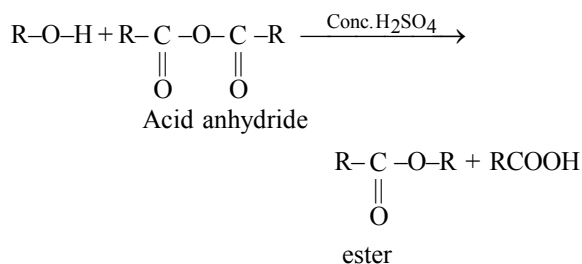
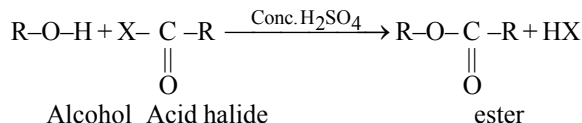


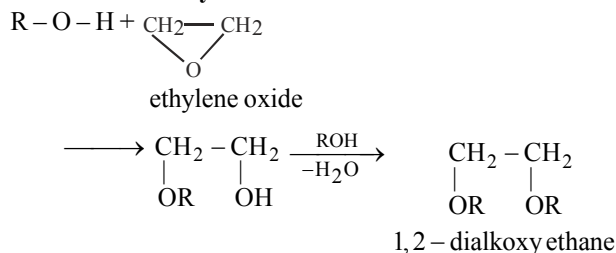




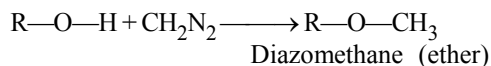
**3 Reaction with Acid derivatives (Acetylation) :**



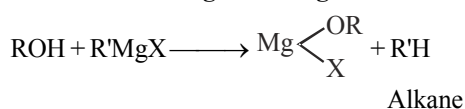
**4. Reaction with ethylene oxide :**



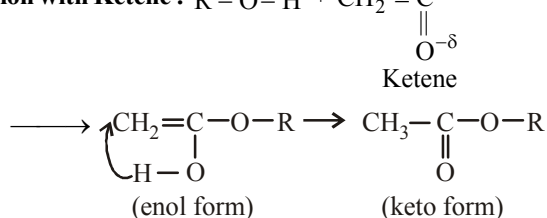
**5. Reaction with Diazomethane :**



**6. Reaction with Grignard Reagent :**



**7. Reaction with Ketene :**  $\text{R}-\overset{\delta-}{\text{O}}-\overset{\delta+}{\text{H}} + \text{CH}_2 = \overset{\delta+}{\text{C}} = \overset{\delta-}{\text{O}}$

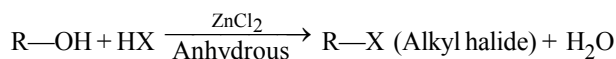


**(B) Reaction involving the cleavage of C-OH bond :**

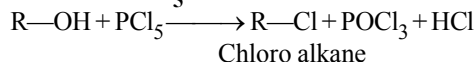
The order of reactivity in this type of reaction is –  
3° alcohol > 2° alcohol > 1° alcohol

**1. Reaction with dry HX (Grove's Process) :**

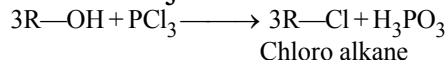
Reactivity order of halogen acid is HI > HBr > HCl



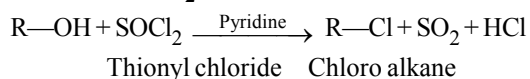
**2. Reaction with PCl<sub>5</sub> :**



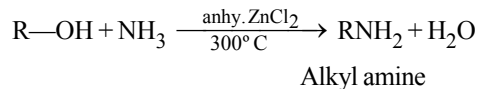
**3. Reaction with PCl<sub>3</sub> :**



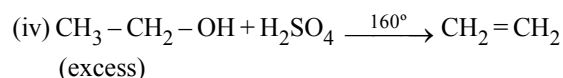
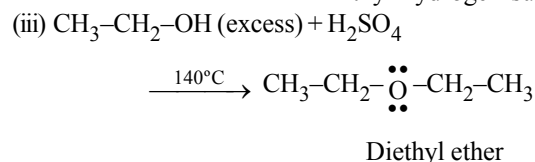
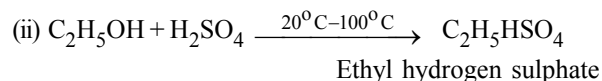
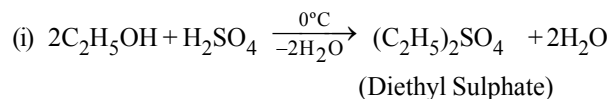
**4. Reaction with SOCl<sub>2</sub> (Darzen reaction) :**



**5. Reaction with ammonia :**



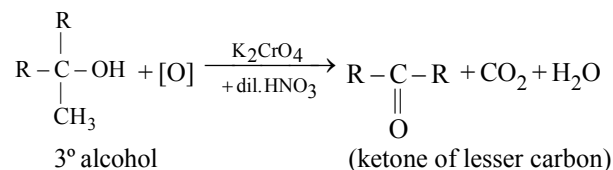
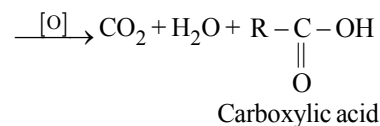
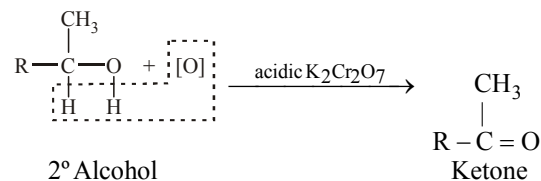
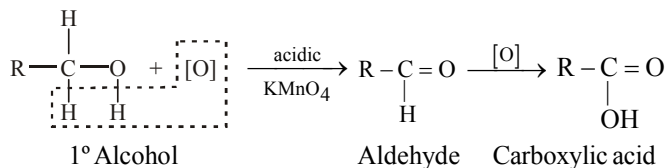
**6. Reaction with H<sub>2</sub>SO<sub>4</sub> :**



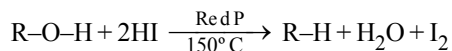
**General reaction of Alcohols**

**1. Oxidation :**

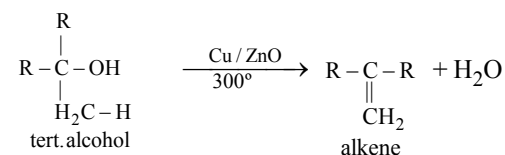
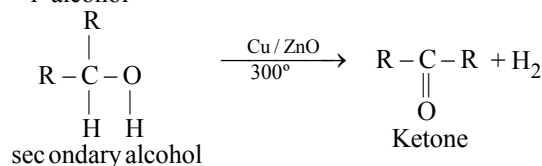
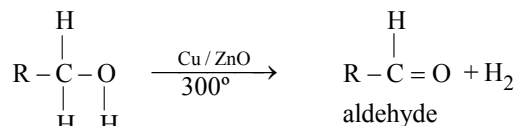
- (i) Primary alcohol initially forms aldehyde on oxidation and on further oxidation forms respective acid.
- (ii) Secondary alcohol initially forms respective ketone on oxidation which on further oxidation forms acid of less carbon. Oxidation of ketone is slightly difficult than aldehyde due to stability so, we use strong oxidising agent for oxidation.
- (iii) Tertiary alcohols are resistant to oxidation in normal conditions but on taking strongest oxidising agent like chromic acid in dilute nitric acid then they form less carbon ketone.
- (iv) For oxidation of 1° alcohol, acidic KMnO<sub>4</sub> is used as oxidant while for 2° alcohol acidic K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> is used.



## 2. Reduction :



## 3. Dehydrogenation :



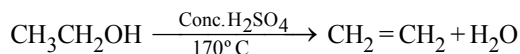
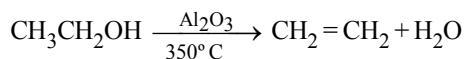
## 4. Dehydration :

The elimination of water from a compound is known as dehydration. The alcohols on dehydration yield alkene.

The order of ease of dehydration is :

Tertiary alcohols > Secondary alcohols > Primary alcohols.

The process of dehydration is done by heating the alcohols with concentrated sulphuric acid or alumina at high temp.



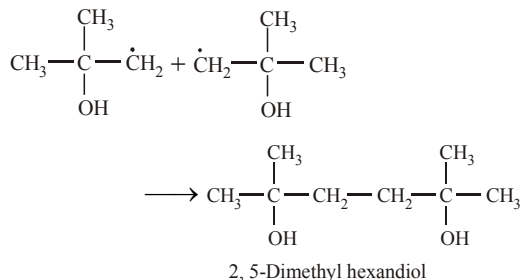
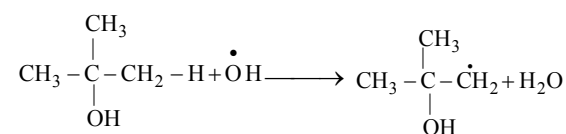
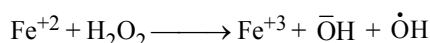
Ethanol

Ethene

## 5. Oxidation through Fenton's Reagent :

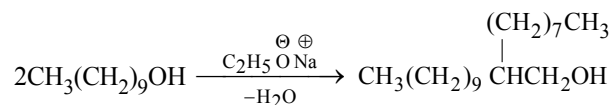
Higher and branched alcohols are converted into diols through Fenton's reagent.

(FeSO<sub>4</sub> + H<sub>2</sub>O<sub>2</sub>) is Fenton's reagent.



## 6. Self Condensation :

When alcohol is heated with sodium ethoxide then by self condensation they convert into higher alcohol.



Higher alcohol

The above reaction is called as "Guerbet's Reaction".

## GENERAL DEFINITIONS

1. Fermentation : In presence of microbes like yeast break down of complex organic compounds into simple compounds is called fermentation. It is an exothermic process.
2. Yeast is unicellular living parasite fungi.
3. Enzymes : Nitrogenous high molecular weight complex compound which converts complex organic compound in simple organic compound without taking part in reactions are called enzymes. They are also called as biocatalyst. They are made of protein.
4. They are sensitive to temperature, concentration and pH.
5. Temperature at which enzymes are maximum efficient is called optimum temperature. For yeast enzyme it is 20–35°C.
6. They always work in dilute solution. They cannot work in conc. solution.
7. Their working pH range is 6.5–7.5 (slightly acidic slightly basic).
8. Food of yeast cell is ammon. phosphate or ammonium sulphate.

## PRIMARY, SECONDARY & TERTIARY ALCOHOL

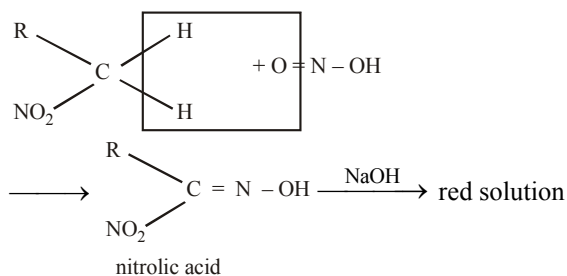
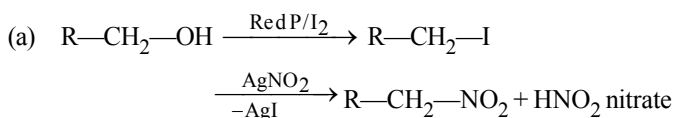
**By Oxidation Reaction :** Primary alcohol gives aldehyde on oxidation, secondary alcohol gives ketone and tertiary alcohols are resistant to oxidation.

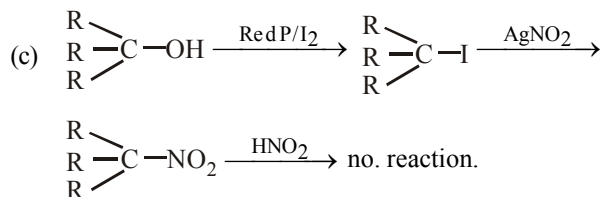
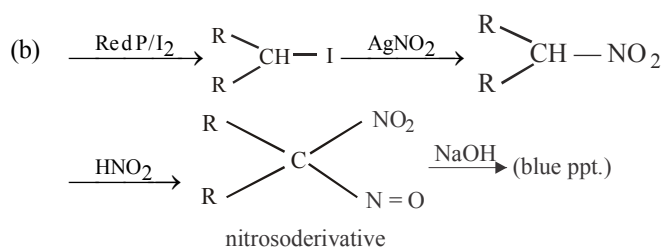
**By Catalytical Oxidation/Dehydrogenation :** Primary alcohol gives aldehyde on oxidation, secondary alcohol gives ketone and tertiary gives alkene (dehydration takes place in this condition to tertiary alcohols)

**Lucas Test :** A mixture of (anhydrous ZnCl<sub>2</sub> + Conc. H<sub>2</sub>SO<sub>4</sub>) is called as Lucas Reagent.

- (i) 3° alcohol gives white ppt. with lucas reagent in 2–3 seconds only.
- (ii) 2° alcohol takes 9–10 minutes.
- (iii) 1° alcohol does not give white ppt. at room temperature.

**Victor Meyer Test :** This test is also known as RBW (Red, Blue, White) test.





**Difference between methanol and Ethanol :**

Methanol	Ethanol
1. When CH <sub>3</sub> OH is heated on Cu coil it gives formalin like smell.	Ethanol does not give formalin like smell.
2. When CH <sub>3</sub> OH is heated with salicylic acid in H <sub>2</sub> SO <sub>4</sub> (conc.) then methyl salicylate is formed which has odour like winter green oil	No such odour is given by ethanol.
3. It does not give haloform or Iodoform test.	It gives haloform test.

**IMPORTANT FACTS**

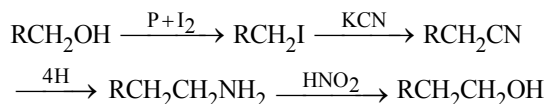
- Rectified spirit — [95.5% ethanol + 4.5% water] (an example of azeotropic solution)
- Absolute alcohol — [100% ethanol]
- Power alcohol — [ethanol + benzene + petrol]
- Methylated spirit — [rectified spirit + 0.5 % methanol]
- Denatured spirit — [rectified spirit + pyridine]
- Wash — [10% to 12% Alcohol]
- Grain spirit — [Ethylalcohol]
- Raw spirit — [90% Alcohol]
- Wood spirit — [Methanol]
- Boiling point of methanol is 65°C and of ethanol is 78.3°C.
- Ternary mixture — Ethanol + Benzene + Water (boiling point 65°C)
- Binary mixture — Benzene + Ethanol (boiling point 68°C)
- Alcoholic beverages :**  

Drink	Brandy	Rum	Gin	Whisky	Beer	Champaign
% of alcohol	40-50	45-55	40-45	40-50	3-6	8-10

**INTERCONVERSIONS**

- (1) **Conversion of lower primary alcohol into higher primary alcohol.**

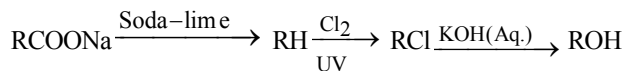
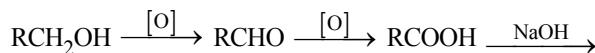
(a) **By cyanide synthesis :**



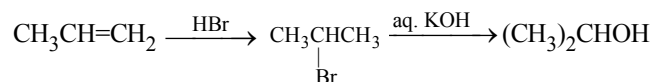
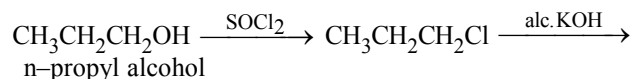
(b) **By Grignard synthesis :**



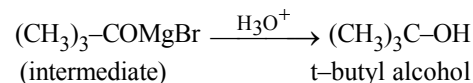
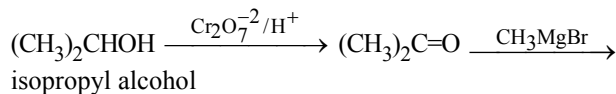
- (2) **Conversion of higher primary alcohol into a lower primary alcohol.**



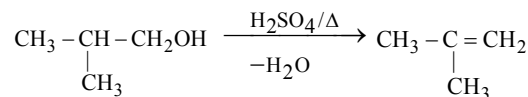
- (3) **Conversion of 1° Alcohol to 2° alcohol :**



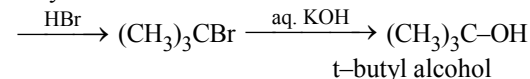
- (4) **Conversion of 2° Alcohol to 3° alcohol :**



- (5) **Conversion of 1° Alcohol to 3° alcohol :**



iso-butyl alcohol

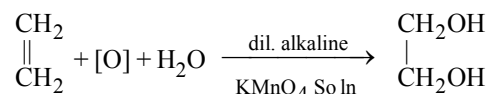


**ETHYLENE GLYCOL [Glycol] :**

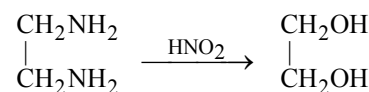
HOCH<sub>2</sub>—CH<sub>2</sub>OH is the simpler dihydric alcohol.

**Preparation :**

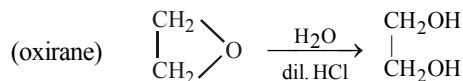
- (1) **From ethylene :**



- (2) **From ethylene diamine :**



- (3) **Industrial Methods :** By Acid hydrolysis of ethylene oxide



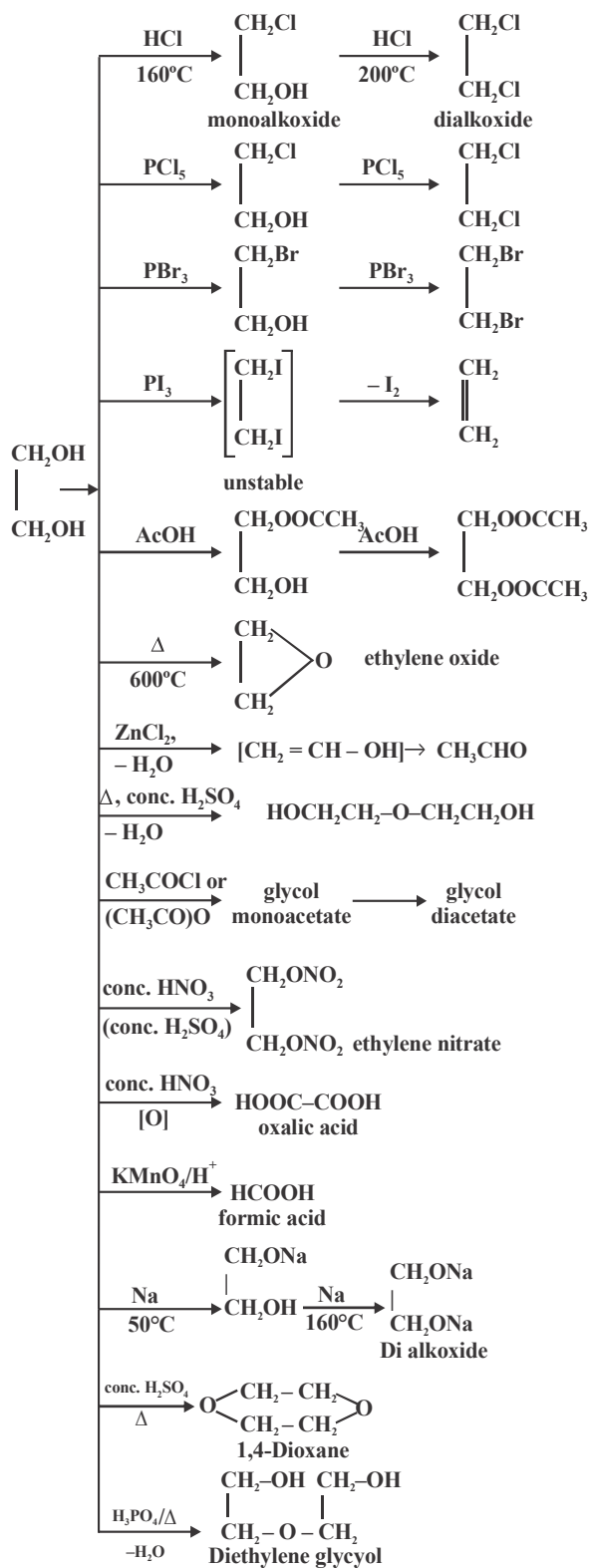
**Properties :**

- \* Colourless, syrupy liquid [b.p. 197° C] (H—bonding)
- \* Soluble in water and ethanol (H—Bonding)
- \* As toxic as methyl alcohol
- \* It contains two primary alcoholic groups.

**Uses :**

- \* Used as anti-freeze for motor car radiation [60% solution (-49°C)]
- \* Used as a solvent and preservative
- \* Used in the manufacture of oxirane
- \* Used as an explosive (glycol dinitrate)

**Chemical properties**

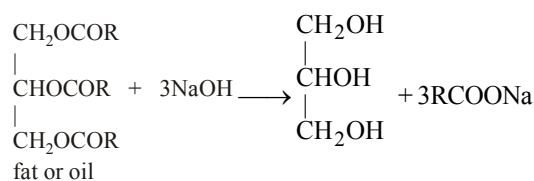


**GLYCEROL OR GLYCERINE OR 1,2,3-PROPANTRIOL**

- \* It is trihydric alcohol. Obtained by replacing three hydrogen atoms from different carbon atoms of propane by three -OH groups.
- \* It contain two primary and one sec. alcoholic group.
- \* It is the most viscous liquid.
- \* It decompose on boiling at its B.P. hence purified by vacuum distillation.
- \* It is found in animal and vegetable fats and oils, which are triesters of glycerol with higher fatty acids.

**PREPARATION**

**From Fat or Oil :** By alkaline hydrolysis

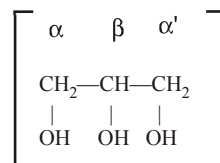


Salts of fatty acids (soap)

Glycerol is obtained as a by product of soap industry

**PROPERTIES**

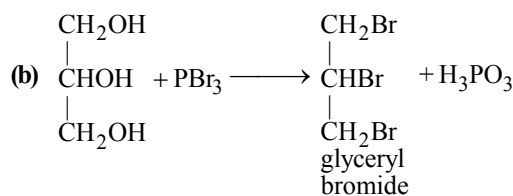
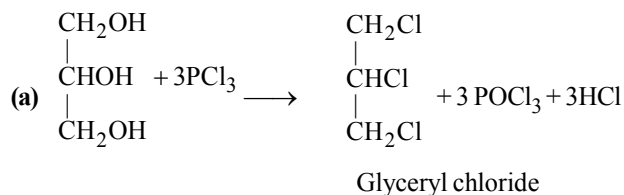
- \* Colourless, odourless, viscous (H-bonding) and hygroscopic liquid
- \* Non-toxic and sweet in taste
- \* High boiling point [290°C] [H-bonding]
- \* Soluble in water due to strong H-bonding.
- \* Glycerol molecule contains two primary (1°) and one secondary (2°) alcoholic groups.

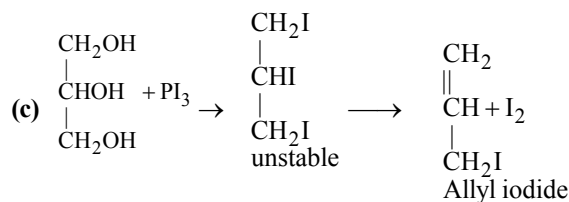


Pr. OH group are more reactive than sec. OH group

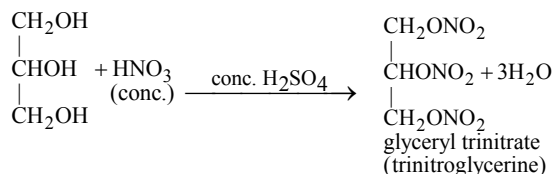
**Reactions :**

(1) **With PCl<sub>5</sub>, PBr<sub>3</sub> and PI<sub>3</sub> :**





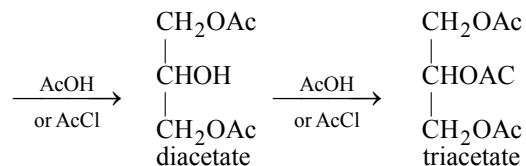
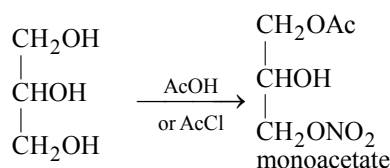
**(2) With HNO<sub>3</sub> : (TNG)**



**Note :**

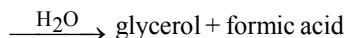
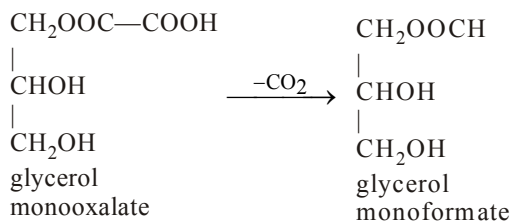
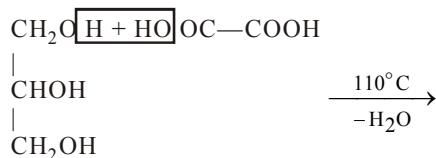
- (i) TNG is an yellow oily, poisonous liquid and causes head ache.
- (ii) TNG explodes violently when heated rapidly.

**(3) With acetic acid or acetyl chloride or acetic anhydride :**  
Glycerol monoacetate, glycerol diacetate and glycerol triacetate are formed.

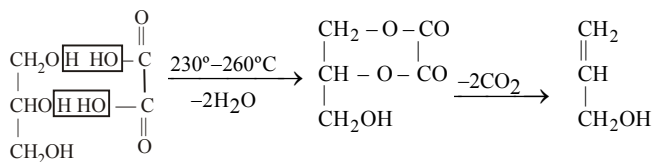


**(4) With Oxalic Acid :**

(a) At 110°C formic acid is formed.

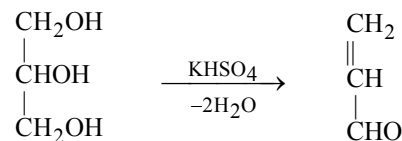


(b) At 230–260°C [Allyl alcohol is formed]



glycerol dioxalate      allyl alcohol

**(5) With KHSO<sub>4</sub> or P<sub>2</sub>O<sub>5</sub> (Dehydration)**



acraldehyde

(α, β-unsaturated aldehyde)

**USES :**

- \* Used in the preparation of non-drying, printing and stamp pad inks.
- \* Used as anti freeze in automobile radiators.
- \* Used in the manufacture of various compounds e.g. formic acid, acrolein etc.
- \* Used in the manufacture of explosives such as dynamite, cordite by the help of TNG.
- \* Used in making bath soaps, hand lotions, vanishing creams etc.
- \* Used in the manufacture of plastic and synthetic fibres.
- \* Used as a sweetening agent in beverages & confectionery.

**TESTS :**

- \* Glycerol + KHSO<sub>4</sub>  $\xrightarrow{\Delta}$  offensive odours of acrolein
- \* 5 ml aqueous Borax solution + (one drop) phenolphthalein makes pink colour solution on adding glycerol pink colour disappears (Dunstan Test).

