Ranjan Singh
Chemistry Classes
JEE (Main & Advanced) • NEET • XI • XII

Study Package

Ranjan Singh
M.Sc. Bio-Chemistry(P.U)
Ex-Faculty : Narayana & Goal

ORGANIC CHEMISTRY

ALCOHOL, PHENOL & ETHER

Director's Message

Ranjan Singh
M.Sc.(Biochemistry), P.U.

Chemistry plays a central and important role in all competitive examinations as well as in day to day life. For last so many years, I have constantly been in touch with students, guiding them in Chemistry and looking into their difficulties for them to succeed in their board as well as competitive examinations JEE(Mains & Advance) | NEET.

I have felt a need for a good coaching centre to fulfil the requirements of students. Students need a highly experienced and qualified faculty in chemistry, who can guide them well, clear their doubts, provide them the effective & tricky notes, and make them do much needed practice. More importantly they should also be provided Classroom Monitoring, Periodical & Surprise Tests to guide them in the proper direction. I realize that, it is very important to diagnose the basic weaknesses and problems of students not succeeding in JEE(Mains & Advance) | NEET and Board exams. In fact, as question patterns are changing, now they need to have a different approach for these Examinations.

At RANJAN SINGH CHEMISTRY CLASSES, we have our own way to prepare students for Competitive Examinations as well as Board Examination at a time so they can crack the entrance exam like JEE(Mains & Advance) and NEET as well as 12th Board simultaneously. We act as a medium to provide the simplest, easiest and a comfortable way to make students achieve their target. At RANJAN SINGH CHEMISTRY CLASSES(RSCC), we guide our students with the best motivational classes so weak students are also able to believe that, They can do it.

When you join RANJAN SINGH CHEMISTRY CLASSES you become a part of the powerful force which propels you towards your goal and if you get a position among the rankers with my excellent guidance, I will think that our efforts have borne fruits.

M.Sc(Biochemistry), P.U.
Ex-faculty : Narayana IIT Academy
& Goal Institute

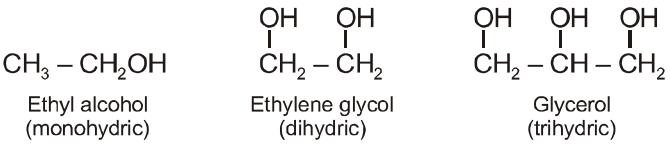
Ranjan Singh

ALCOHOLS

INTRODUCTION :

Molecules containing –OH group are termed as alcohols. Classification of alcohols they are classified as primary, secondary or tertiary alcohol according to the carbon that is bonded with –OH.

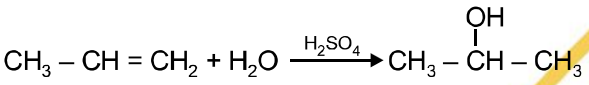
Again when any molecule contain 1, 2 or 3 –OH groups then it is called mono, di or tri hydric alcohols respectively. (as in case of alkyl halides)



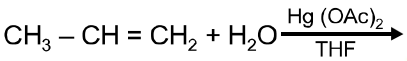
GENERAL METHODS OF PREPARATION

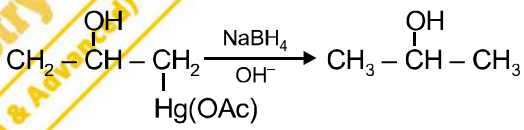
1. From Alkenes :

(i) **By direct hydrolysis :**

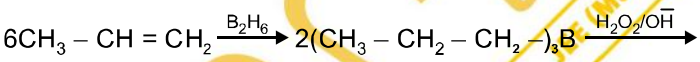


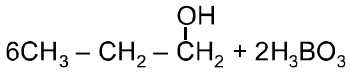
(ii) **Oxymercuration demercuration :**





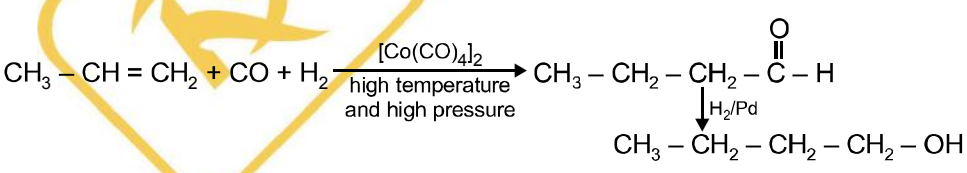
(iii) **Hydroboration oxidation :**





Overall result of above reaction is anti Markwonikoff addition of water and with no rearrangement.

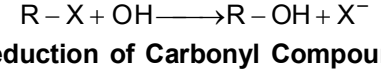
(iv) **Oxo process followed by hydrogenation :**



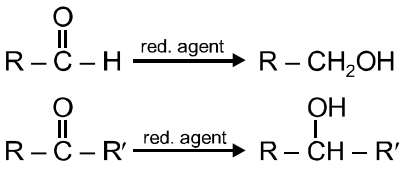
Product has one more carbon.

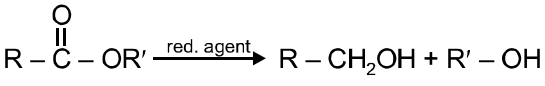
2. From Alkyl Halides :

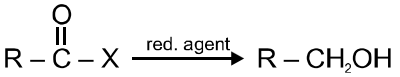
When alkyl halides are treated with aq. KOH or aq. NaOH or moist Ag_2O, alcohols are formed.



3. Reduction of Carbonyl Compounds, Carboxylic Acids and their Derivatives :







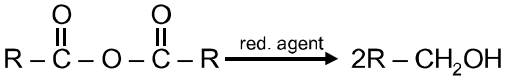
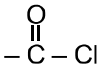
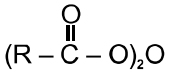
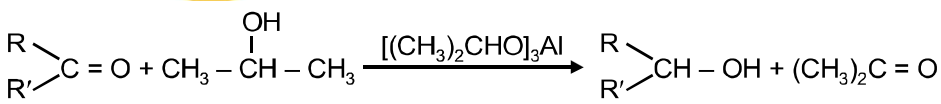


Table : Reducing nature of different reagents

Group	Product	$LiAlH_4/H_2O$	$NaBH_4/C_2H_5OH$	B_2H_6/THF	H_2/Pt
	$-CH_2-OH$	Yes	Yes	Yes	Yes
$>C=O$	$>CH-OH$	Yes	Yes	Yes	Yes
$-COOH$	$-CH_2OH$	Yes	No	Yes	Yes
	$-CH_2OH$	Yes	Yes	No	Yes
	$R-CH_2OH$	Yes	No	Yes	Yes
	$-CH_2OH + R-OH$	Yes	No	Yes	Yes
$>C=C<$	$>CH-CH<$	No ($LiAlH_4$ reduces) C = C only when it is conjugated with Phenylic system	No	Yes	Yes

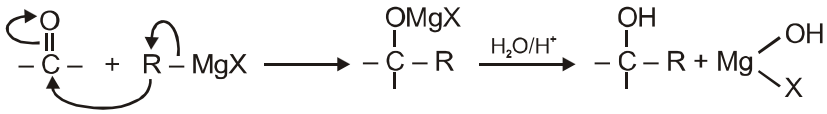
Meerwein-Ponndorf-Verley Reduction (MPV Reduction) : Its a name reaction of reduction of  → alcohol

Ketones can be reduced to secondary alcohols with aluminium isopropoxide in 2-propanol solution.



4. Using Grignard Reagent :

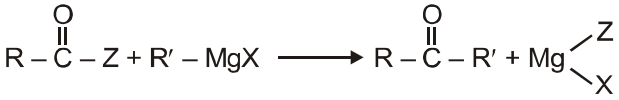
(i) From aldehydes or ketones :



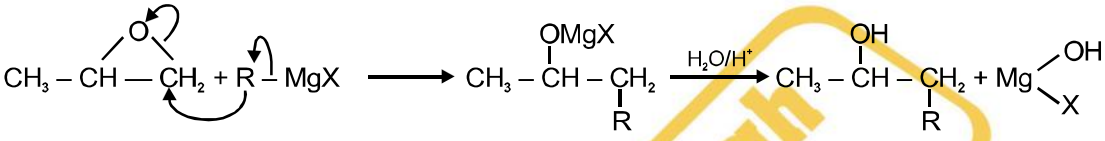
In this reaction

Formaldehyde gives	1°-alcohol
Other aldehyde gives	2°-alcohol
Ketones give	3°-alcohol

(ii) **From carboxylic acid and their derivatives :**

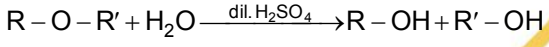


(iii) **From epoxides :**



5. Hydrolysis of Ether :

Ether undergo acid hydrolysis with dilute H_2SO_4 under pressure to give corresponding alcohols.



Physical Properties

(i) Physical state : At ordinary temperature, lower members are colourless liquids with burning taste and a pleasant smell.

(ii) Boiling Point :

The boiling point of alcohols rise regularly with the rise in the molecular mass. Amongst isomeric alcohols, the boiling point decrease in the order.

1° > 2° > 3°

(iii) Solubility : The extent of solubility of any alcohol in water depends upon the capability of its molecules to form hydrogen bonds with water molecule.

(iv) Alcohols are lighter than water however, the density increases with the increase in molecular mass.

Chemical Properties

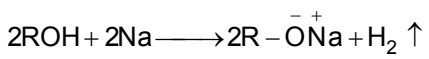
1. Reactions involving cleavage of O – H Bond

Alcohols are acidic in nature but they are less acidic than water hence they do not give H^+ in aqueous solution. They do not change the colour of litmus paper.

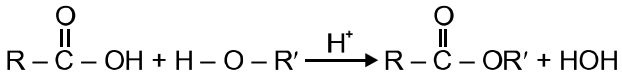
Their acidic strength increases by increasing–I strength of the groups attached and decreases by increasing +I strength of the groups.

(i) Alcohols do not react with aqueous alkali, as it does not give H^+ in aqueous solution.

(ii) **Action of active metal :** When alcohols are treated with active metal they form alkoxides with the liberation of H_2 gas.



(iii) **Esterification :** When carboxylic acid is treated with alcohols in the presence of acid as catalyst, esters are formed.



Note :

(a) OH is removed from carboxylic acid and H is removed from alcohol.

(b) Overall reaction is S_N2 in which alcohol acts as nucleophile.

(iv) Reaction with Grignard Reagent : When Grignard reagents are treated with alcohol (or any proton donor) they form alkanes.

$$R - MgX + H - OR' \longrightarrow R - H + R' - OMgX$$

Other proton donors can be carboxylic acids, phenols, alkynes, H_2O, Amines, NH_3 etc.

2. Reactions Involving Cleavage of C– O Bond

(i) Reaction with HX : Most alcohols undergo S_N1.

