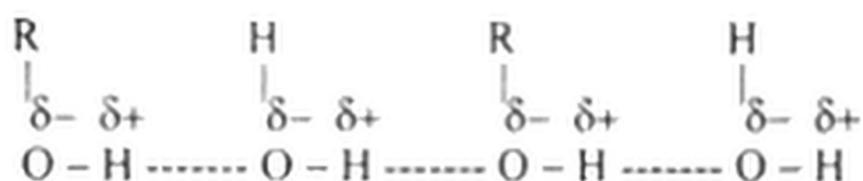


## Short Questions and Answers.

**Q1: Write down the physical properties of alcohol?**

**Answer**

Alcohol up to butanols are generally colourless liquids characteristics sweet smell and burning taste. They are readily soluble in H<sub>2</sub>O. The solubility of alcohol is due to hydrogen bonding which is significant in lower alcohols but decreases in high alcohols.



Bonding which is present in alcohols but absent in alkanes.

**Q2: Write down the structure of alcohol?**

**Answer**

The alcohol functional group consists of an O atom bonded to a C atom and an H atom via  $\sigma$  bonds.

But the C-O and O-H bonds are polar due to the high electronegativity of the O atom.

**Q3: Write down the acidity of alcohols?**

**Answer**

Due to the electronegativity of the O-atoms alcohols are slightly acidic.

The atom deprotonated by the deprotonation of an alcohol is the alkoxide.

Alkoxides are important bases in organic chemistry.

Alcohol reacts with Na (or) like  $H_2O$  to give the alkoxide.

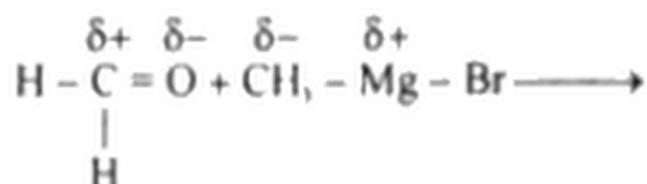


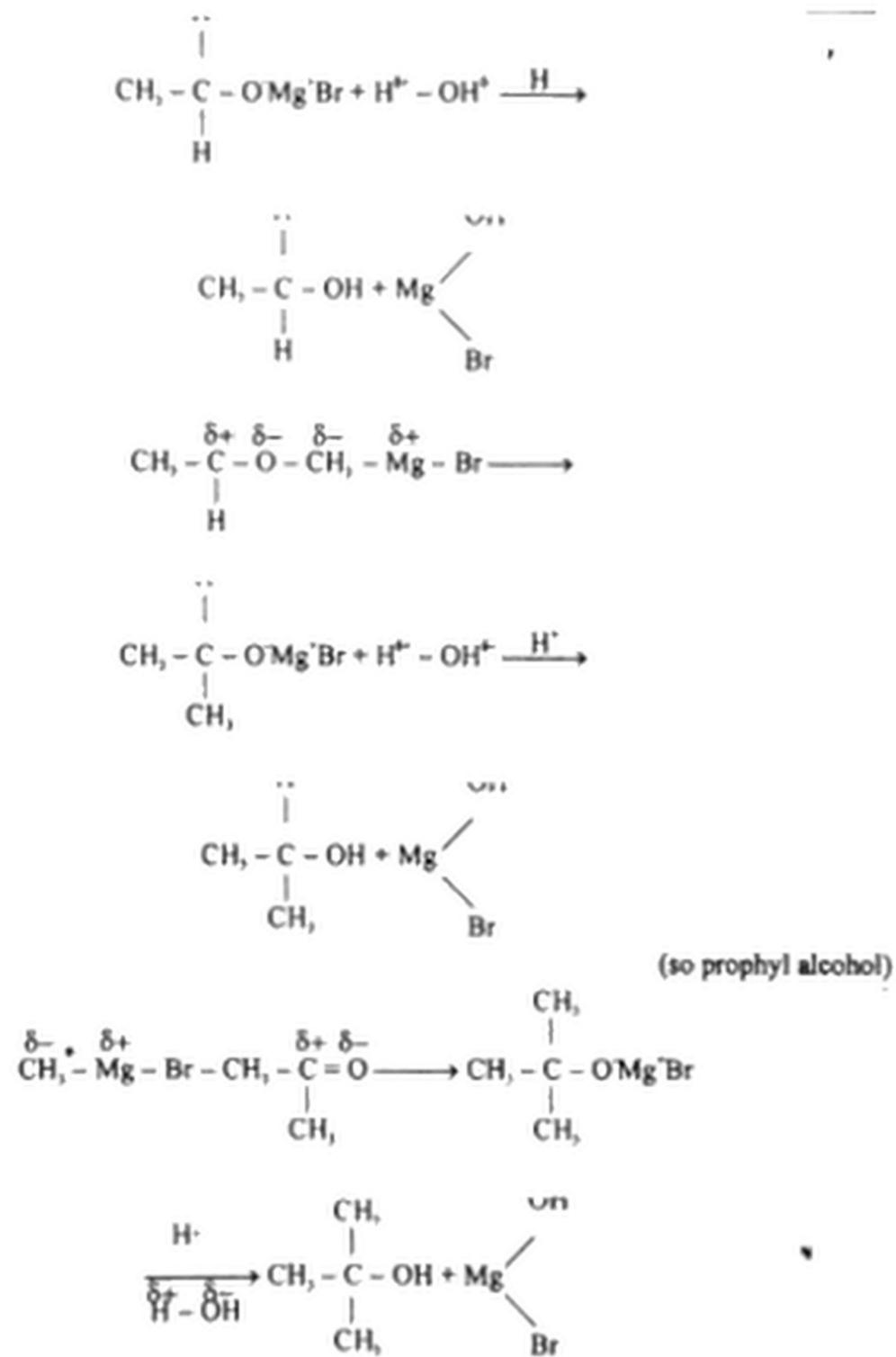
**Q4: Write down the reaction of RLi or RMgX aldehydes and ketones.**

**Answer**

Primary, secondary and tertiary alcohols can be prepared by the use of Grignard reagents. The Grignard reagent acts to a carbonyl molecule and the resulting compound from alcohol on hydrolysis.