**TRY IT YOURSELF-1**

**Q.1** Which of the following has the lowest solubility in water?

- (A) CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OH      (B)  $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{CH} - \text{CH}_2\text{OH} \end{array}$
- (C) HOH<sub>2</sub>C-CH<sub>2</sub>OH      (D) C<sub>6</sub>H<sub>5</sub>CH<sub>2</sub>CH<sub>2</sub>OH

**Q.2** Ethanol is heated with concentrated H<sub>2</sub>SO<sub>4</sub>. The product formed is –

- (A)  $\text{CH}_3 - \text{C} - \text{O} - \text{C}_2\text{H}_5$       (B) C<sub>2</sub>H<sub>6</sub>
- ||  
O

(C) C<sub>2</sub>H<sub>4</sub>      (D) C<sub>2</sub>H<sub>2</sub>

**Q.3** LiAlH<sub>4</sub> converts acetic acid into –

- (A) Acetaldehyde      (B) Methane
- (C) Ethyl alcohol      (D) Methyl alcohol

**Q.4** The increasing order of boiling points of 1°, 2°, 3° alcohol is –

- (A) 1° > 2° > 3°      (B) 3° > 2° > 1°
- (C) 2° > 1° > 3°      (D) None

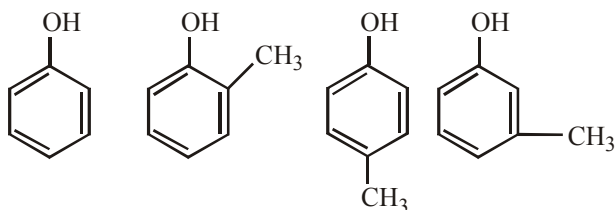
- Q.5** The solubility of lower alcohols in water is due to –  
 (A) Formation of hydrogen bond between alcohol and water molecules.  
 (B) Hydrophobic nature of alcohol.  
 (C) Increases in boiling points  
 (D) None of these
- Q.6** Which of the following reactions of an alcohol does not involve O – H bond breaking –  
 (A) Reaction with alkali metals.  
 (B) Reaction with an acyl chloride.  
 (C) Reaction with sulphonyl chloride.  
 (D) Reaction with conc. sulphuric acid.
- Q.7** When ethyl alcohol reacts with acetic acid, the products formed are –  
 (A) Sodium ethoxide + hydrogen  
 (B) Ethyl acetate + water  
 (C) Ethyl acetate + soap  
 (D) Ethyl alcohol + water
- Q.8** The –OH group of methyl alcohol cannot be replaced by chlorine by the action of –  
 (A) Chlorine  
 (B) Hydrogen chloride  
 (C) Phosphorus trichloride  
 (D) Phosphorus pentachloride
- Q.9** Reaction of alcohol does not show cleavage of R – O linkage  
 (A)  $\text{ROH} + \text{PCl}_5$  (B)  $\text{ROH} + \text{SOCl}_2$   
 (C)  $\text{ROH} + \text{HCl}$  (D)  $\text{ROH} + \text{Na}$
- Q.10** Replacement of –OH group in alcohol by –Cl cannot be carried out with –  
 (A)  $\text{PCl}_5$  (B)  $\text{SO}_2\text{Cl}_2$   
 (C)  $\text{PCl}_3$  (D)  $\text{SOCl}_2$

**ANSWERS**

- (1) (D) (2) (C) (3) (C)  
 (4) (A) (5) (A) (6) (D)  
 (7) (B) (8) (A) (9) (D)  
 (10) (B)

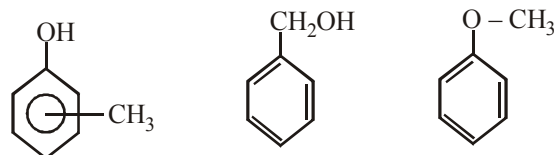
**PHENOLS****INTRODUCTION**

Compounds in which hydroxyl group is directly attached to the benzene nucleus are known as phenols.

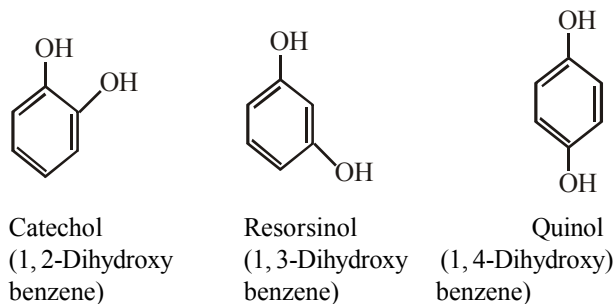


Phenol o-Cresol p-Cresol m-cresol

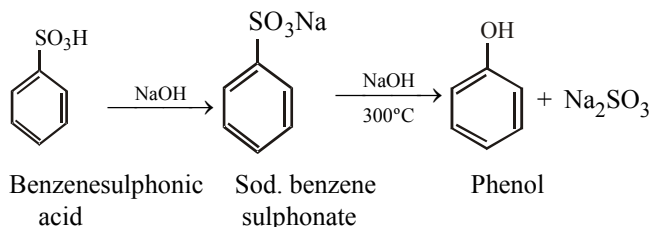
Like other classes of organic compounds, phenols also show isomerism. The three cresols (o-, m-, and p-) are position isomers while benzyl alcohol and anisole ( $\text{C}_7\text{H}_8\text{O}$ ) are functional isomers.



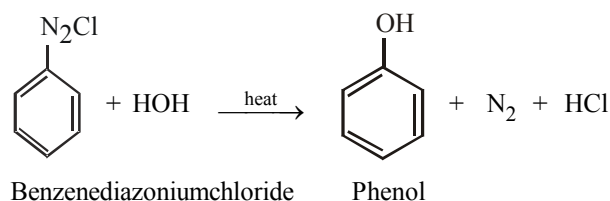
o-, m- and p-Cresols Benzyl alcohol Anisole  
 Similarly, dihydroxybenzene (dihydric phenols) may exist in three isomeric forms.

**METHODS OF PREPARATION**

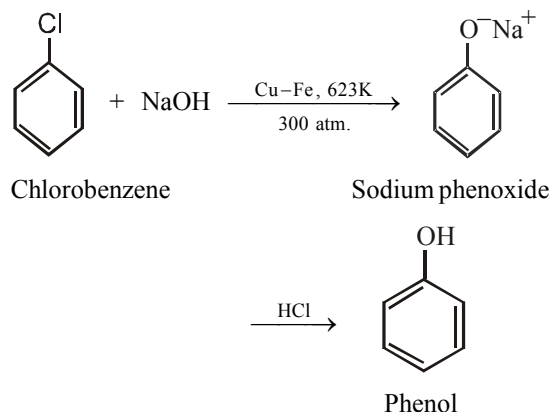
- (i) By fusing the sodium salt of benzenesulphonic acid with NaOH.



- (ii) By adding benzene diazonium chloride to a large volume of boiling dilute  $\text{H}_2\text{SO}_4$ .

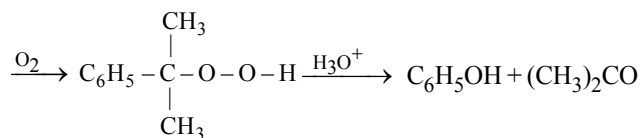
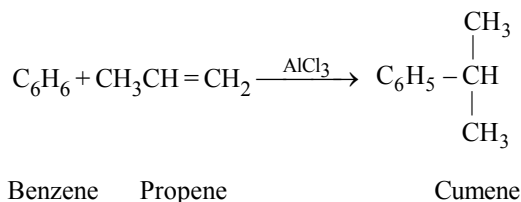


- (iii) By heating chlorobenzene with caustic soda under pressure (**Dow's process**). This is commercial method. The reaction involves nucleophilic substitution.



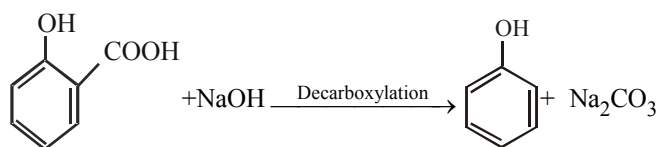


(iv) From cumene hydroperoxide



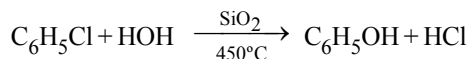
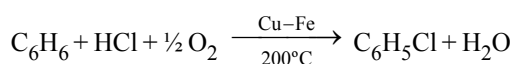
Cumene hydroperoxide      Phenol      Acetone

(v) By distilling a phenolic acid with soda lime.



Salicylic acid

(vi) By Raschig process :



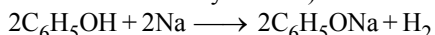
### PHYSICAL PROPERTIES

- (i) Colourless crystalline solid with carbolic smell.
- (ii) m.p. = 40°C    b.p. = 182°C
- (iii) Turns pinkish when exposed in air.
- (iv) Soluble in organic solvent, partially soluble in cold water.

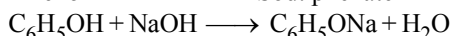
### CHEMICAL PROPERTIES

#### Acidic character (Salt formation) :

Unlike alcohols, phenols are acidic in nature and react with alkali metals and their hydroxides to form salts known as phenoxides or phenates. However, phenols do not react with weak alkalies like carbonates or bicarbonates (difference from carboxylic acids).



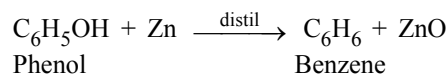
Phenol                                  Sod. phenate



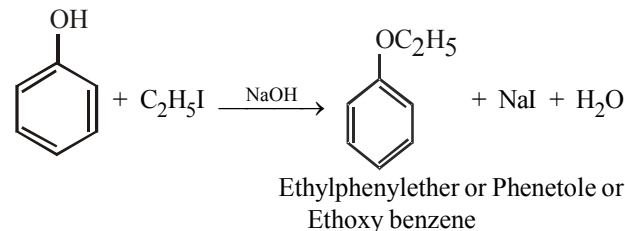
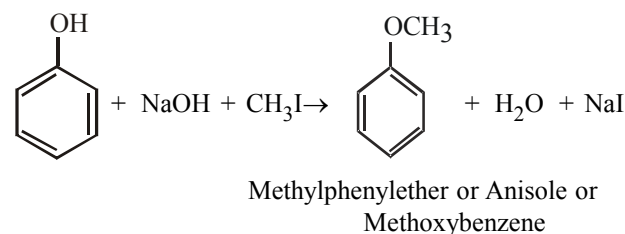
In short, phenols are stronger acids than alcohols but weaker than the carboxylic acids.

#### Reaction of –OH group :

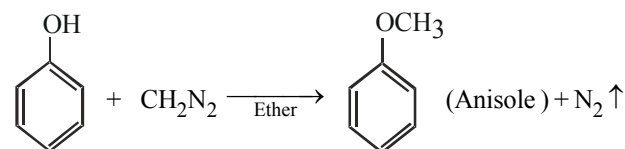
- (i) **Action of ferric chloride :** Unlike alcohols, phenols give characteristic colour with neutral ferric chloride solution. The characteristic colour is believed to be due to the formation of coloured co-ordination compounds. Reaction of phenols with ferric chloride is used in analytic chemistry for distinguishing phenols from carboxylic acids.
- (ii) **Reduction with zinc dust :** Phenols, when distilled with zinc dust, give aromatic hydrocarbon.



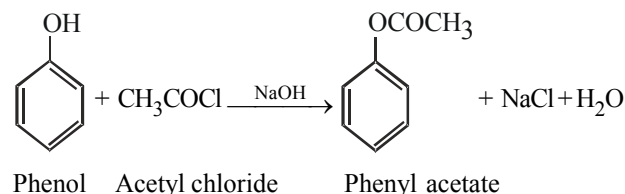
(iii) **Alkylation :** (a) Phenol is alkylated to give Phenolic ethers in the presence of alkali with alkyl halides for example



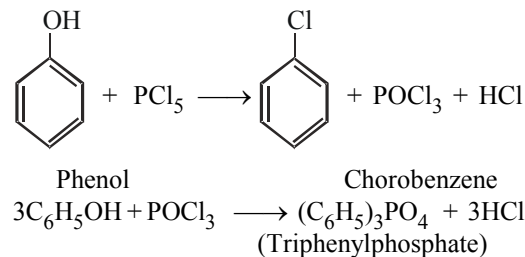
(b) Phenol can be methylated by treatment with diazomethane.



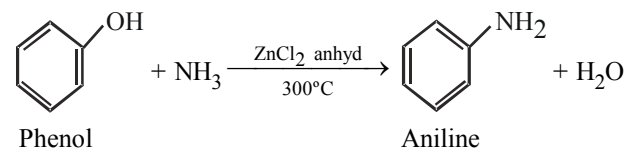
(iv) **Acylation :**



(v) **Reaction with PCl<sub>5</sub> :** Chlorobenzene is formed in low yield and mainly triphenyl phosphate is formed.



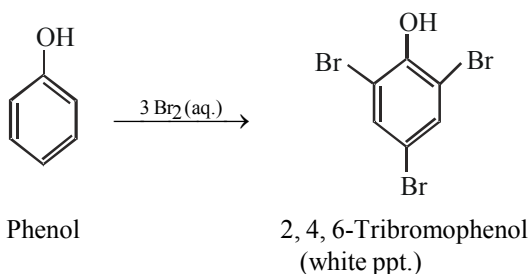
(vi) **Reaction with NH<sub>3</sub> :** Aniline is obtained



#### Reaction of Benzene ring :

The –OH group in phenol, being activating group, facilitates further substitution in the ortho and para positions. In fact, the –OH group is so highly activating that unless precautions are taken, polysubstitution takes place.

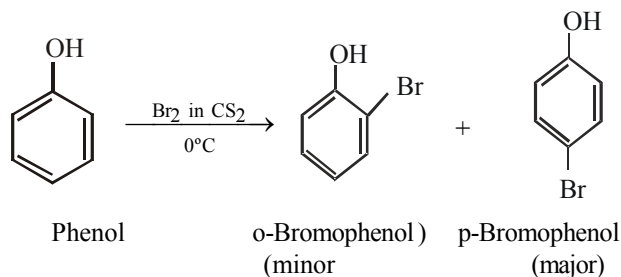
- (i) **Halogenation** : Phenols when treated with aqueous solution of halogens undergo halogenation very rapidly to form polyhalogeno derivatives. For example,



In fact, phenols are so reactive towards bromine water that even substituent like  $-\text{SO}_3\text{H}$ ,  $-\text{NO}_2$ ,  $-\text{COOH}$ , etc. if present, in o- and p-positions, may be replaced by halogens. Polyhalogenation while using water as solvent is because of the fact that water (a highly polar solvent) facilitates the ionisation of phenol to phenoxide ion which is more reactive than phenol towards electrophilic substitution.

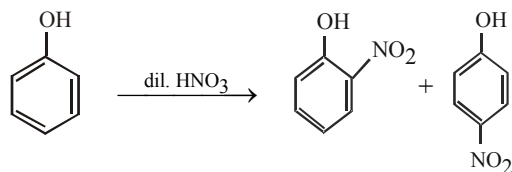
**For preparing monohalogeno derivatives**, halogenation is carried out at low temperature and in non-polar solvents such as carbon tetrachloride or carbon disulphide.

For example,

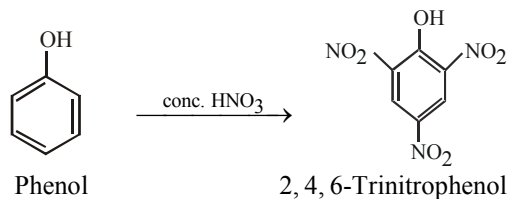


Non-polar solvents ( $\text{CS}_2$ ,  $\text{CCl}_4$ ) decreases the electrophilic character of  $\text{Br}_2$  and minimizes ionization of phenol.

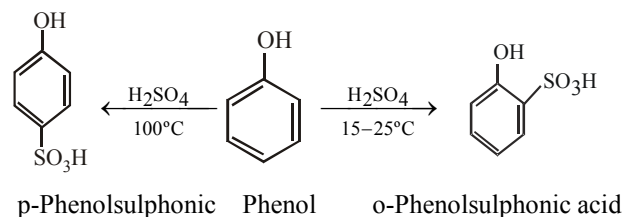
- (ii) **Nitration** : With dilute nitric acid, phenol giving a mixture of o- and p- nitrophenols. The relatively low yields are due to oxidation of phenol by nitric acid. Since o-nitrophenol is more volatile than the para, the two isomers can be separated by steam distillation.



Nitration of phenol with concentrated nitric acid or a nitrating reagent gives 2, 4, 6-trinitrophenol (picric acid). However, the yield is low because of excessive oxidation of phenol.

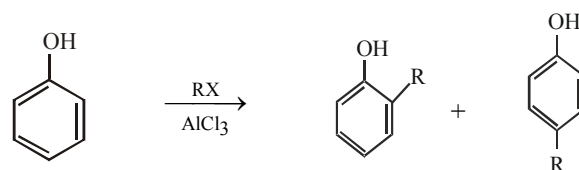


- (iii) **Sulphonation** : Sulphonation of phenols occurs readily giving a mixture of o- and p- isomers; o-isomer predominates at low temperature while p-isomer at high temperatures. Further, the o-isomer can be changed to p-isomer on heating.

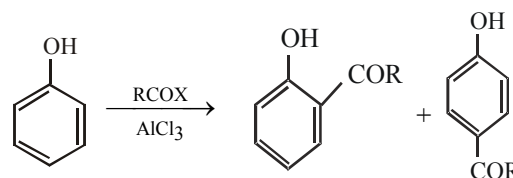


- (iv) **Friedel - Craft reaction** : Phenols undergo Friedel-Craft alkylation and acylation forming predominantly para isomers. However, the yields are poor presumably due to overactivity of phenols.

(a) Alkylation

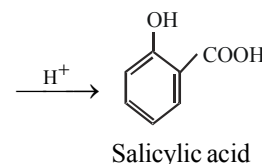
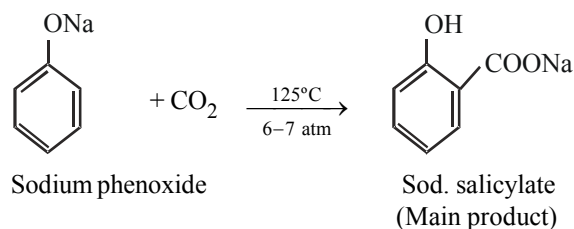


(b) Acylation

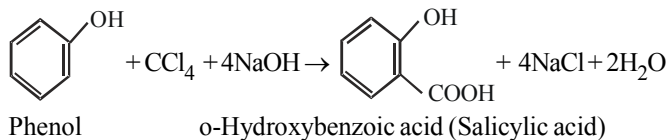
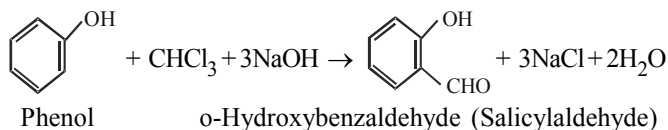


- (v) **Kolbe reaction** :

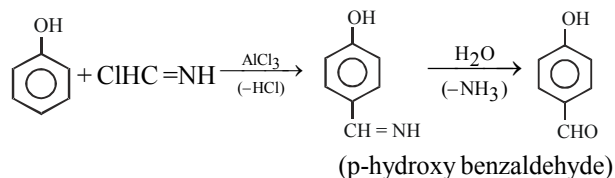
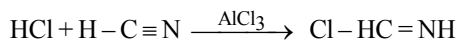
When sodium salt of a phenol is heated with carbon dioxide gas at  $120-140^\circ\text{C}$  under pressure (6-7 atmospheres), a carboxyl group is introduced mainly in the ortho position with respect to the phenolic group to form o-hydroxy benzoates. This reaction is known as **Kolbe reaction**. A small amount of p-isomer is also obtained. However, if the reaction is carried out at high temperature, p-isomer is the main product.



- (vi) **Riemer-Tiemann reaction** : (reaction between phenol and alkaline chloroform or carbon tetrachloride to form salicylaldehyde and salicylic acid respectively).

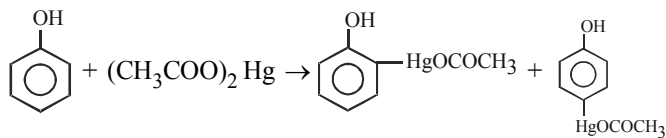


(vii) **Gattermann's reaction** : Phenol when treated with liquid hydrogen cyanide and HCl gas in presence of anhydrous  $\text{AlCl}_3$  yields mainly p-hydroxy benzaldehyde [formylation].



(viii) **Mercuration** :

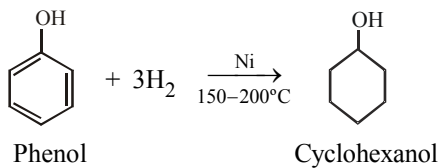
Phenol when heated with mercuric acetate undergoes mercuration to form o- & p-isomers.



o- & p- hydroxy phenyl mercuric acetate

(ix) **Hydrogenation** :

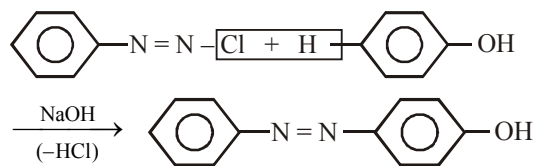
Phenols when hydrogenated in presence of nickel catalyst at about 150–200°C give the corresponding cyclohexanol.



**Miscellaneous Reactions :**

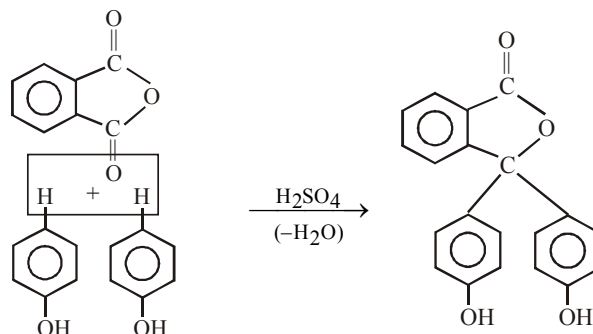
(i) **Coupling reaction** :

Phenol reacts with benzene diazonium chloride in presence of an alkaline solution to form a red dye (p-Hydroxyazobenzene).



(ii) **Phthalein Reaction** :

Phenol reacts with phthalic anhydride in presence of concentrated  $\text{H}_2\text{SO}_4$  to form phenolphthalein.

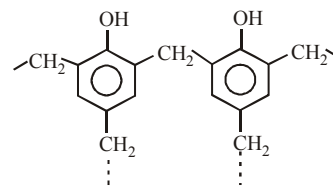
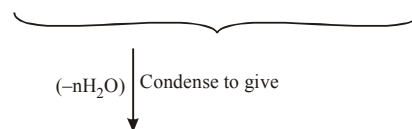
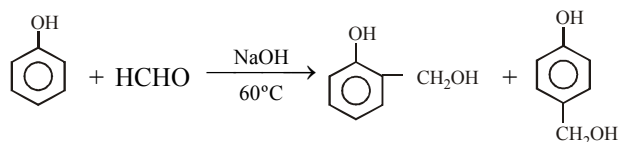


Phenol (2 molecules)

Phenolphthalein (a dye)

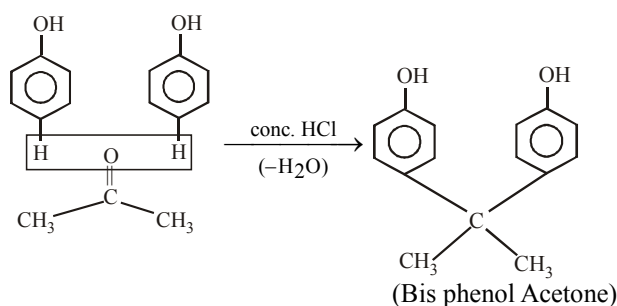
(iii) **Condensation with formaldehyde** :

Phenol reacts with HCHO in weak acidic or alkaline medium to form a mixture of o- and p-Hydroxy benzyl alcohol. The reaction is called Lederer-Manasse reaction. These products further condense to give a cross linked polymer known as bakelite.



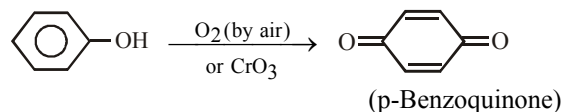
Bakelite (a resin)

(iv) **With Acetone** :

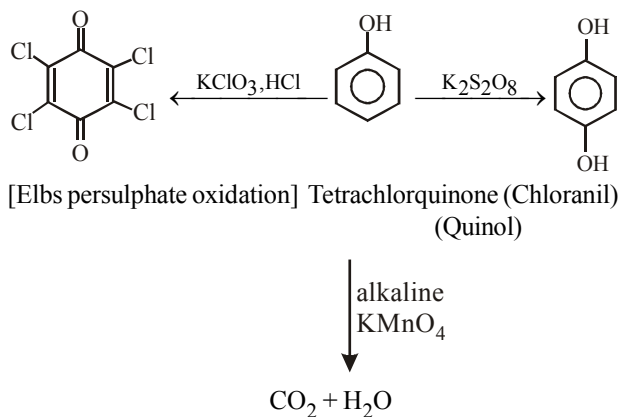


**Oxidation** :

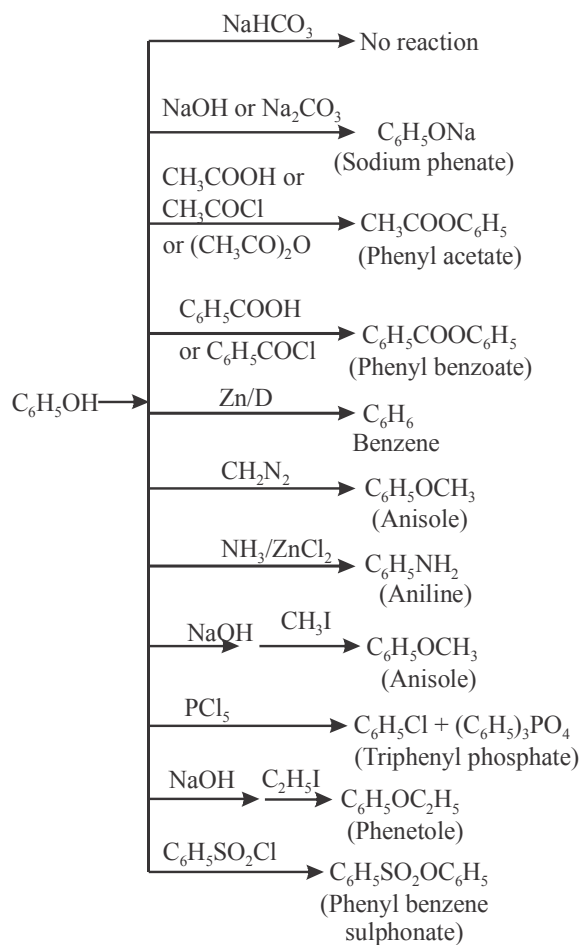
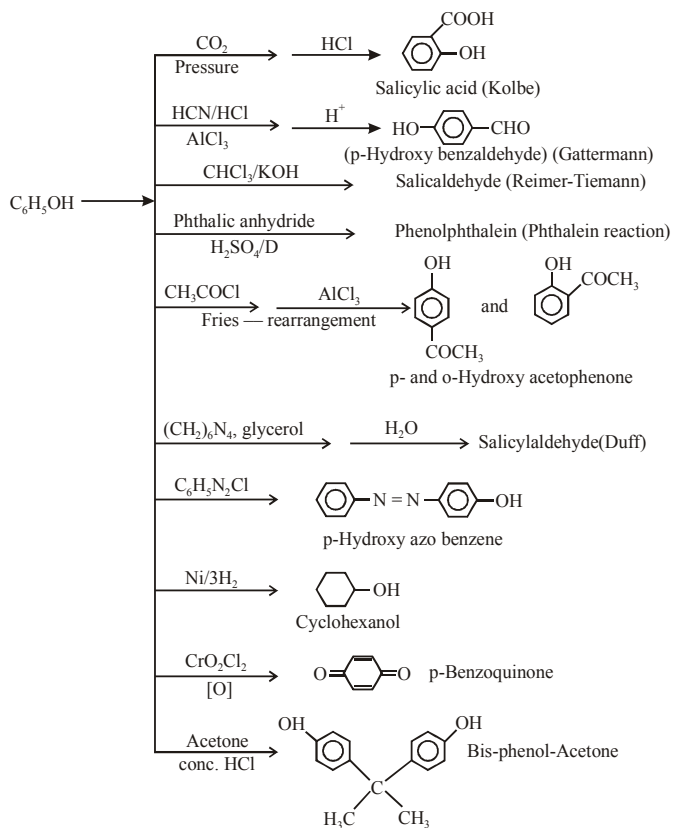
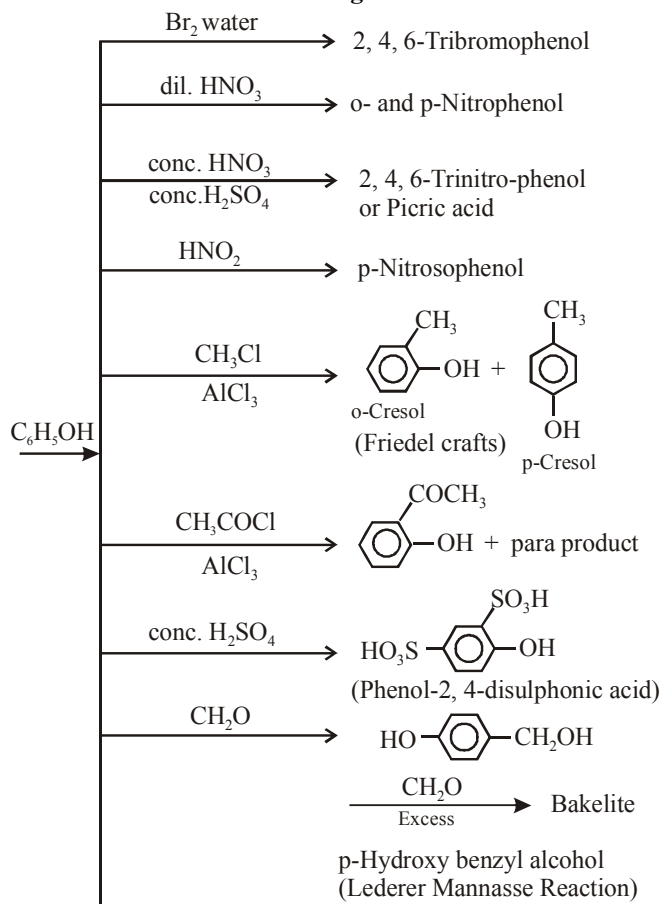
(i) Phenol turns pink or red or brown on exposure to air and light due to slow oxidation. The colour is probably due to the formation of p-benzoquinone.



