^0$  benzyllic alcohols

## ALCOHOLS, PHENOLS AND ETHERS

### Benzyllic alcohols

#### 1<sup>o</sup> benzylic alcohols

For eg.



(Benzyl alcohol)

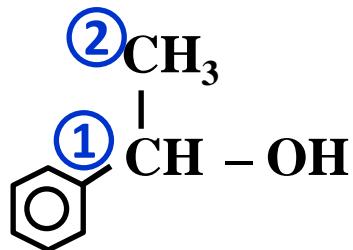
(Phenyl methanol)

## ALCOHOLS, PHENOLS AND ETHERS

### Benzyllic alcohols

#### 2<sup>0</sup> benzyllic alcohols

For eg.



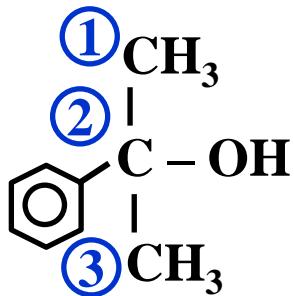
(1 – Phenyl ethanol)

## ALCOHOLS, PHENOLS AND ETHERS

### Benzyllic alcohols

#### 3<sup>0</sup> benzylic alcohols

For eg.



(2 – Phenyl propan – 2 – ol)

### Classification of Monohydric alcohols

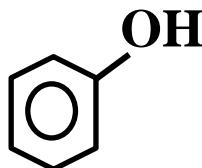
#### 2. Alcohols Containing C<sub>sp2</sub> – OH bond

- – OH group is attached to a sp<sup>2</sup> hybridised carbon atom i.e. vinylic carbon or aryl carbon. these alcohols are also known as vinylic alcohols or phenols.

For eg.



(Vinyl alcohol)



(Phenol)

1). In alkyl alcohol –OH group is attached to... hybridized carbon atom

a)  $sp^2$

b)  $sp$

c)  $sp^3$

d)  $sp^3d$

## ALCOHOLS, PHENOLS AND ETHERS

- 2). In secondary alcohol, hydroxyl group is attached to... carbon atom.
- a) Primary ( $1^0$ )
  - b) Tertiary ( $3^0$ )
  - c) Secondary ( $2^0$ )
  - d) None of these

## ALCOHOLS, PHENOLS AND ETHERS



- a) Primary benzylic alcohol 
- b) Secondary benzylic alcohol
- c) Tertiary benzylic alcohol
- d) None of these

## ALCOHOLS, PHENOLS AND ETHERS

4). In vinylic alcohols, – OH group is attached to...hybridized carbon atom.

a) sp

b)  sp<sup>2</sup>

c) sp<sup>3</sup>

d) sp<sup>3</sup>d

## ALCOHOLS, PHENOLS AND ETHERS



# **ALCOHOLS, PHENOLS AND ETHERS**

ALCOHOLS, PHENOLS AND ETHERS

# NOMENCLATURE

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

No.	Structure	Common name
1.	$\text{H}_3\text{C} - \text{OH}$	Methyl alcohol

Common name:- common name of alkyl group(Methyl)+alcohol  
=Methyl alcohol

I.U.P.A.C. Name
Methanol

Root word +an + ol=  
Meth+an+ol=Methanol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

No.	Structure	Common Name
2.	$\text{H}_3\text{C} - \text{CH}_2 - \text{OH}$	Ethyl alcohol

I.U.P.A.C. Name

Ethanol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

No.	Structure	Common Name
3.	$\text{H}_3\text{C}-\overset{\textcircled{3}}{\text{CH}_2}-\overset{\textcircled{2}}{\text{CH}_2}-\overset{\textcircled{1}}{\text{OH}}$	n – propyl alcohol

I.U.P.A.C. Name

Propan – 1 – ol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

No.	Structure	Common Name
4.	$\begin{array}{c} \text{③} & \text{②} & \text{①} \\ \text{H}_3\text{C} - & \text{CH} - & \text{CH}_3 \\ &   & \\ & \text{OH} & \end{array}$	Iso / sec – propyl alcohol

I.U.P.A.C. Name

Propan – 2 – ol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

No.	Structure	Common Name
5.	$\text{H}_3\text{C}-\overset{\textcircled{4}}{\text{CH}_2}-\overset{\textcircled{3}}{\text{CH}_2}-\overset{\textcircled{2}}{\text{CH}_2}-\underset{\textcircled{1}}{\underset{ }{\text{CH}_2-\text{OH}}}$	n – butyl alcohol

I.U.P.A.C. Name

Butan – 1 – ol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

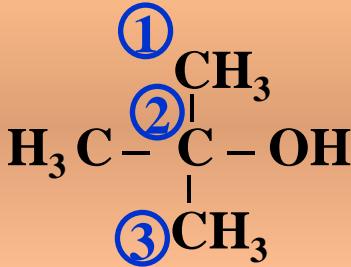
No.	Structure	Common Name
6.	$\text{H}_3\text{C} - \underset{\text{OH}}{\overset{\text{②}}{\text{CH}}} - \underset{\text{③}}{\text{CH}_2} - \underset{\text{④}}{\text{CH}_3}$	sec – butyl alcohol

I.U.P.A.C. Name

Butan – 2 – ol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

No.	Structure	Common Name
7.	 <chem>CC(C)C(O)C</chem>	tert – butyl alcohol

I.U.P.A.C. Name

2 – Methyl propan – 2 – ol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

No.	Structure	Common Name
8.	$\text{H}_3\text{C} - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_2 - \text{OH}$ ③    ②    ①	Isobutyl alcohol

I.U.P.A.C. Name

2 – Methyl propan – 1 – ol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

No.	Structure	Common Name
9.	$\begin{array}{c} \text{CH}_3 \\   \\ \text{H}_3\text{C} - \text{C}(\text{CH}_3) - \text{C}(\text{CH}_3) - \text{CH}_2 - \text{OH} \\   \\ \text{③} \quad \text{②} \quad \text{①} \end{array}$	neo – pentyl alcohol

### I.U.P.A.C. Name

2,2-Dimethyl propan – 1 – ol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

No.	Structure
10.	$\begin{array}{ccccccc} \text{H}_3\text{C} & - & \overset{\textcircled{5}}{\text{CH}} & - & \overset{\textcircled{4}}{\text{CH}} & - & \overset{\textcircled{3}}{\text{CH}} \\ &   & &   & &   & \\ & \text{CH}_3 & & \text{OH} & & \text{CH}_3 & \\ & & & & & & \overset{\textcircled{2}}{\text{C}} \\ & & & & &   & \\ & & & & & \text{CH}_3 & \\ & & & & & & \overset{\textcircled{1}}{\text{CH}_3} \end{array}$

For complicated structure instead of common name IUPAC name is more preferred for example

### I.U.P.A.C. Name

2,2,4 – Trimethyl pentan – 3 – ol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

No.	Structure
11.	$\text{H}_3\text{C} - \underset{\text{OH}}{\overset{\text{④}}{\text{CH}}} - \underset{\text{OH}}{\overset{\text{③}}{\text{CH}}} - \underset{\text{②}}{\overset{\text{①}}{\text{CH}}} - \text{CH}_3$

### I.U.P.A.C. Name

Butane-2,3-diol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

No.	Structure
12.	$\text{H}_3\text{C}-\overset{\textcircled{1}}{\underset{\text{OH}}{\text{CH}}}-\overset{\textcircled{2}}{\underset{\text{OH}}{\text{CH}_2}}-\overset{\textcircled{3}}{\underset{\text{C}_2\text{H}_5}{\text{CH}}}-\overset{\textcircled{4}}{\underset{ }{\text{CH}}}-\overset{\textcircled{5}}{\underset{ }{\text{CH}}}-\overset{\textcircled{6}}{\underset{ }{\text{CH}_2}}-\overset{\textcircled{7}}{\underset{ }{\text{CH}_3}}$

### I.U.P.A.C. Name

4-Ethylheptane-2,3-diol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

No.	Structure
13.	$\text{HO} - \text{CH}_2 - \underset{\text{OH}}{\overset{\text{②}}{\text{CH}}} - \underset{\text{③}}{\text{CH}_2} - \underset{\text{④}}{\text{CH}_2} - \underset{\text{⑤}}{\text{CH}_3}$

### I.U.P.A.C. Name

Pentane –1,2 – diol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

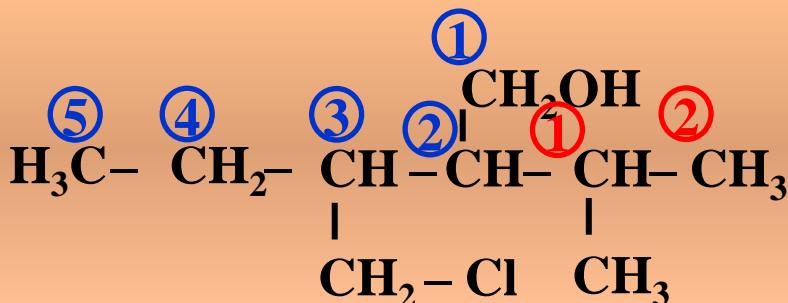
No.	Structure
14	$\text{H}_3\text{C} - \underset{\text{Cl}}{\overset{\textcircled{5}}{\text{CH}}} - \underset{\text{CH}_3}{\overset{\textcircled{4}}{\text{CH}}} - \underset{\text{CH}_3}{\overset{\textcircled{3}}{\text{CH}}} - \underset{\text{CH}_3}{\overset{\textcircled{2}}{\text{CH}}} - \underset{\text{CH}_2\text{OH}}{\overset{\textcircled{1}}{\text{CH}_2}}$

### I.U.P.A.C. Name

4 – Chloro–2, 3 – dimethyl  
pentan – 1 – ol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

No.	Structure
15	

### I.U.P.A.C. Name

3 –Chloro methyl – 2 – (1 – methyl  
ethyl) pentan – 1 – ol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

No.	Structure
16	$\begin{array}{cccccc} & \textcircled{1} & \text{CH}_2\text{OH} \\ \text{H}_3\text{C}- & \text{CH}- & \text{CH}_2- & \text{CH}- & \text{CH}- & \text{CH}_3 \\ \textcircled{6} & \textcircled{5} & \textcircled{4} & \textcircled{3} & \textcircled{2} & \\   & & &   &   & \\ \text{CH}_3 & & & \text{OH} & \text{I} & \end{array}$

### I.U.P.A.C. Name

2,5 – Dimethylhexane –1,3 – diol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

No.	Structure
17	$\text{H}_2\text{C}=\overset{\textcircled{1}}{\text{CH}}-\overset{\textcircled{2}}{\text{CH}}-\overset{\textcircled{3}}{\underset{\text{OH}}{\text{CH}}}-\overset{\textcircled{4}}{\text{CH}_2}-\overset{\textcircled{5}}{\text{CH}_2}-\overset{\textcircled{6}}{\text{CH}_3}$

### I.U.P.A.C. Name

Hex-1-en-3-ol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

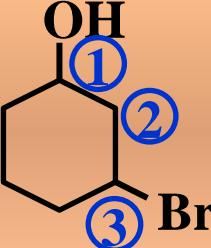
No.	Structure
18	$\text{H}_3\text{C}-\overset{\textcircled{1}}{\text{CH}}-\overset{\textcircled{2}}{\text{CH=}}-\overset{\textcircled{3}}{\text{CH}}-\overset{\textcircled{4}}{\text{CH}_2}-\overset{\textcircled{5}}{\text{CH}_2}-\overset{\textcircled{6}}{\text{CH}_3}$          OH    Br

### I.U.P.A.C. Name

3 – Bromo – hex – 2 – en – 2 – ol

## ALCOHOLS, PHENOLS AND ETHERS

### Nomenclature

No.	Structure
19	

### I.U.P.A.C. Name

3 – Bromo – cyclohexan – 1 – ol

## ALCOHOLS, PHENOLS AND ETHERS

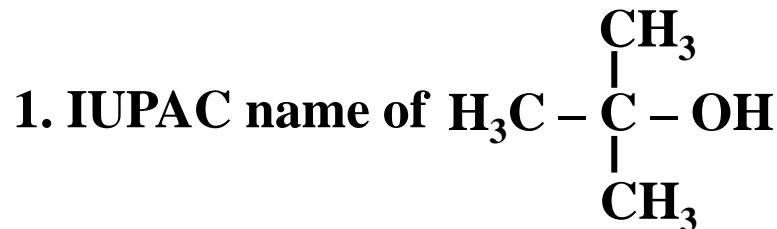
To find out no. of

Possible isomers of alkyl alcohols =  $2^{n-2}$

Possible isomers of alkyl alcohols + ethers =  $2^{n-1} - 1$

Possible isomers of ethers =  $(2^{n-1} - 1) - (2^{n-2})$

Where, n = No. of Carbon atoms



a) 2 – Methylpropan – 1 – ol

b)  2 – Methylpropan – 2 – ol

c) 1 – Methylpropan – 3 – ol

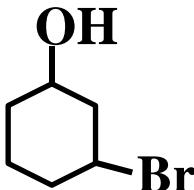
d) 1 – Methylpropan – 2 – ol

## ALCOHOLS, PHENOLS AND ETHERS

2. IUPAC name of  $\text{H}_3\text{C} - \overset{\text{CH}_3}{\underset{\text{Cl}}{\text{CH}}} - \overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{CH}}} - \text{CH} - \text{CH}_2\text{OH}$

- a) 2 – Chloro –3, 4– dimethylpentan – 5 – ol
- b) 4 – Chloro –2, 3 – dimethylpentan – 2 – ol
- c)  4 – Chloro –2, 3 – dimethylpentan – 1 – ol
- d) None of these

## ALCOHOLS, PHENOLS AND ETHERS

3. IUPAC name of 

- a) 1 – Bromocyclohexanol
- b) 5 – Bromocyclohexanol
- c) 4 – Bromocyclohexanol
- d)  3 – Bromocyclohexanol

## ALCOHOLS, PHENOLS AND ETHERS

4. Possible isomers of alkyl alcohols can be given by...

a)  $2^{n-1}$

b)  $2^n$

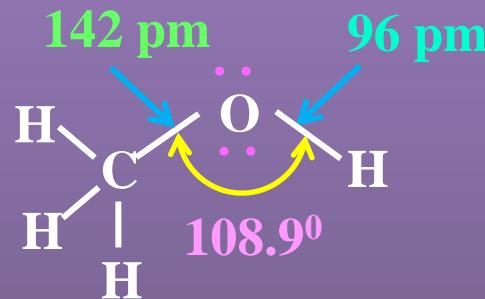
c)   $2^{n-2}$

d)  $2^{n-1} + 1$

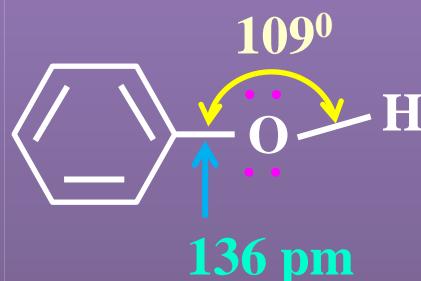
# STRUCTURE OF FUNCTIONAL GROUPS

# ALCOHOLS, PHENOLS AND ETHERS

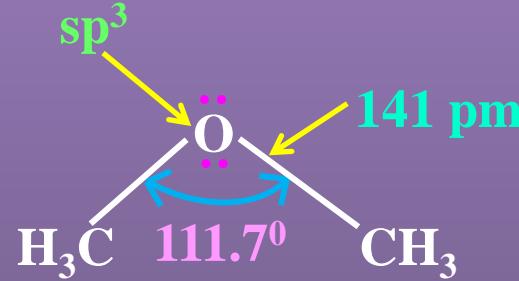
## Structure of Methanol



## Structure of Phenol



## Structure of dimethyl ether



## ALCOHOLS, PHENOLS AND ETHERS

- The bond angle COH in alcohol is slightly less than the tetrahedral bond angle  $109^{\circ} 28'$
- It's due to repulsion between the unshared electron pairs of oxygen .
- The carbon – oxygen bond length (136 pm) in phenol is slightly less than that in methanol.
- It's due to
  - I. Partial double bond character (by delocalization)
  - II.  $SP^2$  – carbon attached to – OH group of phenol.

## ALCOHOLS, PHENOLS AND ETHERS

**Order of bond angle:-**

Alcohol < Phenol < Ether

Due to big size  
alkyl groups  
around the oxygen

**Order of bond length :-**

Alcohol (or) Ether > Phenol

### Uses of Methanol

- Industrial solvent for oils , fats, gums etc.
- For dry cleaning & preparation of perfumes.
- As an antifreezing agent.
- To prepare chloromethane, dimethyl sulphate and formaldehyde etc.

### Uses of Ethanol :

- As a solvent for dyes, oils, perfumes, cosmetics and drugs
- Mixture of 10 – 20% Ethanol with petrol is used as motor fuel.
- As an alcoholic beverages
- Effective topical antiseptic
- Used to prepare chloroform, iodoform, acetic acid etc.

## ALCOHOLS, PHENOLS AND ETHERS

### Note :

- Rectified spirit = **95.6%** ethyl alcohol + **4.4%** water ( **azeotropic mixture** )
  
- Power alcohol = **20%** Absolute alcohol + **80%** petrol
  
- Absolute alcohol = ethyl alcohol containing not more than **1%** water ( **99%** Pure ethyl alcohol )

1. Alcohols have high boiling points than that of corresponding alkanes, due to...
- a) Metallic bonding
  - b) Intramolecular hydrogen bonding
  - c)  Intermolecular hydrogen bonding
  - d) None of these

## ALCOHOLS, PHENOLS AND ETHERS

2. Following is used as an “antifreezing agent”...

a) Methanol

b)  Ethanol

c) Propanol

d) None of these

## ALCOHOLS, PHENOLS AND ETHERS

3. Following is used as an alcoholic beverage...

a) Methanol

b)  Ethanol

c) Propanol

d) None of these

4. 95.6% ethyl alcohol and 4.4% water is...

- a) Power alcohol
- b)  Rectified spirit
- c) Absolute alcohol
- d) None of these

## ALCOHOLS, PHENOLS AND ETHERS

5. More CO bond length of CO is observed in ---

a) Alcohols

b) Phenols

c) Both are equal

d) Ethers

## ALCOHOLS, PHENOLS AND ETHERS

6. Bond length of CO in phenol is slightly less than CO of methanol because...

- a)  partial double bond character
- b)  $sp^2$ – carbon attached to –OH group of phenol
- c) Both a &b
- d) none of these

## ALCOHOLS, PHENOLS AND ETHERS



# **ALCOHOLS, PHENOLS AND ETHERS**

ALCOHOLS, PHENOLS AND ETHERS

# PREPARATION OF ALCOHOLS

## ALCOHOLS, PHENOLS AND ETHERS

### Methods of preparation of Alcohols ( $R - OH$ )

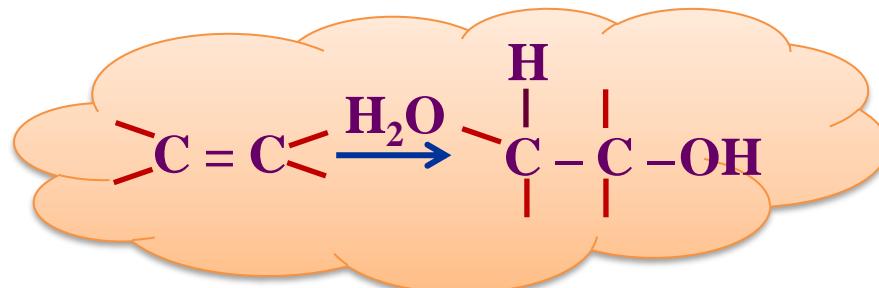
- Hydration of Alkenes.
- Hydroboration – oxidation of alkenes.
- Reduction or hydrogenation of Carbonyl compounds.
- From Grignard's reagent  
**(alkyl magnesium halide) ( $R - Mg - X$ ).**

## ALCOHOLS, PHENOLS AND ETHERS

### Methods of preparation of Alcohols (R – OH)



(Commercial / Industrial method)



## ALCOHOLS, PHENOLS AND ETHERS

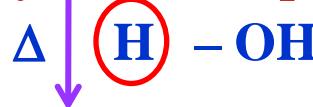


Ethene or Ethylene

Cold



Ethyl hydrogen sulphate



Ethanol

1<sup>o</sup> alcohol

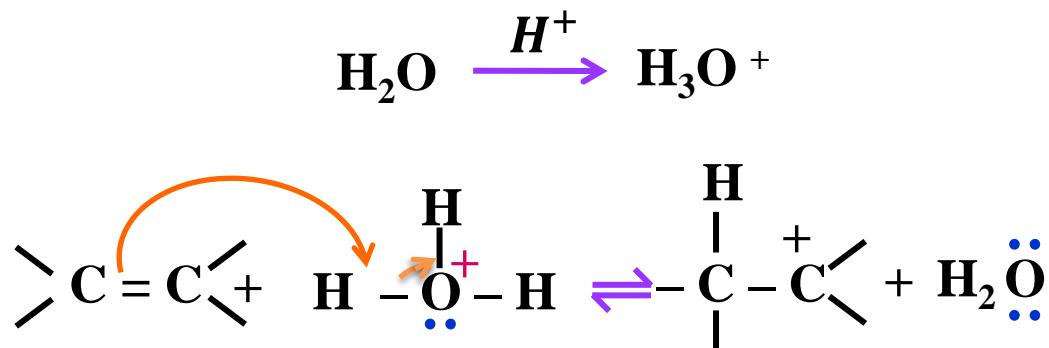
Commonly called as Grain alcohol

## ALCOHOLS, PHENOLS AND ETHERS

### Mechanism of Hydration of alkenes :

Step I :

Protonation of alkene to form carbocation by Electrophilic attack of  $\text{H}_3\text{O}^+$

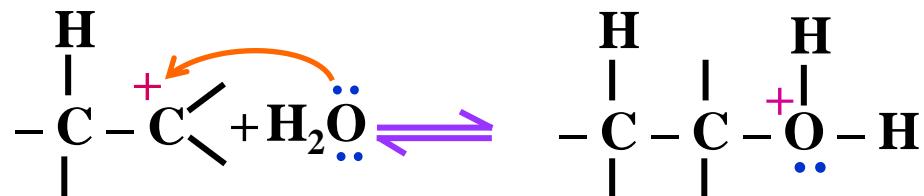


## ALCOHOLS, PHENOLS AND ETHERS

### Mechanism of Hydration of alkenes :

Step II :

Nucleophilic attack of water on carbocation

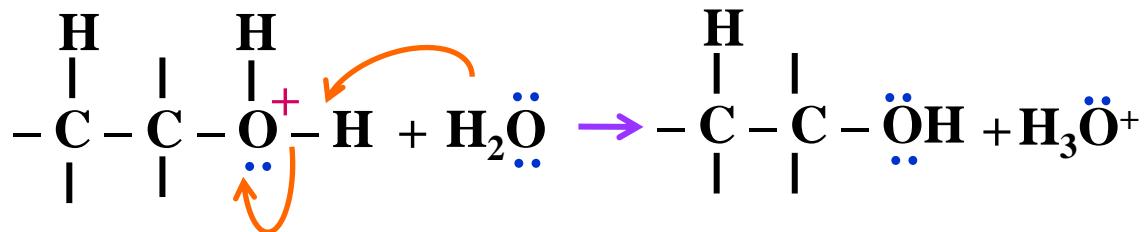


## ALCOHOLS, PHENOLS AND ETHERS

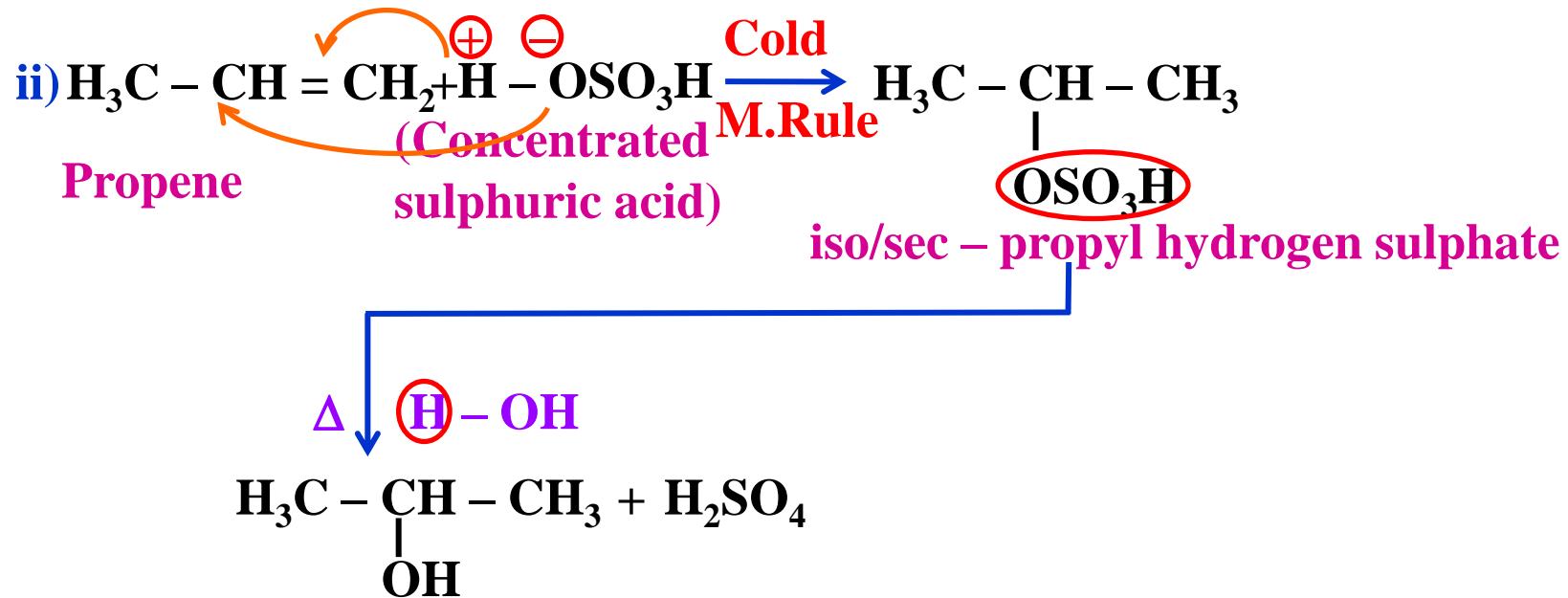
### Mechanism of Hydration of alkenes :

#### Step III :

Deprotonation to form an alcohol

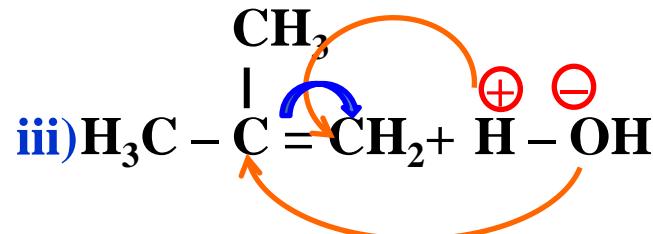


## ALCOHOLS, PHENOLS AND ETHERS

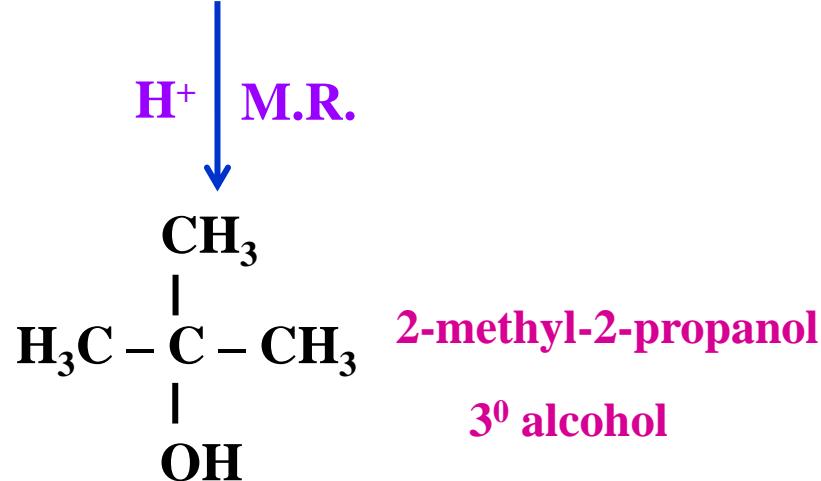


Iso/sec – propyl alcohol or Propan-2-ol  
2<sup>o</sup> alcohol

## ALCOHOLS, PHENOLS AND ETHERS



Isobutylene  
2-methylpropene



Tert – butyl alcohol

## ALCOHOLS, PHENOLS AND ETHERS

### Note :

- i) This method is used to prepare  $2^0$  and  $3^0$  alcohols.
- ii) This method is not useful to prepare  $1^0$  alcohol except Ethanol.

## SOME COMMERCIALLY IMPORTANT ALCOHOLS

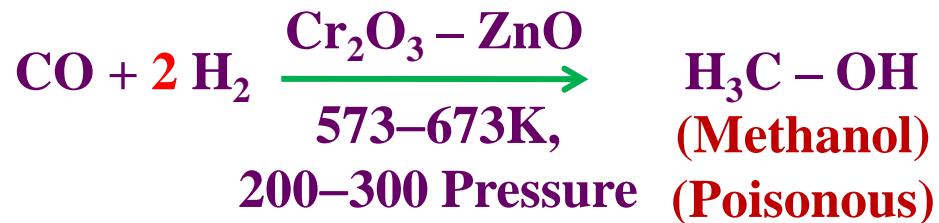
Methanol

Ethanol

## ALCOHOLS, PHENOLS AND ETHERS

### Methanol :

Methanol,  $\text{CH}_3\text{OH}$ , also known as ‘wood spirit’, was produced by destructive distillation of wood.



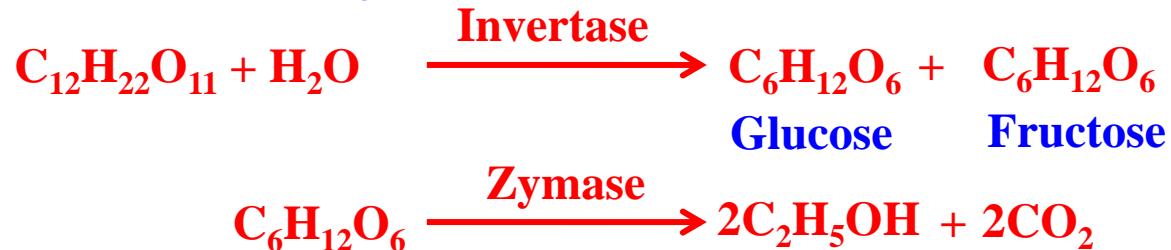
Methanol is a colourless liquid, boils at 337 K and highly poisonous in nature.

Methanol is used as a solvent in paints, varnishes.

## ALCOHOLS, PHENOLS AND ETHERS

### Ethanol:

- Ethanol,  $C_2H_5OH$ , is obtained commercially by fermentation.



- Ethanol is a colourless liquid with boiling point 351 K
- Ethanol is used as a solvent in paint industry and in the preparation of a number of carbon compounds.

1). Hydrolysis of 1-bromopentane by an aq NaOH gives...

a) 1 - propanol

b) 2 - propanol

 c) 1 - pentanol

d) 2 - pentanol

## ALCOHOLS, PHENOLS AND ETHERS

2). Hydration of ethene produces ---

a) Propanol

b) 2-butanol

c) ethanol

d) methanol

3). Hydration of 2 - methyl but – 2 - ene produces...

- a) 1 – methyl butanol
- b) 2 – methyl pentan – 2 - ol
- c)  2 – methyl butan - 2 - ol
- d) 2 – ethyl butan – 2 - ol

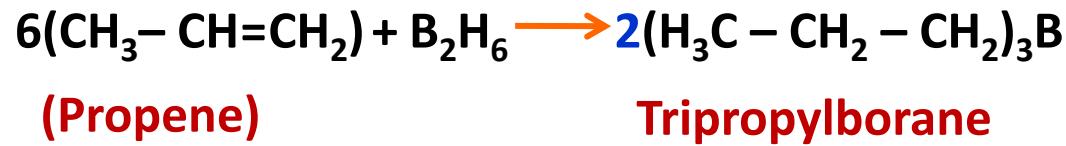
# **HYDROBORATION - OXIDATION OF ALKENES**

## ALCOHOLS, PHENOLS AND ETHERS

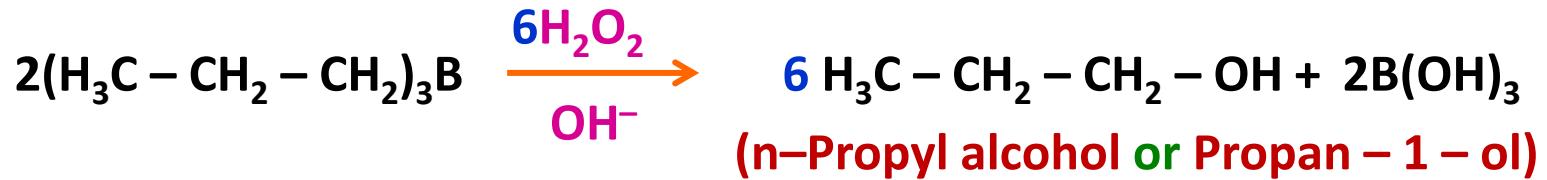
### Methods of preparation of Alcohols (R – OH)

Hydroboration – oxidation of alkenes

(Excellent yield of primary alcohol )



## ALCOHOLS, PHENOLS AND ETHERS



Note :

This reaction gives AntiMarkownikoff's product.

## ALCOHOLS, PHENOLS AND ETHERS

1). The only primary alcohol that can be prepared by hydration of alkene is...

a) Propanol

b) Butanol

c) Ethanol

d) Ethene

2). Hydroboration...oxidation reaction follows

- a) Markownikoffs rule
- b) Anti – Markownikoff's rule
- c) Saytzeff rule
- d) Hoffmann

3). Isobutylene on hydration in presence of 50%  $\text{H}_2\text{SO}_4$  gives...

- a) n-butyl alcohol
- b) Isobutyl alcohol
- c)  Tert–butyl alcohol
- d) All of these

ALCOHOLS, PHENOLS AND ETHERS

**REDUCTION  
OR  
HYDROGENATION OF  
CARBONYL COMPOUNDS.**

## ALCOHOLS, PHENOLS AND ETHERS

### Methods of preparation of Alcohols (R – OH)

Reduction or Hydrogenation of  
Carbonyl compounds

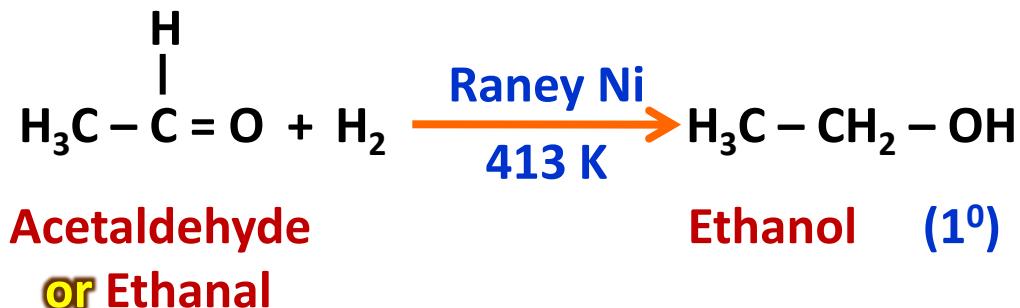
Reduction

Catalytic  
hydrogenation

Using  $\ddot{2}[\text{H}]$



## ALCOHOLS, PHENOLS AND ETHERS



## ALCOHOLS, PHENOLS AND ETHERS



Acetone

or

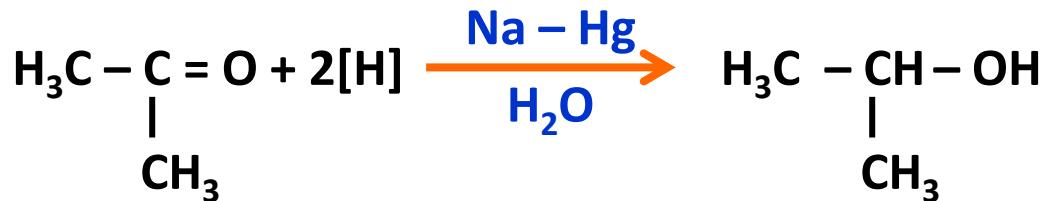
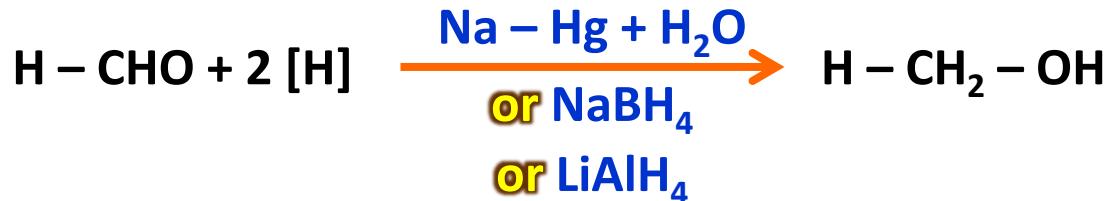
Dimethyl ketone

or

Propanone

or  
Propan – 2 – ol) ( $2^{\circ}$ )

## ALCOHOLS, PHENOLS AND ETHERS

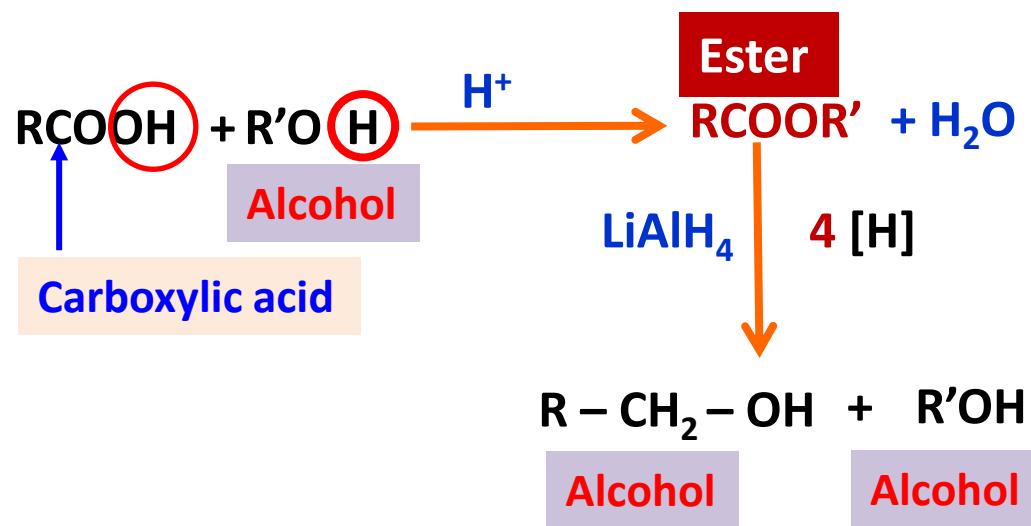


## ALCOHOLS, PHENOLS AND ETHERS

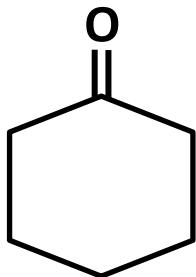
### Note :

- i) Aldehyde gives  $1^0$  alcohol on reduction.
- ii) Ketone gives  $2^0$  alcohol on reduction.
- iii)  $3^0$  alcohol can not be prepared by reduction.
- iv)  $\text{LiAlH}_4$  is an expensive reagent, so used for preparing special chemicals only. Acids are reduced to alcohols by converting them to the esters followed by their catalytic reduction.

# ALCOHOLS, PHENOLS AND ETHERS

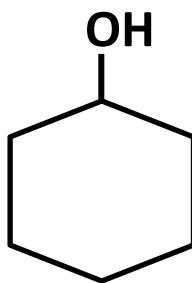


## ALCOHOLS, PHENOLS AND ETHERS



Reduction  
oxidation

Cyclohexanone



Cyclohexanol

1. The reagent used for converting ethanoic acid to ethanol is...

a)   $\text{LiAlH}_4$

b)  $\text{BH}_3$

c)  $\text{PCl}_5$

d)  $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+$

## ALCOHOLS, PHENOLS AND ETHERS

2. Esterification of carboxylic acid followed by reduction with lithium aluminum hydride yields...

- a) esters
- b) ethers
- c) alcohols
- d) aldehydes

ALCOHOLS, PHENOLS AND ETHERS

**FROM:GRIGNARD'S REAGENT**

## ALCOHOLS, PHENOLS AND ETHERS

### Methods of preparation of Alcohols ( $R - OH$ )

From Grignard's reagent (alkyl magnesium halide) ( $R - Mg - X$ )

## ALCOHOLS, PHENOLS AND ETHERS

The first step of the reaction is the nucleophilic addition of Grignard reagent



Use :

$\text{R}, \text{R}', \text{R}'' = -\text{H}, -\text{H}, -\text{CH}_3$

$\text{R}, \text{R}', \text{R}'' = -\text{H}, -\text{CH}_3, -\text{CH}_3$

$\text{R}, \text{R}', \text{R}'' = -\text{CH}_3, -\text{CH}_3, -\text{CH}_3$

$\text{AlCl}_3$

$\text{Cl} (\text{H}^+)$

H

## ALCOHOLS, PHENOLS AND ETHERS

### Note:

- i) Formaldehyde + G.R. →  $1^0$  alcohol
- ii) Aldehyde except formaldehyde + G.R. →  $2^0$  alcohol
- iii) ketone + G.R. →  $3^0$  alcohol

### Note:

- i) By Grignard's reagent we can't prepare Methanol.
- ii) By G.R. we can't prepare any compound which contains only one carbon atom.

1). Alcohols can be obtained from carbonyl compounds by...

a) Oxidation

b) Reduction

c) Hydration

d) Dehydration

## ALCOHOLS, PHENOLS AND ETHERS

2). Acetaldehyde on reduction gives...

a) Methanol

b) Propanol

c) Ethanol  


d) Ethene

## ALCOHOLS, PHENOLS AND ETHERS

3. sec-propyl alcohol is obtained from reduction of...

a) acetaldehyde

b)  acetone

c) formaldehyde

d) propanol

4). By using Grignard reagent, we can't prepare...

a) Methanol

b) ethanol

c) propanol

d) butanol

## ALCOHOLS, PHENOLS AND ETHERS

5). Identify the reagent to form t-butyl alcohol from acetone...

a)  $\text{CH}_3\text{MgI}$

b)  $\text{AgNO}_3$

c)  $\text{CuSO}_4$

d)  $\text{Zn-Hg}$

## ALCOHOLS, PHENOLS AND ETHERS

6). When  $\text{C}_2\text{H}_5\text{MgCl}$  is treated with formaldehyde to form..

a) Pentanol-1

b)  Propan-1-ol

c) pentanol-2

d) Propan - 2 - ol

## ALCOHOLS, PHENOLS AND ETHERS



# **ALCOHOLS, PHENOLS AND ETHERS**

## PROPERTIES OF ALCOHOLS

## ALCOHOLS, PHENOLS AND ETHERS

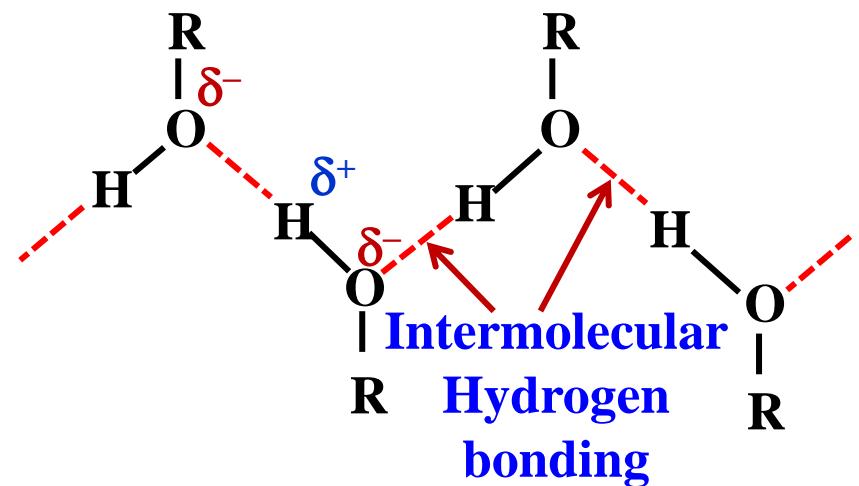
### Physical properties of alcohols

- Lower members are colourless liquids and have distinctive smell.
- Higher members are solids and almost colourless.
- Lower members of alcohols are soluble in water, solubility decreases with increase in their molecular weight.

## ALCOHOLS, PHENOLS AND ETHERS

### Physical properties of alcohols

- Alcohols have high boiling points than that of corresponding alkanes, alkyl halides, aldehydes, ketones, ethers etc. due to the presence of intermolecular hydrogen bonding.



## ALCOHOLS, PHENOLS AND ETHERS

### Physical properties of alcohols

- Such hydrogen bonding is absent in alkyl halide, aldehydes, ketones, etc. and we require more energy to break this hydrogen bonding in case of alcohol, therefore, Alcohols have more boiling points than that of corresponding alkanes, alkyl halides, aldehydes, ketones, etc.
- Boiling point of alcohols increases with increase in their molecular weights.

## ALCOHOLS, PHENOLS AND ETHERS

### Note :

- Branched chain alcohols have low boiling points due to weak *Vander Waals forces*.
- Alcohols are neutral to litmus.
- Alcohols are acting as Bronsted acids as well as lewis bases, therefore they are reactive.

# ALCOHOLS, PHENOLS AND ETHERS

## Chemical Properties of Alcohols ( $R - O - H$ )



Reactions involving  
breaking of  $O - H$  bond

(Reactivity of  
alcohols  $1^0 > 2^0 > 3^0$ )

Reactions involving breaking  
of  $R - O$  i.e.  $C - O$  bond

(Reactivity of  
alcohols  $3^0 > 2^0 > 1^0$ )

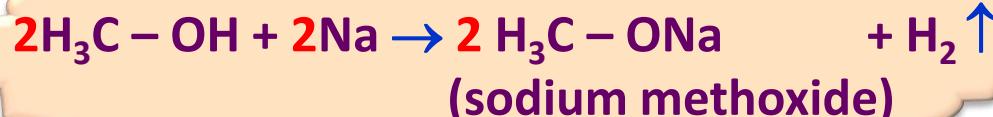
# ALCOHOLS, PHENOLS AND ETHERS

## Chemical Properties of Alcohols

Reactions involving  
breaking of O – H bond



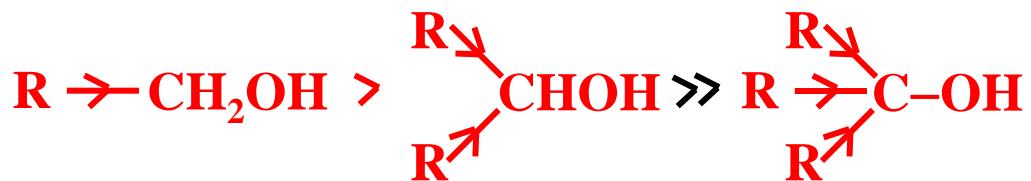
Action of Metals



## ALCOHOLS, PHENOLS AND ETHERS

### Acidity of alcohols:

Electron-releasing group (-CH<sub>3</sub>, -C<sub>2</sub>H<sub>5</sub>)  $\propto \frac{1}{\text{Acid strength}}$



Primary

Secondary

Tertiary

## ALCOHOLS, PHENOLS AND ETHERS

Alcohol can act as Brönsted acid as well as a Lewis base due to donation of proton and presence of unpaired electron on oxygen respectively.