(a) $R-OH + HCl(g) \xrightarrow{\text{Anhyd. } ZnCl_2} R-Cl + H_2O$

Note : *HCl + anhyd. $ZnCl_2$ is called Lucas reagent.*

(b) $R-OH + HBr \xrightarrow[\text{conc.}]{H^+/H_2SO_4} R-Br + H_2O$

(c) $R-OH + HI \xrightarrow[\text{conc.}]{H^+/H_2SO_4} R-I + H_2O$

Reactivity order of HX is

HI > HBr > HCl

(ii) Dehydration : Alkyl chlorides can also be prepared by following methods :

$$R - OH + PCl_5 \longrightarrow R - Cl + POCl_3 + HCl$$

$$3R - OH + PCl_3 \longrightarrow 3R - Cl + H_3PO_3$$

$$R - OH + SOCl_2 \longrightarrow R - Cl + SO_2 + HCl \text{ (Darzen's process)}$$

Darzen's process is the best method as the other products are gases.

3. Reduction :

Alcohols are reduced to alkanes when they are treated with Zn-dust or red P + HI.

$$R-OH \xrightarrow{\text{Zn dust}} R-H + ZnO$$

4. Oxidation :

$$CH_3OH \xrightarrow{[O]} H-\overset{\overset{O}{\|}}{C}-H \xrightarrow{[O]} H-\overset{\overset{O}{\|}}{C}-OH \xrightarrow{[O]} CO_2$$

3°-alcohols can't be oxidised.

(i) Strong oxidising agent like $KMnO_4$ or $K_2Cr_2O_7$ cause maximum oxidation as above.

(ii) If 1°-alcohol has to be converted into aldehyde PCC + CH_2Cl_2 or CrO_3 should be used among which PCC + CH_2Cl_2 is the best.

(iii) 2°-alcohol can converted to ketone best by PCC + CH_2Cl_2 or CrO_3 or H_2CrO_4 in aq. acetone (Jones reagent).

(iv) MnO_2 selectively oxidises the –OH group of allylic and benzylic 1° and 2° alcohols to aldehydes and ketones respectively.

5. Action of Heated Copper :

(i) $CH_3 - CH_2 - OH \xrightarrow[573K]{Cu} CH_3 - \overset{O}{\overset{\|}{C}} - H + H_2$ (Dehydrogenation)

(ii) $CH_3 - \underset{OH}{\underset{|}{CH}} - CH_3 \xrightarrow[573K]{Cu} CH_3 - \overset{O}{\overset{\|}{C}} - CH_3 + H_2$ (Dehydrogenation)

(iii) Tertiary alcohols undergo dehydration to give alkene under similar condition.

$$CH_3 - \underset{CH_3}{\overset{CH_3}{\overset{|}{\underset{|}{C}}}} - OH \xrightarrow[573\ K]{Cu} CH_3 - \underset{CH_3}{\overset{CH_2}{\overset{\|}{C}}} + H_2O$$

Distinction Between 1°, 2° and 3° Alcohols

1. Lucas Test : Any alcohol is treated with Lucas reagent (HCl + an hyd. $ZnCl_2$) at room temperature if

(i) Solution becomes cloudy immediately, alcohol is 3°.

(ii) Solution becomes cloudy after 5-min, alcohol is 2°.

(iii) In solution cloud does not form at room temperature, alcohol is 1°.

2. Victor Meyer's Method :

$$\underset{(1°\text{-alcohol})}{R - CH_2OH} \xrightarrow{P + I_2} R - CH_2I \xrightarrow{AgNO_2} R - CH_2 - NO_2 + HNO_2 \xrightarrow{-H_2O} R - \underset{N}{\overset{\|}{C}} - \underset{OH}{\underset{\diagdown}{\diagup}}$$

(Nitrolic acid)

$\xrightarrow{NaOH}$ blood red colour

$$\underset{(2°\text{-alcohol})}{R_2CH - OH} \xrightarrow{P + I_2} R_2 - CH - I \xrightarrow{AgNO_2} R_2CH - NO_2 + HNO_2 \xrightarrow{-H_2O} R_2C - \underset{NO}{\underset{|}{NO_2}}$$

Pseudonitrol

$\xrightarrow{NaOH}$ blue colour

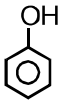
$$\underset{(3°\text{-alcohol})}{R_3 - C - OH} \xrightarrow{P + I_2} R_3C - I \xrightarrow{AgNO_2} R_3C - NO_2 \xrightarrow{HNO_2} \text{No reaction} \xrightarrow{NaOH} \text{Colourless}$$

Note :

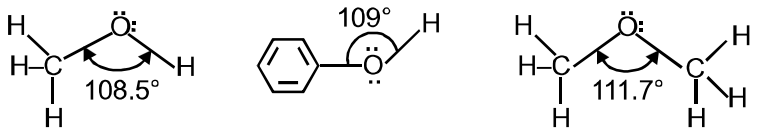
Rectified Spirit : *Azeotropic mixture of 95% C_2H_5OH and 5% H_2O is called rectified spirit.*

Denatured Spirit : *Azeotropic mixture of C_2H_5OH and CH_3OH is called methylated spirit.*

PHENOLS


and their derivatives are called phenols. In phenol R– of alcohol is replaced by aryl ring.

Comparison of bond Angles in Phenols, Alcohols and Ethers :

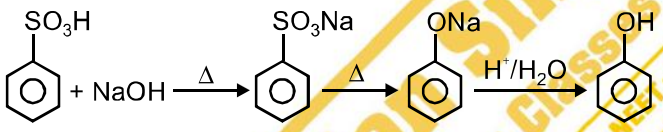


Bond angle increases with the increase in hindrance.

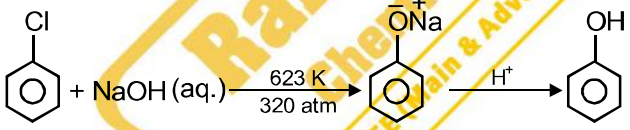
Method of Preparation

1. From Aryl Sulphonic Acids :

When aryl sulphonic acids are fused with NaOH at 570 – 620 K followed by hydrolysis phenols are formed.

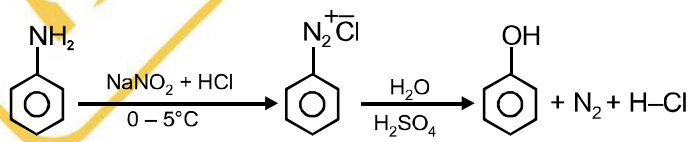


2. From Haloarenes : (Dow's process)

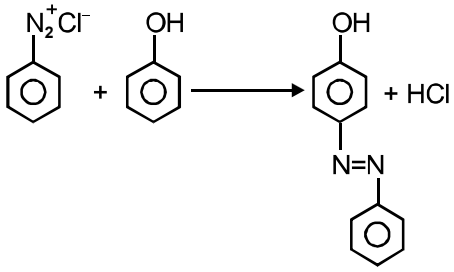


Note : *Condition of reaction become less vigorous when –M groups are present at ortho or para or both position to the chlorine atom.*

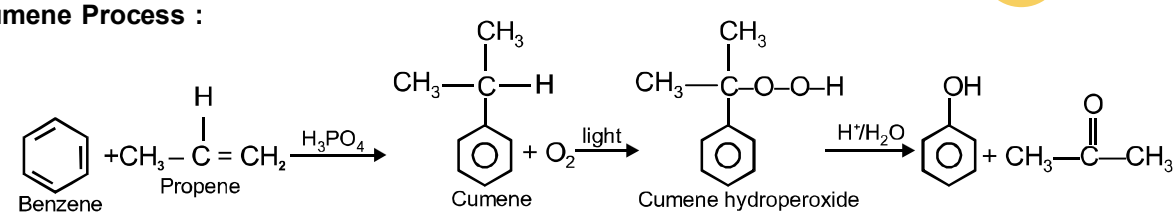
3. From Benzene Diazonium Salts :



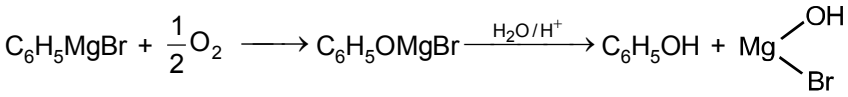
Note : *In the absence of H_2SO_4 diazocoupling will also take place.*



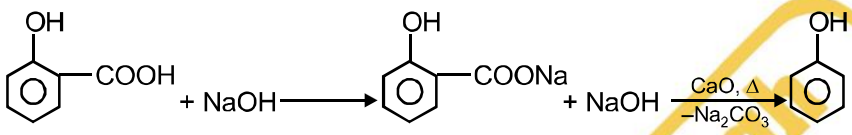
4. Cumene Process :



5. Grignard's Synthesis :



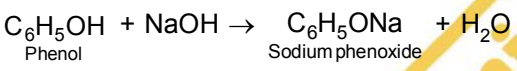
6. From Salicylic Acid :



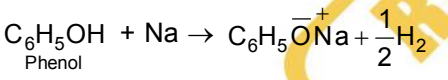
Chemical Properties

1. Acidic Nature :

(i) Phenol behave as a weak acid forming phenoxide ion with strong alkalies.



(ii) It also reacts with sodium metal to form sodium phenoxide and hydrogen is evolved



(a) Effect of substituents on the acidity of phenols : It should be noted that the presence of electron withdrawing groups like $-NO_2$, – CN, –CHO,–X, –COOH, etc. increases the acidic strength (because of the greater polarity of O–H bond the greater stability of the phenoxide ion by the dispersal of –ve charge, by –R effect). On the other hand, electron-releasing groups like $-CH_3$, $-NH_2$, –OH, etc., tend to destabilize the phenoxide ion by intensifying its –ve charge by +R effect and hence decreases the acidic strength.

o - chlorophenol > m - chlorophenol > p - chlorophenol

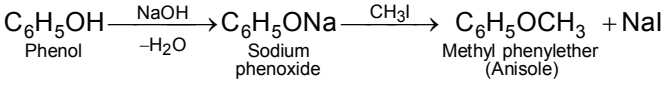
K_a = 7.7×10^{-9} 1.6×10^{-9} 6.3×10^{-10}

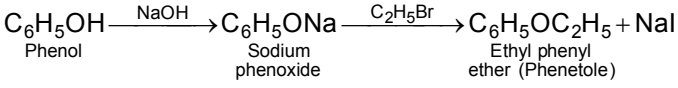
In case of haloarenes –I effect of halogens dominates over it's +M effect. (except for fluorine)

p-nitrophenol > o-nitrophenol > m - nitrophenol > phenol

(b) Steric Effect : 3, 5 -dimethyl-4-nitrophenol is weaker acid than the isomeric 2, 6-dimethyl - 4 - nitrophenol.