(ii) Oxidation by other oxidants :



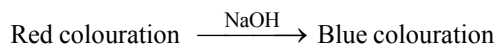
Reactions Of Benzene Ring :



**TESTS**

- (i) Phenol + FeCl<sub>3</sub> [neutral] → Violet colour  
 (ii) Bromine water + phenol → white precipitate  
 (iii) Blue litmus + phenol → red

**Libermann's nitroso test :**

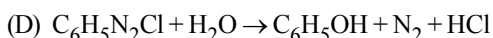
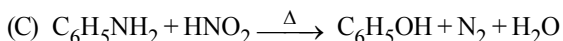
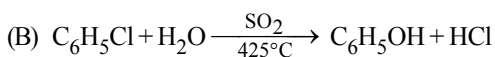
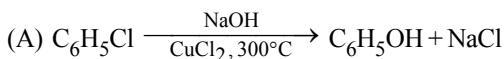


**USES :**

- (i) In the formation of bakelite plastic  
 (ii) Manufacturing of dyes.  
 (iii) In the formation of phenolphthalein.  
 (iv) As antiseptic and germicidal.  
 (v) In the preparation of aspirin, salol, methyl salicylate.  
 (vi) In the manufacturing of picric acid.

**TRY IT YOURSELF-2**

**Q.1** Dow's process used in the industrial preparation of phenol, is



**Q.2** Which of the following is not a phenolic compound –

- (A) Salol (B) o-Cresol  
 (C) Anisole (D) Quinol

**Q.3** Unacceptable name for a compound containing one – OH group attached to benzene nucleus would be –

- (A) Carboic acid (B) Hydroxybenzene  
 (C) Catechol (D) Phenol

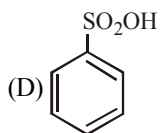
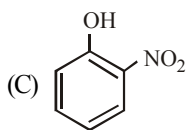
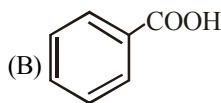
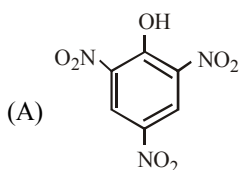
**Q.4** How many π electrons are there in a planar ring of phenol

- (A) 4 (B) 6  
 (C) 8 (D) 10

**Q.5** In phenols –

- (A) – OH group is attached in side chain.  
 (B) – OH group is directly attached to benzene nucleus.  
 (C) Both (A) & (B)  
 (D) None

**Q.6** Which of the following will not be soluble in sodium carbonate solution –



**Q.7** Kolbe's reaction consists in obtaining –

- (A) Anisol from phenol  
 (B) Salicylaldehyde from phenol and CHI<sub>3</sub>  
 (C) Salicylic acid from sodium phenate and CO<sub>2</sub>.  
 (D) Salicylic acid from phenol and CO<sub>2</sub>.

**Q.8** p-Nitrophenol is stronger acid than phenol because nitro group is –

- (A) Electron withdrawing (B) Electron donating  
 (C) Basic (D) Acidic

**Q.9** The product obtained by the reaction of phenol with benzene diazonium chloride is –

- (A) Phenyl hydroxyl amine (B) Para amino azobenzene  
 (C) Phenyl hydrazine (D) Parahydroxy azobenzene

**Q.10** Phenol is converted into salicylaldehyde by –

- (A) Etard reaction (B) Kolbe reaction  
 (C) Reimer-Tiemann reaction (D) Cannizzaro reaction

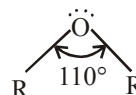
**ANSWERS**

- (1) (A) (2) (C) (3) (B)  
 (4) (C) (5) (B) (6) (C)  
 (7) (C) (8) (A) (9) (D)  
 (10) (C)

**ETHERS**

**GENERAL CHARACTER**

- (a) Ether (R—O—R) is a dialkyl derivative of water or alkoxy derivative of alkane or anhydride of alcohols.  
 (b) General formula is C<sub>n</sub>H<sub>2n+2</sub>O  
 (c) Bond angle is 110° due to counter balance repulsion of alkyl groups. Hybridisation state of oxygen is sp<sup>3</sup>



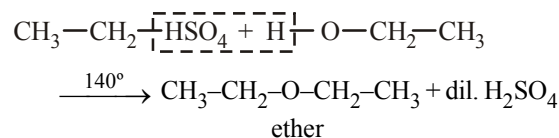
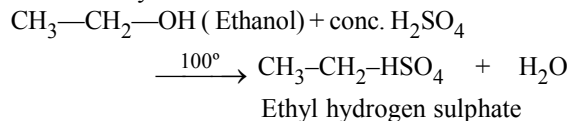
sp<sup>3</sup> Hybridisation

- (d) Carbon oxygen bond length is 1.42 Å.  
 (e) If both alkyl groups are similar then these are called as simple ether (R—O—R) if different they are called as mixed ether [R—O—R'].  
 (f) In IUPAC system ethers are called as "Alkoxy alkane".

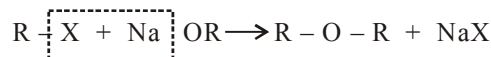
**METHODS OF PREPARATION**

**Williamson's continous Etherification process :**

Excess of ethanol reacts with conc. H<sub>2</sub>SO<sub>4</sub> at 140° C and forms ethoxy ethane.

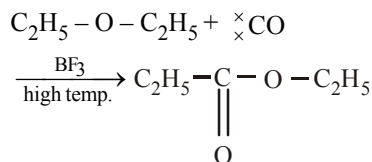


**Williamson Synthesis :** When ethyl halide reacts with sodium ethoxide then ether is formed. Mechanism of the reaction is based on Nucleophilic Substitution.



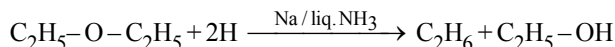


**Reaction with Carbon monoxide (carbonylation) :**



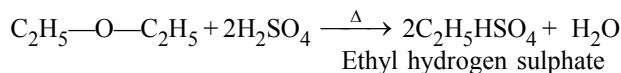
**Note :** In the case of unsymmetrical ether, CO-group attaches with the bigger alkyl group.

**Reduction :**

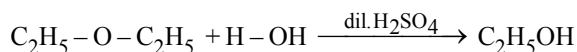


**Reaction with H<sub>2</sub>SO<sub>4</sub> :**

**(a) With conc. H<sub>2</sub>SO<sub>4</sub>**

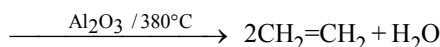
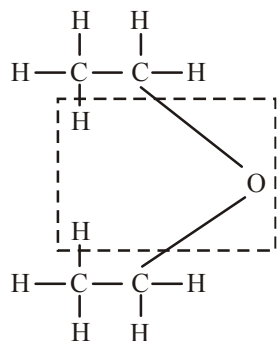


**(b) With dil. H<sub>2</sub>SO<sub>4</sub> :**



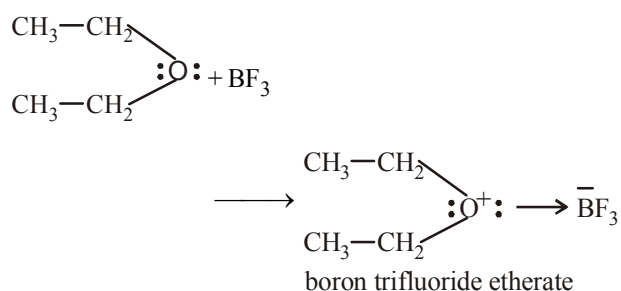
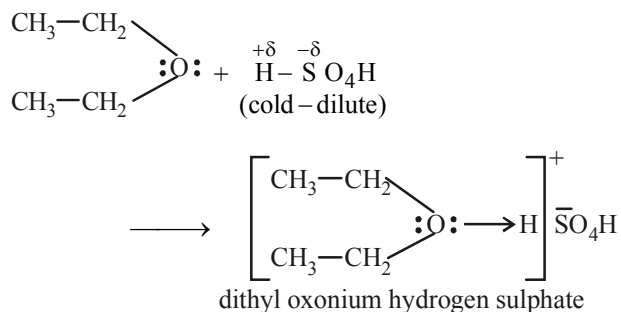
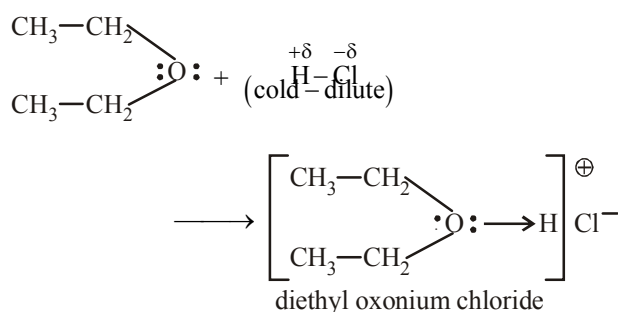
**Dehydration :**

When vapours of ether are passed on 380° C heated alumina then by the elimination of water alkene is formed :

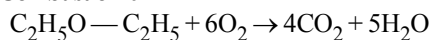


**Preparation of Oxonium Salt :**

Oxygen of ether has lone pair of electron so it can form salt with mineral acid or lewis acid by forming coordinate bond with it. Such type of salt is called Oxonium Salt.

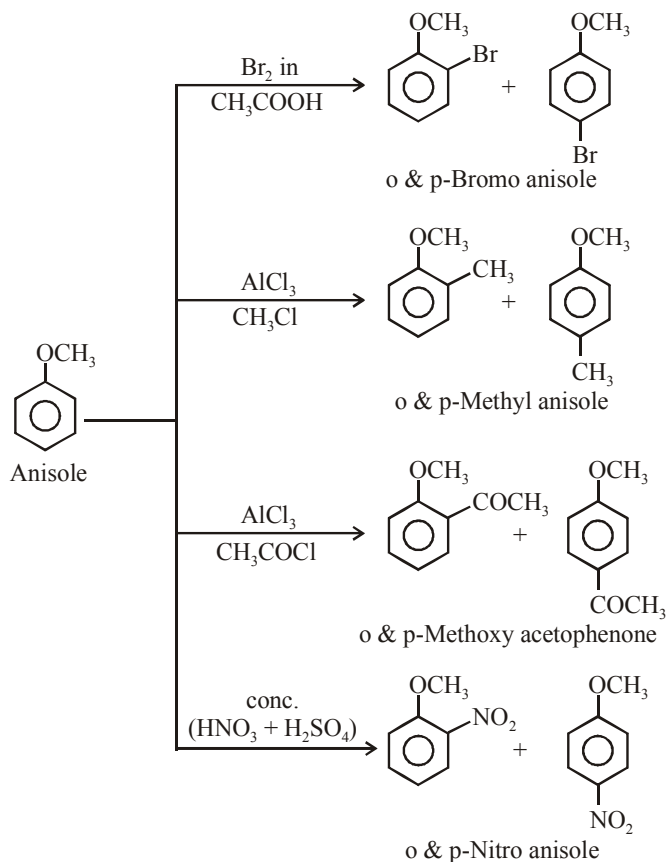


**Combustion %**



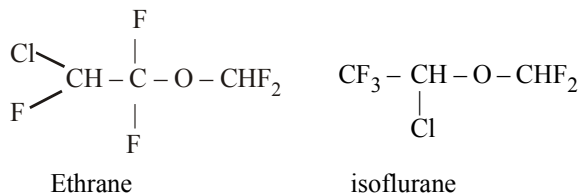
**Electrophilic substitution reactions of Anisole :**

-OCH<sub>3</sub> group is a ortho and para directing group. Some reactions are



## USES

1. Wurtz reaction
2. Alcohol + ether  $\rightarrow$  Nalite  $\frac{1}{4}$  Used in place of petrol  $\frac{1}{2}$
3. Ether is also called as inert solvent of aliphatic chemistry, due to inertness of oxygen.
4. Due to inertness of oxygen, it is best solvent for preparation of highly reactive compounds such as G.R.
5. It is used as an anesthetic. Other compounds such as ethrane and isoflurane also used as an anaesthetic.

**TRY IT YOURSELF-3**

- Q.1** The number of alkanols and ethers represented by the molecular formulae  $\text{C}_3\text{H}_8\text{O}$  and  $\text{C}_4\text{H}_{10}\text{O}$  respectively are given by the set –
- (A) 2, 1 ; 3, 2 (B) 1, 2 ; 2, 3  
(C) 2, 1 ; 4, 3 (D) 2, 1 ; 3, 4
- Q.2** Anhydrides of alcohol are nothing but
- (A) Ethers (B) Aldehydes  
(C) Esters (D) Alkyl anhydrides
- Q.3** In which case the product is neither a cyclic ether nor open chain symmetrical ether –
- (A)  $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_3 \xrightarrow{\text{C}_6\text{H}_5\text{CO}_3\text{H}}$   
(B)  $\text{CH}_3\text{CH}_2\text{ONa} + \text{C}_2\text{H}_5\text{Br} \rightarrow$   
(C)  $\text{KCN} + (\text{CH}_3)_3\text{CBr} \rightarrow$   
(D)  $\text{C}_2\text{H}_5\text{OH} (\text{excess}) + \text{H}_2\text{SO}_4 \xrightarrow{140^\circ\text{C}}$
- Q.4** For making  $(\text{CH}_3)_3\text{C}-\text{O}-\text{C}_2\text{H}_5$  the ideal combination is
- (A)  $(\text{CH}_3)_3\text{CONa}$  &  $\text{C}_2\text{H}_5\text{Br}$  (B)  $(\text{CH}_3)_3\text{CBr}$  &  $\text{C}_2\text{H}_5\text{ONa}$   
(C) Both of these (D) None of these
- Q.5** Diethyl ether acts as a –
- (A) Lewis acid (B) Lewis base  
(C) Reducing agent (D) Oxidising agent
- Q.6** The compound obtained by the reaction of diethyl ether chlorine in the presence of sunlight, is –
- (A) Perchloro diethyl ether  $\text{H}_5\text{C}_2-\text{OC}_2\text{Cl}_5$   
(B) Perchloro diethyl ether  $\text{Cl}_5\text{C}_2-\text{OC}_2\text{Cl}_5$   
(C)  $\beta, \beta'$ -Dichloro diethyl ether  
 $\text{ClCH}_2\text{CH}_2-\text{O}-\text{CH}_2\text{CH}_2\text{Cl}$   
(D)  $\alpha, \alpha'$ -Dichlorodiethylether  
 $\begin{array}{c} \text{CH}_3-\text{CH}-\text{O}-\text{CH}-\text{CH}_3 \\ | \quad | \\ \text{Cl} \quad \text{Cl} \end{array}$
- Q.7** Diethyl ether absorbs oxygen to form –
- (A) Red coloured sweet smelling compound.  
(B) Acetic acid  
(C) Ether suboxide  
(D) Ether peroxide
- Q.8** Ether does not form oxonium salt on reaction with –
- (A) Conc conc.  $\text{H}_2\text{SO}_4$  (B) Cold conc.  $\text{HCl}$   
(C) Conc.  $\text{HI}$  (D) None of the above
- Q.9** Unsymmetrical ethers are best prepared by –
- (A) Williamson's continuous etherification process.  
(B) Reacting Grignard reagent with alkyl halide.  
(C) Treating sodium alkoxides with alkyl bromides.  
(D) Heating an alkanol with conc.  $\text{H}_2\text{SO}_4$ .
- Q.10** The structure of the compound formed by the reaction of diethyl ether with oxygen of air is –
- (A)  $\text{CH}_3\text{CH}_2-\text{O}-\text{O}-\text{CH}_2\text{CH}_3$   
(B)  $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3\text{CH}_2-\text{O}-\text{CH}-\text{O}-\text{O}-\text{H} \end{array}$   
(C)  $\text{CH}_3\text{CH}_2-\text{O}-\text{O}-\text{CH}_2-\text{O}-\text{CH}_3$   
(D)  $\text{CH}_2(\text{OCH}_3)-\text{CH}_2-\text{O}-\text{C}_2\text{H}_5$

**ANSWERS**

- (1) (C) (2) (A) (3) (C)  
(4) (A) (5) (B) (6) (B)  
(7) (D) (8) (C) (9) (C)  
(10) (B)

**ADDITIONAL EXAMPLES****Example 1 :**

Which of the following has the highest value of  $\text{pK}_a$  ?

- (A)  $\text{CH}_3-\text{CH}_2\text{OH}$  (B)  $\text{Cl}-\text{CH}_2-\text{CH}_2\text{OH}$   
(C)  $\text{F}_3\text{C}-\text{CH}_2-\text{OH}$  (D)  $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{CH}-\text{CH}_2\text{OH} \end{array}$

**Sol.** (D). Acidic nature  $\propto \frac{1}{\text{pK}_a - \text{value}}$

Acidity of  $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{CH}-\text{CH}_2\text{OH} \end{array}$  is minimum due to

$\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{CH}-\text{CH}_2\text{OH} \end{array}$   
+I-effect isopropyl group.

**Example 2 :**

Which of the following has the highest boiling point?

- (A)  $\text{CH}_3-\text{CH}_2-\text{CH}-\text{CH}_3$  (B)  $\begin{array}{c} \text{OH} \\ | \\ \text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2\text{OH} \end{array}$

- (C)  $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{CH}-\text{CH}_2\text{OH} \end{array}$  (D)  $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{C}-\text{OH} \\ | \\ \text{CH}_3 \end{array}$

**Sol.** (B). Due to effective hydrogen bonding boiling point of unbranched alcohol is more than branched chain alcohol.



**Example 3 :**

The compound which reacts faster with Lucas reagent at room temperature is –

- (A) butan-1-ol (B) butan-2-ol  
(C) 2-methyl propan-1-ol (D) 2-methyl propan-2-ol

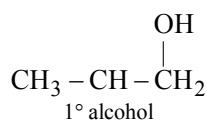
**Sol. (D).** Reactivity order of alcohol with Lucas reagent  
 $3^\circ > 2^\circ > 1^\circ$

**Example 4 :**

The hydroboration oxidation of 2-methyl propene yields

- (A)  $1^\circ$  alcohol (B)  $2^\circ$  alcohol  
(C)  $3^\circ$  alcohol (D) None

**Sol. (A).**  $\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} = \text{CH}_2 \xrightarrow[\text{(ii) H}_2\text{O}_2/\text{NaOH}]{\text{(i) BH}_3\text{-THF/HOH}}$



This is a method of addition of HOH molecule by Anti-Markovnikov's rule.

**Example 5 :**

Which of the following isomeric alcohols have highest melting and boiling points –

- (A) Primary (B) Secondary  
(C) Tertiary (D) All equal

**Sol. (A).** Melting point and boiling point of branched chain alcohols are less than unbranched chain alcohol.

**Example 6 :**

Alkyl chloride is formed when alcohol is treated with HCl in presence of anhydrous  $\text{ZnCl}_2$ . The order of reactivity with respect to alcohol is –

- (A)  $3^\circ > 2^\circ > 1^\circ$  (B)  $1^\circ > 2^\circ > 3^\circ$   
(C)  $2^\circ > 1^\circ > 3^\circ$  (D)  $1^\circ > 3^\circ > 2^\circ$

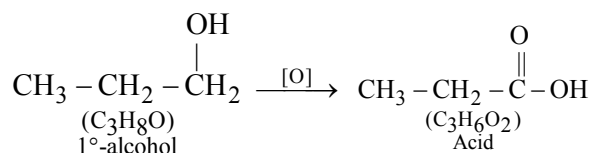
**Sol. (A).** Reactivity order of alcohols with HCl +  $\text{ZnCl}_2$  (Lucas reagent) is  $3^\circ > 2^\circ > 1^\circ$ , because stability of carbocation of alcohol is  $3^\circ > 2^\circ > 1^\circ$ .

**Example 7 :**

A compound X with molecular formula  $\text{C}_3\text{H}_8\text{O}$  can be oxidised to a compound Y with the molecular formula  $\text{C}_3\text{H}_6\text{O}_2$ . X is most likely to be –

- (A) Primary alcohol (B) Secondary alcohol  
(C) Aldehyde (D) Ketone

**Sol. (A).**



**Example 8 :**

Phenol and benzoic acid can be distinguished by –

- (A) Aqueous  $\text{Na}_2\text{CO}_3$  (B) Aqueous  $\text{NaNO}_3$   
(C) Aqueous  $\text{NaOH}$  (D) Conc.  $\text{H}_2\text{SO}_4$

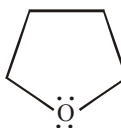
**Sol. (A).** Due to more acidic nature of benzoic acid, benzoic acid show efferevecense due to release of  $\text{CO}_2$  ( $\uparrow$ ) from  $\text{NaHCO}_3$ .

**Example 9 :**

Which of the following is a cyclic ether –

- (A) Ethyl ether (B) Vinty ether  
(C) Phenyl ether (D) Tetrahydrofuran

**Sol. (D).**



Tetrahydrofuran (A cyclic ether of 5 member)

**Example 10 :**

In order to obtain diethyl ether from ethanol, the latter is taken in –

- (A) In equal amount of sulphuric acid  
(B) In slightly lesser amount of sulphuric acid  
(C) In excess amount of sulphuric acid  
(D) In far lesser amount of sulphuric acid

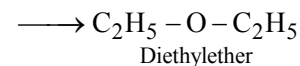
**Sol. (C).**  $\text{CH}_3 - \text{CH}_2 - \text{OH} \xrightarrow[\text{Excess amount}]{\text{H}_2\text{SO}_4/\Delta} \text{CH}_3 - \text{CH}_2 - \text{O} - \text{CH}_2 - \text{CH}_3$

**Example 11 :**

In the Williamson's synthesis for diethyl ether, which species works as a nucleophile –

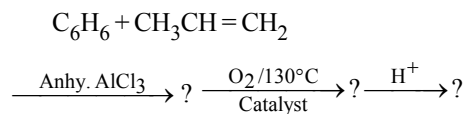
- (A) Halide ion (B) Ethoxide ion  
(C) Ethyde ion (D) Hydride ion

**Sol. (B).**  $\text{CH}_3 - \text{CH}_2 - \text{Br} + \text{NaOC}_2\text{H}_5$   
Sodium ethoxide  
(As-Nucleophile)

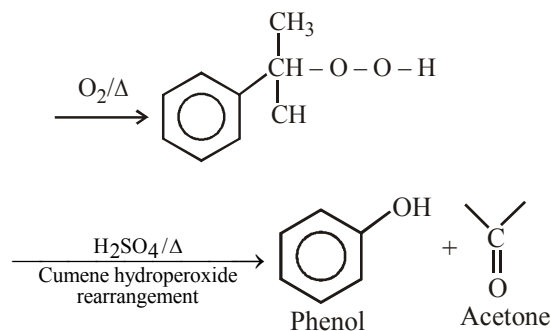
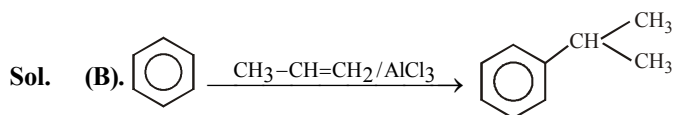


**Example 12 :**

What are the final products of the following sequence of reactions?

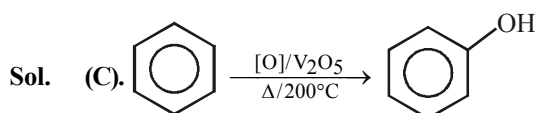


- (A) Cumene and phenol  
 (B) Phenol and acetone  
 (C) Cumene and acetone  
 (D) Benzoic acid and ethane

**Example 13 :**

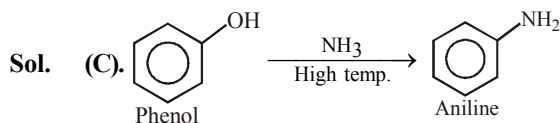
The product of the reaction of benzene with oxygen in the presence of  $\text{V}_2\text{O}_5$  as catalyst at  $200^\circ\text{C}$  is –

- (A) Maleic anhydride                      (B) Benzoic acid  
 (C) Phenol                                      (D) None of these

**Example 14 :**

Phenol on treatment with ammonia gives –

- (A) Benzene                                      (B) Benzoic acid  
 (C) Aniline                                      (D) None

**Example 15 :**

Under suitable conditions  $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$  (A)  $\text{C}_6\text{H}_5\text{OH}$  (B), and  $\text{C}_6\text{H}_5\text{COOH}$  (C) can act as acids. The increasing order of their acidic strength is –

- (A)  $\text{A} < \text{B} < \text{C}$                                       (B)  $\text{A} < \text{C} < \text{B}$   
 (C)  $\text{B} < \text{A} < \text{C}$                                       (D)  $\text{C} < \text{B} < \text{A}$

**Sol. (A).** Acidic nature of  $\text{Ph}-\text{COOH}$  is more than  $\text{Ph}-\text{OH}$  than because the stability of conjugate base of  $\text{Ph}-\text{COOH}$  is more stable than  $\text{Ph}-\text{OH}$  and that  $\text{Ph}-\text{OH}$  is more than benzyl alcohol  $\text{Ph}-\text{CH}_2-\text{OH}$ .

**Example 16 :**

The most suitable method of separation of a 1 : 1 mixture of o- and p-nitrophenol is –

- (A) Sublimation                                      (B) Chromatography  
 (C) Crystallisation                                      (D) Distillation

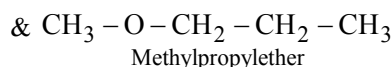
**Sol. (D).** Due to intramolecular hydrogen bond (chelation) boiling point of o-nitrophenol is less than p-nitrophenol. So they can be separated by distillation.

**Example 17 :**

Diethyl ether is metamer of –

- (A) Ethoxyethane                                      (B) Methyl propyl ether  
 (C) Methoxyethane                                      (D) Ethoxymethane

**Sol. (B).**  $\text{CH}_3-\text{CH}_2-\text{O}-\text{CH}_2-\text{CH}_3$   
 Diethylether



Metamers

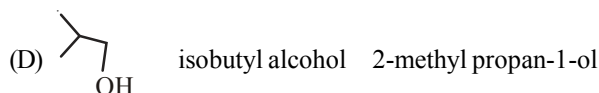
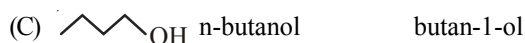
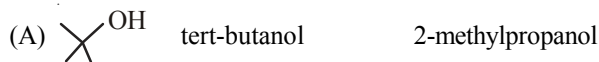
(because alkyl group attached with 'O' in both ether are different).

