

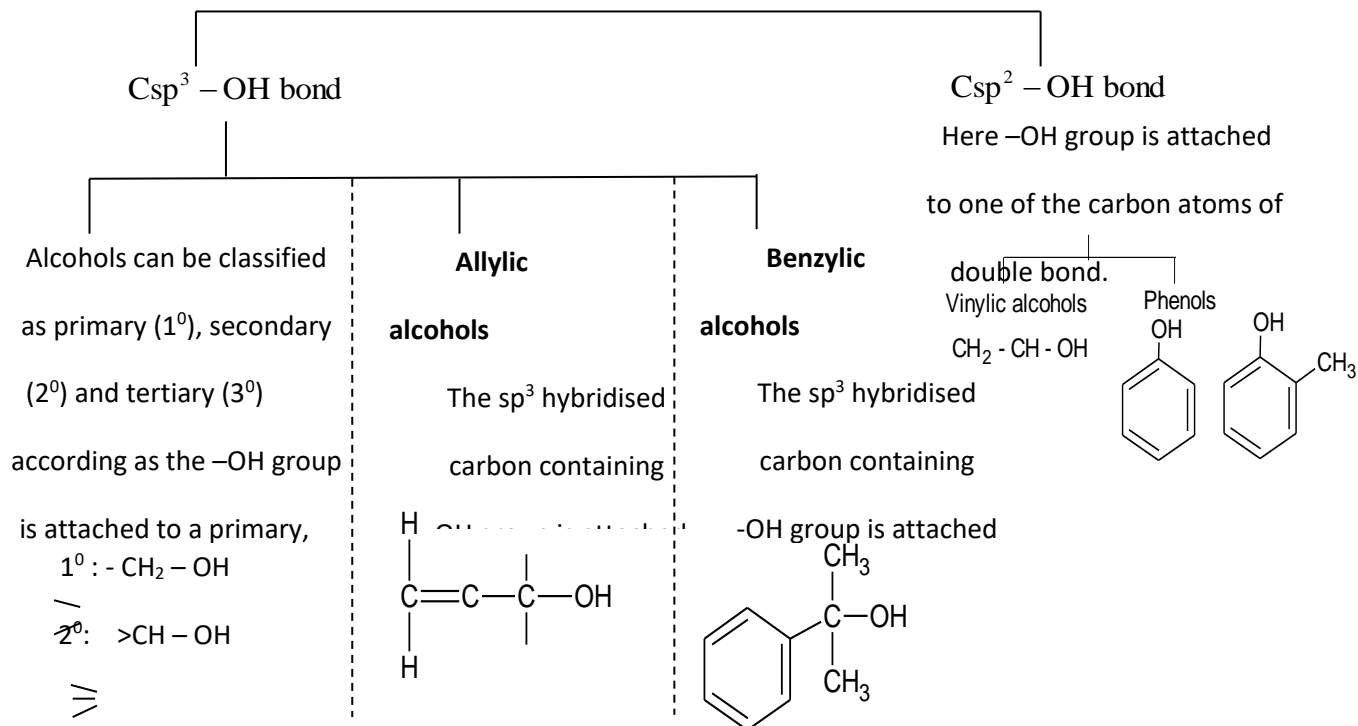
ALCOHOLS , PHENOLS & ETHERS- II PUC

ALCOHOLS

CLASSIFICATION

Alcohols and phenols are classified as mono-, di-, tri- or polyhydric depending upon whether they contain one, two, three or many hydroxyl groups in their structures.

Monohydric alcohols are further classified according to hybridisation of C-atom to which -OH is attached.



Based on the number of -OH groups per molecule of alcohol, they are classified as

a) **Monohydric alcohols**: contains one - OH group per molecule

Example: $CH_3 - CH_2 - OH$ (ethyl alcohol)

b) **Dihydric alcohols**: contains 2 - OH groups per molecule:

Glycol

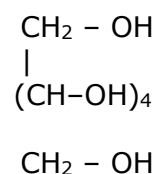
$$\begin{array}{c} CH_2 - OH \\ | \\ CH_2 - OH \end{array}$$

c) **Trihydric alcohols**: contains 3 - OH groups per molecule:

Glycerol

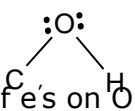
$$\begin{array}{c} CH_2 - OH \\ | \\ CH - OH \\ | \\ CH_2 - OH \end{array}$$

d) **Polyhydric alcohol**: contains many - OH groups per molecule: Sorbitol



Structures of functional groups

In alcohols, O of -OH bond is attached to sp^3 hybridised carbon.

The bond angle  is less than tetrahedral angle ($109^\circ 28'$) due to repulsion between unshared pair of e's on O.

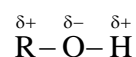
In phenols, -OH group is attached to sp^2 hybridised C of aromatic ring. The C-O bond length in phenols is less than methanol.

This is because of

- (i) partial double bond character of C-O bond
- (ii) sp^2 - hybridized state of C to which O is attached.

In alcohols and phenols due to high electronegativity O-atom acquires partial negative charge and

results in formation of dipole.



Dipole moment of alcohols are higher than phenols. It is because C-O bond in phenol is less polar

due to electron-withdrawing effect of the benzene ring whereas in alcohols C-O bond is more polar

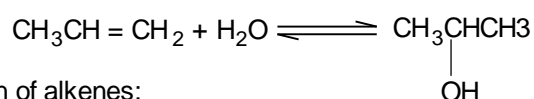
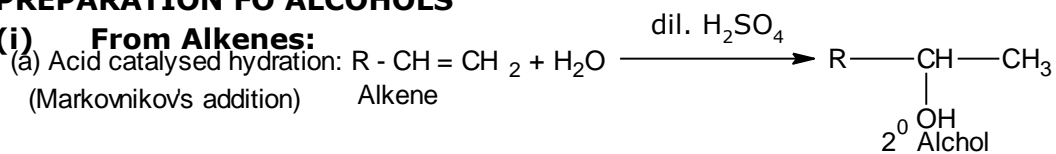
due to electron donating effect of - R group.