2. Alkylation or Etherification : When sodium phenoxide is treated with alkyl halides (but not with aryl halides as they are inert) form phenolic ethers.

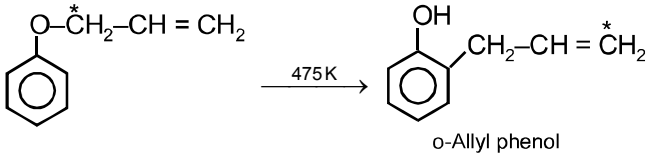




3. Claisen rearrangement :

$$C_6H_5ONa + BrCH_2 - CH = CH_2 \rightarrow \underset{\text{Allyl phenyl ether}}{C_6H_5 - O - CH_2CH = CH_2} + NaBr$$

When aryl allyl ether is heated to 475 K, the allyl group of the ether migrates from ethereal oxygen to the ring carbon at **ortho position**.



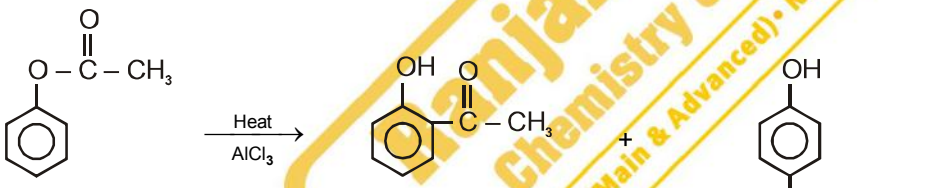
o-Allyl phenol

Note : *Carbon attached with oxygen is not attached with the carbon of benzene ring in the product.*

4. Acylation and benzoylation :

$$\underset{\text{Phenol}}{C_6H_5 - OH} + \underset{\text{Acetyl chloride}}{CH_3 - \overset{\overset{O}{\|}}{C} - Cl} \xrightarrow{\text{Pyridine}} \underset{\text{Phenyl acetate}}{C_6H_5 - O - \overset{\overset{O}{\|}}{C} - CH_3}$$

5. Fries Rearrangement : When heated with anhydrous aluminium chloride, phenyl esters undergo **Fries rearrangement** forming a mixture of o- and p-hydroxy ketones.



Phenyl acetate — o-hydroxyacetophenone — p-Hydroxyacetophenone

The para isomer is formed predominantly at low temperature while at higher temperatures o - isomer is predominant.

6. Reactions due to C–O Bond :

(i) Reaction with PCl_5 :

$$C_6H_5OH + PCl_5 \rightarrow C_6H_5Cl + POCl_3 + HCl$$

$$3C_6H_5OH + PCl_3 \rightarrow \underset{\text{Triphenyl phosphate}}{P(OC_6H_5)_3} + 3HCl$$

The yields of C_6H_5Cl is very poor due to the formation of triaryl phosphate.

(ii) Reaction with Ammonia :

$$\underset{\text{Phenol}}{C_6H_5OH} + NH_3 \xrightarrow[573\ K]{ZnCl_2} \underset{\text{Aniline}}{C_6H_5NH_2} + H_2O$$

(iii) Reaction with Zinc Dust :

$$\underset{\text{Phenol}}{C_6H_5OH} + Zn \xrightarrow{\Delta} \underset{\text{Benzene}}{C_6H_6} + ZnO$$

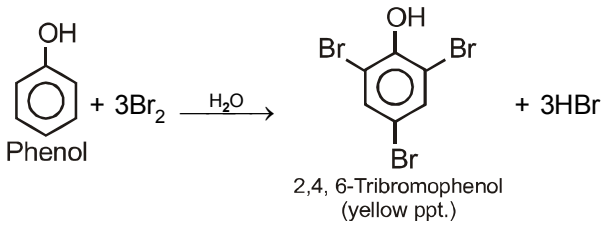
(iv) Reaction with Neutral $FeCl_3$: (Test for phenol)

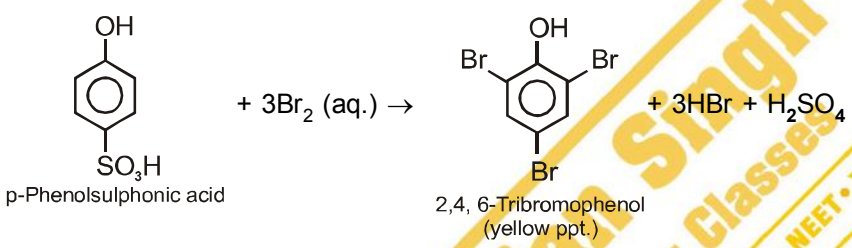
$$3C_6H_5OH + FeCl_3 \longrightarrow \underset{\substack{\text{Ferric phenoxide}\\ \text{(Violet)}}}{(C_6H_5O)_3Fe} + 3HCl$$

7. Electrophilic Substitution Reaction on the Benzene Ring :

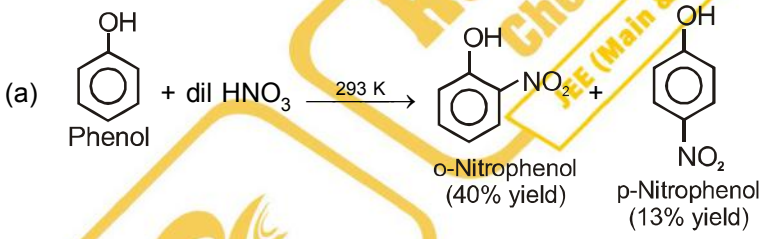
From the contributing structure of phenol, it is clear that *ortho*- and *para*-position on it become rich in electron density. Thus the electrophilic attack at these positions is facilitated. Again –$\ddot{\underset{\cdot\cdot}{O}}$H present on the benzene ring is the very powerful ring activator towards electrophilic aromatic substitution.

(i) Bromination :

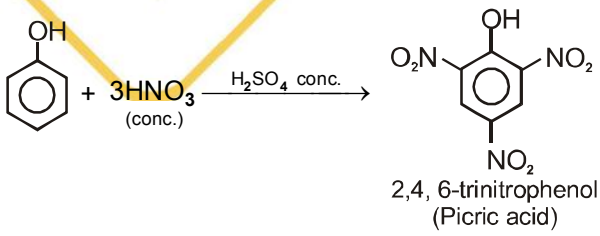




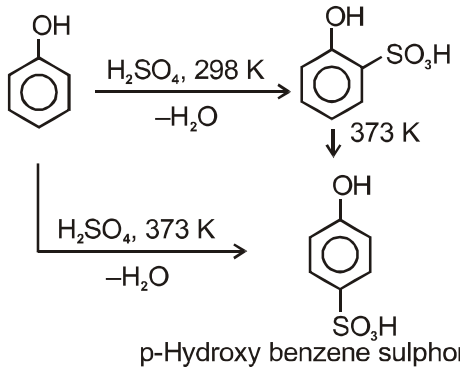
(ii) Nitration :



(b) With concentrated nitric acid and sulphuric acid, it forms 2, 4, 6-trinitrophenol (Picric acid).

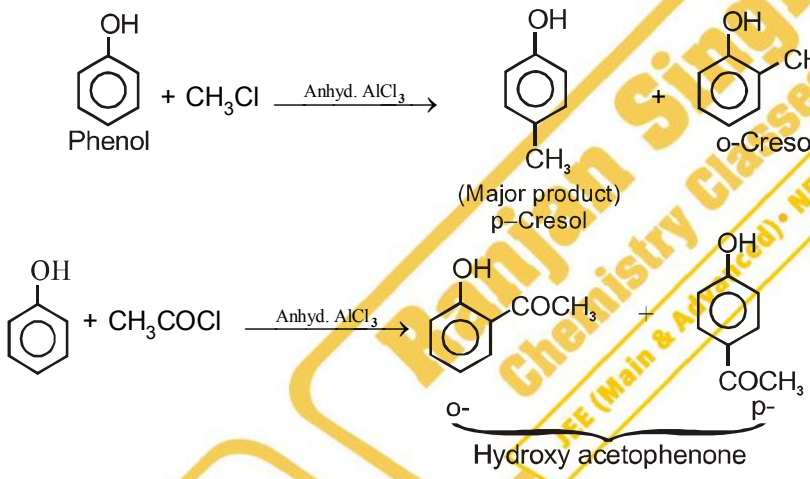


(iii) Sulphonation : When heated with conc. sulphuric acid, phenol forms hydroxy benzene sulphonic acid.



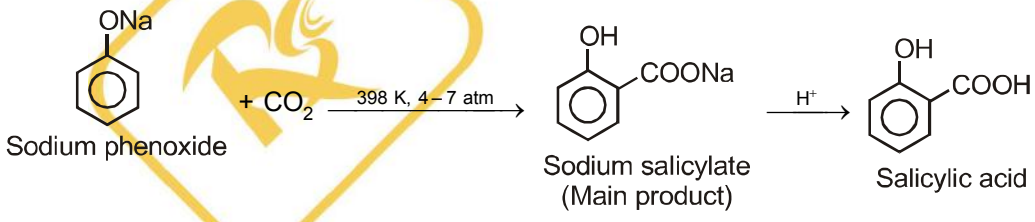
p-Hydroxy benzene sulphonic acid

(iv) Friedel-Crafts Alkylation and Acylation : Phenol undergo both these reaction to form mainly p-isomer.



Hydroxy acetophenone

8. Kolbe's reaction

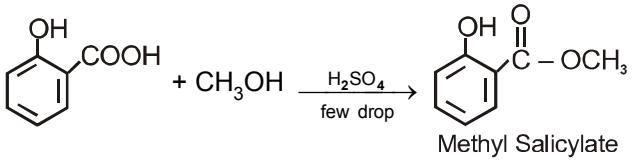


Sodium phenoxide

Sodium salicylate
(Main product)

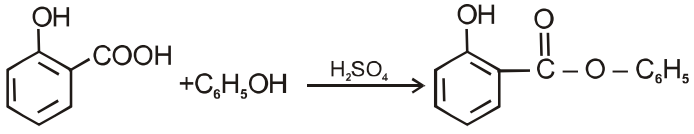
Salicylic acid

Note : *(i) Methylsalicylate with methanol.*



Methyl Salicylate

(ii) Salol (with phenol) :

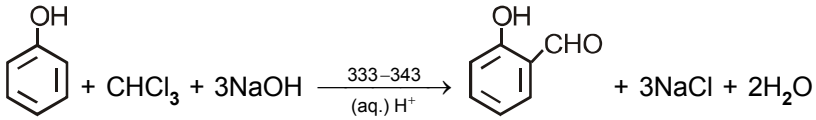


Phenyl salicylate
(Salol)

Methyl salicylate is known as oil of winter green. Phenyl salicylate is known as salol. Salol is an intestinal antiseptic.