- Ethers do not have H-bond, so they have boiling points similar to hydrocarbons.
- Ethers are only slightly soluble in water and are highly flammable.

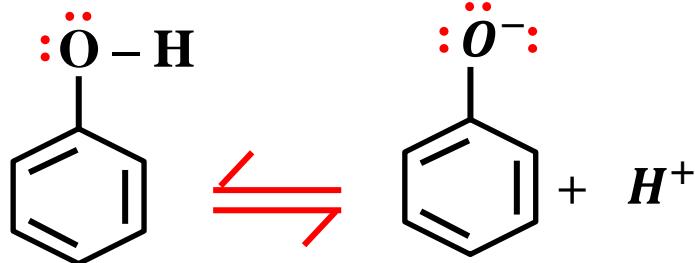
## ALCOHOLS, PHENOLS AND ETHERS

### Acidity of phenols:

- The reaction of phenol with metals like sodium, aluminum and sodium hydroxide indicate its acidic nature.

This is because OH group directly attached to benzene ring of  $sp^2$  hybridized carbon in phenol experiences electron withdrawing effect by benzene ring resulting in ionization of O-H more readily.

## ALCOHOLS, PHENOLS AND ETHERS

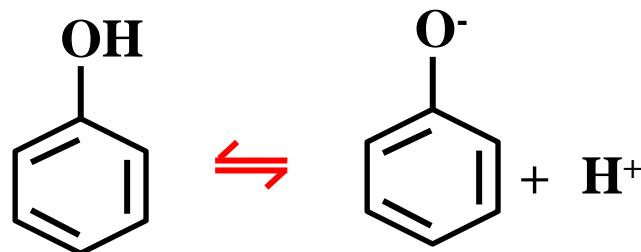


## ALCOHOLS, PHENOLS AND ETHERS

*Comparity of acidic nature of phenols and aliphatic alcohols*



alkoxide ion



Phenoxide ion

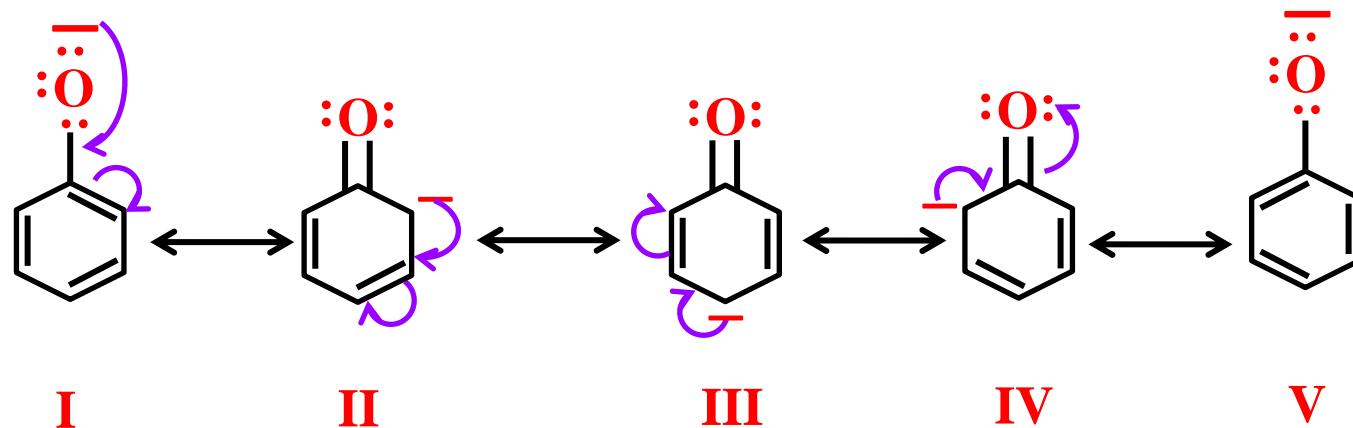
- The delocalization of negative charge makes phenoxide ion more stable and favours the acidic nature to the phenol (Resonance).

## ALCOHOLS, PHENOLS AND ETHERS

- Where as in alkoxide ion the negative charge is localized on oxygen. Hence the acidic nature of phenol is more than alcohol.
  
- In alkoxide ion, the negative charge is localised on oxygen while in phenoxide ion, the charge is delocalised.

## ALCOHOLS, PHENOLS AND ETHERS

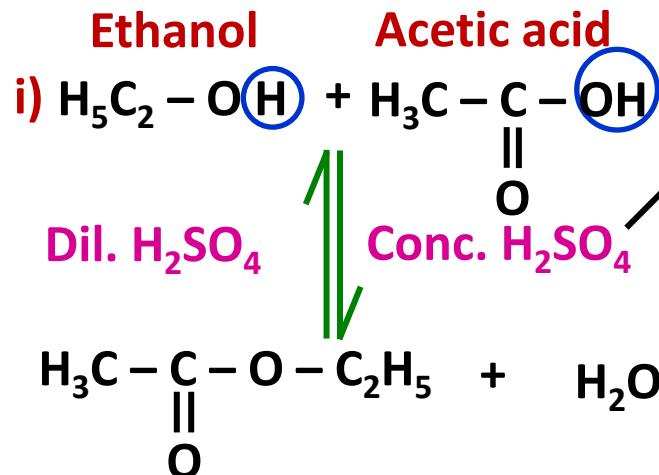
- The delocalisation of negative charge (structures I-V) makes phenoxide ion more stable and favours the ionisation of phenol.



# ALCOHOLS, PHENOLS AND ETHERS

Reactions involving  
breaking of O – H bond

Esterification



Ethyl acetate

or

Ethylethanoate

Conc.  $\text{H}_2\text{SO}_4$  is acting as a  
dehydrating agent

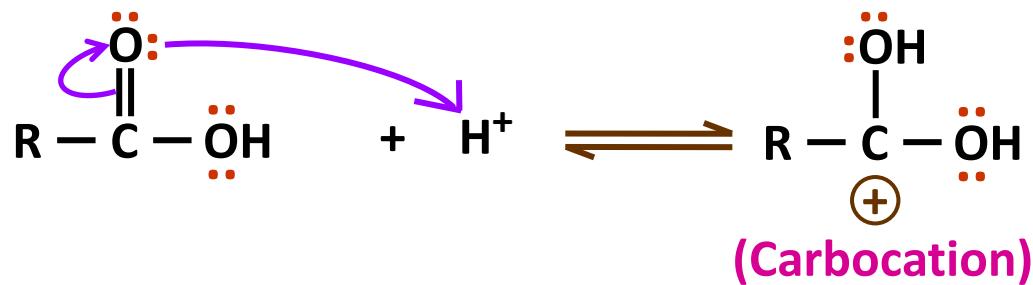
### Note :

- 1) Hydrolysis of an ester is a reversible reaction of Esterification.
  
- 2) This reaction involves breaking of acyl – oxygen linkage.

## ALCOHOLS, PHENOLS AND ETHERS

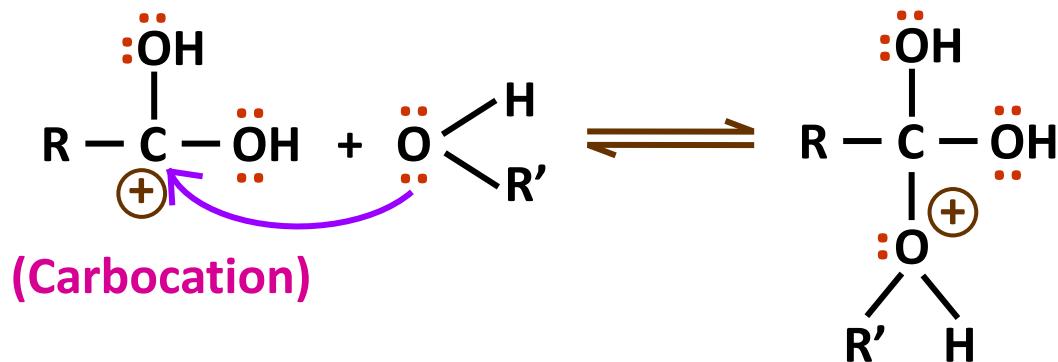
**Mechanism :** It involves following 3 steps :

**Step I : Protonation of the carbonyl group:**



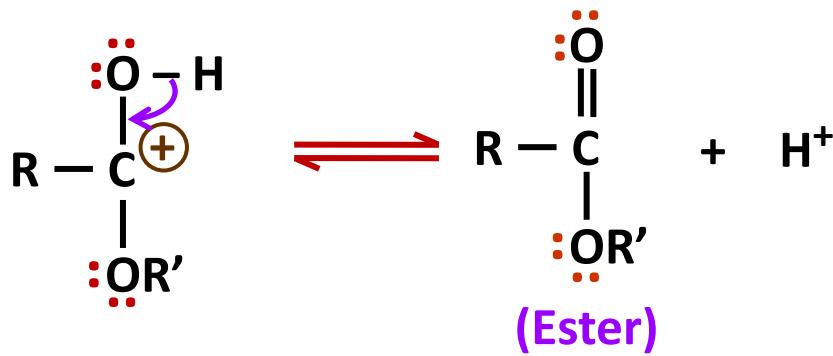
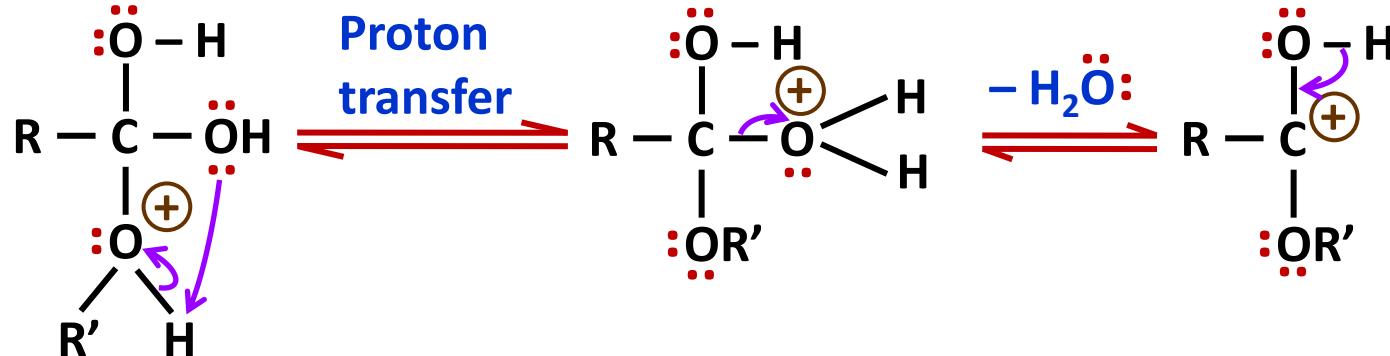
## ALCOHOLS, PHENOLS AND ETHERS

Step II : Nucleophilic attack by the alcohol molecule:



## ALCOHOLS, PHENOLS AND ETHERS

Step III : Loss of water molecule and a proton transfer :

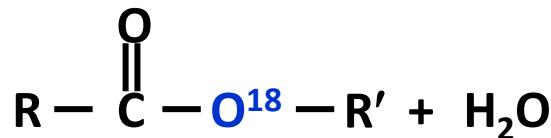
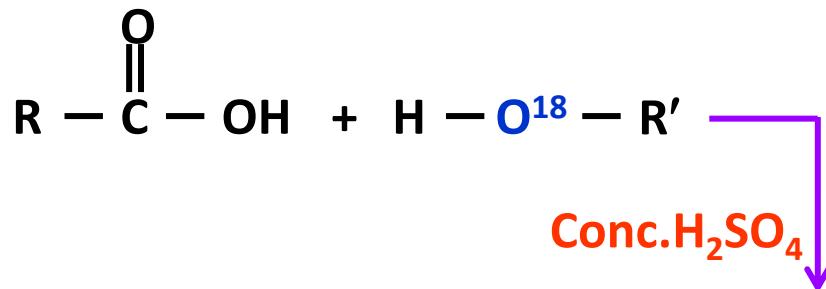


## ALCOHOLS, PHENOLS AND ETHERS

### Note

It is observed from the experiments of **tracer technique** that,

- 1) If an esterification is carried out by using an alcohol containing radio – isotopic oxygen,  $O^{18}$  is found in ester.



### 1. Reactivity of alcohols towards reactions involving breaking of O – H bond...

a)  $1^0 > 3^0 > 2^0$

b)  $1^0 > 2^0 > 3^0$

c)  $3^0 > 1^0 > 2^0$

d)  $2^0 > 1^0 > 3^0$

2. Esterification is ... process

a) Irreversible

b)  reversible

c) discontinuous

d) None of these

## ALCOHOLS, PHENOLS AND ETHERS

3. Ester is obtained when alcohols react with...

a)  Carboxylic acids

b) metals

c) Aldehydes

d) Ketones

## ALCOHOLS, PHENOLS AND ETHERS

4. Alcohols when react with metals, gives corresponding...

a) alkane

b)  alkoxides

c) ester

d) Metal oxides

# ACTION OF HALOACID LUCAS TEST

# ALCOHOLS, PHENOLS AND ETHERS

## Reactions involving breaking of C – O bond



### Action of Haloacid



Conc. HCl + Anhydrous  $ZnCl_2$  = Lucas reagent

$R - OH + \text{Lucas reagent} =$  The reaction is  
called Groove's process.

This is called Lucas test for alcohols.

( $R - Cl$  is prepared)

## ALCOHOLS, PHENOLS AND ETHERS

Q

Note : Distinguishable reaction  
between  $1^{\circ}$ ,  $2^{\circ}$  and  $3^{\circ}$  alcohol

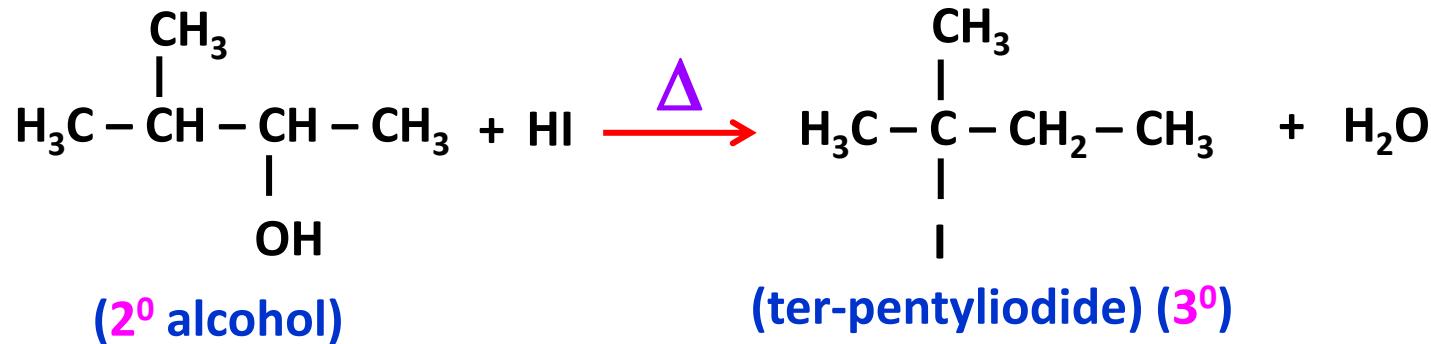
⇒  $3^{\circ}$  alcohol  $\xrightarrow[\text{Lucas reagent}]{} \text{Immediate appearance of turbidity.}$

⇒  $2^{\circ}$  alcohol  $\xrightarrow[\text{Lucas reagent}]{} \text{Turbidity within 5 min.}$

⇒  $1^{\circ}$  alcohol  $\xrightarrow[\text{Lucas reagent}]{} \text{Do not produce turbidity at room temp.}$

## ALCOHOLS, PHENOLS AND ETHERS

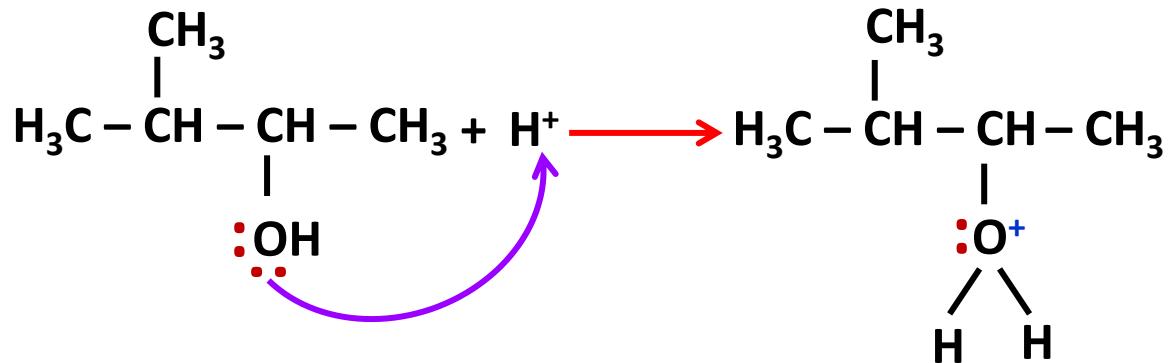
Note :



## ALCOHOLS, PHENOLS AND ETHERS

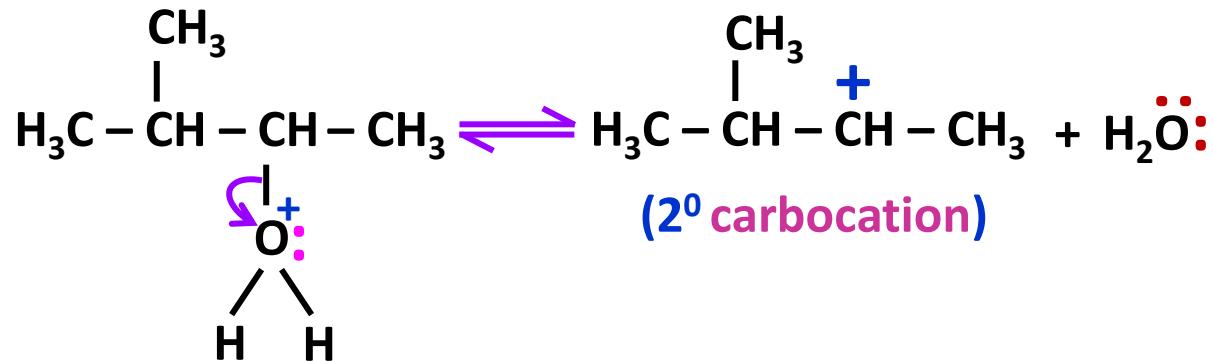
Mechanism :

**Step I : The alcohol is protonated by an acid :**



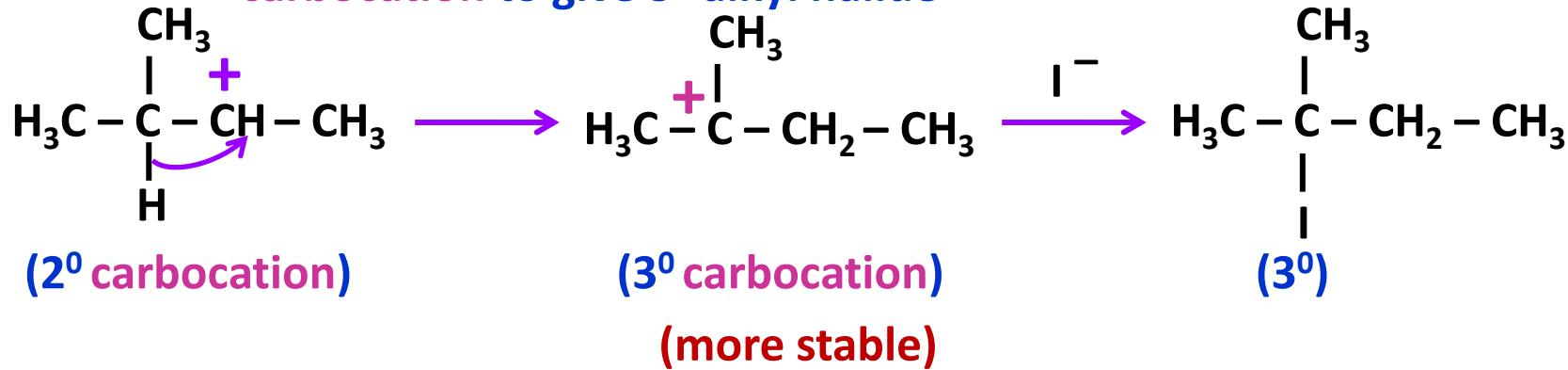
## ALCOHOLS, PHENOLS AND ETHERS

### Step II : Formation of carbocation :



## ALCOHOLS, PHENOLS AND ETHERS

Step III : Hydride shift followed by formation of stable  $3^0$  carbocation to give  $3^0$  alkyl halide



1. Primary, secondary and tertiary alcohols are distinguished by...
- a) Oxidation method
  - b) Lucas test
  - c) Victor Meyer's method
  - d) All the above
- 

## ALCOHOLS, PHENOLS AND ETHERS

2. Which alcohol is most reactive towards HCl in the presence of anhydrous  $\text{ZnCl}_2$ ?
- a) primary
  - b) secondary
  - c) tertiary
  - d) All are equal

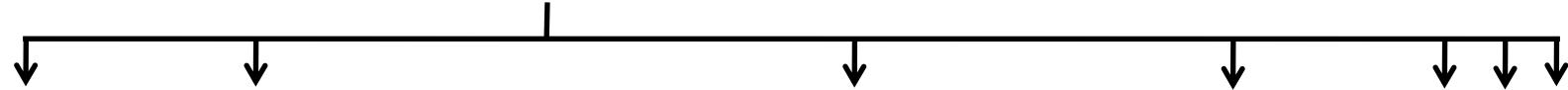
3. Lucas reagent is...

- a) Conc.  $\text{HNO}_3$  + anhydrous  $\text{MgCl}_2$ ,
- b) dil.  $\text{HCl}$  + anhydrous  $\text{ZnCl}_2$ ,
- c) Conc.  $\text{HNO}_3$  + anhydrous  $\text{ZnCl}_2$ ,
- d)  Conc.  $\text{HCl}$  + anhydrous  $\text{ZnCl}_2$

# REACTIONS INVOLVING BREAKING OF C – O BOND

# ALCOHOLS, PHENOLS AND ETHERS

## Reactions involving breaking of C – O bond



With  $\text{PX}_3$

With  $\text{PCl}_5$



## ALCOHOLS, PHENOLS AND ETHERS

### Reactions involving breaking of C –O bond



Darzen's  
Method

Best method for chlorination  
due to by products are gases

With  $\text{SOCl}_2$



1. Alcohols on treatment with  $\text{PCl}_3$ , gives...

a) alkyl bromide

b) alkane

c)  alkyl chloride

d) None of these

2. Best method to prepare alkyl chloride is...

- a) Reaction of alcohol with  $\text{SOCl}_2$
- b) Darzen's method
- c) Reaction of alcohol with  $\text{PCl}_3$
- d) Both a & b

## ALCOHOLS, PHENOLS AND ETHERS



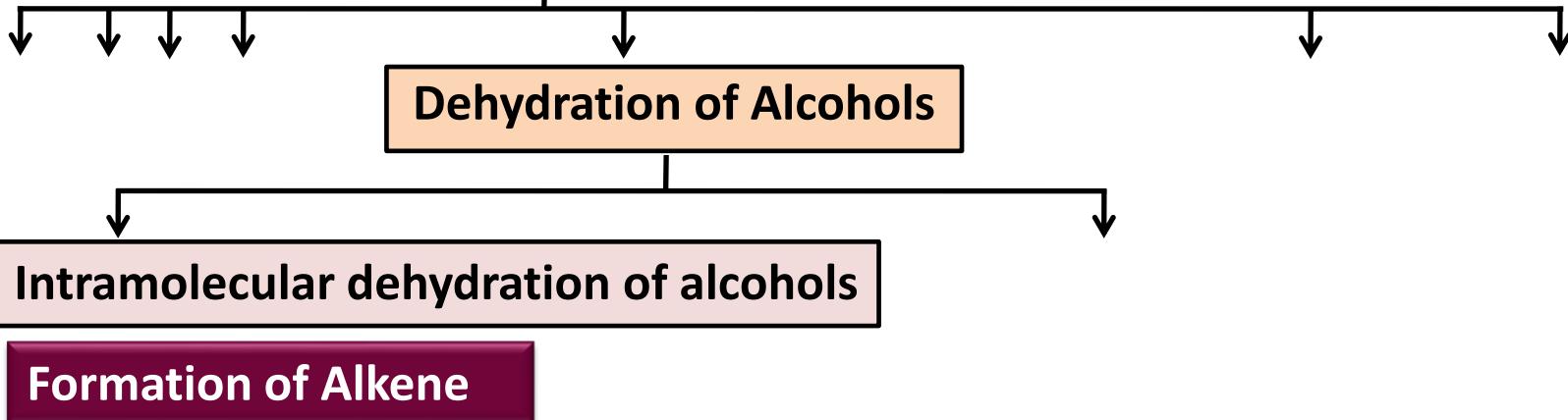
# **ALCOHOLS, PHENOLS AND ETHERS**

ALCOHOLS, PHENOLS AND ETHERS

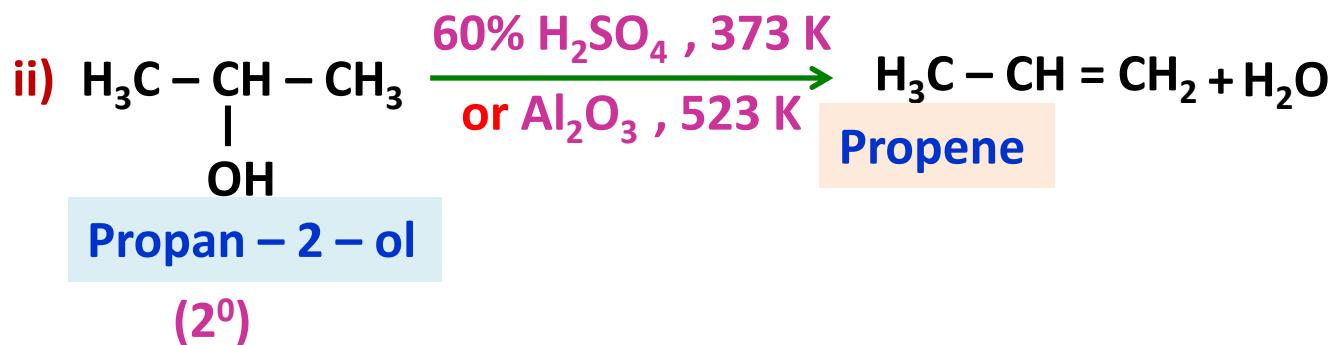
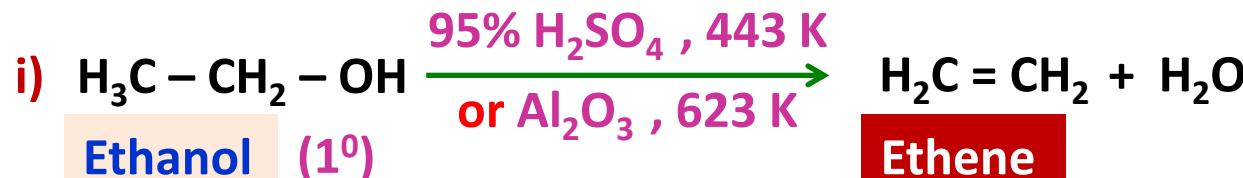
# DEHYDRATION OF ALCOHOLS

# ALCOHOLS, PHENOLS AND ETHERS

Reactions involving breaking of C – O bond



# ALCOHOLS, PHENOLS AND ETHERS



## ALCOHOLS, PHENOLS AND ETHERS

iii)



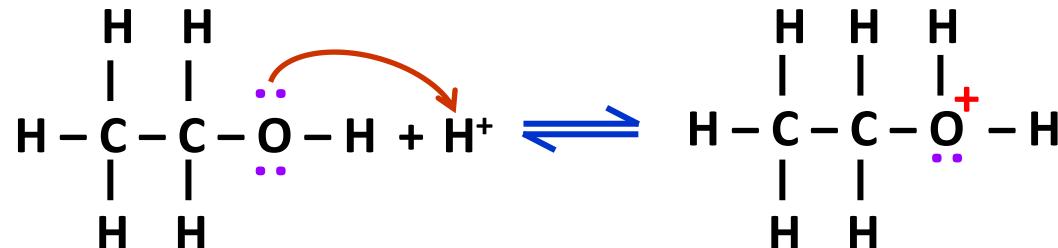
(tert – butyl alcohol)  
(3°)

(isobutylene or  
2- Methyl propene)

## ALCOHOLS, PHENOLS AND ETHERS

Mechanism : Dehydration of Ethanol :

Step I : Formation of Protonated alcohol



Step II : Formation of Carbocation

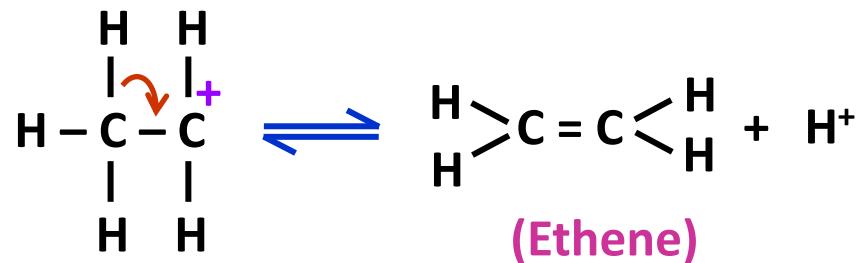


Carbocation

R.D.S = Rate Determining Step.

## ALCOHOLS, PHENOLS AND ETHERS

### Step III : Formation of Ethene by deprotonation

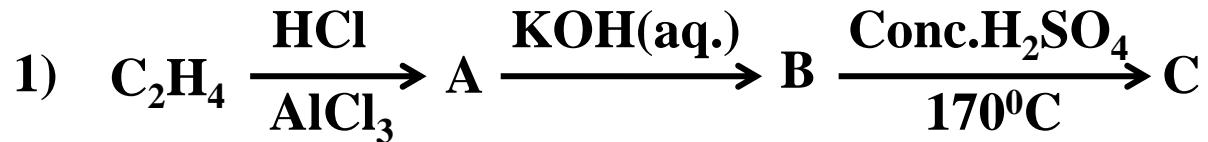


**Order of ease of dehydration of alcohols .**

**Tertiary > Secondary > Primary**

## ALCOHOLS, PHENOLS AND ETHERS

*MCQs*



- a)  $\text{C}_2\text{H}_4$
- b)  $\text{C}_2\text{H}_5 - \text{O} - \text{C}_2\text{H}_5$
- c)  $\text{C}_2\text{H}_5 \text{OH}$
- d)  $\text{C}_2\text{H}_5 - \text{O} - \text{SO}_3\text{H}$

## ALCOHOLS, PHENOLS AND ETHERS



a) Conc.  $\text{H}_2\text{SO}_4$

b)  $\text{CaCl}_2$

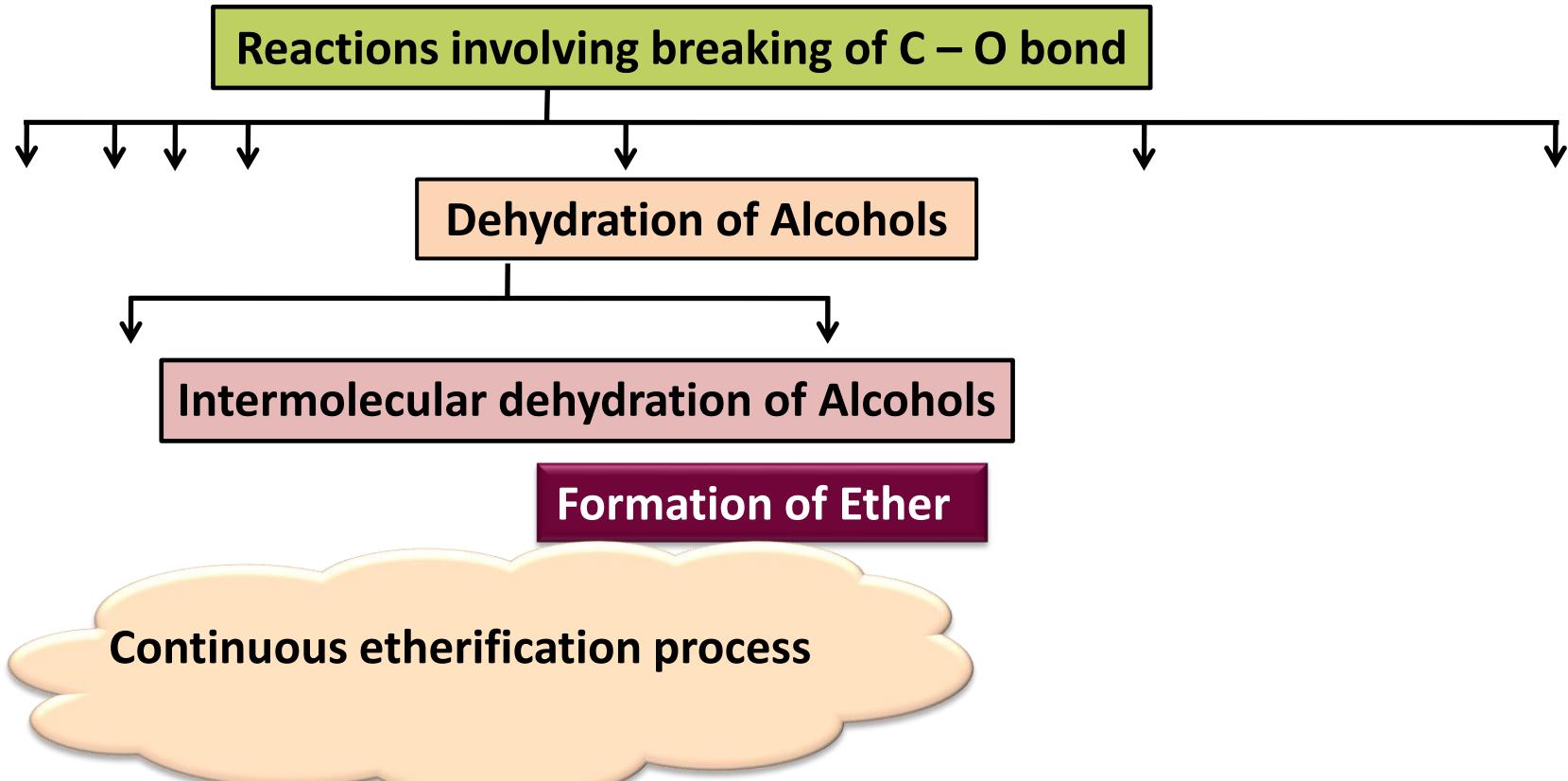
c)  $\text{CaO}$

d)  $\text{Al}_2\text{O}_3$

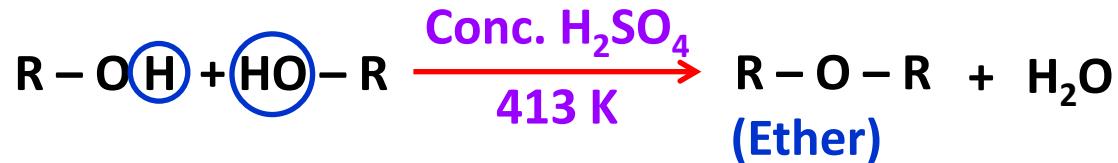


# **DEHYDRATION OF ALCOHOLS FORMATION OF ETHER.**

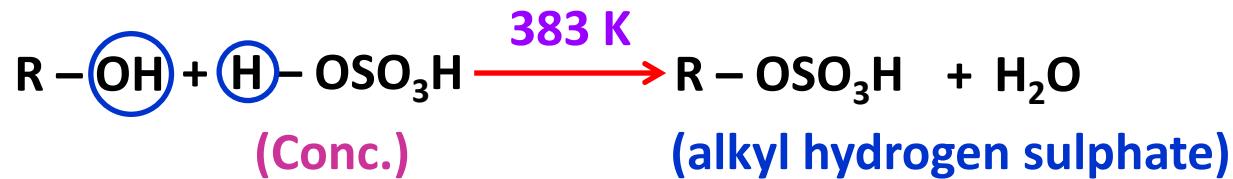
# ALCOHOLS, PHENOLS AND ETHERS



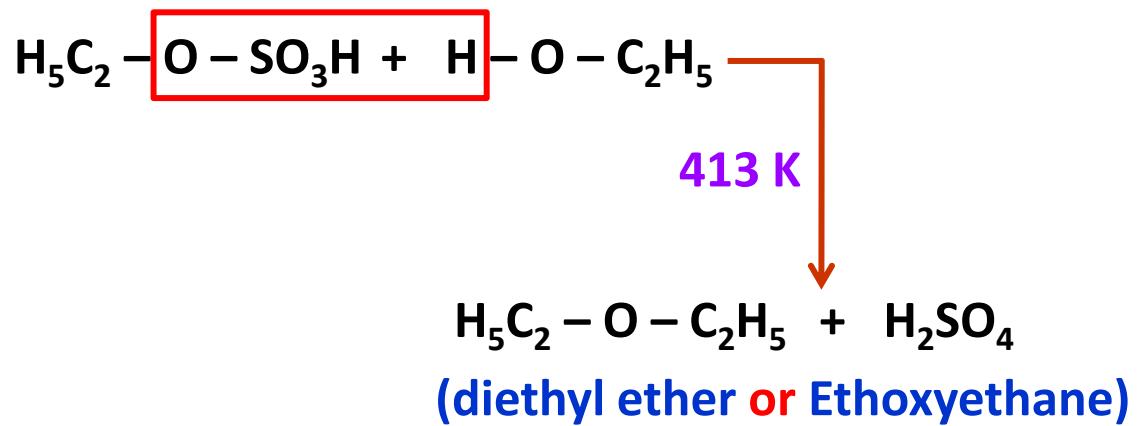
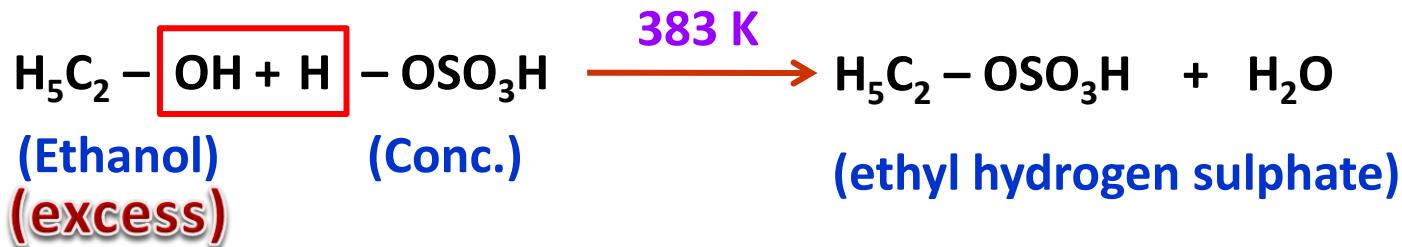
# ALCOHOLS, PHENOLS AND ETHERS



## Note :



# ALCOHOLS, PHENOLS AND ETHERS



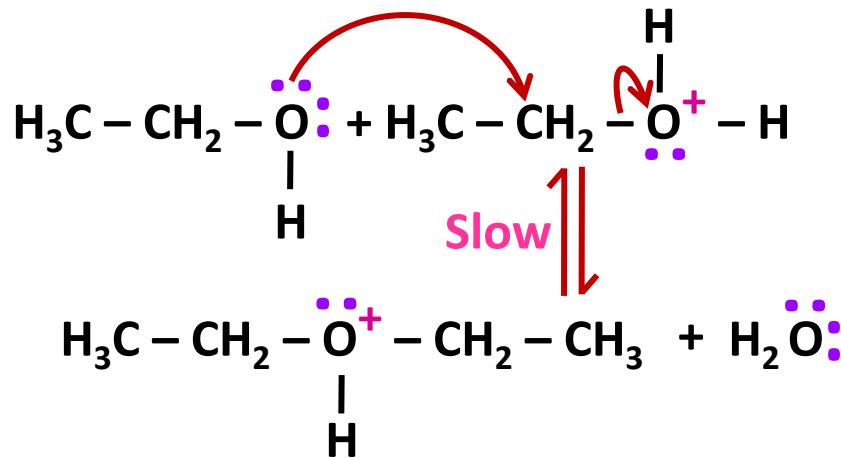
## ALCOHOLS, PHENOLS AND ETHERS

### Mechanism

#### i) Formation of protonated alcohol :

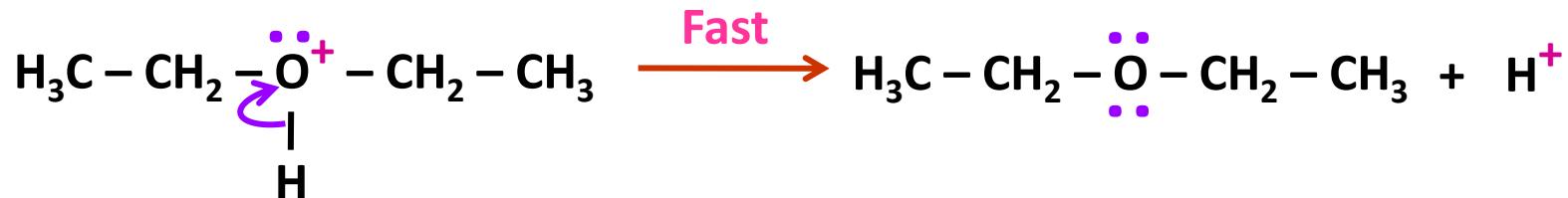


#### ii) Attack of Nucleophilic alcohol on protonated alcohol :



## ALCOHOLS, PHENOLS AND ETHERS

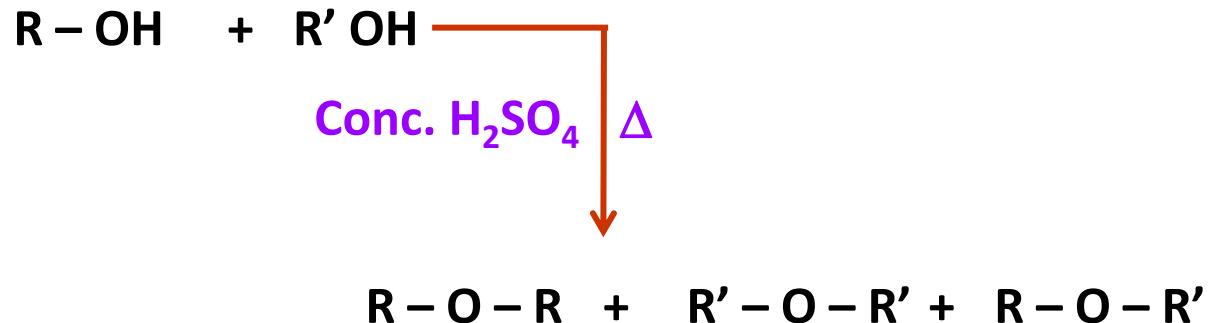
### iii) Deprotonation to give ether



## ALCOHOLS, PHENOLS AND ETHERS

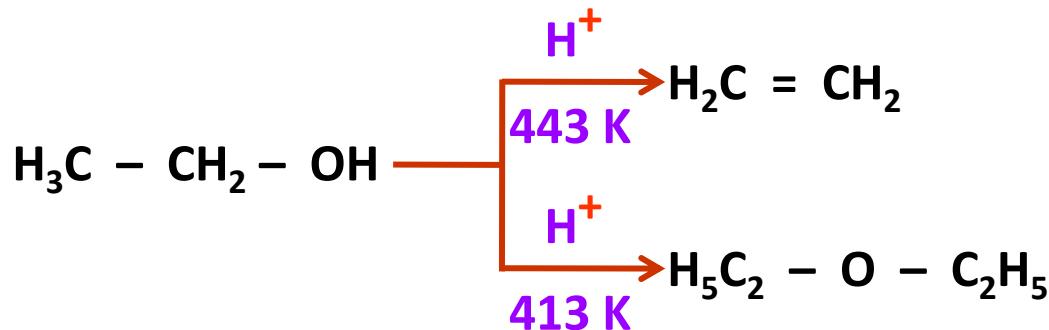
### Limitations

- i) Only simple ethers are prepared by this method, if a mixture of two different alcohols is used then a mixture of three different ethers is obtained which is difficult to separate.



## ALCOHOLS, PHENOLS AND ETHERS

- ii) Ethers prepared from this method is from only  $1^0$  alcohol because  $2^0$  &  $3^0$  alcohols gives alkene by elimination.
- iii) If temp rises above 413 K then alcohol gives formation of an alkene.



1). Removal of water molecule from an alcohol is called...of alcohols.

a) hydration

b)  dehydration

c) hydrogenation

d) dehydrogenation

## ALCOHOLS, PHENOLS AND ETHERS

2). Dehydrating agent used for dehydration of alcohols is...

a) Conc. HCl

b)  Conc.  $\text{H}_2\text{SO}_4$

c) Conc.  $\text{HNO}_3$

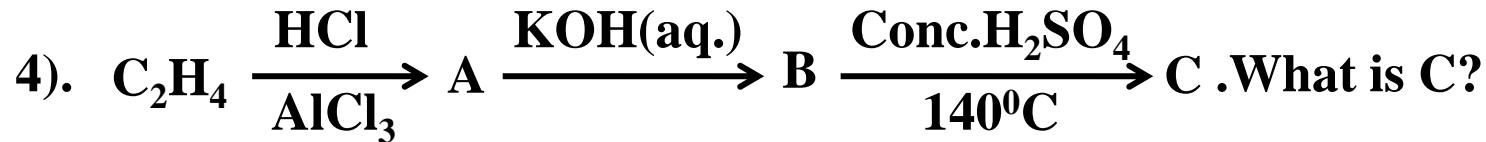
d) None of these

## ALCOHOLS, PHENOLS AND ETHERS

3). Ethyl alcohol when treated with concentrated sulphuric acid at 413K gives...