**Example 18 :**

The correct combination of names for isomeric alcohols with molecular formula  $\text{C}_4\text{H}_{10}\text{O}$  is/are

- (A) Tert-butanol and 2-methylpropan-2-ol.  
 (B) Tert-butanol and 1, 1-dimethylethan-1-ol.  
 (C) n-butanol and butan-1-ol.  
 (D) Isobutyl alcohol and 2-methylpropan-1-ol.

**Sol. (ACD).**                      **Common name**                      **IUPAC name**

**Example 19 :**

The increasing order of boiling points of the alcohols is –

- (I) 1, 2-dihydroxybenzene                      (II) 1, 3-dihydroxybenzene  
 (III) 1, 4-dihydroxybenzene                      (IV) Hydroxybenzene  
 (A)  $\text{I} < \text{II} < \text{IV} < \text{III}$                       (B)  $\text{I} < \text{II} < \text{III} < \text{IV}$   
 (C)  $\text{IV} < \text{II} < \text{I} < \text{III}$                       (D)  $\text{IV} < \text{I} < \text{II} < \text{III}$

**Sol. (D).** Among the given compounds, hydroxybenzene (IV) has least molar mass and therefore possess least boiling point. Among the three isomeric dihydroxybenzenes. 1-2-dihydroxybenzene (I) forms intramolecular H-bonding with the result it will not form intermolecular H-bonding leading to lowest boiling point. On the other hand the 1-4-dihydroxybenzene (III) does not undergo chelation, hence it will involve extensive intermolecular H-bonding leading to highest boiling point. Thus the decreasing order of boiling points is  $\text{III} > \text{II} > \text{I} > \text{IV}$ .

**QUESTION BANK**

**CHAPTER 10 : ALCOHOLS, PHENOLS AND ETHERS**

**EXERCISE - 1 [LEVEL-1]**

Choose one correct response for each question.

**PART - 1 : CLASSIFICATION AND NOMENCLATURE**

- Q.1** Wood spirit is known as –  
 (A) Methanol (B) Ethanol  
 (C) Acetone (D) Benzene
- Q.2**  $\text{CH}_3\text{OC}_2\text{H}_5$  is/are known as  
 (A) ethyl methyl ether (B) methylethyl ether  
 (C) Both (A) and (B) (D) None of these
- Q.3** IUPAC name of m-cresol is  
 (A) 3-methylphenol (B) 3-chlorophenol  
 (C) 3-methoxyphenol (D) benzene-1,3-diol
- Q.4** Alcohols and phenols are classified as  
 I. monohydric II. dihydric  
 III. trihydric IV. polyhydric  
 Select an appropriate option with correct choices  
 (A) I and II (B) II and III  
 (C) III, IV and I (D) I, II, III and IV
- Q.5** IUPAC name of  $\text{CH}_3\text{CH}_2\text{CH}_2\underset{\text{CH}_2\text{OH}}{\text{CH}}-\text{CH}_2\text{CH}_3$  is –  
 (A) 3-propylbutan-1-ol  
 (B) 2-ethylpentan-1-ol  
 (C) 3-methyl hydroxyhexane  
 (D) 2-ethyl-2-propyl ethanol
- Q.6** Which is primary alcohol ?  
 (A) Butan-2-ol (B) Butan-1-ol  
 (C) Propan-2-ol (D) Isopropyl alcohol
- Q.7** Which of the following alcohol contains  $\text{C}_{\text{sp}^3} - \text{OH}$  bond ?  
 (A) Allylic alcohol (B) Vinylic alcohol  
 (C) Phenols (D) None of these
- Q.8** Give IUPAC name of the compound given :  
 $\text{CH}_3 - \underset{\text{Cl}}{\text{CH}} - \text{CH}_2 - \text{CH}_2 - \underset{\text{OH}}{\text{CH}} - \text{CH}_3$   
 (A) 2-Chloro-5-hydroxyhexane  
 (B) 2-Hydroxy-5-chlorohexane  
 (C) 5-Chlorohexan-2-ol  
 (D) 2-Chlorohexan-5-ol
- Q.9** Select the incorrect match from the following options.  
 (A) Butan-2-ol  $\rightarrow$  sec-butyl alcohol  
 (B)  $\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_2\text{OH} \rightarrow$  isobutyl alcohol  
 (C)  $\text{CH}_2 - \underset{\text{OH}}{\text{CH}} - \underset{\text{OH}}{\text{CH}} - \underset{\text{OH}}{\text{CH}_2} \rightarrow$  glycerol  
 (D) 2-methylpropan-2-ol  $\rightarrow$  isobutyl alcohol

**PART - 2 : STRUCTURES OF FUNCTIONAL GROUPS**

- Q.10** The C–O–C angle in ether is about  
 (A)  $180^\circ$  (B)  $190^\circ 28'$   
 (C)  $110^\circ$  (D)  $105^\circ$
- Q.11** In alcohols, the oxygen of the OH group is attached to a carbon by a \_\_\_\_\_ bond formed by the overlap of a \_\_\_\_\_ hybridised orbital of carbon with a  $\text{sp}^3$  hybridised orbital of oxygen.  
 (A) sigma;  $\text{sp}^2$  (B) sigma;  $\text{sp}^3$   
 (C)  $\pi$ ;  $\text{sp}^2$  (D)  $\pi$ ;  $\text{sp}^3$
- Q.12** The C–O–H bond angle in alcohols is slightly less than the tetrahedral angles whereas the C–O–C bond angle in ether is slightly greater because  
 (A) Of repulsion between the two bulky R groups  
 (B) O atom in both alcohols and ether is  $\text{sp}^3$ , hybridised  
 (C) Lone pair - lone pair repulsion is greater than bond pair bond pair repulsion  
 (D) None of these
- Q.13** In ethers, the two bond pairs and two lone pairs of electrons on oxygen are arranged in a  
 (A) planar arrangement  
 (B) tetrahedral arrangement  
 (C) trigonal bipyramidal arrangement  
 (D) linear arrangement



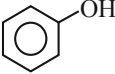
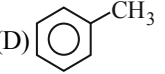
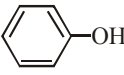
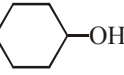
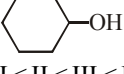
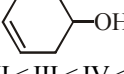
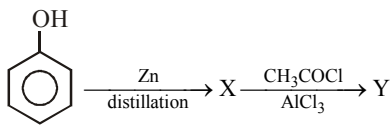
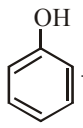
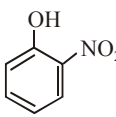
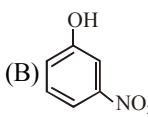
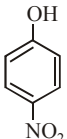
**PART - 3 : PREPARATION OF ALCOHOLS**

- Q.14** Ethyl alcohol is industrially prepared from ethylene by  
 (A) Permanganate oxidation  
 (B) Catalytic reduction  
 (C) Absorbing in  $\text{H}_2\text{SO}_4$  followed by hydrolysis  
 (D) Fermentation
- Q.15** Action of nitrous acid with ethylamine produces  
 (A) Ethane (B) Ammonia  
 (C) Ethyl alcohol (D) Nitroethane
- Q.16** In the commercial manufacture of ethyl alcohol from starchy substances by fermentation method, which enzymes stepwise complete the fermentation reaction –  
 (A) Diastase, maltase and zymase  
 (B) Maltase, zymase and invertase  
 (C) Diastase, zymase and lactase  
 (D) Diastase, invertase and zymase
- Q.17** Commercially methanol is prepared by  
 (A) Reduction of CO in presence of  $\text{ZnO} \cdot \text{Cr}_2\text{O}_3$   
 (B) Methane reacts with water vapours at  $900^\circ\text{C}$  in presence of Ni catalyst  
 (C) Reduction of HCHO by  $\text{LiAlH}_4$   
 (D) Reduction of HCHO by aqueous NaOH
- Q.18** Tertiary butyl alcohol can be prepared by the reaction of  
 (A) Acetaldehyde and ethyl magnesium iodide  
 (B) Acetone and methyl magnesium iodide  
 (C) Formaldehyde and propyl magnesium iodide  
 (D) Butanone and methyl magnesium iodide

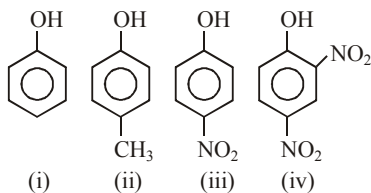
- Q.19** Which of the following statement(s) is/are correct about hydroboration-oxidation?
- (A) Diborane reacts with alkenes to give trialkyl boranes as addition product which is oxidised to alcohol by  $\text{H}_2\text{O}_2$  in the presence of aqueous NaOH.  
 (B) The alcohol so formed by the addition of water to the alkene by the Markownikoff's rule  
 (C) Alcohol is obtained in the poor yield.  
 (D) All of the above.
- Q.20** Alkenes react with water in the presence of acid as catalyst to form alcohols.
- $$\text{CH}_3\text{CH}=\text{CH}_2 + \text{H}_2\text{O} \xrightleftharpoons{\text{H}^+} \text{CH}_3-\underset{\text{OH}}{\text{CH}}-\text{CH}_3$$
- The reaction takes place in accordance with
- (A) Hofmann elimination rule  
 (B) Saytzeff rule  
 (C) Markownikoff's rule  
 (D) Anti-Markownikoff's addition
- Q.21** Which of the following compounds on reaction with  $\text{CH}_3\text{MgBr}$  will give a tertiary alcohol?
- (A)  $\text{C}_6\text{H}_5\text{CHO}$  (B)  $\text{C}_2\text{H}_5\text{COOCH}_3$   
 (C)  $\text{C}_2\text{H}_5\text{COOH}$  (D)  $\text{CH}_3\text{CH}(\text{O})\text{CH}_3$
- Q.22** One mole of ethyl acetate on treatment with an excess of  $\text{LiAlH}_4$  in dry ether and subsequent acidification produces
- (A) 1 mol acetic acid + 1 mol ethyl alcohol  
 (B) 1 mol ethyl alcohol + 1 mol methyl alcohol  
 (C) 2 moles of ethyl alcohol  
 (D) 1 mol of 2-butanol
- Q.23** The mechanism of the reaction (acid catalysed hydration of alkene) involves the following three steps.
- I. Nucleophilic attack of water on carbocation.  
 II. Protonation of an alkene to form carbocation by the electrophilic attack of  $\text{H}_3\text{O}^+$ .  
 III. Deprotonation to form an alcohol.
- Identify the sequence for the mechanism of reaction in the acid catalysed hydration of alkenes.
- (A) I, II and III (B) II, I and III  
 (C) III, I and II (D) III, II and I
- PART - 4 : PHYSICAL AND CHEMICAL PROPERTIES OF ALCOHOLS**
- Q.24** Which statement is not correct about alcohol
- (A) Alcohol is lighter than water.  
 (B) Alcohol evaporates quickly.  
 (C) Alcohol of less number of carbon atoms is less soluble in water than alcohol of high number of carbon atoms.  
 (D) All of these
- Q.25** Dehydration of ethanol gives
- (A) Acetic acid (B) Ethane  
 (C) Ethylene (D) Acetylene
- Q.26** Alcohols of low molecular weight are
- (A) Soluble in water  
 (B) Soluble in all solvents  
 (C) Insoluble in all solvents  
 (D) Soluble in water on heating
- Q.27** Ethyl alcohol on oxidation with  $\text{K}_2\text{Cr}_2\text{O}_7$  gives
- (A) Acetic acid (B) Acetaldehyde  
 (C) Formaldehyde (D) Formic acid
- Q.28** The reaction between an alcohol and an acid with the elimination of water molecule is called
- (A) Esterification (B) Saponification  
 (C) Etherification (D) Elimination
- Q.29** Maximum solubility of alcohol in water is due to
- (A) Covalent bond (B) Ionic bond  
 (C) H-bond with  $\text{H}_2\text{O}$  (D) None of the above
- Q.30** When primary alcohol is oxidised with chlorine, it produces
- (A)  $\text{HCOH}$  (B)  $\text{CH}_3\text{CHO}$   
 (C)  $\text{CCl}_3\text{CHO}$  (D)  $\text{C}_3\text{H}_7\text{CHO}$
- Q.31** Which of the following reagents can not be used to oxidise primary alcohols to aldehydes?
- (A)  $\text{CrO}_3$  in anhydrous medium  
 (B)  $\text{KMnO}_4$  in acidic medium  
 (C) Pyridinium chlorochromate  
 (D) Heat in the presence of Cu at 573 K.
- Q.32** The acidic character of alcohols is due to the
- (A) non-polar nature of O – H bond  
 (B) polar nature of O – H bond  
 (C) non-polar nature of C – O bond  
 (D) polar nature of C – O bond
- Q.33** In the esterification reaction of alcohols
- (A)  $\text{OH}^-$  is replaced by  $\text{C}_2\text{H}_5\text{OH}$   
 (B)  $\text{OH}^-$  is replaced by chlorine  
 (C)  $\text{H}^-$  is replaced by sodium metal  
 (D)  $\text{OH}^-$  is replaced by  $\text{CH}_3\text{COO}$  group
- Q.34** Order of esterification of alcohols is
- (A)  $3^\circ > 1^\circ > 2^\circ$  (B)  $2^\circ > 3^\circ > 1^\circ$   
 (C)  $1^\circ > 2^\circ > 3^\circ$  (D) None of these
- Q.35** Which of the following alcohols will give the most stable carbocation during dehydration?
- (A) 2-Methyl-1-propanol (B) 1-Butanol  
 (C) 2-Methyl-2-propanol (D) 2-Butanol
- Q.36** Arrange the following alcohols in order of increasing reactivity towards sodium metal.
- (i)  $(\text{CH}_3)_3\text{C}-\text{OH}$  (ii)  $(\text{CH}_3)_2\text{CH}-\text{OH}$   
 (iii)  $\text{CH}_3\text{CH}_2\text{OH}$   
 (A) (iii) < (ii) < (i) (B) (ii) < (i) < (iii)  
 (C) (i) < (ii) < (iii) (D) (iii) < (i) < (ii)
- Q.37** Identify an appropriate reagent for the conversion of alcohol to carboxylic acid.
- (A) PCC (B) Anhydrous  $\text{CrO}_3$   
 (C)  $\text{Cu}/573\text{ K}$  (D)  $\text{KMnO}_4/\text{H}^+$
- Q.38** The process of converting alkyl halides into alcohols involves
- (A) addition reaction  
 (B) substitution reaction  
 (C) dehydrohalogenation reaction  
 (D) rearrangement reaction.



**PART - 8 : PHYSICAL AND CHEMICAL  
PROPERTIES OF PHENOLS**

- Q.54** For phenol, which of the following statements is correct  
 (A) It is insoluble in water  
 (B) It has lower melting point compared to aromatic hydrocarbons of comparable molecular weight  
 (C) It has higher boiling point than toluene  
 (D) It does not show acidic property
- Q.55** In phenols –  
 (A) – OH group is attached in side chain.  
 (B) – OH group is directly attached to benzene nucleus.  
 (C) Both (A) & (B)  
 (D) None
- Q.56** Action of diazomethane on phenol liberates  
 (A) O<sub>2</sub> (B) H<sub>2</sub>  
 (C) N<sub>2</sub> (D) CO<sub>2</sub>
- Q.57** Which of the following compounds will be most easily attacked by an electrophile ?  
 (A)  (B)   
 (C)  (D) 
- Q.58** Select the incorrect statement about Kolbe's reaction.  
 (A) Phenoxide ion is less reactive than phenol towards electrophilic aromatic substitution.  
 (B) A weak electrophile CO<sub>2</sub> is used in this reaction.  
 (C) ortho-hydroxy benzoic acid is formed as the main product.  
 (D) Salicylic acid is formed as the main product.
- Q.59** The reaction between phenol and chloroform in the presence of aqueous NaOH is –  
 (A) nucleophilic substitution reaction.  
 (B) electrophilic addition reaction.  
 (C) electrophilic substitution reaction.  
 (D) nucleophilic addition reaction.
- Q.60** Dehydration of the following in increasing order is  
 (I)  (II)   
 (III)  (IV)   
 (A) I < II < III < IV (B) II < III < IV < I  
 (C) I < III < IV < II (D) None of these
- Q.61** Phenol is less acidic than  
 (A) ethanol (B) o-nitrophenol  
 (C) o-methylphenol (D) o-methoxyphenol.
- Q.62** Which of the following statement(s) is/are correct?  
 (A) OH group in phenols is more strongly held as compared to OH group in alcohols.  
 (B) OH group in phenols is less strongly held as compared to OH group in alcohols.  
 (C) OH group in phenols is equally strongly held as compared to OH group in alcohols.  
 (D) All of the above
- Q.63** Identify the final product of the reaction sequence.  
  
 (A) Benzophenone (B) Acetophenone  
 (C) Diphenyl (D) Methyl salicylate
- Q.64** Salicylic acid can be prepared using Reimer-Tiemann's reaction by treating phenol with  
 (A) Methyl chloride in the presence of anhydrous aluminium chloride.  
 (B) Carbon dioxide under pressure in sodium hydroxide solution.  
 (C) Carbon tetrachloride and concentrated sodium hydroxide.  
 (D) Sodium nitrite and a few drops of concentrated sulphuric acid.
- Q.65**  + dilute HNO<sub>3</sub> → ?  
 Select the product(s) formed in the given reaction.  
 (A)  (B)   
 (C)  (D) Only (A) and (C)
- Q.66** Ortho-nitrophenol is less soluble in water than p- and m-nitrophenols because  
 (A) o-nitrophenol shows intramolecular H-bonding.  
 (B) o-nitrophenol shows intermolecular H-bonding.  
 (C) melting point of o-nitrophenol is lower than those of m- and p-isomers.  
 (D) o-nitrophenol is more volatile in steam than those of m- and p-isomers.
- Q.67** Which of the following compounds will react with sodium hydroxide solution in water?  
 (A) C<sub>6</sub>H<sub>5</sub>OH (B) C<sub>6</sub>H<sub>5</sub>CH<sub>2</sub>OH  
 (C) (CH<sub>3</sub>)<sub>3</sub>COH (D) C<sub>2</sub>H<sub>5</sub>OH
- Q.68** Benzoquinone is prepared by reaction of phenol with –  
 (A) Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, H<sub>2</sub>SO<sub>4</sub> (B) KMnO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>  
 (C) Na<sub>2</sub>CrO<sub>4</sub>, HCl (D) K<sub>2</sub>MnO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>
- Q.69** For phenol, which of the following statements is correct?  
 (A) It has higher boiling point than toluene  
 (B) It has lower melting point compared to aromatic hydrocarbons of comparable molecular weight  
 (C) It is insoluble in water  
 (D) It does not show acidic property

- Q.70** Phenol when treated with excess of bromine water gives a white precipitate of –  
 (A) 2, 4, 6-tribromophenol (B) o-bromophenol  
 (C) p-bromophenol (D) bromobenzene
- Q.71** The correct order of strength of acidity of the following compounds is



- (A) (ii) > (i) > (iii) > (iv) (B) (i) > (ii) > (iii) > (iv)  
 (C) (iv) > (iii) > (ii) > (i) (D) (iv) > (iii) > (i) > (ii)
- Q.72** Which of the following is phenol?  
 (A) Cresol (B) Catechol  
 (C) Benzenol (D) All of these

### PART - 9 : USES AND TESTS OF PHENOLS

- Q.73** Phenol can be distinguished from aliphatic alcohol with  
 (A) Tollens reagent (B) Schiff's base  
 (C) FeCl<sub>3</sub> (D) HCl
- Q.74** Choose the correct statement –  
 (A) Some phenols can be used as flavouring agents.  
 (B) Some phenols can be used as perfumes.  
 (C) Vanillin (present in oil of vanilla bean) is an example of phenol used as a flavouring agents.  
 (D) All of these
- Q.75** Choose the correct statement –  
 (A) Phenol give deep blue or violet colour with neutral FeCl<sub>3</sub>.  
 (B) Phenol give liebermann's nitroso reaction.  
 (C) Phenol produces white precipitate of 2,4, 6 - tribromophenol with bromine water.  
 (D) All of these

### PART - 10 : PREPARATION OF ETHERS

- Q.76** The reaction given below is known as  

$$C_2H_5ONa + IC_2H_5 \longrightarrow C_2H_5OC_2H_5 + NaI$$
  
 (A) Kolbe's synthesis (B) Wurtz's synthesis  
 (C) Williamson's synthesis (D) Grignard's synthesis
- Q.77** The reagent used for the preparation of higher ether from halogenated ethers is –  
 (A) conc. H<sub>2</sub>SO<sub>4</sub> (B) Sodium alkoxide  
 (C) Dry silver oxide (D) Grignard reagent
- Q.78** In which case methyl-t-butyl ether is formed –  
 (A) (C<sub>2</sub>H<sub>5</sub>)<sub>3</sub>CONa + CH<sub>3</sub>Cl (B) (CH<sub>3</sub>)<sub>3</sub>CONa + CH<sub>3</sub>Cl  
 (C) (CH<sub>3</sub>)<sub>3</sub>CONa + C<sub>2</sub>H<sub>5</sub>Cl (D) (CH<sub>3</sub>)<sub>2</sub>CONa + CH<sub>3</sub>Cl
- Q.79** Ethers are prepared by the reaction of sodium alkoxides and alkyl halides. Which of the following reagents should be taken to prepare methyl tert-butyl ether?  
 (A) (CH<sub>3</sub>)<sub>3</sub>C – Br + NaOCH<sub>3</sub>  
 (B) CH<sub>3</sub>Br + NaOC(CH<sub>3</sub>)<sub>3</sub>

- (C) CH<sub>3</sub>CH<sub>2</sub>Br + NaOC(CH<sub>3</sub>)<sub>2</sub>  
 (D) (CH<sub>3</sub>)<sub>2</sub>C – Br + NaOCH<sub>2</sub>CH<sub>3</sub>
- Q.80** \_\_\_\_\_ is an important method for the preparation of symmetrical and unsymmetrical ethers.  
 (A) Williamson's synthesis  
 (B) Riemer-Tiemann reaction  
 (C) Kolbe's reaction  
 (D) None of these
- Q.81** Ether is obtained from ethyl alcohol in presence of H<sub>2</sub>SO<sub>4</sub> at  
 (A) 113K (B) 443K  
 (C) 413 K (D) 213 K
- Q.82** An equimolar quantities of ethanol and propanol is heated with cone. H<sub>2</sub>SO<sub>4</sub>. The product formed is/are  
 (A) C<sub>2</sub>H<sub>5</sub>OC<sub>2</sub>H<sub>5</sub> (B) C<sub>3</sub>H<sub>7</sub>OC<sub>3</sub>H<sub>7</sub>  
 (C) C<sub>2</sub>H<sub>5</sub>OC<sub>3</sub>H<sub>7</sub> (D) All of these

### PART - 11 : PHYSICAL AND CHEMICAL PROPERTIES OF ETHERS

- Q.83** According to Lewis concept of acids and bases, ether is  
 (A) Acidic (B) Basic  
 (C) Neutral (D) Amphoteric
- Q.84** An ether is more volatile than an alcohol having the same molecular formula. This is due to –  
 (A) Dipolar character of ethers  
 (B) Alcohols having resonance structures  
 (C) Inter-molecular hydrogen bonding in ethers  
 (D) Inter-molecular hydrogen bonding in alcohols
- Q.85** Which of the following product is formed, when ether is exposed to air  
 (A) Oxide (B) Alkanes  
 (C) Alkenes (D) Peroxide of diethyl ether
- Q.86** The ether that undergoes electrophilic substitution reaction is  
 (A) CH<sub>3</sub>OC<sub>2</sub>H<sub>5</sub> (B) C<sub>6</sub>H<sub>5</sub>OCH<sub>3</sub>  
 (C) CH<sub>3</sub>OCH<sub>3</sub> (D) C<sub>2</sub>H<sub>5</sub>OC<sub>2</sub>H<sub>5</sub>
- Q.87** Ethers have lower boiling points than their corresponding isomeric alcohols because of  
 (A) hydrogen bonding in alcohols that is absent in ethers due to low polarity.  
 (B) hydrogen bonding in ethers due to high polarity.  
 (C) insolubility of ethers in water due to less polarity.  
 (D) inertness of ethers as compared to alcohols.
- Q.88** Ethers have a net dipole moment because  
 (A) C – O bonds in ethers are non-polar.  
 (B) C – O bonds in ethers are polar.  
 (C) C – C bonds in ethers are polar.  
 (D) C – C bonds in ethers are non-polar.
- Q.89** The large difference in the boiling points of alcohols and ethers is due to the presence of –  
 (A) van der Waals' forces in alcohols.  
 (B) dipole-dipole interaction in alcohols.  
 (C) hydrogen bonding in alcohols.  
 (D) ion-ion interaction in alcohols.

## EXERCISE - 2 [LEVEL-2]

Choose one correct response for each question.