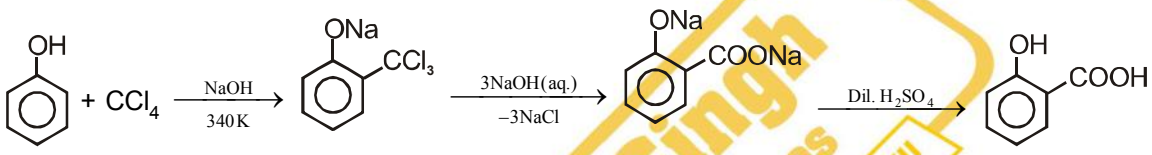
9. Riemer Tiemann Reaction :

(a) On heating with chloroform and alkali phenols are converted to phenolic aldehydes



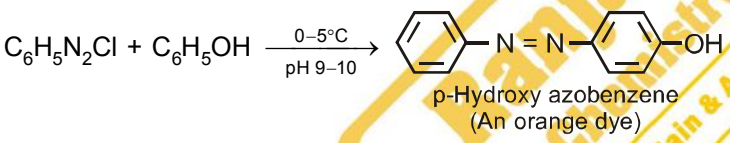
In this reaction dichloro carbene is formed as intermediate which attack on benzene ring as electrophile.

(b) If instead of chloroform, carbon tetrachloride is used, salicylic acid is formed. Some para isomers is also formed.



In this reaction $^{\oplus}CCl_3$ is formed as intermediate which attack on benzene ring as electrophile.

10. Coupling with Diazonium Salts :



11. Test for phenol

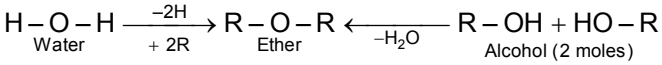
(i) Neutral $FeCl_3$ test → Aqueous solution of phenol gives a violet colouration with $FeCl_3$.

(ii) Br_2 water test → Aqueous solution of phenol gives a yellow precipitate of 2, 4, 6-tribromophenol with bromine water.

(iii) Phenol gives Liebermann's nitroso reaction.

ETHERS

Ethers are those organic compounds which contain two alkyl groups attached to an oxygen atom, *i.e.*, R–O–R. They are regarded as dialkyl derivatives of water or anhydrides of alcohols.



Ethers may be of two types : (i) **Symmetrical or simple ether** are those in which both the alkyl groups are identical and (ii) **unsymmetrical or mixed ethers** are those in which the two alkyl groups are different.

CH_3–O–CH_3; C_6H_5–O–C_6H_5 Symmetrical (simple) ethers

CH_3–O–C_2H_5; CH_3–O–C_6H_5 Unsymmetrical (mixed)ethers

Like water, ether has two unshared pair of electrons on oxygen atom, yet its angle is greater than normal tetrahedral (109°28′) and different from that in water (105°). This is because of the fact that in ethers the repulsion between lone pairs of electrons is overcome by the repulsion between the bulky alkyl groups.

Preparation of Ethers :

1. **By dehydrating excess of alcohols :** Simple ethers can be prepared by heating an excess of primary alcohols with conc. H_2SO_4 at 413K. Alcohol should be taken in excess so as to avoid its dehydration to alkenes.

$$\underset{\text{Ethanol (2 molecules)}}{C_2H_5-OH} + HO-C_2H_5 \xrightarrow[413K]{\text{Conc. } H_2SO_4} \underset{\text{Diethyl ether}}{C_2H_5-O-C_2H_5} + H_2O$$

Dehydration may also be done by passing alcohol vapours over heated catalyst like alumina under high pressure and temperature of 200 – 250°C.

2. **By heating alkyl halide with dry silver oxide** (only for simple ethers) :

$$C_2H_5I + \underset{\text{Dry}}{Ag_2O} + IC_2H_5 \rightarrow C_2H_5OC_2H_5 + 2AgI$$

Remember that reaction of alkyl halides with moist silver oxide ($Ag_2O + 2H_2O = 2AgOH$) gives alcohols

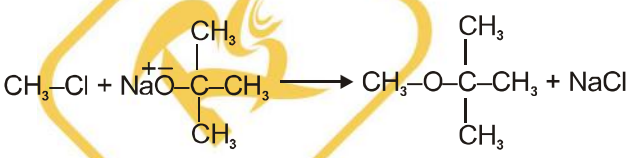
$$C_2H_5I + Ag_2O \text{ (moist)} \rightarrow C_2H_5OH + AgI$$

3. **By heating alkyl halide with sod. or pot. alkoxides** (Williamson synthesis):

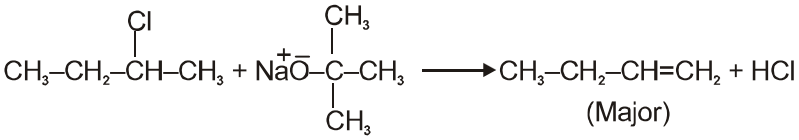
$$C_2H_5ONa + ICH_3 \rightarrow C_2H_5OCH_3 + NaI$$

Sod. phenoxide — Methoxybenzene (Anisole)

However



If alkyl halide is other than methyl halide and it is treated with tertiary alkoxide ion, Hoffmann elimination takes place instead of Williamson's ether synthesis.



4. Methyl ethers can be prepared by treating primary or secondary alcohol or phenol with diazomethane in presence of BF_3.

$$C_2H_5OH + CH_2N_2 \xrightarrow{BF_3} \underset{\text{Ethylmethyl ether}}{C_2H_5OCH_3} + N_2$$

Chemical Properties :

A. Properties due to Alkyl Groups :

1. Halogenation : When ethers are treated with chlorine or bromine in the dark, substitution occurs at the α-carbon atom. The extent of substitution depends upon the reaction conditions.

$$\overset{\beta}{C}H_3 - \overset{\alpha}{C}H_2 - O - \overset{\alpha'}{C}H_2 - \overset{\beta'}{C}H_3 + Cl_2 \xrightarrow{\text{dark}} \underset{\alpha\text{–Chlorodiethyl ether}}{CH_3.CHCl - O - CH_2.CH_3}$$

$$\downarrow Cl_2$$

$$\underset{\alpha,\,\beta\text{–Dichlorodiethyl ether}}{CH_2Cl.CHCl - O - CH_2.CH_3} + \underset{\alpha,\,\alpha'\text{–Dichlorodiethyl ether}}{CH_3CHCl - O - CHCl.CH_3}$$

$$CH_3CH_2 - O - CH_2.CH_3 + 10Cl_2 \xrightarrow{\text{light}} \underset{\text{Perchlorodiethyl ether}}{CCl_3.CCl_2 - O - CCl_2.CCl_3}$$

2. **Combustion :**

$$C_2H_5.O.C_2H_5 + 6O_2 \longrightarrow 4CO_2 + 5H_2O$$

B. Properties due to Ethereal Oxygen :

1. **Chemical inertness :** Since ethers do not have an active group, in their molecules, these do not react with active metals like Na, strong bases like NaOH, reducing or oxidising agents.
2. **Formation of peroxide** (Autoxidation) **:** On standing in contact with air and light ethers are converted into unstable **peroxides** ($R_2O \longrightarrow O$) which are highly explosive even in low concentrations.
3. **Basic nature :** Owing to the presence of unshared electron pairs on oxygen, ether behave as Lewis bases. Hence they dissolve in strong acids (*e.g.* conc. HCl, conc. H_2SO_4) at low temperature to form oxonium salts.

$$\underset{\text{Diethyl ether}}{(C_2H_5)_2O} + H_2SO_4 \rightarrow \underset{\text{Diethyloxonium hydrogen sulphate}}{[(C_2H_5)_2OH]^+HSO_4^-}$$

On account of this property, ether is removed from ethyl bromide by shaking with conc. H_2SO_4.

Being Lewis bases, ethers also form coordination complexes with Lewis acids like BF_3, $AlCl_3$, RMgX, etc.

$$R_2\ddot{O}: + BF_3 \longrightarrow R_2O \rightarrow BF_3$$

$$2R_2O + RMgX \longrightarrow \begin{matrix} R_2O & & R \\ & \searrow\ \swarrow & \\ & Mg & \\ R_2O & \nearrow\ \searrow & \\ & & X \end{matrix}$$

It is for this reason that ethers are used as solvent for Grignard reagents.

C. Properties due to carbon-oxygen bond :

1. **Hydrolysis :**

$$C_2H_5 - O - C_2H_5 + H_2O \xrightarrow{H_2SO_4} \underset{\text{Ethyl alcohol}}{2C_2H_5OH}$$

The hydrolysis may also be effected by boiling the ether with water or by treating it with steam.

Note : *Ethers can never be hydrolysed in alkaline medium.*

2. Action of conc. sulphuric acid :

$$C_2H_5-O-C_2H_5 + H_2SO_4\ (conc.) \rightarrow \underset{\text{Ethyl alcohol}}{C_2H_5OH} + \underset{\text{Ethyl hydrogen sulphate}}{C_2H_5HSO_4}$$

$$C_2H_5OH + H_2SO_4(conc.) \rightarrow C_2H_5HSO_4 + H_2O$$

3. Action of hydroiodic or hydrobromic acid :

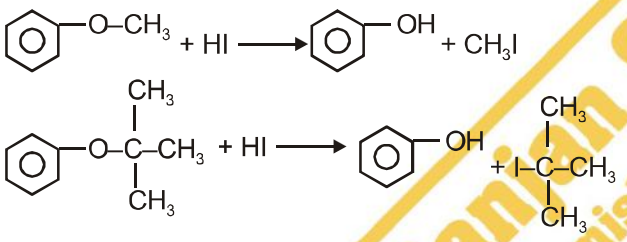
In cold, ether react with HI or HBr to give the corresponding alkyl halide and alcohol. In case of mixed ethers, the halogen atom attaches itself to the smaller alkyl group.

$$\underset{\text{Ethyl ether}}{C_2H_5-O-C_2H_5} + HI \rightarrow \underset{\text{Ethyl iodide}}{C_2H_5I} + \underset{\text{Ethyl alcohol}}{C_2H_5OH}$$

The order of reactivity of halogen acids is :

HI > HBr > HCl

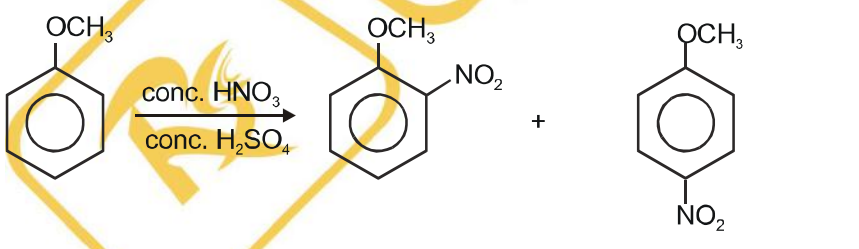
If one of the the group around oxygen is aryl group then I^- will always attack on the group other than aryl group.



