Unit 11. Alcohols, Phenols and Ethers

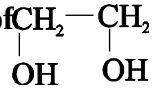
One mark questions

1. **Name the alcohol which is used for polishing wooden furniture.**

   Ans: **Ethanol**

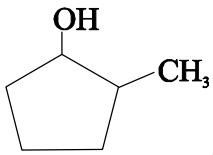
2. **What are alcohols?**

   Ans: **Hydroxyl derivatives of aliphatic compounds are called alcohols.**

3. **What is the IUPAC name of**  **?**

   Ans: **Ethane-1, 2-diol**

4. **Write the structure of 2-methyl cyclopentanol.**

   Ans: 

5. **Name the simplest hydroxyl derivative of benzene.**

   Ans: **Phenol**

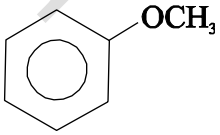
6. **What is the IUPAC name of Resorcinol?**

   Ans: **Benzene-1, 3-diol**

7. **What is the common name of $CH_3OC_2H_5$?**

   Ans: **Ethylmethyl ether**

8. **Write the formula of anisole.**

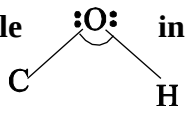
   Ans: **$C_6H_5OCH_3$** **or** 

9. **What is the IUPAC name of anisole?**

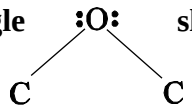
   Ans: **Methoxybenzene.**

10. **Write the IUPAC name of $CH_2 = CH – CH_2OH$**

    Ans: **prop-2-en-1-ol**

11. **Why is the bond angle**  **in alcohols is slightly less than the tetrahedral angle?**

    Ans: **It is due to the repulsion between the unshared electron pairs of oxygen atom.**

12. **Why is the bond angle**  **slightly greater than the tetrahedral angle in ethers?**

    Ans: **It is due to the repulsive interaction between the two bulky – R groups or alkyl groups.**

13. **Name the product obtained when propene is subjected to acid catalysed hydration.**

    Ans: **Propan-2-ol or 2-propanol**

14. **In the reaction,** $H_2C = CH_2 + H_2O \xrightarrow{H^+} X$ **Identify X.**

    Ans: **Ethanol**

15. **In a reaction,** $CH_3 - CH = CH_2 \xrightarrow[H_2O_2/NaOH]{\text{diporane}} X$ **Name the product X formed in the reaction.**

    Ans: **Propan-1-ol.**

16. **Write the chemical name of cumene.**

    Ans: **Isopropyl benzene.**

17. **The boiling point of alcohols is much higher than ethers and other classes of compounds with similar molecular masses. Give reason.**

    Ans: **Due to intermolecular hydrogen bonding in alcohols.**

18. **Give reason: Lower alcohols are soluble in water.**

    Ans: **Due to the formation of hydrogen bonds with water molecules.**

19. **Name the compound which is also known as carbolic acid.**

    Ans: **Phenol**

20. Name the method by which O-nitrophenol and p-nitrophenol are separated.

Ans: **By steam distillation the two isomers are separated.**

21. Ether is soluble in water. Give reason.

Ans: **Ether is soluble in water because oxygen of ether form hydrogen bonds with water molecule.**

Two Mark Questions

1. What happens when an aldehyde is reduced? Write the general reaction OR explain the reduction of aldehydes.

Ans: **Aldehydes on reduction by hydrogen in presence of catalyst like finely divided Nickel or platinum give the respective primary alcohols.**

$$RCHO + H_2 \xrightarrow{Ni} RCH_2OH$$

Or

Aldehydes on reduction in presence of sodium borohydride ($NaBH_4$) or lithium aluminium hydride ($LiAlH_4$) yield the respective primary alcohols.

$$RCHO + 2(H) \xrightarrow[LiAlH_4]{NaBH_4 \text{ or}} RCH_2OH$$

2. An aldehyde reacts with Grignards reagent forming an inter immediate product which on hydrolysis gives primary alcohol. Name the aldehyde and write the chemical equation.