- Q.1** Coconut oil upon alkaline hydrolysis gives –  
 (A) Glycol (B) Alcohol  
 (C) Glycerol (D) Ethylene oxide
- Q.2** Which enzyme converts glucose and fructose both into ethanol  
 (A) Diastase (B) Invertase  
 (C) Zymase (D) Maltase
- Q.3** Salicylaldehyde can be prepared from  
 (A) Phenol and chloroform  
 (B) Phenol, chloroform and sodium hydroxide  
 (C) Phenol, carbon tetrachloride and NaOH  
 (D) None
- Q.4** Acetone on treatment with  $\text{CH}_3 - \text{Mg} - \text{I}$  and on further hydrolysis gives  
 (A) Isopropyl alcohol (B) Primary alcohol  
 (C) Acetic acid (D) 2-Methylpropan-2-ol
- Q.5** In the following reaction 'A' is  

$$\text{C}_2\text{H}_5\text{MgBr} + \text{H}_2\text{C}(\text{O})\text{CH}_2 \xrightarrow{\text{H}_2\text{O}} \text{A}$$
  
 (A)  $\text{C}_2\text{H}_5\text{CH}_2\text{CHO}$  (B)  $\text{C}_2\text{H}_5\text{CH}_2\text{CH}_2\text{OH}$   
 (C)  $\text{C}_2\text{H}_5\text{CH}_2\text{OH}$  (D)  $\text{C}_2\text{H}_5\text{CHO}$
- Q.6** In Williamson's synthesis, ethoxyethane is prepared by  
 (A) Passing ethanol over heated alumina  
 (B) Sodium ethoxide with ethyl bromide  
 (C) Ethyl alcohol with sulphuric acid  
 (D) Ethyl iodide and dry silver oxide
- Q.7** Formation of diethyl ether from ethanol is based on a  
 (A) Dehydration reaction  
 (B) Dehydrogenation reaction  
 (C) Hydrogenation reaction  
 (D) Heterolytic fission reaction
- Q.8**  $\text{C}_6\text{H}_5 - \text{CH} = \text{CHCHO} \xrightarrow{\text{X}} \text{C}_6\text{H}_5\text{CH} = \text{CHCH}_2\text{OH}$ .  
 In the above sequence X can be  
 (A)  $\text{H}_2/\text{Ni}$  (B)  $\text{NaBH}_4$   
 (C)  $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+$  (D) Both (A) and (B)
- Q.9** Methylphenyl ether can be obtained by reacting  
 (A) Phenolate ions and methyl iodide  
 (B) Methoxide ions and bromobenzene  
 (C) Methanol and phenol  
 (D) Bromo benzene and methyl bromide
- Q.10** 23 g of Na will react with methyl alcohol to give  
 (A) One mole of oxygen (B) One mole of  $\text{H}_2$   
 (C) 1/2 mole of  $\text{H}_2$  (D) None of these
- Q.11** Which reagent is useful in converting 1-butanol to 1-bromobutane.  
 (A)  $\text{CHBr}_3$  (B)  $\text{Br}_2$   
 (C)  $\text{CH}_3\text{Br}$  (D)  $\text{PBr}_3$
- Q.12** Which of the following gives ketone on oxidation  
 (A)  $(\text{CH}_3)_3\text{COH}$  (B)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$   
 (C)  $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$  (D)  $\text{CH}_3\text{CHOHCH}_3$
- Q.13** Which of the following compounds is oxidised to prepare methyl ethyl ketone  
 (A) 2-propanol (B) 1-butanol  
 (C) 2-butanol (D) Tert-butyl alcohol
- Q.14** Isopropyl alcohol heated at  $300^\circ\text{C}$  with copper catalyst to form  
 (A) Acetone (B) Dimethyl ether  
 (C) Acetaldehyde (D) Ethane
- Q.15** Glycerol is a –  
 (A) Primary alcohol (B) Monohydric alcohol  
 (C) Secondary alcohol (D) Trihydric alcohol
- Q.16** Glycerine has –  
 (A) One primary and two secondary –OH groups.  
 (B) One secondary and two primary –OH groups.  
 (C) Three primary –OH groups.  
 (D) Three secondary –OH groups.
- Q.17**  $\text{RMgBr}$  on reaction with an excess of oxygen followed by hydrolysis gives –  
 (A)  $\text{RH}$  (B)  $\text{ROOR}$   
 (C)  $\text{ROOH}$  (D)  $\text{ROH}$
- Q.18** Which compound is formed when  $\text{CH}_3\text{OH}$  reacts with  $\text{CH}_3 - \text{Mg} - \text{X}$ .  
 (A) Acetone (B) Alcohol  
 (C) Methane (D) Ethane
- Q.19** Glycerol reacts with  $\text{P}_4 + \text{I}_2$  to form –  
 (A) Aldehyde (B) Allyl iodide  
 (C) Allyl alcohol (D) Acetylene
- Q.20** The reagent which easily reacts with ethanol and propanol is  
 (A) Fehling solution (B) Grignard reagent  
 (C) Schiff's reagent (D) Tollen's reagent
- Q.21** When vapour of ethanol are passed over platinised asbestos in excess of air, the compound formed is –  
 (A)  $\text{CH}_3\text{CHO}$  (B)  $\text{CH}_3\text{COCH}_3$   
 (C)  $\text{C}_2\text{H}_2$  (D)  $\text{CH}_3\text{COOH}$
- Q.22** Which of the following is the most suitable method for removing the traces of water from ethanol  
 (A) Heating with Na metal.  
 (B) Passing dry HCl through it  
 (C) Distilling it  
 (D) Reacting with Mg
- Q.23** Conc.  $\text{H}_2\text{SO}_4$  heated with excess of  $\text{C}_2\text{H}_5\text{OH}$  at  $140^\circ\text{C}$  to form  
 (A)  $\text{CH}_3\text{CH}_2 - \text{O} - \text{CH}_3$   
 (B)  $\text{CH}_3\text{CH}_2 - \text{O} - \text{CH}_2\text{CH}_3$   
 (C)  $\text{CH}_3 - \text{O} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$   
 (D)  $\text{CH}_2 = \text{CH}_2$
- Q.24** Methanol & ethanol are miscible in water due to  
 (A) Covalent character  
 (B) Hydrogen bonding character  
 (C) Oxygen bonding character  
 (D) None of these
- Q.25** Amongst the following,  $\text{HBr}$  reacts fastest with–  
 (A) Propane-1-ol (B) Propane-2-ol  
 (C) 2-methyl propan-1-ol (D) 2-methyl propan-2-ol





- Q.47** Unlike phenol, 2,4-dinitrophenol is soluble in sodium carbonate solution in water because –
- (A) presence of two  $-\text{NO}_2$  groups in the ring makes 2, 4-dinitrophenol a stronger acid than phenol.  
 (B) presence of two  $-\text{NO}_2$  groups in the ring makes 2, 4-dinitrophenol a weaker acid than phenol.  
 (C) presence of two  $-\text{NO}_2$  groups make the hydrogen bonding easier, making 2, 4-dinitrophenol soluble.  
 (D) nitro group reacts with  $\text{Na}_2\text{CO}_3$  while  $-\text{OH}$  group does not.

- Q.48** Out of 2-chloroethanol and ethanol which is more acidic and why?

- (A) 2-Chloroethanol due to + I-effect of Cl  
 (B) Ethanol due to + I-effect of  $\text{CH}_3$   
 (C) 2-Chloroethanol due to – I-effect of Cl  
 (D) Ethanol due to – I-effect of  $\text{CH}_3$

- Q.49** Compound  $\text{C}_2\text{H}_6\text{O}$  has two isomers X and Y. On reaction with HI, X gives alkyl iodide and water while Y gives alkyl iodide and alcohol. Compounds X and Y are respectively –

- (A)  $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$  and  $\text{CH}_3\text{OC}_2\text{H}_5$   
 (B)  $\text{CH}_3\text{OCH}_3$  and  $\text{C}_2\text{H}_5\text{OCH}_3$   
 (C)  $\text{C}_2\text{H}_5\text{OH}$  and  $\text{CH}_3\text{OCH}_3$   
 (D)  $\text{CH}_3\text{OH}$  and  $\text{CH}_3\text{OCH}_3$

- Q.50** An oxygen containing organic compound upon oxidation forms a carboxylic acid as the only organic product with its molecular mass higher by 14 units. The organic compound is –

- (A) a primary alcohol (B) an aldehyde  
 (C) a ketone (D) a secondary alcohol

- Q.51** The compound which gives turbidity immediately with Lucas reagent at room temperature is –

- (A) butan-2-ol (B) butan-1-ol  
 (C) 2-methyl propan-1-ol (D) 2-methyl propan-2-ol

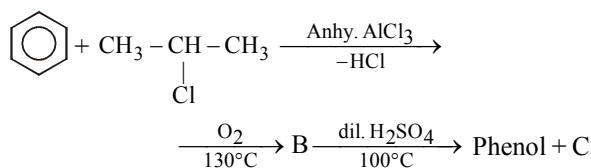
- Q.52** The conversion of m-nitrophenol to resorcinol involves respectively

- (A) diazotization, reduction and hydrolysis  
 (B) hydrolysis, diazotization and reduction  
 (C) reduction, diazotization and hydrolysis  
 (D) hydrolysis, reduction and diazotization

- Q.53** Power alcohol is a mixture of

- (A) 80% Petrol + 20% Benzene + Small quantity of Ethanol  
 (B) 80% Petrol + 20% Ethanol + Small quantity of Benzene  
 (C) 80% Ethanol + 20% Benzene + Small quantity of Petrol  
 (D) 50% Petrol + 50% Ethanol + Small quantity of Benzene

- Q.54** Identify C in the following

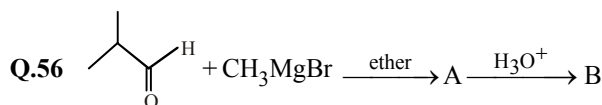


- (A) Water (B) Ethanol  
 (C) Propanone (D) Cumene hydroperoxide

- Q.55** 0.44 g of a monohydric alcohol when added to methylmagnesium iodide in ether liberates at S.T.P.,  $112\text{cm}^3$  of methane. With PCC the same alcohol forms a

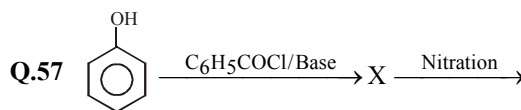
carbonyl compound that answers silver mirror test. The monohydric alcohol is

- (A)  $\text{H}_3\text{C} - \underset{\text{OH}}{\text{CH}} - \text{CH}_2 - \text{CH}_3$   
 (B)  $(\text{CH}_3)_3\text{C} - \text{CH}_2\text{OH}$   
 (C)  $\text{H}_3\text{C} - \underset{\text{OH}}{\text{CH}} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$   
 (D)  $(\text{CH}_3)_2\text{CH} - \text{CH}_2\text{OH}$

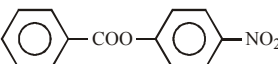
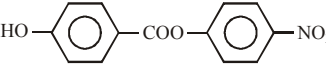
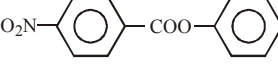
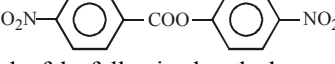


The IUPAC name of 'B' is

- (A) 3-methylbutan-2-ol (B) 2-methylbutan-3-ol  
 (C) 2-methylbutan-2-ol (D) Pentan-2-ol



Y (Major product). Y is –

- (A)   
 (B)   
 (C)   
 (D) 

- Q.58** Which of the following has the lowest solubility in water?

- (A)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$  (B)  $\text{CH}_3 - \overset{\text{CH}_3}{\underset{|}{\text{C}}} - \text{CH}_2\text{OH}$   
 (C)  $\text{HOCH}_2 - \text{CH}_2\text{OH}$  (D)  $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{OH}$

- Q.59** Ethanol is heated with concentrated  $\text{H}_2\text{SO}_4$ . The product formed is –

- (A)  $\text{CH}_3 - \underset{\text{O}}{\underset{||}{\text{C}}} - \text{O} - \text{C}_2\text{H}_5$  (B)  $\text{C}_2\text{H}_6$

- (C)  $\text{C}_2\text{H}_4$  (D)  $\text{C}_2\text{H}_2$

- Q.60**  $\text{LiAlH}_4$  converts acetic acid into –

- (A) Acetaldehyde (B) Methane  
 (C) Ethyl alcohol (D) Methyl alcohol

- Q.61** The increasing order of boiling points of

$1^\circ, 2^\circ, 3^\circ$  alcohol is –

- (A)  $1^\circ > 2^\circ > 3^\circ$  (B)  $3^\circ > 2^\circ > 1^\circ$   
 (C)  $2^\circ > 1^\circ > 3^\circ$  (D) None

- Q.62** Solubility of lower alcohols in water is due to –

(A) Formation of hydrogen bond between alcohol and water molecules.

(B) Hydrophobic nature of alcohol.

(C) Increases in boiling points

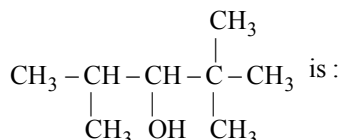
(D) None of these

- Q.63** Dow's process used in the industrial preparation of phenol, is
- (A)  $C_6H_5Cl \xrightarrow[CuCl_2, 300^\circ C]{NaOH} C_6H_5OH + NaCl$
- (B)  $C_6H_5Cl + H_2O \xrightarrow[425^\circ C]{SO_2} C_6H_5OH + HCl$
- (C)  $C_6H_5NH_2 + HNO_2 \xrightarrow{\Delta} C_6H_5OH + N_2 + H_2O$
- (D)  $C_6H_5N_2Cl + H_2O \rightarrow C_6H_5OH + N_2 + HCl$
- Q.64** Which of the following is not a phenolic compound
- (A) Salol (B) o-Cresol  
(C) Anisole (D) Quinol
- Q.65** Unacceptable name for a compound containing one – OH group attached to benzene nucleus would be –
- (A) Carboic acid (B) Hydroxybenzene  
(C) Catechol (D) Phenol
- Q.66** How many  $\pi$  electrons are there in a planar ring of phenol
- (A) 4 (B) 6  
(C) 8 (D) 10
- Q.67** Anhydrides of alcohol are nothing but
- (A) Ethers (B) Aldehydes  
(C) Esters (D) Alkyl anhydrides
- Q.68** Diethyl ether acts as a –
- (A) Lewis acid (B) Lewis base  
(C) Reducing agent (D) Oxidising agent

**EXERCISE - 3 (NUMERICAL VALUE BASED QUESTIONS)**

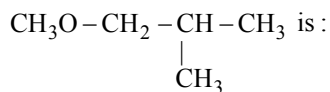
**NOTE:** The answer to each question is a NUMERICAL VALUE.

**Q.1** If IUPAC name of the compound



X, 2, 4-trimethylpentan-3-ol. Find the value of X.

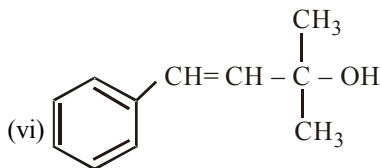
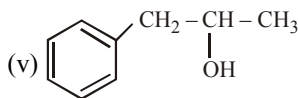
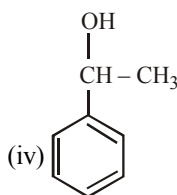
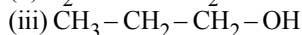
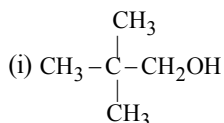
**Q.2** If IUPAC name of the compound



X-methoxy-2-methylpropane. Find the value of X.

**Q.3** IUPAC name of aspirin is : X-acetoxybenzoic acid. Find the value of X.

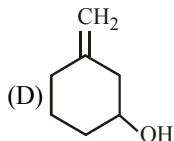
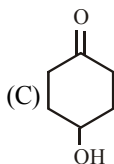
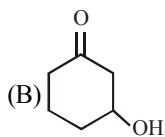
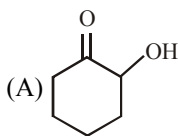
**For Q.4-Q.6**



- Q.4** Number of primary alcohols in above structures are –
- Q.5** Number of secondary alcohols in above structures are –
- Q.6** Number of tertiary alcohols in above structures are –
- Q.7**  $\text{CH}_3 - \underset{\text{CH}_3}{\text{C}} = \underset{\text{CH}_3}{\text{CH}} - \underset{\text{CH}_3}{\text{C}} = \underset{\text{CH}_3}{\text{CH}} - \underset{\text{CH}_3}{\text{C}} = \underset{\text{CH}_3}{\text{CH}} - \underset{\text{O}}{\text{C}} - \text{CH}_3$
- Find (X + Y – Z) for the above given product which is formed by aldol condensation :
- X = total products (including stereoisomers)  
Y = Number of acetone molecules used in the reaction  
Z = Number of aldol condensation reaction.

## EXERCISE - 4 [PREVIOUS YEARS JEE MAIN QUESTIONS]

Q.1 Maximum dehydration takes place that of [AIIEE 2002]



Q.2 An ether is more volatile than alcohol having the same molecular formula. This is due to – [AIIEE 2003]

- (A) Inter molecular hydrogen bonding in ethers  
 (B) Inter molecular hydrogen bonding in alcohols  
 (C) Dipolar character of ethers  
 (D) Alcohols having resonance structures

Q.3 When  $\text{CH}_2 = \text{CH} - \text{COOH}$  is reduced with  $\text{LiAlH}_4$ , the compound obtained will be – [AIIEE 2003]

- (A)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2\text{OH}$  (B)  $\text{CH}_3 - \text{CH}_2 - \text{CHO}$   
 (C)  $\text{CH}_3 - \text{CH}_2 - \text{COOH}$  (D)  $\text{CH}_2 = \text{CH} - \text{CH}_2\text{OH}$

Q.4 The general formula  $\text{C}_n\text{H}_{2n}\text{O}_2$  represents –

- (A) Diols (B) Dialdehydes  
 (C) Diketones (D) Carboxylic acids

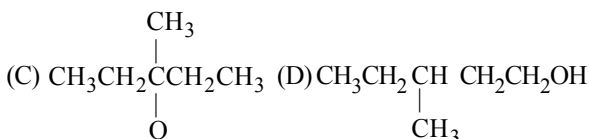
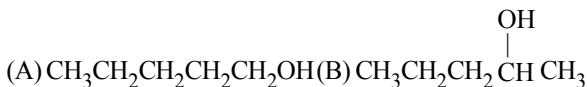
Q.5 Which one of the following is reduced with zinc and hydrochloric acid to give the corresponding hydrocarbon [AIIEE 2004]

- (A) Ethyl acetate (B) Acetic acid  
 (C) Acetamide (D) Butane-2-one

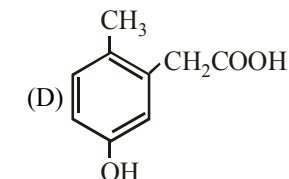
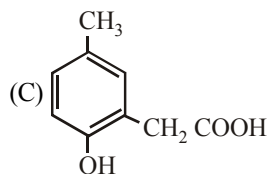
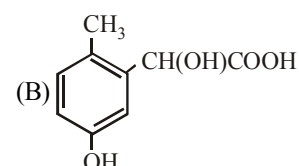
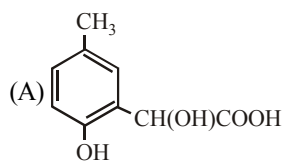
Q.6 Which one of the following undergoes reaction with 50% sodium hydroxide solution to give the corresponding alcohol and acid? [AIIEE 2004]

- (A) Phenol (B) Benzaldehyde  
 (C) Butanal (D) Benzoic acid

Q.7 Among the following compounds which can be dehydrated very easily is – [AIIEE 2004]

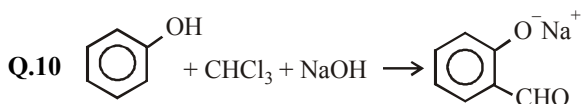


Q.8 p-cresol reacts with chloroform in alkaline medium to give the compound A which adds hydrogen cyanide to form, the compound. B The latter on acidic hydrolysis gives chiral carboxylic acid. The structure of the carboxylic acid is – [AIIEE-2005]



Q.9 HBr reacts with  $\text{CH}_2 = \text{CH} - \text{OCH}_3$  under anhydrous conditions at room temperature to give – [AIIEE 2006]

- (A)  $\text{BrCH}_2\text{CHO}$  and  $\text{CH}_3\text{OH}$  (B)  $\text{BrCH}_2 - \text{CH}_2 - \text{OCH}_3$   
 (C)  $\text{H}_3\text{C} - \text{CHBr} - \text{OCH}_3$  (D)  $\text{CH}_3\text{CHO}$  and  $\text{CH}_3\text{Br}$



The electrophile involved in the above reaction is –

- (A) dichlorocarbene ( $:\text{CCl}_2$ ) [AIIEE 2006]

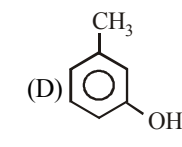
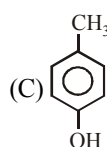
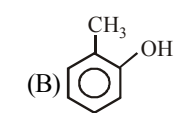
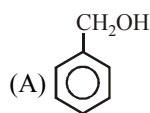
- (B) trichloromethyl anion ( $\text{CCl}_3^-$ )

- (C) formyl cation ( $\text{CHO}^+$ )

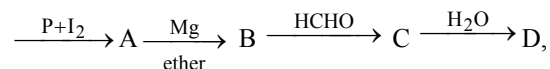
- (D) dichloromethyl cation ( $\text{CHCl}_2^+$ )

Q.11 The structure of the compound that gives a tribromo derivative on treatment with bromine water is –

[AIIEE 2006]



Q.12 In the following sequence of reactions,  $\text{CH}_3\text{CH}_2\text{OH}$



then compound 'D' is–

[AIIEE 2007]

- (A) butanal (B) n-butyl alcohol  
 (C) n-propyl alcohol (D) propanal

Q.13 Phenol, when it first reacts with concentrated sulphuric acid and then with concentrated nitric acid, gives –

[AIIEE 2008]

- (A) o-nitrophenol (B) p-nitrophenol  
 (C) nitrobenzene (D) 2,4,6-trinitrobenzene

**Q.14** The major product obtained on interaction of phenol with sodium hydroxide and carbon dioxide is

[AIEEE 2009]

- (A) salicylaldehyde (B) salicylic acid  
(C) phthalic acid (D) benzoic acid

**Q.15** From amongst the following alcohols the one that would react fastest with conc. HCl and anhydrous ZnCl<sub>2</sub>, is

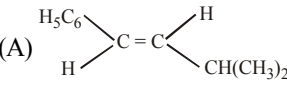
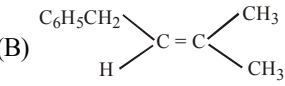
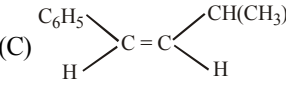
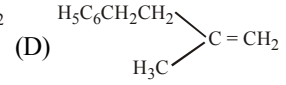
[AIEEE 2010]

- (A) 2-Butanol (B) 2-Methylpropan-2-ol  
(C) 2-Methylpropanol (D) 1-Butanol

**Q.16** The main product of the following reaction is



[AIEEE 2010]

- (A)  (B)   
(C)  (D) 

**Q.17** Phenol is heated with a solution of mixture of KBr and KBrO<sub>3</sub>. The major product obtained in the above reaction is:

[AIEEE 2011]

- (A) 2-Bromophenol (B) 3-Bromophenol  
(C) 4-Bromophenol (D) 2, 4, 6-Tribromophenol

**Q.18** Which of the following reagents may be used to distinguish between phenol and benzoic acid?

[AIEEE 2011]

- (A) Aqueous NaOH (B) Tollen's reagent  
(C) Molisch reagent (D) Neutral FeCl<sub>3</sub>

**Q.19** Trichloroacetaldehyde was subjected to Cannizzaro's reaction by using NaOH. The mixture of the products contains sodium trichloroacetate ion and another compound. The other compound is –

[AIEEE 2011]

- (A) 2, 2, 2-Trichloroethanol (B) Trichloromethanol  
(C) 2, 2, 2-Trichloropropanol (D) Chloroform

**Q.20** Ortho-Nitrophenol is less soluble in water than p- and m- Nitrophenols because:

[AIEEE 2012]

- (A) o-Nitrophenol is more volatile steam than those of m- and p-isomers.  
(B) o-Nitrophenol shows Intramolecular H-bonding  
(C) o-Nitrophenol shows intermolecular H-bonding  
(D) Melting point of o-Nitrophenol is lower than those of m- and p-isomers.

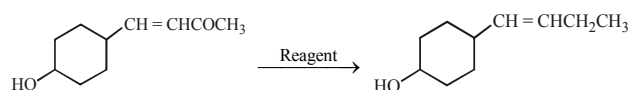
**Q.21** Iodoform can be prepared from all except

[AIEEE 2012]

- (A) Ethyl methyl ketone (B) Isopropyl alcohol  
(C) 3-Methyl-2-butanone (D) Isobutyl alcohol

**Q.22** In the given transformation, which the following is the most appropriate reagent?

[AIEEE-2012]



- (A)  $NH_2NH_2, OH^-$  (B) Zn-Hg/HCl  
(C) Na, Liq. NH<sub>3</sub> (D) NaBH<sub>4</sub>

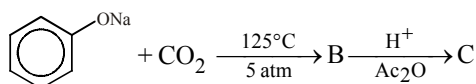
**Q.23** An unknown alcohol is treated with the Lucas reagent to determine whether the alcohol is primary, secondary or tertiary. Which alcohol reacts fastest and by what mechanism –

[JEE MAIN 2013]

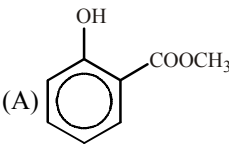
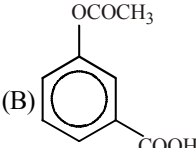
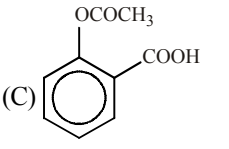
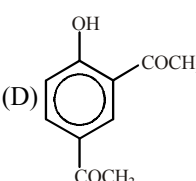
- (A) secondary alcohol by S<sub>N</sub>1  
(B) tertiary alcohol by S<sub>N</sub>1  
(C) secondary alcohol by S<sub>N</sub>2  
(D) tertiary alcohol by S<sub>N</sub>2

**Q.24** Sodium phenoxide when heated with CO<sub>2</sub> under pressure at 125°C yields a product which on acetylation produces C.

[JEE MAIN 2014]



The major product C would be:

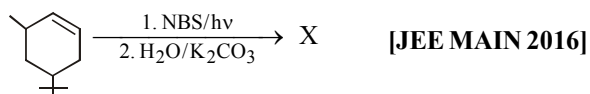
- (A)  (B)   
(C)  (D) 

**Q.25** The most suitable reagent for the conversion of R-CH<sub>2</sub>-OH → R-CHO is –

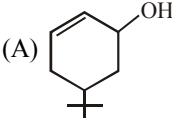
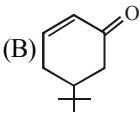
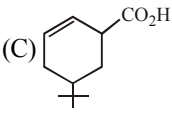
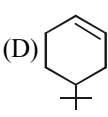
[JEE MAIN 2014]

- (A) CrO<sub>3</sub>  
(B) PCC (Pyridinium Chlorochromate)  
(C) KMnO<sub>4</sub>  
(D) K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>

**Q.26** The product of the reaction given below is:

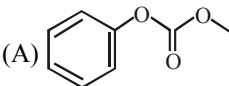
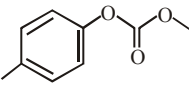
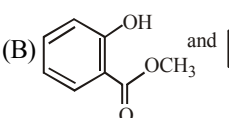
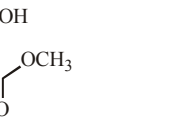


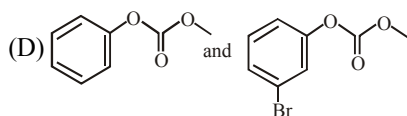
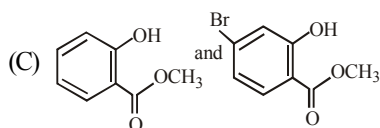
[JEE MAIN 2016]

- (A)  (B)   
(C)  (D) 

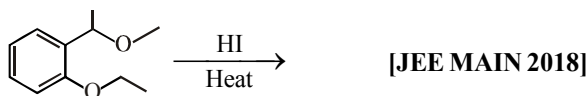
**Q.27** Phenol reacts with methyl chloroformate in the presence of NaOH to form product A. A reacts with Br<sub>2</sub> to form product B. A and B are respectively:

[JEE MAIN 2018]

- (A)  and   
(B)  and 

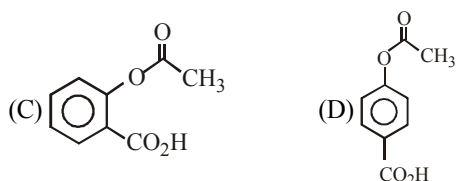
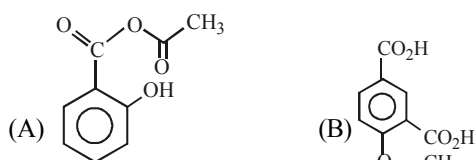


**Q.28** The major product formed in the following reaction is :



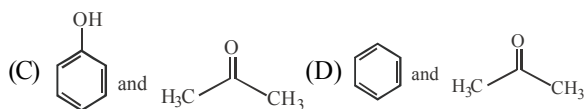
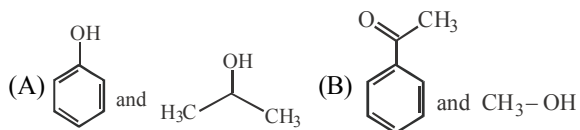
**Q.29** Phenol on treatment with  $\text{CO}_2$  in the presence of  $\text{NaOH}$  followed by acidification produces compound X as the major product. X on treatment with  $(\text{CH}_3\text{CO})_2\text{O}$  in the presence of catalytic amount of  $\text{H}_2\text{SO}_4$  produces :

**[JEE MAIN 2018]**



**Q.30** The product formed in the reaction of cumene with  $\text{O}_2$  followed by treatment with dil.  $\text{HCl}$  are :

**[JEE MAIN 2019 (Jan)]**



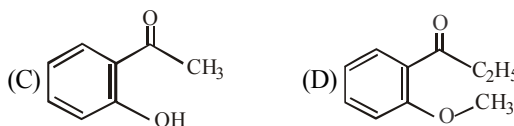
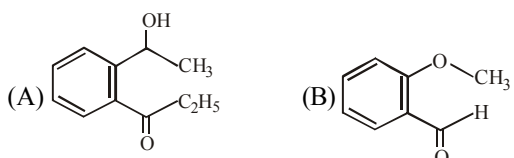
**Q.31** An organic compound 'X' showing the following solubility profile is - **[JEE MAIN 2019 (April)]**

'x'	water	→ Insoluble
	5% HCl	→ Insoluble
	10% NaOH	→ Soluble
	10% $\text{NaHCO}_3$	→ Insoluble

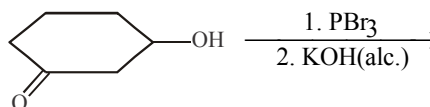
- (A) m-Cresol (B) Oleic acid  
(C) o-Toluidine (D) Benzamide

**Q.32** An organic compound neither reacts with neutral ferric chloride solution nor with Fehling solution, It however, reacts with Grignard reagent and gives positive iodoform test. The compound is

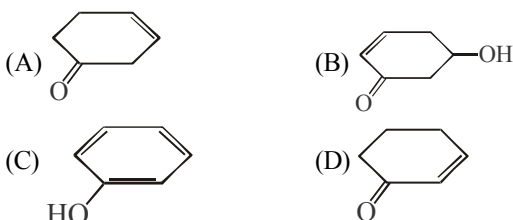
**[JEE MAIN 2019 (April)]**



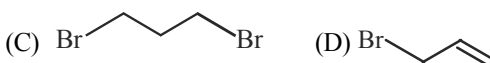
**Q.33** The major product of the following reaction is :



**[JEE MAIN 2019 (APRIL)]**



**Q.34** 1-methyl ethylene oxide when treated with an excess of  $\text{HBr}$  produces : **[JEE MAIN 2020 (JAN)]**

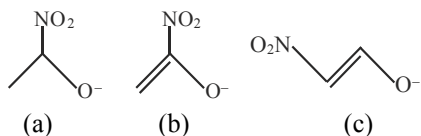


**Q.35** A solution of m-chloroaniline, m-chlorophenol and m-chlorobenzoic acid in ethyl acetate was extracted initially with a saturated solution of  $\text{NaHCO}_3$  to give fraction A. The left over organic phase was extracted with dilute  $\text{NaOH}$  solution to give fraction B. The final organic layer was labelled as fraction C. Fractions A, B and C, contain respectively : **[JEE MAIN 2020 (JAN)]**

- (A) m-chlorobenzoic acid, m-chloroaniline and m-chlorophenol.  
(B) m-chloroaniline, m-chlorobenzoic acid and m-chlorophenol.