- a) Ethene
- b) Ethyl ether
- c) Diethyl ether
- d) None of these

## ALCOHOLS, PHENOLS AND ETHERS



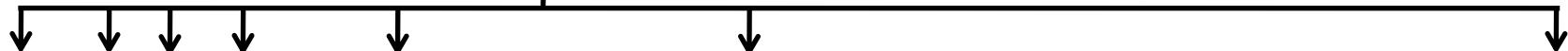
- a)  $\text{C}_2\text{H}_4$
- b)  $\text{C}_2\text{H}_5 - \text{O} - \text{C}_2\text{H}_5$
- c)  $\text{C}_2\text{H}_5\text{OH}$
- d)  $\text{C}_2\text{H}_5 - \text{O} - \text{SO}_3\text{H}$

ALCOHOLS, PHENOLS AND ETHERS

## OXIDATION OF ALCOHOLS

## ALCOHOLS, PHENOLS AND ETHERS

Reactions involving breaking of C – O bond



Distinguishable reaction Between  $1^{\circ}$ ,  $2^{\circ}$  and  $3^{\circ}$  alcohols

Oxidation

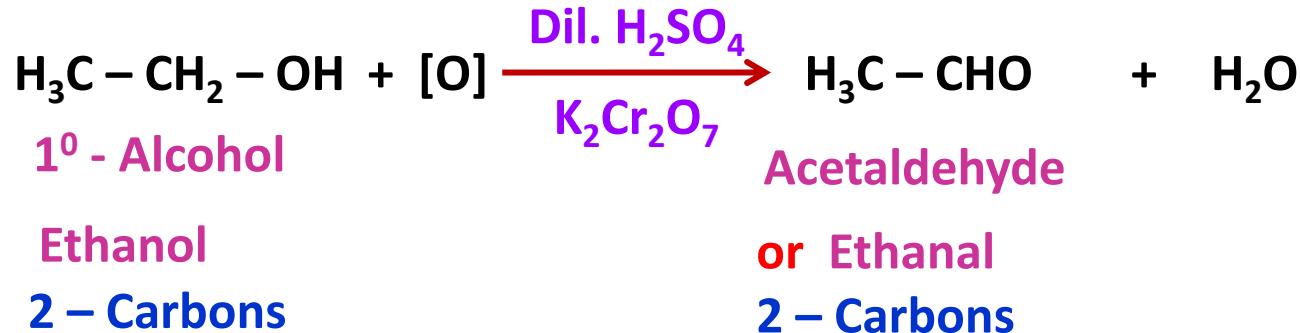
ppt

Oxidation of alcohols is used to differentiate  
between  $1^{\circ}$ ,  $2^{\circ}$  and  $3^{\circ}$  alcohols

dichromate (PDC)

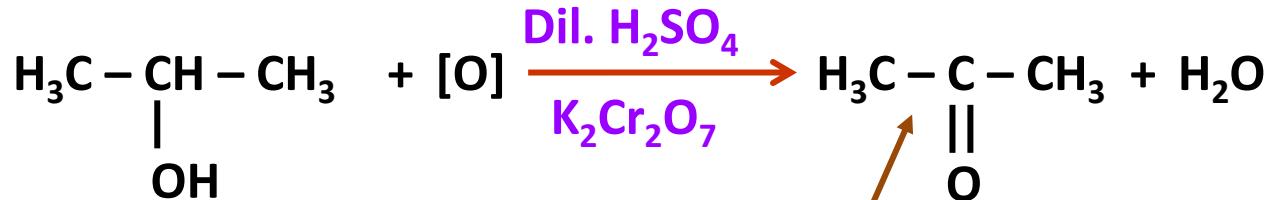
# ALCOHOLS, PHENOLS AND ETHERS

### (i) Oxidation of $1^{\circ}$ alcohol



## ALCOHOLS, PHENOLS AND ETHERS

### (ii) Oxidation of 2<sup>o</sup> alcohol



Iso/sec – propyl alcohol

or

Propan – 2 – ol

2<sup>o</sup> -Alcohol

3 – Carbons

Acetone

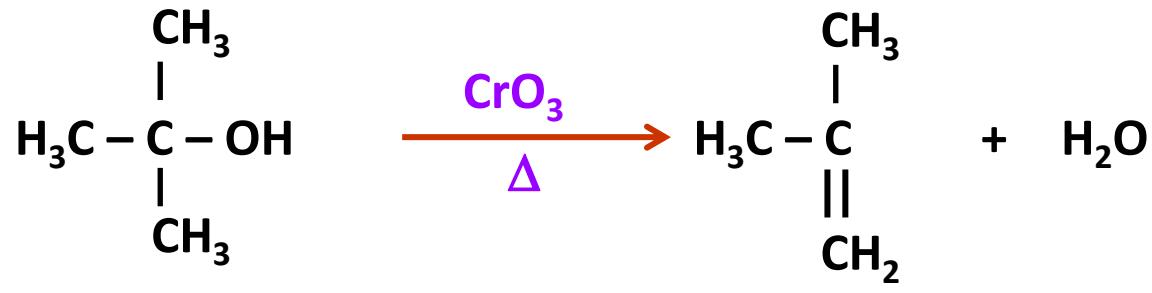
Propan-2-one

Dimethyl ketone

3 – Carbons

## ALCOHOLS, PHENOLS AND ETHERS

### iii) Oxidation of $3^0$ alcohol



tert – butyl alcohol ( $3^0$ )  
(4 – C)

isobutylene  
(4 – C)

## ALCOHOLS, PHENOLS AND ETHERS

### Note :

$1^{\circ}$ ,  $2^{\circ}$  and  $3^{\circ}$  alcohol on vigorous oxidation gives carboxylic acid but  $1^{\circ}$  alcohol gives carboxylic acid with same no. of 'C' atom,  $2^{\circ}$  alcohol gives carboxylic acid with one 'C' atom less and  $3^{\circ}$  alcohol gives carboxylic acid with two 'C' atoms less.

1. Oxidation of alcohols is carried out by using...

- a) dilute  $\text{H}_2\text{SO}_4$  and  $\text{K}_2\text{Cr}_2\text{O}_7$
- b) pyridinium chlorochromate
- c) pyridinium dichromate
- d) All of these

## ALCOHOLS, PHENOLS AND ETHERS

2. Primary alcohol on oxidation gives...

a)  aldehyde

b) ketone

c) Both a & b

d) None of these

3. Secondary alcohol on oxidation gives...

a) aldehyde

b)  ketone

c) Both a & b

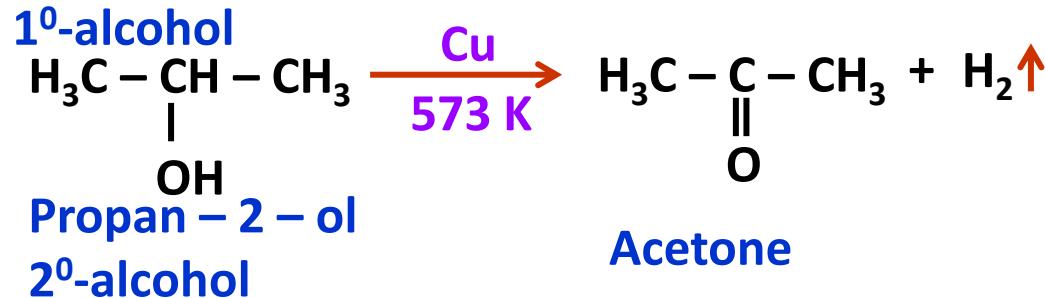
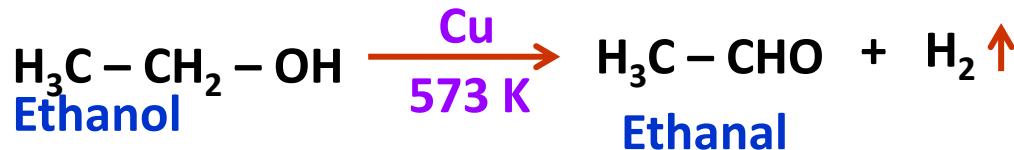
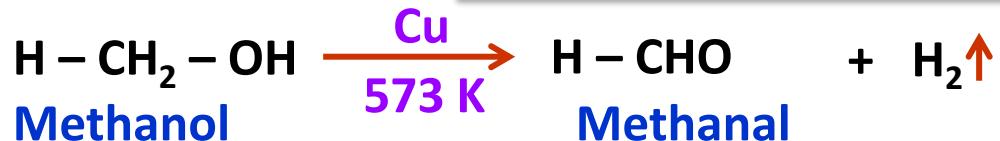
d) None of these

ALCOHOLS, PHENOLS AND ETHERS

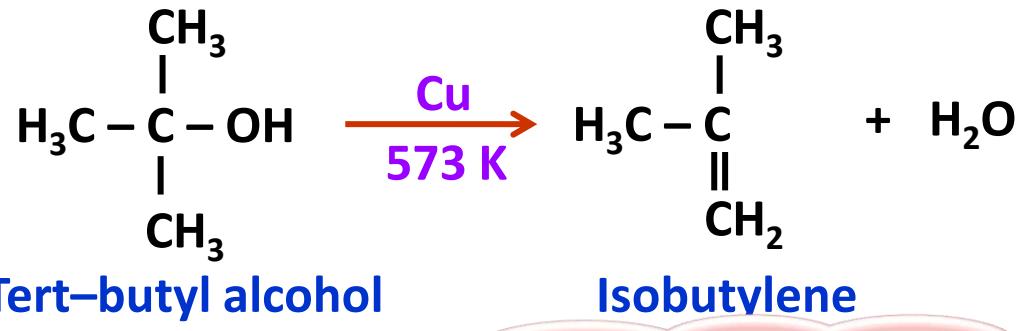
# **DEHYDROGENATION OF ALCOHOLS WITH 'Cu' AT 573 K**

## ALCOHOLS, PHENOLS AND ETHERS

### Reactions involving breaking of C – O bond



# ALCOHOLS, PHENOLS AND ETHERS



# What will be the product ?

**Catalytic dehydrogenation is also useful to distinguish 1°, 2° and 3° alcohols**

1. Primary alcohols on dehydrogenation with Cu at 573 K gives

- a) ketone
- b)  aldehyde
- c) acid
- d) None of these

2. Ethanol on dehydrogenation gives...

a) Methanol

b) Ethanal  


c) Both a & b

d) Ethyl chloride

3. Propan – 2– ol on dehydrogenation gives --

- a) acetaldehyde
- b) Formaldehyde
-  c) acetone
- d) All of these

## ALCOHOLS, PHENOLS AND ETHERS



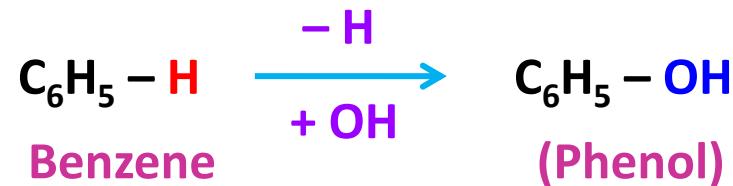
# **ALCOHOLS, PHENOLS AND ETHERS**

# INTRODUCTION OF PHENOLS

## ALCOHOLS, PHENOLS AND ETHERS

### Phenols

The aromatic hydroxyl compounds in which one or more hydroxyl groups are directly attached to the aromatic nucleus (i.e. Benzene ring) are called Phenols.



# ALCOHOLS, PHENOLS AND ETHERS

## Classification of Phenols

Monohydric Phenols

(One –OH group)

Dihydric Phenols

(Two – OH groups)

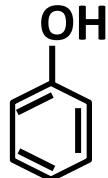
Trihydric Phenols

(Three – OH groups)

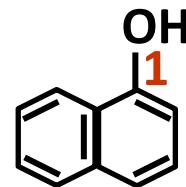
Phenols are classified into three types

# ALCOHOLS, PHENOLS AND ETHERS

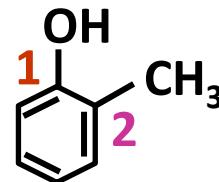
## Monohydric phenols



Phenol  
Carbolic acid



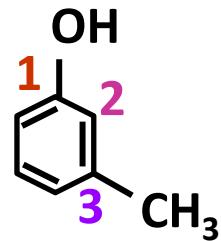
$\alpha$  – Naphthol  
1 – Naphthol



o – Cresol  
2–Methylphenol

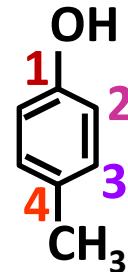
# ALCOHOLS, PHENOLS AND ETHERS

## Monohydric phenols



m – Cresol

3 – Methylphenol

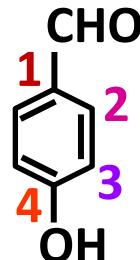


p – Cresol

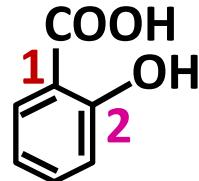
4 – Methylphenol

# ALCOHOLS, PHENOLS AND ETHERS

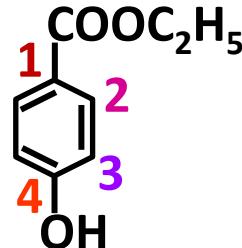
## Monohydric phenols



(4 – Hydroxybenzaldehyde)



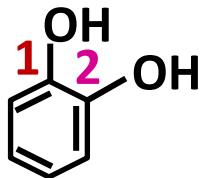
(2 – Hydroxybenzoic acid)



(4 – Hydroxyethylbenzoate)

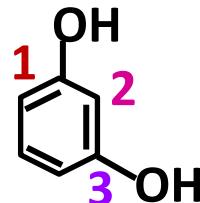
# ALCOHOLS, PHENOLS AND ETHERS

## Dihydric phenols



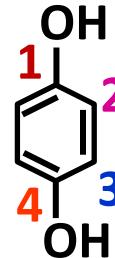
Catechol

Benzene-1,2-diol



Resorcinol

Benzene -1,3- diol

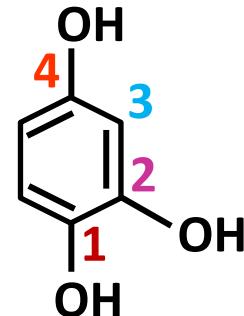
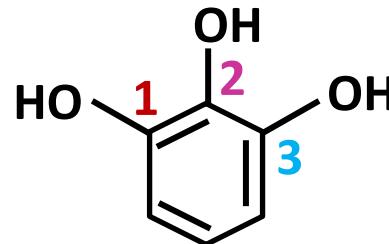
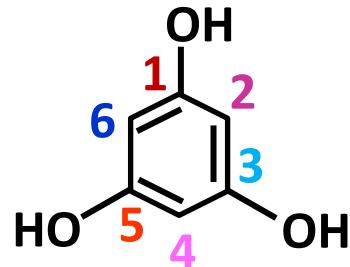


Hydroquinone  
(or)  
Quinol

Benzene -1,4-diol

# ALCOHOLS, PHENOLS AND ETHERS

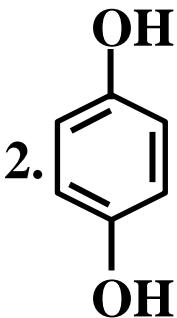
## Trihydric phenols



1. Phenols are classified as..

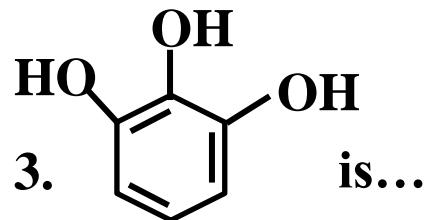
- a) Monohydric Phenols
- b) Dihydric Phenols
- c) Trihydric Phenols
- d) all of these

## ALCOHOLS, PHENOLS AND ETHERS

2.  Is...

- a) Benzene-1,4-diol
- b) Hydroquinone
- c) Both (a) and (b) 
- d) None of these

## ALCOHOLS, PHENOLS AND ETHERS



- a) trihydric phenol
- b) dihydric phenol
- c) benzene-1,2,3-triol
- d) both (a) and (c)



## ALCOHOLS, PHENOLS AND ETHERS

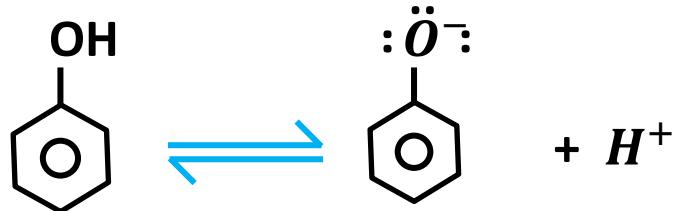
4. p-cresol is an example of...

- a) dihydric phenol
- b) trihydric phenol
- c)  monohydric phenol
- d) monohydric alcohol

# **PREPARATION OF PHENOLS**

## ALCOHOLS, PHENOLS AND ETHERS

Acidic character of phenol (According to Lowry - Bronsted)

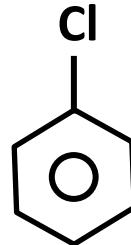


(Phenoxide (Phenate) ion )

# ALCOHOLS, PHENOLS AND ETHERS

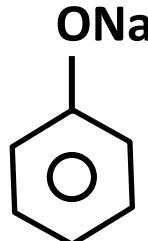
## Methods of preparation of Phenol

Dow's process



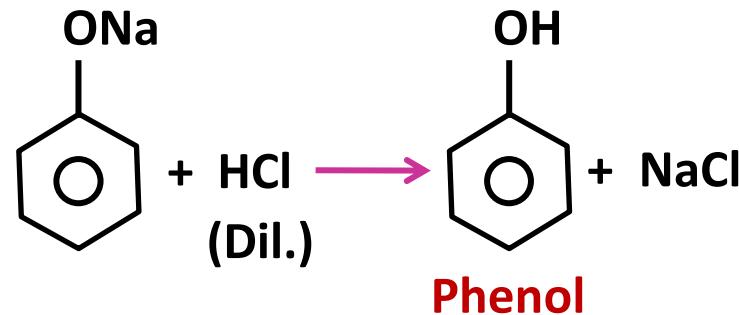
Chlorobenzene  
(or)  
Phenyl chloride

Phenol can be prepared from  
First is Dow's process

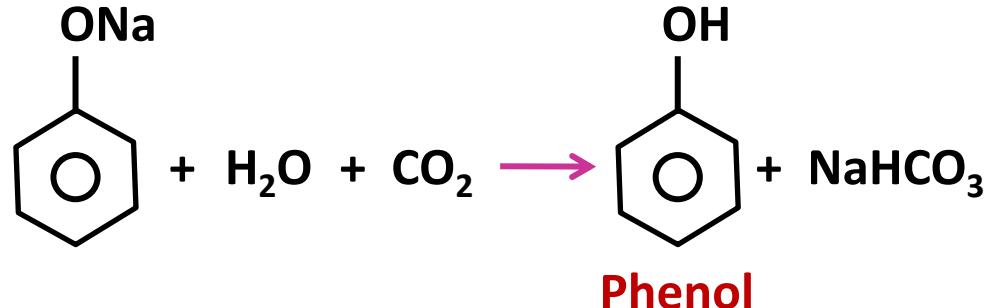


Sodium phenoxide (phenate)

## ALCOHOLS, PHENOLS AND ETHERS

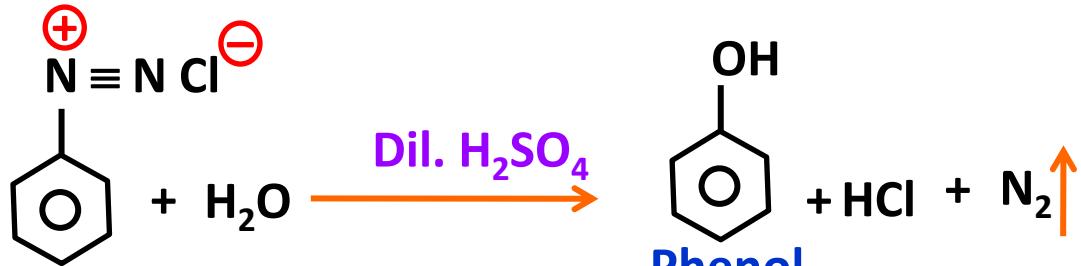


or



## ALCOHOLS, PHENOLS AND ETHERS

Phenol can be prepared  
from diazonium salt



## ALCOHOLS, PHENOLS AND ETHERS

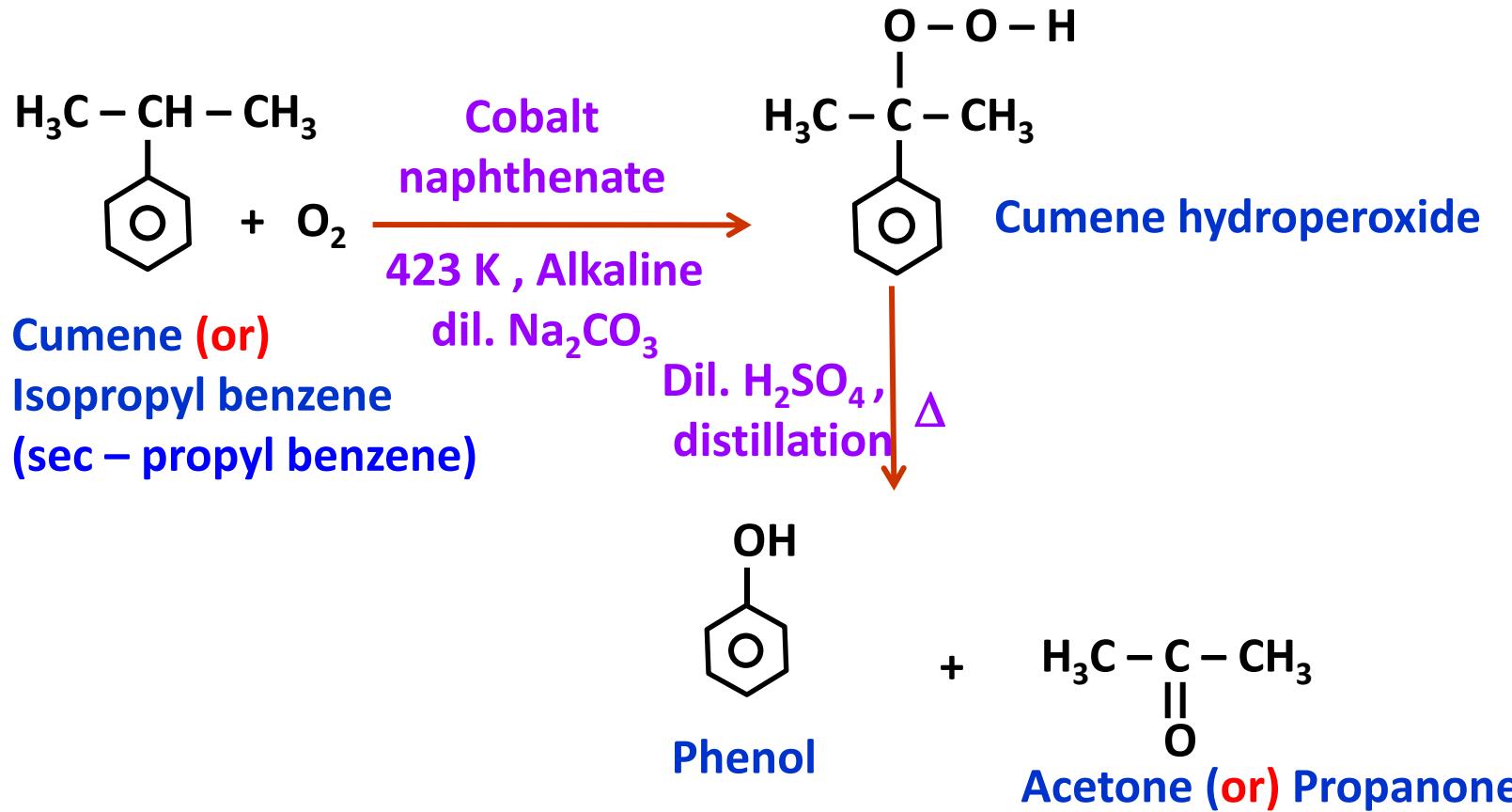
From Cumene

Commercial method

Phenol can be prepared  
commercially from Cumene.

Cumene is  
Isopropyl benzene

## ALCOHOLS, PHENOLS AND ETHERS



1. Cumene is nothing but...

- a) Isopropyl benzene
- b) n-propyl alcohol
- c) sec-propyl benzene
- d) Both a & c

2. Phenol can be obtained commercially from...

a) chlorobenzene

b) aniline

c)  cumene

d) benzene sulphonic acid

**ELECTROPHILIC SUBSTITUTION  
REACTION,  
BROMINATION & NITRATION**

# ALCOHOLS, PHENOLS AND ETHERS

## Chemical properties of Phenol

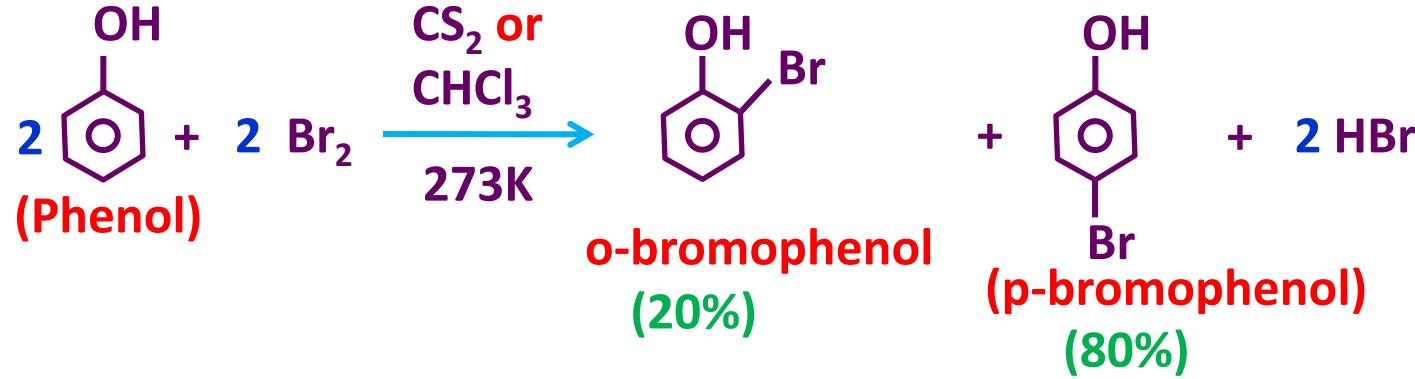
### Electrophilic substitution reaction

Bromination

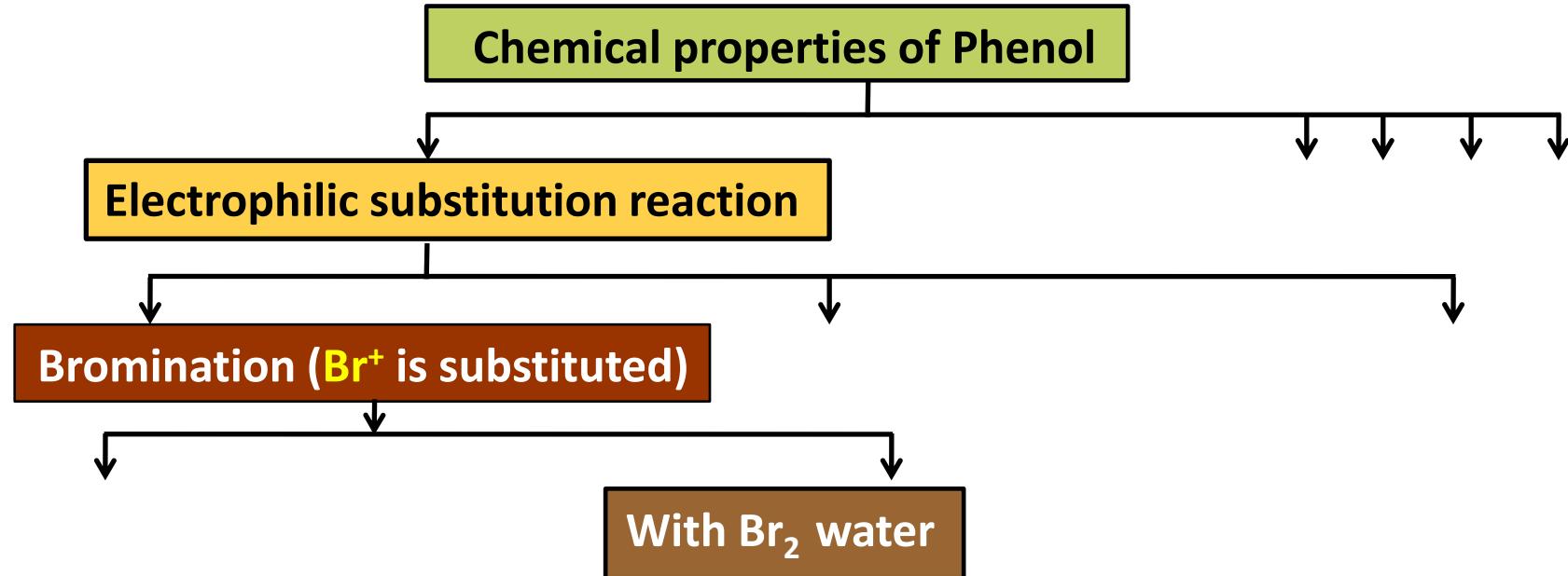
Let us see action of phenol  
with liquid  $\text{Br}_2$

With liquid  $\text{Br}_2$

## ALCOHOLS, PHENOLS AND ETHERS

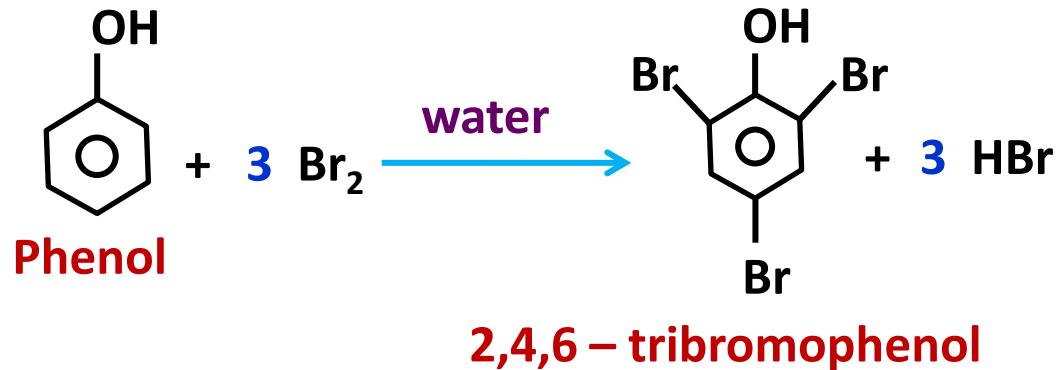


# ALCOHOLS, PHENOLS AND ETHERS



Let us see action of phenol  
with  $\text{Br}_2$  water

## ALCOHOLS, PHENOLS AND ETHERS



white ppt

# ALCOHOLS, PHENOLS AND ETHERS

## Chemical properties of Phenol

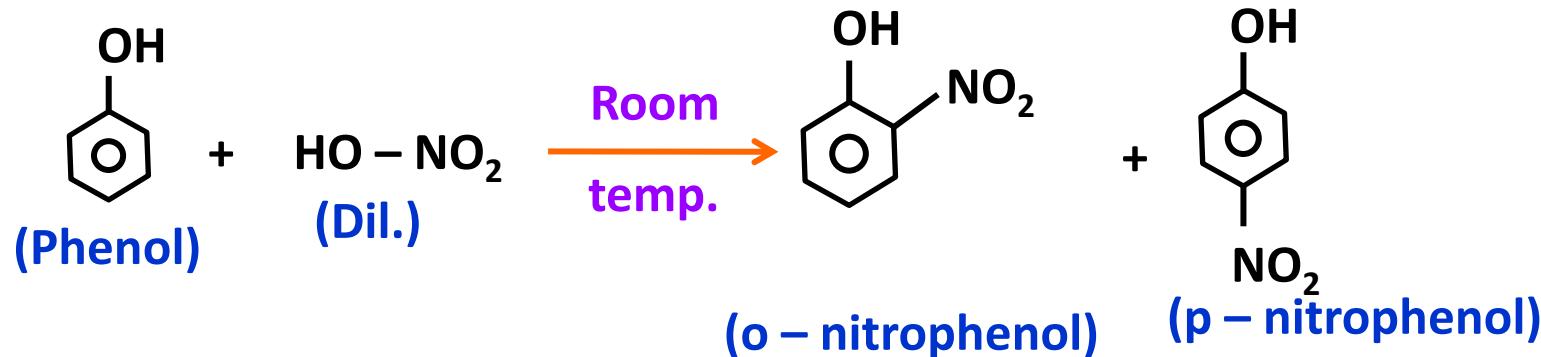
### Electrophilic substitution reaction

Nitration  
(Nitronium ion ( $\text{NO}_2^+$ ) is substituted)

With Dil.

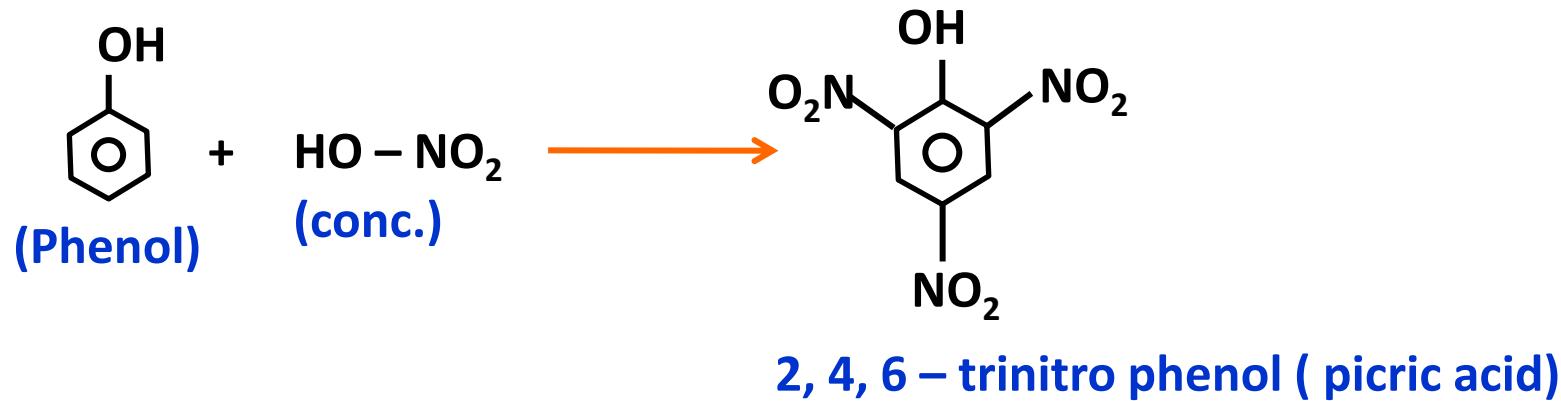
Let us see reaction of phenol  
with Dil.  $\text{HNO}_3$  (Nitric acid)

## ALCOHOLS, PHENOLS AND ETHERS



$\text{o-nitrophenol}$  is steam volatile due to intramolecular hydrogen bonding , while  $\text{p-nitrophenol}$  is less volatile due to intermolecular hydrogen bonding.

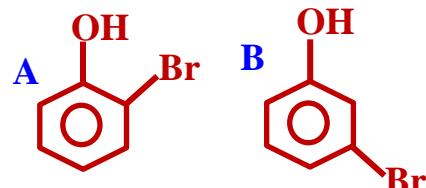
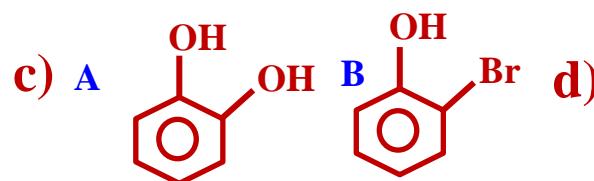
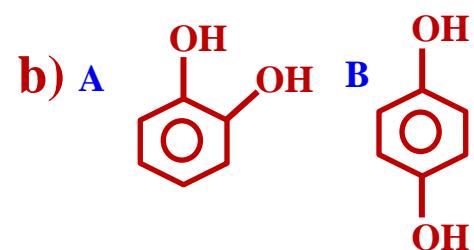
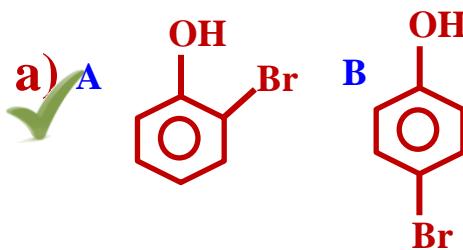
## ALCOHOLS, PHENOLS AND ETHERS



## ALCOHOLS, PHENOLS AND ETHERS

MCQs

1. Phenol  $\xrightarrow[\text{Cs}_2]{\text{Br}_2}$  A + B identify A & B



## ALCOHOLS, PHENOLS AND ETHERS



a) 2,4,6 – Trihydroxy nitro benzene

b) 2,4,6 – Trihydroxy benzene

c) 2,4,6 – Trinitro benzene

d) Picric acid



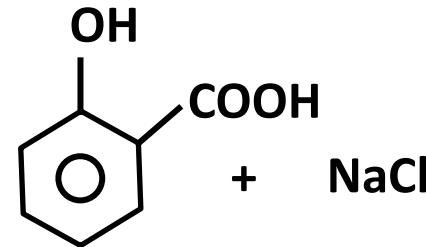
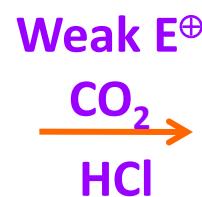
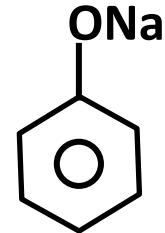
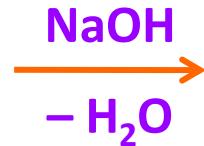
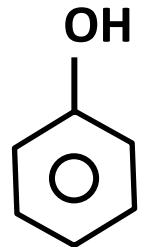
ALCOHOLS, PHENOLS AND ETHERS

**KOLBE'S  
&  
REIMER – TIEMANN  
REACTION**

# ALCOHOLS, PHENOLS AND ETHERS

## Chemical properties of Phenol

### Kolbe's Reaction

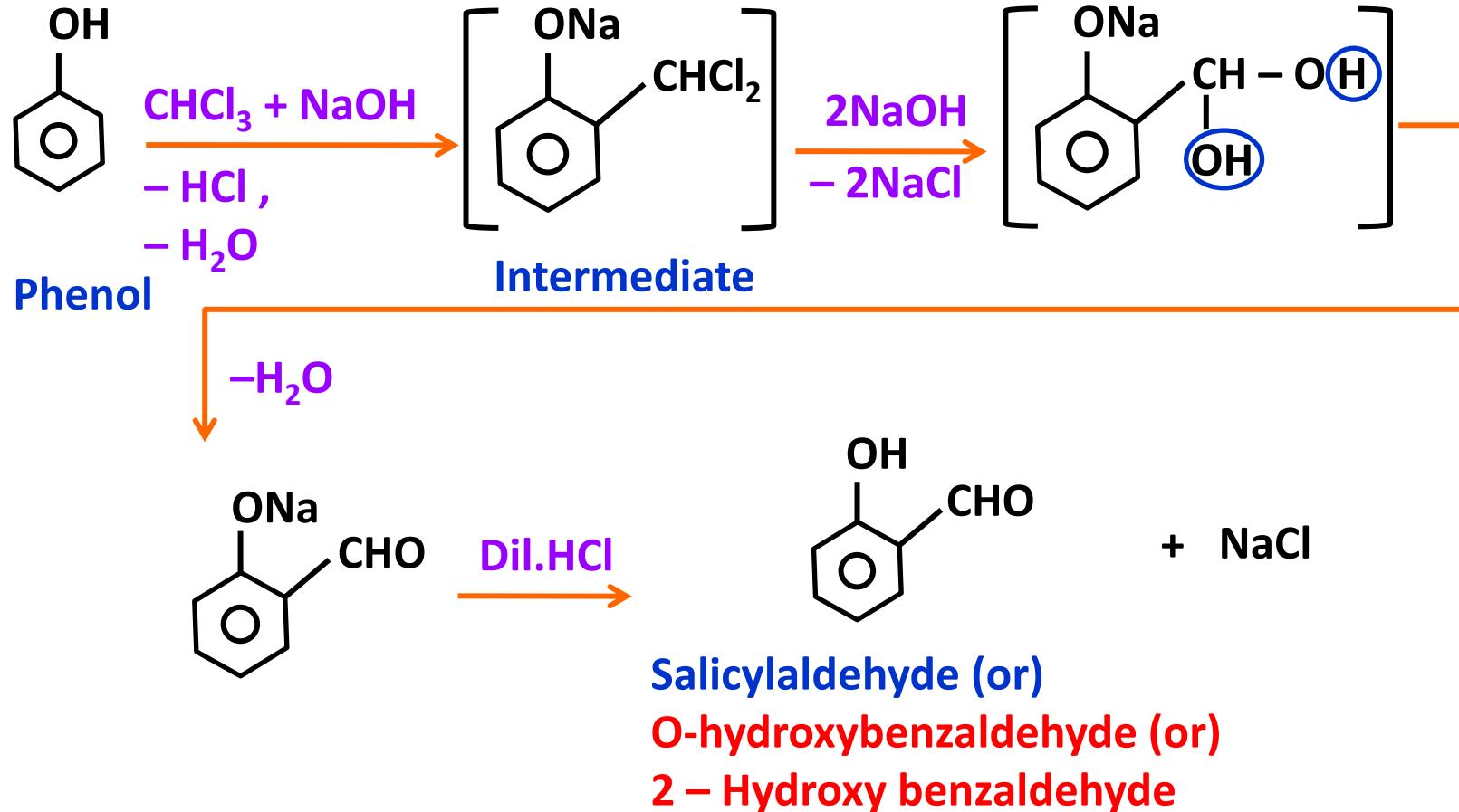


# ALCOHOLS, PHENOLS AND ETHERS

## Chemical properties of Phenol

Reimer – Tiemann reaction

## ALCOHOLS, PHENOLS AND ETHERS



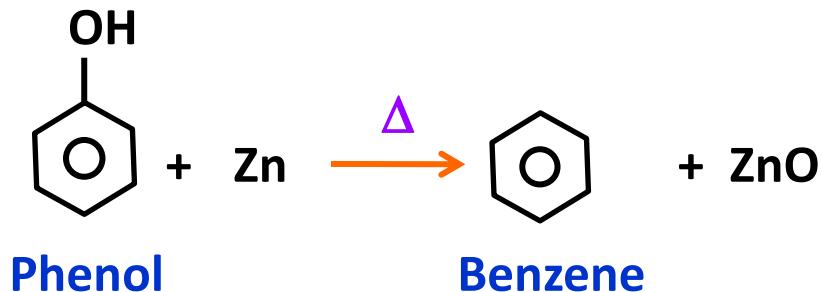
# ALCOHOLS, PHENOLS AND ETHERS

## Chemical properties of Phenol



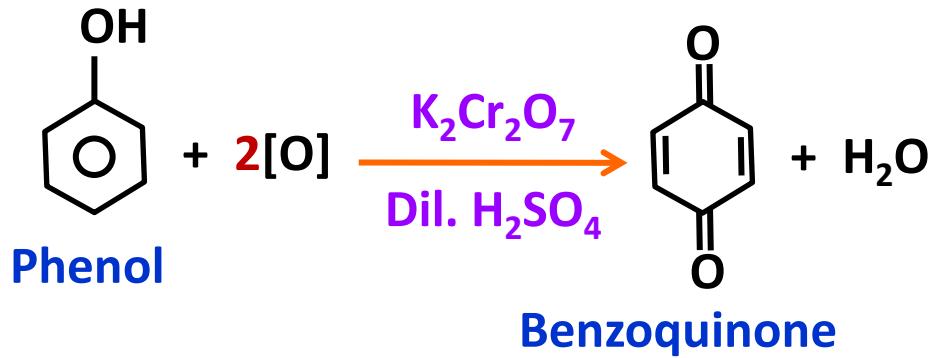
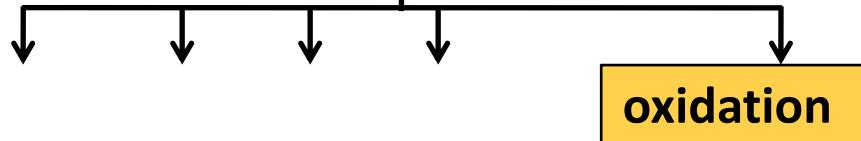
### Reaction with Zn dust

#### Reduction



# ALCOHOLS, PHENOLS AND ETHERS

## Chemical properties of Phenol



# ALCOHOLS, PHENOLS AND ETHERS

## Distinguishing test between Alcohol and Phenol

# Alcoh

b1

**Let us see how we can differentiate between**

## **Alcohol and phenol**

(F)

# Neutral FeCl<sub>3</sub>

$$3 \text{C}_6\text{H}_5\text{OH} + \text{FeCl}_3$$

## Phenol

# Ferric chloride



$$(C_6H_5O)_3Fe + 3 HCl$$

## Ferric phenoxide)

## Violet coloration

1. Riemer Tiemann reaction gives formation of ...

- a) salicylic acid
- b)  salicylaldehyde
- c) sodium phenoxide
- d) Both b & c

## ALCOHOLS, PHENOLS AND ETHERS

2. Phenol gives violet coloration when treated with...

- a) litmus paper
- b) acidic  $\text{FeCl}_3$  solution
- c) aq. Neutral  $\text{FeCl}_3$  solution
- d) None of these

## ALCOHOLS, PHENOLS AND ETHERS



# **ALCOHOLS, PHENOLS AND ETHERS**

# INTRODUCTION TO ETHERS

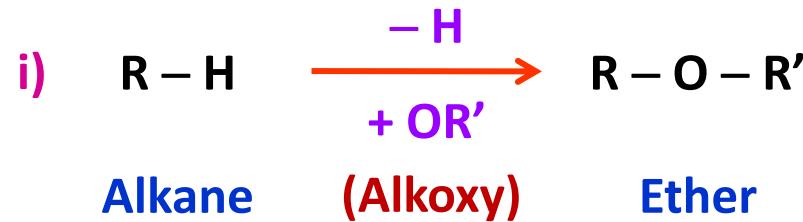
# ALCOHOLS, PHENOLS AND ETHERS

## Ethers

Ethers

Alkoxy or Aryloxy derivatives of alkane

IUPAC Name: Alkoxyalkane or Aryloxy alkane



## ALCOHOLS, PHENOLS AND ETHERS

Functional group of Ether is  $\begin{array}{c} | & & | \\ -C & -O & -C- \\ | & & | \end{array}$   
(Ether linkage)

G.F. for aliphatic ethers  $\Rightarrow C_n H_{2n+2} O$  (or)  $C_n H_{2n+1} - O - C_n H_{2n+1}$

Which is same as monohydric alcohols therefore they are **functional isomers**

**For eg.**  $H_3C - CH_2 - OH$  Ethanol

&  $H_3C - O - CH_3$  Dimethyl ether

1. Ethers are...derivatives of alkane

- a) alkoxy
- b) aryloxy
- c) Both a & b 
- d) Alkyl or aryl

## 2. General representation of Ether is...

a)  $\text{R} - \text{OH}$

b)   $\text{R} - \text{O} - \text{R}$

c)  $\text{R} - \underset{\substack{\text{O} \\ \parallel}}{\text{C}} - \text{OH}$

d)  $\text{R} - \text{COOR}$

3. Ethers are functional isomers of...

- a) Aldehydes
- b) Dihydric alcohols
- c) Trihydric alcohols
- d) Monohydric alcohols

4. General formula for aliphatic ethers is...

a)  $C_nH_{2n+2}$

b)  $C_nH_{2n}O$

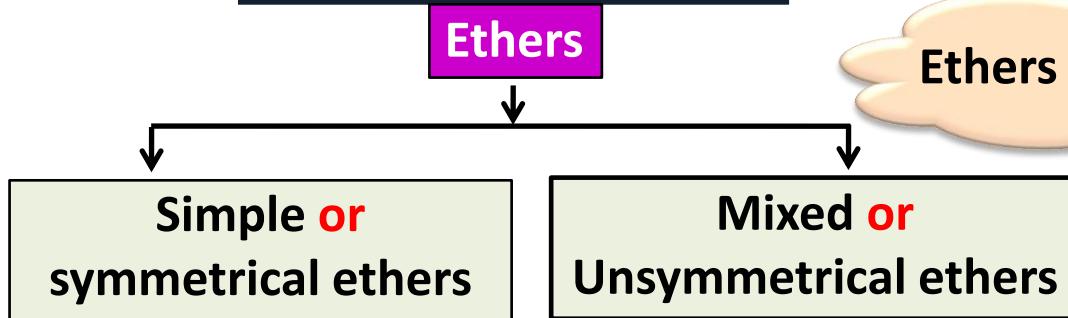
c)   $C_nH_{2n+2}O$

d) None of these

# ISOMERISM OF ETHERS

# ALCOHOLS, PHENOLS AND ETHERS

## Classification of Ethers



Ethers are of two types

G.R. :  $R - O - R$

(Both the alkyl groups which are attached to the oxygen atom are same) For eg.