In ethers, 2 bond pairs and 2 lone pairs on O are arranged approximately tetrahedrally. The bond

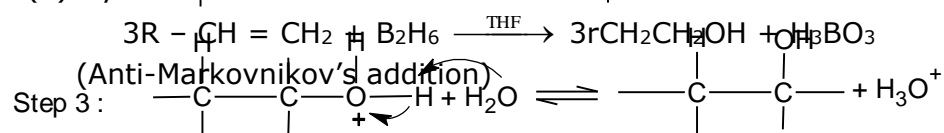
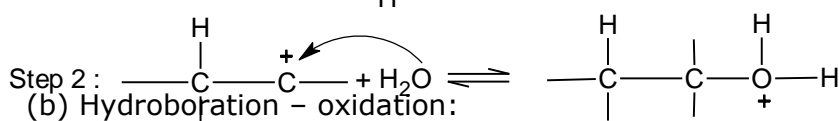
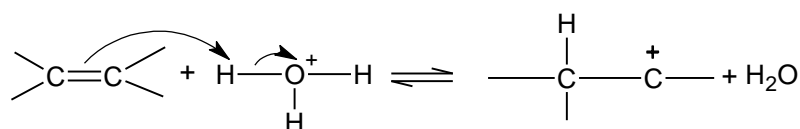
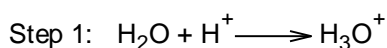
angle is slightly greater than tetrahedral angle due to repulsive interaction between bulky -R groups. The C-O bond length is almost same as that in alcohols.

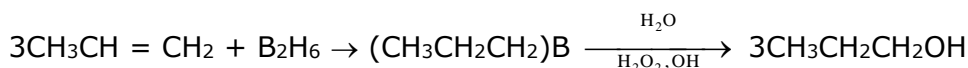
PREPARATION OF ALCOHOLS

(i) From Alkenes:



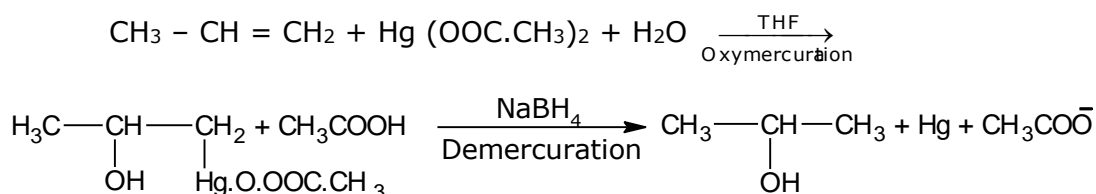
Mechanism of acid catalysed hydration of alkenes:



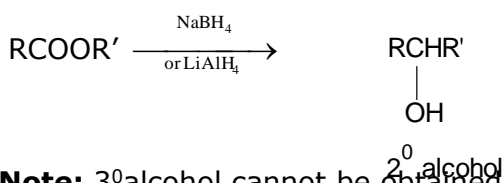
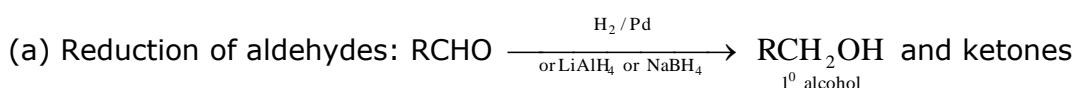


c) Alkene reacts with carbon monoxide and hydrogen in the presence of octacarbonyl dicobalt $[\text{Co}(\text{CO})_4]_2$ as catalyst and at high temperature and pressure to yield aldehydes. Catalytic hydrogenation of aldehydes gives primary alcohols. (OXO PROCESS)

d) Alkenes can also be converted to alcohols by **oxymercuration-demercuration** reaction. In this reaction alkene is treated mercuric acetate in THF water solution to yield a product which on reduction with NaBH_4 gives alcohol.

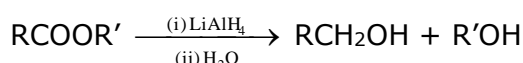
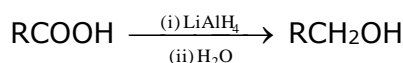


(ii) Reduction by LiAlH_4 or NaBH_4 : Aldehydes, ketones, esters, amides and halides are reduced by LiAlH_4 to alcohols. Aldehydes and ketones are also reduced by NaBH_4 .



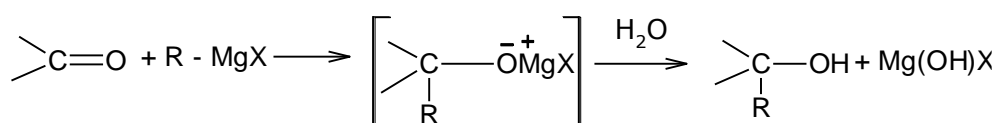
Note: 3° alcohol cannot be obtained by this method.

(b) Reduction of acids and esters :

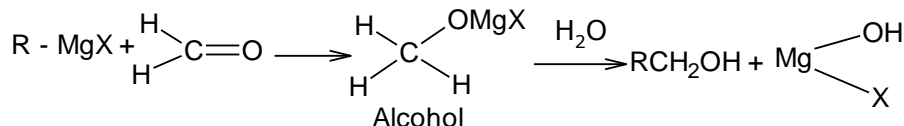


Commercially, acids are reduced to alcohols by first converting them into esters.

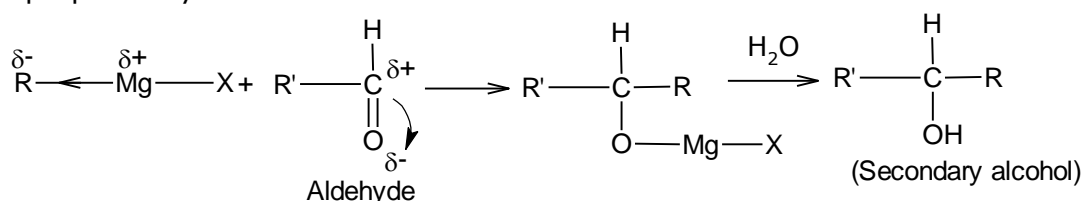
(iii) Grignard reagents:



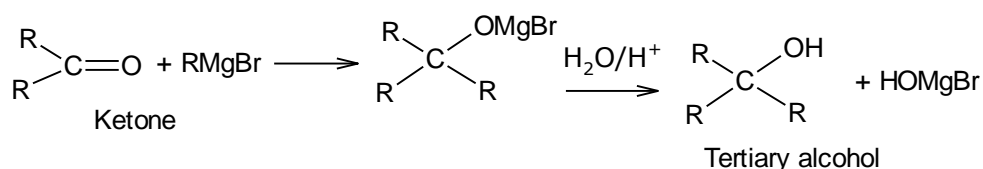
When formaldehyde is used primary alcohols are formed.



with aldehydes other than HCHO secondary alcohols are obtained. Secondary alcohol can also be prepared by addition of esters.