- (C) m-chlorobenzoic acid, m-chlorophenol and m-chloroaniline.  
 (D) m-chlorophenol, m-chlorobenzoic acid and m-chloroaniline.

**Q.36** Stability order of following alkoxide ions is

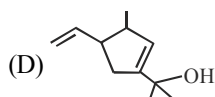
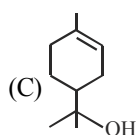
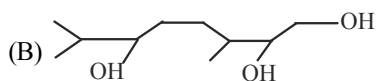
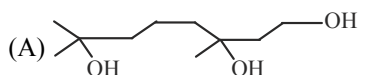
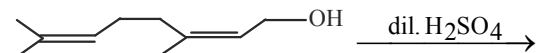


[JEE MAIN 2020 (JAN)]

- (A)  $c > b > a$       (B)  $a > c > b$   
 (C)  $b > a > c$       (D)  $c > a > b$

**Q.37** Major product in the following reaction is

[JEE MAIN 2020 (JAN)]



**Q.38** Arrange the order of C – OH bond length of the following compounds.

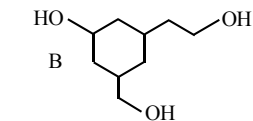
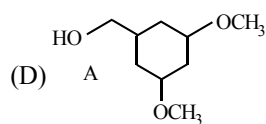
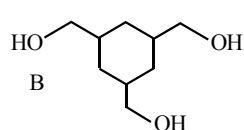
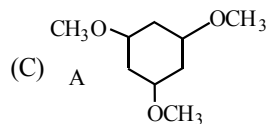
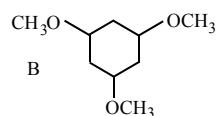
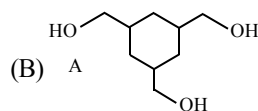
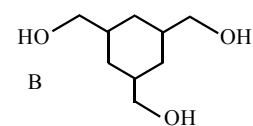
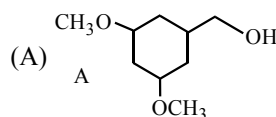
- Methanol      Phenol      p-Ethoxyphenol  
 (a)      (b)      (c)

[JEE MAIN 2020 (JAN)]

- (A)  $a > b > c$       (B)  $a > c > b$   
 (C)  $c > b > a$       (D)  $b > c > a$

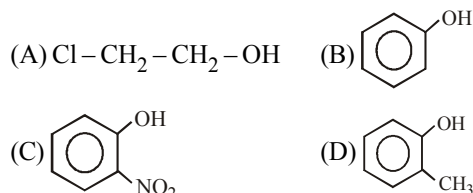
**Q.39** There are two compounds A and B of molecular formula  $C_9H_{18}O_3$ . A has higher boiling point than B. What are the possible structures of A and B?

[JEE MAIN 2020 (JAN)]



## EXERCISE - 5 [PREVIOUS YEARS AIPMT / NEET QUESTIONS]

Q.1 Which one of the following compounds is most acidic – [AIPMT 2005]



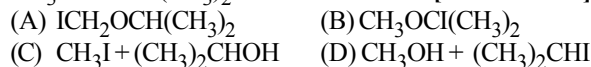
Q.2 The general molecular formula, which represents the homologous series of alkanols is – [AIPMT 2006]



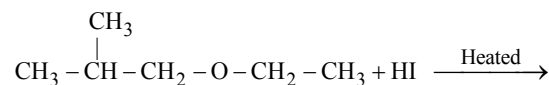
Q.3 Ethylene oxide when treated with Grignard reagent yields [AIPMT 2006]



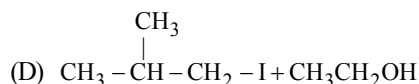
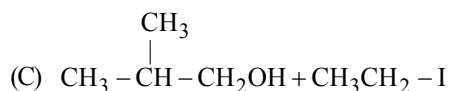
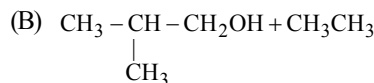
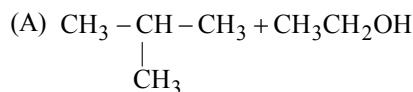
Q.4 The major organic product in the reaction,  $\text{CH}_3-\text{O}-\text{CH}(\text{CH}_3)_2 + \text{HI} \rightarrow$  Product is – [AIPMT 2006]



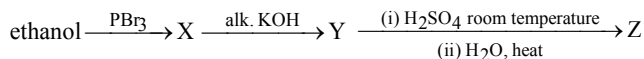
Q.5 In the reaction :



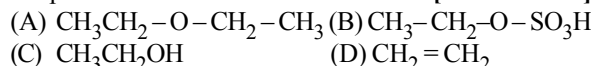
Product formed are [AIPMT 2007]



Q.6 Consider the following reaction,



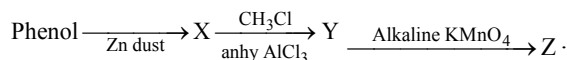
the product Z is: [AIPMT 2009]



Q.7  $\text{H}_2\text{COH}-\text{CH}_2\text{OH}$  on heating with periodic acid gives: [AIPMT 2009]



Q.8 Consider the following reaction :



The product Z is: [AIPMT 2009]

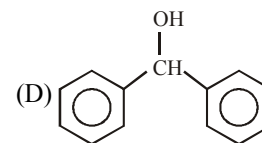
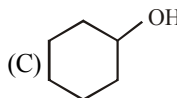
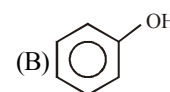
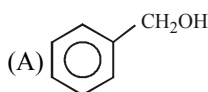


Q.9 Given are cyclohexanol (I), acetic acid (II), 2, 4, 6-trinitrophenol (III) and phenol (IV). In these the order of decreasing acidic character will be:

[AIPMT (PRE) 2010]



Q.10 Which one of the following compounds has the most acidic nature? [AIPMT (PRE) 2010]



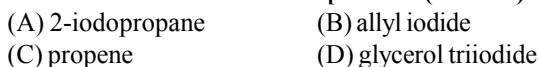
Q.11 Among the following four compounds :



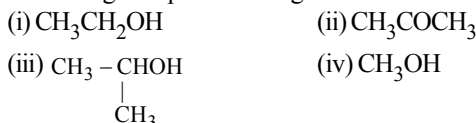
The acidity order is : [AIPMT (MAINS) 2010]



Q.12 When glycerol is treated with excess of HI, it produces [AIPMT (MAINS) 2010]

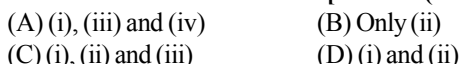


Q.13 Following compounds are given

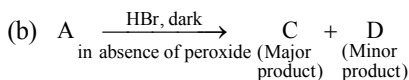
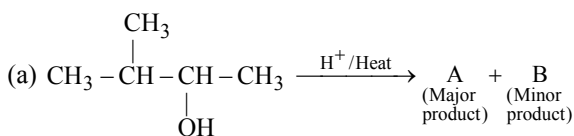


Which of the above compound (s), on being warmed with iodine solution and NaOH, will give iodoform?

[AIPMT (MAINS) 2010]



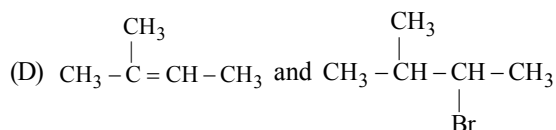
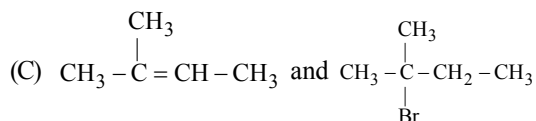
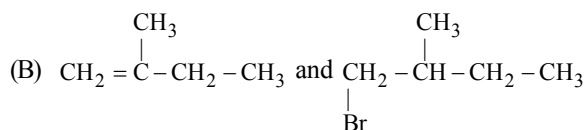
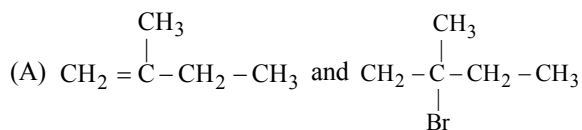
Q.14 In the following reactions,



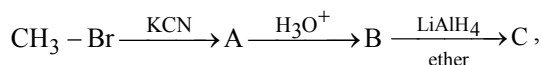
The major products (A) and (C) are respectively

[AIPMT (PRE) 2011]





**Q.15** In the following sequence of reactions



the end product (C) is : **[AIPMT (PRE) 2012]**

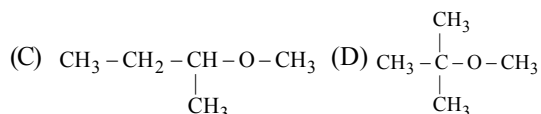
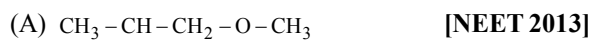
- (A) Acetone (B) Methane  
(C) Acetaldehyde (D) Ethyl alcohol

**Q.16** Which of the following compounds can be used as antifreeze in automobile radiators ?

**[AIPMT (MAINS) 2012]**

- (A) Methyl alcohol (B) Glycol  
(C) Nitrophenol (D) Ethyl alcohol

**Q.17** Among the following ethers, which one will produce methyl alcohol on treatment with hot concentrated HI?



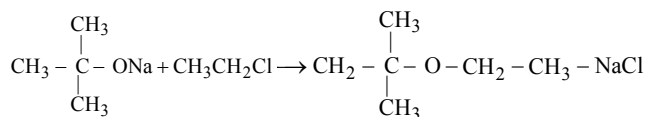
**Q.18** Among the following sets of reactants which one produces anisole? **[AIPMT 2014]**

- (A)  $\text{CH}_3\text{CHO}$ ;  $\text{RMgX}$   
(B)  $\text{C}_6\text{H}_5\text{OH}$ ;  $\text{NaOH}$ ;  $\text{CH}_3\text{I}$   
(C)  $\text{C}_6\text{H}_5\text{OH}$ ; neutral  $\text{FeCl}_3$   
(D)  $\text{C}_6\text{H}_5 - \text{CH}_3$ ;  $\text{CH}_3\text{COCl}$ ;  $\text{AlCl}_3$

**Q.19** Which of the following will not be soluble in sodium hydrogen carbonate? **[AIPMT 2014]**

- (A) 2,4,6-trinitrophenol (B) Benzoic acid  
(C) o-Nitrophenol (D) Benzenesulphonic acid

**Q.20** The reaction



is called –

**[AIPMT 2015]**

- (A) Williamson continuous etherification process  
(B) Etard reaction  
(C) Gatterman-Koch reaction  
(D) Williamson Synthesis

**Q.21** Reaction of phenol with chloroform in presence of dilute sodium hydroxide finally introduces which one of the following functional group? **[RE-AIPMT 2015]**

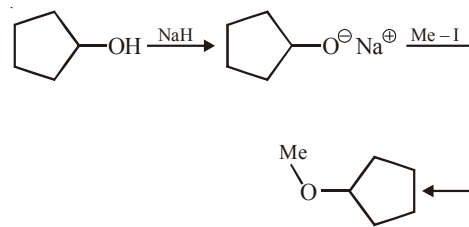
- (A)  $-\text{CHCl}_2$  (B)  $-\text{CHO}$   
(C)  $-\text{CH}_2\text{Cl}$  (D)  $-\text{COOH}$

**Q.22** Which of the following reaction(s) can be used for the preparation of alkyl halides? **[RE-AIPMT 2015]**

- (I)  $\text{CH}_3\text{CH}_2\text{OH} + \text{HCl} \xrightarrow{\text{Anhy. ZnCl}_2}$   
(II)  $\text{CH}_3\text{CH}_2\text{OH} + \text{HCl} \rightarrow$   
(III)  $(\text{CH}_3)_3\text{COH} + \text{HCl} \rightarrow$   
(IV)  $(\text{CH}_3)_2\text{CHOH} + \text{HCl} \xrightarrow{\text{Anhy. ZnCl}_2}$

- (A) (IV) only (B) (III) and (IV) only  
(C) (I), (III) and (IV) only (D) (I) and (II) only

**Q.23** The reaction



can be classified as

**[NEET 2016 PHASE 1]**

- (A) Williamson ether synthesis reaction  
(B) Alcohol formation reaction  
(C) Dehydration reaction  
(D) Williamson alcohol synthesis reaction

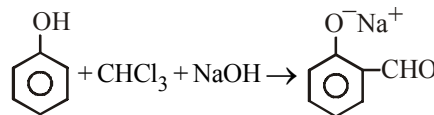
**Q.24** The heating of phenyl-methyl ethers with HI produces

- (A) iodobenzene (B) phenol **[NEET 2017]**  
(C) benzene (D) ethyl chlorides

**Q.25** The compound A on treatment with Na gives B, and with  $\text{PCl}_5$  gives C. B and C react together to give diethyl ether. A, B and C are in the order **[NEET 2018]**

- (A)  $\text{C}_2\text{H}_5\text{Cl}$ ,  $\text{C}_2\text{H}_6$ ,  $\text{C}_2\text{H}_5\text{OH}$   
(B)  $\text{C}_2\text{H}_5\text{OH}$ ,  $\text{C}_2\text{H}_5\text{Cl}$ ,  $\text{C}_2\text{H}_5\text{ONa}$   
(C)  $\text{C}_2\text{H}_5\text{OH}$ ,  $\text{C}_2\text{H}_6$ ,  $\text{C}_2\text{H}_5\text{Cl}$   
(D)  $\text{C}_2\text{H}_5\text{OH}$ ,  $\text{C}_2\text{H}_5\text{ONa}$ ,  $\text{C}_2\text{H}_5\text{Cl}$

**Q.26** In the reaction:

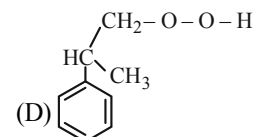
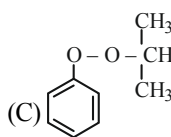
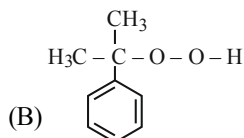
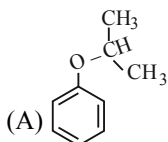
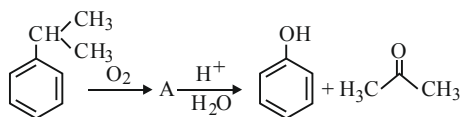


The electrophile involved is  $\oplus$

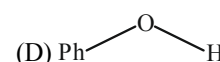
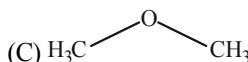
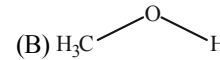
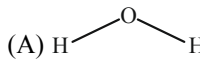
**[NEET 2018]**

- (A) Dichloromethyl anion ( $\text{C}^-\text{HCl}_2$ )  
(B) Formyl cation ( $\text{C}^+\text{HO}$ )  
(C) Dichloromethyl cation ( $\text{C}^+\text{HCl}_2$ )  
(D) Dichlorocarbene ( $:\text{CCl}_2$ )

Q.27 The structure of intermediate A in the following reaction, is [NEET 2019]



Q.28 The compound that is most difficult to protonate is [NEET 2019]



## ANSWER KEY

## EXERCISE - 1

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
A	A	A	A	D	B	B	A	C	D	C	B	A	B	C	C	A	A	B	A	C	B	C	B	C	C
Q	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A	B	A	A	C	C	B	B	D	C	C	C	D	B	A	B	C	C	C	A	C	B	B	B	B	C
Q	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
A	B	D	D	C	B	C	C	A	C	A	B	A	B	C	D	A	A	A	A	A	D	D	C	D	D
Q	76	77	78	79	80	81	82	83	84	85	86	87	88	89											
A	C	D	B	B	A	C	D	B	D	D	B	A	B	C											

## EXERCISE - 2

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
A	C	C	B	D	B	B	A	B	A	C	D	D	C	A	D	B	D	C	B	B	A	D	B	B	D
Q	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A	B	B	B	A	D	B	C	D	D	D	C	A	C	D	B	A	B	A	C	B	C	A	C	C	A
Q	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68							
A	D	C	B	C	C	A	A	D	C	C	A	A	A	C	C	C	A	B							

## EXERCISE - 3

Q	1	2	3	4	5	6	7
A	2	1	2	3	2	1	9

## EXERCISE - 4

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
A	B	B	D	D	D	B	C	A	D	A	D	C	A	B	B	A	D	D	A	B	D	A	B	C	B
Q	26	27	28	29	30	31	32	33	34	35	36	37	38	39											
A	A	A	B	C	C	A	A	D	B	C	A	C	B	B											

## EXERCISE - 5

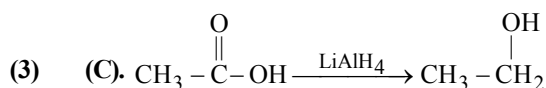
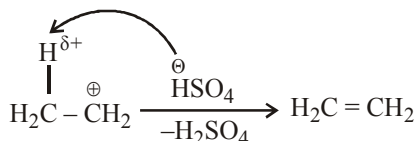
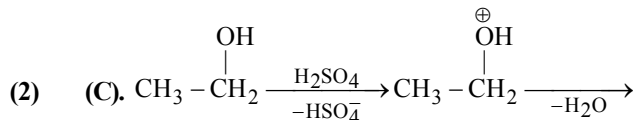
Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
A	C	C	C	C	C	C	C	B	A	B	A	A	C	C	D	B	D	B	C	D	B	C	A	B	D
Q	26	27	28																						
A	D	B	D																						

**ALCOHOLS, PHENOLS AND**

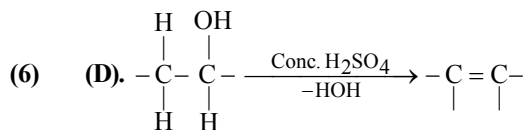
**ETHERS**

**TRY IT YOURSELF-1**

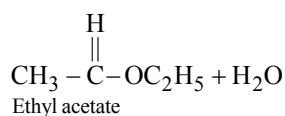
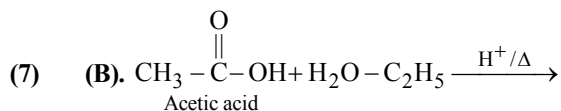
- (1) (D). Due to less-effective hydrogen bonding solubility of Ph-CH<sub>2</sub>-CH<sub>2</sub>-OH becomes minimum



- (4) (A). As branching increases boiling point decreases.  
 (5) (A). Compound which can form hydrogen bond with water are soluble and lower alcohols forming effective hydrogen bond with H<sub>2</sub>O. So, soluble in H<sub>2</sub>O.

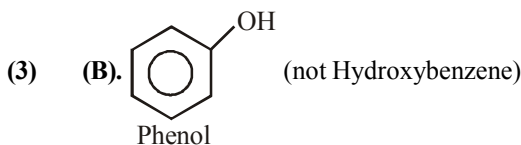
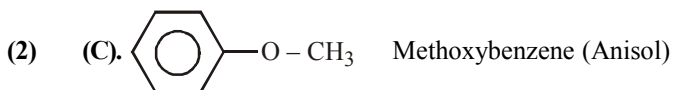
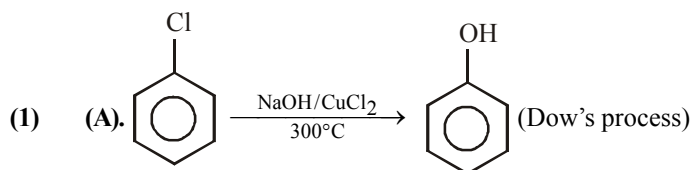


This reaction involve breaking of 'C-O' bond not 'O-H' bond.

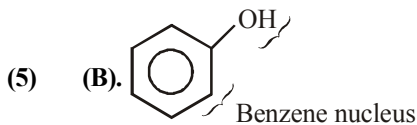


- (8) (A). PCl<sub>3</sub>, PCl<sub>5</sub>, SOCl<sub>2</sub>, HCl can replace -OH group but not Cl<sub>2</sub>.  
 (9) (D). 
$$\text{R} - \text{O} - \text{H} + \text{Na} \rightarrow \text{R} - \overset{\ominus}{\text{O}}\text{Na} + \frac{1}{2}\text{H}_2(\uparrow)$$
  
 (10) (B). SO<sub>2</sub>Cl<sub>2</sub> cannot replace -OH group.

**TRY IT YOURSELF-2**

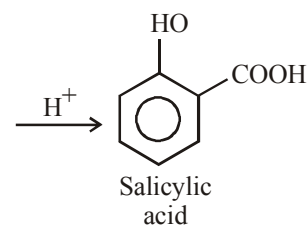
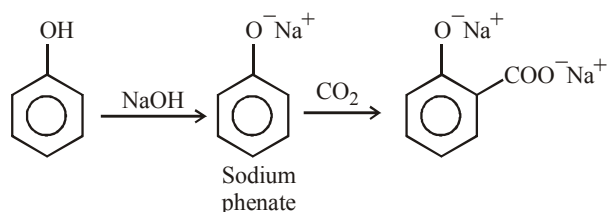


- (4) (C). Electron in π bonds are π electrons & lone pair electrons which delocalises in the process of resonance are also counted as π electrons.

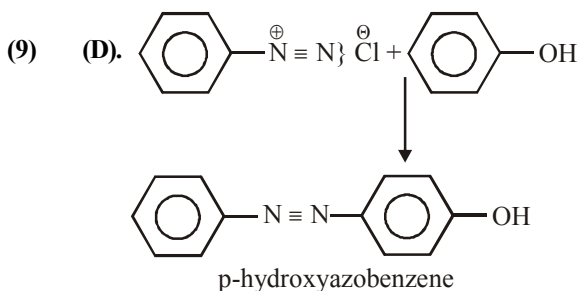


- (6) (C). Acidic nature of o-nitrophenol is less than H<sub>2</sub>CO<sub>3</sub>. So, it does not react with Na<sub>2</sub>CO<sub>3</sub> solution.

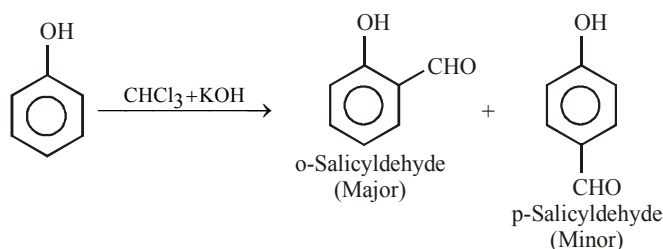
- (7) (C).



- (8) (A). Electron withdrawing (-m/-R) nature of -NO<sub>2</sub> group increases acidic nature of p-nitrophenol.

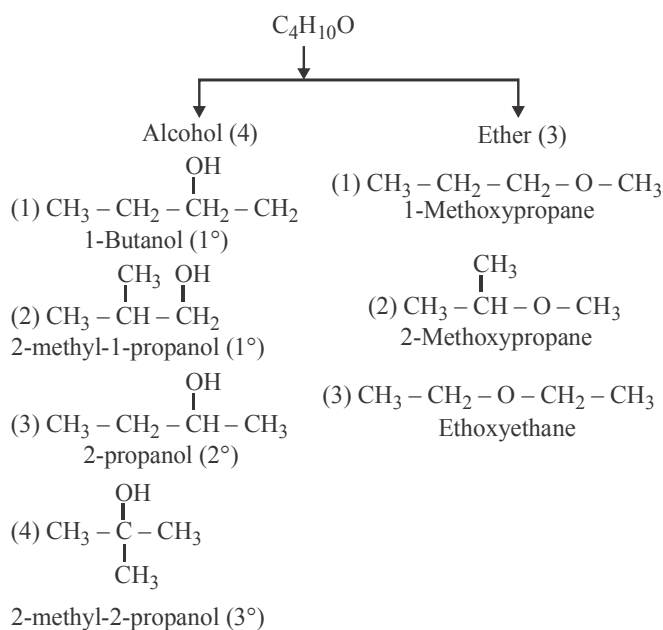
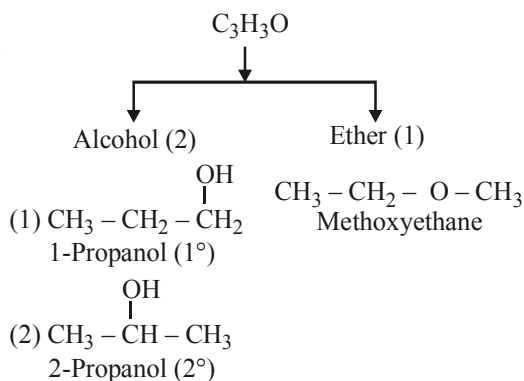


- (10) (C). Reimer-Tiemann reaction

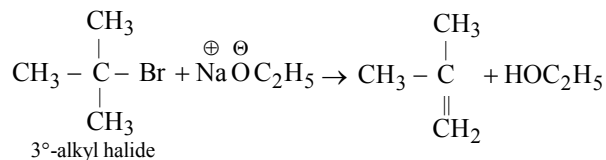
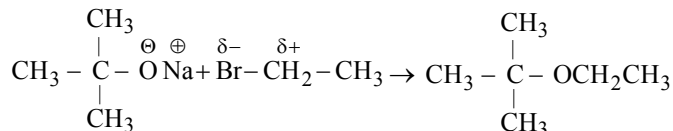


### TRY IT YOURSELF-3

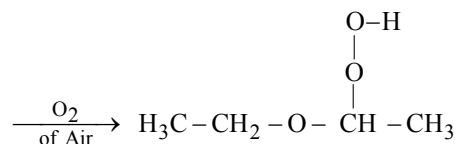
(1) (C).

(3) (C). Reaction of  $R - X$  with  $KCN$  does not produce ether.

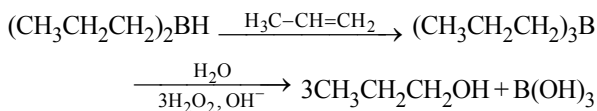
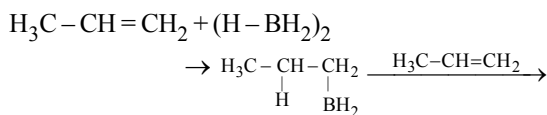
(4) (A). Williamson's synthesis



(5) (B). Due to presence of lone pair electron on O-atom.