- a) Primary Alcohol: Form aldehyde gives primary alcohol with Grignard's reagent.
- b) Secondary Alcohol: All other aldehyde gives secondary alcohols.
- c) Tertiary Alcohols: Ketones from tertiary alcohols with Grignard's reagent under similar conditions.





**Q5: Write down the reduction of aldehydes and ketones?**

**Answer**

Reduction of aldehydes, ketones and carboxylic acid (esters in the presence of Ni, Pd or Pt) gives alcohol.

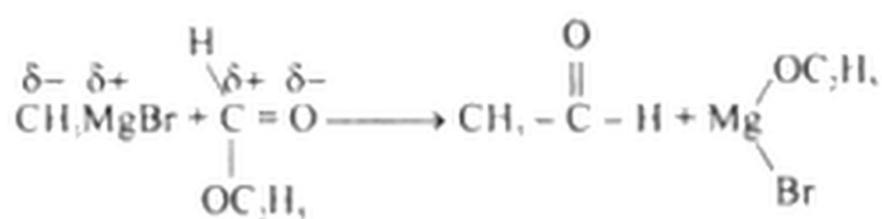
$\text{LiAlH}_4$  besides reducing aldehydes, ketones and ester, also reduces carboxylic acid.



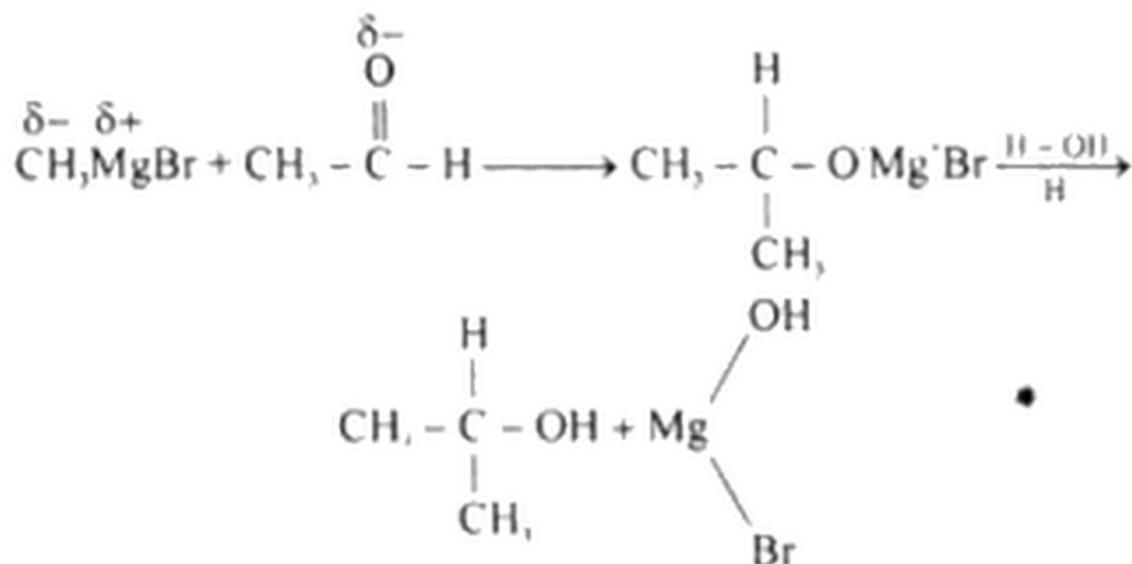
**Q6: Write down the reaction of  $\text{RLi}$  or  $\text{RMgX}$  with esters?**

**Ester react with Grignard reagent to form alcohols? Justify it?**

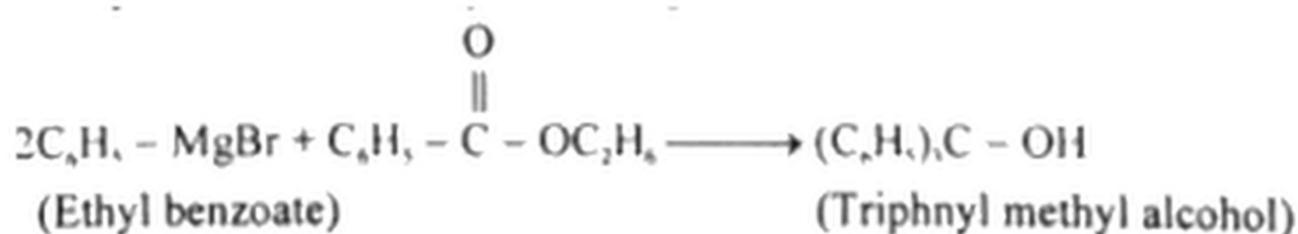
**Answer**



The aldehyde so formed reacts with another molecule of Grignard's reagent to form alcohol.



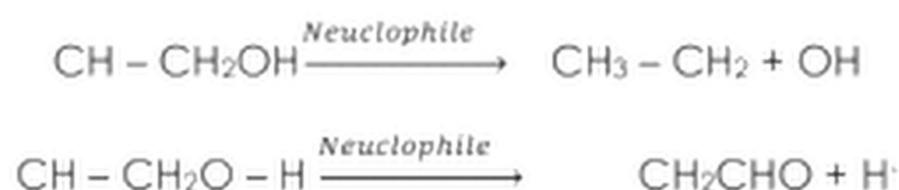
Ester give tertiary alcohols with Grignard's reagents.