D. Properties Due to Benzene Nucleus :

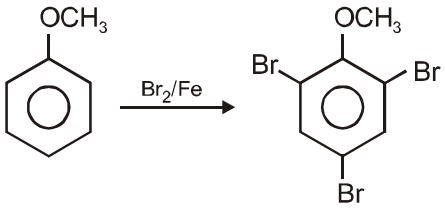
Alkoxy group, being o-, p- directing, anisole undergoes substitution in o- and p- positions. However, –OR group is less activating than the phenolic group.

(i) Nitration :

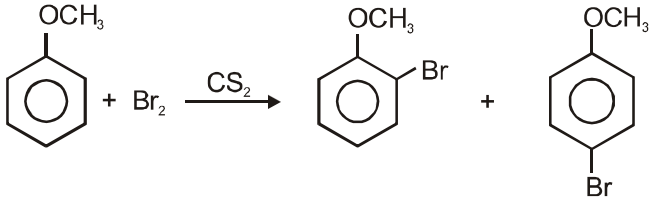


Methylphenyl ether (Anisole) | Methyl 2-nitrophenyl ether or o-Nitroanisole | Methyl 4-nitrophenyl ether or p-Nitroanisole

(ii) Bromination :

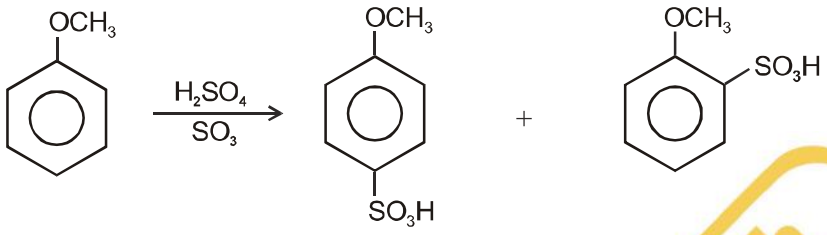


Anisole | 2, 4, 6, Tribromoanisole



Anisole | 2-Bromoanisole | 4-Bromoanisole

(iii) Sulphonation :



Anisole | p-Methoxybenzene sulphonic acid | o-Methoxybenzene sulphonic acid

TOPIC WISE MCQS

ALCOHOL

Introduction

1. Which of the following statements is untrue :

(A) A primary alcohol has CH_2OH group

(B) A secondary alcohol has two carbon atoms

(C) A tertiary alcohol has a minimum of four carbon atoms

(D) A primary alcohol with a branched chain has a minimum of four carbon atoms

2. Which of the following is not a dihydric alcohol :

(A) Trimethylene glycol (B) Ethylene glycol

(C) Glycerine (D) Glycol

3. Which of the following compounds does not contain at least two primary carbon atoms and two primary alcoholic groups :

(A) Glycerol (B) Glycol

(C) Trimethylene glycol (D) Methyl glycol

4. Which of the isomers of n–butyl alcohol exhibit optical isomerism :

(A) Butyl alcohol

(B) Sec. Butyl alcohol

(C) 2–Methyl–1–propanol

(D) 2–Methyl–2–Propanol

5. The molecular formula C_7H_8O represents the following except :

(A) A mixed aliphatic ether

(B) Phenolic compounds

(C) A cycloalkanol

(D) An aralkanol

6. Which of the following compounds shows intramolecular hydrogen bonding :

(A) p–Nitrophenol (B) Ethanol

(C) o–Nitrophenol (D) Methanamine

7. Which statement is not correct about alcohol :

(A) Alcohol is lighter than water

(B) Alcohol evaporates quickly

(C) Alcohol of less no. of carbon atoms is less soluble in water than alcohol of high no. of carbon atoms

(D) All of these

8. 3–pentanol is a :

(A) Primary alcohol (B) Secondary alcohol

(C) Tertiary alcohol (D) None of these

Method of Preparation

9. Propan–1–ol can be prepared from propene by:

(A) H_2O / H_2SO_4

(B) $Hg(OAc)_2$ / H_2O followed by $NaBH_4$

(C) B_2H_6 followed by H_2O_2

(D) CH_3CO_2H / H_2SO_4

10. $CH_2{=}CH_2 + B_2H_6 \xrightarrow[H_2SO_4]{NaOH}$ Product, Product is :

(A) CH_3CH_2CHO (B) CH_3CH_2OH

(C) CH_3CHO (D) None of the above

11. Which of the following reactions does not lead to formation of an alkanol :

(A) $RCOOR' + KOH \longrightarrow$

(B) $R_2O + H_2O \xrightarrow[\Delta]{dil./H_2SO_4}$

(C) $RCOR' + 2H \xrightarrow{Na+ethanal}$

(D) $(RCO)_2O + H_2O \longrightarrow$

12. Which of the following reducing agents reduces carboxylic acids to alkanols :

(A) Sodium and ethanol

(B) Sodium and n–butyl alcohol

(C) Lithium aluminium hydride

(D) Magnesium amalgam and conc. HCl

Properties

13. Which of the following statements is false :

(A) Industrial alcohol is rectified spirit

(B) Industrial methylated spirit contains 95% ethanol and 5% methanol

(C) Mineralised methylated spirit contains 90% rectified spirit, 9% methanol and 1% petroleum oil

(D) Alcohol can be dried over calcium chloride

14. Ethanol cannot be denatured by adding :

(A) Pyridine (B) Caoutchoucine

(C) Methanol (D) Methanal

15. Methanol reacts with calcium chloride to form an alcoholate of the structure :

(A) $CaCl_2.2CH_3OH$ (B) $CaCl_2.4CH_3OH$

(C) $CaCl_2.3CH_3OH$ (D) $CaCl_2.CH_3OH$

16. Which of the following reactions of alkanols does not involve C–O bond breaking :

(A) $CH_3CH_2OH + SOCl_2$

(B) $CH_3CH(OH)CH_3 + PBr_3$

(C) $CH_3CH_2OH + CH_3COOH$

(D) ROX + HX

17. Which of the following compounds does not have an ester linkage :

(A) Ethyl acid sulphate

(B) Diethyl hydrogen phosphate

(C) Ethyl acetate

(D) $CH_3CO–O–CO–CH_3$

18. Which of the following is a correct statement :

(A) An alcohol is a stronger acid than water

(B) An alkoxide ion is a stronger base than hydroxide ion

(C) Amide ion is a weaker base than alkoxide ion

(D) Ammonia is a stronger acid than an alcohol

19. Which of the following is least soluble in water :

(A) CH_3OH (B) CH_3CH_2OH

(C) $CH_3CH_2CH_2OH$ (D) $CH_3CH_2CH_2CH_2OH$

20. Alcohols are reduced by red phosphorus and hydroiodic acid into :

(A) Aldehydes (B) Alkoxyalkanes

(C) Alkanes (D) Anhydrides

21. Which of the following alcohols does not give an aldehyde on oxidation :

(A) Benzyl alcohol (B) Sec. butyl alcohol

(C) Allyl alcohol (D) Crotyl alcohol

22. Which of the following alcohols gives a red colour in victor Meyer test :

(A) n–Propyl alcohol (B) Isoproyl alcohol

(C) $(CH_3)_3C–OH$ (D) Sec. Butyl alcohol

23. The compound A, B and C in the reaction sequence :

$CH_3–CH_2OH \xrightarrow{PBr_3} A \xrightarrow{alc.\ KOH} B \xrightarrow{Br_2} C$

are given by the set :

(A) Ethyl bromide, CH_3CH_2OH, CH_3CHBr_2

(B) C_2H_5Br, $CH\equiv CH$, $CH_2=CHBr$

(C) C_2H_5Br, $CH_2=CH_2$, $CH_2Br–CH_2Br$

(D) C_2H_5Br, CH_3CH_2OH, $BrCH_2–CH_2Br$

24. Alcohol are stronger acids than alkanes. This is clear from the reaction :

(A) $2ROH + 2Na \longrightarrow 2RO^-Na^+ + H_2$

(B) $ROH + R'MgX \longrightarrow R'H + RO–MgX$

(C) $ROH + R'COOH \longrightarrow R'COOR + H_2O$

(D) $ROH + R'COCl \longrightarrow R'COOR + H_2O$

25. The compounds A, B and C in the reaction sequence cumene $\xrightarrow{O_2} A \xrightarrow{Aq.\ H_3O^+} B + C$ are given by the set :

(A) Cumene oxide, phenol, CH_3CHO

(B) Cumene hydroperoxide, Catechol, CH_3CHO

(C) Cumene hydroperoxide, Phenol CH_3COCH_3

(D) Cumene oxide, Phenol, CH_3COCH_3

PHENOL

General Method of Preparation

1. What is the end product 'B' of following sequence of reaction ?

$C_6H_5NH_2 \xrightarrow[H_2SO_4/0°C]{HNO_2}$ 'A' $\xrightarrow[\Delta]{H_2O}$ 'B'

(A) $C_6H_5N_2Cl$ (B) C_6H_6

(C) $C_6H_5NH_2.H_2SO_4$ (D) C_6H_5OH

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

$C_6H_6 + CH_3CH = CH_2 \xrightarrow{Anhy.\ AlCl_3} ?$

$\xrightarrow[Catalyst]{O_2/130°C} ? \xrightarrow{H^+} ?$

(A) Cumene and phenol

(B) Phenol and acetone

(C) Cumene and acetone

(D) Benzoic acid and ethane

3. Phenol is obtained in large scale from which fraction of coal-tar ?

(A) Light oil fraction

(B) Green oil fraction

(C) Pitch

(D) Middle oil fraction

4. By which of the following reactions phenol can be prepared industrially –

(A) Rasching process

(B) Dow process

(C) Cumene is oxidised and the product obtained is treated with dil. H_2SO_4

(D) All of the above

5. The compound obtained by heating cumene-hydroperoxide with dil. H_2SO_4 is –

(A) Phenol

(B) Isopropyl benzene

(C) Benzene sulphonic acid

(D) None of these

6. The product of the reaction of benzene with oxygen in the presence of V_2O_5 as catalyst at 200°C is -

(A) Maleic anhydride (B) Benzoic acid

(C) Phenol (D) None of these

7. Dow's process used in the industrial preparation of phenol, is -

(A) $C_6H_5Cl \xrightarrow[CuCl_2,300°]{NaOH} C_6H_5OH + NaCl$

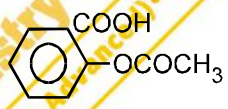
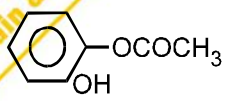
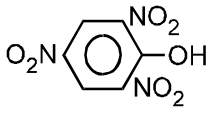
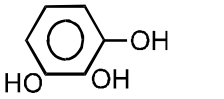
(B) $C_6H_5Cl + H_2O \xrightarrow[425°]{SiO_2} C_6H_5OH + HCl$