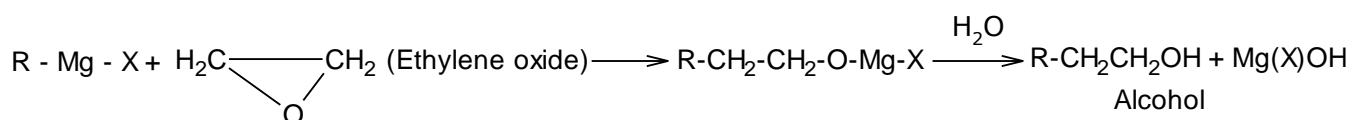


If carbonyl compound is ketone, product will be tertiary alcohol.



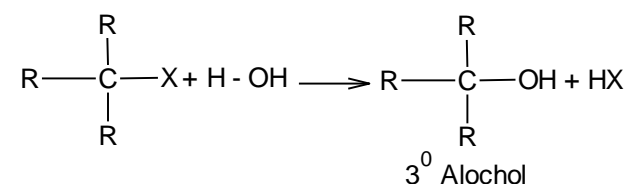
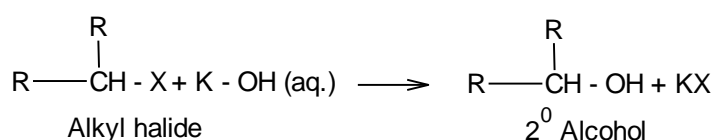
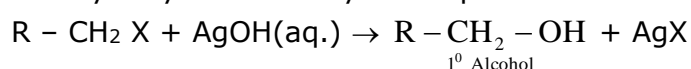
(iv) With Ethylene Oxide:

The alcohol obtained has two carbon atoms more than alkyl group of the Grignard reagent.



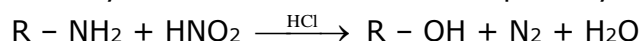
(v) From Alkyl Halides (Hydrolysis):

The hydrolysis occurs by nucleophilic substitution reaction.



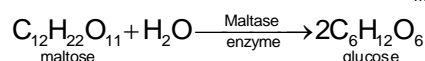
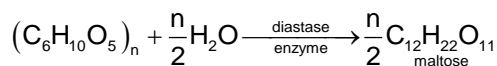
(vi) From Primary Amines:

Primary alcohols are formed when primary amines are treated with nitrous acid (HNO₂)

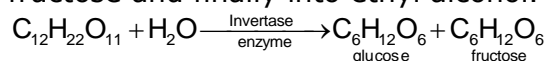


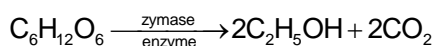
vii) By fermentation: Slow decomposition of a complex organic compound into simpler compounds by means of micro organisms such as yeast, a single celled micro organism. (e.g., yeast)

viii) From starch: Common sources of starch are wheat, barley, potato etc. The grain is mashed with hot water. It is then heated with freshly germinated barley (malt) at 50°C for 1 hour. Malt contains the enzyme diastase. Diastase converts starch into the sugar, maltose by hydrolysis. This maltose on fermentation (24 – 72 hours) in presence of maltase enzyme (produced by yeast) gives glucose.



ix) From molasses: Molasses is the mother liquor left behind after the crystallization of sugar from sugarcane juice. It contains about 30 – 40% uncrystallised sucrose. This dark syrupy liquid is diluted with water to have the percentage of sugar in the solution to about 10%. To this diluted molasses solution H₂SO₄ is added to maintain the pH of the solution at 4. Ammonium sulphate and ammonium phosphate are added as food for the yeast. Yeast ferment with sugar solution for 24 – 72 hours and converts it into glucose and fructose and finally into ethyl alcohol.





(Invertase and zymase enzymes are produced by yeast and function as biocatalyst in fermentation process).

Rectified spirit:

The glucose or fructose fermented liquor known as wash or wort contains 6 to 10% ethyl alcohol. It is subjected to fractional distillation to get 93 to 95% (w/w) ethyl alcohol known as rectified spirit. Generally 95% aqueous alcohol is called **rectified spirit**. Rectified spirit is also called industrial alcohol.

Methylated spirit:

The industrial alcohol is denatured (denature means to make it unfit for drinking), then it is called methylated spirit. Methylated spirit is of two kinds:

- i) **Mineralised methylated spirit** : is 90% rectified spirit + 9% methyl alcohol and + 1% petroleum and purple dye.
- ii) **Industrial methylated spirit**: is 95% rectified spirit and 5% methyl alcohol.

Absolute alcohol: is 99.5% to 100% pure ethyl alcohol. It is obtained by distillation of rectified spirit over calcium oxide and then over.

Physical Properties of ethyl alcohol:

- i) Ethyl alcohol is colourless is inflammable sweet smelling liquid.
- ii) It is miscible with water in all proportions because of intermolecular hydrogen bonding and is also miscible with organic solvent due to nonpolar ethyl group.
- iii) Its boiling point is 78.1°C.
Anhydrous CaCl_2 cannot be used to dry alcohol, as it forms crystalline alcoholates
For example: $\text{CaCl}_2 \cdot 3\text{C}_2\text{H}_5\text{OH}$

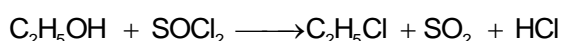
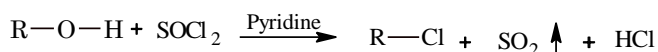
A mixture of absolute alcohol and petrol in 20: 80 percent is called power alcohol or gashol. It is used to as a fuel for internal combustion engine

- ⊙ Pyrolygineous acid contains methyl alcohol, acetone and acetic acid
- ⊙ Benzyl alcohol is obtained by the reaction of benzaldehyde with strong solution of NaOH (Cannizzaro's reaction)
- ⊙ Alcohols contain a hydrophilic - OH group and hydrophobic alkyl or aryl group. The hydrophilic - OH group involves in hydrogen bonding with water. Hence the lower members are readily soluble in water As the carbons atoms in the alcohol increase its solubility in water decreases.