Ans: **The aldehyde is methanal or formaldehyde.**

Reaction: $HCHO + RMgX \longrightarrow RCH_2OMgX \xrightarrow{H_2O} RCH_2OH + MgX(OH)$

3. How is phenol prepared from aniline? Write the equation.

Ans: **Aniline is treated with nitrous acid in presence of HCl at 273-278 K, when benzene diazonium chloride is obtained. Which on warming with water or treating with dilute acids gives phenol.**

$$C_6H_5NH_2 + \xrightarrow[+HCl]{NaNO_2} C_6H_5N = NCl \xrightarrow[\text{warm}]{H_2O} C_6H_5OH + N_2 + HCl$$

4. **What is meant by hydroboration – oxidation reaction. Illustrate with an example.**

   Ans: **Diborane reacts with alkenes to give trialkyl boranes which is oxidized to alcohol by hydrogen peroxide in presence of sodium hydroxide.**

   Reaction $3CH_3-CH=CH_2+(BH_3)_2 \longrightarrow (CH_3CH_2CH_2)_3B$

   $\xrightarrow[3H_2O_2]{OH^-} 3CH_3CH_2CH_2-OH+B(OH)_3$

5. **Give two reactions that show acidic nature of phenol.**

   Ans: **Reaction (1)** $C_6H_5OH + Na \rightarrow C_6H_5ONa + H_2$

   (2) $C_6H_5OH + NaOH \rightarrow C_6H_5ONa + H_2O$

   These two reactions prove that phenol is acidic.

6. **Name the following reaction and predict the product X obtained.**

   R'COOH + RO-H $\xrightarrow{H_2SO_4} X + H_2O$

   Ans: **The name of the reaction is esterification and product X is an ester with the formula R′COOR.**

7. **When phenol is treated with acid chloride in presence of pyridine base, what is the product obtained. Write the equation.**

   Ans: **The reaction is** $C_6H_5OH+RCOCl \xrightarrow{pyridine} C_6H_5OCOR+HCl$

   The product is an ester.

8. **Explain the dehydration of ethanol with equation.**

   Ans: **Ethanol undergoes dehydration by heating it with conc. H_2SO_4 at 443 K. forming ethene.**

   $CH_3CH_2OH \xrightarrow[443\ K]{conc.\ H_2SO_4} CH_2=CH_2+H_2O$

9. **Explain the dehydration of a secondary alcohol with equation. OR**

   How is isopropyl alcohol converted to propene by dehydration reaction?

   Ans: **Secondary alcohols like isopropyl alcohol undergo dehydration on heating with 85% phosphoric acid at 440 K. forming an alkene (propene)**

Reaction $CH_3-\underset{\underset{OH}{|}}{CH}-CH_3 \xrightarrow[440\ K]{85\%\ H_3PO_4} CH_3-CH=CH_2+H_2O$

10. Explain the dehydration of tertiary alcohols.

Ans: **Tertiary alcohols undergo dehydration when heated with 20% H_3PO_4 at 358 K forming the respective alkene.**

Reaction: $H_3C-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH \xrightarrow[358\ K]{20\%\ H_2PO_4} H_3C-\underset{\underset{CH_3}{|}}{C}=CH_2 + H_2O$

11. Complete the following reactions:

(a) $RCH_2OH \xrightarrow[573]{Cu} X$ **(b)** $X \xrightarrow[573]{Cu} R-\underset{\underset{O}{||}}{C}-R$

Name X in both the reactions.

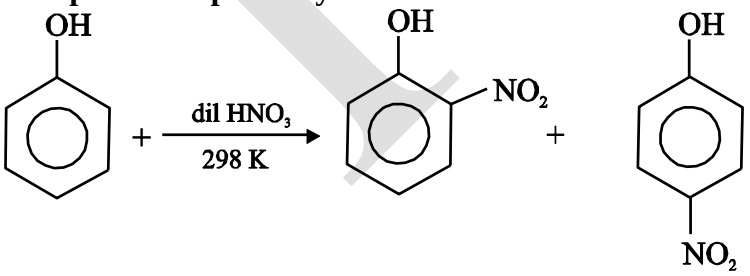
Ans:

(a) $RCH_2OH \xrightarrow[573]{Cu} RCHO$ **X-Aldehyde**

(b) $R-\underset{\underset{R}{|}}{CH}-OH \xrightarrow[573]{Cu} R-\underset{\underset{O}{||}}{C}-R$ **X = Secondary alcohol**

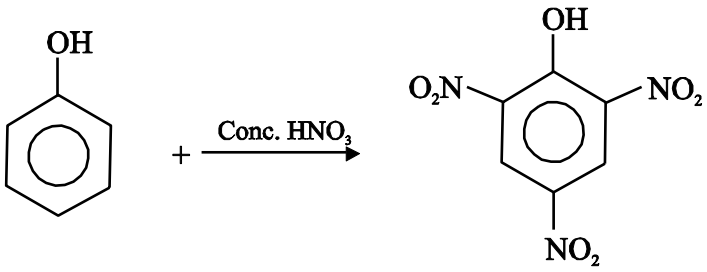
12. Explain the reaction of phenol with dil. nitric acid at 298 K. Write equation.