Dimethyl ether

(or) Methoxymethane

G.R. :  $R - O - R'$

(Both the alkyl groups which are attached to the oxygen atom are different)

For eg.



Ethyl methyl ether(or) Methoxyethane

# ALCOHOLS, PHENOLS AND ETHERS

## Isomerism of Ethers



### Chain isomerism

(Different arrangement of carbon chain)

For eg.



n – butyl methyl ether

&



|



Isobutyl methyl ether



### Functional isomerism

(Functional groups are different)

For eg.



Dimethyl ether

&



Ethanol

## ALCOHOLS, PHENOLS AND ETHERS

For eg.

Compounds having M.F.  $C_4H_{10}O$  has the following metamers :



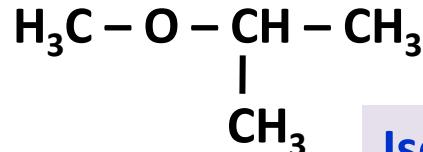
Diethyl ether

Ethoxy ethane



Methyl n – propyl ether

1-methoxypropane



Isopropyl methyl ether

2-methoxypropane

# ALCOHOLS, PHENOLS AND ETHERS

## Metamerism

Metamers are either chain **or** position isomers with same functional group & have different alkyl groups attached to oxygen atom

Eg.



1.  $\text{C}_2\text{H}_5 - \text{O} - \text{CH}_3$  is an example of...

- a) symmetrical ether
- b) Mixed ether
- c) unsymmetrical ether
- d) Both b & c

2.  $\text{H}_3\text{C} - \text{O} - \text{CH}_3$  and  $\text{H}_3\text{C} - \text{CH}_2 - \text{OH}$  are...of each other

- a) Chain isomers
- b) metamers
- c)  Functional isomers
- d) All of these

3. Ethers having same molecular formula but different alkyl groups on either side of oxygen atom, called as...
- a) chain isomers
  - b)  metamers
  - c) functional isomers
  - d) All of these

4. Ethers in which both alkyl groups attached to oxygen are same, are called...
- a) simple ethers
  - b) mixed ethers
  - c) symmetrical ethers
  - d) Both a & c
- 

# NOMENCLATURE OF ETHERS

# ALCOHOLS, PHENOLS AND ETHERS

No.	Structure	Common Name
1.	$\text{H}_3\text{C} - \text{O} - \text{CH}_3$	Dimethyl ether

V  
Think about its IUPAC name.

I.U.P.A.C. Name (Alkoxyalkane)

Methoxymethane

# ALCOHOLS, PHENOLS AND ETHERS

## Nomenclature of Ethers

No.	Structure	Common Name
2.	$\text{H}_3\text{C} - \text{O} - \text{CH}_2 - \text{CH}_3$	Ethyl methyl ether

Think about its IUPAC name.

I.U.P.A.C. Name (Alkoxyalkane)

Methoxyethane

# ALCOHOLS, PHENOLS AND ETHERS

## Nomenclature of Ethers

No.	Structure	Common Name
3.	$\text{CH}_3 - \text{H}_2\text{C} - \text{O} - \text{CH}_2 - \text{CH}_3$	Diethyl ether

V

It's IUPAC name is

...

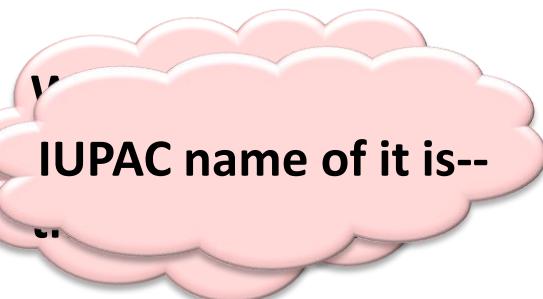
I.U.P.A.C. Name (Alkoxyalkane)

Ethoxyethane

# ALCOHOLS, PHENOLS AND ETHERS

## Nomenclature of Ethers

No.	Structure	Common Name
4.	$\text{H}_3\text{C}-\text{O}-\text{CH}_2-\text{CH}_2-\text{CH}_3$ ①      ②      ③	Methyl n -propyl ether



I.U.P.A.C. Name (Alkoxyalkane)

1 – Methoxypropane

# ALCOHOLS, PHENOLS AND ETHERS

## Nomenclature of Ethers

No.	Structure	Common Name
5.	$\text{H}_3\text{C} - \text{O} - \underset{\substack{\text{③} \\   \\ \text{CH}_3}}{\text{CH}} - \text{CH}_3$ ②      ①	isopropyl methyl ether

Now, can you tell me  
the IUPAC name ?

I.U.P.A.C. Name (Alkoxyalkane)

2 – Methoxypropane

# ALCOHOLS, PHENOLS AND ETHERS

## Nomenclature of Ethers

No.	Structure	Common Name
6.	$\begin{array}{c} \textcircled{1} \text{CH}_3 \\   \\ \text{H}_3\text{C} - \text{O} - \text{C} - \text{CH}_3 \\   \\ \textcircled{2} \text{ } \\   \\ \textcircled{3} \text{CH}_3 \end{array}$	tert-butyl methyl ether

Now, can you tell me  
the IUPAC name ?

I.U.P.A.C. Name (Alkoxyalkane)

2 – Methoxy – 2 – methylpropane

No.	Structure	Common Name
7.		<p>Most common called as Anisole</p> <p>Other name based on alkyl and aryl groups</p> <p>Methyl phenyl ether</p>

I.U.P.A.C. Name (Alkoxyalkane)

Methoxybenzene

V

IUPAC name of it is --

# ALCOHOLS, PHENOLS AND ETHERS

## Nomenclature of Ethers

No.	Structure	Common Name
8.	$\text{OCH}_2 - \text{CH}_3$ 	Phenetole Other name: Ethyl phenyl ether

V

IUPAC name of it is --

I.U.P.A.C. Name (Alkoxyalkane)

Ethoxybenzene

1. IUPAC name of ether in general is...

a) Alkoxyalkane  


b) Alkylalkane

c) Allylalkane

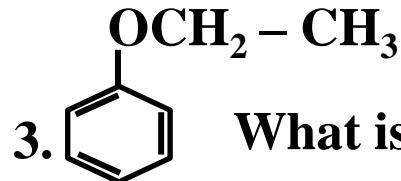
d) None of these

## ALCOHOLS, PHENOLS AND ETHERS



- a) 2–Methyl–2–Methoxypropane
- b) 2, 2–Dimethyl–2–methoxy ethane
- c)  2–Methoxy–2–methylpropane
- d) All of these

## ALCOHOLS, PHENOLS AND ETHERS



What is the name of this compound?

- a) Phenyl ethoxy
- b) Ethylbenzoxy
- c)  Ethoxy benzene
- d) All of these

# **PHYSICAL PROPERTIES OF ETHERS**

## Physical properties of Ethers

- Boiling points of ethers are slightly higher than that of alcohols but much lower than that of alcohols.
- Ethers are immiscible with water because they do not form H – bonding with water molecule readily due to alkyl groups or hydrocarbon part.
- Dipole moment for diethyl ether is 1.18 D.
- Some ethers are Volatile and are highly inflammable.

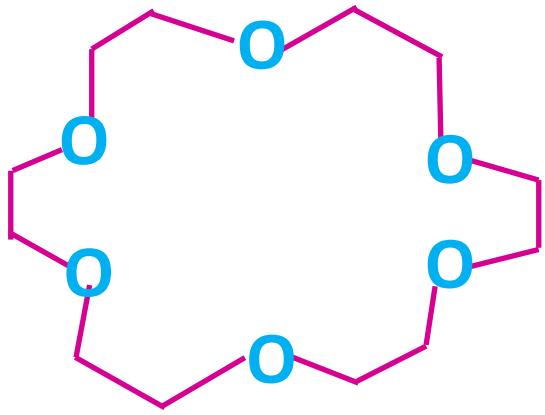
Let us go through physical properties carefully.

## Uses of Diethyl ether

- Used as industrial solvent for oils, fats, etc.
- Used as solvent in the reaction of Grignards reagent.
- Used as refrigerant.
- A mixture of diethyl ether & ethyl alcohol, known as **Natalite**, which is used as fuel (substitute for petrol)

Some important uses of  
Diethyl ether....

# ALCOHOLS, PHENOLS AND ETHERS



Did you come  
across this type of  
structure so far?

Imagine what it  
could be?

Let us travel to next slide for  
better understanding

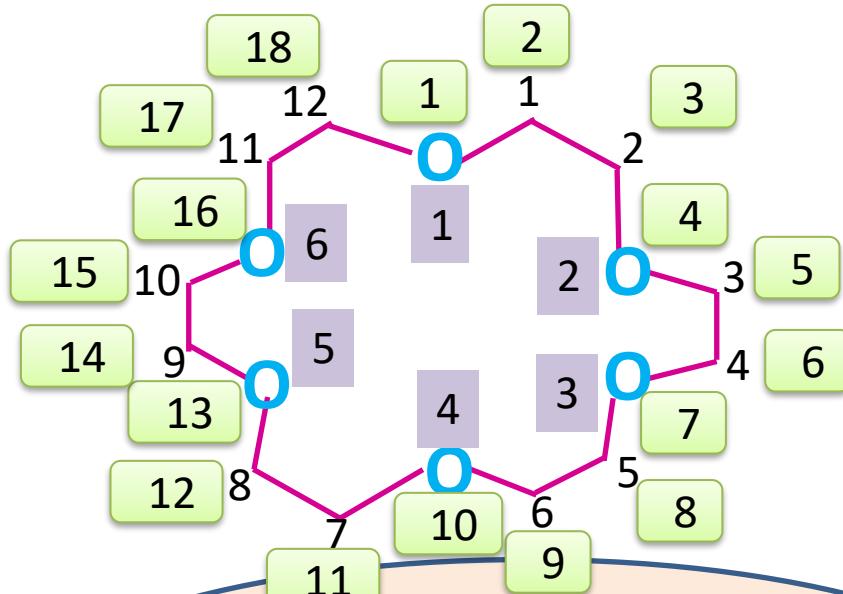
## Crown ethers

Charles J. Pederson discovered Macroscopic polyethers, which are the organic compounds with molecules containing large rings of carbon & oxygen atoms, called crown ethers.

Crown ethers are named as **n – crown – m**, where , n is the total number of atoms and m is the number of oxygen atoms in the ring.

The number of carbons=total number of atoms- number of oxygen atoms.  
The first crown ether synthesized is  
**18 – crown – 6.**

# ALCOHOLS, PHENOLS AND ETHERS



6-indicates number of oxygens

18 -indicates number of atoms  
including carbons

Number of carbons = $18-6=12$

## Structure of 18 – crown – 6

1 to 6 are oxygens

1 to 12 are carbons

1 to 18 total number of atoms.

1. Boiling points of ethers are lower than that of...

a) Carboxylic acids

b)  Alcohol

c) Amides

d) all of these

2. Those ethers which are... in nature, are highly inflammable

a) Non – volatile

b) Volatile  


c) Both a & b

d) None of these

3. Natalite is...

- a) diethyl ether and methyl alcohol
- b) dimethyl ether and methyl alcohol
- c)  diethyl ether and ethyl alcohol
- d) diethyl ether and propyl alcohol

4. The first crown ether to be synthesized was...

- a) 16 – crown – 6
- b) 14 – crown – 6
- c) 17 – crown – 6
- d)  18 – crown – 6

## ALCOHOLS, PHENOLS AND ETHERS



# **ALCOHOLS, PHENOLS AND ETHERS**

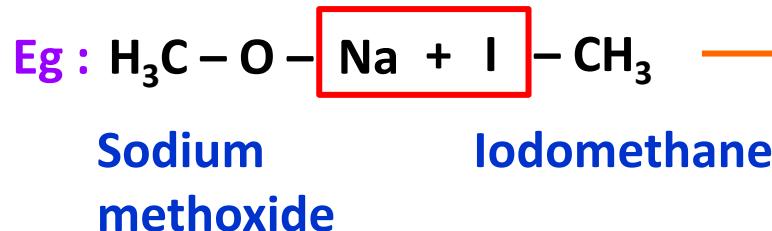
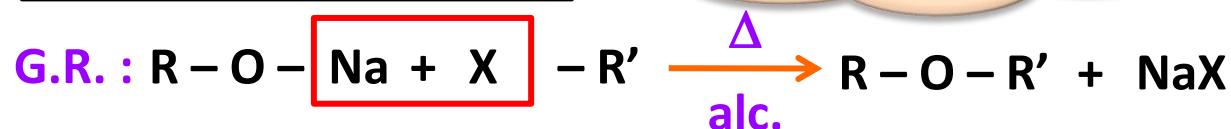
# **PREPARATION OF ETHERS**

# ALCOHOLS, PHENOLS AND ETHERS

## Methods of preparation of Ethers

### Williamson's Synthesis

There are 3 methods of preparation of ethers

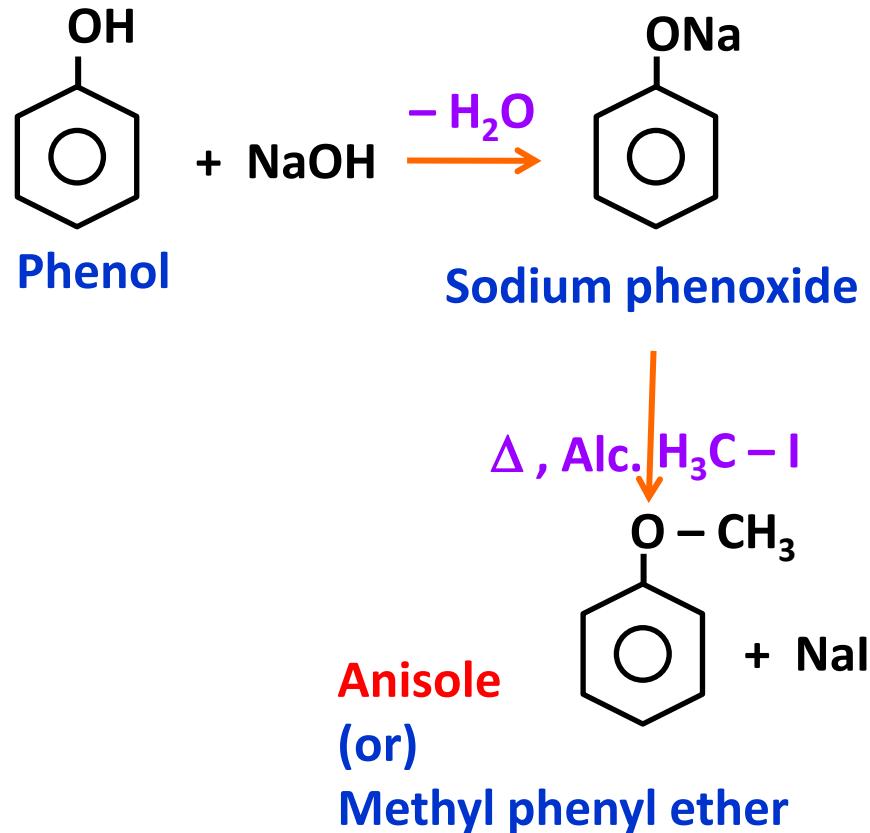


Dimethyl ether

## ALCOHOLS, PHENOLS AND ETHERS



# ALCOHOLS, PHENOLS AND ETHERS



## ALCOHOLS, PHENOLS AND ETHERS

### Limitation

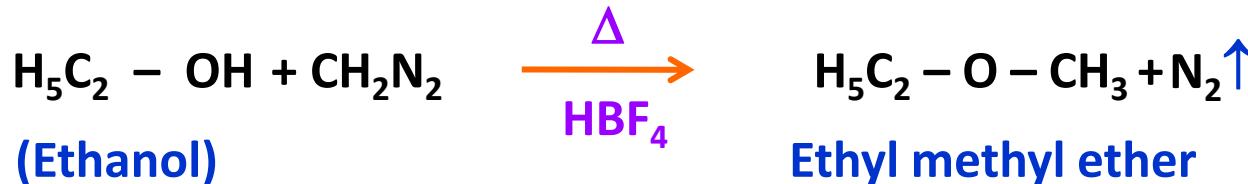
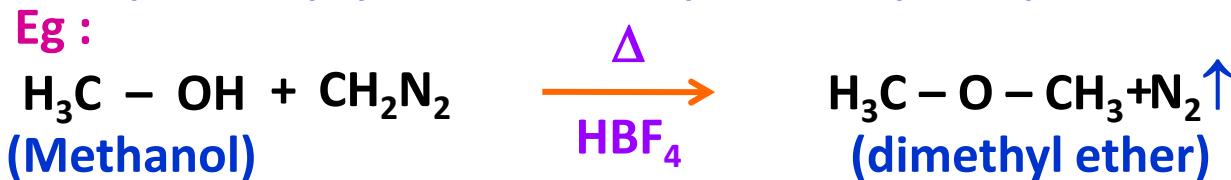
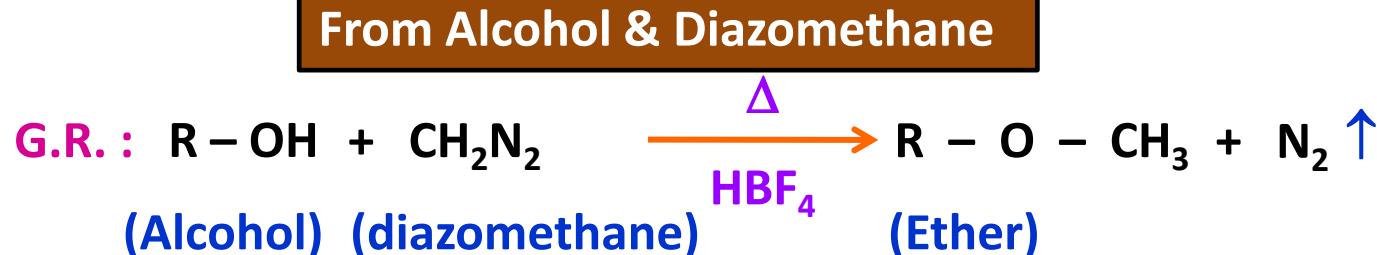


Tert – butyl  
bromide ( $3^0$ )

Only  $1^0$  alkyl halide is used in this method, because  $2^0$  &  $3^0$  alkyl halide gives alkene on Elimination.

# ALCOHOLS, PHENOLS AND ETHERS

## Methods of preparation of Ethers



## ALCOHOLS, PHENOLS AND ETHERS

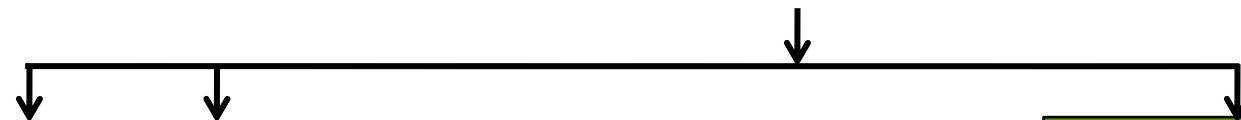
### Limitation

Only Methyl ethers are obtained by this method.

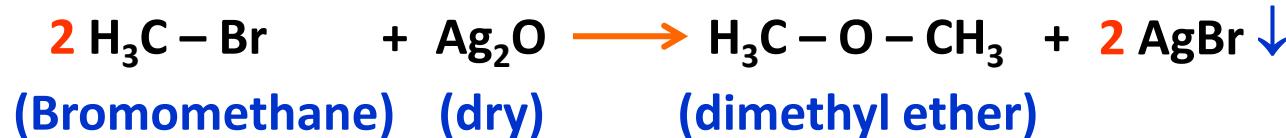
Diethyl ether can't be prepared by this method.

# ALCOHOLS, PHENOLS AND ETHERS

## Methods of preparation of Ethers



With dry  $\text{Ag}_2\text{O}$



1. Methyl iodide when heated with alcoholic sodium ethoxide, product is...
- a) diethyl ether
  - b)  ethyl methyl ether
  - c) diethyl ether
  - d) all of these

2. In Williamson's synthesis, only...alkyl halide is used

a) Secondary ( $2^0$ )

b) Tertiary ( $3^0$ )

c) Primary ( $1^0$ )

d) all of these

3. Only...ethers are obtained from alcohols and diazomethane

- a) ethyl
- b) diethyl
- c) dimethyl
- d) methyl

4. Bromomethane on treatment with dry  $\text{Ag}_2\text{O}$ , gives...

- a) diethyl ether
- b) ethyl methyl ether
- c) dimethyl ether 
- d) All of these

# CHEMICAL PROPERTIES OF ETHERS

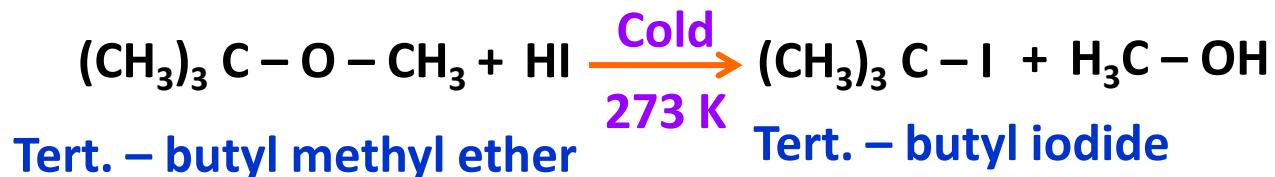
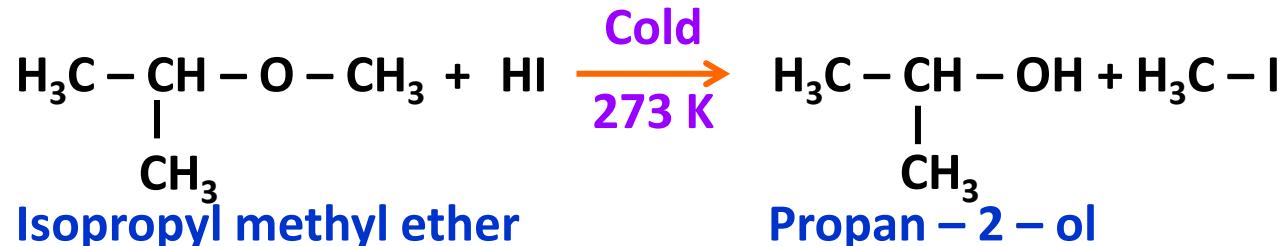
# ALCOHOLS, PHENOLS AND ETHERS

# Chemical properties of Ethers

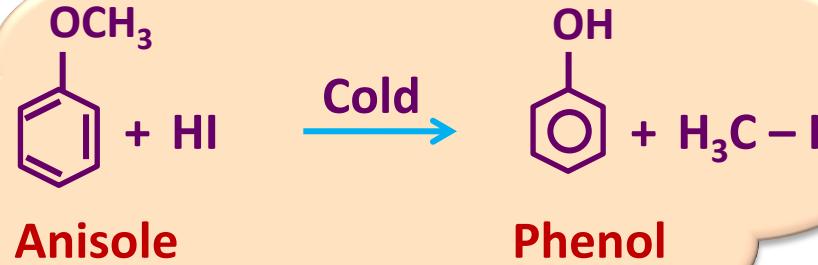
## With cold HI



## ALCOHOLS, PHENOLS AND ETHERS



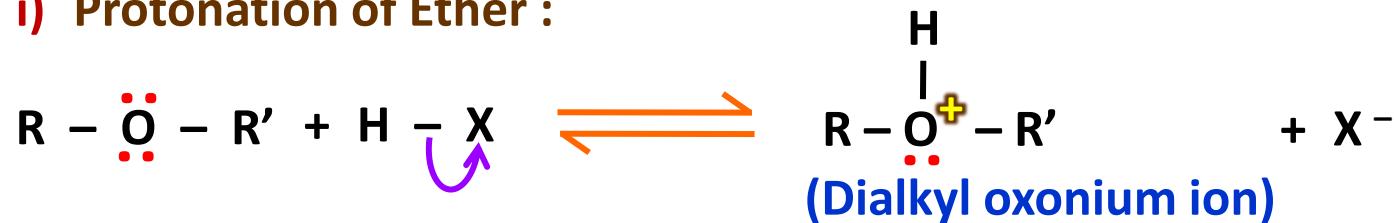
## ALCOHOLS, PHENOLS AND ETHERS



# ALCOHOLS, PHENOLS AND ETHERS

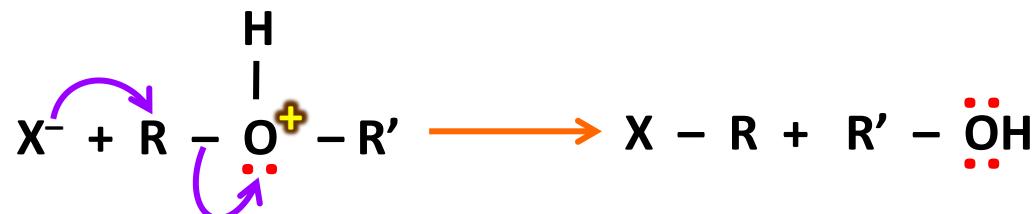
## Mechanism

### i) Protonation of Ether :



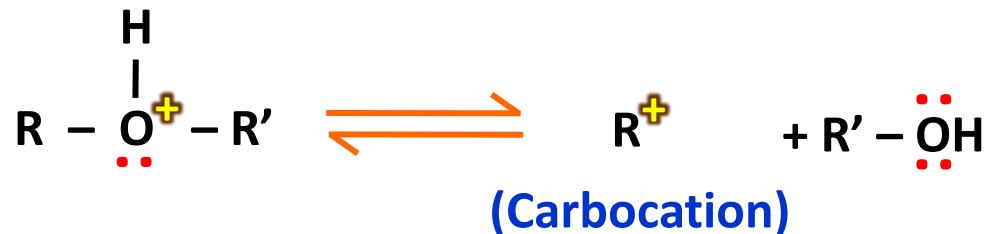
### ii) $\text{S}_{\text{N}}^2$ cleavage :

(a) If alkyl groups are  $1^\circ$  or  $2^\circ$  then lower alkyl group forms alkyl halide

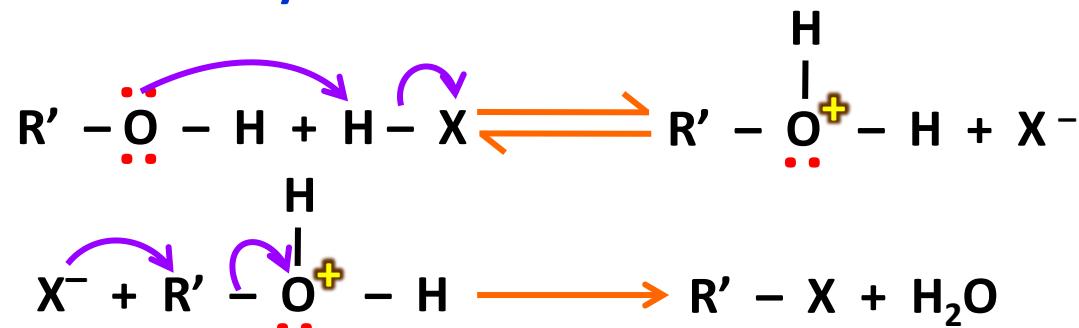


## ALCOHOLS, PHENOLS AND ETHERS

(b) If alkyl group is tertiary then tertiary alkyl halide is formed.



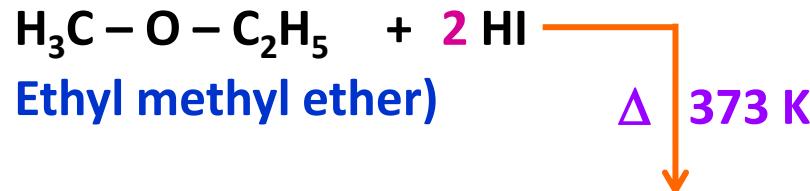
iii) At high temperature alcohol molecule reacts with excess of HX to give alkyl halide :



# ALCOHOLS, PHENOLS AND ETHERS

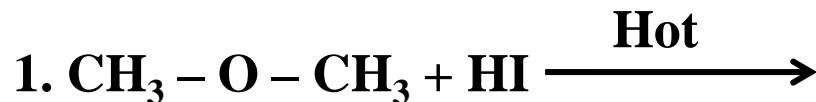
## Chemical properties of Ethers

Let us see reaction of  
ether with Hot HI



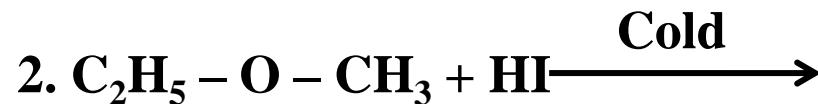
## ALCOHOLS, PHENOLS AND ETHERS





- a)  $\text{CH}_3\text{I}$ ,  $\text{CH}_3\text{OH}$
- b)  $\text{CH}_3\text{I}$ ,  $\text{CH}_4$
- c)  $\text{CH}_3\text{OH}$ ,  $\text{CH}_3\text{OH}$
- d)   $\text{CH}_3\text{I}$

## ALCOHOLS, PHENOLS AND ETHERS



a)  $\text{C}_2\text{H}_5\text{I}, \text{CH}_3\text{OH}$

b)  $\text{CH}_3\text{I}, \text{C}_2\text{H}_5\text{I}$

c)   $\text{CH}_3\text{I}, \text{C}_2\text{H}_5\text{OH}$

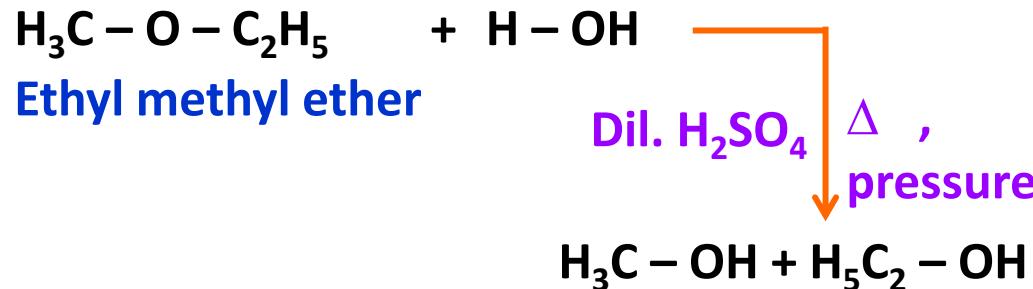
d)  $\text{C}_2\text{H}_5\text{OH}, \text{CH}_3\text{OH}$

# ELECTROPHILIC SUBSTITUTION REACTION OF ETHERS

# ALCOHOLS, PHENOLS AND ETHERS

## Chemical properties of Ethers

Let us see action of  
dil.  $\text{H}_2\text{SO}_4$  on ethers



# ALCOHOLS, PHENOLS AND ETHERS

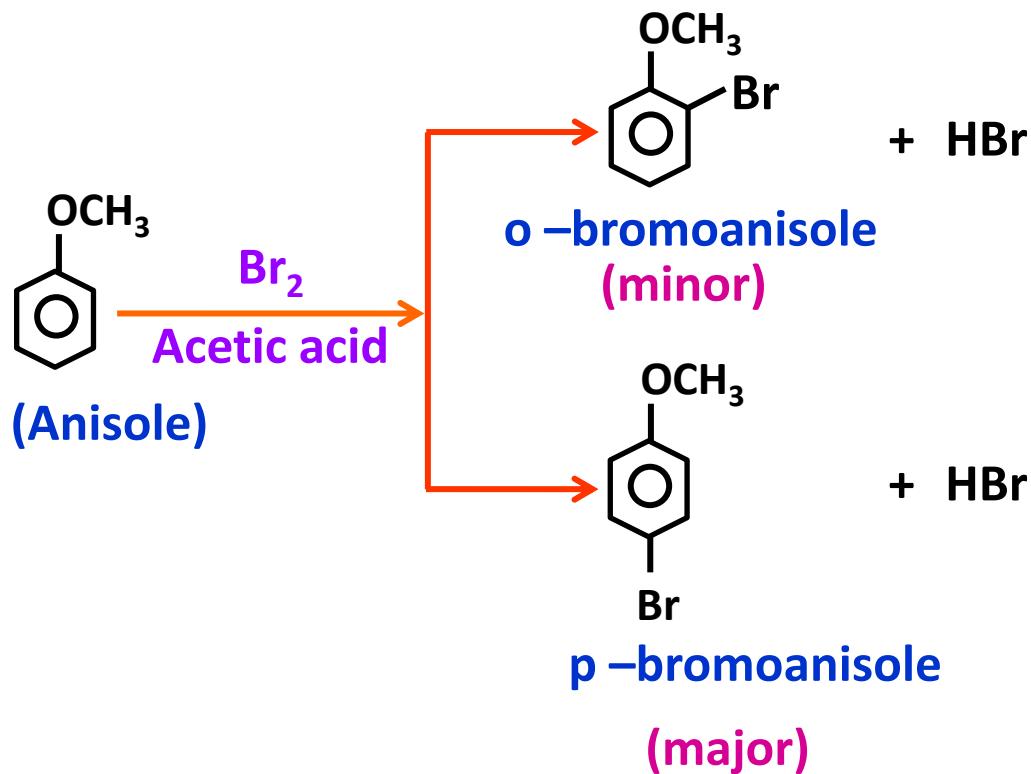
## Chemical properties of Ethers

### Electrophilic substitution reaction

Halogenation

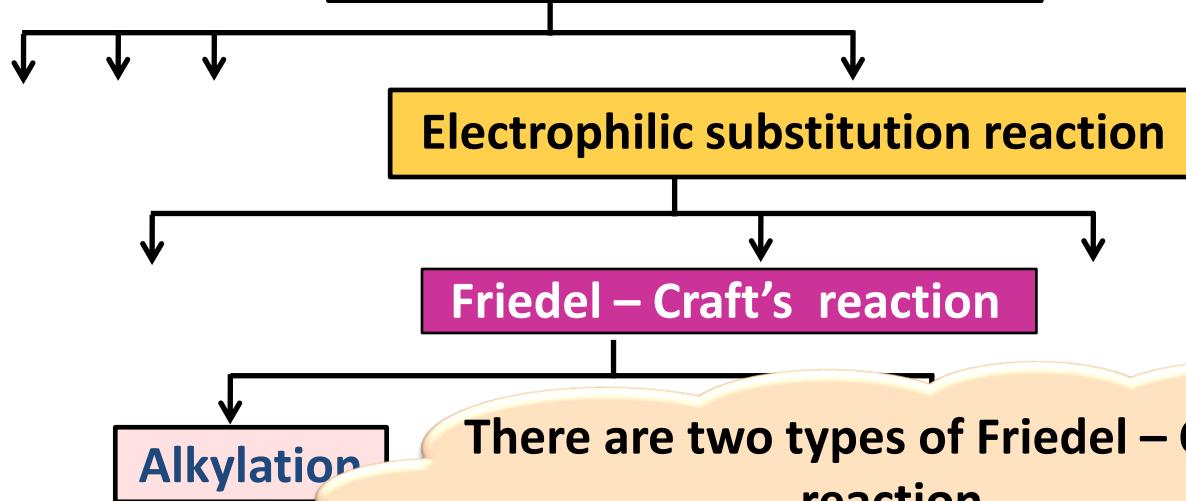
There are three types of electrophilic substitution reactions

# ALCOHOLS, PHENOLS AND ETHERS

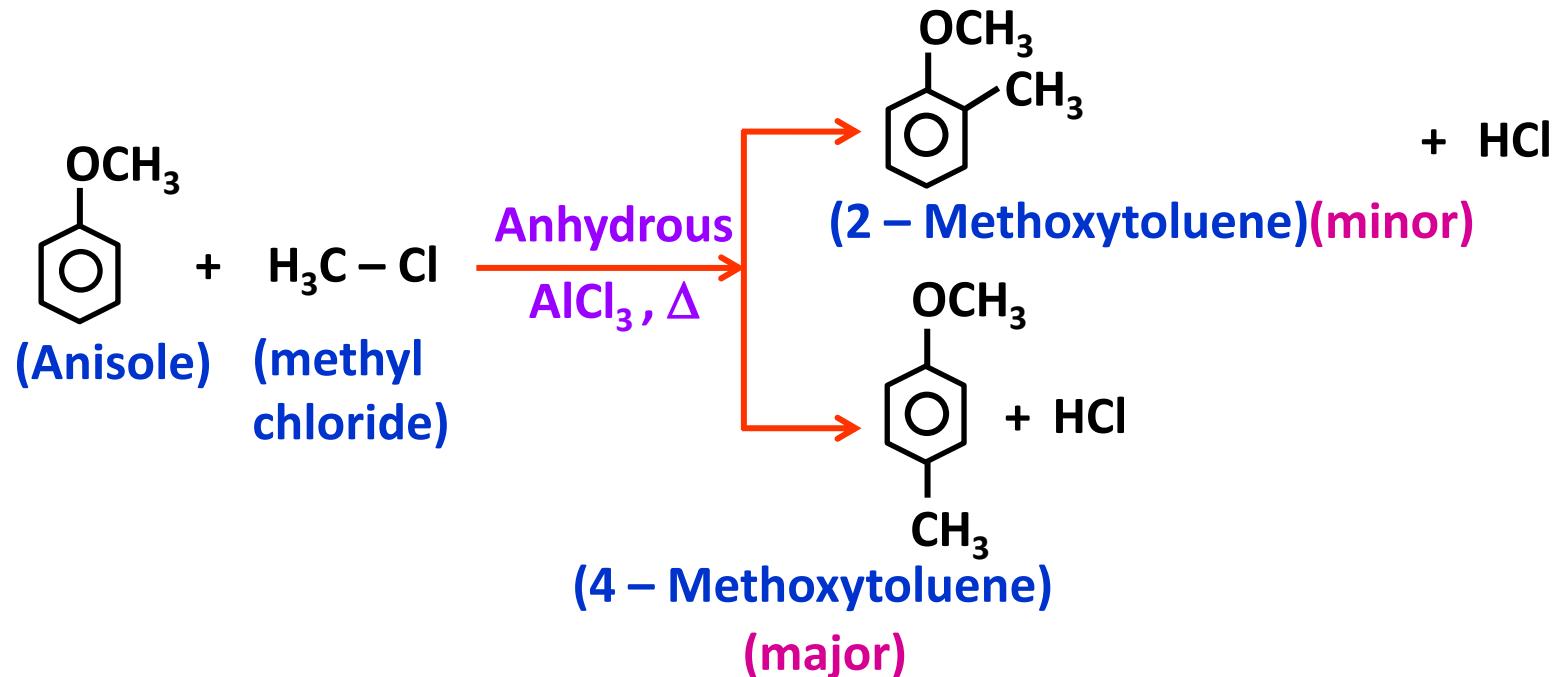


# ALCOHOLS, PHENOLS AND ETHERS

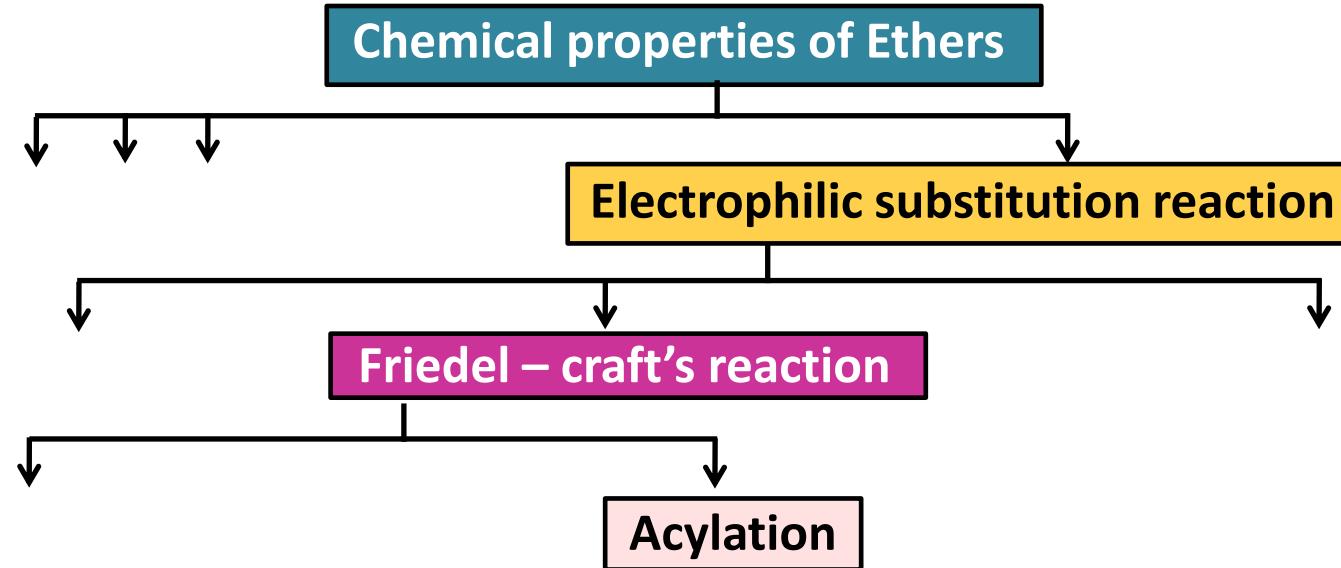
## Chemical properties of Ethers



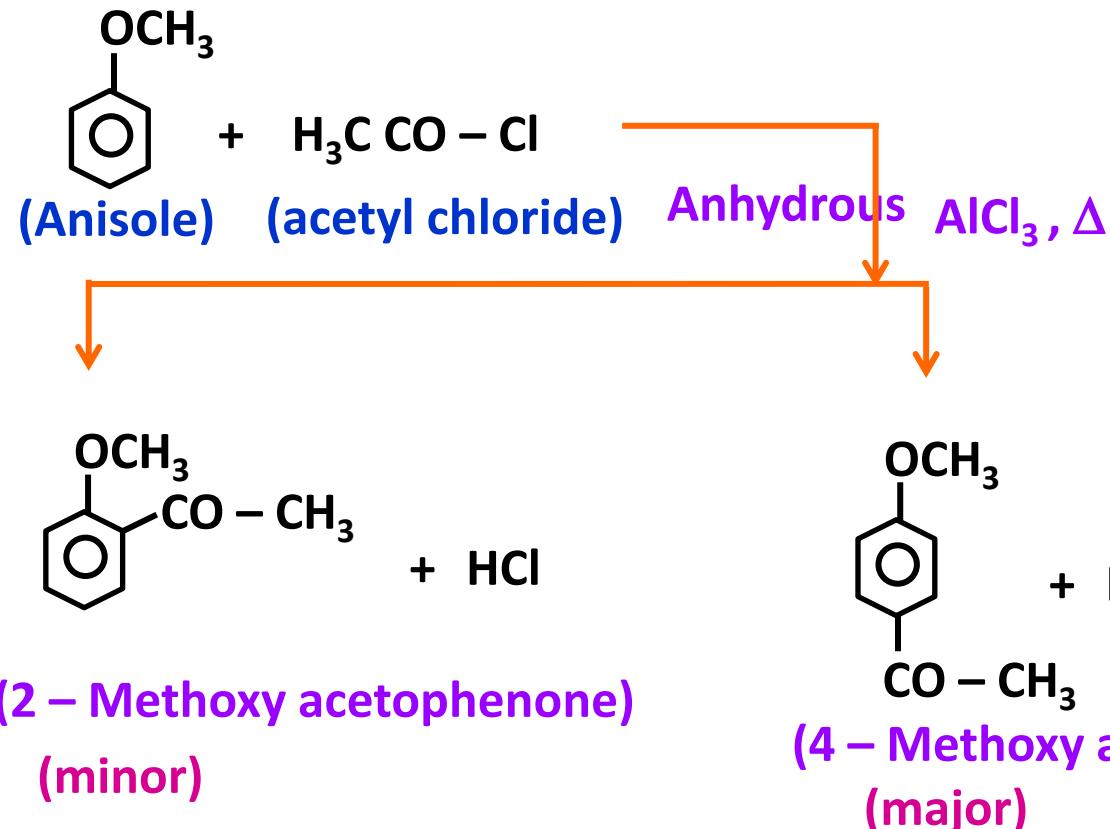
## ALCOHOLS, PHENOLS AND ETHERS



# ALCOHOLS, PHENOLS AND ETHERS



## ALCOHOLS, PHENOLS AND ETHERS



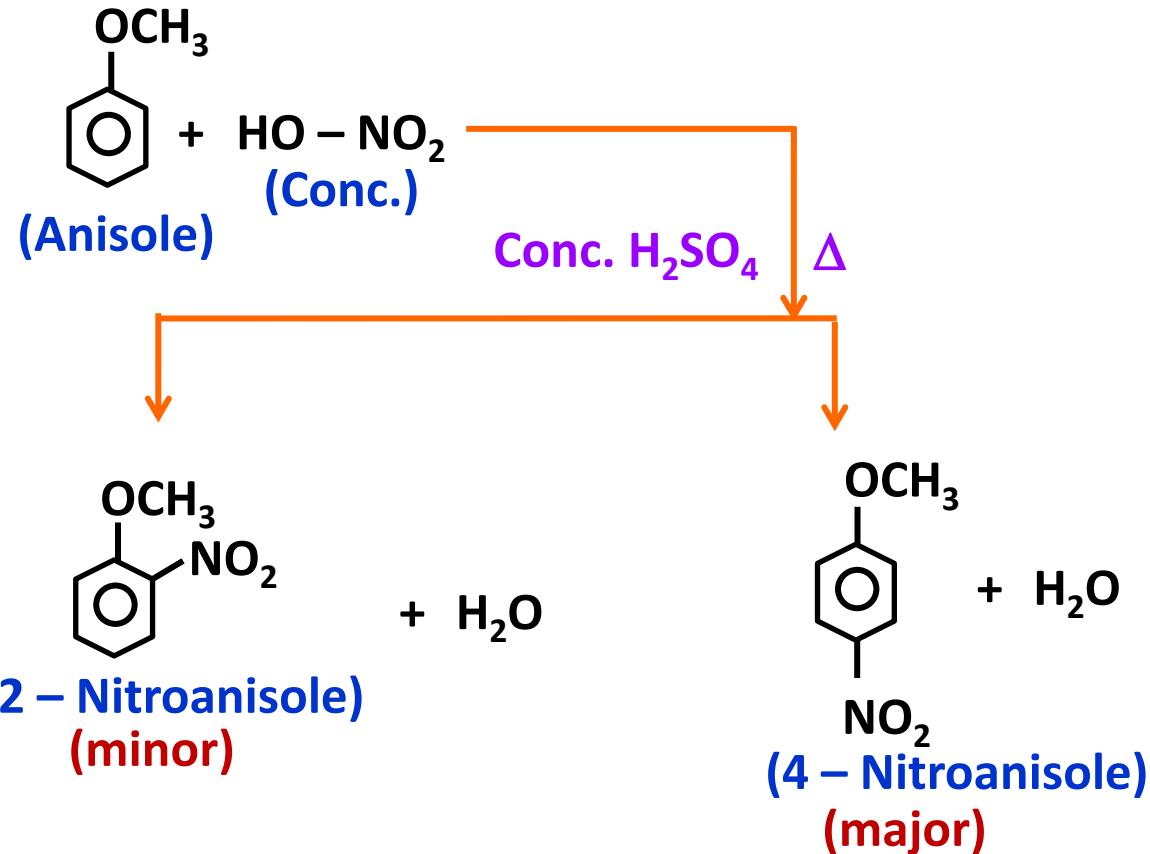
# ALCOHOLS, PHENOLS AND ETHERS

## Chemical properties of Ethers

### Electrophilic substitution reaction

#### Nitration

## ALCOHOLS, PHENOLS AND ETHERS



1. Anisole when treated with  $\text{Br}_2$  in acetic acid gives,

- a) o – bromoanisole
- b) m – bromoanisole
- c) p – bromoanisole
- d) Both a & c

## ALCOHOLS, PHENOLS AND ETHERS

2. Anisole when heated with acetyl chloride in presence of anhydrous  $\text{AlCl}_3$ ...

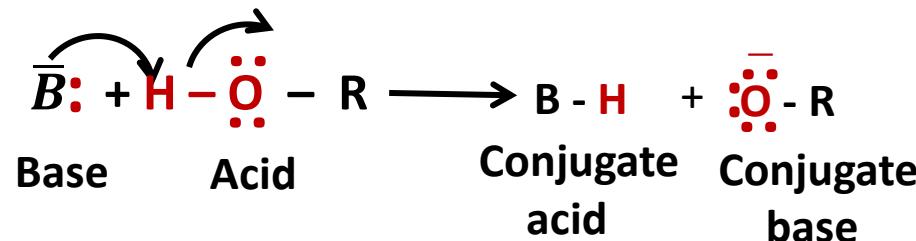
- a) 2 – methoxyacetophenone
- b) 3 – methoxyacetophenone
- c) 4 – methoxyacetophenone
- d) Both a & c

**ACIDIC NATURE OF  
ALCOHOLS, PHENOLS  
& ETHERS**

## ALCOHOLS, PHENOLS AND ETHERS

### Acidic nature of Alcohols , Phenols & Ethers

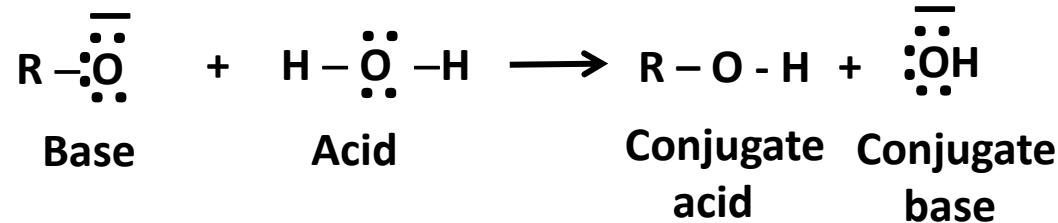
The reactions show that alcohols and phenols are acidic in nature. In fact, alcohols and phenols are brownsted acids i.e., they can donate a proton to a stronger base ( $B:.$ ).