(C) $C_6H_5NH_2 + HNO_2 \xrightarrow{\Delta} C_6H_5OH + N_2 + H_2O$

(D) $C_6H_5N_2Cl + H_2O \rightarrow C_6H_5OH + N_2 + HCl$

Structure

8. Match structures given in list I with names given in list II and then select the correct answer from the codes given below the lists–

List I	List II
(A) 	(a) Picric ac.id
(B) 	(b) Methyl salicylate
(C) 	(c) Pyrogallol
(D) 	(d) Aspirin

Codes :

(A) Ad, Ba, Cb, Dc (B) Ad, Bb, Cc, Da

(C) Ad, Bb, Ca, Dc (D) Ad, Bc, Cb, Da

9. Benzo redical in the following is-

(A) $C_6H_5CH_2-$ (B) $C_6H_4<$

(C) C_6H_5- (D) $C_6H_5\text{-}C\lessdot$

10. Next higher homologue of phenol is –

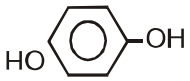
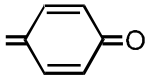
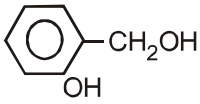
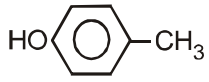
(A) Hydroxy toluene

(B) Hydroxy benzene

(C) Dihydroxy benzene

(D) None of the above

11. Match this list I with list II and then select the answer from the codes given below the lists –

List I	List II
(A) 	(a) *p*-Cresol
(B) 	(b) Hydroquinone
(C) 	(c) *p*-Benzoquinone
(D) 	(d) Salicyl alcohol

Codes :

(A) Ab, Bc, Cd, Da (B)Ab, Bd, Ca, Dc

(C) Ab, Bc, Ca, Dd (D) Ac, Bb, Cd, Da

13. Which of the following is not a phenolic compound –

(A) Salol (B) *o*-Cresol

(C) Anisole (D) Quinol

14. Unacceptable name for a compound containing one -OH group attached to benzene nucleus would be-

(A) Carbolic acid (B) Hydroxybenzene

(C) Catechol (D) Phenol

15. How many π electons are there in a planar ring of phenol –

(A) 4 (B) 6

(C) 8 (D) 10

Properties

16. Match list I with II and then select the correct answer from the codes given below the lists–

List I

(A) Phenol + NaOH + $C_2H_5I \xrightarrow{\Delta}$

(B) Phenol + NaOH +$CHCl_3 \xrightarrow{\Delta}$

(C) Phenol + Phthalic anhydride + conc. $H_2SO_4 \xrightarrow{Heat}$

(D) Phenol + conc. HNO_3

List II

(a) Phenolphthalein

(b) Picric acid

(c) Phenetole

(d) Salicylaldehyde

Codes :

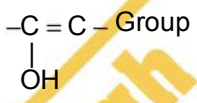
(A) Ac, Bd, Ca, Db (B) Ab, Bc, Ca, Dd

(C) Ac, Bd, Cb, Da (D) Ac, Ba, Cd, Db

17. Which of the following is not a correct statement-

(A) Phenol is a much weaker acid than benzoic acid

(B) The reaction of ferric chloride with phenol to give violet colour is characteristic of



(C) Phenol is a stronger acid than ethanol but weaker than benzyl alcohol

(D) Picric acid does not contain a -COOH group.

18. Which of the following is a correct statement-

(A) Phenol is more acidic than ethanol

(B) Phenol is less acidic than ethanol

(C) Phenol reacts with $NaHCO_3$

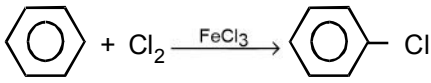
(D) Phenol reacts with NH_2OH and HCl to form oxime

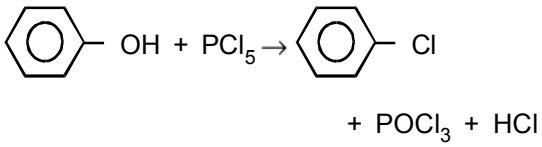
19. Phenol with Hinsberg's reagent gives-

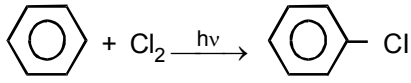
(A) Sulphone (B) Sulphanilic acid

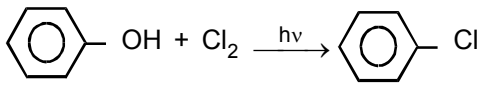
(C) Sulphonic ester (D) Sulphonal

20. The best method for the prepration of chlorobenzene is-

(A) 

(B) 

(C) 

(D) 

21. Which of the following reaction is called 'Schotten-Baumann' reaction –

(A) $C_6H_6 \xrightarrow{AlCl_3/CH_3COCl} C_6H_5COCH_3$

(B) $C_6H_5NH_2 \xrightarrow{CH_3COCl} C_6H_5NHCOCH_3$

(C) $C_6H_5OH \xrightarrow{C_6H_5COCl} C_6H_5OCOC_6H_5$

(D) $C_6H_6 \xrightarrow[C_6H_5COCl]{AlCl_3} C_6H_5COC_6H_5$

22. Phenol reacts with bromine in CS_2 at a low temperature, the product is -

(A) m-Bromophenol

(B) p-Bromophenol

(C) o-and p-Bromophenol

(D) 2, 4, 6-Tribromophenol

23. Phenol reacts with conc. HNO_3 in the presence of conc. H_2SO_4 to give –

(A) Meta nitrophenol

(B) Ortho nitrophenol

(C) Ortho and para nitrophenol

(D) Picric acid

24. Phenol on heating with $NaNO_2$ and a few drops of conc. H_2SO_4 gives –

(A) *p*-Nitrophenol (B) *p*-Nitrosophenol
(C) *o*-Nitrophenol (D) *m*-Nitrosophenol

25. Ortho and para hydroxy acetophenone and anhydrous $AlCl_3$ are related with the following reaction –

(A) Phthalein reaction

(B) Fries rearrangement

(C) Schmidt reaction

(D) Wurtz-Fittig reaction

26. Reimer Tiemann reaction involves -

(A) Carbanion intermediate

(B) A carbene intermediate

(C) Carbonium ion intermediate

(D) Free redical intermediate

ETHER

Introduction

1. The number of alkanols and ethers represented by the molecular formulae C_3H_8O and $C_4H_{10}O$ 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

2. Which is mismatched -

(A) C_2H_5–O–C_2H_5
Four primary carbon atoms

(B) CH_3–CH_2–CH(OH)CH_3
Optically active

(C) CH_3–O–CH $(CH_3)_2$
Two secondary carbon atoms

(D) Ether is heated with CH_3COCl in presence of $AlCl_3$ $CH_3COOC_2H_5$ + C_2H_5Cl

3. Diethyl ether is metamer of -

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

4. Anhydrides of alcohol are nothing but -

(A) Ethers (B) Aldehydes
(C) Esters (D) Alkyl anhydrides

5. Electron pair donating tendency is maximum in-

(A) Me–O–H (B) Me–O–Me
(C) Et–O–H (D) Et–O–Et

6. Which of the following is a cyclic ether-

(A) Ethyl ether (B) Vinyl ether
(C) Phenyl ether (D) Tetrahydrofurane

Method of Preparation

7. In which case the product is neither a cyclic ether nor open chain symmetrical ether-

(A) CH_3– CH = CH – $CH_3 \xrightarrow{C_6H_5CO_3H}$

(B) $CH_3CH_2ONa + C_2H_5Br \longrightarrow$

(C) KCN + $(CH_3)_3$ CBr $\longrightarrow$

(D) C_2H_5OH (Excess) + $H_2SO_4 \xrightarrow{140^\circ}$

8. 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

9. For making $(CH_3)_3C–O–C_2H_5$ the ideal combination is -
(A) $(CH_3)_3CONa$ and C_2H_5Br
(B) $(CH_3)_3CBr$ and C_2H_5ONa
(C) Both the above
(D) None

10. Mixed ether will not be formed in the reaction-
(A) $CH_3OCH_2Cl + C_2H_5MgBr$
(B) $CH_2N_2 + C_2H_5OH$
(C) $C_2H_5ONa + CH_3I$
(D) $C_2H_5OH + H_2SO_4$ (140°C)

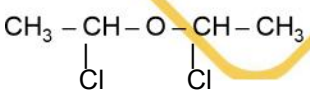
11. In which case ether is formed -
(A) $(CH_3)_3C–Br + CN^-$
(B) $CH_3CH_2Br + (CH_3)_3CO^-$
(C) $(CH_3)_3C–Cl + OC_2H_5^-$
(D) None of the above

Properties

12. Diethyl ether acts as a -
(A) Lewis acid (B) Lewis base
(C) Reducing agent (D) Oxidising agent

13. Ethers like alcohols do not form strong..... bonding . Hence they are more volatile -
(A) Covalent (B) Hydrogen
(C) Coordinate (D) None of the above

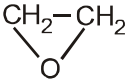
14. The compound obtained by the reaction of diethyl ether with chlorine in the presence of sun light, is -
(A) Perchloro diethyl ether $H_5C_2–OC_2Cl_5$
(B) Perchloro diethyl ether $Cl_5C_2–O–C_2Cl_5$
(C) β,β' - Dichloro diethyl ether $ClCH_2CH_2–O–CH_2CH_2Cl$
(D) α,α' - Dichlorodiethylether



15. Diethyl ether absorbs oxygen to form -
(A) Red coloured sweet smelling compound
(B) Acetic acid
(C) Ether sub oxide (D) Ether peroxide

16. Diethyl ether and air gives ether- hydroperoxide. The mechanism of the reaction is -
(A) Nucleophilic substitution
(B) Free radical addition
(C) Free radical substitution
(D) None of the above

17. The order of reactivity of halogen acids with ether is -
(A) HCl > HBr > HI (B) HI > HBr > HCl
(C) HCl > HI > HBr (D) HI > HCl > HBr

18. The reaction of ethoxyethane and ethanoyl chloride is carried out in presence of anhydrous aluminium chloride. The product on alkaline hydrolysis gives -
(A) CH_3CH_2OH (B) $CH_3CH_2OCH_2CH_3$
(C) CH_3OCH_3 (D) 

19. Ether on carbonylation gives -
(A) Alkanoic acid (B) Alkanone
(C) Alkyl alkanoate (D) Alkanal

20. First member of ether series on reaction with sodium and liquified ammonia gives -
(A) Methanol + methane
(B) Ethane+ methanol
(C) Ethanol
(D) Ethane

21. Which of the following compounds forms an adduct with diethyl ether through coordinate bond -
(A) BF_3 (B) Oxygen of air
(C) HCl gas (D) All of the above

22. Which of the following is a false statement -
(A) Diethyl ether gives ethyl iodide on reacting with HI
(B) Diethyl ether and methyl isopropyl ether are chain isomers
(C) Diethyl ether is a Lewis base
(D) Diethyl ether hydrolyses to ethanol by dil.H_2SO_4