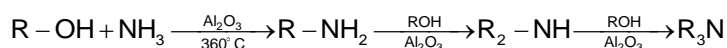
Chemical properties of alcohols (specially ethylalcohol):

Alcohols are reactive compounds mainly due to the presence of hydroxyl group. The reactions can be broadly divided into three categories, namely,

1. reactions involving the cleavage of C - OH bond (order of reactivity $3^\circ > 2^\circ > 1^\circ$)
When an alcohol is heated with carboxylic acid in the presence of concentrated sulphuric acid an ester is formed. This reaction is called esterification.
Ethanol vigorously reacts with sodium to give sodium ethoxide liberating hydrogen gas.
When an alcohol is reacts with acetyl chloride an ester is formed. This reaction is called acetylation.
2. reactions involving the cleavage of O - H bond (order of reactivity $1^\circ > 2^\circ > 3^\circ$)
Alcohols react with phosphorus trichloride to give haloalkane and phosphorus acid.
Ethanol reacts with phosphorus trichloride to form chloroethane and phosphorus acid.
When ethanol reacts with PCl_5 it gives chloroethane (ethyl chloride).
When alcohol reacts with thionyl chloride, chloro alkane is formed.



- (ii) **Reaction with ammonia:**



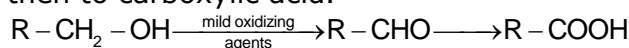
3. reactions involving the cleavage of both alkyl and hydroxyl group

3) Reactions Involving the Cleavage of both Alkyl and Hydroxyl Group:

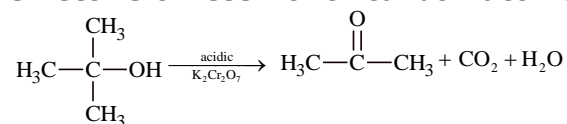
(i) Oxidation:

The oxidation of alcohol depends upon the nature of alcohol. The oxidizing agents usually employed are: acidified potassium dichromate ($K_2Cr_2O_7$), acidified or alkaline potassium permanganate or dilute nitric acid.

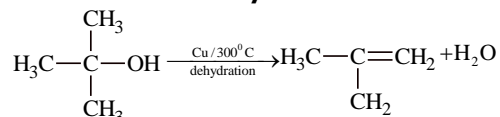
a) Oxidation of primary alcohol: A primary alcohol is easily oxidized to an aldehyde and then to carboxylic acid.



b) Oxidation of secondary alcohol: On oxidation, secondary alcohol forms ketone.
Tertiary alcohols give ketone of less no. of carbon atoms:



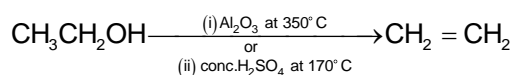
Tertiary alcohols gives alkene with Cu/300°C:



(ii) Dehydration:

Alcohols on dehydration (elimination of water molecule) forms alkene. Dehydration takes place easily in case of tertiary alcohol in comparison to primary alcohol.

⊙ When ethyl alcohol is treated with excess of concentrated H_2SO_4 at $170^\circ C$, ethylene is obtained.



⊙ When excess of ethyl alcohol is heated with concentrated H_2SO_4 to $140^\circ C$, diethyl ether is obtained

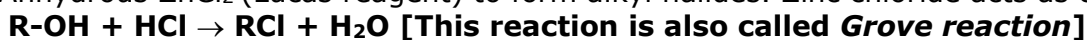
⊙ Benzyl alcohol undergoes oxidation with cupric nitrate to form benzaldehyde and with alkaline $KMnO_4$ it gives benzoic acid.

⊙ Benzyl alcohol cannot be directly nitrated. The $-OH$ group undergoes oxidation with HNO_3 . Hence benzyl alcohol is first converted to benzyl chloride and then subjected to nitration to give ortho and para product

Identification of primary, secondary, tertiary alcohols:

Tests to distinguish primary, secondary and tertiary alcohols

1. Lucas test: In the test alcohols are treated with a solution of concentrated HCl and Anhydrous $ZnCl_2$ (Lucas reagent) to form alkyl halides. Zinc chloride acts as catalyst.

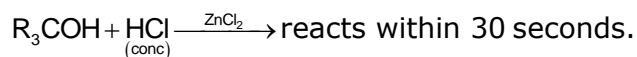
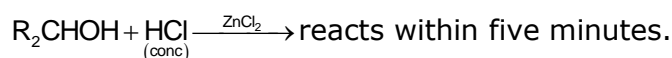
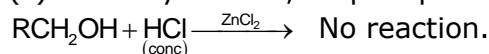


An alcohol is mixed with concentrated hydrochloric acid and anhydrous zinc chloride at room temperature. The alkyl chloride which is formed is insoluble in the medium. It causes the solution to become before it separates as a distinct layer.

(a) Tertiary alcohol gives precipitation immediately.

(b) Secondary alcohol gives precipitation after 5 minutes.

(c) Primary alcohol, no precipitation at room temperature.



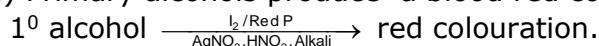
2. **Victor Meyer test:** This test is based on the different behaviour of primary, secondary and tertiary nitroalkanes towards nitrous acid. The test involves the following steps.

a) Alcohol is treated with concentrated hydroiodic acid or red phosphorus and iodine to form the corresponding alkyl halide.

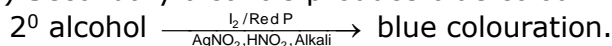
b) Alkyl iodide is treated with silver nitrite to form the corresponding nitroalkane.

c) The nitroalkane is treated with nitrous acid followed by treatment with alkali. Upon such alcohols give different colours.