**Q7: Write down the order of reactivity of alcohol with respect to O-H bonds cleavage?**

**Answer**

Alcohol reacts with other reagents due to the breaking of C — O and O — H bonds. Breaking of bonds depends upon the nature of the attacking reagent. If a nucleophile attacks the C-O bond, it breaks and if an electrophile attacks the O-H bond, it breaks.



The order of reactivity of alcohol with respect to cleavage of C-O bond is

Tertiary alcohol > Secondary alcohol > primary alcohol

The order of reactivity, of alcohol with respect to O-H bonds cleavage, CH<sub>3</sub>OH

Tertiary alcohol > Secondary alcohol > Primary alcohol.

**Q8: What is Lucas test?**

**Answer**

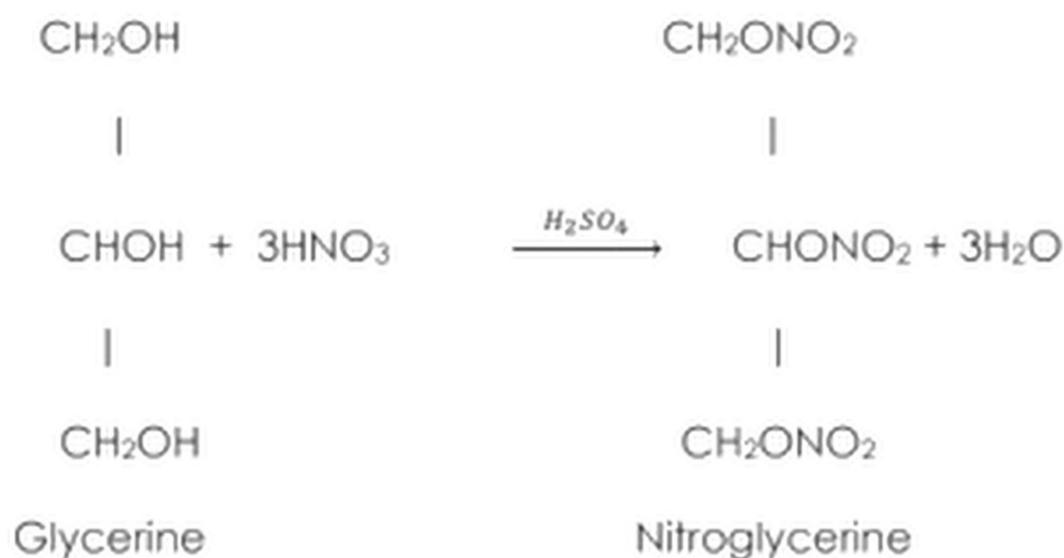
The difference of chemical reactivity of alcohol with halogen acid is used for their identification.

For this purpose, alcohol is treated with a solution of ZnCl<sub>2</sub> in concentrated HCl.

- 1) Tertiary alcohol immediately forms an insoluble layer of a ter-alkyl chloride.
- 2) Secondary alcohol forms an insoluble Sec alkyl chloride in 5-10 minutes.
- 3) Primary alcohol forms an insoluble prim-alkyl chloride on heating.

**Q9: Write down the mechanisms for alcohol condensation to give an ether?**





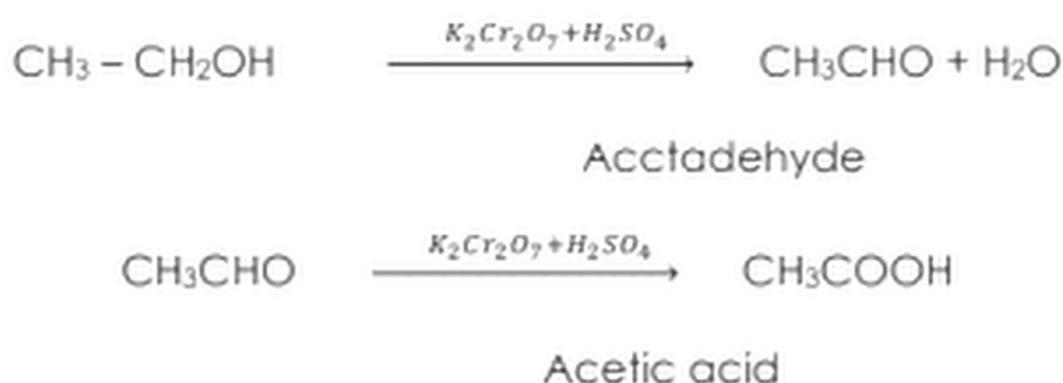
**Q11: Write the oxidation of primary, alcohols and secondary alcohols?**

**Answer**

Alcohols are easily oxidized by alkaline  $\text{KMnO}_4$  or  $\text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{SO}_4$  solution to give different products.

**i) Primary alcohols:**

Primary alcohol is first oxidized to an aldehyde, which is further oxidized to a carboxylic acid.



**ii) Secondary alcohol:**

A secondary alcohol is oxidized under similar condition to give a ketone which is not further oxidized.