23. Mark the correct statement -
(A) Ethers behave as Lewis base
(B) Ethers form coordination complexes with Lewis acids
(C) With cold HI diethyl ether gives ethyl alcohol & ethyl iodide
(D) All are correct

24. Ethers are quite stable towards -
(A) Oxidising agents (B) Reducing agents
(C) Na metal (D) Bases

25. Ether is used as -
(A) An antiseptic and a solvent
(B) An anaesthetic and a solvent
(C) A fire extinguisher under the trade name pyrene
(D) A dry cleaning solvent

MISCELLANEOUS QUESTIONS

1. The role of conc. H_2SO_4 in the esterification process is :

(A) Catalyst (B) Dehydrating agent

(C) Hydrolysing agent

(D) Dehydrating agent and catalyst

2. Methanol and ethanol are distingusihed by the :

(A) Action of HCl (B) Iodoform test

(C) Solubility in water (D) Sodium

3. When 2–ethylanthraquinol dissolved in a mixture of benzene and cyclohexanol is oxidised, the product is

(A) Ethanol (B) Hydrogen peroxide

(C) Anthracene (D) None of these

4. Phenol is heated with phthalic anhydride in the presence of concentrated H_2SO_4. The product gives pink colour with alkali. The product is :

(A) Bakelite (B) Fluorescein

(C) Salicylic acid (D) Phenolphthalein

5. $A \xleftarrow[\Delta]{Cu} CH_3CH_2OH \xrightarrow[\Delta]{Al_2O_3} B$. A and B respectively are

(A) Alkene, alkanal (B) Alkyne, alkanal

(C) Alkanal, alkene (D) Alkene, alkyne

6. The alcohol manufactured from water gas is :

(A) Ethanol (B) Butanol

(C) Methanol (D) Isobutanol

7. Which of the following does not form phenol or phenoxide :

(A) C_6H_5Cl (B) C_6H_5COOH

(C) $C_6H_5N_2Cl$ (D) $C_6H_5SO_3Na$

8. Which of the following differentiate between C_2H_5OH and CH_3OH:

(A) HCl (B) NH_3

(C) H_2O (D) I_2 + KOH

9. Action of nitrous acid with ethylamine produces :

(A) Ethane (B) Ammonia

(C) Ethyl alcohol (D) Nitroethane

10. An unknown compound 'D', first oxidised to aldehyde and then acetic acid by a dilute solution of $K_2Cr_2O_7$ and H_2SO_4. The unknown compound 'D' is :

(A) CH_3CHO (B) CH_3CH_2OH

(C) $CH_3CH_2CH_2OH$ (D) $CH_3CH_2CH_3$

11. Carbinol is :

(A) C_2H_5OH (B) CH_3OH

(C) $(CH_3)_2CHOH$

(D) $CH_3CH_2CH(OH)CH_3$

12. From which of the following tertiary butyl alcohol is obtained by the aciton of methyl magnesium iodide :

(A) HCHO (B) CH_3CHO

(C) CH_3COCH_3 (D) CO_2

13. Reaction : $CH_3OH + O_2 \xrightarrow[Ag]{600°C}$ product

The product is :

(A) $CH_2=C=O$ (B) $H_2C=O$

(C) C_2H_4 (D) C_2H_2

14. $CH_3–CH=CH–CH(OH)–CH_3 \xrightarrow[\text{reagent}]{\text{Jone's}} X$,

Product X is :

(A) $CH_3CH_2CH_2CH(OH)CH_3$

(B) $CH_3CH=CHCOCH_3$

(C) Both the above

(D) $CH_3CH_2CH_2COCH_3$

15. Methyl alcohol is toxic. The reason assigned is :

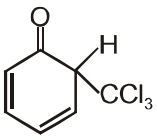
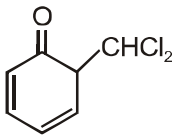
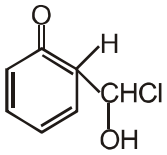
(A) It stops respiratory track

(B) It reacts with nitrogen and forms CN^- in the lungs

(C) It increases CO_2 content in the blood

(D) It is a reduction product of formaldehyde

16. When phenol is reacted with $CHCl_3$ and NaOH followed by acidification, salicyldehyde is obtained. Which of the following species are involved in the above mentioned reaction as inter mediate :

(A) 
(B) 
(C) 
(D) All of these

17. Which of the following compound dehydrates most easily :

(A) R_3COH (B) R_2CHOH
(C) CH_3CH_2OH (D) $CH_3CH_2CH_2OH$

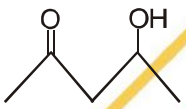
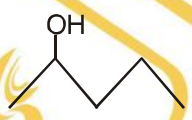
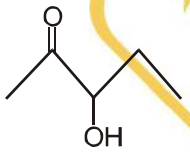
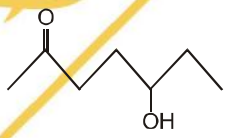
18. The reaction of ethylene glycol with PI_3 gives :

(A) ICH_2CH_2I (B) $CH_2=CH_2$
(C) $CH_2=CHI$ (D) $ICH=CHI$

19. The reaction of Lucas reagent is fast with :

(A) $(CH_3)_3COH$ (B) $(CH_3)_2CHOH$
(C) $CH_3(CH_2)_2OH$ (D) CH_3CH_2OH

20. Which one of the following will most readily be dehydrated in acidic condtion :

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

21. Acetone on treatement with CH_3–Mg–I and on further hydrolysis gives :

(A) Isopropyl alcohol
(B) Primary alcohol
(C) Acetic acid
(D) 2–methyl –2–propanol

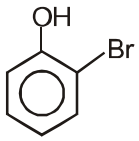
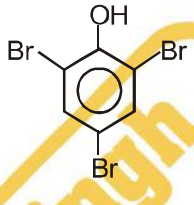
22. When phenol reacts with ammonia in presence of $ZnCl_2$ at 300°C, it gives :

(A) Primary amine (B) Secondary amine
(C) Tertiary amine (D) Both (B) and (C)

23. Maltose, on hydrolysis, gives :

(A) Glucose (B) Fructose
(C) Maltose (D) Mannose

24. With excess bromine, phenol reacts to form :

(A) 
(B) 
(C) 
(D) Mixture of (A) and (B)

25. Condensation of phenol and phthalic anhydride gives :

(A) Methyl orange (C) Phenol red
(C) Salicylic acid (D) Phenolphthalein

26. 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

27. The compound containing hydrogen bond is-

(A) Toluene (B) Phenol
(C) Chlorobenzene (D) Nitrobenzene

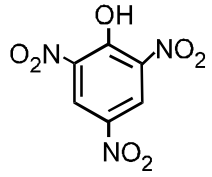
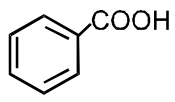
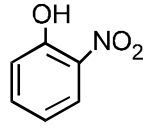
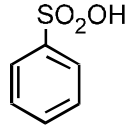
28. Phenol on treatment with ammonia gives –

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

29. Salicylic acid, aspirin, nylon, plastics and picric acid have a common raw material, namely –

(A) Methane (B) Formic acid
(C) Phenol (D) Alcohol

30. Which of the following will not be soluble in sodium carbonate solution –

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

31. Under suitable conditions $C_6H_5CH_2OH$ (A) C_6H_5OH (B), and C_6H_5COOH (C) can act as acids. The increasing order of their acidic strength is -

(A) A < B < C (B) A < C < B

(C) B < A < C (D) C < B < A

32. Kolbe's reaction consists in obtaining –

(A) Anisol from phenol

(B) Salicylaldehyde from phenol and CHI_3

(C) Salicylic acid from sodium phenate and CO_2

(D) Salicylic acid from phenol and CO_2

33. 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

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

(A) Electron withdrawing

(B) Electron donating

(C) Basic

(D) Acidic

35. Which derivative of phenol gives effervescence with $NaHCO_3$ –

(A) *o*-Cresol

(B) Catechol

(C) 2,4,6- Trinitrophenol

(D) 2,4,6- Tribromophenol

36. The product obtained by the reaction of phenol with benzene diazonium chloride is –

(A) Phenyl hydroxylamine

(B) Para amino azobenzene

(C) Phenyl hydrazine

(D) Para hydroxy azobenzene

37. Phenol and benzoic acid can be distinguished by –

(A) Aqueous $NaHCO_3$ (B) Aqueous $NaNO_3$

(C) Aqueous NaOH (D) Conc. H_2SO_4

38. Phenol is converted into salicylaldehyde by–

(A) Etard reaction

(B) Kolbe reaction

(C) Reimer- Tiemann reaction

(D) Cannizzaro reaction

39. Phenol and cyclohexanol can be distinguished by using –

(A) $FeCl_3$ (B) Na

(C) PCl_5 (D) CH_3COCl

40. The main product of the reduction of benzaldehyde with Zn-Hg/conc. HCl, is –

(A) Benzyl alcohol

(B) Cyclohexyl methanol

(C) Toluene

(D) None of these

41. Which of the groups will increase the acidity of phenol –

(A) – NO_2 (B) – CN

(C) – X (halogens) (D) All

42. (a) Main product of phenol and PCl_5 is chlorobenzene

(b) Phenol and ethanol can be distinguished by $FeCl_3$

(c) Phenol and benzoyl chloride reaction is called Schotten-Baumann reaction

(d) o-Cresol is the higher homologue of phenol

Of the above statements –

(A) Only a is correct

(B) b,c and d are correct

(C) a,b are correct

(D) a,c and d are correct

43. When phenol is treated with PCl_5, the yield of chlorobenzene is generally poor because of the formation of -

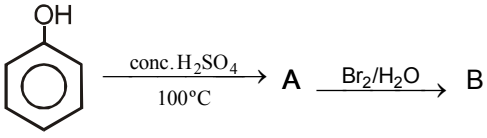
(A) Benzoyl chloride

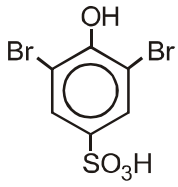
(B) p- Chlorophenol

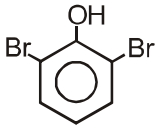
(C) o-chlorophenol

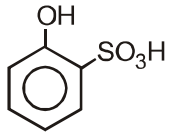
(D) Triphenyl phosphate

44. Idenfity the end product (B) of the following sequence of reaqction.



(A) 

(B) 

(C) 

(D) 

45. The compound which will readily couple with benzene diazonium chloride is –

(A) Benzoic acid (B) Phenol

(C) Benzene (D) Benzaldehyde

46. Benzyl alcohol is –

(A) CH_3CH_2OH (B) C_6H_5COCl

(C) $C_6H_5CH_2OH$ (D) $C_6H_5CH_2CH_2OH$

47. In the following sequence A and B are –

$C_6H_5OH \xrightarrow[HCl]{CH_2=O} A$

$C_6H_5OH \xrightarrow[CH_2=O]{aq.NaOH} O - HOC_6H_4CH_2OH \xrightarrow{SOCl_2} B$