Ans: **Phenol reacts with dil. HNO_3 at 298 K forming O-nitrophenol and p-nitrophenol respectively.**



13. How do you convert phenol to picric acid? Explain with equation.

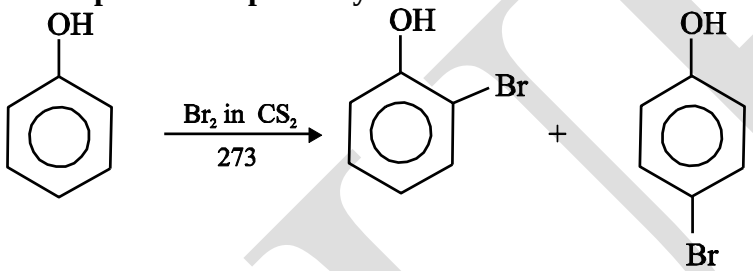
Ans: **Phenol reacts with concentrated nitric acid forming picric acid or 2, 4, 6-trinitro phenol.**



Picric acid

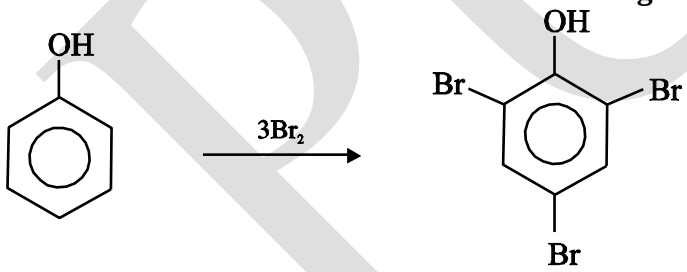
14. Explain the bromination of phenol forming ortho and para bromophenols with equation.

Ans: **Phenol reacts with bromine in CS_2 at 273 K forming ortho – and para bromophenols respectively.**



15. How is phenol converted to 2, 4, 6-tribromophenol? Explain with equation.

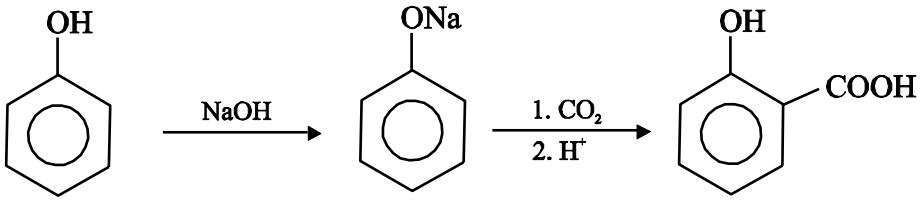
Ans: **Phenol reacts with bromine water forming a white ppt of 2, 4, 6-trinitrophenol**



Picric acid

16. Explain Kolbe's reaction with equation. OR What happens when sodium phenate is treated with carbon dioxide? Write equation and name the reaction.

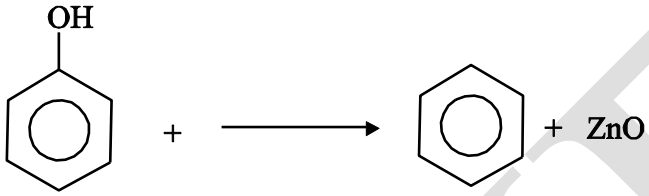
Ans: **Sodium phenate is treated with carbon dioxide and the product on acidification forms salicylic acid. This reaction is called Koble's reaction.**



2-hydroxy benzoic acid
(Salicylic acid)

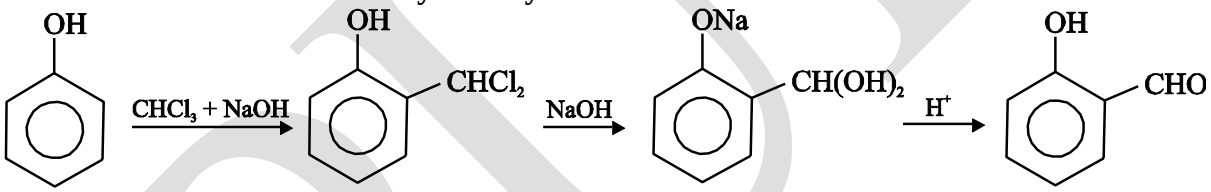
17. How is phenol converted to benzene? Write the equation.