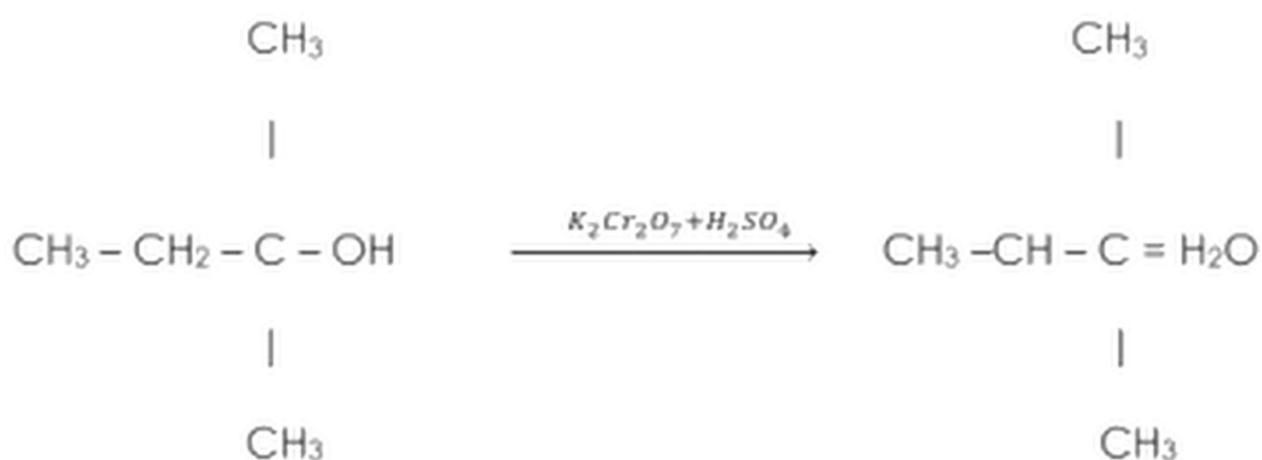


**Q12: Write down the oxidation of tertiary alcohol and cleavage of 1, 2 diols?**

**Answer**

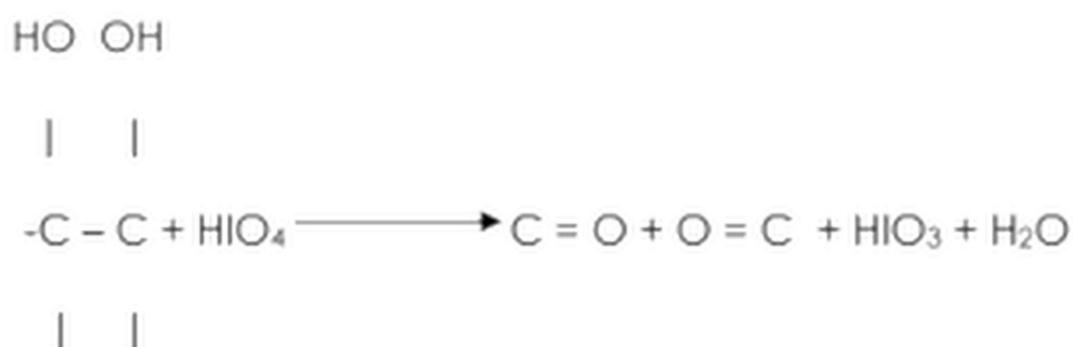
**Tertiary alcohol:**

Tertiary alcohol is not oxidized by alkaline  $\text{KMnO}_4$  when heated with a mixture of  $\text{K}_2\text{Cr}_2\text{O}_7$  and  $\text{H}_2\text{SO}_4$ . It is first dehydrated to an alkene in the presence of acid. Then the alkene is oxidized to a ketone and a carboxylic acid by  $\text{K}_2\text{Cr}_2\text{O}_7$  and  $\text{H}_2\text{SO}_4$ .



**Cleavage of 1, 2 Diols.**

Oxidation cleavage of Diols.



1,2 or vicinal diols are cleaved by periodic acid and  $\text{HIO}_4$  into two carbonyl compounds.

The reaction is selective for 1, 2 diols.

The reaction occurs with the formation of a cyclic periodate ester.

This can be used as a functional group test for 1, 2 diols.

The products are determined by the substituents on the diol.



**Q13: Draw and explain the structure of phenols?**

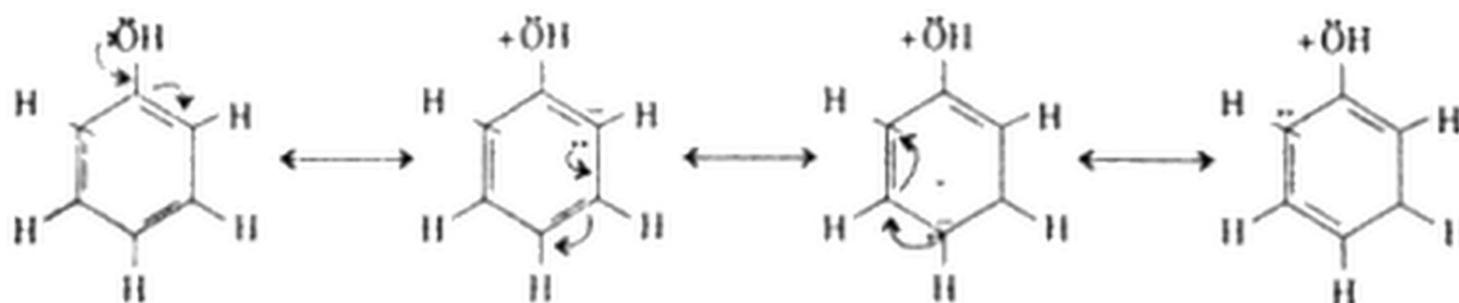
**Answer**

The alcohol functional group consist on an O atom bonded to a  $sp^2$  hybridized aromatic C atom and a H atom via O bonds.

Both the C-O and O-H bonds are polar due to the high electronegativity of the O atom. Conjugation exist between an unshared electron pair on the oxygen and the aromatic ring.

This result is compound to simple alcohol.

- a shorter carbon oxygen bond distance.
- a more basic hydroxyl oxygen
- a more oxidic hydroxyl oxygen.