## ALCOHOLS, PHENOLS AND ETHERS

Alcohols are however, weaker acids than water.

~This can be illustrated by the reaction of water with an alkoxide.



This reaction shows that water is a better proton donor (i.e., stronger acid) than alcohol.

Also, in the above reaction, we note that alkoxides are strong bases (sodium ethoxide is a stronger base than sodium hydroxide).

## ALCOHOLS, PHENOLS AND ETHERS



**ALCOHOLS**

# **ALCOHOLS**

## **OBJECTIVES (LEVEL - I)**

1. The general formula of monohydric alcohol is

- 1)  $C_n H_{2n+2} O$
- 2)  $C_n H_{2n} O$
- 3)  $C_n H_{2n+1} O$
- 4)  $C_n H_{2n-1} O$

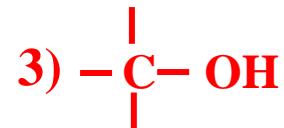
Solution:

Monohydric alcohols (ROH) have general formula  $C_n H_{2n+1} OH$  where  $n \geq 1$

2. Primary alcoholic group is



2) > CHOH



4) > C=O

Solution :

-CH<sub>2</sub>OH carbon atom is attached to only one other carbon atom

3. Which one of the following is a secondary alcohol?

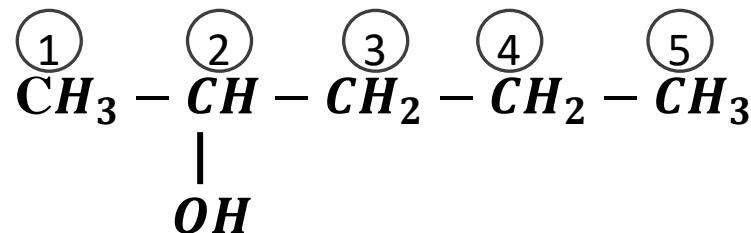
1) 2-methyl-1-propanol

2) 1-propanol

3) 1-butanol

✓ 2-pentanol

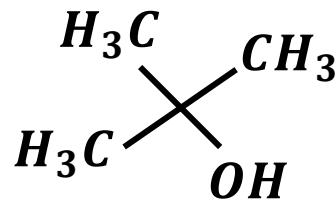
Solution:



4. Which of the following is tertiary alcohol?

- 1) Ethyl alcohol
- 2) Isopropyl alcohol
- 3) Neopentyl alcohol
- ✓ 2-methyl 2-propanol**

Solution:

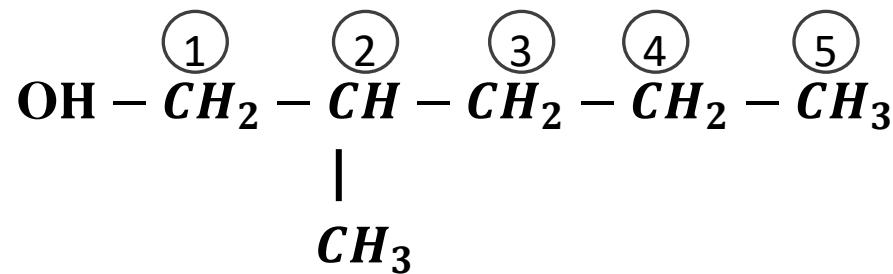


*tert – butyl alcohol*

5. 2-methyl pentanol-1 is a

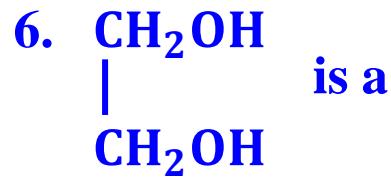
- 1)  $1^0$  alcohol
- 2)  $2^0$  alcohol
- 3)  $3^0$  alcohol
- 4) enol

Solution:



## ALCOHOLS

## LEVEL-1



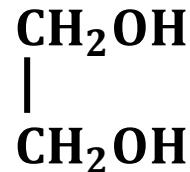
✓ 1<sup>0</sup> alcohol

2) 2<sup>0</sup> alcohol

3) 3<sup>0</sup> alcohol

4) Carbinol

Solution:



Has both primary carbon atoms

## ALCOHOLS

## LEVEL-1

7.  $\text{CH}_2\text{OH}-\text{CHOH}-\text{CH}_2\text{OH}$  is glycerol. It doesn't contain -----  
alcoholic group

1)  $1^0$

2)  $2^0$



4) both  $1^0$  &  $2^0$

Solution:



Has two primary and one secondary  
carbon atoms

8. An example for a polyhydric alcohol is

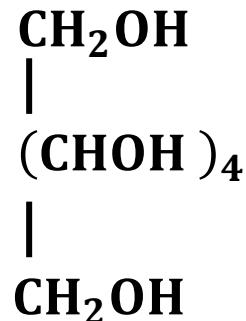
1) Methyl alcohol

2) Neopentyl alcohol

3) Sec butyl alcohol

 4) Mannitol

Solution:



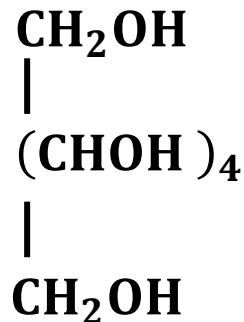
Mannitol (or)  
Sorbitol (or)  
Hexahydric alcohols

9. The number of  $1^0$ ,  $2^0$  and  $3^0$  alcoholic groups in Mannitol or Sorbitol are



- 1) 2, 4 and 0
- 2) 1, 4 and 0
- 3) 2, 2 and 0
- 4) 2, 1 and 1

Solution:



Has two primary and four secondary carbon atoms

**10. IUPAC name of sec.butyl alcohol is**

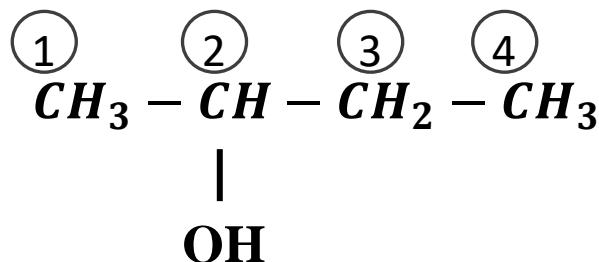
1) 2-methyl, 1 - propanol

 2-Butanol

3) 1 - Butanol

4) 2 - methyl-2 - propanol

**Solution:**



11. The other name of Isopropyl carbinol is

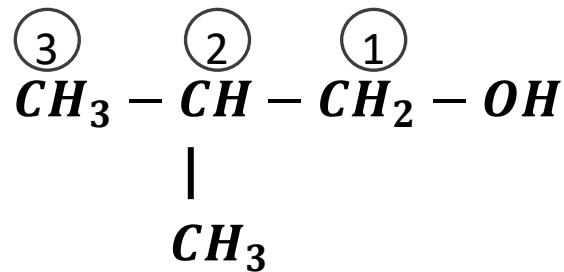
1) 2-methyl-2-propanol

2) Sec. butyl alcohol

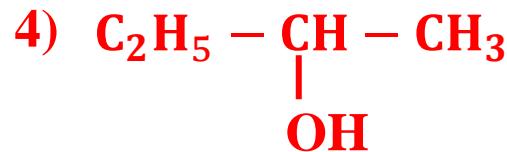
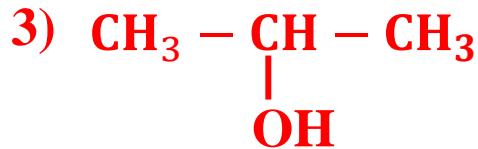
 3) Isobutyl alcohol

4) Tertiary butyl alcohol

Solution:



12. The formula of grain alcohol is



Solution:

Ethyl alcohol is also known as grain alcohol as it is obtained from food grains

13. Spirit of wine is the common name of

- 1)  $\text{CH}_3\text{OH}$
- 2)  $\text{C}_2\text{H}_5\text{OH}$

- 3)  $\text{HCHO}$

- 4)  $\text{CH}_3\text{COCH}_3$

Solution:

Ethyl alcohol is also known as spirit of wine as it is used in making of wine

**14. An isomer of ethanol is**

1) methanol

 2) dimethyl ether

3) acetone

4) diethyl ether

**Solution:**

**Ethanol is a functional isomer of dimethyl ether**

15. Which one of the following compound is an isomer of 1-butanol?

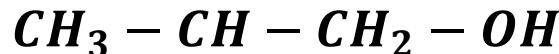
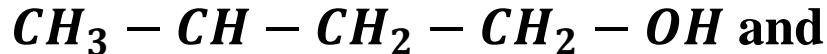
1) 2-methyl-2-butanol

3) 3-methyl-2-butanol

2) 1-methyl-2-butanol

 2-methyl-1-propanol

Solution:



16. Which one of the following pairs of compounds are functional isomers?

- 1)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ ,  $\text{CH}_3\text{CHOHCH}_3$
- 2)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ ,  $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$
- 3)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ ,  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$
- ✓ 4)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ ,  $\text{CH}_3\text{OCH}_2\text{CH}_3$

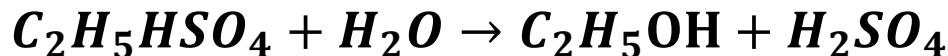
Solution:

Functional group isomers have different functional groups

17. Ethyl alcohol is manufactured from ethylene by reaction with

- 1) Permanganate
- 2) Catalytic oxidation
- ✓ 3)  $H_2SO_4$  followed by hydrolysis
- 4) Reduction

Solution:



18. The intermediate product in the preparation of ethanol from ethylene and  $H_2SO_4$  is

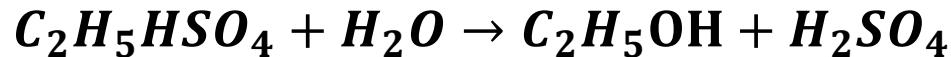
1)  $C_2H_5^+$

2)  $C_2H_4$

3)   $C_2H_5HSO_4$

4)  $C_2H_5O^+H_2$

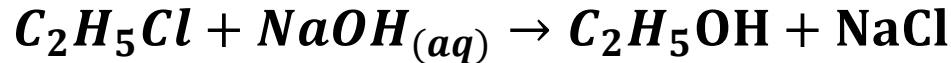
Solution:



19. Ethyl alcohol is the hydrolysis product of



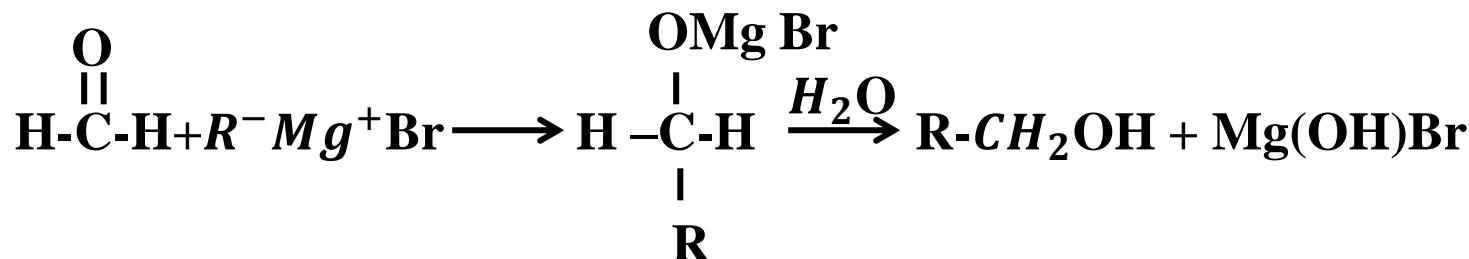
Solution:



20. Primary alcohols are obtained by the reaction of Grignard reagent with



Solution:



21. Which of the following gives ethyl alcohol by the action of Methyl magnesium halide followed by hydrolysis?



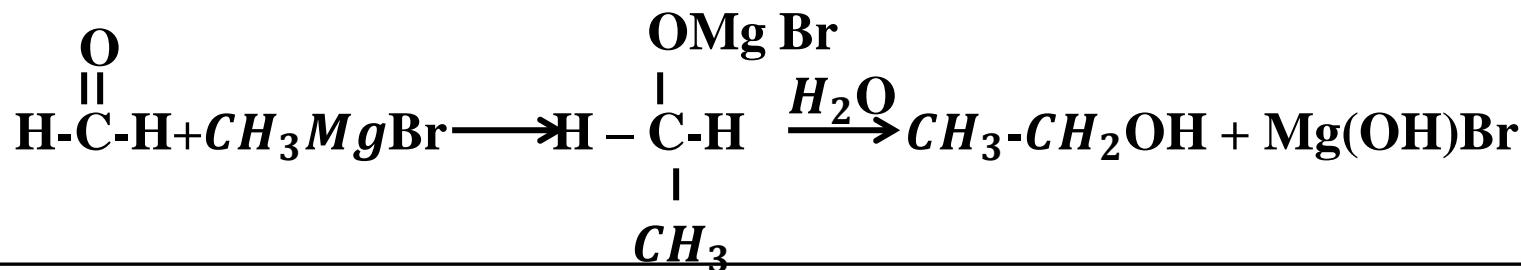
1) formaldehyde

2) acetaldehyde

3) acetic acid

4) methyl alcohol

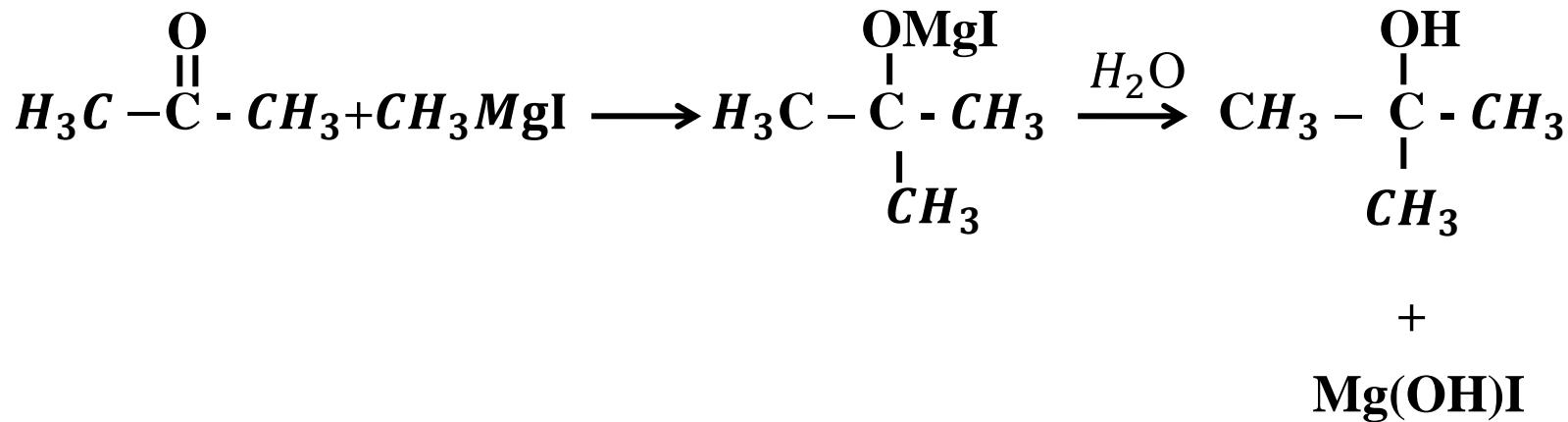
Solution:



22. When  $\text{CH}_3\text{MgI}$  is made to react with acetone and addition product is hydrolysed we get

- 1) Primary alcohol
- 2) Secondary alcohol
- 3) Tertiary alcohol
- 4) An aldehyde

Solution:



KEY : 3

23. The reagent used for converting ethanoic acid to ethanol is

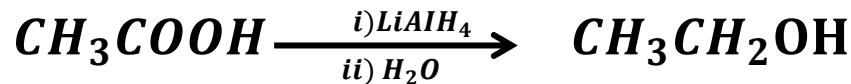
✓ 1)  $\text{LiAlH}_4$

2)  $\text{BH}_3$

3)  $\text{PCl}_3$

4)  $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+$

Solution:



24. Basic hydrolysis of ethyl acetate gives acetate ion and .....

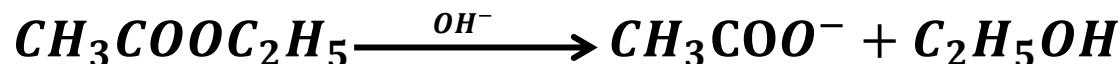
✓) Ethyl alcohol

2) Ethoxide ion

3) Acetaldehyde

4) Acetone

Solution:



25. Ethyl alcohol is manufactured by the fermentation of

1) Molasses

2) Starch

 3) Both

4) Glucose

**Solution:**

Both molasses and starch on fermentation produce ethyl alcohol

26.  $C_2H_5Br \xrightarrow{x} C_2H_5OH$ . In this reaction 'x' is

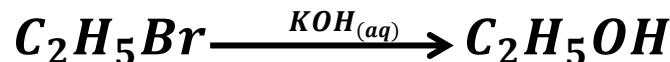
1) KOH +  $C_2H_5OH$

 2) KOH(aq)

3)  $Ag_2O/Ether$

4)  $Ag_2O + C_2H_5OH$

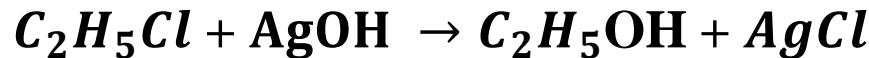
**Solution:**



27.  $\text{C}_2\text{H}_5\text{Cl} \xrightarrow{\text{Ag}_2\text{O}/\text{H}_2\text{O}}$  X. In the above reaction 'X' is



Solution:



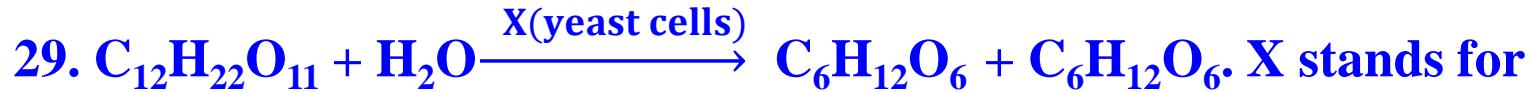
**28. Breaking of big Organic molecules in the presence of enzymes is called**

1) Cracking

2) Pyrolysis

 3) Fermentation

4) Oxidation



1) Zymase

 2) Invertase

3) Diatase

4) All

30. Dehydration is fastest in case of

1) Propan -1-ol

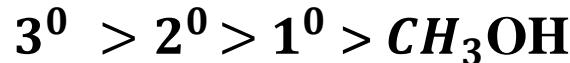
2) Propan -2-ol

 3) 2-methylpropan-2-ol

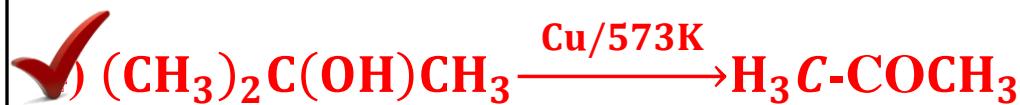
4) Ethanol

Solution:

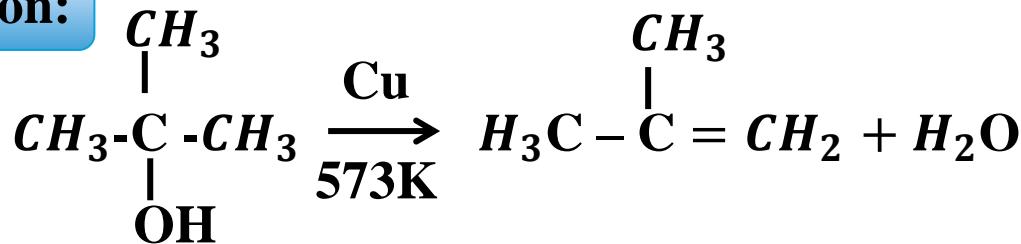
Rate of dehydration of alcohols is as follows



31. Which one of the following is not correct ?



**Solution:**



3° alcohol in presence  
of Cu undergo  
dehydration to give  
alkenes

32. Reaction of propanone with methyl magnesium iodide followed by hydrolysis yields

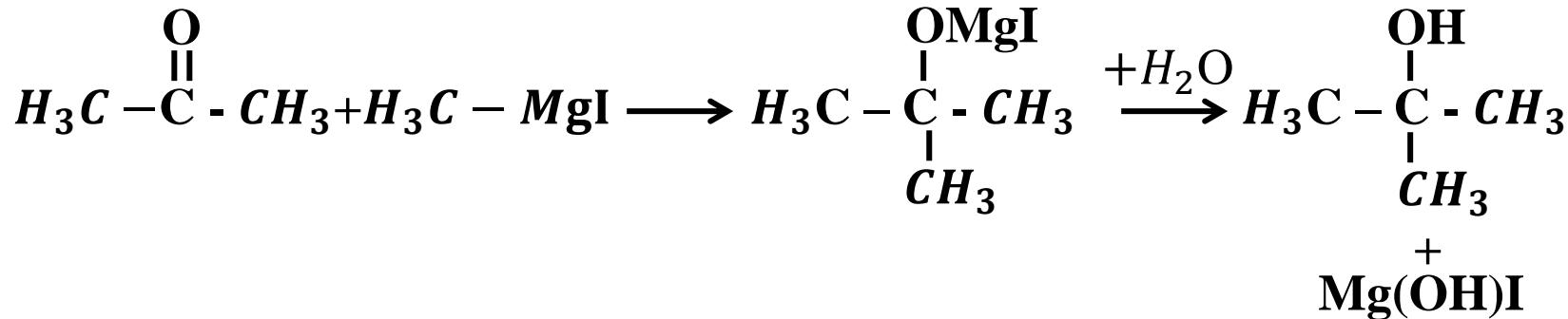
1) Ethanol

2) Propan-1-ol

3) Propan-2-ol

✓ 4) 2-methylpropan-2-ol

Solution:



33. The enzyme which converts glucose to ethylalcohol is

 1) Zymase

2) Invertase

3) Maltase

4) Diastase

Solution:



34. The enzyme not produced by yeast

 1) Diastase

2) Maltase

3) Zymase

4) Invertase

35. The two enzymes present in yeast that are responsible for the formation of ethyl alcohol from molasses in the fermentation process are

 1) Invertase, Zymase

2) Invertase, Diastase

3) Zymase, Diastase

4) Invertase, Maltase

36. The Gas liberated during fermentation is

1) Alcoholic vapours

2) Hydrogen

3) CO

✓)  $\text{CO}_2$

Solution:



**37. During the fermentation of molasses the optimum  $p^H$  maintained is**

 4

2) 2

3) 7

4) 10

**Solution:**

**Optimum  $p^H$  is 4**

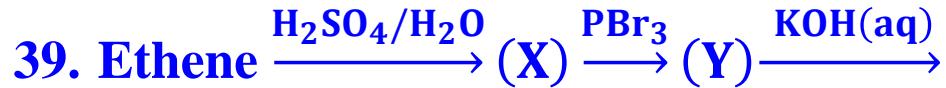
**38. The following substance can be used as a raw material for obtaining alcohol**

- 1) Potatoes**
- 2) Molasses**
- 3) Maize**

 All

## ALCOHOLS

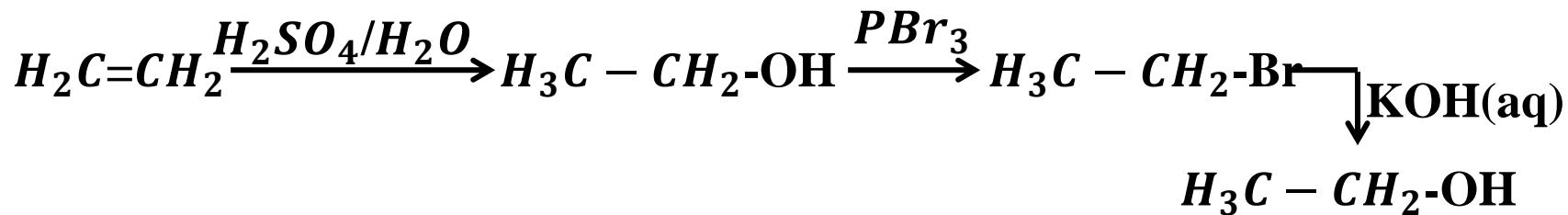
## LEVEL-1



(Z); (Z) in the reaction sequence is :



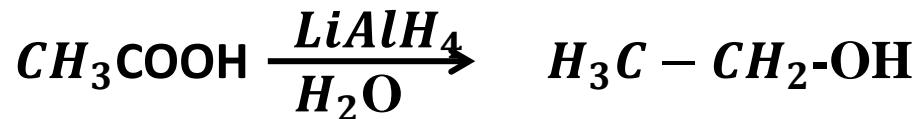
Solution:



40. Best reagent to convert ethanoic acid to ethanol is :

- 1)  $\text{NaBH}_4$
- 2)  $\text{NaBH}_4$
- 3)  $\text{LiAlH}_4$  / Water
-  4)  $\text{LiAlH}_4$  / dry ether

Solution:



**41. Assertion (A): Alcoholic fermentation involves conversion of sugar into ethanol by the action of yeast.**

**Reason(R): Fermentation involves the liberation of  $\text{CO}_2$  gas.**



**Both A and R are true and R is the correct explanation to A**

**2) Both A and R are true and R is not the correct explanation to A**

**3) A is true but R is false**

**4) A is false but R is true**

**42. The amount of water present in rectified spirit is**

 1) 4.4 %

2) 10%

3) 95%

4) 80%

**Solution:**

**Rectified spirit is (Alcohol 95.6% and water 4.4%)**

43. Ethyl alcohol containing 9.5% methyl alcohol and 0.5% pyridine is called

1) Spirit

 Denatured spirit

3) Rectified spirit

4) Absolute alcohol

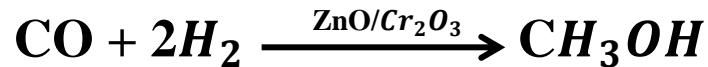
Solution:

Ethanol which is made unfit for drinking is called denatured spirit

44. Which is the catalyst in the conversion of water gas and hydrogen into methyl alcohol ?

- 1) MnO
- 2) Raney Ni
- 3) Fe
- 4) ZnO-Cr<sub>2</sub>O<sub>3</sub>

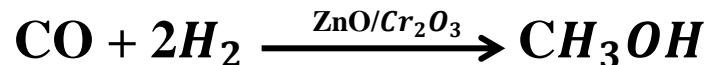
Solution:



45. Which alcohol is prepared from water gas?

- 1)  $C_2H_5OH$
- 2)  $CH_3CH_2CH_2OH$
-  3)  $CH_3OH$
- 4)  $C_6H_5CH_2OH$

Solution:



46. Absolute alcohol is prepared from rectified spirit by

- 1) Steam distillation
- 2) Fractional distillation
- ✓ 3) Distillation with CaO &Ca
- 4) Simple distillation

Solution:

Rectified spirit is a Azeotropic mixture (constant boiling point possessing mixture)

47. Wash or wort possesses the ---- percentage of ethyl alcohol

1) 95%

2) 100%

3) 66.9%

 6-10%

48.  $\text{CH}_3\text{OH}$ ,  $\text{CH}_3\text{CH}_2\text{OH}$  can be distinguished by the following reagent

1) Anhydrous  $\text{ZnCl}_2 + \text{HCl}$

2)  $\text{Na}_2\text{CO}_3$

✓ 3)  $\text{I}_2 + \text{Na}_2\text{CO}_3$

4) KOH

Solution:



49. Concentration of  $\text{C}_2\text{H}_5\text{OH}$  is not possible beyond 95% by simple distillation. Because

- 1) Ether is formed
-  2) Azeotrope is formed
- 3)  $\text{C}_2\text{H}_5\text{OH}$  and  $\text{H}_2\text{O}$  react
- 4) H-bonding takes place

**Solution:**

Ethyl alcohol forms a constant boiling mixture with water  
(Alcohol 95.6% and water 4.4%)

50. Absolute alcohol cannot be obtained by simple fractional distillation because

- 1) Pure  $C_2H_5OH$  is unstable
- 2)  $C_2H_5OH$  forms hydrogen bonding with water
- 3) Oxidation



It is a azeotropic mixture with water.

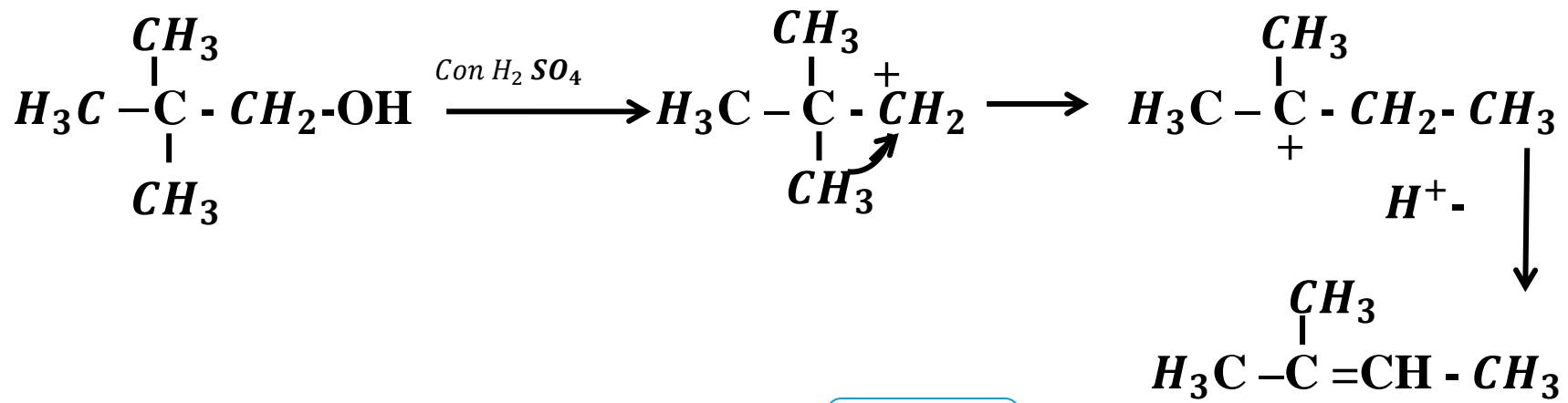
Solution:

Alcohol 95.6% and water 4.4% is an Azeotropic mixture  
(constant boiling point mixture)

51. The major product of dehydration of neopentyl alcohol with conc. $H_2SO_4$  is

- 1) 2-methylpent - 1 - ene
- 2) neopentyl aldehyde
- 3) 2-methylbut - 1 - ene
- 4) 2-methylbut-2-ene

Solution:



Key : 4

52. Which of the following are correct?

- i) Ordinary ethyl alcohol is known as grain alcohol.
- ii) Methylated spirit contains rectified spirit.
- iii) Absolute alcohol is 100%  $C_2H_5OH$
- iv) Rectified spirit is 100% ethanol.

The correct statement is

- 1) ii, iii, iv
- 2) ii, iii

 i, ii, iii

4 ) all are correct

**53. High boiling point of  $C_2H_5OH$  is due to**

- 1) Strong electrostatic forces**
- 2) Intra molecular hydrogen bonding**
- ✓) Inter molecular hydrogen bonding**
- 4) Vander waals force of attraction**

**Solution:**

**Hydrogen bond**

54. The highest boiling point is for



Solution:

Hydrogen bond

55. Which of the following is soluble in water?



Solution:

Hydrogen bond

**56. Ethanol and Methanol are miscible in water due to**

- 1) Dissociation of water**
- 2) Their Acidic character**
- 3) Allyl Groups**



**Hydrogen bonding**

**Solution:**

**Hydrogen bond**

57. Which statement is not correct about alcohol?



- 1) Ethyl alcohol is heavier than water**
- 2) Ethyl alcohol evaporates more quickly**
- 3) Alcohol with less number of carbon atoms is more soluble in water than alcohol with more number of carbon atoms.**
- 4) Alcohol produces  $H_2$  by reaction with Na metal**

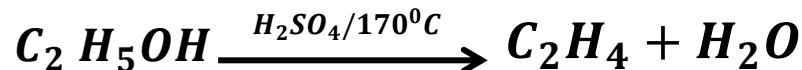
58. To bring about dehydration of alcohols we can use

- 1) Conc.  $\text{H}_2\text{SO}_4$
- 2) Anhydrous  $\text{Al}_2\text{O}_3$
- 3)  $\text{CaO}$
-  4) Both 1and 2

59. Which of the following reaction conditions are used for the conversion of ethanol to ethylene?

- 1) conc.  $H_2SO_4/ 70^0c$
- 2) dil.  $H_2SO_4/ 140^0c$
- 3) dil.  $H_2SO_4/ 100^0c$
-  4) conc.  $H_2SO_4/ 170^0c$

Solution:



60. The reaction between an alcohol and carboxylic acid leads to the formation of

1) Aldehyde

 2) Ester

3) Ketone

4) Paraffins

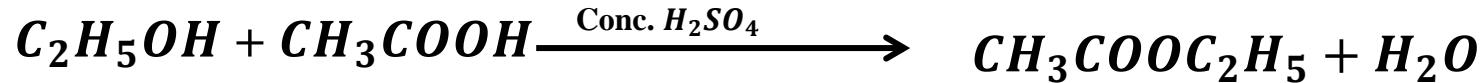
Solution:

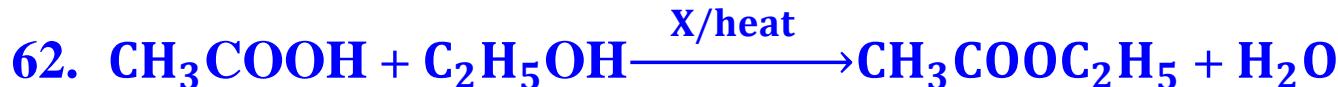


61. Which of the following compound is formed when ethanol reacts with acetic acid in the presence of conc. $H_2SO_4$



Solution:

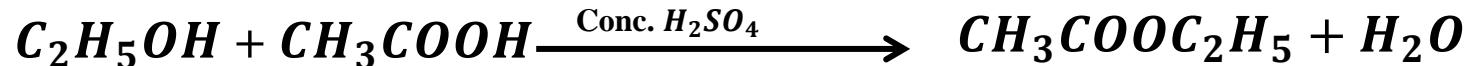




In the above reaction 'X' is

- 1) Sodium metal
- 2) aq KOH
- 3) conc  $\text{H}_2\text{SO}_4$
- 4) dil HCl

Solution:





The above reaction is known as

- 1) Hydrolysis
- 2) Esterification
- 3) Saponification
- 4) Dehydration

64. An organic compound reacts with carboxylic acid in presence of dehydrating agent to form an Ester, the compound may be

- 1) Aldehyde
- 2) Ester
- 3) Alcohol
- 4) Ketone

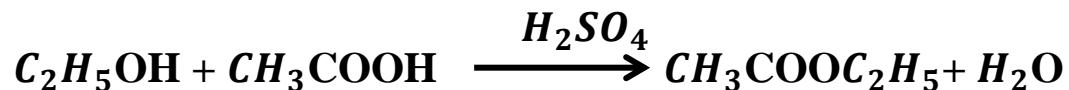
Solution:



65. In the esterification reaction Conc. $H_2SO_4$  act as.

- 1) Catalyst
- 2) Dehydrating agent
- 3) Oxidizing agent
- 4) Both 1,2

Solution:



66. What is the product formed when methyl magnesium bromide reacts with isopropyl alcohol?

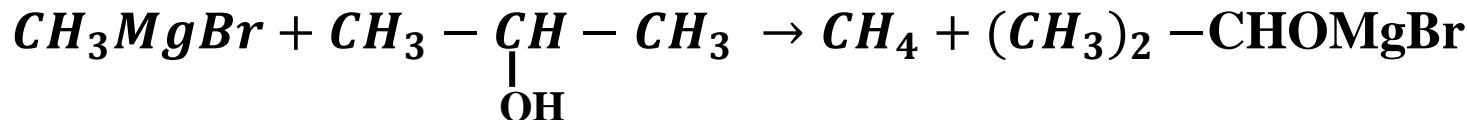
1) Isobutane

2) Propane

 3) Methane

4) Isopropyl methyl ether

Solution:



67. Ethyl alcohol and phenol can be distinguished by the following reagents except

- 1) Na
- 2)  $I_2 + Na_2CO_3$
- 3) Neutral  $FeCl_3$
- 4)  $Br_2 + H_2O$

**Solution:**

Aqueous solution of phenol gives violet colour with a drop of  $FeCl_3$   
Ethyl alcohol do not undergo this reaction

68. The acidic strength of Acetylene(I), Benzene(II), Ethane(III), Methanol(IV)

- ✓) IV > I > II > III  
2) II > I > III > IV  
3) I > II > III > IV  
4) III > I > II > IV

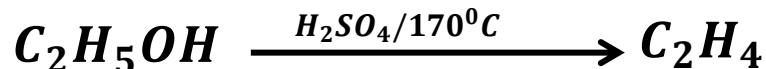
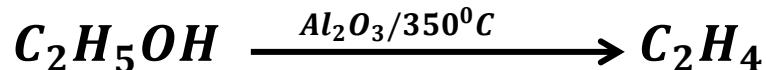
Solution:

As the % of 'S' character increases acidic nature increases

69. Which of the following pair of reagents produces same product with ethyl alcohol?

- 1) Conc.  $H_2SO_4$   $170^0C$ , Cu- $300^0C$
- 2) Conc.  $H_2SO_4$  -  $170^0C$ , Conc.  $H_2SO_4$  -  $140^0C$
- 3) Conc.  $H_2SO_4$  -  $100^0C$ ,  $Al_2O_3$  -  $350^0C$
-  4) Conc.  $H_2SO_4$  -  $170^0C$ ,  $Al_2O_3$  -  $350^0C$

Solution:





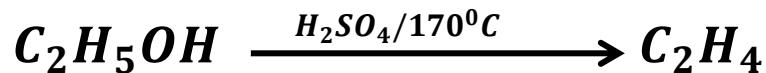
 1)  $\text{C}_2\text{H}_4$

2) Isopropyl alcohol

3) Neopentyl alcohol

4) 2-Methyl2-propanol

Solution:



71. With which one of the following reagents O-H bond fission in alcohol can not take place?

- 1) Na
- 2)  $\text{CH}_3\text{COOH}$
- 3)  $\text{CH}_3\text{MgBr}$
- 4)  $\text{PCl}_5$

Solution:

C-O bond  
cleavage  
takes place

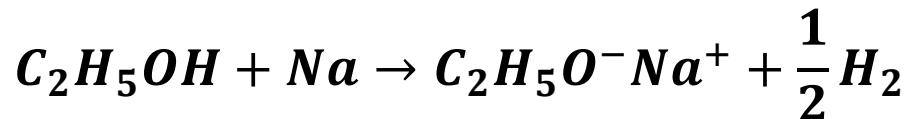


72. Which one of the following reagents can not cause C-O bond fission in alcohols?



✓ Na

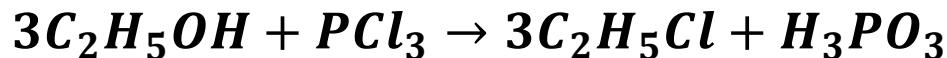
Solution:



73.  $C_2H_5OH + PCl_3 \rightarrow C_2H_5Cl + X$ . Here X is an oxy acid of phosphorus  
X is

- 1)  $H_3PO_4$
- 2)  $H_3PO_3$
- 3)  $H_3PO_2$
- 4)  $HPO_3$

Solution:



74. When  $C_2H_5OH$  vapours is passed over red hot copper at  $300^{\circ}C$  the product formed is

✓)  $CH_3CHO$

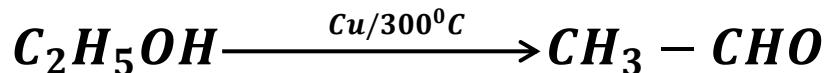
2)  $CH_3COCH_3$

3)  $C_2H_4$

4)  $CH_3COOH$

Solution:

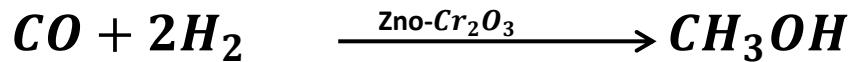
Dehydrogenation  
takes place in  
presence of Cu or  
Ag



75. By the reduction of water gas in the presence of  $ZnO - Cr_2O_3$  the chemical compound produced is :

- 1) Methanal
- 2) Ethanol
- 3) Methanol
- 4) Ethanal

Solution:



76. On oxidation with acidified  $K_2Cr_2O_7$  a compound gives a Ketone containing same no. of carbon atoms. The substance is