Ans: **Phenol is converted to benzene on heating with zinc dust.**



18. Explain Reimer – Tiemann reaction with equation.

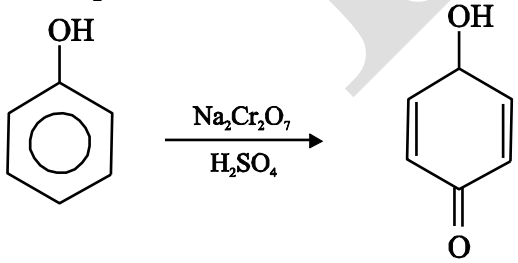
Ans: **Phenol is treated with chloroform and sodium hydroxide solution. The product on acidification forms salicyl aldehyde.**



2-hydroxy
benzaldehyde
(salicylal dehydrde)

19. Explain the oxidation of phenol with equation.

Ans: **Phenol undergoes oxidation with acidified sodium dichromate forming benzoquinone.**



Benzoquinones

20. How is diethyl ether or ethoxy ethane prepared from ethanol? Write equation.

Ans: **Ethanol is heated with conc. H_2SO_4 to 413 K when ethoxy ethane is obtained.**

$2C_2H_5OH \rightarrow C_2H_5OC_2H_5+H_2O$

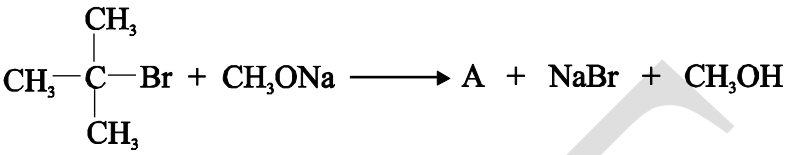
21. Explain Wilhamson synthesis with equation.

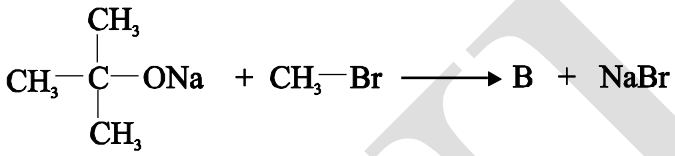
Ans: **An alkyl halide reacts with sodium alkoxide forming the respective ethers.**

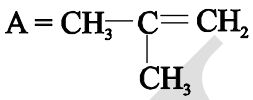
By this method both symmetrical and unsymmetrical ethers can be prepared.

$$R-X+R'ONa \longrightarrow R-O-R'+NaX$$

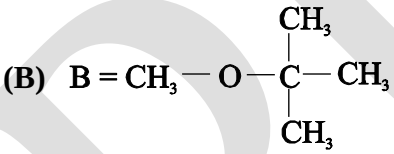
22. Identify A and B in the following reactions and name the product obtained.

(A) 

(B) 

Ans: **(A)** 

2-methyl propene (alkene)

(B) 

2-methoxy-2-methylpropane (ether)

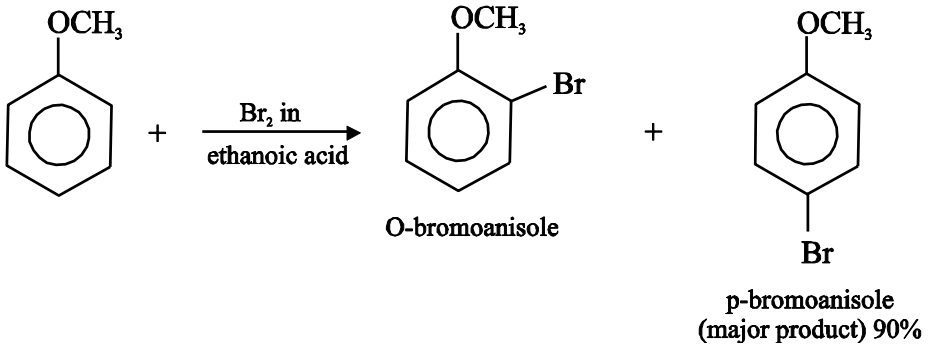
23. Explain the reaction of anisole with HI. Write the equation.