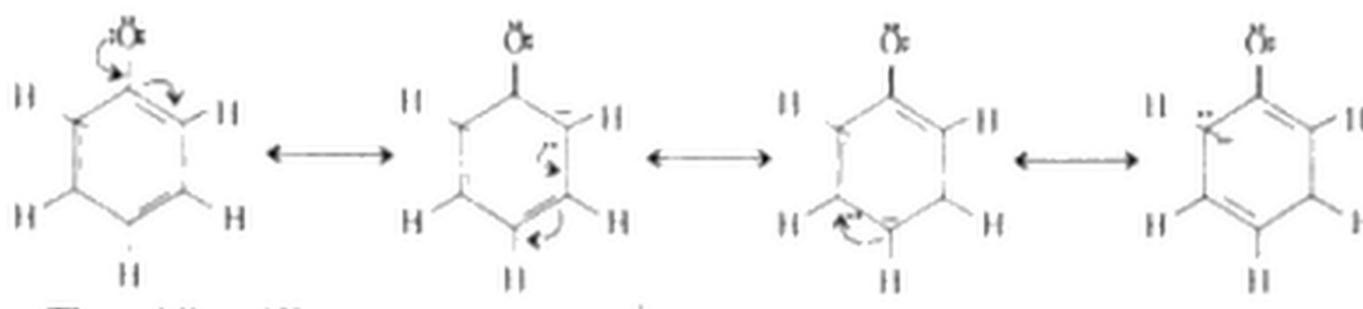


**Q14: Write down the acidity of phenols?**

**Answer**

Phenols are more acidic ( $\text{PKa} \gg 10$ ) than alcohol ( $\text{PKa} \gg 16-20$ ) but less acidic than carboxylic acids ( $\text{PKa} \gg 5$ ).

The negative charge of the phenolate ion is stabilized by resonance due to electron delocalization onto the ring as shown.

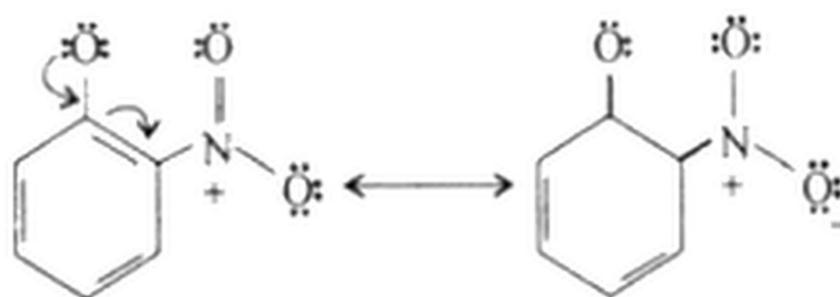


The acidity difference means that it is possible separate from alcohols and / or carboxylic acids.

Nucleophilic substitution reactions of phenols are generally carried out under basic condition as the phenolate ion is a better nucleophile.

**Q15: Substituent effect the acidity of phenols? Justify?****Answer**

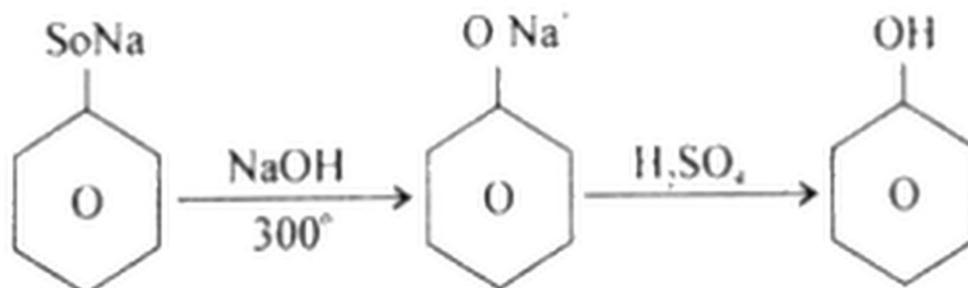
Substituents particularly those located ortho or para to the OH group can dramatically influence the acidity of the phenol due to resonance and / or inductive effect. Electron withdrawing group enhance the acidity electron donating. Substituents decrease the acidity. The resonance stabilization of O-nitrophenol is



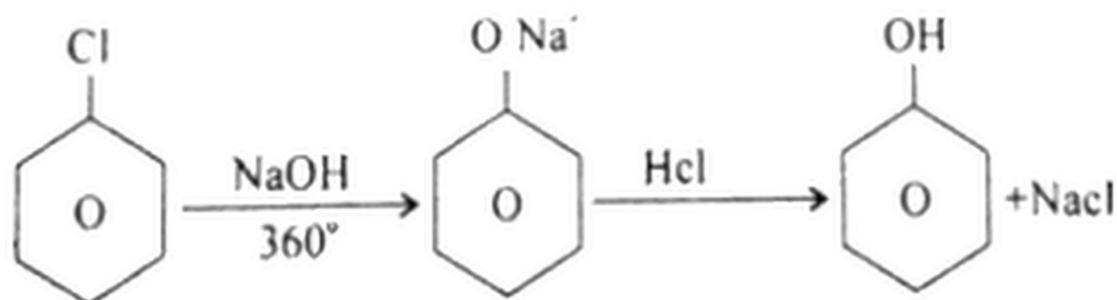
**Q16: Write down the reaction for the preparation of phenol?**

**Answer**

→ Rex of Benzene sulfonic acid with hydroxides.