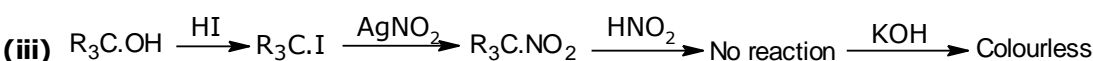
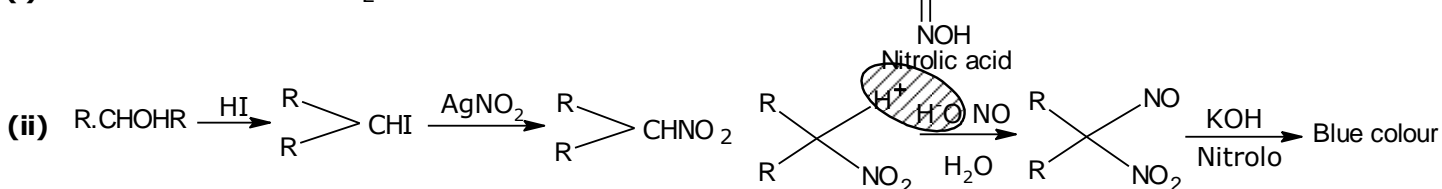
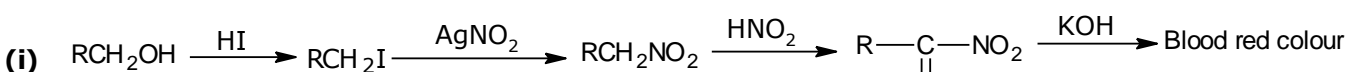
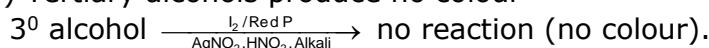
1) Primary alcohols produce a blood red colour



2) Secondary alcohols produce blue colour.



3) Tertiary alcohols produce no colour



Uses of methyl alcohol:

- i) As a solvent for paints and varnishes.
- ii) In the preparation of formaldehyde, perfumes and dyes.
- iii) In the preparation of methylated spirit.

Uses of ethyl alcohol:

- i) As a solvent for pharmaceutical preparations, paints, perfumes, varnishes, gum.
- ii) As alcoholic beverage.
- iii) as a preservative for biological specimens
- iv) As an antifreeze for automobile radiators
- v) As fuel in spirit lamps, stove etc.
- vi) As a source for the preparation of acetaldehyde, chloral, chloroform, iodoform, acetic acid, ether etc.

PHENOLS

Introduction:

Phenols are aromatic hydroxy compounds in which -OH group is directly linked to the aromatic ring.

Eg: C₆H₅ - OH

Phenols are classified as

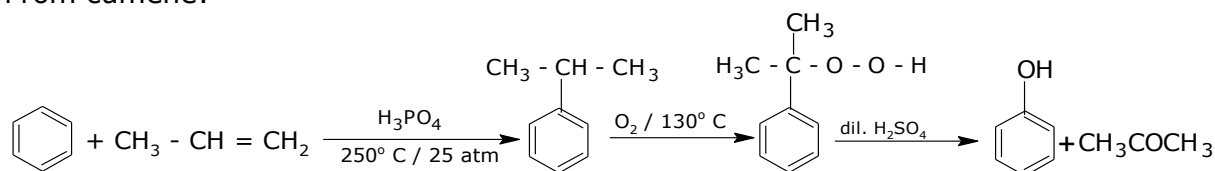
- Monohydric phenols:** These are the phenols containing only one - OH group.
Eg: Phenol, ortho, meta and para -cresols.
- Dihydric phenols:** These are the phenols containing two - OH groups.
Eg: catechol, resorcinol and quinol
- Trihydric phenols:** These are the phenols containing three -OH groups.
Eg: Phloroglucinol, pyrogallol, o-Hydroxyquinol

Preparation:

Methods

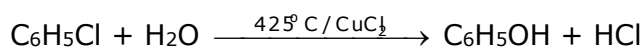
- $$\text{C}_6\text{H}_5\text{SO}_3\text{Na} + 2 \text{NaOH} \xrightarrow{300^\circ\text{C} / \Delta} \text{C}_6\text{H}_5\text{ONa} \xrightarrow{\text{HCl}} \text{C}_6\text{H}_5\text{OH}$$
- $$\text{C}_6\text{H}_6 + \text{Cl}_2 \xrightarrow{\text{FeCl}_3} \text{C}_6\text{H}_5\text{Cl} \xrightarrow{\text{NaOH} / 300^\circ\text{C} / 200\text{atm}} \text{C}_6\text{H}_5\text{ONa} \xrightarrow{\text{HCl}} \text{C}_6\text{H}_5\text{OH}$$

(Dow's process)
- $$\text{C}_6\text{H}_5\text{NH}_2 \xrightarrow{\text{Diazotisation}} \text{C}_6\text{H}_5 - \text{N} = \text{N} - \text{Cl} \xrightarrow{\text{H}_2\text{O}} \text{C}_6\text{H}_5\text{OH}$$
- Coal $\xrightarrow{\text{Fractional/ distillation}}$ middle oil fraction cooled, Naphthalene is separated
 $\xrightarrow{\text{NaOH}}$ Sodium phenate $\xrightarrow{\text{HCl}}$ Phenol
- From cumene:



Raschig's process:

When the chlorobenzene is heated with steam at 425° C in the presence of CuCl₂ as catalyst phenol is formed.

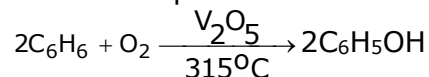


Grignard reagents:

Grignard reagent on oxidation followed by hydrolysis gives phenol.



Oxidation of benzene: This is the latest method for the manufacture of phenol. The mixture of benzene and air is passed over vanadium pentoxide at 315°C. Benzene is directly oxidized to phenol.



Properties:

Phenols are sparingly soluble in water and they become completely miscible at 66°C. Phenols have higher boiling point due to intermolecular hydrogen bonding.

Phenol containing 5% water is called **carbolic acid**.

Phenol is corrosive and it causes blisters when falls on skin.

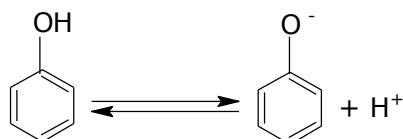
Chemical properties:

Phenol is weakly acidic and hence reacts with sodium hydroxide forming sodium phenate.

Phenol is more acid than alcohol.

It is a weaker acid than carbonic acid and hence cannot liberate carbon dioxide from carbonates and bicarbonates.

Phenol is acidic due to the formation of phenoxide ion which is resonance stabilized.



Acidity of phenol is explained on the basis of the stability of phenoxide ion.

Higher the stability of phenoxide ion more is the acidic strength.