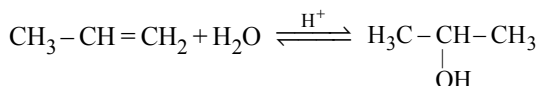
(6) (B).  $CH_3 - CH_2 - O - CH_2 - CH_3$ (7) (D).  $C_2H_5OC_2H_5 \xrightarrow{\text{Oxygen}}$  Ether peroxide(8) (C).  $R - \ddot{O} - R \xrightarrow{H-I} R - I + HO - R$ (9) (C).  $R - Br + Na \overset{\oplus}{O} \overset{\ominus}{R}' \rightarrow R - O - R' + NaBr$   
Unsymmetrical ether(10) (B).  $CH_3 - CH_2 - O - CH_2 - CH_3$ 





The alcohol is formed by the addition of water to the alkene in a way opposite to the Markownikoff's rule. In this reaction, alcohol is obtained in excellent yield.

- (20) (C). Alkenes react with water in the presence of acid as catalyst to form alcohols. In case of unsymmetrical alkenes, the addition reaction takes place in accordance Markownikoff's rule.

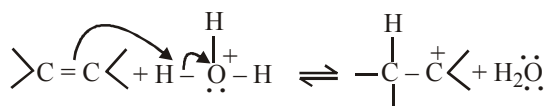
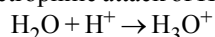


- (21) (B). Tertiary alcohols are formed by treating Grignard reagents either with ketones or excess of an ester other than formate which will give 2° alcohol.

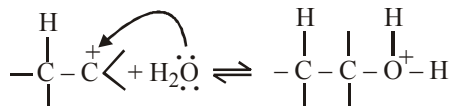


- (23) (B). **Mechanism** : The mechanism of the reaction involves the following steps

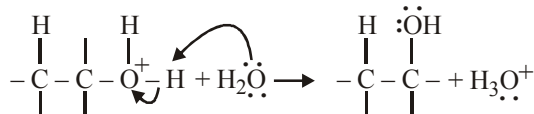
**Step I** : Protonation of alkene to form carbocation by electrophilic attack of  $\text{H}_3\text{O}^+$ .



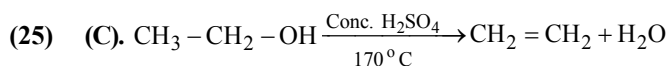
**Step II** : Nucleophilic attack of water on carbocation.



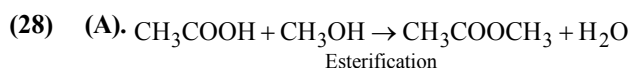
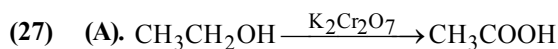
**Step III** : Deprotonation to form an alcohol.



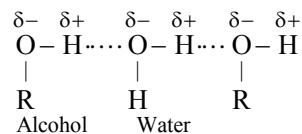
- (24) (C). Alcohols having less number of carbon atoms are more soluble in water.



- (26) (B). Lower alcohols are soluble in all solvents.



- (29) (C). Alcohol is soluble in water due to H-bonding.

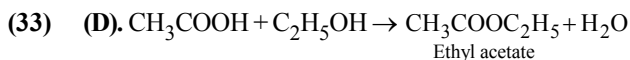


- (30) (C).  $\text{CH}_3\text{CH}_2-\text{OH} + 2\text{Cl}_2 \rightarrow \text{CCl}_3-\text{CHO}$

Oxidation will occur with chlorination of methyl group.

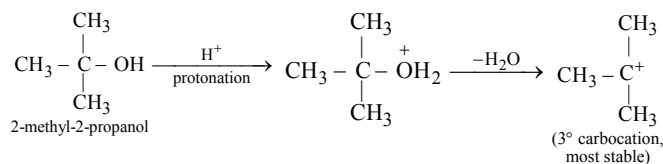
- (31) (B).  $\text{KMnO}_4$  will oxidise initially formed aldehydes to carboxylic acids.

- (32) (B). The acidic character of alcohols is due to the polar nature of -OH bond.

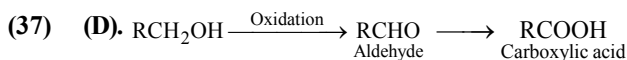


- (34) (C). Order of reactivity of different alcohols towards esterification is 1° alcohol > 2° alcohol > 3° alcohol due to increased steric hindrance in 2° and 3° alcohols.

- (35) (C). The tertiary carbocation formed during dehydration of 2-methyl-2-propanol is most stable.

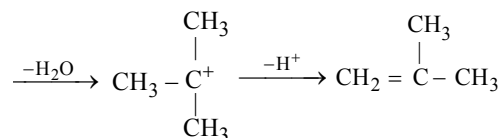
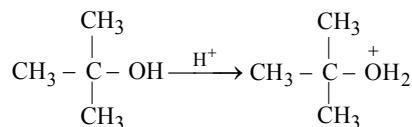


- (36) (C). More the number of methyl groups (electron releasing) lesser will be the acidity. Hence the reactivity towards sodium metal will be tertiary < secondary < primary

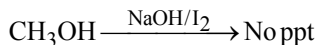
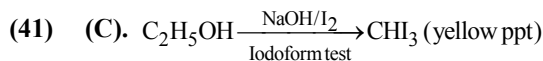


- (38) (B). The process of converting alkyl halides into alcohols involves substitution reaction.

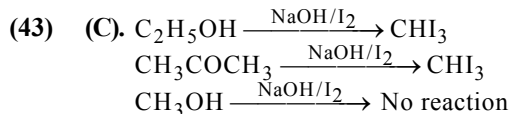
- (39) (A). During the reaction carbocations are formed. 3° carbocation is more stable than 1°, hence the dehydration in 3° alcohol proceeds faster than 1° alcohol.



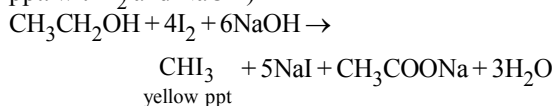
- (40) (B). Alcohols are soluble in Lucas reagent (conc. HCl and  $\text{ZnCl}_2$ ) while their halides are immiscible and produce turbidity in solution. In case of tertiary alcohols, turbidity is produced immediately as they form the halides easily. Primary alcohols do not produce turbidity at room temperature.



(42) (C). Tertiary alcohol produces the turbidity immediately on the reaction with Lucas reagent.



(44) (A). Ethyl alcohol gives positive iodoform test (i.e. yellow ppt. with  $I_2$  and NaOH)



(45) (C). The rate of reaction with Lucas reagent is  $3^\circ > 2^\circ > 1^\circ$ .

Tertiary alcohols immediately react to give turbidity, secondary alcohols after sometime and primary alcohols do not give turbidity until heated.

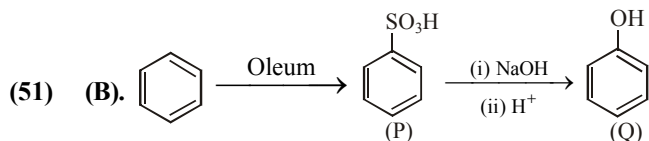
(46) (B). The reaction of alcohol with Lucas reagent is mostly an  $S_N1$  reaction and the rate of reaction is directly proportional to the carbocation stability formed in the reaction, since  $3^\circ R-OH$  forms  $3^\circ$  carbocation hence it will react fastest.

(47) (B). 5-10% methyl alcohol and remaining ethanol is called methylated spirit. It is also known as denatured alcohol because it is unfit for drinking.

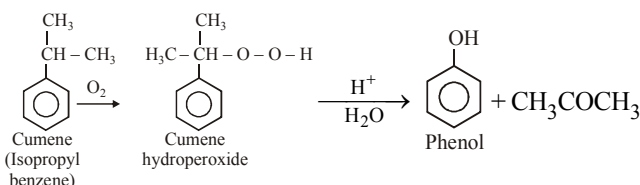
(48) (B). The commercial alcohol is made unfit for drinking by mixing in it some copper sulphate (to give it colour) and pyridine (a foul smelling liquid). It is known as denaturation of alcohol.

(49) (B). Power alcohol 80% petrol and 20% ethyl alcohol

(50) (C). Denaturing can also be done by adding 0.5% pyridine, petroleum naphtha,  $CuSO_4$  etc.

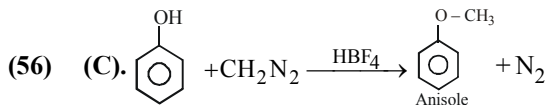
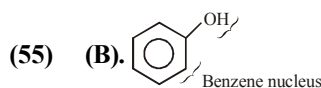


(52) (D).

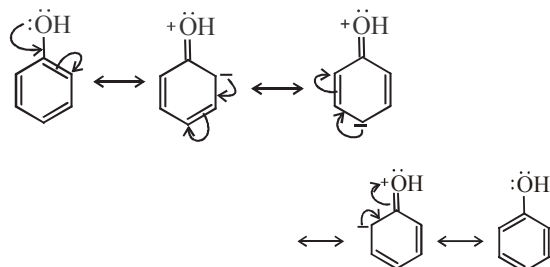


(53) (D). Chlorobenzene does not undergo hydrolysis on treatment with aqueous NaOH at 298K.

(54) (C). Phenol has higher boiling point than toluene because of hydrogen bonding.

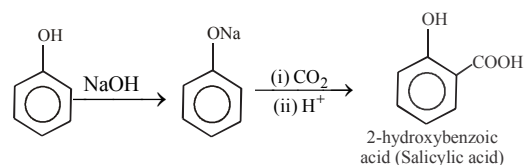


(57) (C).  $-OH$  group in phenol can release electrons to the ring better than  $-CH_3$  group in toluene. Cl atom has electron withdrawing effect which inhibits electrophile attack.

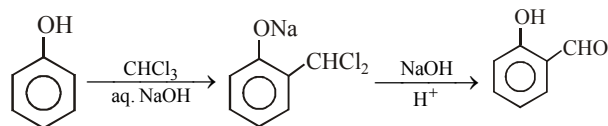


(58) (A). **Kolbe's reaction** : Phenoxide ion generated by treating phenol with NaOH is even more reactive than phenol towards electrophilic aromatic substitution.

Hence, it undergoes electrophilic substitution with  $CO_2$ , a weak electrophile ortho-hydroxybenzoic acid is formed as the main reaction product.



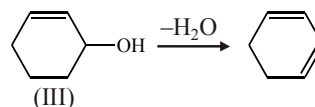
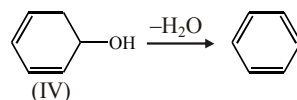
(59) (C).



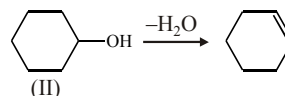
This reaction is Reimer-Tiemann reaction.

(60) (A). Dehydration of IV is most facile since, it gives an aromatic compound.

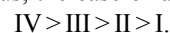
Dehydration of III gives a conjugated diene which is stabilized by resonance.



Dehydration of II gives only cyclohexene which is not stabilized by resonance.



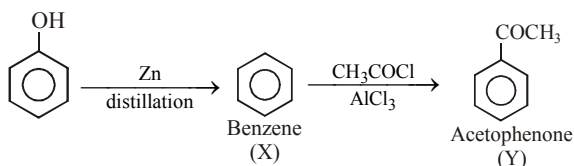
In contrast, phenol (I) does not undergo dehydration. Thus, the ease of dehydration is:



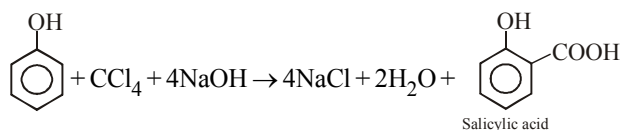
(61) (B). Phenol is less acidic than o-nitrophenol as electron withdrawing ( $-\text{NO}_2$ ) group increases the acidity of phenols while electron donating groups ( $-\text{CH}_3$ ,  $-\text{OCH}_3$ ) decrease the acidity of phenols. Phenols are more acidic than alcohols.

(62) (A). OH group in phenols is more strongly held compared to OH group in alcohols.

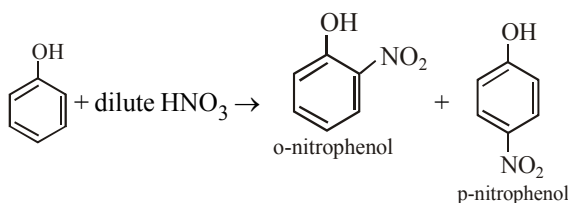
(63) (B).



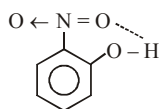
(64) (C).



(65) (D). Nitration of phenol with dilute nitric acid at low temperature (298 K), phenol yields a mixture of ortho and para nitrophenols.

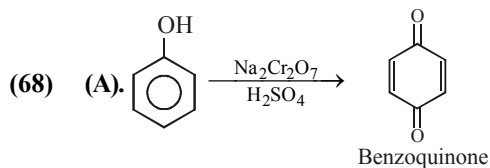


(66) (A). o-Nitrophenol is stable due to intramolecular hydrogen bonding.



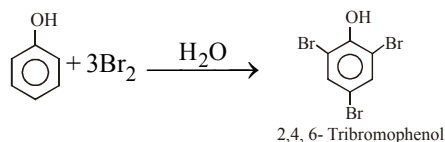
It is difficult to break the H-bonding when dissolved in water thus less soluble.

(67) (A). Phenol ( $\text{C}_6\text{H}_5\text{OH}$ ) will react with sodium hydroxide solution in water, as phenols are more acidic than alcohols.



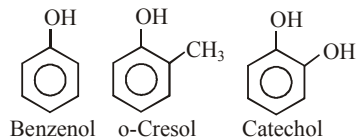
(69) (A). Phenol has higher boiling point than toluene because of hydrogen bonding.

(70) (A). Phenol on reaction with excess of bromine water gives a white precipitate of 2, 4, 6-tribromophenol.



(71) (D). Presence of electron withdrawing groups such as nitro group enhances the acidic strength of phenol and the presence of electron releasing groups such as alkyl group decreases the acidic strength of phenol.

(72) (D). Compounds containing  $-\text{OH}$  group directly attached to benzene ring are called phenolic compounds.



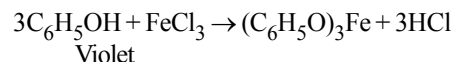
(73) (C). Phenol (all enols) can be oxidised by  $\text{FeCl}_3$  to form coloured complexes. Alcohols, however, cannot get oxidised by  $\text{FeCl}_3$ .

(74) (D).

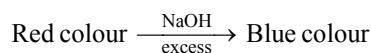
- Some phenols can be used as flavouring agents.
- Some phenols can be used as perfumes.
- Vanillin (present in oil of vanilla bean) is an example of phenol used as a flavouring agents.

(75) (D).

- Phenol give deep blue or violet colour with neutral  $\text{FeCl}_3$ .

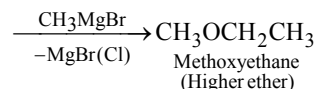
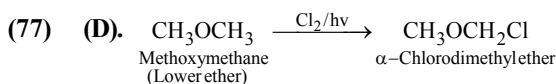


- Phenol give liebermann's nitroso reaction.

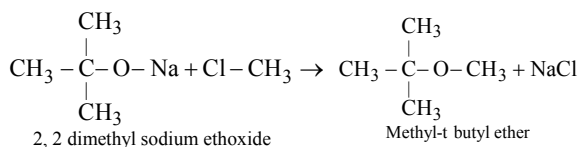


- Phenol produce a white precipitate of 2, 4, 6-tribromophenol with bromine water.

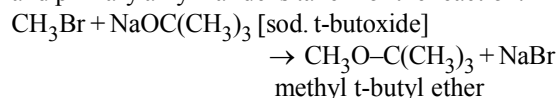
(76) (C). Williamson's synthesis



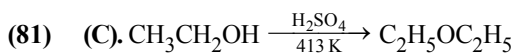
(78) (B).



(79) (B). Tertiary halide can involve elimination of HX to give alkene in presence of a base. Hence, a tertiary alkoxide and primary alkyl halide is taken for the reaction.



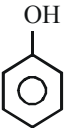

(80) (A). **Williamson's synthesis** : It is an method for the preparation of symmetrical and unsymmetrical ethers.  
 $\text{RX} + \text{RO}^-\text{Na}^+ \rightarrow \text{ROR} + \text{NaX}$



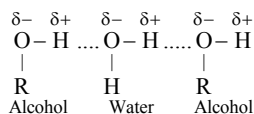


- (82) (D).  $C_2H_5OH + CH_3CH_2CH_2OH \xrightarrow[\Delta]{\text{Conc. } H_2SO_4} C_2H_5OC_2H_5 + C_3H_7OC_3H_7 + C_2H_5OC_3H_7$
- (83) (B). Ether is basic because lone pairs of electrons are present on oxygen atom,  $R-\ddot{O}-R$ .
- (84) (D). Due to inter-molecular hydrogen bonding in alcohols boiling point of alcohols is much higher than ether.
- (85) (D).  $C_2H_5-O-C_2H_5 + O_2 \xrightarrow[25^\circ C]{h\nu} CH_3-CH(OOH)-O-C_2H_5$
- (86) (B). Alkyl aryl ethers undergo substitution reactions.
- (87) (A). Ethers have lower boiling points than the corresponding isomeric alcohols because of absence of hydrogen bonding in ethers.
- (88) (B). The C-O bonds in ethers are polar and thus, ethers have a net dipole moment.
- (89) (C). The large difference in the boiling point of alcohols and ethers is due to the presence of H bonding interaction in alcohols.
- (9) (A).  $C_6H_6O^- + CH_3I \rightarrow C_6H_6OCH_3 + I^-$
- (10) (C).  $CH_3OH + Na \rightarrow CH_3ONa + \frac{1}{2}H_2$   
1 mole            1 mole            1/2 mole  
(23gms)
- (11) (D).  $3CH_3CH_2CH_2CH_2-OH + PBr_3 \rightarrow 3CH_3CH_2CH_2CH_2-Br + H_3PO_3$
- (12) (D).  $CH_3-\underset{\text{OH}}{\underset{|}{CH}}-CH_3 \xrightarrow{[O]} CH_3-\underset{\text{O}}{\underset{||}{C}}-CH_3$
- (13) (C).  $CH_3-\underset{\text{OH}}{\underset{|}{CH}}-CH_2-CH_3 \xrightarrow{[O]} CH_3-\overset{\text{O}}{\underset{||}{C}}-CH_2CH_3$
- (14) (A). Secondary alcohol on dehydrogenation gives acetone  
 $CH_3-\underset{\text{OH}}{\underset{|}{CH}}-CH_3 \xrightarrow[300^\circ C]{Cu} CH_3-\underset{\text{O}}{\underset{||}{C}}-CH_3 + H_2$

**EXERCISE-2**

- (1) (C). Coconut oil + Alkali  $\rightarrow$  Soap + Glycerol  
It is a saponification reaction.
- (2) (C).  $C_6H_{12}O_6 \xrightarrow{\text{Zymase}} 2C_2H_5OH + 2CO_2$   
Glucose or Fructose                      Ethylalcohol
- (3) (B).  +  $CHCl_3 + 3NaOH \rightarrow$   
Salicylaldehyde +  $3NaCl + 2H_2O$
- (4) (D). Acetone reacts with Grignard's reagent to give tertiary alcohol.  
 $(CH_3)_2C=O + CH_3MgBr \xrightarrow{H_2O} (CH_3)_3C-OH$   
ter-butyl alcohol  
(2-Methylpropan-2-ol)
- (5) (B).  $C_2H_5MgBr + H_2C \begin{matrix} \diagup \\ \diagdown \end{matrix} CH_2 \xrightarrow{H_2O}$   
  
 $C_2H_5CH_2CH_2OH + MgBr(OH)$   
(A)  
n-butylalcohol
- (6) (B). Williamson's synthesis -  
 $CH_3-CH_2-ONa + Cl-CH_2-CH_3 \rightarrow$   
 $CH_3-CH_2-O-CH_2-CH_3$
- (7) (A). Dehydration of alcohols gives ethers.
- (8) (B).  $NaBH_4$  and  $LiAlH_4$  attacks only carbonyl group and reduce it into alcohol group. They do not attack on double bond.  
 $C_6H_5-CH=CHCHO \xrightarrow{NaBH_4} C_6H_5-CH=CH.CH_2OH$   
cinnamic aldehyde                      cinnamic alcohol
- (9) (A).  $C_6H_6O^- + CH_3I \rightarrow C_6H_6OCH_3 + I^-$
- (10) (C).  $CH_3OH + Na \rightarrow CH_3ONa + \frac{1}{2}H_2$   
1 mole            1 mole            1/2 mole  
(23gms)
- (11) (D).  $3CH_3CH_2CH_2CH_2-OH + PBr_3 \rightarrow 3CH_3CH_2CH_2CH_2-Br + H_3PO_3$
- (12) (D).  $CH_3-\underset{\text{OH}}{\underset{|}{CH}}-CH_3 \xrightarrow{[O]} CH_3-\underset{\text{O}}{\underset{||}{C}}-CH_3$
- (13) (C).  $CH_3-\underset{\text{OH}}{\underset{|}{CH}}-CH_2-CH_3 \xrightarrow{[O]} CH_3-\overset{\text{O}}{\underset{||}{C}}-CH_2CH_3$
- (14) (A). Secondary alcohol on dehydrogenation gives acetone  
 $CH_3-\underset{\text{OH}}{\underset{|}{CH}}-CH_3 \xrightarrow[300^\circ C]{Cu} CH_3-\underset{\text{O}}{\underset{||}{C}}-CH_3 + H_2$
- (15) (D).  $CH_2-\underset{\text{OH}}{\underset{|}{CH}}-\underset{\text{OH}}{\underset{|}{CH}}-\underset{\text{OH}}{\underset{|}{CH}}-CH_2$   
Glycerol is trihydric alcohol.
- (16) (B).  $CH_2-OH$   
 $|$   
 $CH-OH$   
 $|$   
 $CH_2-OH$   
One secondary and two primary alcoholic groups.
- (17) (D).  $RMgBr + O_2 \rightarrow R-OMgBr$   
Grignard reagent  
 $\xrightarrow{\text{hydrolysis}} R-OH + Mg \begin{matrix} \diagup \\ \diagdown \end{matrix} \begin{matrix} Br \\ OH \end{matrix}$   
Alcohol
- (18) (C).  $CH_3-OH + CH_3Mg-X \rightarrow CH_4 + CH_3O-Mg-X$
- (19) (B).  $CH_2-OH$                        $CH_2-I$                        $CH_2$   
 $|$                        $|$                        $||$   
 $CH-OH \xrightarrow[\text{Small amount}]{P_4+I_2} CH-I \xrightarrow{-I_2} CH$   
 $|$                        $|$                        $|$   
 $CH_2OH$                        $CH_2-I$                        $CH_2-I$   
Unstable                      Allyl iodide
- (20) (B).  $C_2H_5OH + R-Mg-X \rightarrow RH + C_2H_5OMgX$   
Alkane  
 $C_3H_7OH + R-Mg-X \rightarrow RH + C_3H_7OMgX$
- (21) (A).  $C_2H_5OH \xrightarrow[\text{air}]{Pt} CH_3CHO$
- (22) (D). Traces of water from ethanol is removed by reacting with Mg metal.
- (23) (B).  $CH_3CH_2-OH + HO-CH_2-CH_3 \xrightarrow[140^\circ C]{\text{Conc. } H_2SO_4} CH_3CH_2-O-CH_2-CH_3 + H_2O$   
Diethyl ether

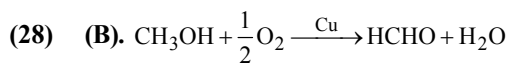
(24) (B). Hydrogen bonding :



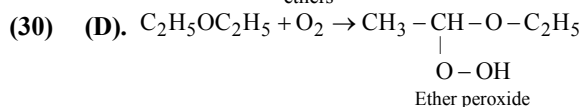
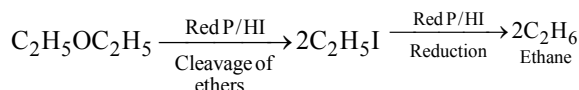
(25) (D). Tertiary alcohols react fastest with hydrogen halides. 2 methyl propan-2-ol is a tertiary alcohol.

(26) (B). Aspirin or Acetyl salicylic acid.

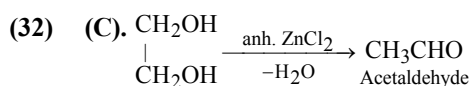
(27) (B).  $\text{CH}_3\text{OH}$  has highest boiling point because of hydrogen bonding.



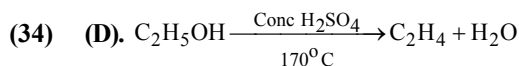
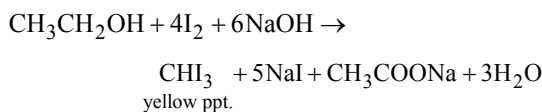
(29) (A).



(31) (B). Methanol has high boiling point than methyl thiol because there is intermolecular hydrogen bonding in methanol and no hydrogen bonding in methyl thiol.

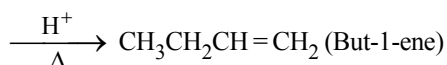
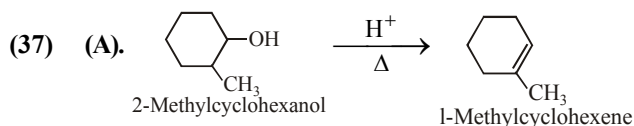


(33) (D). Ethyl alcohol give positive iodoform test (i.e. yellow ppt. with  $\text{I}_2$  and  $\text{NaOH}$ )



(35) (D). Pyridinium chlorochromate oxidises an alcoholic group selectively in the presence of carbon-carbon double bond.

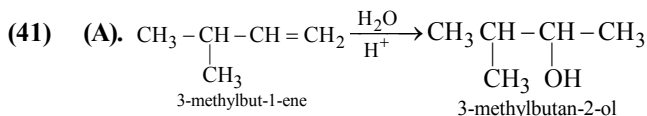
(36) (C). Primary alcohols readily form ether when heated with conc.  $\text{H}_2\text{SO}_4$ .



(38) (C).  $\text{CH}_3(\text{CH}_2)_3\text{CH}_3$  (X)  $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$  (Y)  $\text{CH}_3(\text{CH}_2)_3\text{OH}$  (Z)  
Boiling point (K)  
309.1                      307.6                      390

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

(40) (B). Presence of electron releasing group decreases the acidity of the alcohols. Hence  $t < s < p$ .  
 $\text{CH}_3\text{OH} > \text{C}_2\text{H}_5\text{OH} > (\text{CH}_3)_2\text{CHOH} > (\text{CH}_3)_3\text{COH}$ .



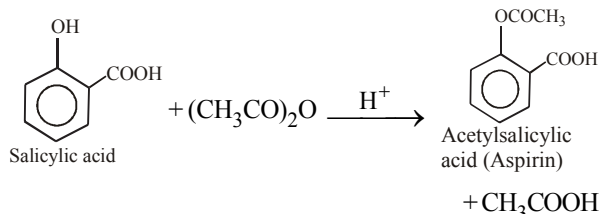
(42) (B). 2,4,6-Trinitrophenol is commonly known as picric acid.

(43) (A).  $\text{C}_4\text{H}_{10}\text{O}$  can have two structures:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$  and  $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$ . Since it does not react with Na metal, it can not be an alcohol.  $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5 + \text{HI}$  (excess)  $\rightarrow 2\text{C}_2\text{H}_5\text{I} + \text{H}_2\text{O}$

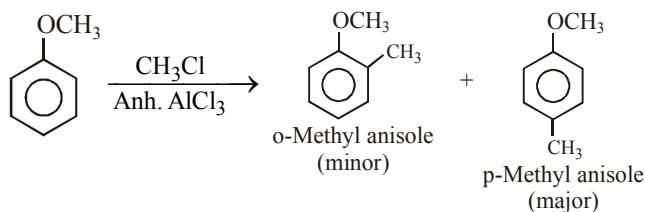
(44) (C). Electron releasing inductive effect of  $-\text{OCH}_3$  group facilitates the protonation of alcohol involved in dehydration mechanism.