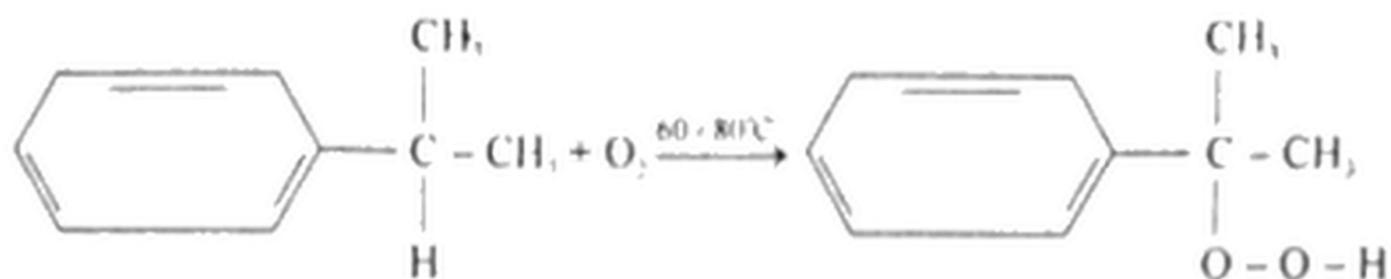


→ Rex of hydrolysis of chlorobenzene.

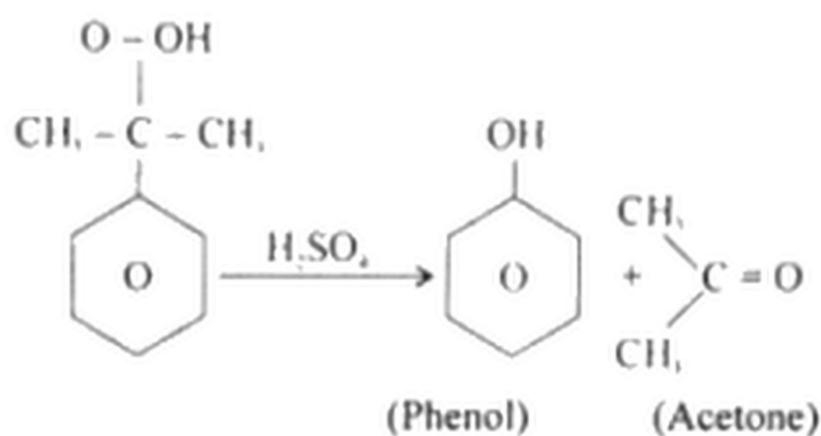


Acidic oxidation of cumene.

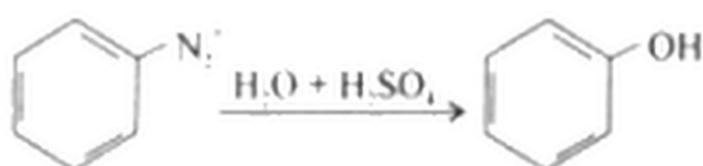
It is recently developed commercial method for the preparation of phenol, cumene is oxidized by atmosphere oxygen in presence of metal catalyst in to cumene hydroperoxide.



The hydroperoxide is converted into phenol through and acid catalyzed reaceangement.



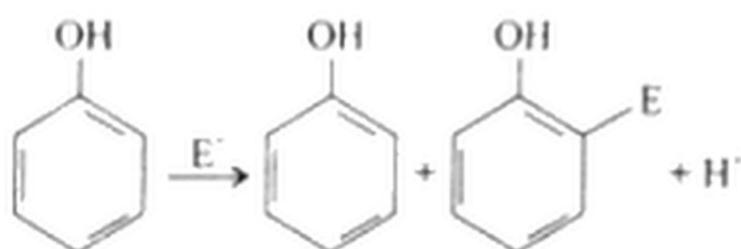
Preparation of phenols from acyl Diazonium salts.



**Q17: Write down the reactions of phenols?**

**Answer**

Electrophilic aromatic substitution:



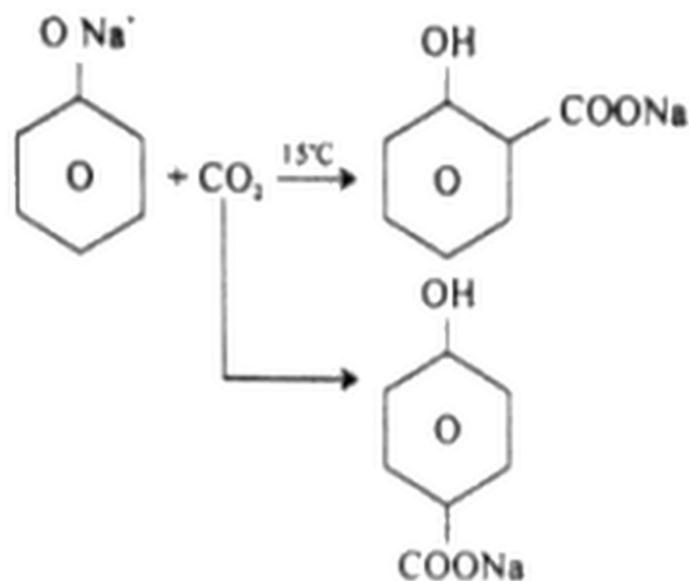
Phenols are potentially very reactive towards electrophilic substitution.

This is because the hydroxyl group OH is activating other, para, directing substituent. Substitution typically occurs para to the hydroxyl group unless the para position is blocked, then ortho substitution occurs the strong activation often means that milder reaction conditions than those used for benzene itself can be used. Phenols are so activated that polysubstitution can be a problem.