Effect of substituents on acidity of Phenol:

a) Electron withdrawing groups:

(1) Electron withdrawing groups such as - Cl, - NO₂, -CN, -CHO, etc increase the acidity of phenols by stabilizing the phenoxide ion.

For example, o - nitro phenol and para nitro phenol are more acidic due to the involvement of nitro group in resonance.

m- nitro phenol is less acidic as the nitro group in the meta apposition is not involved in resonance.

Acidity decrease in the order: p nitrophenol > o- nitrophenol > m- nitrophenol

o - nitrophenol is less acidic than p-nitrophenol due to intramolecular hydrogen bonding.

Ortho nitrophenol is steam volatile because intramolecular hydrogen bonding make these molecules independent of each other.

(2) Higher the number of electron withdrawing groups, higher is the acidic character of phenols. Trinitrophenol is more acidic than all mononitrophenols.

Acidic Character: RCOOH > H₂CO₃ > C₆H₅OH > H₂O > C₂H₅OH

b) Electron releasing groups:

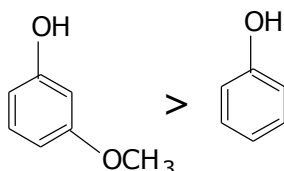
1) Electron releasing groups such as -R, -OR, -NH₂ etc destabilize the phenoxide ion.

Hence acidity of phenol decreases. The effect is more pronounced if the electron releasing group is present on the -o and -p positions than the meta position.

Acidity decrease in the order: Phenol > m-cresol > p-cresol > o-cresol

Groups with +M effect and -I effect (OCH₃ -NH₂) etc decrease the acidity at para position due to resonance but increase the acidity at meta position due to -I effect.

Hence



In case of aminophenols, o-aminophenol is stronger acid due to intramolecular hydrogen bonding, m- aminophenol is stronger acid due to non involvement of $-NH_2$ group in resonance. P- aminophenol is a weaker acid than phenol due to + M effect

Hence

o- Aminophenol > m- Aminophenol > Phenol > p- Aminophenol

Greater the value of K_a or lower the value of pK_a , stronger will be the acidity.

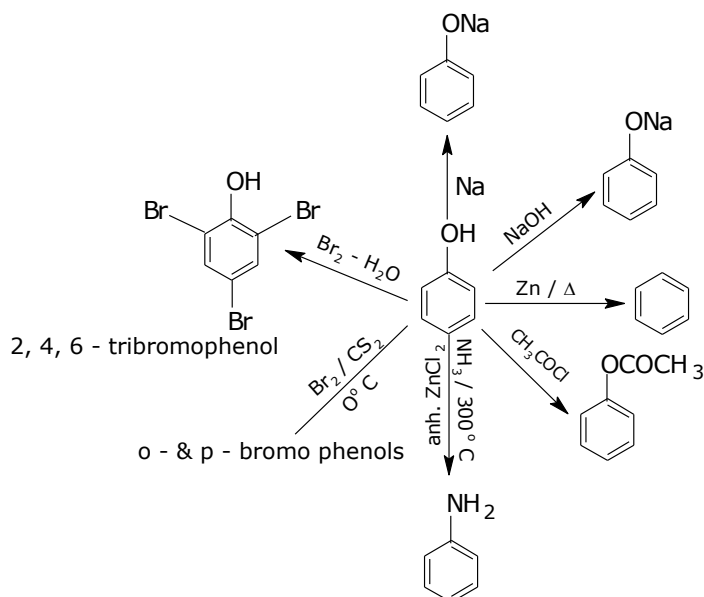
Chloro phenols - o- > m- > p- > phenol

Cresols - m- > p- > o-

Dihydric phenols - m- > o- > p-

Methoxy phenols - m- > o- > p-

Amino phenols - o- > m- > p-



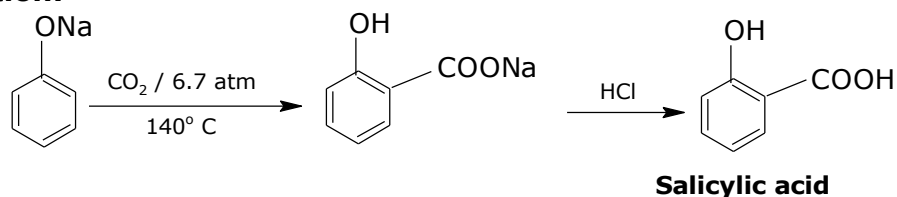
Phenol reacts with a mixture of conc.HNO₃ and Conc. H₂SO₄ to give picric acid (2, 4, 6 - trinitro phenol)

Phenol on treating with dilute HNO₃ at 20°C gives a mixture of o - & p - nitrophenol

Friedel – Craft’s reaction:

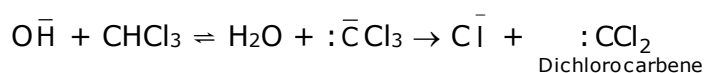
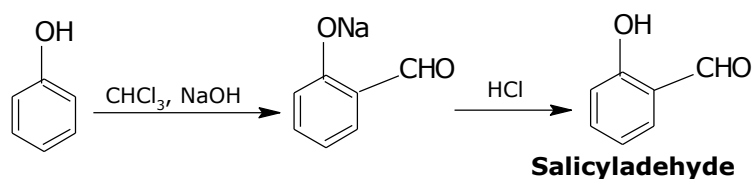
Phenol reacts with methyl chloride in the presence of anhydrous AlCl₃ to give o-and p-cresols.

Kolbe’s reaction:

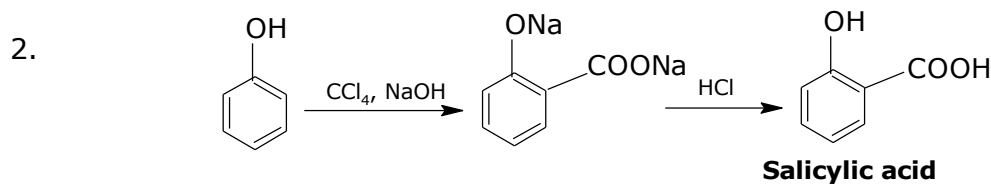


Reimer – Tiemann reaction:

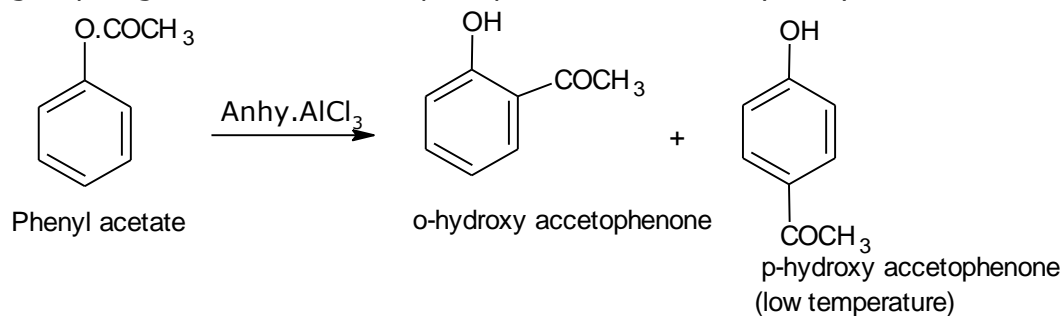
1.