(45) (B). Aspirin possesses analgesic, antiinflammatory and antipyretic properties.

Acetylation of salicylic acid produces aspirin.

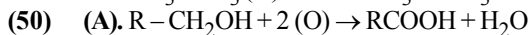
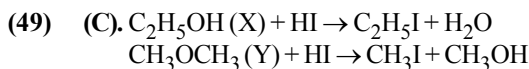


(46) (C).



(47) (A). Presence of two electron withdrawing  $-\text{NO}_2$  groups in the ring makes 2,4-dinitrophenol a stronger acid than phenol. Hence it reacts with aqueous  $\text{Na}_2\text{CO}_3$  solution to form sodium salt thus making it soluble in  $\text{Na}_2\text{CO}_3$ .

(48) (C). 2-Chloroethanol is more acidic due to  $-I$  effect of chlorine.

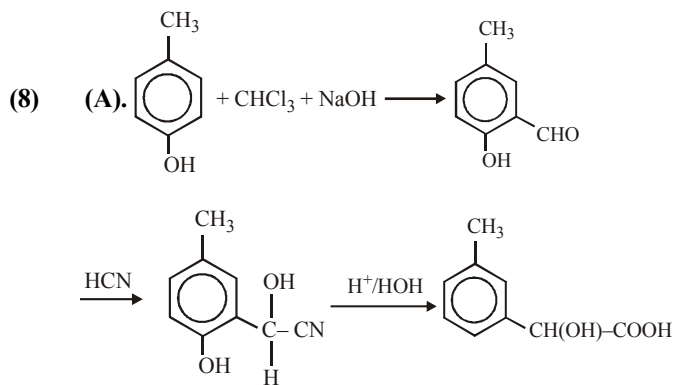


When primary alcohol is oxidized, two hydrogens are removed and one oxygen is added to the molecule. Hence, molecular mass increases by 14 units.

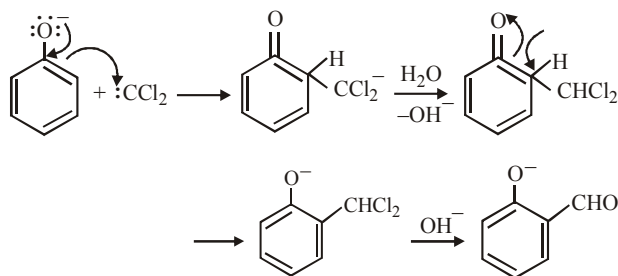


## EXERCISE-4

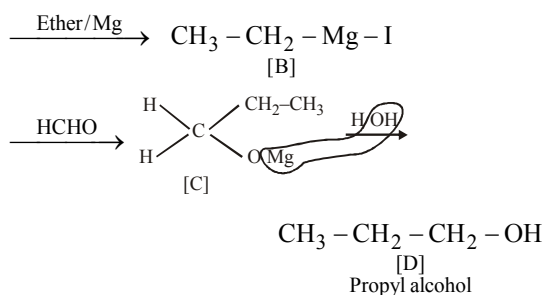
- (1) (B).  
 (2) (B).  $\begin{array}{c} \text{O} - \text{H} \cdots \text{O} - \text{H} \cdots \text{O} - \text{H} \\ | \quad \quad | \quad \quad | \\ \text{R} \quad \quad \text{R} \quad \quad \text{R} \end{array}$   
 (3) (D).  $\text{CH}_2 = \text{CH} - \text{CH}_2\text{OH}$   
 (4) (D). The general formula  $\text{C}_n\text{H}_{2n}\text{O}_2$  represents carboxylic acids.  
 (5) (D) Butane-2-one  
 (6) (B). Benzaldehyde  
 (7) (C). Sequence of dehydration of alcohol  
 $3^\circ > 2^\circ > 1^\circ$



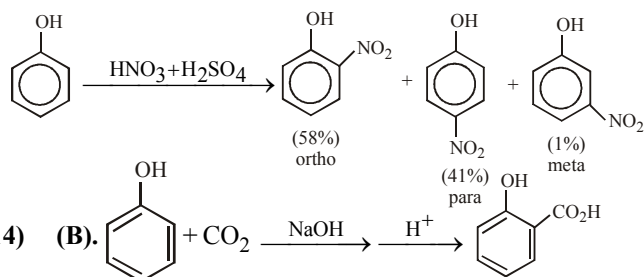
- (9) (D).  
 (10) (A). Mechanism:  
 $\text{CHCl}_3 + \text{OH}^- \longrightarrow \text{Cl}_3\text{C}^- + \text{H}_2\text{O} \longrightarrow \text{Cl}^- + \text{:CCl}_2$   
 Dichloromethylene (electrophile)



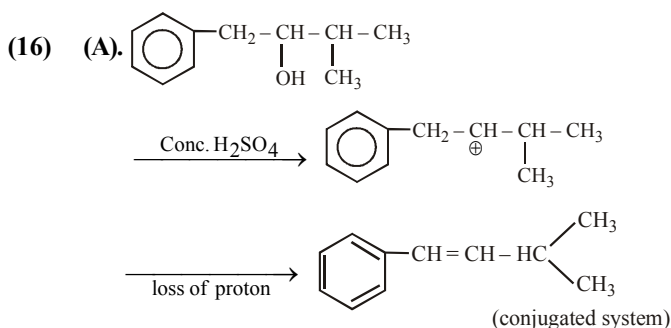
- (11) (D).  
 (12) (C).  $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{P} + \text{I}_2} \text{CH}_3 - \text{CH}_2 - \text{I}$  [A]



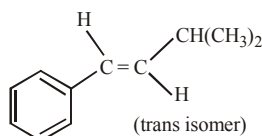
- (13) (A).



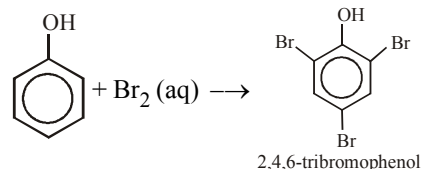
- (14) (B). This is Kolbe's synthesis.  
 (15) (B).  $3^\circ$  alcohols react fastest with  $\text{ZnCl}_2/\text{conc. HCl}$  due to formation of  $3^\circ$  carbocation and  $\therefore$  2-methyl propan-2-ol is the only  $3^\circ$  alcohol



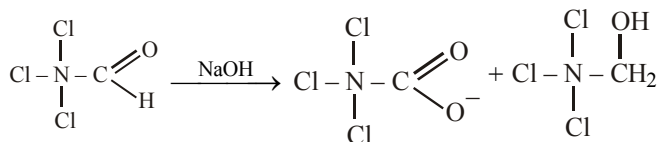
Trans isomers is more stable &amp; main product here



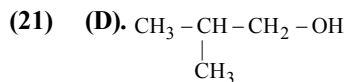
- (17) (D).
- $\text{KBr (aq.)} + \text{KBrO}_3 \text{ (aq.)} \longrightarrow \text{Br}_2 \text{ (aq.)}$



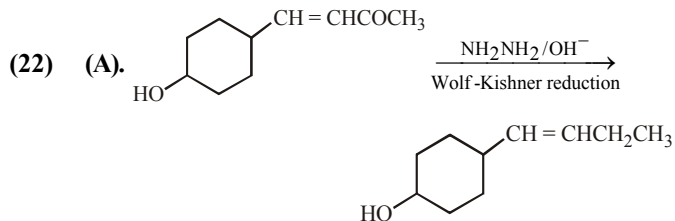
- (18) (D). Neutral  $\text{FeCl}_3$  reacts with phenol and give violet coloured complex.  
 (19) (A). The Cannizzaro product of given reaction yields 2,2,2-trichloroethanol.



- (20) (B). Intra-molecular H-bonding.

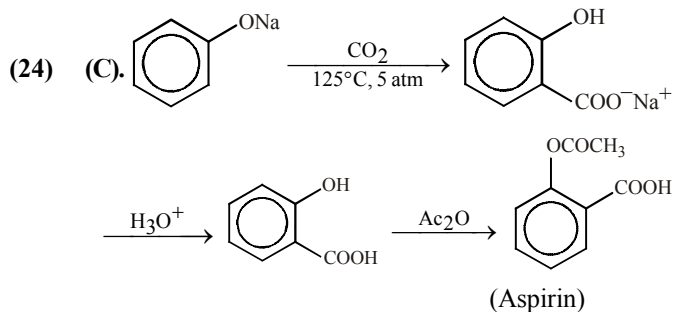


isobutyl alcohol does't give positive iodoform test.

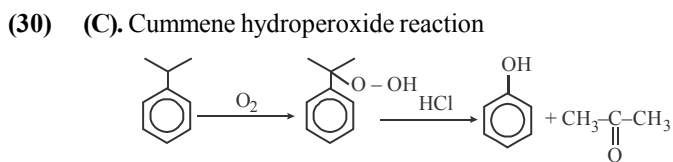
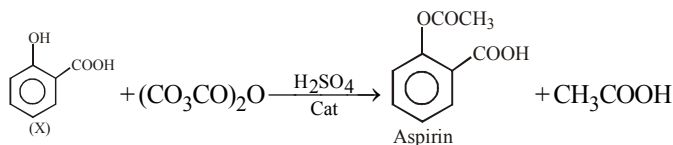
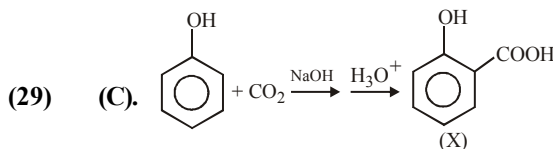
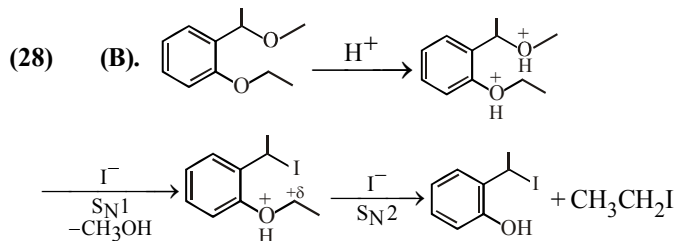
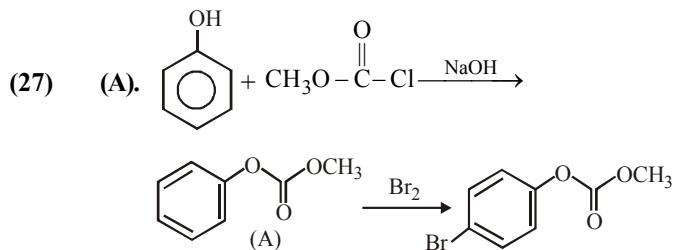
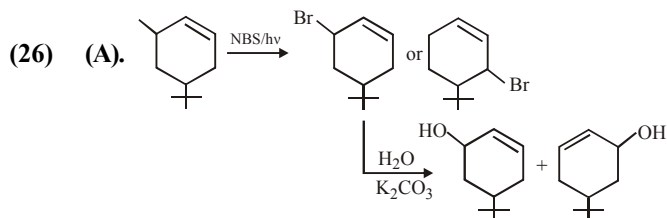


-OH group and alkene are acid-sensitive groups so Clemmensen reduction can not be used.

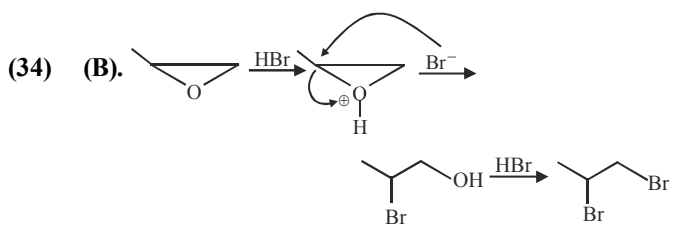
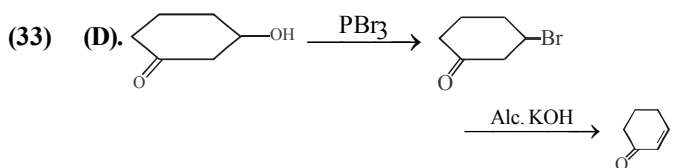
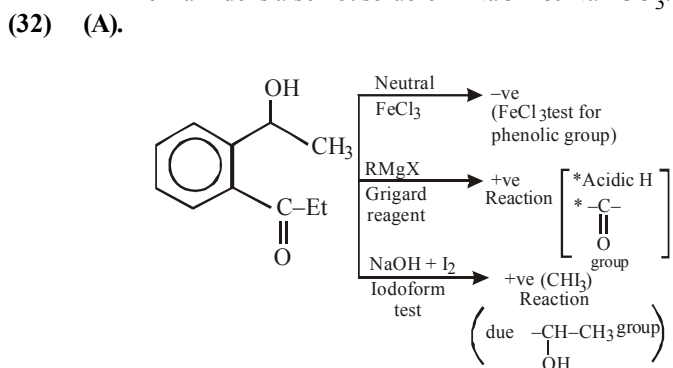
(23) (B). The reaction of alcohol with Lucas reagent is mostly an  $\text{S}_{\text{N}}1$  reaction and the rate of reaction is directly proportional to the carbocation stability formed in the reaction, since  $3^\circ \text{R} - \text{OH}$  forms  $3^\circ$  carbocation hence it will react fastest.

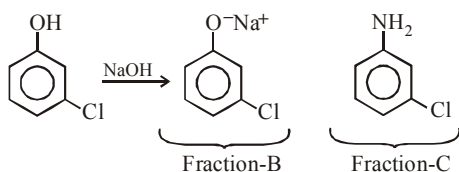
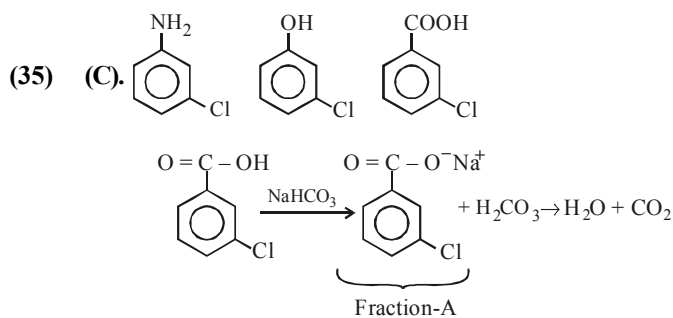


(25) (B). PCC is mild oxidising agent, it will convert  $\text{RCH}_2\text{OH} \xrightarrow{\text{PCC}} \text{RCHO}$

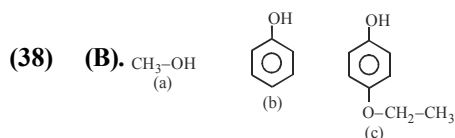
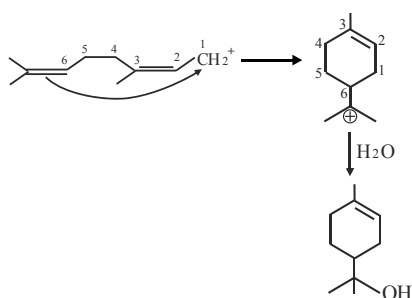
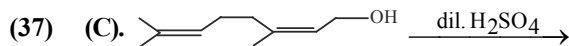


- \* Oleic acid is also soluble in  $\text{NaHCO}_3$ .
- \* o-toluidine is not soluble in  $\text{NaOH}$  as well as  $\text{NaHCO}_3$ .
- \* Benzamide is also not soluble in  $\text{NaOH}$  &  $\text{NaHCO}_3$ .





- (36) (A). When negative charge is delocalised with electron withdrawing group like ( $\text{NO}_2$ ) then stability increases.
- Negative charge is delocalised with  $\text{NO}_2$  group.
  - Negative charge is delocalised with carbon of alkene.
  - Negative charge is localised.



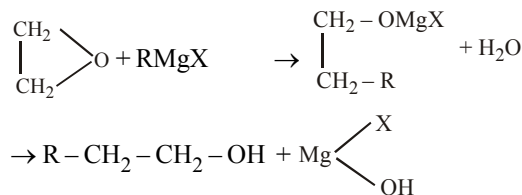
There is not any resonance in  $\text{CH}_3\text{-OH}$ . Resonance is poor in p-Ethoxyphenol than phenol.

- (39) (B). In A, extensive inter-molecular H-bonding is possible while in B there is no Inter-molecular H-bonding.

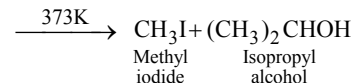
### EXERCISE-5

- (1) (C). Phenols are more acidic than alcohol as they are resonance stabilised whereas alcohols are not. Further nitro group is an electron withdrawing group hence helps in stabilizing the negative charge on oxygen hence equilibrium shifts towards forward direction and hence  $\text{H}^+$  remove easily, whereas  $-\text{CH}_3$  is an electron donating group hence density increases on the oxygen and helps in destabilizing the product hence the equilibrium shifts in backward direction, thus removal of  $\text{H}^+$  becomes very difficult.

- (2) (C). Alkanols :  $\text{C}_n\text{H}_{2n+2}\text{O}$  [ $\text{C}_n\text{H}_{2n+1}\text{OH}$ ]  
 (3) (C). Ethylene oxide when treated with Grignard reagent gives primary alcohol.

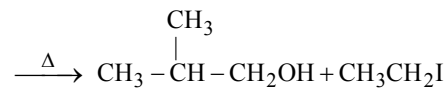
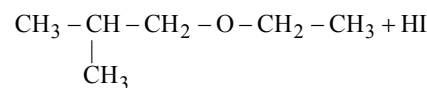


- (4) (C). In case of unsymmetrical ethers, the site of cleavage depends on the nature of alkyl group e.g.,  
 $\text{CH}_3 - \text{O} - \text{CH}(\text{CH}_3)_2 + \text{HI}$

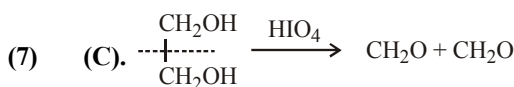


The alkyl halide is always formed from the smaller alkyl group.

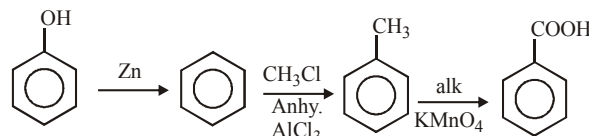
- (5) (C). In the cleavage of mixed ethers with two different alkyl groups, the alcohol and alkyl iodide that form depend on the nature of alkyl group. When primary or secondary alkyl groups are present, it is the lower alkyl group that forms alkyl iodide therefore



- (6) (C).  $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{PBr}_3} \text{CH}_3\text{CH}_2\text{Br}$   
 $\xrightarrow{\text{Alc. KOH}} \text{CH}_2 = \text{CH}_2 \xrightarrow{\text{(i) H}_2\text{SO}_4} \text{CH}_3\text{CH}_2 - \text{HSO}_4$   
 $\xrightarrow[\text{Heat}]{\text{H}_2\text{O}} \text{CH}_3\text{CH}_2\text{OH}$



- (8) (B).



- (9) (A). Higher the tendency to give a proton, higher is the acidic character, and tendency to lose a proton depends upon the stability of intermediate, i.e., carbanion formed.  
 2, 4, 6-trinitrophenol after the loss of a proton gives 2,4,6-trinitrophenoxide ion which is stabilised by resonance,  $-\text{I}$  effect and  $-\text{M}$  effect, thus is most acidic among the given compounds.  
 Phenol after losing a proton form phenoxide ion which is also stabilised by resonance,  $-\text{M}$  and  $-\text{I}$  effects but is less stabilised as compared to 2, 4, 6-trinitrophenoxide ions.

Thus, it is less acidic as compared to 2,4,6-trinitrophenol. ( $\text{CH}_3\text{COOH}$ ) after losing a proton

gives acetate ( $\text{CH}_3\text{C}(=\text{O})\text{O}^-$ ) ion which is stabilised by

only resonance. However, it is more resonance stabilised as compared to a phenoxide ion, thus more acidic as compared to phenol. 2,4,6-trinitrophenol, however, is more acidic than acetic acid due to the presence of three electron withdrawing  $-\text{NO}_2$  groups. Cyclohexanol gives an anion that is least stable among the given, thus, it is least acidic. Hence, the correct order of acidic strength is 2, 4, 6-trinitrophenol > acetic acid > phenol > cyclohexanol.

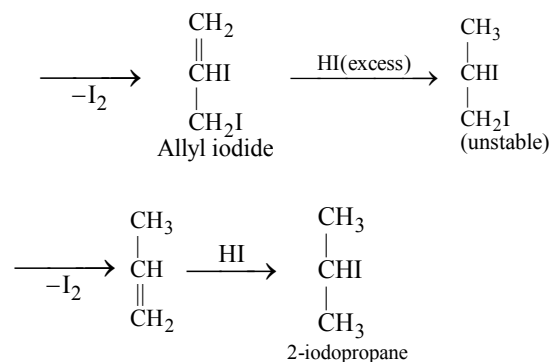
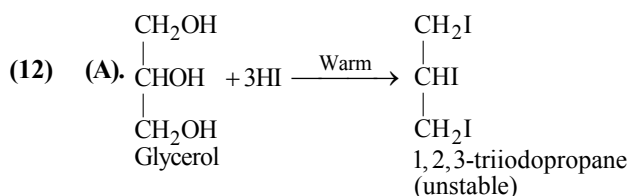
(10) (B). Presence of electron withdrawing substituent increases the acidity while electron releasing substituent, when present, decreases the acidity.

Phenyl is an electron withdrawing substituent while  $-\text{CH}_3$  is an electron releasing substituent. Moreover, phenoxide ion is more resonance stabilised as compared to benzyloxy ion, thus releases proton more easily. That's why it is a strong acid among the given.

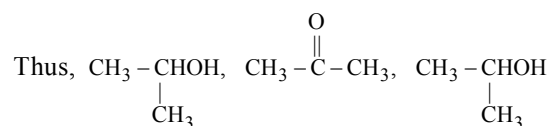
(11) (A). In phenols, the presence of electron releasing groups decreases the acidity, whereas presence of electron withdrawing groups increase the acidity, compared to phenol. Among the meta and para-nitrophenols, the latter is more acidic as the presence of  $-\text{NO}_2$  group at para position stabilises the phenoxide ion to a greater extent than when it is present at meta position. Thus, correct order of acidity is :

Para-nitrophenol > meta-nitrophenol

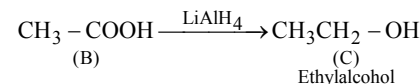
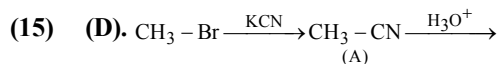
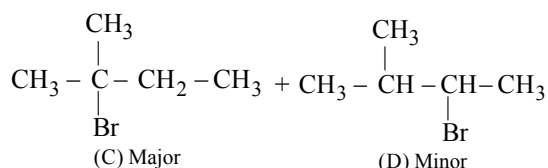
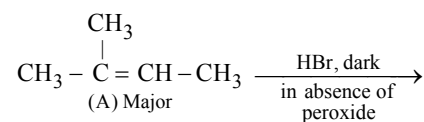
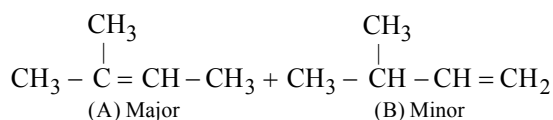
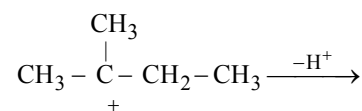
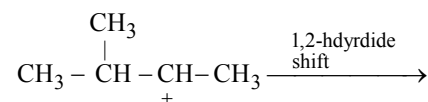
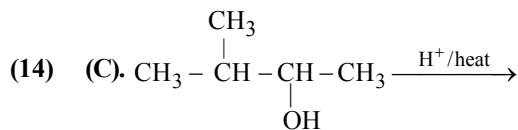
(iv) (iii)  
> phenol > methyl phenol  
(i) (ii)



(13) (C). Compounds having either group or  $\text{CH}_3\text{CHOH}-$  group, give iodoform when warmed with  $\text{I}_2$  and  $\text{NaOH}$ .

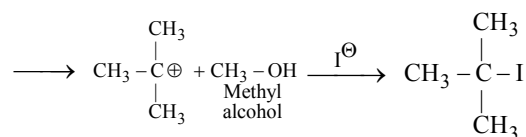
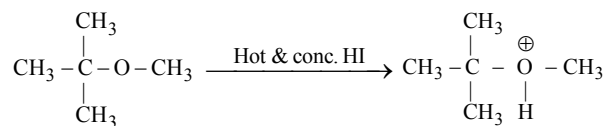


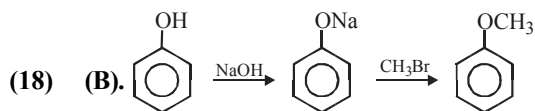
give iodoform when warmed with  $\text{I}_2$  and  $\text{NaOH}$ , (Remember,  $\text{NaOI}$  oxidises  $\text{CH}_3\text{CH}_2\text{OH}$  to  $\text{CH}_3\text{CHO}$ , thus it gives positive iodoform test.)



(16) (B). Glycol is used as an antifreeze in automobiles.

(17) (D). C-O bond cleavage of ether depends on mechanism involved in reaction which can be  $\text{S}_{\text{N}}1$  or  $\text{S}_{\text{N}}2$ . If any one group can form stable carbocation like tertiary butyl group then reaction follows  $\text{S}_{\text{N}}1$  mechanism

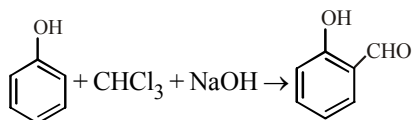




(19) (C). o-nitrophenol is weaker acid than  $\text{HCO}_3^-$ .

(20) (D). It is Williamson-synthesis reaction.

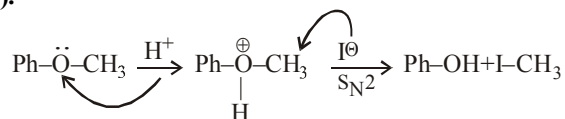
(21) (B). Reimer Tieman reaction



(22) (C). (I) and (IV) can be used due to presence of anhydrous  $\text{ZnCl}_2$  (III) gives alkyl halide due to formation of more stable carbocation.

(23) (A). Williamson ether synthesis reaction involves the treatment of sodium alkoxide with a suitable alkyl halide to form an ether.

(24) (B).



(25) (D).  $\text{C}_2\text{H}_5\text{OH} \xrightarrow{\text{Na}} \text{C}_2\text{H}_5\text{O}^-\text{Na}^+$

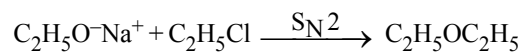
(A)

$\downarrow \text{PCl}_5$

$\text{C}_2\text{H}_5\text{Cl}$

(C)

(B)

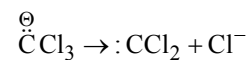
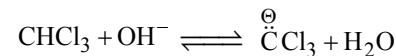


(B) (C)

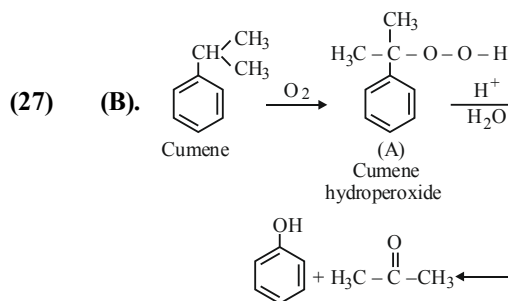
So the correct option is (D).

(26) (D). It is Reimer-Tiemann reaction.

The electrophile formed is  $:\text{CCl}_2$  (Dichlorocarbene) according to the following reaction



Electrophile



(28) (D). Due to involvement of lone pair of electrons in resonance in phenol, it will have positive charge (partial), hence incoming proton will not be able to attack easily.