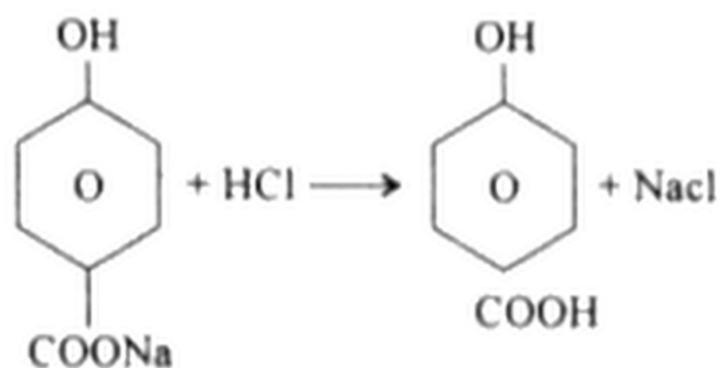
**Q18: Write down the reaction of phenol with sodium metal?**

**Answer**

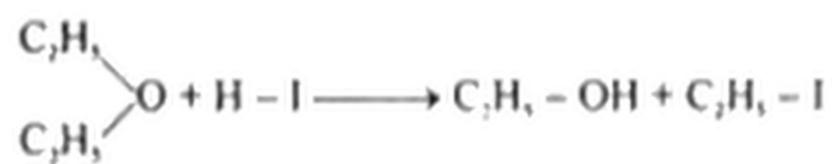
Kolbe Schmitt reaction (carboxylation of phenol)



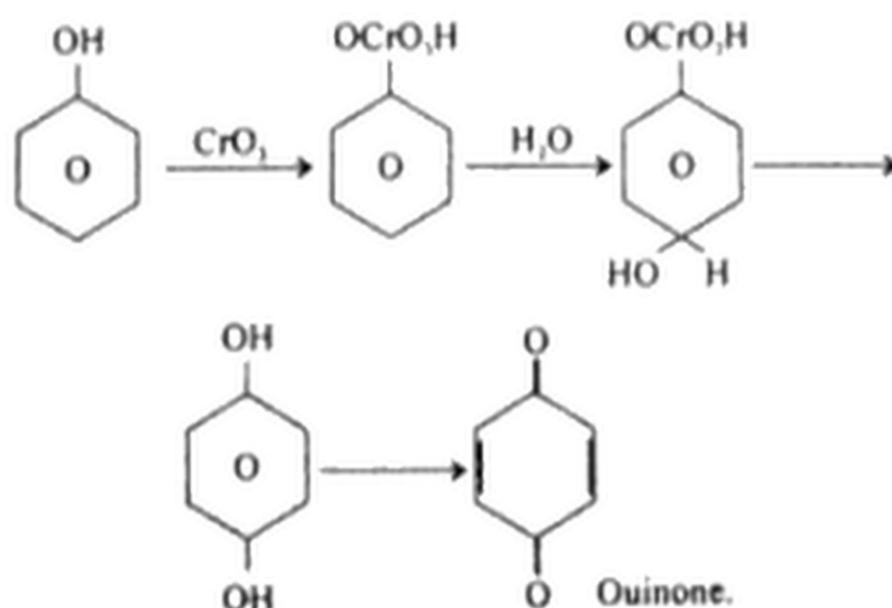
Carbon of  $\text{CO}_2$  acts as electrophilic centre in this reaction acidification of the salt gives corresponding hydroxyl acid. OH

**Oxidation of Phenols:**

Phenols are very reactive towards diethyl ethers reacts with HI to form  $\text{C}_2\text{H}_5\text{—OH}$  and  $\text{C}_2\text{H}_5\text{I}$ .



Oxidizing agents. The oxidation takes place through several steps eventually storying the ring.



**Q19: Differentiate between the alcohols and phenols.**

**Answer**

The compound in which hydroxyl group is attached to an alkyl group. Alcohols are hydroxyl derivatives of alkanes, the compounds in which one hydrogen of  $\text{H}_2\text{O}$  is replaced by an alkyl group. The general formula of alcohol is  $\text{R-OH}$ . Alcohols may be monohydric and polyhydric depending on the number  $\text{-OH}$  groups attached. However, alcohol generally colorless liquids. Alcohol have a characteristic sweet smell and burning taste. They are readily soluble in  $\text{H}_2\text{O}$  but solubility decreases in higher alcohols. Alcohols react with  $\text{C-O}$  bond breaks or in which  $\text{O-H}$  bond breaks.

Phenols:

The compounds in which hydroxyl group is attached to an acyl group. Phenols are decivate or benzene. The compounds in which one hydrogen of  $\text{H}_2\text{O}$  is replaced by an acyl on group. The general formula of phenol is it is also known as calbolic acid.

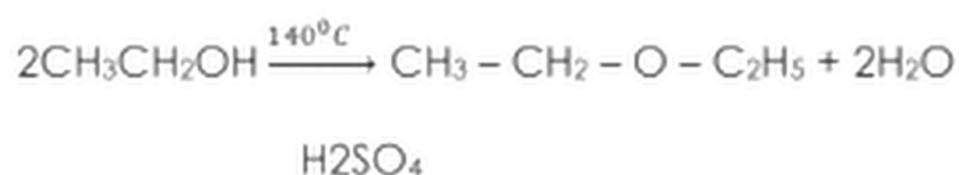
Phenols are not monohydric or polyhydric. They are colourless, crystalline, deliquescent solids. They have characteristics phenolic order its melting points is  $41^\circ\text{C}$ . Phenol are made acidic ( $\text{Pka} \gg 10$ ) than alcohols ( $\text{Pka} \gg 16-20$ ). It is

sparingly soluble in H<sub>2</sub>O forming pink solution at room temperature but completely soluble above 68.5°C. Phenols ion have resonance structure but alcohols do not have such type structure.