Reimer-Tiemann reaction is electrophilic substitution reaction and electrophile is dichloro carbene.

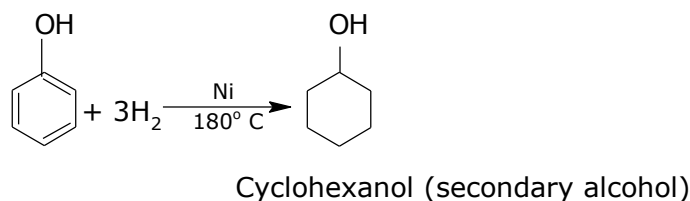


Fries rearrangement: The phenyl ester when heated with anhy. AlCl_3 or ZnCl_2 the acetyl group migrates to ortho and para positions to form hydroxy ketones



Reduction

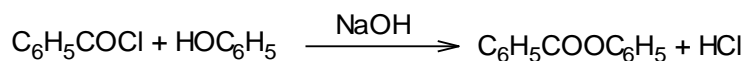
a) When phenol is subjected to hydrogenation at 430 K in the presence of nickel catalyst gives cyclohexanol.



b) $\text{C}_6\text{H}_5\text{OH} + \text{Zn} \rightarrow \text{C}_6\text{H}_6 + \text{ZnO}$

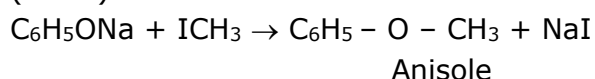
Schotten Baumann's reaction (Benzoylation)

Phenol reacts with benzoyl chloride in the presence of NaOH, phenyl benzoate is formed.



Formation of anisole: (Williamson's ether Synthesis)

Sodium or Potassium phenate is heated with methyl iodide (alkyl halide) to form anisole (ether)

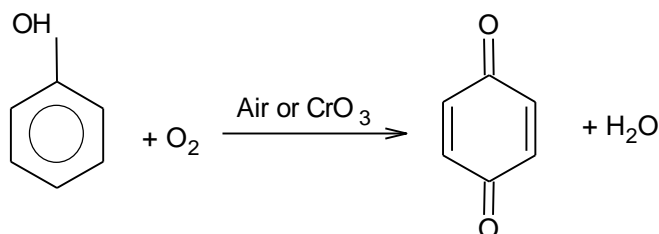


Common name of anisole: methyl phenyl ether

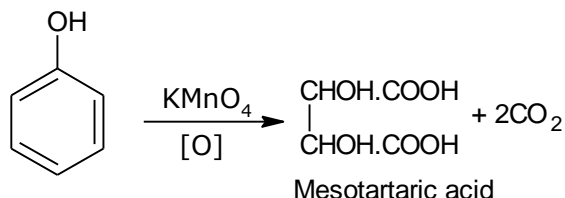
IUPAC name of anisole: methoxybenzene

Oxidation:

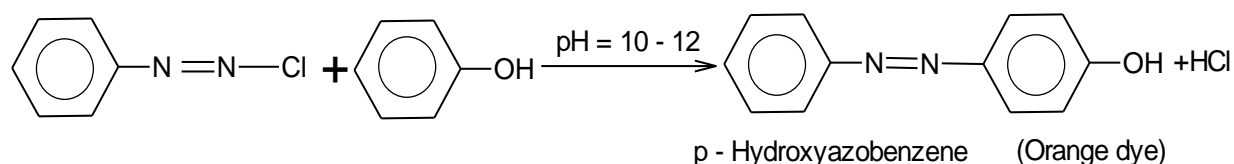
(i) Phenol undergoes oxidation in air to give quinone (pink colour)



(ii) **With potassium permanganate:** Mesotartaric acid is obtained



Coupling reaction:

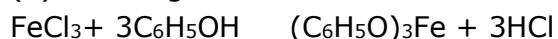


Phenol reacts with phthalic anhydride in the presence of concentrated H_2SO_4 to form phenolphthalein.

Phenetole is ethoxybenzene, it is example for ether. Phenol reacts with sodium hydroxide to form sodium phenoxide. Sodium phenoxide reacts with ethyl iodide to give phenetole.

a) Colour reactions of phenol

(1) Phenol gives violet colouration with neutral ferric chloride



(2) Phenol is heated with crystals of sodium nitrite and Conc. H_2SO_4 and poured into water. Red colour is obtained which turns blue on adding excess of NaOH (Liebermann's test)

(3) Phenol is heated with phthalic anhydride and conc H_2SO_4 . It is poured into sodium hydroxide solution. Pink colour is obtained due to the formation of Phenolphthalein (Phthalein fusion test)

b) Uses of phenol

1) used as an antiseptic and disinfectant

2) used in the manufacture of salicylic acid, picric acid, Phenolphthalein etc

3) used in the manufacture of bakelite (A polymer of phenol and formaldehyde)

4) Phenol couples with phthalic anhydride in presence of concentrated H_2SO_4 to form a dye, (phenolphthalein) used as an indicator.

ETHERS (R - O - R):

A class of organic compounds which contain C-O-C linkage, i.e. these are (dialkyl or diaryl) derivatives of water (H-O-H) where both the hydrogen atoms are replaced by alkyl or aryl groups.

Ethers are also known as alkyl or aryl derivatives of alcohols (R-O-H) where both the hydrogen atom is replaced by alkyl or aryl groups.