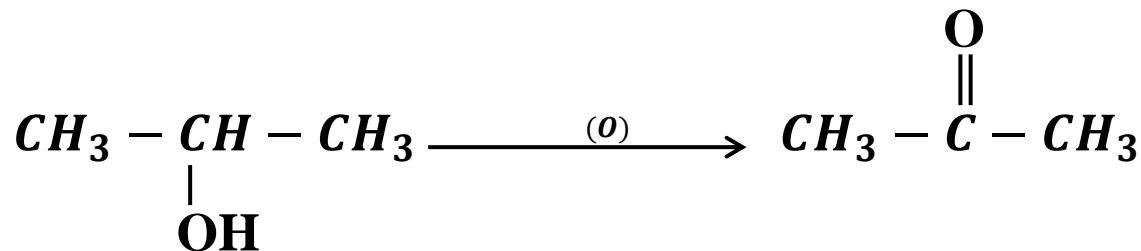
1) Aldehyde

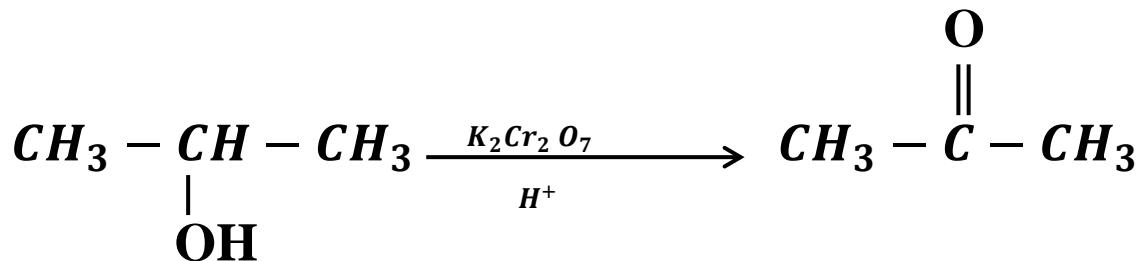
2)  $1^0$  alcohol

 3)  $2^0$  alcohol

4) Both  $1^0$  and  $2^0$  alcohols

Solution:

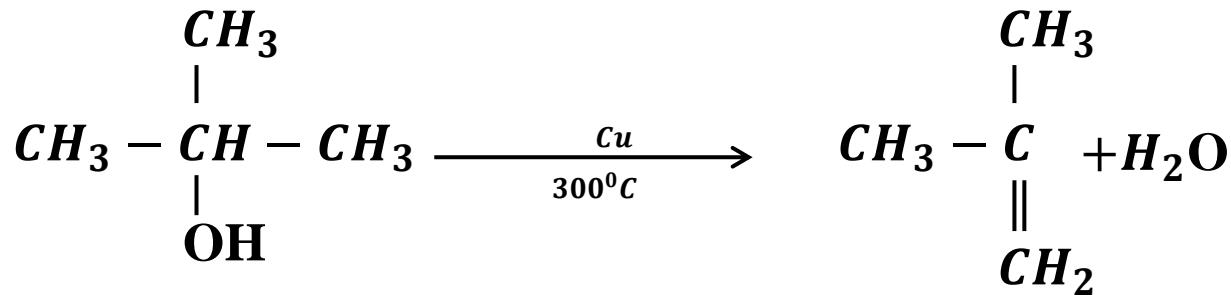


**77. Isopropyl alcohol on oxidation forms****1) Ethylene****✓ Acetone****3) Ether****4) Acetaldehyde****Solution:**

78. When tertiary butyl alcohol is passed over reduced copper, the reaction taking place is

- 1) Oxidation    2) Reduction     3) Dehydration    4) Substitution

Solution:



79. Ethyl alcohol when passed over copper at  $300^{\circ}\text{C}$  is dehydrogenated to give

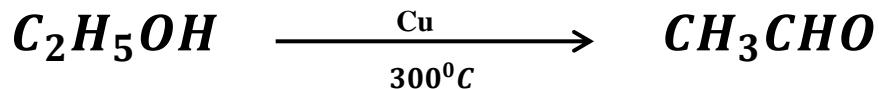
1) Acetone

 Acetaldehyde

3) Ether

4) Ethylene

Solution:



80. Alcohols can be oxidized to carboxylic acids by

- 1) Alkaline  $\text{KMnO}_4$
- 2) Acidified  $\text{K}_2\text{Cr}_2\text{O}_7$
- 3) Conc. $\text{HNO}_3$
- ✓) All of these

Solution:



81. The first oxidation product of a primary alcohol is

1) Acid

 Aldehyde

3) Ketone

4) Ether

Solution:



82. When  $C_2H_5OH$  is heated with acidified  $K_2Cr_2O_7$  it forms  $CH_3COOH$ .  
It is an example of .

1) Molecular rearrangement

2) Hydrolysis

✓ Oxidation

4) Dehydration

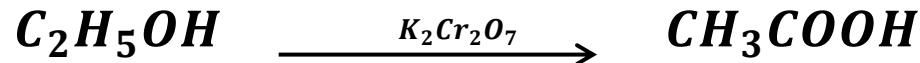
Solution:



83. Ethyl alcohol on oxidation with acidified  $K_2Cr_2O_7$  gives



Solution:



84. The reagent used to convert ethanoic acid to ethanol is

1)  $\text{LiAlH}_4$

2)  $\text{BH}_3$

3)  $\text{PCl}_3$

4)  $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+$

Solution:



85. Ethyl alcohol can be distinguished from n-propyl alcohol by using.

1) Lucas reagent

✓ I<sub>2</sub> + NaOH

3) Na metal

4) Bosches reagent

Alcohols having  
 $\alpha$  -methyl groups  
undergo Iodoform  
reaction

Solution:



86.  $C_2H_5OH + I_2 + KOH \rightarrow CHI_3 + KI + X$ . Here the missing product X is

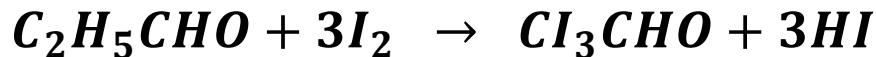
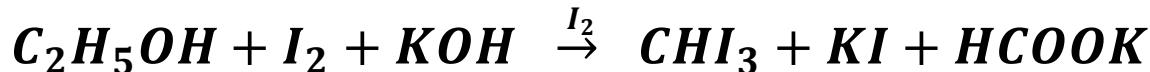
 HCOOK

2) CH<sub>3</sub>COOK

3) (CH<sub>3</sub>COO)<sub>2</sub>Ca

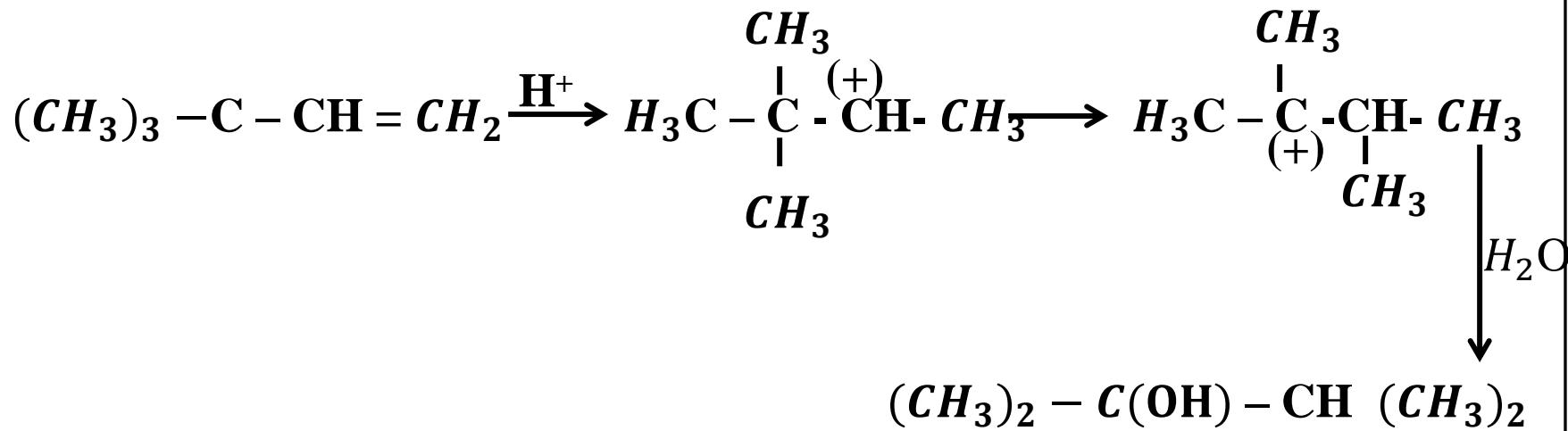
4) (HCOO)<sub>2</sub>Ca

Solution:



87. In the following reaction  $(\text{CH}_3)_3\text{C}-\text{CH} = \text{CH}_2 \xrightarrow{\text{H}_2\text{O}/\text{H}^+}$  the major product is :

- 1)  $(\text{CH}_3)_2\text{C}(\text{OH}) - \text{CH}(\text{CH}_3)_2$
- 2)  $\text{CH}_2(\text{OH}) - \text{C}(\text{CH}_3)_2 - \text{CH}_2 - \text{CH}_3$
- 3)  $\text{C}(\text{CH}_3)_3 - \text{CH}(\text{OH}) - \text{CH}_3$
- 4)  $\text{C}(\text{CH}_3)_3 - \text{CH}_2 - \text{CH}_2 - \text{OH}$

**Solution:****Key : 1**

**88. Primary, secondary and tertiary alcohols are distinguished by**

- 1) Oxidation method**
- 2) Lucas test**
- 3) Victor Meyer's method**
- 4) All the above**

**Solution:**

**1<sup>0</sup> alcohol  $\xrightarrow{\text{oxidation}}$  first aldehyde and then acid both having same no of 'C' atoms**

**2<sup>0</sup> alcohol  $\xrightarrow{\text{oxidation}}$  first ketones but then acid having less no of 'C' atoms**

**3<sup>0</sup> alcohol  $\xrightarrow{\text{oxidation}}$  first ketones then gives acid both with less no of 'C' atoms**

**1<sup>0</sup> alcohol gives no turbidity with Lucas reagent**

**2<sup>0</sup> alcohol gives turbidity after 5-10 minutes**

**3<sup>0</sup> alcohol gives turbidity immediately after**

**Victor Meyer's test gives red colour with  $1^0$ alcohols**

**Victor Meyer's test gives blue colour with  $2^0$ alcohols**

**Victor Meyer's test gives no colour with  $3^0$ alcohols**

**Key : 4**

89. Lucas reagent is

1) Conc. $\text{HNO}_3$  + anhydrous  $\text{MgCl}_2$

2) dil. $\text{HCl}$  + anhydrous  $\text{ZnCl}_2$

3) Conc.  $\text{HNO}_3$  + anhydrous  $\text{ZnCl}_2$



✓ Conc. $\text{HCl}$  + anhydrous  $\text{ZnCl}_2$

Solution:

Mixture of Conc. $\text{HCl}$  + anhydrous  $\text{ZnCl}_2$  is called Lucas reagent

90. Which of the following alcohols reacts most readily with Lucas reagent



Solution:

$3^0 \text{ ol} > 2^0 \text{ ol} > 1^0 \text{ ol}$  due to the formation of stable  $C^\oplus$

91. Which alcohol is most reactive towards HCl in the presence of anhydrous  $\text{ZnCl}_2$  ?

- 1) Primary    2) Secondary     3) Tertiary    4) All are equal

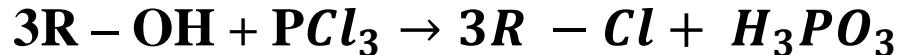
Solution:

$3^0 \text{ ol} > 2^0 \text{ ol} > 1^0 \text{ ol}$  due to the formation of stable  $C^\oplus$

92. Primary, secondary and tertiary alcohol cannot be differentiated by

- 1) Reduced Cu
  - 2) Acidified KMnO<sub>4</sub>
  - 3) Lucas reagent
- ✓ 4) PCl<sub>3</sub>

Solution:



93. The reagent for distinguishing ethyl alcohol from methyl alcohol is

- 1)  $I_2 + NaOH$
- 2)  $HCl + ZnCl_2$
- 3) Na
- 4)  $PCl_5$

Solution:

Iodoform test is given by ethyl alcohol

94. Which of the following is Lucas reagent?

1) Ammonical silver nitrate

2)  $\text{Br}_2/\text{CCl}_4$

 dry  $\text{ZnCl}_2/\text{con.HCl}$

4) alk. $\text{KMnO}_4$

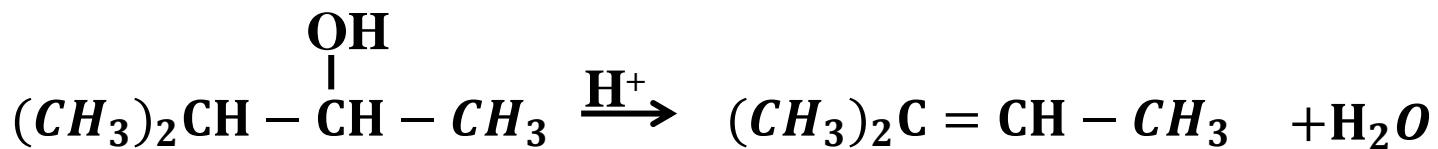
**95. Primary, secondary and tertiary alcohols are distinguished by which of the following methods?**

- 1) Oxidation method**
  - 2) Lucas test**
  - 3) Victor Meyer's method**
-  **all of the above**

96. Major product of acid catalysed dehydration of  $(\text{CH}_3)_2\text{CH}-\text{CH}(\text{OH})-\text{CH}_3$  is

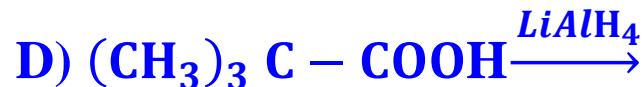
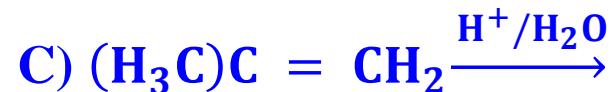
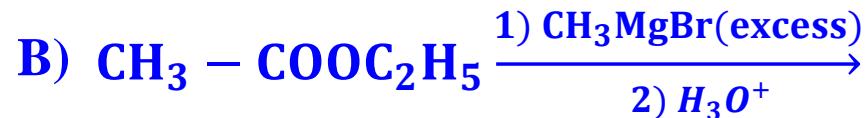


Solution:



Key : 1

97. Tertiary alcohol is formed in



The correct answer is



1) A, B, C

2) B, C, D

3) C, D

4) A, D

98. Methanol and ethanol can be distinguished by

- A)  $I_2 + NaOH$       B) Na      C)  $PCl_5$       D) dehydration

The correct answer is

- 1) A, B      2) B, C      3) C, D      ✓) A, D

Solution:

Methanol does not give iodoform test

Methanol gives formaldehyde or di methyl ether or methyl hydrogen sulphate or dehydrogenation in presence of  $H_2SO_4$  at different temperatures

99. Which is an antifreeze ?

- 1) Water
- 2) Ether
- 3) Ethyl alcohol
- 4) Aniline

Solution:

Ethyl alcohol is used to an anti freeze for auto mobile radiators

100. Natalite is used as

- 1) Motor fuel
- 2) Insecticide
- 3) Hypnotic drug
- 4) Drying agent

Solution:

Natalite is a mixture of  $C_2H_5OH + Ether$



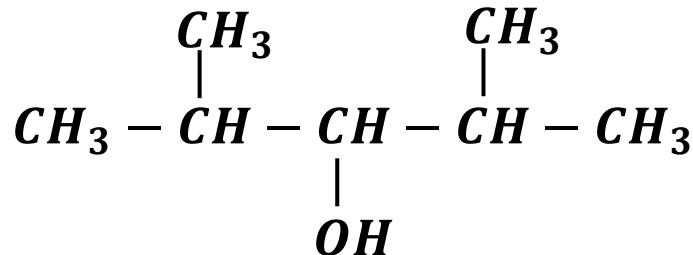
**ALCOHOLS**

# **ALCOHOLS OBJECTIVES (LEVEL – II)**

1. 2,4-dimethyl -3-pentanol is a

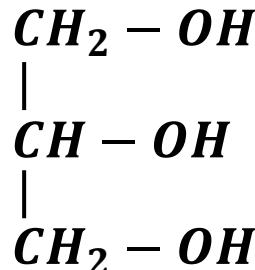
- 1) Primary alcohol
- 2) Secondary alcohol
- 3) Tertiary alcohol
- 4) Dihydric alcohol

Solution:



**2. Glycerol contains**

- 1) Two secondary and one primary alcoholic groups
- ✓ 2) One secondary and two primary alcoholic groups**
- 3) Three secondary alcoholic groups
- 4) Three primary alcoholic groups

**Solution:**

3. The IUPAC name of sec. butyl alcohol is

1) 1-butanol

✓ 2) 2-butanol

3) 2-methyl-1-butanol

4) 2-methyl-2-butanol

Solution:



**4. The IUPAC name for****1) 2-methyl butyl alcohol****2) 2-methyl butanol - 1** **Pent-1-ene-3-ol****4) 2-methyl butanol and - 2-ol****Solution:**

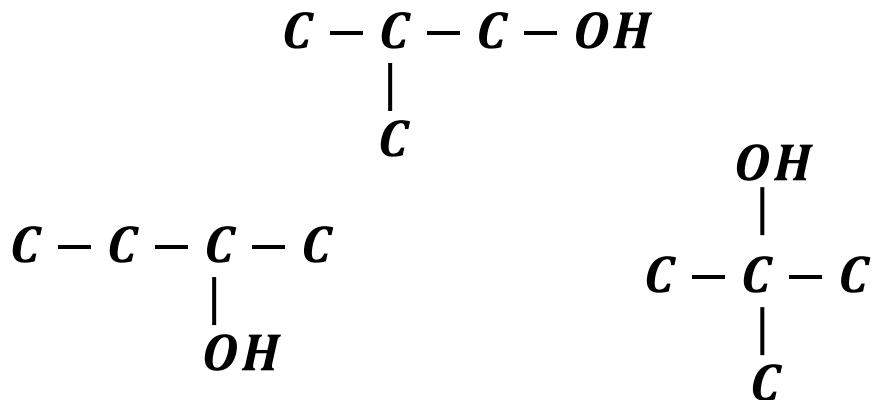
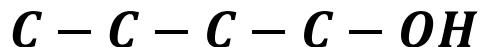
**5. Total number of structural isomeric alcohols with formula C<sub>4</sub>H<sub>10</sub>O is**

1) 2

2) 1

3) 3

4) 4

**Solution:**

No of isomers =  $2^{n-2}$   
n=no of carbon atoms

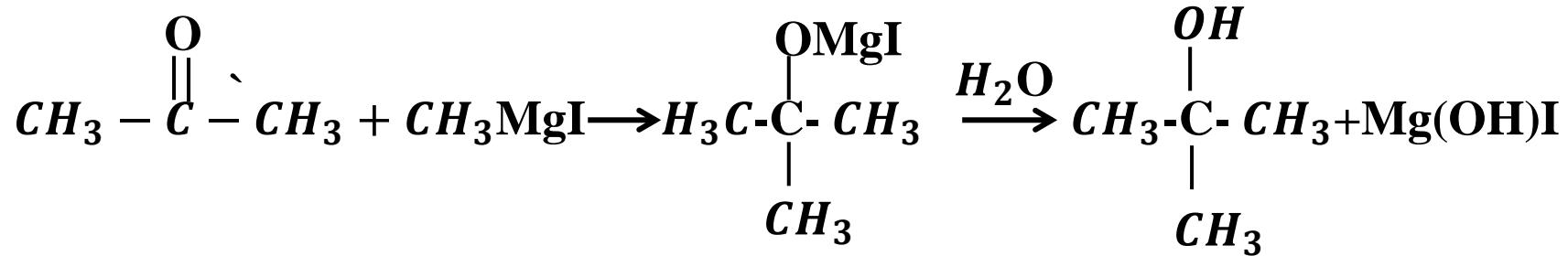
If stereo isomer is considered total number of alcohols will be 5

**Key : 4**

6. The reaction of  $\text{CH}_3\text{MgI}$  with acetone and hydrolysis of the resulting product gives



Solution:



7. Assertion(A): In the fermentation process of molasses, along with yeast  $(\text{NH}_4)_2\text{SO}_4$ ,  $(\text{NH}_4)_3\text{PO}_4$  is added.

Reason(R):  $(\text{NH}_4)_3\text{PO}_4$  and  $(\text{NH}_4)_2\text{SO}_4$ , acts as food and helps the growth of yeast.



- 1) Both A and R are true and R is the correct explanation to A
- 2) Both A and R are true and R is not the correct explanation to A
- 3) A is true but R is false
- 4) A is false but R is true

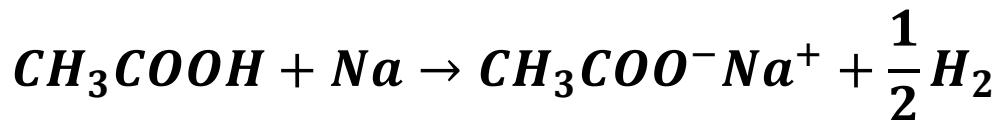
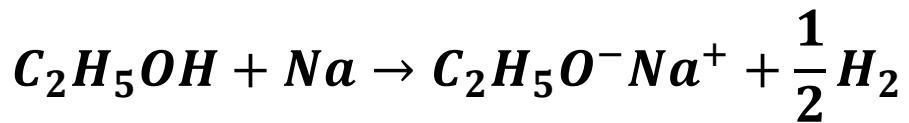
8. Assertion (A): The boiling point of  $\text{C}_2\text{H}_5\text{OH}$  is less than that of  $\text{H}_2\text{O}$  though the molecular weight of  $\text{C}_2\text{H}_5\text{OH}$  is more than that of water.

Reason (R) :  $\text{C}_2\text{H}_5\text{OH}$  molecules are not highly associated through hydrogen bonding as in water.

-  1) Both A and R are true and R is the correct explanation to A
- 2) Both A and R are true and R is not the correct explanation to A
- 3) A is true but R is false
- 4) A is false but R is true

9. Two organic compounds A and B react with sodium metal and release  $H_2$  gas. A and B react with each other to give ethyl acetate. The A and B are

- 1)  $CH_3COOH$  and  $C_2H_5OH$
- 2)  $HCOOH$  and  $C_2H_5OH$
- 3)  $CH_3COOH$  and  $CH_3OH$
- 4)  $CH_3COOH$  and  $HCOOH$

**Solution:****Key : 1**

### 10. Alcohol beverages contain

1) Glycerol

 Ethyl alcohol

3) Methyl alcohol

4) Isopropyl alcohol

**11. n-propyl alcohol (I) and isopropyl alcohol (II) can be distinguished by**

- A) Lucas reagent      B) Iodoform test    C) Oxidation with PCC**
- D)  $\text{PBr}_3$**

**The correct answer is**

- 1) A, B, C**
- 2) B, C, D**
- 3) A, B, D**
- 4) A, B, C, D**

**Solution:** n - propyl alcohol is primary alcohol and iso propyl alcohol is secondary alcohol

$1^0$  alcohol does not give ppt with Lucas reagent,  $2^0$  alcohol react slowly

$2^0$ alcohol does not give yellow ppt in iodoform test

$1^0$ alcohol on oxidation gives aldehydes and acids with same number of 'C' atoms  $2^0$  alcohol oxidation give ketone with same number of carbon atoms but acid with less number of carbon atom

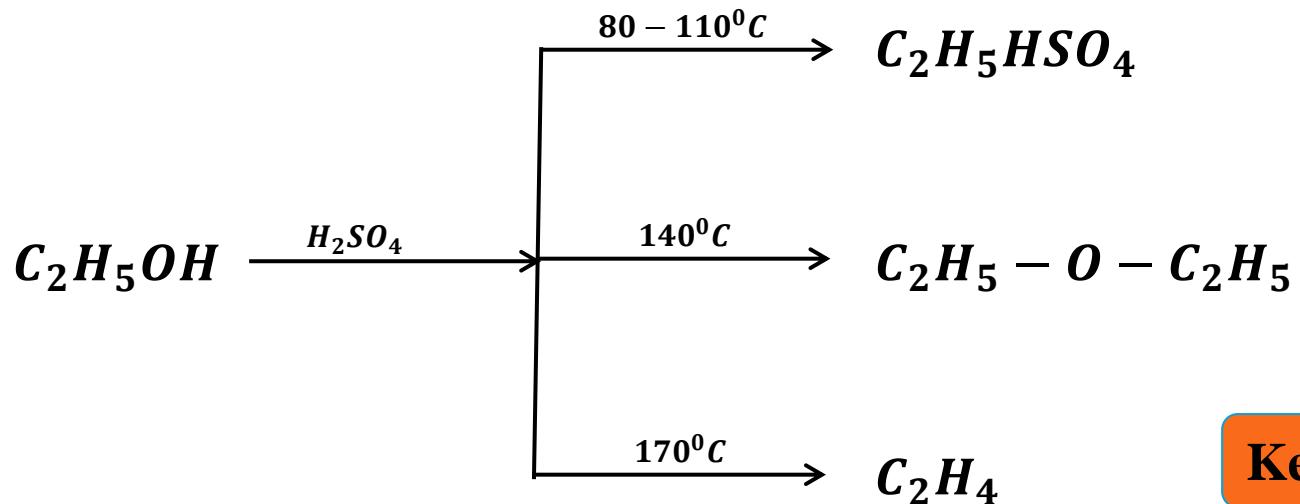
So n-propyl alcohol and isopropyl alcohol containing  $\alpha$  methyl groups

Key : 1

**12. The reaction of ethanol with  $\text{H}_2\text{SO}_4$  does not give.**

- 1) Ethylene**
- 2) Diethyl ether**
- 3) Acetylene**
- 4) Ethyl hydrogen sulphate**

Solution:



Key : 3

13.  $\text{R-OH} + \text{HX} \rightarrow \text{RX} + \text{H}_2\text{O}$ . In this reaction the reactivity of alcohol is  
 1) Tertiary > secondary > primary

2) Tertiary < secondary < primary

3) Tertiary > primary > secondary

4) Secondary > primary > tertiary

Solution:

Reaction involves formation of stable carbocation

14. The reaction  $\text{R}-\text{OH} + \text{HCl} \rightleftharpoons \text{R}-\text{Cl} + \text{H}_2\text{O}$  is reversible, so for the completion of the reaction we use along with the reactants.

✓) Conc.  $\text{H}_2\text{SO}_4$

2)  $\text{P}_2\text{O}_5$

3)  $\text{H}_3\text{PO}_4$

4)  $\text{N}_2\text{O}_5$

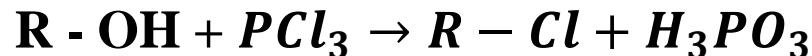
Solution:

Removal of water makes the reaction move in forward direction

15. Which group can be completely displaced by a Halogen group?

-  1) Hydroxyl group(OH)
- 2) aldehyde (-CHO) group
- 3) nitro (-NO<sub>2</sub>) group
- 4) Keto (C=O) group

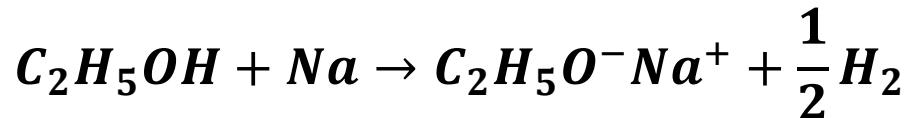
Solution:



16. An Organic compound dissolved in benzene and evolved hydrogen with sodium. It is

- 1) Ketone
- 2) An aldehyde
- 3) A tertiary amine
-  4) An alcohol

Solution:



17. Regarding ethyl alcohol the wrong statement is

- 1) It is neutral to litmus
  - 2) It gives yellow crystalline ppt with  $I_2 + \text{dil. NaOH}$
  - 3) It gives a product of fruity odour on reaction with  $\text{CH}_3\text{COOH}$
-  It gives turbidity spontaneously on the addition of Lucas reagent.

Solution:

Ethyl alcohol is a  $1^0$  alcohol ( $1^0$  no turbidity with Lucas reagent)

**18.  $1^0$ ,  $2^0$  and  $3^0$  alcohols may be distinguished from one another by**

**1) Oxidation method**

**2) Action of hot HI**

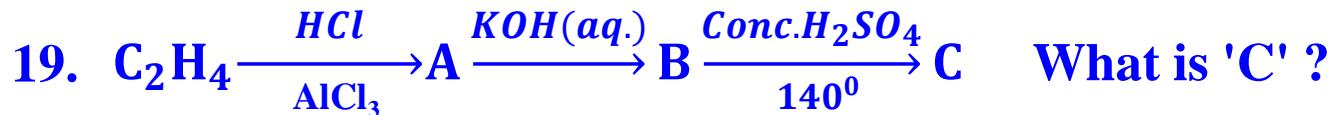
**3) Lucas reagent**



**Both 1 and 3**

## ALCOHOLS

## LEVEL-2



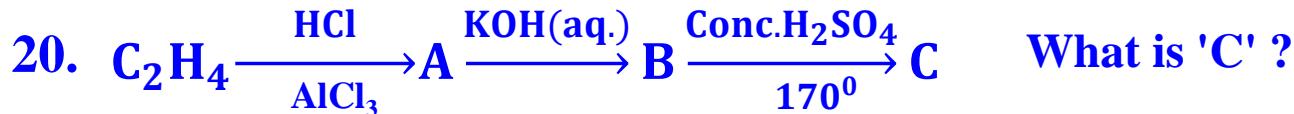
- 1)  $\text{C}_2\text{H}_4$
- ✓ 2)  $\text{C}_2\text{H}_5 - \text{O} - \text{C}_2\text{H}_5$
- 3)  $\text{C}_2\text{H}_5\text{OH}$
- 4)  $\text{C}_2\text{H}_5 - \text{O} - \text{SO}_3\text{H}$

Solution:



## ALCOHOLS

## LEVEL-2



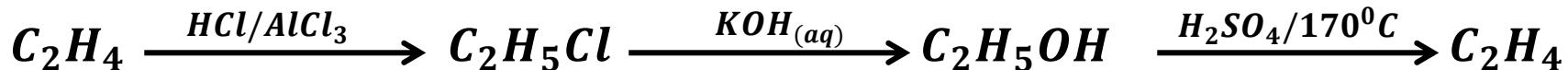
✓)  $\text{C}_2\text{H}_4$

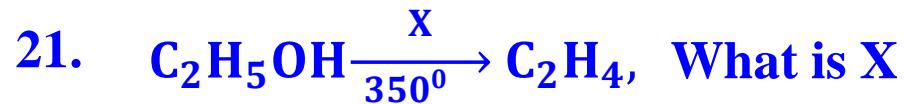
2)  $\text{C}_2\text{H}_5 - \text{O} - \text{SO}_3\text{H}$

3)  $\text{C}_2\text{H}_5\text{OH}$

4)  $\text{C}_2\text{H}_5 - \text{O} - \text{C}_2\text{H}_5$

Solution:





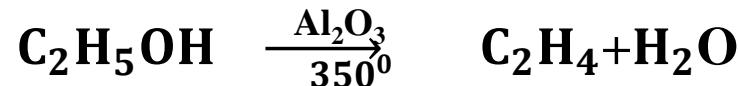
1) Conc.  $\text{H}_2\text{SO}_4$

2)  $\text{CaCl}_2$

3)  $\text{CaO}$

✓  $\text{Al}_2\text{O}_3$

Solution:



22. The product formed when  $\text{C}_2\text{H}_5\text{OH}$  is heated to  $250\text{-}260^\circ\text{C}$  in the presence of  $\text{Al}_2\text{O}_3$  is

1)  $\text{C}_2\text{H}_4$

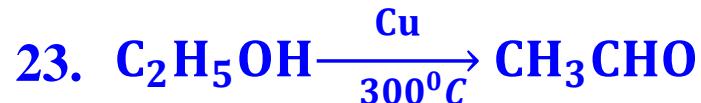
3)  $\text{CH}_3\text{CHO}$

✓)  $\text{C}_2\text{H}_5 \cdot \text{O} \cdot \text{C}_2\text{H}_5$

4)  $\text{CH}_3\text{COOH}$

Solution:





The above reaction is an example of

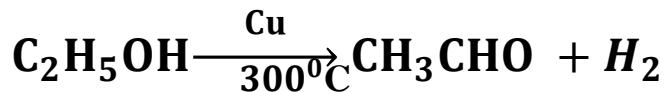
1) dehydration

 2) dehydrogenation

3) dehalogenation

4) dehydrohalogenation

Solution:



## ALCOHOLS

## LEVEL-2



A

B

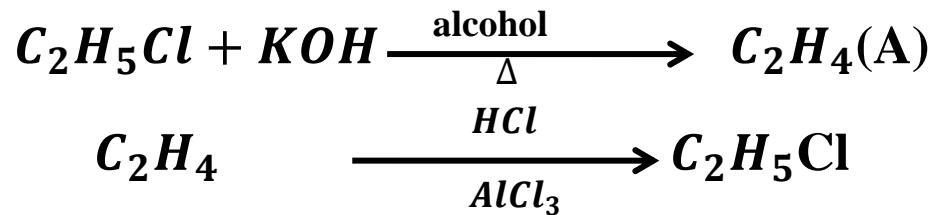
C



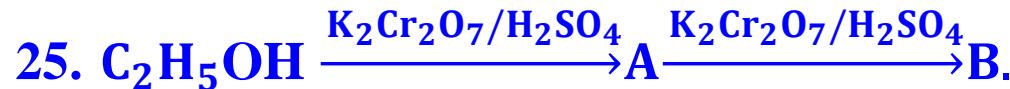
## ALCOHOLS

## LEVEL-2

Solution:



Key : 3



A and B in the above reaction are

- 1) Acetone and acetaldehyde
- 2) Acetaldehyde and acetone
- 3) Acetic acid and acetaldehyde
- 4) Acetaldehyde and acetic acid

Solution:



26. A compound X on reaction with  $I_2$  in the presence of NaOH forms yellow crystalline solid. X may be



Solution:

Ethyl alcohol gives positive iodoform test

**27. Hydrogen bonding is maximum in**

**✓ 1) Ethanol**

**2) Diethyl ether**

**3) Ethyl chloride**

**4) Triethyl amine**

**Solution:**

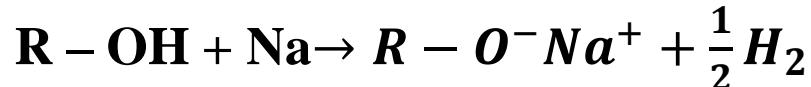
**Alcohols exhibit extensive hydrogen bonding due to – OH group**

28. 23 mg of Na metal is placed in excess of alcohol. Which alcohol can produce more amount of H<sub>2</sub> gas.



 Same for all

Solution:



1mole

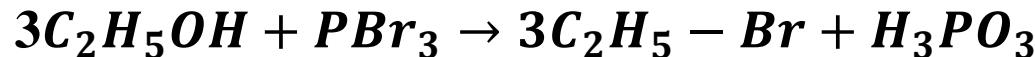
1 mole

11.2 lt.

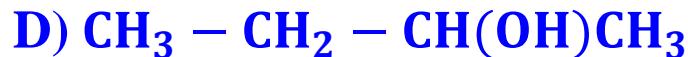
29. 3 moles of ethanol reacts with 1 mole of phosphorous tribromide to form 3 moles of bromo ethane and 1 mole of X. X is

- 1)  $H_3PO_4$
- 2)  $H_3PO_2$
- 3)  $HPO_3$
- 4)  $H_3PO_3$

Solution:



30. Which of the following compounds give yellow precipitate on heating with alkaline solution of iodine ?



The correct answer is

1) A,B,C



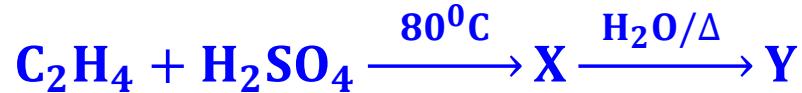
3) A,B,D

4) A,B,C,D

Solution:

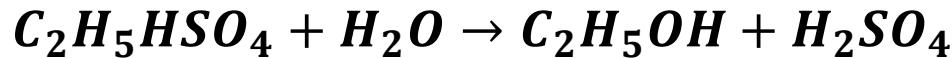
Alcohols having  $\alpha$ - methyl groups give yellow ppt in iodoform test

31. What are X and Y in the reaction,



- 1)  $\text{C}_2\text{H}_6, \text{C}_2\text{H}_5\text{OH}$
- 2)  $\text{C}_2\text{H}_4, \text{C}_2\text{H}_5\text{SH}$
- ✓ 3)  $\text{C}_2\text{H}_5\text{OSO}_3\text{H}, \text{C}_2\text{H}_5\text{OH}$
- 4)  $\text{C}_2\text{H}_2, \text{CH}_3\text{CHO}$

Solution:



32. Hydrogen chloride and  $\text{SO}_2$  are the side products in the reaction of ethanol with thionyl chloride. Which of the following is main product in this reaction.



Solution:



**33. Assertion (A): Ethanol is miscible in all proportions with water**

**Reason (R) : Hydrogen bond is formed between water and alcohol molecules.**

-  1) Both A and R are true and R is the correct explanation to A
- 2) Both A and R are true and R is not the correct explanation to A
- 3) A is true but R is false
- 4) A is false but R is true

34. Assertion (A):  $\text{CaCl}_2$  can't be used for drying ethyl alcohol

Reason (R) : Calcium chloride can form an addition compound with ethyl alcohol

 1) Both A and R are true and R is the correct explanation to A

2) Both A and R are true and R is not the correct explanation to A

3) A is true but R is false

4) A is false but R is true

35. Assertion (A): Ethyl alcohol is soluble in organic solvents

Reason (R) : Ethyl alcohol is having non polar ethyl group.

-  1) Both A and R are true and R is the correct explanation to A
- 2) Both A and R are true and R is not the correct explanation to A
- 3) A is true but R is false
- 4) A is false but R is true

**36. Assertion (A): Alcohols on dehydration can produce ether as well as alkene under different conditions.**

**Reason(R): Dehydration of alcohol proceeds through formation of carbonium ion.**

 **Both A and R are true and R is the correct explanation to A**

**2) Both A and R are true and R is not the correct explanation to A**

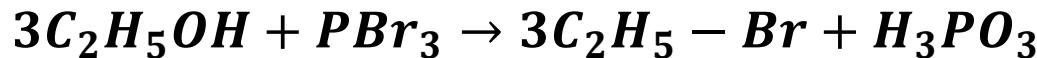
**3) A is true but R is false**

**4) A is false but R is true**

37. When ethyl alcohol reacts with  $\text{Br}_2$  in presence of red phosphorus the compound formed is

- 1)  $\text{C}_2\text{H}_6$
- 2)  $\text{PBr}_3$
- 3)  $\text{CH}_3\text{Br}$
- ✓ 4)  $\text{C}_2\text{H}_5\text{Br}$

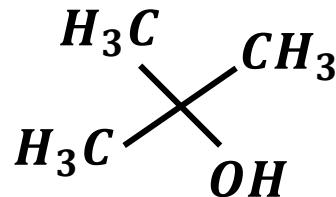
Solution:



38. The alcohol that produces turbidity immediately with  $ZnCl_2$  and Con.  $HCl$  at room temperature

- 1) 1-hydroxybutane
- 2) 2-hydroxybutane
- 3) 2-hydroxy-2-methyl propane
- 4) 1-hyrdoxy-2-methyl propane

Solution:



*tert – butyl alcohol*

39. In the following reaction X and Y respectively



1)  $\text{CH}_3\text{OH}, \text{C}_2\text{H}_5\text{OH}$

2)  $\text{CH}_3\text{CHO}, \text{CH}_3\text{OH}$

3)  $\text{CH}_2 = \text{CH}_2, \text{CH}_3\text{COOH}$

✓ 4)  $\text{CH}_3\text{COOH}, \text{C}_2\text{H}_5\text{OH}$

Solution:



40. The molecular formula of X is :  $C_2H_5OH \xrightarrow{Cu/300^0C} X$

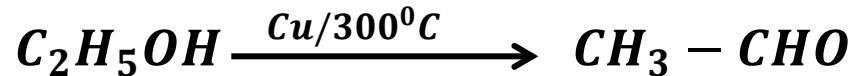
1)  $C_4H_6O$

2)  $C_4H_{10}O$

✓ 3)  $C_2H_4O$

4)  $C_2H_6O$

Solution:



Thank you...



**ALCOHOLS**

# **ALCOHOLS**

# **OBJECTIVES (LEVEL – III)**

1. Industrial alcohol mixed with petrol and benzene is called
- 1) Absolute alcohol
  - 2) Proof spirit
  - 3) Power alcohol
  - 4) None of these

2. When 3g of an alcohol is treated with excess of  $\text{CH}_3\text{MgI}$ , then 1.12 lit. of  $\text{CH}_4$  is obtained at S.T.P. Then the alcohol is

1)  $\text{CH}_3\text{OH}$

2)  $\text{CH}_3 - \text{CH}_2\text{OH}$

✓ 3)  $\text{C}_3\text{H}_7\text{OH}$

4)  $\text{C}_4\text{H}_9\text{OH}$

Solution:



3 gms of alcohol  $\rightarrow$  1.12lit of  $\text{CH}_4$

$X \leftarrow 22.4$  lit of  $\text{CH}_4$

$$X = \frac{22.4 \times 3}{1.12} = 60 \text{ grams}$$

## ALCOHOLS

## LEVEL-3



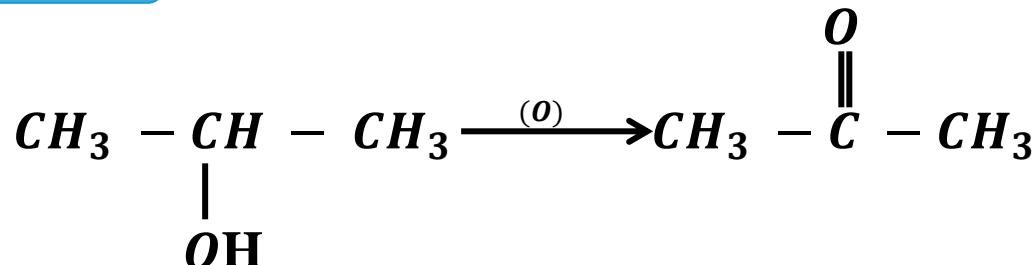
Solution:



4. A compound reacts with sodium and liberates hydrogen and on oxidation gives ketone. The formula of the compound could be.



Solution:



**5. Iodoform cannot be prepared from**

**Solution:**

$\text{CH}_3\text{OH}$  can not give +ve iodoform test

## ALCOHOLS

## LEVEL-3



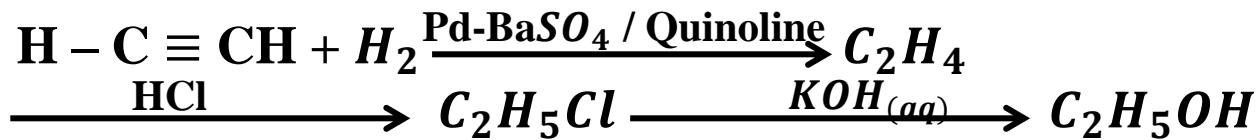
1) Propane

Ethanol

3) Ethyne

4) Ethylene

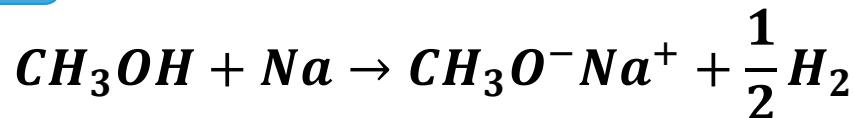
**Solution:**



7. Compound A reacts with Na metal to give B. A also reacts with  $\text{PCl}_5$  to give C. B and C reacts with each other to give dimethyl ether. Then A, B and C respectively are

- 1)  $\text{CH}_3\text{OH}$ ,  $\text{CH}_3\text{ONa}$ ,  $\text{CH}_3\text{COCl}$       2)  $\text{CH}_3\text{OH}$ ,  $\text{CH}_4$ ,  $\text{CH}_3\text{Cl}$   
 3)  $\text{CH}_3\text{OH}$ ,  $\text{CH}_3\text{ONa}$ ,  $\text{CH}_3\text{Cl}$       4)  $\text{CH}_3\text{Cl}$ ,  $\text{CH}_4$ ,  $\text{CH}_3\text{OH}$

Solution:



8. A compound (X) of molecular formula  $C_3H_8O$  can be oxidized to a compound of molecular  $C_3H_6O_2$  (C), (X) is most likely to be.

1) Aldehyde

 Alcohol

3) Ether

4) Both 2 and 3

**Solution:**

The general formula of alcohol is  $C_n H_{2n+2}O$ .

Alcohol gives acid on complete oxidation

9. In the sequence of reactions (Z) is



- 1) Ethylene bromide
- 2) Ethylidene bromide
- 3) Ethyl bromide
- 4) Vinyl bromide

Solution:



10. I<sub>2</sub> produced when ozone reacts with moist KI is used to convert C<sub>2</sub>H<sub>5</sub>OH to Cl<sub>3</sub>CHO. Number of moles of ozone required to convert 1 mole of C<sub>2</sub>H<sub>5</sub>OH into Cl<sub>3</sub>CHO is

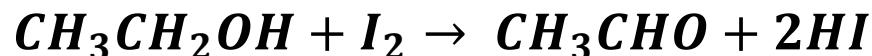
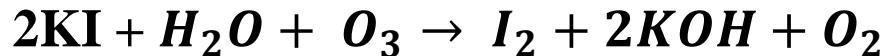
1) 1

2) 2

✓ 4

4) 3

Solution:



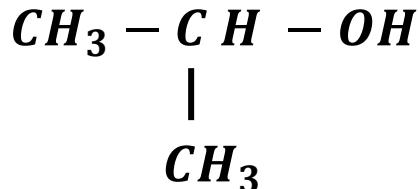
11. Which of the following gives Iodo form test?



 Both 2 and 3

Solution:

Containing groups show positive iodoform test



12. The compound B formed in the following sequence of reaction is



- 1) Propane      2) Propanol       3) Propene      4) Propyne

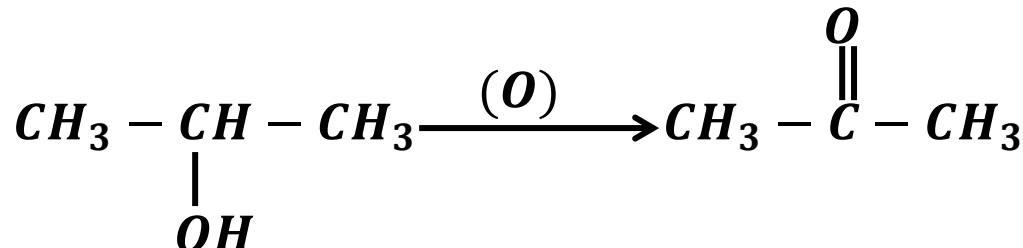
Solution:



13. A compound "X" of the formula  $C_3H_8O$  gives iodoform test. On oxidation with acidified  $K_2Cr_2O_7$ , X gave Y. Y also gives iodoform test then X and Y are

- 1)  $CH_3CH_2CH_2OH$ ,  $CH_3CH_2CHO$
- 2)  $CH_3CHOHCH_3$ ,  $CH_3COCH_3$
- 3)  $CH_3CH_2CHO$ ,  $CH_3CH_2CH_2OH$
- 4)  $CH_3COCH_3$ ,  $CH_3CHOHCH_3$

Solution:



14. There are three alcohols x,y,z which have 2,1 and 0 alpha hydrogen atom(s) respectively. Which does not give Lucas Test immediately

- 1) x
- 2) y
- 3) z
- 4) all the three do not give test

Solution:

Tertiary alcohols readily give turbidity with in 30 seconds

**15. Match the following****List - I**

- A. Glycerol
- B. Ethylene glycol
- C. Methylated spirit
- D. Power alcohol

**List - II**

- I. Denatured alcohol
  - II. Absolute ethanol + petrol
- III. Coolant
- IV. Moisturiser

The correct match is

A   B   C   D

1) IV III II I

A   B   C   D

✓ IV III I II

3) III IV II I

4) II III IV I

**16. Which of the following can participate in both esterification and iodoform reactions?**

**1) Acetic acid**

**2) Acetaldehyde**



**Ethyl alcohol**

**4) Acetone**

17. Assertion (A): Dehydration of alcohols can be carried out with Conc.  $\text{H}_2\text{SO}_4$  but not with Conc. HCl.