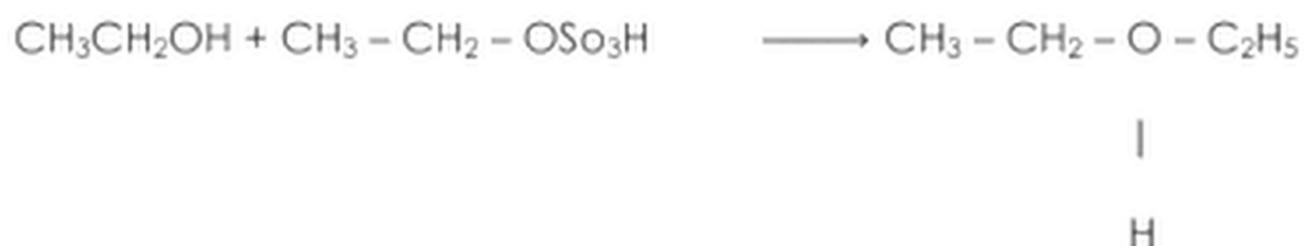
**Q20: Write down the preparation of ethers?**

**Answer**

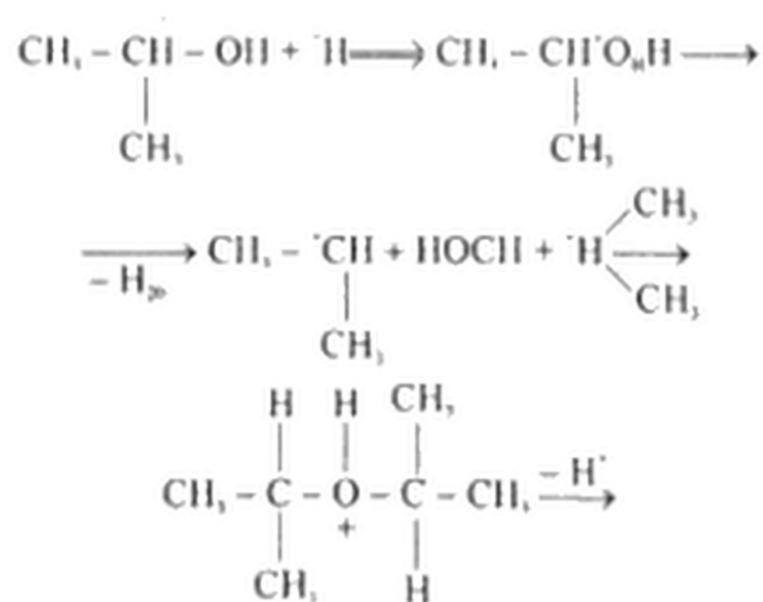
By heating excess of alcohol with concentrated H<sub>2</sub>SO<sub>4</sub> at 140°C dehydration to ethers occurs.

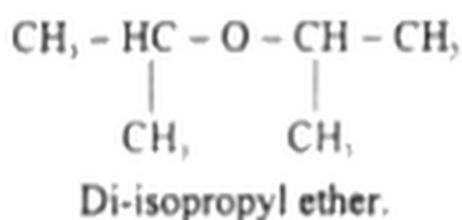


Primary alcohol reacts through SN<sub>2</sub> mechanism



Secondary alcohol reacts by SN<sub>1</sub> mechanism.





Two different primary alcohol give three ethers when treated with H<sub>2</sub>SO<sub>4</sub>



Ter-butyl and ethyl alcohol give one ether.

**Q21: Write down the physical properties of ethers?**

**Answer**

Ethers are colourless, low boiling, highly flammable compounds.

Their chemical reactivity and their ability to dissolve fats, oil, gum, and many other organic compounds make them very good solvent.

Ethers are soluble in concentrated sulphuric acid, a characteristic of oxygen containing compounds. This property is used as a test to distinguish between ethers and saturated hydrocarbons.

**Q22: How ethers show resistance to oxidation?**

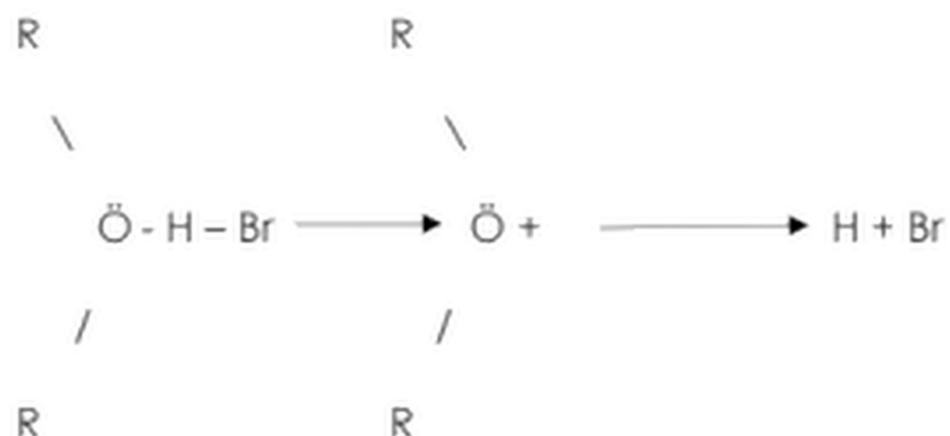
**Answer**

Ethers are resistance to attack by the usual chemical oxidizing agents. Moreover, reagent like NH<sub>3</sub> Na, alkali and acids have no action on ethers.

**Q23: How ethers react with H-Br?**

**Answer**

The oxygen atom of an ether molecule possesses unshared electron pair which accepts portion of H-Br to form oxonium ions.



No further reaction takes place.

**Q24: How ether react H-I?****Answer**

The oxygen atom of an ether molecules possesses unshared electron pair which accept a proton of H-I to form oxonium ion which react with I to form R-OH and RI.