Ether are classified as

(i) Simple or symmetrical, if alkyl or aryl groups attached to O-atom are same. Example: CH_3OCH_3 .

(ii) mixed or unsymmetrical if the two groups attached to O-atom are different. Example: $\text{CH}_3\text{OC}_2\text{H}_5$.

Ethers can be further classified into aliphatic and aromatic ethers. Aromatic ethers can be further

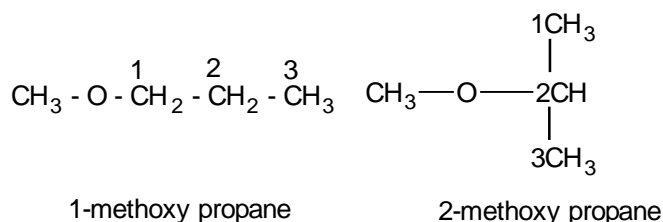
classified into phenolic or alkylarylethers (contain alkyl and aryl group) and aryl ethers (contain aryl group only).

Isomerism: Ethers exhibit two types of isomerism

(i) **Functional Isomerism:** They are isomeric with monohydric alcohols e.g.



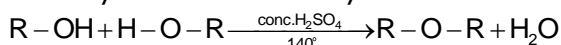
(ii) **Metamerism:** $\text{C}_2\text{H}_5 - \text{O} - \text{C}_2\text{H}_5$
ethoxy ethane



Methods of Preparation Ethers:

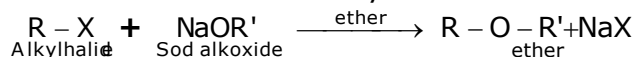
1) From Alcohols:

(i) Primary alcohols on dehydration with conc. H_2SO_4 at lower temperature form ether.

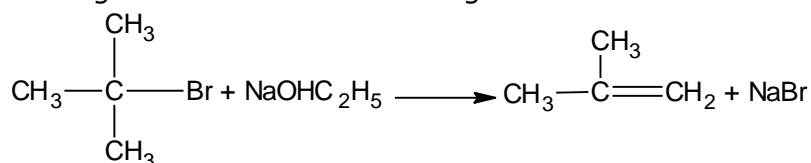


2) From Sodium Alkoxide (Williamson Synthesis)

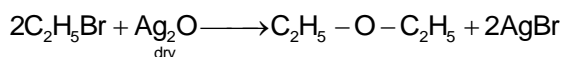
A nucleophilic substitution reaction between sodium alkoxide and alkyl halide gives ether. It is known as Williamson synthesis.



The alkyl halide should be primary. The secondary and tertiary alkyl halides undergo elimination reaction to give alkenes.



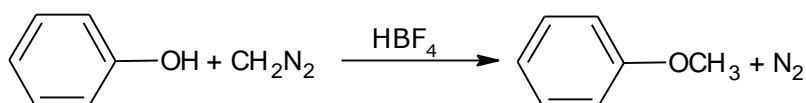
3) Heating alkyl halide with silver oxide



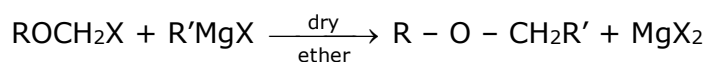
4) **From alcohol** by the action of diazomethane



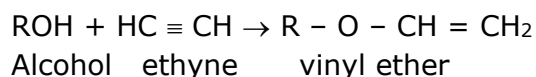
5) **From Phenol**



6) **From Grignard's reagent:** Synthesis of higher ether

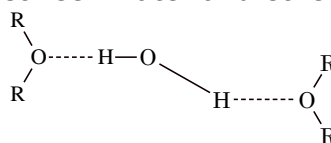


7) Vinyl ethers:



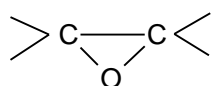
Physical Properties of Ethers:

- i) Lower members are gases or volatile liquids, e.g. $\text{CH}_3 - \text{O} - \text{CH}_3$ and $\text{CH}_3 - \text{OC}_2\text{H}_5$ (gases), $\text{CH}_3 - \text{CH}_2 - \text{O} - \text{CH}_2 - \text{CH}_3$ (volatile liquid).
- ii) They are colourless liquids with pleasant ethereal odour.
- iii) Ether vapours are highly inflammable. Ether fire is extinguished by CO_2 or pyrene (CCl_4) extinguisher and not by water as ether floats on water.
- iv) **Dipole nature:** The C - O bond in ether is polar in nature as oxygen is more electronegative than carbon atom. They have a dipole moment of 1.15 - 1.30 D. The two C - O bonds are inclined at an angle of 110° , hence two dipoles do not cancel each other and makes ether somewhat polar.
- v) **Boiling points:** Ethers are isomeric with alcohols, but their boiling points are much lower than those of the isomeric alcohols as ethers do not form intermolecular hydrogen bonding.
- vi) **Solubility:** Ethers containing upto three carbon atoms are soluble in water due to the formation of hydrogen bonds between water and ether molecules.

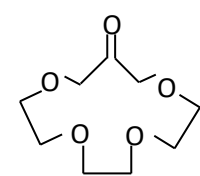


- ⊙ Ethers react with chlorine or bromine in the dark to give substitution products at α - carbon atoms
When Diethyl ether reacts with chlorine in dark, 1,1-Dichlorodiethylether is formed.
When Diethyl ether reacts with chlorine in the presence of sunlight, perchlorodiethyl ether is formed.
- ⊙ When an ether is heated with phosphorous pentachloride, alkyl halides are formed
Diethyl ether reacts with PCl_5 to give ethyl chloride and phosphorus oxychloride.
Diethyl ether reacts with excess of hydroiodic acid to give ethyl iodide.
- ⊙ When ethers are heated with dilute sulphuric acid under pressure alcohols are formed
When Diethyl ether is heated with dilute sulphuric acid under pressure, ethanol is formed.

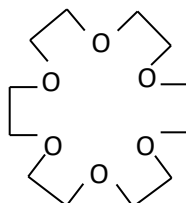
Note:1. Expoxides: Epoxides are cyclic ethers. Etheral oxygen forms a part of three membered ring



2.Crown ethers: They are cyclic poly ethers



[15] CROWN-5



[18] CROWN-6

The first number indicates ring size and second number indicates the number of oxygen atoms

3.Thio ethers: R – S – R – in place of – O – there is –S– linkage. Also known as sulphides.