Reason (R) :  $\text{H}_2\text{SO}_4$  is dibasic and HCl is monobasic.

1) Both A and R are true and R is the correct explanation to A

 Both A and R are true and R is not the correct explanation to A

3) A is true but R is false

4) A is false but R is true

18. Which one of the following reagents is useful in converting 1-butanol to 1-bromobutane?

- 1)  $\text{CHBr}_3$
- 2)  $\text{Br}_2$
- 3)  $\text{CH}_3\text{Br}$
-  4)  $\text{PBr}_3$

Solution:



19. The correct order of boiling point of three isomeric compounds



1) I > II > III

2) I < II < III

✓ 3) II > III > I

4) II > I > III



**ALCOHOLS**

ALCOHOLS

PREVIOUS

# PERVIOUS COMPETITIVE QUESTIONS

**1. The following reaction**

is known as

[J.M.O.L-2014]

- 1) Perkin reaction
- 2) Gattermann - Koch Formylation

- 3) Kolbe's reaction

- Gattermann reaction

2. Which one of the following statements is not correct?

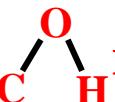
[J.M.O.L-2014]

1) Alcohols are weaker acids than water

2) Acid strength of alcohols decreases in the following order



3) Carbon-oxygen bond length in methanol,  $\text{CH}_3\text{OH}$  is shorter than that of C-O bond length in phenol.

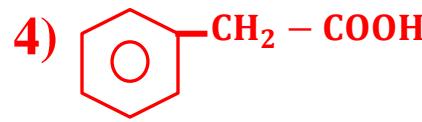
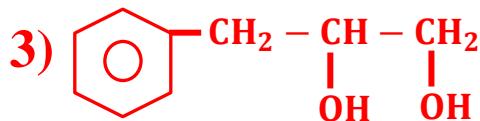
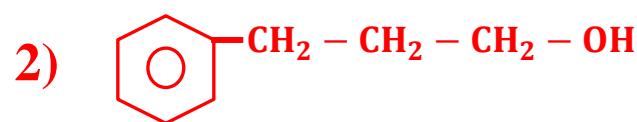
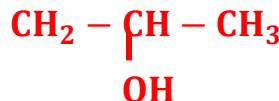
4) The bond angle  in methanol is 108.90

# ALCOHOLS

# PREVIOUS

3.   $\text{CH}_2 - \text{CH} = \text{CH}_2$  on mercuration, demercuration produces the major product:

[J.M.O.L-2014]



Solution :

Markowonikoffs reaction without rearrangement

4. In the Victor - Meyer's test, the colour given by  $1^0$ ,  $2^0$  and  $3^0$  alcohols are respectively: [J.M.O.L-2014]

1) Red, colourless , blue

 2) Red, blue, colourless

3) Colourless, red, blue

4) Red, blue, violet

**5. Rate of dehydration of alcohols follows the order :**

[JEE MAINS ONLINE-2013]



Solution :

The rate of dehydration depends upon the stability of carbocation produced, which can be explained on the basis of +Ve inductive effect (+I effect)  $3^0 > 2^0 > 1^0 > \text{MeOH}$

6. An unknown alcohol is treated with the “Lucas reagent” to determine whether the alcohol is primary, secondary or tertiary. Which alcohol reacts fastest and by what mechanism:

- 1) tertiary alcohol by  $S_N1$
- 2) secondary alcohol by  $S_N2$
- 3) tertiary alcohol by  $S_N2$
- 4) secondary alcohol by  $S_N1$

[JEE MAINS-2013]

**Solution :**

Reaction proceeds through carbocation formation as  $3^0$  carbocation is highly stable, hence reaction proceeds through  $S_N1$  with  $3^0$  alcohol.

7. Amongst the following alcohols which would react fastest with conc. HCl and  $\text{ZnCl}_2$  ?

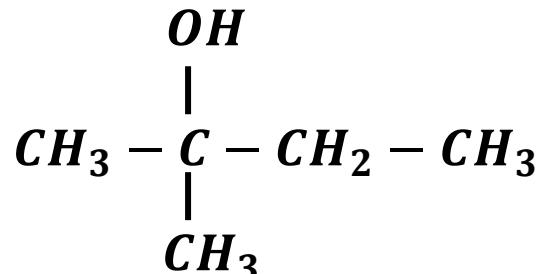
[2012]

- 1) 2 - pentanol
- 2) Pentanol
- 3) 2 - methylbutan - 2 - ol
- 4) 2 - methylbutanol

Solution :

Tertiary alcohols respond to Lucas test immediately i.e with anhydrous  $ZnCl_2$  + Conc. HCl

2 – methyl – 2 – butanol is tertiary alcohol



2 – methyl butan – 2 – ol  
Tertiary pentylcohol

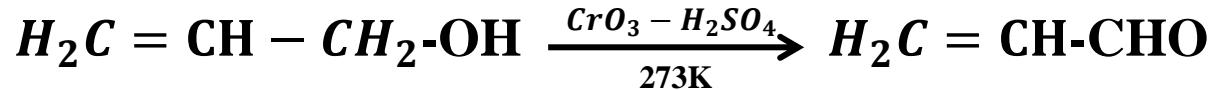
Key : 3

8. Reagent used to convert allyl alcohol to acrolein is

[2011]

-  1)  $CrO_3 - H_2SO_4$     2)  $MnO_2$     3)  $H_2O_2$     4)  $OsO_4$

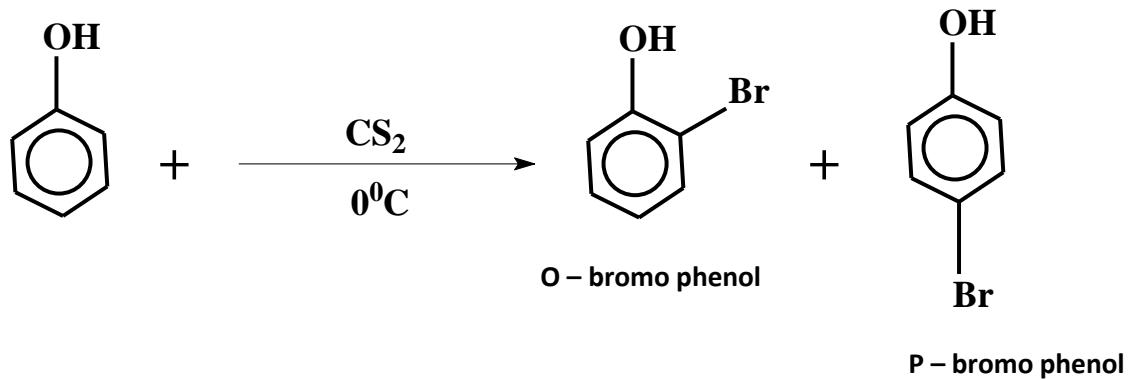
**Solution :**



9. The products formed in the reaction of phenol with  $\text{Br}_2$  dissolved in  $\text{CS}_2$  at  $0^\circ\text{C}$  are: [2010]

- 1) o-bromo, m-bromo and p-bromo phenols
- 2) o-bromo and p-bromo phenols
- 3) 2, 4, 6-tri bromo and 2, 3, 6-tri bromo phenols
- 4) 2, 4-di bromo and 2, 6-di bromophenols

Solution :



Key : 2



**ETHERS**

# OBJECTIVES (LEVEL - I)

1. The dialkyl derivative of  $\text{H}_2\text{O}$  is

1) Alcohol

 2) Ether

3) Ester

4) Ketone

**Solution :**

**Dialkyl derivative of water is ether**

2. The following functional group represents ether



Solution :



3.  $C_nH_{2n+2}O$  is the general formula of ethers. To exhibit the functional group isomerism 'n' must be minimum

1) 1

 2

3) 3

4) 4

Solution :

Alcohols and ethers are functional isomers

4. Which of the following is a simple ether?



Solution :

Simple ethers have identical alkyl groups

5. The central oxygen atom in ether is

- 1) sp hybridised
- 2)  $sp^2$  hybridised
-  3)  $sp^3$  hybridised
- 4)  $sp^3 d^2$  hybridised

Solution :



$2\sigma + 2$  lp. Around oxygen

6. The IUPAC name of  $\text{C}_2\text{H}_5\text{O C}_2\text{H}_5$

- 1) Diethyl ether    Ethoxy ethane 3) Ethoxy propane 4) Dimethyl ether

7. Ethers can exhibit.....isomerism

- 1) Metamerism
- 2) Functional group



both 1 and 2

- 4) geometrical

8. The number of metameric ethers possible with the formula  $C_4H_{10}O$  are

1) 4



3) 2

4) 5

Solution :



Ethoxy ethane



Methoxy propane



2-methoxy propane

9. The compound which is not isomeric with diethyl ether is

✓ Butanone

2) Methyl propyl ether

3) 2-methyl propane-2-ol

4) Butanol-1

Solution :



Ethoxy ethane ( M.F= C<sub>4</sub>H<sub>10</sub>O)

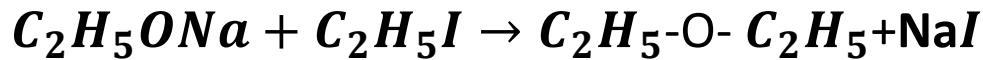


Butanone (M.F= C<sub>4</sub>H<sub>8</sub>O)

10. Williansons synthesis is used to prepare

- 1) Diethyl ether
- 2) PVC
- 3) Bakelite
- 4) Ethyl alcohol

Solution :



11. Excess of  $C_2H_5OH$  at  $140^0C$  reacts with conc. $H_2SO_4$ , then compound formed is

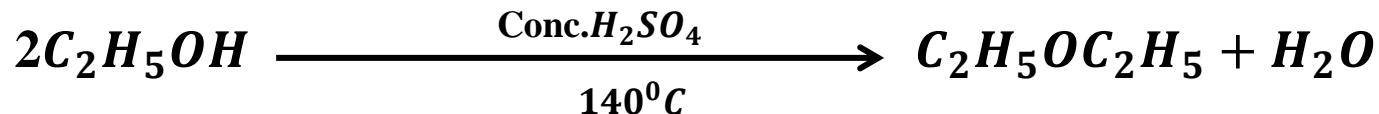
 1) Diethyl ether

2) Diethyl sulphate

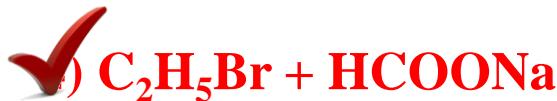
3) Ethylene

4) Ethylene hydrogen sulphate

Solution :



12. Which of the following pairs of reagents will not form ether



Solution :

Sodium salt of carboxylic acid does not participate in Williamson's synthesis

13. What is the functional group isomer of X in the following reaction



1)  $\text{C}_2\text{H}_5\text{I}$

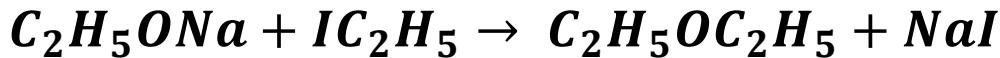
 2)  $\text{C}_4\text{H}_9\text{OH}$

3)  $\text{C}_2\text{H}_4$

4)  $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$

Solution :

Williamson's synthesis



14. The reaction, Sodium alkoxide + Alkyl halide → Ether + Sodium halide is called

- 1) Wurtz reaction
- 2) Kolbe's reaction
- 3) Williamson's synthesis
- 4) Perkin's reaction

Solution :

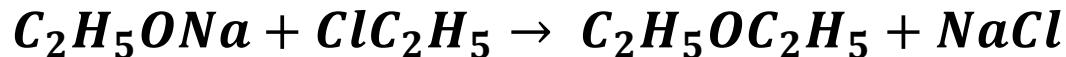
Williamson's synthesis



15. In which of the following reactions, the product is an ether?



Solution :



16. Anisole by reacting with  $\text{Br}_2/\text{CH}_3\text{COOH}$  will give mainly

- 1) p- bromo anisole
- 2) o - bromo anisole
- 3) both 1 and 2
- 4) m- bromo anisole

Solution :

- $\text{OCH}_3$  group in anisole act as o , p. directing group in E. S. R reactions

17. Phenol on heating with NaOH followed by reaction with alkyl halide gives

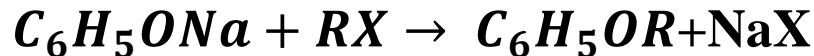
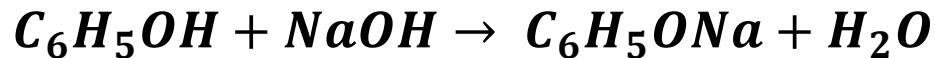
1) Acetone

✓ 2) Ether

3) Ethanol

4) Acetic acid

Solution :



18. Ethers are obtained by

- 1) Reaction of alkyl halide with dry ZnO
- 2) Reaction of alkyl halide with moist ZnO
- 3)  Reaction of alkyl halide with dry Ag<sub>2</sub>O
- 4) Reaction of alkyl halide with moist Ag<sub>2</sub>O

Solution :



19. Sodium phenoxide reacts with methyl iodide and gives anisole. The reaction is known as

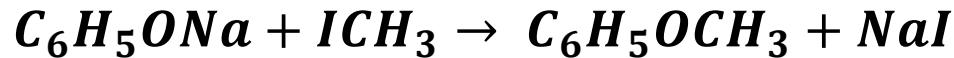
1) Kolbe's reaction

 2) Williamson's reaction

3) Friedel Crafts reaction

4) Riemer - Tiemann reaction

Solution :



20. The compound which has the lowest boiling point is

- 1)  $\text{H}_2\text{O}$
- 2)  $\text{C}_2\text{H}_5\text{OH}$
- 3)  $\text{CH}_3\text{OH}$
-  4)  $\text{CH}_3\text{OCH}_3$

Solution :

Ethers do not show H - bond

21. The compound in which hydrogen bonding is not possible is



Solution :

Ethers do not show H - bond

22. Anisole by reacting with methyl chloride and anhydrous  $\text{AlCl}_3$  will produce

- 1) P- methyloanisole
- 2) O- methylanisole
-  3) Both 1 and 2
- 4) m- methylanisole

Solution :

- $\text{OCH}_3$  group in anisole act as o. p. directing group in E. S. R reactions

**23. Ethers on hydrolysis yield**

 1) Alcohol

2) Aldehyde

3) Acid

4) Ketone

**Solution :**



24. With boiling water or steam diethyl ether gives

1)  $(C_2H_5)_2SO_4$



3)  $CH_2 = CH_2$

4)  $C_2H_5OH + C_2H_5HSO_4$

Solution :



25. The correct statement regarding oxygen atom of ether is

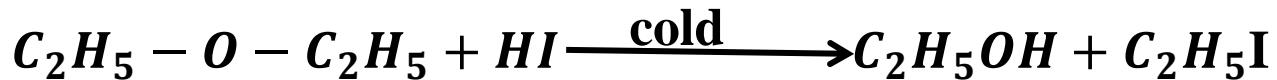
- 1) Chemically less reactive
- 2) Acts as lewis base
- 3) Undergoes  $sp^3$  hybridisation

 all the above

26. Diethyl ether reacts with cold. HI to give

- 1) Ethyl iodide
- 2) Ethyl alcohol
- 3) Both 1 and 2
- 4) Ethylene

Solution :



26. Diethyl ether reacts with cold. HI to give

1) Ethyl iodide

2) Ethyl alcohol

 Both 1 and 2

4) Ethylene

Solution :



28. Ether reacts with conc. HCl or H<sub>2</sub>SO<sub>4</sub> in cold to give

1) Nitroso salt

 Oxonium salt

3) Alcohol

4) Hydrazone salt

Solution :



29. Which of the following can not form Oxonium salts with diethyl ether?

- 1) HCl
- 2) HBr
- 3) H<sub>2</sub>SO<sub>4</sub>
-  4) H<sub>2</sub>CO<sub>3</sub>

30. Diethyl ether when heated to  $350^{\circ}\text{C}$  with  $\text{Al}_2\text{O}_3$  forms

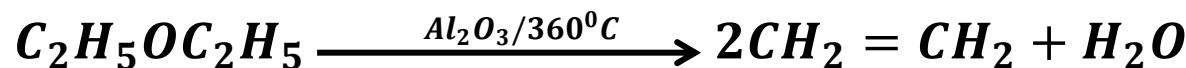
1) Ethane

 2) Ethene

3) Ethyne

4) Ethyl alcohol

Solution :



31. Which one of the following are correct products obtained when diethyl ether reacts with hot HI

✓)  $C_2H_5I$  only

2)  $C_2H_5I + C_2H_5OH$

3)  $C_2H_5OH$  only

4)  $CH_3I + C_3H_7OH$

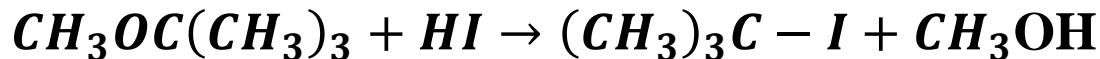
Solution :



32. In which one of the following reactions, primary methyl halide is not formed as one of the product



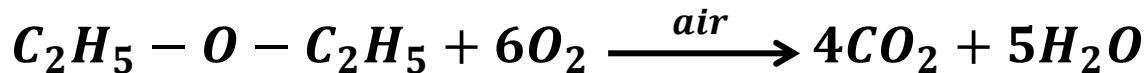
Solution :



33. The products of complete combustion of ether are

- 1) CO<sub>2</sub> and H<sub>2</sub>O
- 2) Ethyl alcohol
- 3) CO and H<sub>2</sub>O
- 4) Ethylene

Solution :



34. The alkoxy group in benzene is

1) Ortho directing

2) Para directing

 3) Ortho and para directing

4) Meta directing

Solution :

- $OCH_3$  group in anisole act as o. p. directing group in E. S. R reactions



**ETHERS**

# OBJECTIVES (LEVEL - II)

1. The IUPAC name of  $\text{CH}_3\text{OCH}(\text{CH}_3)_2$  is

1) 1 – methoxy -1 – methyl ethane

2) 3 – methoxy propane

3) Methyl isopropyl ether

✓) 2 – methoxy propane

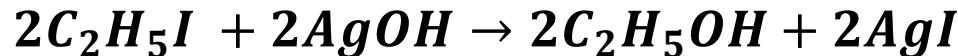
Solution :

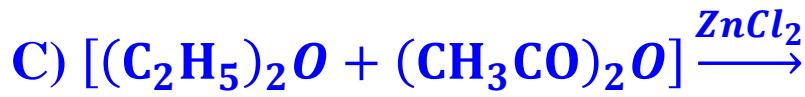
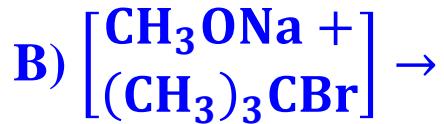
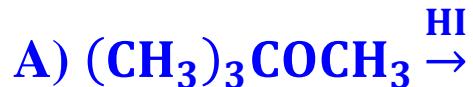
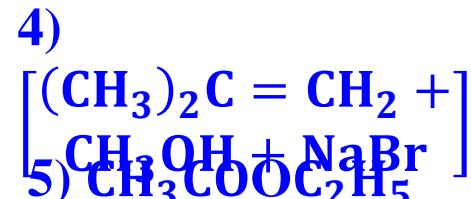
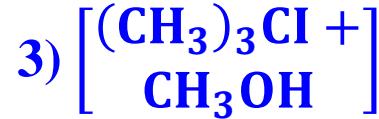
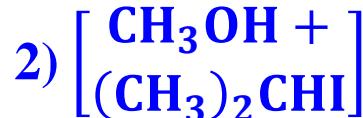
Simplest alkyl group is shown by alkoxy in IUPAC name

2. When ethyl iodide is treated with moist silver oxide, it forms.

- 1) Ag
- 2) C<sub>2</sub>H<sub>5</sub>OH
- 3) C<sub>2</sub>H<sub>5</sub> OC<sub>2</sub>H<sub>5</sub>
- 4) COOH – COOH

Solution :



**3. Match the following****List - I****List - II**

The correct match is

A      B      C      D

1)    3      5      4      2

2)    3      4      1      5

3)    4      3      1      2

 3      4      5      1

**4. Match the following****List - I****The correct match is****List - II**

1) Anisole

2) Simple ether

3) Natalite

4) Mixed ether

5) refrigerant

A      B      C      D

1)    2      1      5      3

2)    2      4      5      3

3)    2      4      5      1

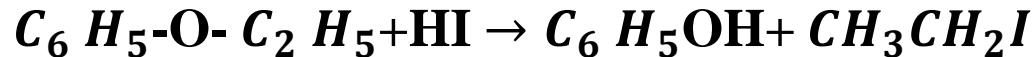
4)    1      2      3      4



5. Phentole +HI → X + Y ; X and Y are



Solution :



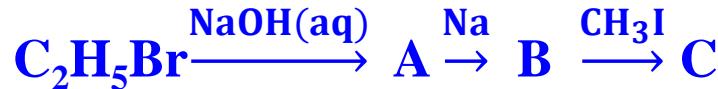
6. Diethyl ether may be regarded as anhydride of



Solution :

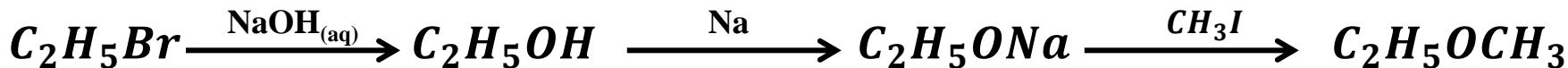
Anhydride is formed by removal of water

7. The product C in the following sequence of reaction is



- 1) Butane
- 2) Ethane
- 3) Methyl ethyl ether
- 4) Propane

Solution :



8. Assertion (A) : Ethyl alcohol reacts with alumina at  $260^{\circ}\text{C}$  and gives di ethyl ether.

Reason (R) : Ethyl alcohol undergoes dehydration.

 Both A and R are true and R is the correct explanation to A

2) Both A and R are true and R is not the correct explanation to A

3) A is true but R is false

4) A is false but R is true

9. Which one of the following does not liberate hydrogen when treated with sodium metal



Solution :

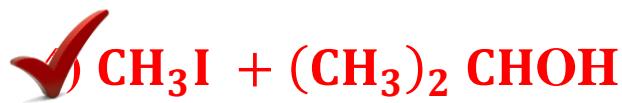
Ethers can not act as acids

10. Which of the following does not react with diethyl ether



Solution :

Sodium alkoxide being a base



Solution :



12. Diethyl ether upon heating with conc. HI gives

 2 moles  $\text{CH}_3\text{CH}_2\text{I}$

2) 2 moles  $\text{CH}_3\text{CH}_2\text{OH}$

3)  $\text{CH}_3\text{CH}_2\text{OH} + \text{CH}_3\text{CH}_2\text{I}$

4)  $\text{CH}_3\text{I} + \text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

Solution :



13. Assertion (A) : Diethyl ether when boiled with water gives ethyl alcohol.

Reason (R) : Diethyl ether is heavier than water.

- 1) Both A and R are true and R is the correct explanation to A
- 2) Both A and R are true and R is not the correct explanation to A
-  3) A is true but R is false
- 4) A is false but R is true

14. Assertion (A) : Ethers behave as Lewis base in the presence of mineral acids in cold condition.

Reason (R) : Oxygen atom in ether has 4 lone pairs of electrons.

- 1) Both A and R are true and R is the correct explanation to A
- 2) Both A and R are true and R is not the correct explanation to A
-  3) A is true but R is false
- 4) A is false but R is true

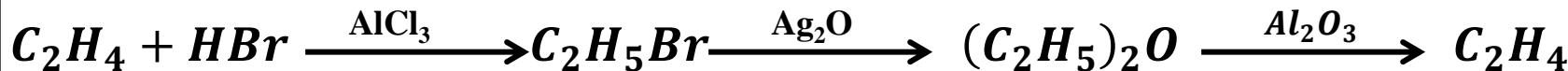
15. Ethylene reacts with HBr forming 'X' which on reaction with moist  $\text{Ag}_2\text{O}$  gives 'Y'. When 'Y' is heated with alumina at  $350^\circ\text{C}$  compound Z is formed. Then X and Z are

- 1) Bromo ethane, ethanol
- 2) Ethanol, ethoxy ethane
- 3) Ethyl bromide, diethyl ether



✓Bromo ethane, Ethene

Solution :



**16. Assertion (A) : Diethyl ether is used as general anaesthetic**

**Reason (R) : Diethyl ether produces unconsciousness without effecting lungs.**



- 1) Both A and R are true and R is the correct explanation to A**
- 2) Both A and R are true and R is not the correct explanation to A**
- 3) A is true but R is false**
- 4) A is false but R is true**

17. Ethoxy ethane is higher boiling than

- A) n-butane    B) pentanal    C) pentan-1-ol    D)methoxy methane

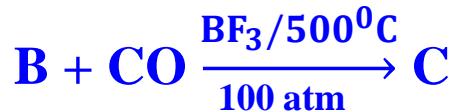
The correct answer is

1) A, B

 2) A, D

3) A, B, C

4) A, B, D



The functional groups present in B and C are respectively

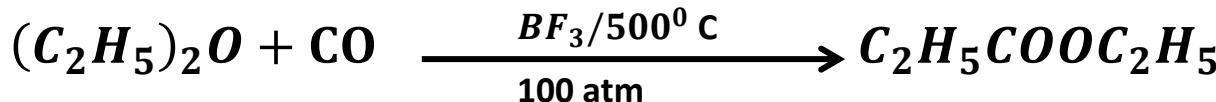
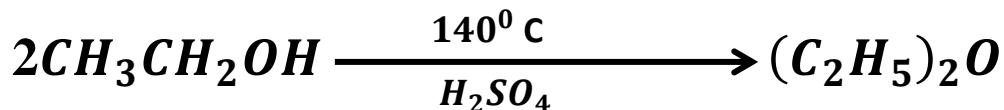
1) Ester, ether



3) Alcohol, ester

4) Ester, alcohol

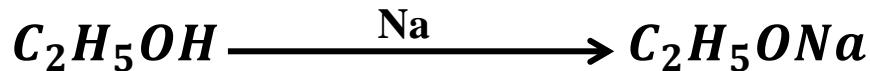
Solution :

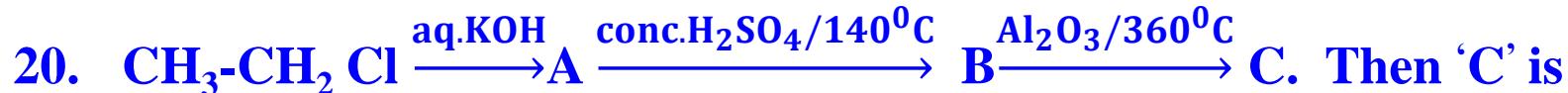


19. A compound X of the formula  $C_2H_6O$ , on reaction with Na metal gave Y, X also reacts with  $PCl_5$  to give Z. The product obtained in the reaction between Y and Z is

- 1)  $CH_3CHO$     2)  $CH_3COCH_3$     3)  $CH_3COOC_2H_5$     ✓  $C_2H_5OC_2H_5$

Solution :



**ETHERS****LEVEL-2**

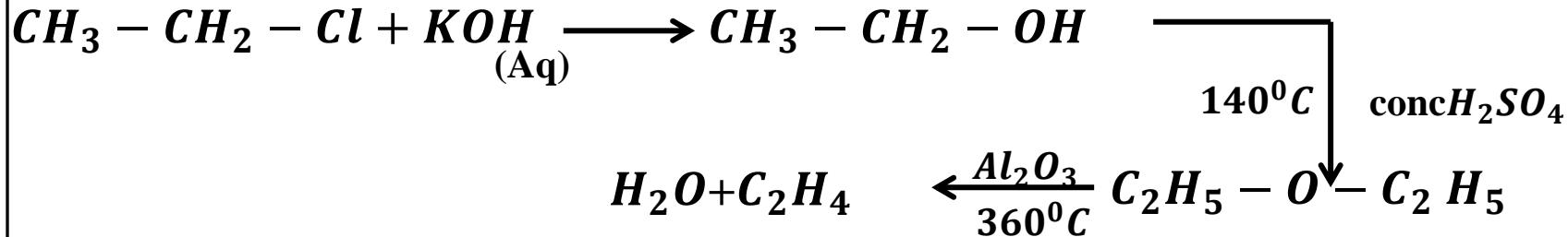
1) Ethyne

✓ Ethene

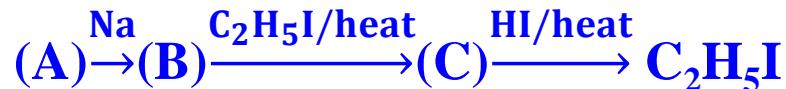
3) Ethoxy ethane

4) Ethyl alcohol

**Solution :**



21. In the sequence of reactions (A) is :



1) Acetic acid

2) Methyl alcohol

 3) Ethyl alcohol

4) Propionic acid

Solution :



22. Consider the following in  $C_2H_5OK + C_2H_5I \xrightarrow{\Delta} 'X'$  (pleasant smelling liquid)

Which of the following reagents converts ethyl bromide to 'X'

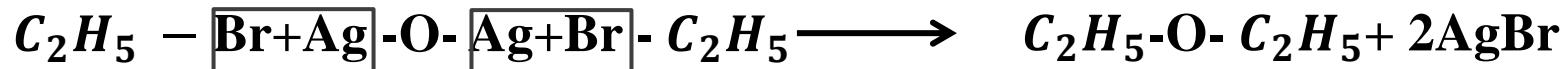
1) Na

 Dry-Ag<sub>2</sub>O

3) C<sub>2</sub>H<sub>5</sub>Cl

4) Dry-Ag powder

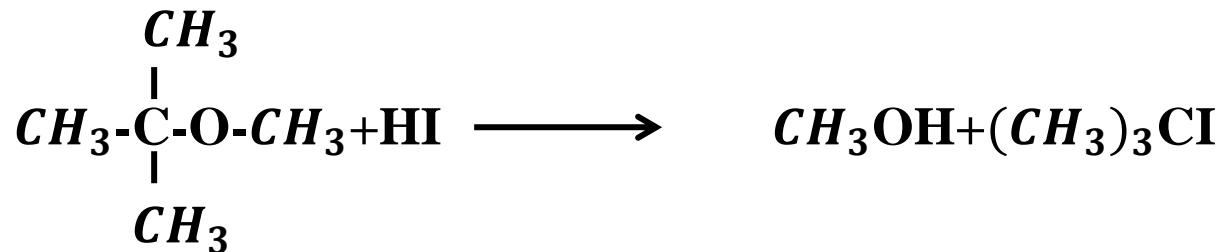
Solution :



23.  $(CH_3)_3C - O - CH_3$  react with dil. HI gives



Solution :



24. Which one of the following is the best method for making isopropyl methyl ether



Solution :

Elimination product is formed with increase in branching



**ETHERS**

ETHERS

PREVIOUS

# PREVIOUS COMPETITIVE QUESTIONS



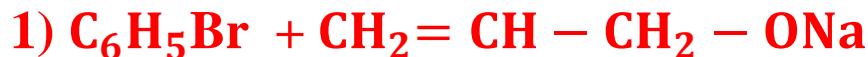
Y

Z

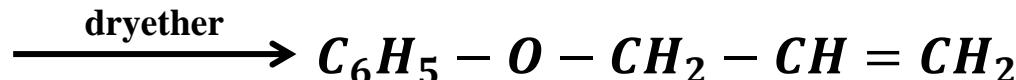
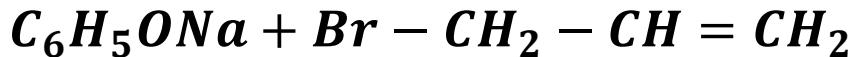
[E-2014]

1)  $\text{C}_2\text{H}_5\text{I}$  $\text{C}_6\text{H}_5\text{CHO}$ 2)  $\text{C}_6\text{H}_5\text{I}$  $\text{H}_3\text{CCH}_2\text{OH}$  3)  $\text{C}_6\text{H}_5\text{OH}$  $\text{H}_3\text{CCH}_2\text{I}$ 4)  $\text{C}_6\text{H}_5\text{OH}$  $\text{H}_3\text{CCH}_3$ **Solution :**

2. Allyl phenyl ether can be prepared by heating : [J.M.O.L-2014]



Solution :



3. Williamson synthesis of ether is an example of : [J.M.O.L-2014]

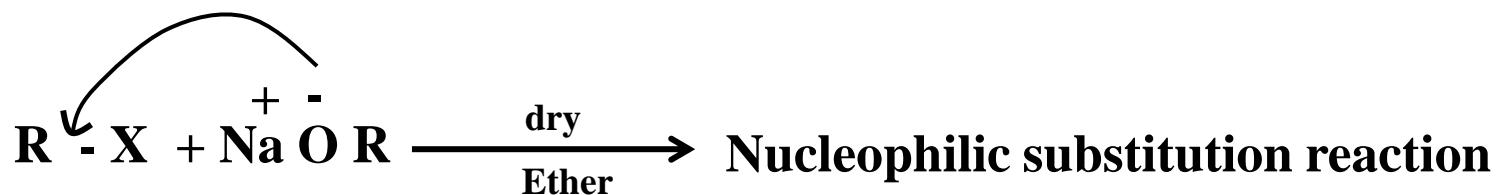
1) Nucleophilic addition

2) Electrophilic addition

3) Electrophilic substitution

✓ Nucleophilic substitution

Solution :



4. An ether (A),  $C_5H_{12}O$ , when heated with excess of hot concentrated HI produced two alkyl halides which when treated with NaOH yielded compounds (B) and (C). Oxidation of (B) and (C) gave a propanone and an ethanoic acid respectively. The IUPAC name of the ether(A) is :  
(JEE MAINS ONLINE-2013)

1) Ethoxypropane

2) 2 - methoxybutane

3) 2 - ethoxypropane

4) Methoxybutane

Solution :

2 – ethoxy propane (A) with HI gives ethyl iodide and isopropyl iodide they give ethyl alcohol (C) and isopropylalchol (B) which on oxidatuon give  $CH_3COOH$  and  $CH_3COCH_3$ , respectively.

5. In Williamson synthesis of mixed ether having a primary and a tertiary alkyl group if tertiary halide is used, then :

(JEE MAINS ONLINE-2013)

- 1) simple ether will form instead of mixed ether
- 2) alkene will be the main product
- 3) rate reaction will be slow due in slow cleavage of carbon - halogen bond
- 4) expected mixed ether will be formed

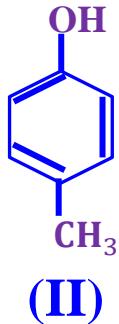
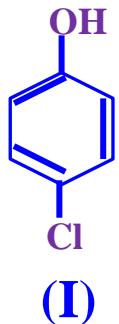
Solution :

Alkene will be main product due to elimination reaction however mixed can be obtained if tertiary ethoxide and primary alkylhalide are taken



Key : 2

6. Arrange the following compounds in order of decreasing acidity



[JEE 2013]

1) II>IV>I>III

2) I>II>III>IV

3) III>I>II>IV

4) IV>III>I>II

**Solution :**

The electron with drawing groups like  $-NO_2$  and  $-Cl$  increase the acidic nature

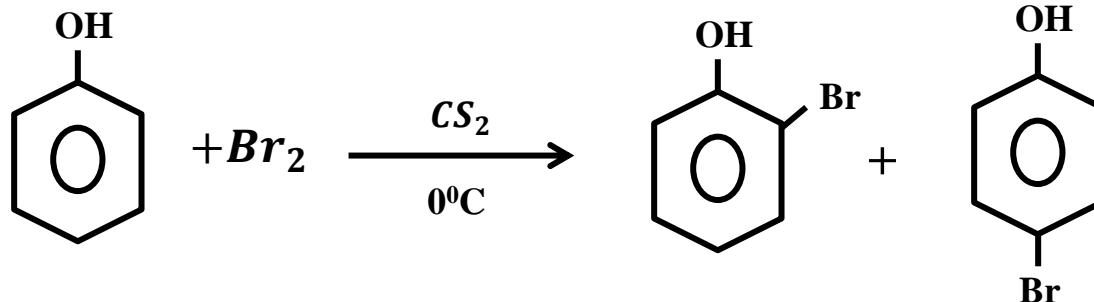
The electron releasing groups like  $-CH_3$  and  $-OCH_3$  decreases the acidic nature

**Key : 3**

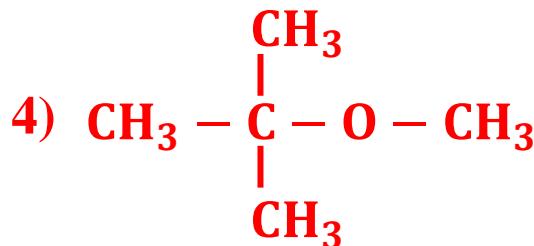
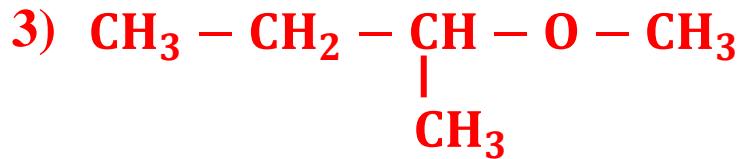
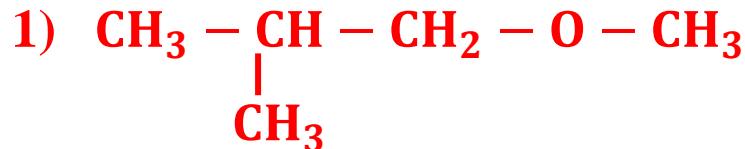
7. The products formed in the reaction of phenol with  $\text{Br}_2$  dissolved in  $\text{CS}_2$  at  $0^\circ\text{C}$  are [Eamcet-2013]

- 1) 0-bromo, m-bromo and p-bromophenols
- ✓ 2) o-bromo and p-bromophenols**
- 3) 2,4,6 -tribromo and 2,3,6-tribromophenols
- 4) 2,4-dibromo and 2,6 -dibromophenols

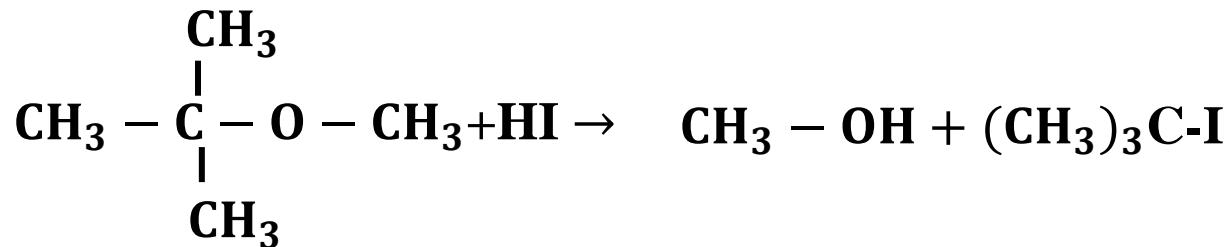
Solution :



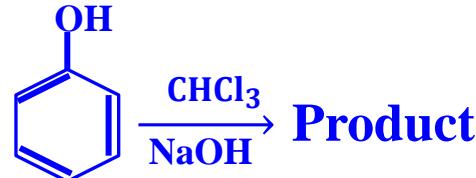
8. Among the following ethers, which one will produce methyl alcohol on treatment with hot concentrated HI ? [NEET-2013]



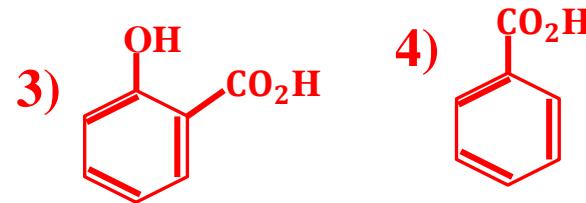
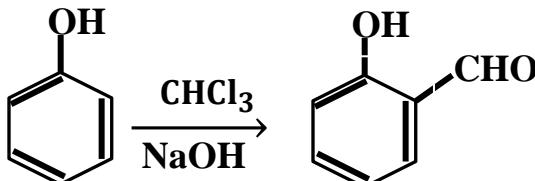
Solution :



Key : 4

**9. Identify the product in the following reactions**

[E-2012]

**Solution :**

10. Iodoform can be prepared from all except

[A-2012]

1) Ethyl methyl ketone

2) Isopropyl alcohol

3) 3-methyl-2-butanone

 4) Isobutyl alcohol

Solution :

The compounds which contain  $-CH_3CO$  group they shows Iodoform test

11. Which of the following reagents may be used to distinguish between phenol and benzoic acid? [AIEEE-2011]

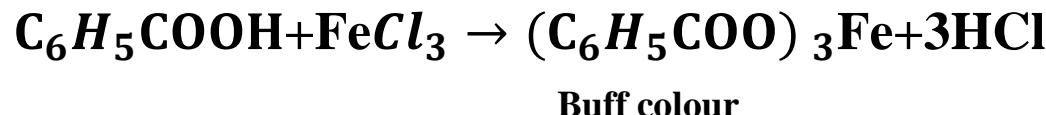
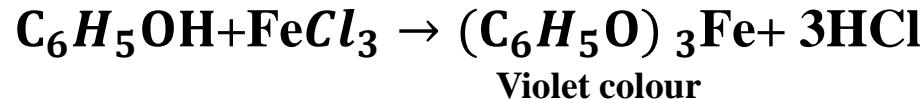
 Neutral  $\text{FeCl}_3$

2) Aqueous  $\text{NaOH}$

3) Tollen's reagent

4) Molisch reagent

Solution :



12. Phenol is heated with a solution of mixture of KBr and  $KBrO_3$ . The major product obtained in the above reactions is : [AIEEE-2011]

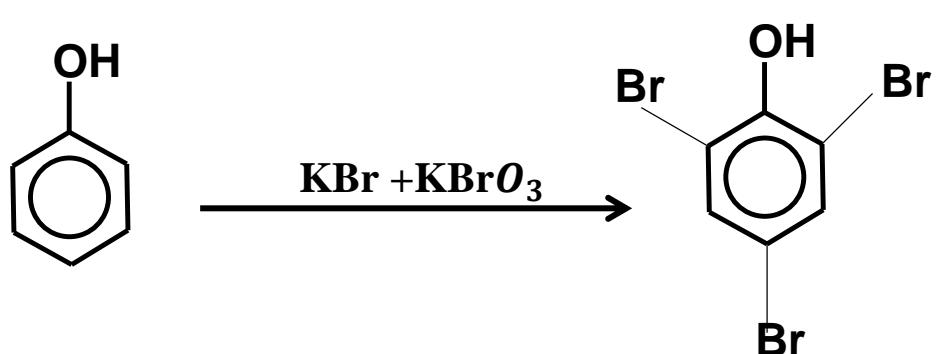
 1) 2,4,6-Tribromophenol

2) 2-Bromophenol

3) 3-Bromophenol

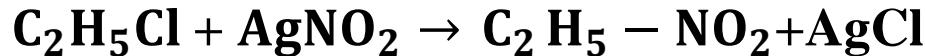
4) 4-Bromophenol

Solution :





Solution :



**14. Assertion (A) : Ethanol boils at lower temperature than ethane**

**Reason (R) : The molecular weight of ethanol is higher than that of ethane.**

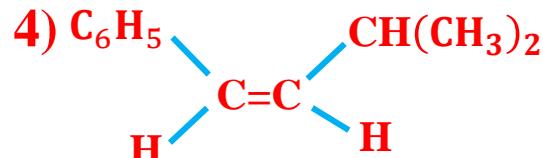
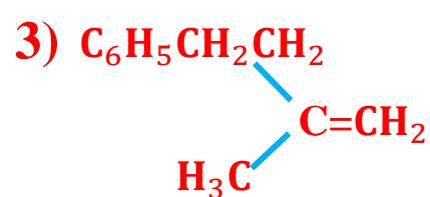
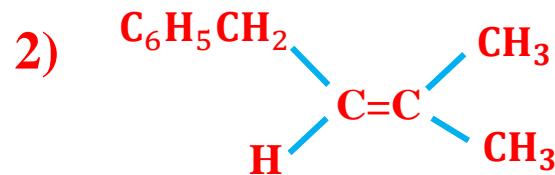
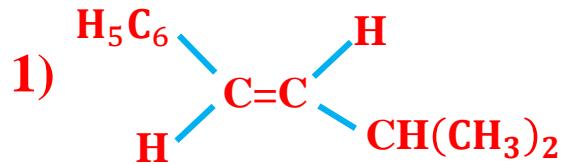
[E-2011]

- 1) Both A and R are true and R is the correct explanation to A**
  - 2) Both A and R are true and R is not the correct explanation to A**
  - 3) A is true but R is false**
-  **A is false but R is true**

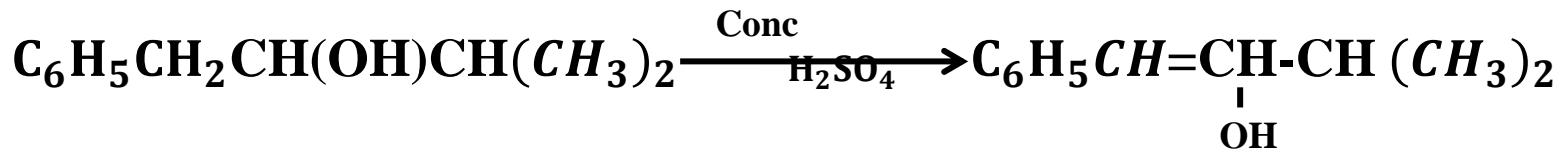
15. The main product of the following reaction is



[E-2010]



Solution :



Key : 1

16. From amongst the following alcohols the one that would react fastest with conc. HCl and anhydrous  $ZnCl_2$ , is

[AIEEE-2010]

1) 2-Butanol



2) 2-Methylpropan-2-ol

3) 2-Methylpropanol

4) 1-Butanol

Solution :

$3^0$  alcohol give immediate precipitate with Lucas reagent (conc HCl+ anhydrous  $ZnCl_2$ )

17. The correct order of reactivity of hydrogen halides with ethyl alcohol is

[E-2008]

1) HF > HCl > HBr > HI

2) HCl > HBr > HF > HI

3) HBr > HCl > HI > HF



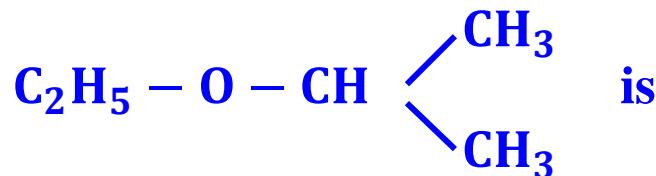
✓ HI > HBr > HCl > HF

Solution :

Good acid protonates alcohol readily

## 18. The IUPAC name of

[E-2008]



is

- 1) Ethoxypropane1
- 2) 1,1 - dimethyl ether
- 3) 2- ethoxy isopropane



- 1) Ethoxypropane1
- 2) 1,1 - dimethyl ether
- ✓ 3) 2- ethoxy propane

Solution :

Simplest alkyl group is shown by alkoxy in IUPAC name

19. The major product obtained on interaction of phenol with sodium hydroxide and carbon dioxide is [AIEEE-2008]

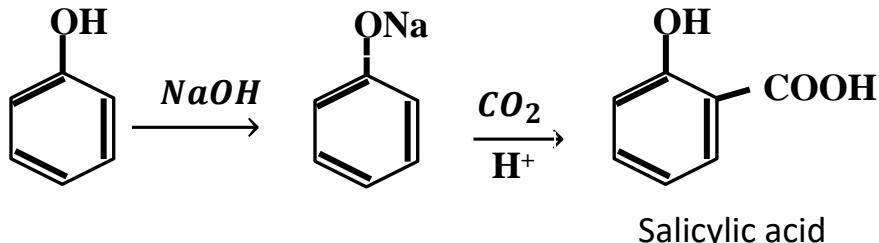
1) salicylaldehyde

✓ 2) salicylic acid

3) phthalic acid

4) benzoic acid

Solution :



20. The functional groups present in ‘salol’ are

[E-2007]

- 1)  $-\text{NH}_2$  and  $-\text{OR}$
  - 2) OH and  $-\text{COR}$
  - 3)  $-\text{NH}_2$  and  $-\text{COOH}$
-  4) OH and  $-\text{COOR}$

Solution :

Salols are compounds having  $-\text{OH}$ ,  $-\text{COOR}$  groups

**21. Hybridisation of oxygen in diethyl ether is****[E-2007]****1) sp****2)  $sp^2$** **✓ 3)  $sp^3$** **4)  $sp^3d$** **Solution :** **$2\sigma + 2 l.p$  Around oxygen**

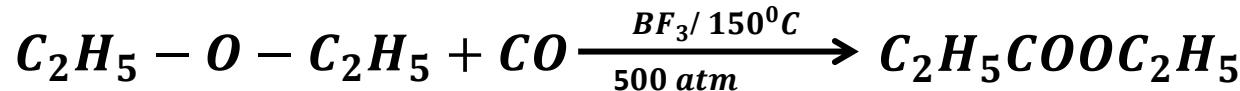
22. Which of the following compounds when heated with CO at  $150^{\circ}\text{C}$  and 500 atm pressure in presence of  $\text{BF}_3$  forms ethyl propionate?