(A) The same compound (the compound o-chloromethylphenol)

(B) Different compounds

(C) Difficult to predict

(D) None

48. $C_6H_5OH \xrightarrow[300^\circ]{NH_3/ZnCl_2} A \xrightarrow{B}$ Benzanilide

Compound (B) in the above reaction is –

(A) Acetyl chloride (B) Benzoyl chloride

(C) Benzamide (D) Acetanilide

49. Phenol is more acidic than cyclohexanol because –

(A) Benzene ring exists in resonance

(B) Cyclohexane ring shows resonance

(C) Phenol is poor in hydrogen

(D) Cyclochexanol is rich in hydrogen

50. Phenol can be converted into salicylic acid by heating with -

(A) CO_2 (under pressure) and alkali

(B) CCl_4 and alkali

(C) $CHCl_3$ and alkali, followed by oxidation

(D) all the above

51. Ether in contact with air for a long time form peroxides. The presence of peroxide in ether can be tested by adding Fe^{2+} ion in it and then adding -

(A) KCNS (B) $SnCl_2$

(C) $HgCl_2$ (D) KI

52. Match list I with list II and then select the correct answer from the codes given below the lists -

List I

(A) $(CH_3)_3C$ — OH

(B) CH_3 — O — C $(CH_3)_3$

(C) C_2H_5 — O — C_2H_5

(D) CH_3 — O — CH $(CH_3)_2$

List II

(a) Sulphuric ether

(b) Chain isomer of 1-butanol

(c) Mixed ether

(d) Has one secondary carbon

Codes :

	A	B	C	D
(A)	b	d	a	c
(B)	b	c	a	d
(C)	b	c	d	a
(D)	c	b	a	d

53. Ether reacts with chlorine in the dark to form-

(A) CH_2Cl — CH_2 — O — CH_2 — CH_3

(B) CH_2Cl — CH_2 — O — CH_2 — CH_2Cl

(C) CH_3 — CH (Cl) — O — CH(Cl) — CH_3

(D) CCl_3 — CH_2 — O — CH_2 — CCl_3

54. Ether does not form oxonium salt on reaction with -

(A) Cold conc. H_2SO_4 (B) Cold conc. HCl

(C) Conc. HI (D) None of the above

55. The ordinary alkyl ethers are cleaved by -

(A) Ethanol (B) Ethyl halide

(C) BF_3 (D) Hydrogen iodide

56. The decomposition of ethers by HI or HBr is called -

(A) Zerewitinoff's reaction

(B) Ziesel's method

(C) Williamson's method

(D) Hell-Volhard-Zelinsky reaction

57. Ether is not formed in this reaction -

(A) $2C_2H_5OH \xrightarrow[140^\circ]{\text{Conc. } H_2SO_4}$

(B) $(CH_3)_3\ C–Cl + C_2H_5ONa \longrightarrow$

(C) $C_2H_5Cl + (CH_3)_3\ C–ONa \longrightarrow$

(D) Oxygen of ether can be replaced by chlorine when treated with PCl_5

58. Unsymmetrical ethers are best prepared by -

(A) Willamson's continuous etherification process

(B) Reacting Grignard reagent with alkyl halide

(C) Treating sodium alkoxides with alkyl bromides

(D) Heating an alkanol with conc. H_2SO_4

59. Which of the following is used as an additive by fire departments under the name Rapid-Water -

(A) Ethylene glycol

(B) Polyethylene oxide

(C) Epichlorohydrin

(D) Epoxy oxide

60. 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

61. The structure of the compounds formed by the reaction of diethyl ether with oxygen of air is -

(A) $CH_3CH_2 – O – O – CH_2CH_3$

(B) $CH_3CH_2 – O – \underset{\displaystyle CH_3}{\underset{|}{CH}} – O – O – H$

(C) $CH_3CH_2 – O – O – CH_2 – O – CH_3$

(D) $CH_2\ (OCH_3) – CH_2 – O – C_2H_5$

62. Ether bottles should not be kept open in air because -

(A) Ether is an anaesthetic

(B) Ether forms an explosive peroxide

(C) Ether is costly

(D) Ether gets oxidised to ethanol

63. Isopropyl alcohol vapour is passed over alumina heated at about at about 240°C. The product formed is -

(A) diisopropyl ether

(B) propene

(C) a mixture of diisopropyl ether and propene

(D) 3-hexene

64. Which of the following is not expected to give ether on reaction with sodium methoxide -

(A) $CH_3CH_2CH_2Cl$ (B) $CH_2 = CHCH_2Cl$

(C) $PhCH_2Cl$ (D) $CH_2 = CHCl$

65. Consider the following reaction,

$$CH_3CH = CH_2 \xrightarrow[2.NaBH_4]{1.(CH_3COO)_2Hg,CH_3OH}$$

The product formed in the reaction is -

(A) $CH_3CH(CH_3) – O – C(=O) – CH_3$

(B) $CH_3 – CH(CH_3) – OCH_3$

(C) $CH_3CH(OCH_3) – CH_2(OCOCH_3)$

(D) $CH_3CH(CH_3COO) – CH_2(OCOCH_3)$

66. Dimethyl ether, Me_2O, is highly soluble in water while diethyl ether, Et_2O, is only sparingly soluble because -

(A) Me_2O reacts with water efficiently due to its small sized methyl groups but Et_2O does not

(B) hydrogen bonding between Et_2O and H_2O is less efficient due to steric crowding around oxygen of Et_2O while the hydrogen bonding between Me_2O and H_2O is much efficient due to small size of the methyl groups

(C) C_2H_5 – groups has a stronger +I effect than CH_3 – group

(D) hyperconjugation of C – H bond is greater in Me_2O than in Et_2O

67. The ether $C_6H_5OCH_2C_6H_5$ on heating with concentrated HI produces -

(A) C_6H_5I and $C_6H_5CH_2OH$

(B) C_6H_5I and $C_6H_5CH_2I$

(C) C_6H_5OH and $C_6H_5CH_2I$

(D) C_6H_5OH and $C_6H_5CH_2OH$

68. Consider the following transformation.

$$CH_3CH = CH - O - CH_2CH_3 \xrightarrow[\text{heat}]{\text{con.HI}}$$

The major product(s) formed is (are) -

(A) $CH_3CH = CHI$ and CH_3CH_2I

(B) $CH_3CH = CHI$ and CH_3CH_2OH

(C) CH_3CH_2CHO and CH_3CH_2I

(D) $CH_3CH_2\underset{\underset{I}{|}}{CH}-O-CH_2CH_3$

69. Ethyl methyl ether on heating with PCl_5 produces-

(A) ethyl chloride and methyl alcohol

(B) acetyl chloride and methyl chloride

(C) ethylidene dichloride and methylene dichloride

(D) ethyl chloride and methyl chloride

70. The reaction $C_2H_5OC_2H_5 + 2HI \xrightarrow{\text{heat}} 2C_2H_5I + H_2O$ involves the mechanism -

(A) S_N1 (B) S_N2

(C) E1 (D) E2

71. Propene is allowed to react with HI.The product (A) is then treated with CH_3ONa to give a new product (B).

$$CH_3CH = CH_2 \xrightarrow{HI} A \xrightarrow{CH_3ONa} B$$

The structure of the product (B) is -

(A) $CH_3CH_2CH_2OCH_3$

(B) $CH_3\underset{\underset{CH_3}{|}}{CH}-OCH_3$

(C) $CH_3CH_2OCH_2CH_3$

(D) $CH_3CH_2OCH=CH_2$

72. In the reaction

$$CH_3CH = CH_2 \xrightarrow[CCl_4]{NBS} A \xrightarrow{C_2H_5ONa} B$$

the product (B) is -

(A) $CH_3\underset{\underset{CH_3}{|}}{CH}-OC_2H_5$

(B) $CH_2=CHCH_2OC_2H_5$

(C) $CH_3CH_2CH_2OC_2H_5$

(D) $C_2H_5CH_2OCH=CH_2$

73. One mole of t-butyl methyl ether on being heated with 1 mole of concentrated hydriodic acid gives -

(A) CH_3OH (1 mole) and $(CH_3)_3CI$ (1 mole)

(B) CH_3I (1 mole) and $(CH_3)_3COH$ (1 mole)

(C) CH_3I (1 mole) and $(CH_3)_3Cl$ (1 mole)

(D) CH_3OH (1 mole) and $(CH_3)_3COH$ (1 mole)

74. Which of the following reactions does not yield an alkyl halide?

(A) $CH_3CH_2OCH_2CH_3 \xrightarrow[hv]{Cl_2}$

(B) $CH_3CH_2OCH_2CH_3 \xrightarrow[\text{heat}]{\text{conc.HI}}$

(C) $CH_3CH_2OCH_2CH_3 \xrightarrow[\text{heat}]{PCl_5}$

(D) $CH_3CH_2OH \xrightarrow{SOCl_2}$

75. Which one among the following reactions is an example of Williamson synthesis -

(A) $CH_3COCH_3 \xrightarrow[\text{Conc.HCl,heat}]{Zn-Hg} CH_3CH_2CH_3$

(B) $CH_3CHO \xrightarrow[2.H_3O^+,\text{heat}]{1.\text{dilNaOH,heat}} CH_3CH=CHCHO$

(C) $C_2H_5I + C_2H_5ONa \xrightarrow{\text{heat}} C_2H_5OC_2H_5$

(D) $HCHO+NaOH \xrightarrow{\text{heat}} HCOONa + CH_3OH$

ANSWER KEY

TOPIC WISE MCQS

ALCOHO

Q.No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	B	C	D	B	C	C	C	B	C	B	D	C	D	D	B	C	D	B	D	C
Q.No	21	22	23	24	25															
Ans.	B	A	C	B	C															

PHENOL

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	D	B	D	D	A	C	A	C	D	A	A	C	B	C	A	C	A	C	A	C
Q.No.	21	22	23	24	25															
Ans.	C	D	B	B	B															

ETHER

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	C	C	B	A	D	D	C	C	A	D	B	B	B	B	D	B	B	A	C	A
Q.No.	21	22	23	24	25															
Ans.	D	B	D	C	B															

MISCELLANEOUS QUESTIONS

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	D	B	A	D	C	C	B	D	C	B	B	C	B	B	B	B	A	B	A	A
Q.No.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	D	A	A	C	D	B	B	C	C	C	A	C	D	A	C	D	A	C	A	C
Q.No.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	D	B	D	A	B	C	A	B	A	D	A	B	C	C	D	B	B	C	B	B
Q.No.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75					
Ans.	B	B	C	D	B	B	C	C	D	B	B	B	A	A	C					

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