[E-2006]



Solution :



23. When compound X is oxidised by acidified potassium dichromate, compound Y is formed. Compound Y on reduction with  $\text{LiAlH}_4$  gives X,X and Y respectively are

[E-2006]



1)  $\text{C}_2\text{H}_5\text{OH}, \text{CH}_3\text{COOH}$

2)  $\text{CH}_3\text{COCH}_3, \text{CH}_3\text{COOH}$

3)  $\text{C}_2\text{H}_5\text{OH}, \text{CH}_3\text{COCH}_3$

4)  $\text{CH}_3\text{CHO}, \text{CH}_3\text{COCH}_3$

Solution :

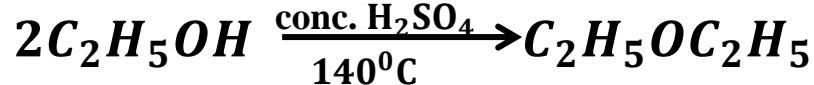
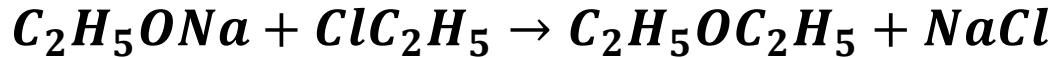


24. Ethyl chloride reacts with sodium ethoxide to form a compound A.  
Which of the following reactions also yields A ?

[E-2006]



Solution :





In above reactions the role of  $\text{Cl}_2$  in step - 1 and step - 2 respectively is

1) oxidation, chlorination

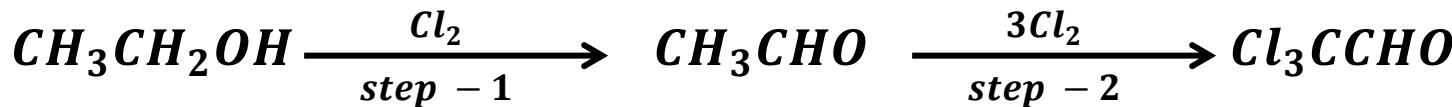
[E-2006]

2) reduction, chlorination

3) oxidation, addition

4) reduction, substitution

**Solution :**



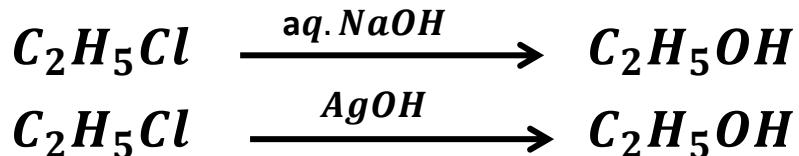
26. Identity A and B in the following reactions :



[E-2005]

- 1) A =  $C_2H_2$ , B =  $C_2H_6$
- 2) A =  $C_2H_5Cl$ , B =  $C_2H_4$
- 3) A =  $C_2H_4$ , B =  $C_2H_5Cl$
- ✓ 4) A =  $C_2H_5Cl$ , B =  $C_2H_5Cl$

Solution :



27. In which of the following reactions the product is an ether ?

[E-2005]



Solution :



28. In the reaction,

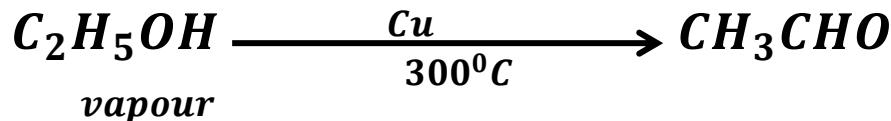


[E-2005]

The molecular formula of X is

- 1)  $\text{C}_4\text{H}_6\text{O}$     2)  $\text{C}_4\text{H}_{10}\text{O}$      3)  $\text{C}_2\text{H}_4\text{O}$     4)  $\text{C}_4\text{H}_6$

Solution :



29. Which one of the following is a secondary alcohol?

[E-2004]

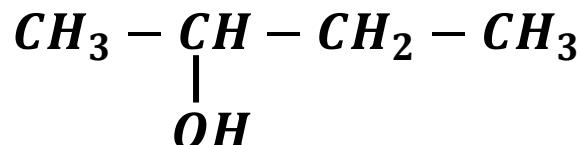
1) 2-methyl - 1 - propanol

2) 2-methyl -2-propanol

✓) 2-butanol

4) 1-butanol

Solution :



30. The IUPAC name of an unsymmetrical ether with the molecular formula,  $C_4H_{10}O$  is

[E-2004]

- 1) Ethoxy propane
- 2) Methoxy ethane
- 3) Ethoxy ethane
- 4)  Methoxy propane

Solution :



Methoxypropane

31. Identify A and B in the following reaction



[E-2004]

 1) A = aqueous KOH; B = AgOH

2) A = alcoholic KOH /Δ; B = aqueous NaOH

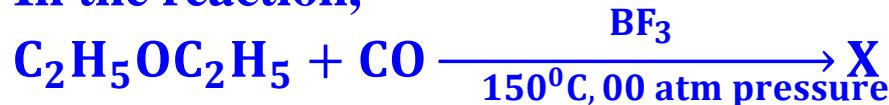
3) A = aqueous NaOH; B = AgNO<sub>2</sub>

4) A = AgNO<sub>2</sub>; B = KNO<sub>2</sub>

Solution :



32. In the reaction,



What is X ?

[E-2003]

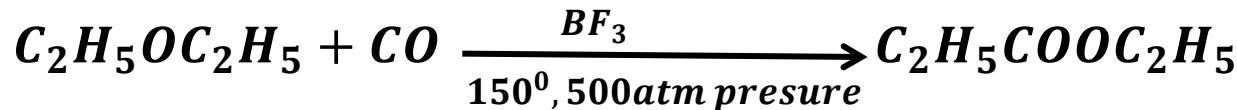
1) Diethyl carbonate

2) Ethyl carbonate

3) Diethyl peroxide

✓ 4) Ethyl propionate

Solution :



33. Which one of the following gases is liberated when ethyl alcohol is heated with methyl magnesium iodide ?

[E-2003]

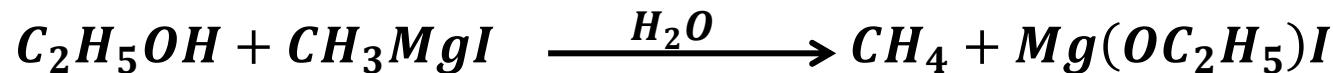
 1) Methane

2) Ethane

3) Carbon dioxide

4) Propane

Solution :



**ETHERS**

**PREVIOIS**

35. The products formed when diethyl ether is reacted with cold HI are



[E-2002]



Solution :



36. In the following reaction, X and Y respectively are



1)  $\text{CH}_3\text{OH}, \text{C}_2\text{H}_5\text{OH}$

2)  $\text{CH}_3\text{CHO}, \text{CH}_3\text{OH}$

3)  $\text{CH}_2 = \text{CH}_2, \text{CH}_3\text{COOH}$

✓ 3)  $\text{CH}_3\text{COOH}, \text{C}_2\text{H}_5\text{OH}$

Solution :

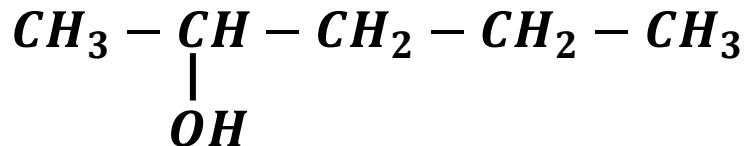


37. Which one of the following is a secondary alcohol?

- 1) 2-methyl - 2 propanol [E-2002]
- 2) 1-propanol
- 3) 1-butanol

 2 - pentanol

Solution :



38. Which one of the following pairs of compounds are functional isomers?

- 1)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ ,  $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$  [E-2001]
  - 2)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ ,  $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$
  - 3)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ ,  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$
-   $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ ,  $\text{CH}_3-\text{O}-\text{CH}_2\text{CH}_3$

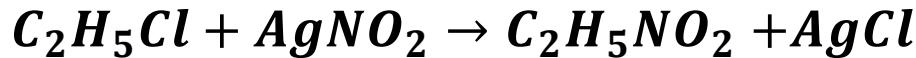
Solution :

Alcohols and Ethers are functional isomers

39. Ethanol, when reacted with  $\text{PCl}_5$  gave A,  $\text{POCl}_3$  and  $\text{HCl}$ . A reacts with silver nitrite to form B (major product) and  $\text{AgCl}$ . A and B are respectively



Solution :



40. Chloro ethane reacts with X to form diethyl ether. What is X ?

[E-2001]

1) NaOH

2) H<sub>2</sub>SO<sub>4</sub>

✓ 3) C<sub>2</sub>H<sub>5</sub>ONa

4) Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>

**Solution :**



41. 3 moles of ethanol react with one mole of phosphorus tribromide to form 3 moles of bromoethane and one mole of X .Which of the following is X ? [E- 2001]



Solution :



42. Absolute alcohol (100% alcohol) is prepared by distilling rectified spirit over

[E-2001]

- 1) Na
- 2)  $\text{CaCl}_2$
- 3) Mg
- 4)  $\text{Mg}(\text{OC}_2\text{H}_5)_2$



Solution :

Distilling of rectified spirit over  $\text{Mg}(\text{OC}_2\text{H}_5)_2$  gives absolute alcohol

43. Which of the following is Lucas reagent ?

[E-2000]

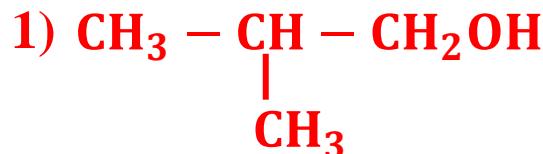
1) Ammonical  $\text{AgNO}_3$

2)  $\text{Br}_2/\text{CCl}_4$

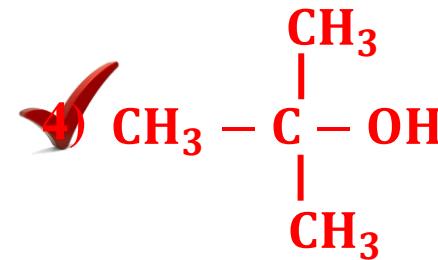
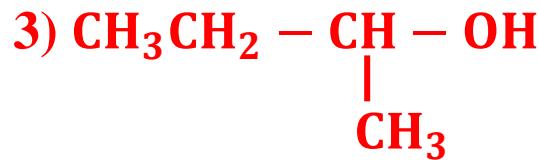
 3)  $\text{ZnCl}_2/\text{conc.HCl}$

4) Cold alk.  $\text{KMnO}_4$

44. Which of the following is a tertiary alcohol?



[E-2000]



Solution :

If 'OH' group is attached to  $3^0$  carbon. it is called tertiary alcohol



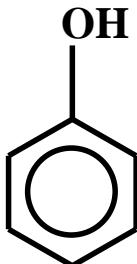
# PHENOLS

# OBJECTIVES (LEVEL - I)

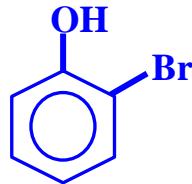
1. Phenol is also called

- 1) Salicylic acid
- 2) Benzyl alcohol
- 3) Carbolic acid
- 4) Salol

Solution :



2. The IUPAC name of



- 1) o-bromo phenol
- 2) p-bromo phenol
- 3) 2-bromo phenol
- 4) 6-bromo phenol

Solution :

Bromine atom is considered to be substituent

3. The IUPAC name of Catechol is

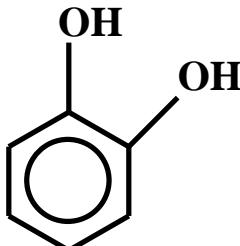
1) 4-hydroxy phenol

 Benzene-1,2 diol

3) 2-methyl phenol

4) 4-methyl phenol

Solution :



4. Which does not have a carboxyl group?

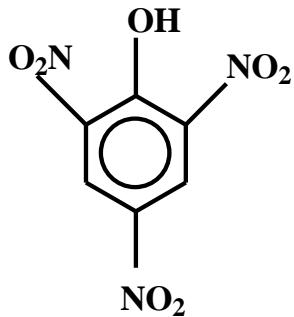
 1) Picric acid

2) Ethanoic acid

3) Aspirin

4) Benzoic acid

Solution :



5. Phenol was first isolated from

1) Coaltar

2) Benzene

3) Nitro benzene

4) Aniline

7. Cumene  $\xrightarrow[\text{ii) } H_2O_2H^+]{\text{i) } O_2}$  (X) and (Y) (X) And (Y) respectively are

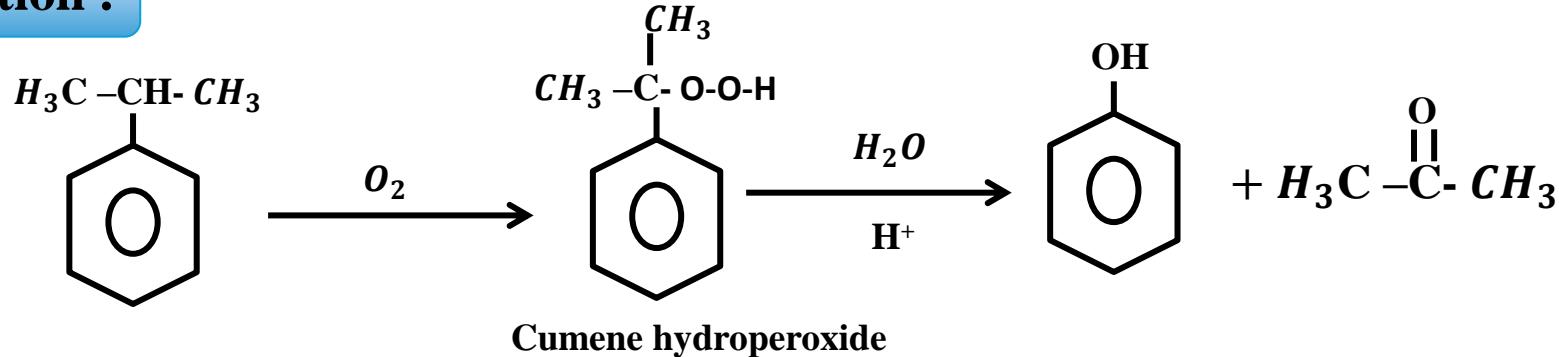
1) Toluene, propene

2) Toluene, propylchloride

 3) Phenol, acetone

4) Phenol, acetadehyde

Solution :



8. Which of the following statements is not true?

- 1) When vapours of phenol are passed over Zn dust, benzene is formed
-  2) The phenolic – OH group is meta directing group
- 3) The phenolic – OH group is ortho-and para directing group
- 4) o-Nitrophenol has a lower boiling point as compared to that of p-nitrophenol

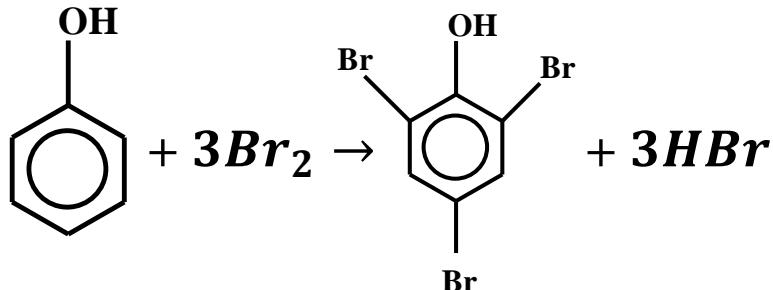
Solution :

-OH group acts as o, p – directing group

9. What amount of bromine will be required to convert 2 g of phenol into 2,4,6 – Tribromophenol?

- 1) 4.00      2) 6.00      3) 10.22      4) 20.44

Solution :



**94 g phenol =  $3 \times 160$  g bromine**

**2 g phenol = x**

$$x = \frac{2 \times 3 \times 160}{94}$$

$$= 10.22\text{g}$$

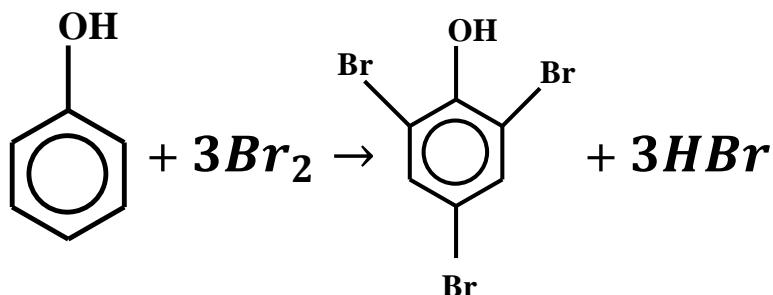
**Key : 3**

10. When phenol is treated with excess of bromine water, it gives

- 1) m-bromophenol
- 2) o-and p-bromophenol
- 3) 2,4-dibromophenol
- 4) 2,4,6-tribromophenol



Solution :



11. Phenols do not react with

1) Sodium bicarbonate

✓ 2) Sodium hydroxide

3) Potassium hydroxide

4) Ferric chloride

Solution :

Phenol is a weak protonic acid

13. Picric acid is a yellow coloured compound. Its chemical name is

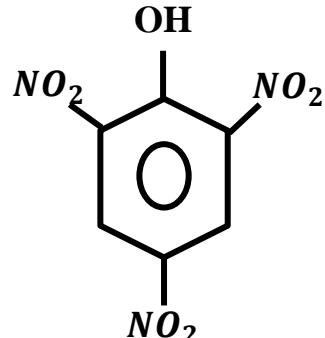
1) m-nitrobenzoic acid

✓ 2,4,6-trinitrophenol

3) trinitrotoluene

4) trinitroaniline

Solution :



14. Phenol reacts with bromine in carbon disulphide at low temperature to give

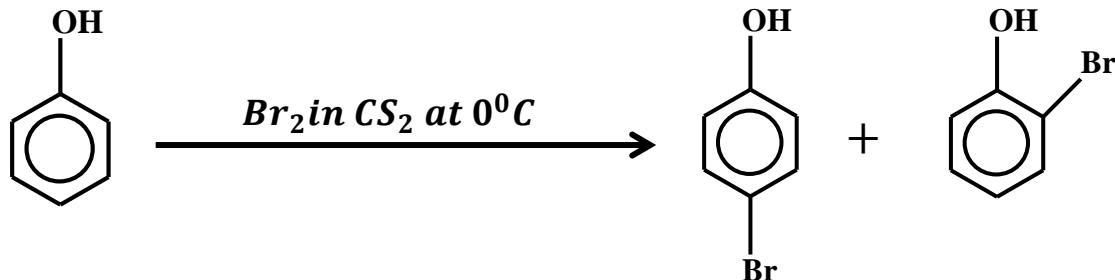
1) m-bromophenol

 o-and p-bromophenol

3) p-bromophenol

4) 2,4,6-tribromophenol

Solution :



15. The bromination of phenol in aqueous medium produces

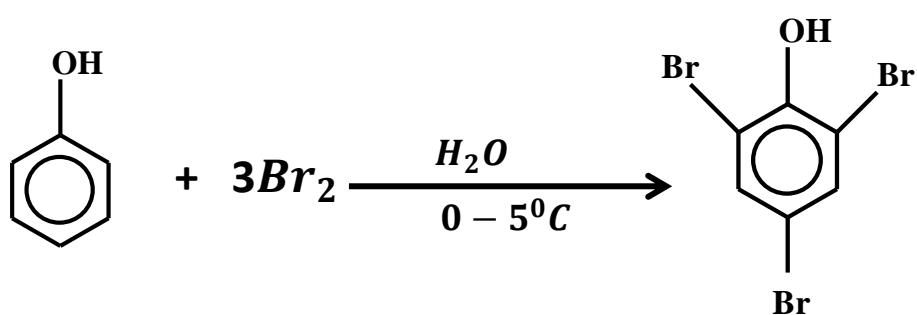
1) 2-bromophenol

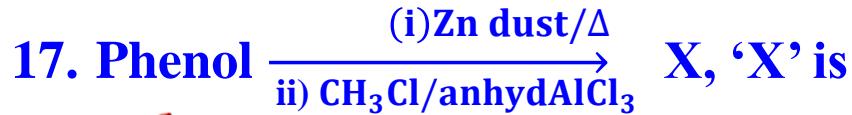
2) 4-bromophenol

✓ 3) 2,4,6-tribromophenol

4) a mixture of 2-and 4-bromophenols

Solution :





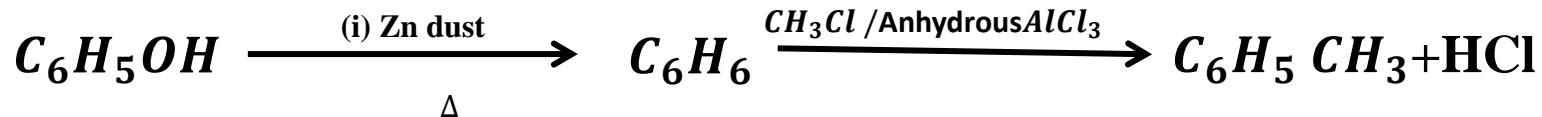
1) Methyl benzene

2) benzene

3) 2-methyl phenol

4) 3-methyl phenol

Solution :



18. Phenol on treating with dilute  $HNO_3$  gives

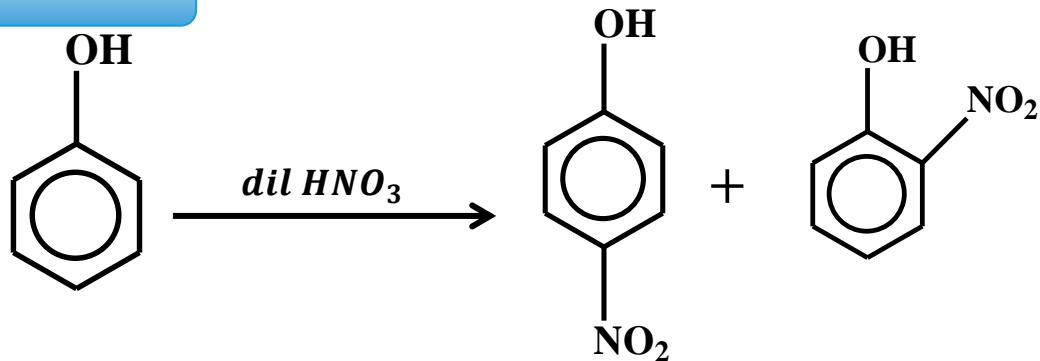
1) ortho-nitrophenol

2) para-nitrophenol

 3) ortho-nitrophenol and para-nitrophenol

4) meta-nitrophenol

Solution :





20. Which one of the following compounds would undergo nitration with greatest ease

1) Benzene

 2) Phenol

3) Nitrobenzene

4) Benzoic acid

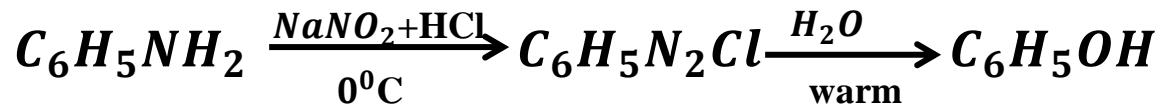
**Solution :**

- OH group is activationg group in E.S.R

21. In the reaction  $C_6H_5NH_2 \xrightarrow[0^{\circ}C]{NaNO_2+HCl} X \xrightarrow[warm]{H_2O} Y$ ; Y is



Solution :



22. On distilling 2-hydroxy benzoic acid with Zn dust, it gives

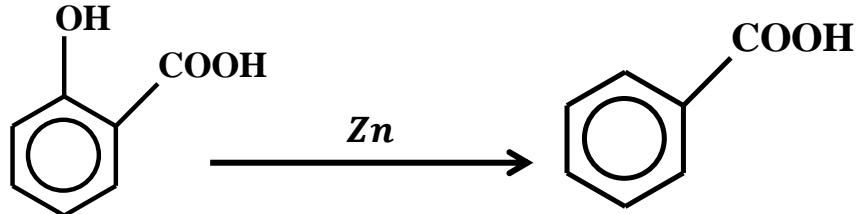
1) Phenol

 2) Benzoic acid

3) Benzaldehyde

4) A polymeric compound

Solution :



### 23. Phenol is

- 1) A base weaker than ammonia
- 2) An acid stronger than carbonic acid
-  3) An acid weaker than carbonic acid
- 4) A neutral compound

24. Phenol is less acidic than

✓ 1) p-nitrophenol

2) ethanol

3) cresol

4) Benzyl alcohol

Solution :

Electron withdrawing groups increase acidic nature of phenols

25. The most acidic compound among the following is

1) Phenol

2) Ethanol

✓ 3,5-dinitrophenol

4) 4-methoxy phenol

Solution :

Electron withdrawing groups increase acidic nature of phenols

**Thank you...**



# PHENOLS

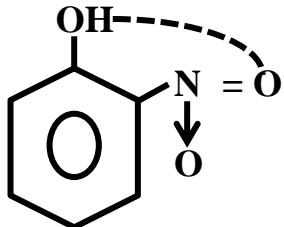
# OBJECTIVES (LEVEL - II)

1. Which of the following is most volatile?

- 1) p-nitrophenol    2) m-nitrophenol     3) o-nitrophenol    4) All of these

Solution :

O- nitro phenol possess intra molecular H-bond



2. Assertion (A) : Phenol is more reactive than benzene towards electrophilic reactions.

Reason (R) : The +R effect of OH group increases the electron density on benzene nucleus.

 Both A and R are true and R is the correct explanation to A

2) Both A and R are true and R is not the correct explanation to A

3) A is true but R is false

4) A is false but R is true



The electrophile involved in the above reaction is

1) Dichloromethyl cation( $\overset{\oplus}{CHCl}_2$ )

 2) Dichlorocarbene ( $:CCl_2$ )

3) Trichloromethyl anion ( $\bar{C}Cl_3$ )

4) Formyl cation( $\overset{\oplus}{CHO}$ )

Solution :



4. Amongst the following phenols which is most acidic

 1) Picric acid

2) 2-Nitrophenol

3) 2,4 - Dinitrophenol

4) m-nitrophenol

Solution :

Electron withdrawing groups increases acidic nature of phenols

5. The lowest pK<sub>a</sub> is that of

- 1) ethanol
- 2) propanol
- 3) propane
- 4) phenol

Solution :

$$P k_a \propto \frac{1}{\text{acidic nature}}$$

6. Assertion (A) : Phenols are more acidic than aliphatic alcohols.

Reason (R) : Phenoxides are stabilized by resonance.

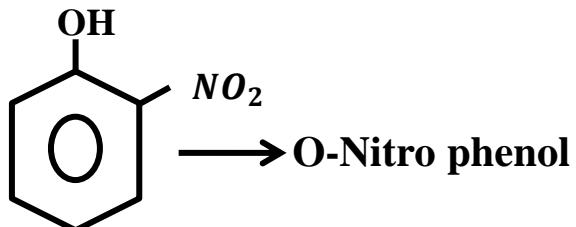
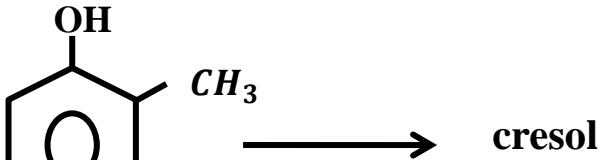
- 1) Both A and R are true and R is the correct explanation to A
- 2) Both A and R are true and R is not the correct explanation to A
- 3) A is true but R is false
- 4) A is false but R is true

7. Which of the following order is true regarding the acidic nature of phenol?

- 1) Phenol > o – Cresol > o - Nitrophenol
- 2) Phenol > o – Cresol < o - Nitrophenol
- 3) Phenol < o – Cresol < o - Nitrophenol
- 4) Phenol < o – Cresol > o - Nitrophenol

**Solution :**

Electron withdrawing groups increase acidic nature of phenols  
where as electron releasing groups decrease acidic nature



key : 2

8. The correct acidic order of the following is

- I) Phenol     II) 4-methylphenol     III) 4-nitrophenol

1) I > II > III

 III > I > II

3) II > III > I

4) I > III > II

### 9. In the following compounds

- I) Phenol      II) 4-methylphenol   III) 3-nitrophenol   IV) 4-nitrophenol

The order of acidity is

1) III > IV > I > II

2) I > IV > III > II

3) II > I > III > IV

✓ 4) IV > III > I > II

**Solution :**

Electron withdrawing groups increase acidic nature of phenols  
where as electron releasing groups decrease acidic nature

10. Which of the following statement is not true?

- 1) Phenol is a weak acid
- 2) Phenol is soluble in NaOH



3) Phenol liberates  $\text{CO}_2$  from  $\text{Na}_2\text{CO}_3$  solution

4) Phenol gives violet colouration with neutral  $\text{FeCl}_3$

11. Assertion (A) : p-Nitrophenol is stronger acid than o-nitrophenol.

Reason (R) : Intramolecular hydrogen bonding makes ortho-isomer weaker acid than para-isomer.



- 1) Both A and R are true and R is the correct explanation to A**
- 2) Both A and R are true and R is not the correct explanation to A**
- 3) A is true but R is false**
- 4) A is false but R is true**

**Solution :**

Electron withdrawing groups increase acidic nature of phenols where as electron releasing groups decrease acidic nature



**Thank you...**

**PHENOLS**

# **OBJECTIVES (LEVEL – III)**

1. Phenol gives anisole on reaction with

- 1) Sodium ethoxide
- 2) Sodium methoxide
- ✓ 3) Diazomethane in the presence of HF
- 4) Methanol

Solution :

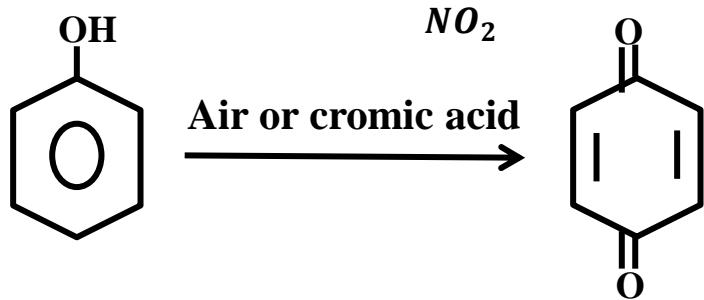


2. Phenol on exposure to air produces a red coloured product known as

-  1) Benzoquinone    2) Hydroquinone    3) Pheno Quine    4) Quinone

Solution :

Phenol undergoes oxidation to give benzoquinone



3. The correct order of relative acidic strength of phenol, ethyl alcohol and water is

- 1) phenol>water>ethyl alcohol
- 2) ethyl alcohol>phenol>water
- 3) water>ethyl alcohol>phenol
- 4) water>phenol>ethyl alcohol

4. Which of the following is most acidic?

- 1) Phenol    2) Benzyl alcohol     3) m-Chlorophenol    4) Cyclohexanol

Solution :

Electron with drawing groups increases acidic nature

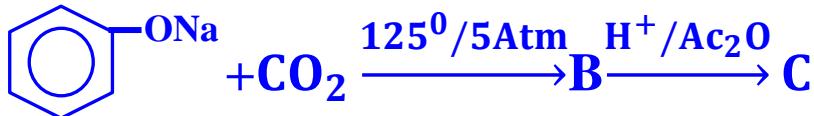
Thank you...



# PHENOLS

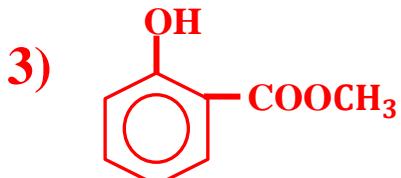
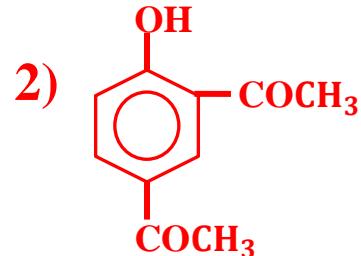
# PREVIUOS COMPETATIVE QUESTIONS

1. Sodium phenoxide when heated with  $\text{CO}_2$  under pressure at  $125^{\circ}\text{C}$  yields a product which on acetylation produces C.

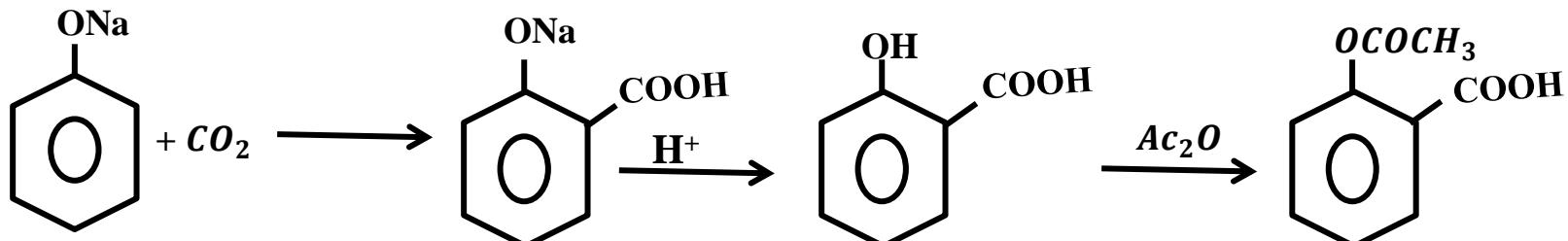


[JEE MAINS-2014]

The major product C would be :



Solution :



Key : 1

2. Pthalic acid reacts with resorcinol in the presence of concentrated  $\text{H}_2\text{SO}_4$  to give :

J.M.O.L-2014]

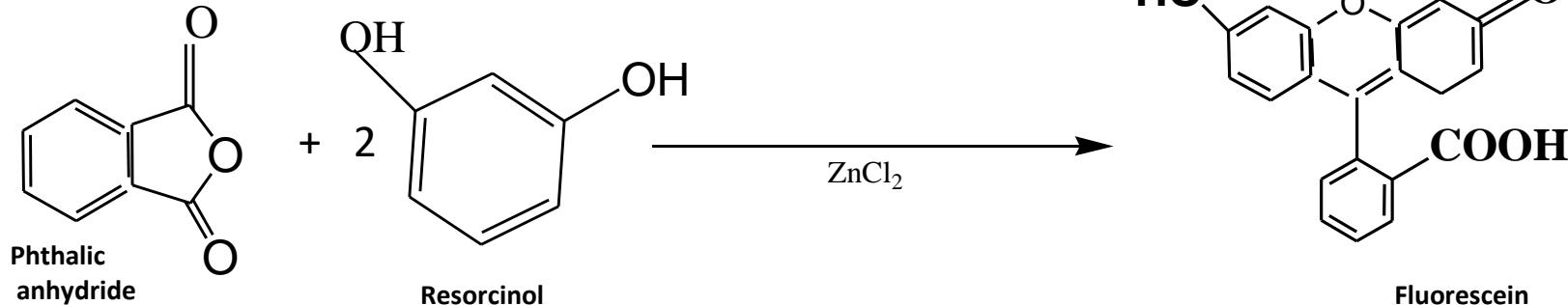
1) Phenolphthalein

2) Alizarin

3) Coumarine

✓ 4) Fluorescein

Solution :



3. Which one of the following compounds will not be soluble in sodium bicarbonate?

J.M.O.L-2014]

1) 2,4,6-Trinitrophenol

2) Benzoic acid

 3) o-Nitrophenol

4) Benzene sulphonic acid

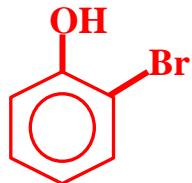
Solution :

Less acidic compounds do not soluble in  $\text{NaHCO}_3$

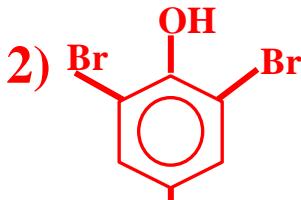
$\therefore$  o – nitro phenol

4. What is the structure of the major product when phenol is treated with bromine water?  
[JEE MAINS ONLINE-2013]

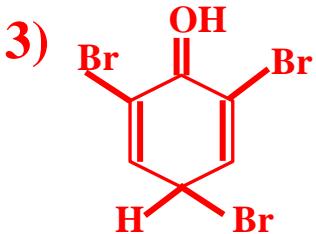
1)



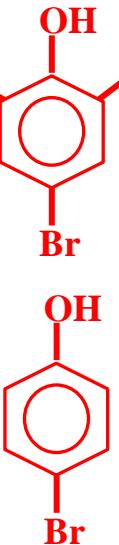
2)



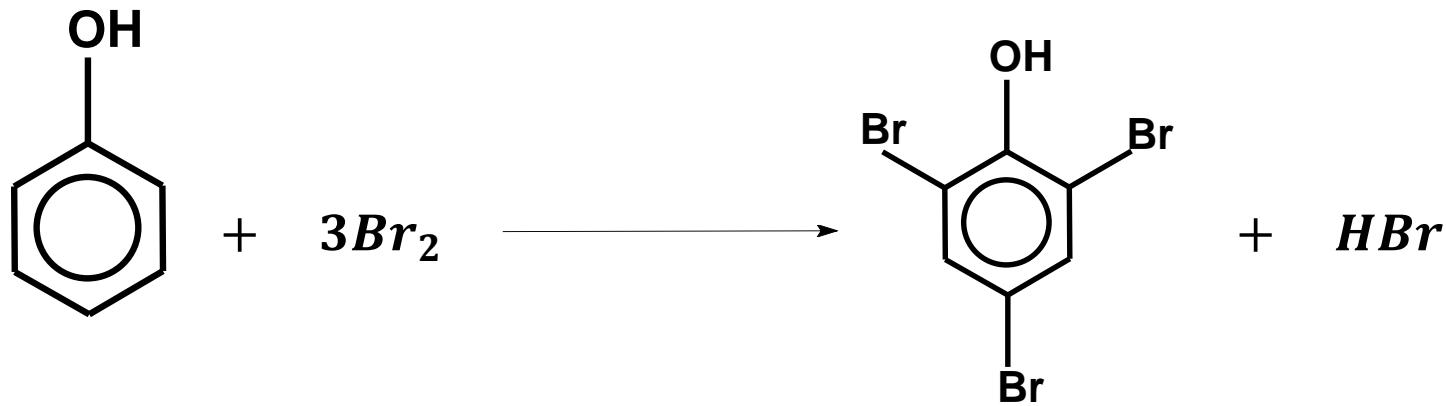
3)



4)



Solution :



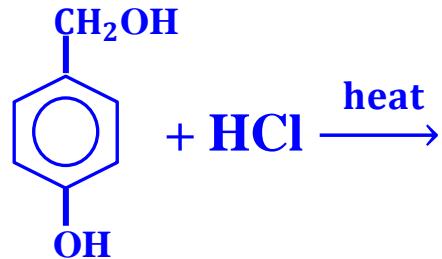
Key : 2

5. The reaction of phenol with benzoyl chloride to give phenyl benzoate is known as

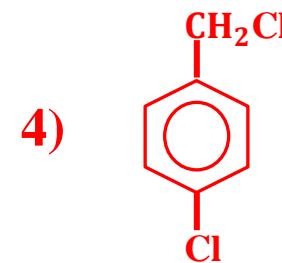
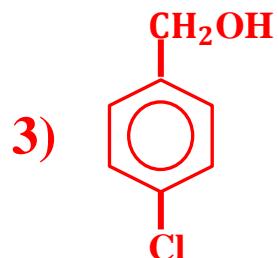
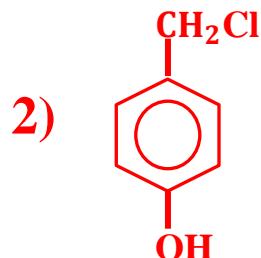
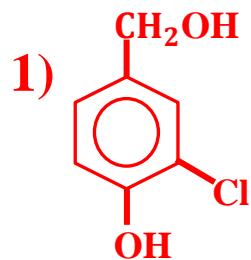
[JEE MAINS ONLINE-2013]

- 1) Claisen reaction
- 2) Schotten-Baumann reaction
- 3) Reimer-Tiemann reaction
- 4) Gatterman-Koch reaction

## 6. The major product in the following reaction



[JEE MAINS ONLINE-2013]



Solution :



7. Phenol on heating with  $\text{CHCl}_3$  and  $\text{NaOH}$  gives salicylaldehyde. The reaction is called

[JEE MAINS ONLINE-2013]

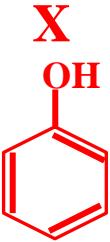
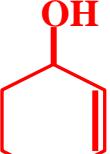
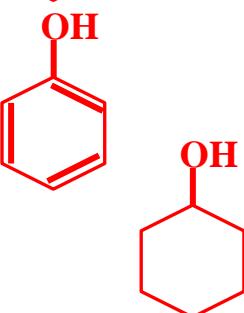
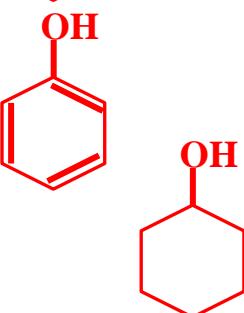
- 1) Reimer-Tiemann reaction
- 2) Claisen reaction
- 3) Cannizzaro's reaction
- 4) Hell-Volhard – Zelinsky reaction

Solution :

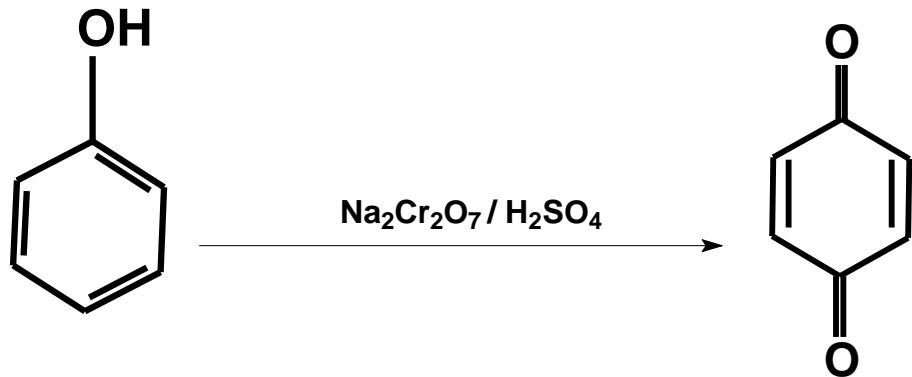
Remier Tiemann reaction.



8.  $X \xrightarrow{Y}$  Benzoquinone. identify X and Y in this reaction :

- 1) 
- 2) 
- 3) 
- 4) 
- Y
- $\text{Na}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4$
- Zn
- Zn

Solution :



Key : 1

9. Arrange the following compounds in order of decreasing acidity:

[JEE MAINS -2013]



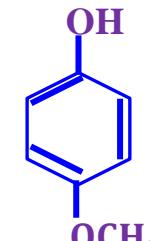
(I)



(II)



(III)



(IV)

1) I>II>III>IV



2) III>I>II>IV

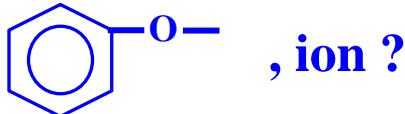
3) IV>III>I>II

4) II>IV>I>III

Solution :

Correct order of acidic strength is III > I > II > IV

10. Which one of the following substituents at para-position is most effective in stabilizing the phenoxide ion?



1)  $-\text{CH}_3$

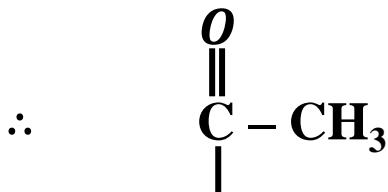
2)  $-\text{OCH}_3$

 3)  $-\text{COCH}_3$

4)  $-\text{CH}_2\text{OH}$

Solution :

Electron withdrawing groups stabilize the phenoxide ion



Stabilizes more

Thank you...