Ans: **Anisole reacts with HI forming phenol and methyl iodide.**

$$C_6H_5O-CH_3+HI \longrightarrow C_6H_5OH+CH_3I$$

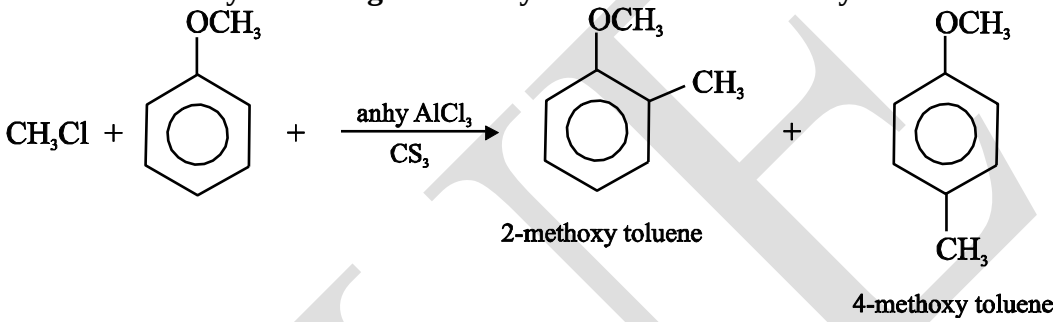
24. Explain the bromination of anisole with equation.

Ans: **Anisole (methoxy benzene) undergoes bromination with bromine in ethanoic acid in absence of $FeBr_3$ catalyst forming O-bromoanisole and p-bromoanisole respectively.**



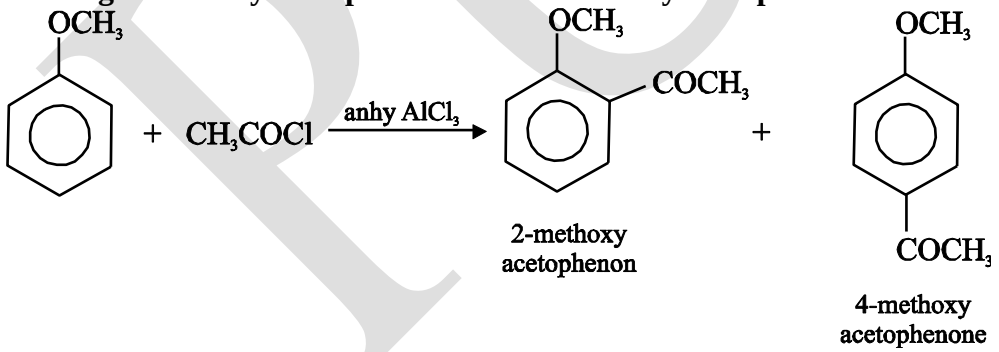
25. Explain the Friedel crafts reaction of anisole with equation.

Ans: **Anisole reacts with chloromethane in presence of anhydrous aluminium chloride as catalyst forming 2-methoxy toluene and 4-methoxy toluene.**



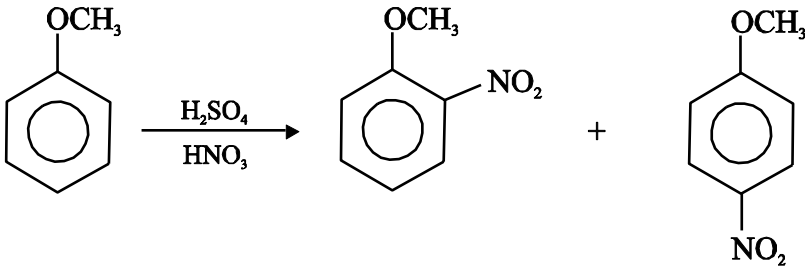
OR

Anisole reacts with acetyl chloride in presence of anhydrous aluminium chloride forming 2-methoxy acetophenone and 4–methoxy acetophenone.



26. Explain the reaction of anisole with a mixture of conc. H_2SO_4 and conc. HNO_3 or Explain the nitration of anisole with equation.

Ans: **Anisole reacts with a mixture of conc. Sulphuric acid and conc. Nitric acid forming ortho nitro anisole and paranitroanisole.**



III. Three Mark Questions

1. **Give three reasons that phenols are more acidic than alcohols.**

   Ans: **(1) In phenol, the – OH group is attached to sp^2 hybridised carbon which is more electronegative, hence the – OH bond becomes more polar.**

   (2) Due to resonance is phenol, oxygen gets a positive charge and this increases the polarity of the O – H bond.

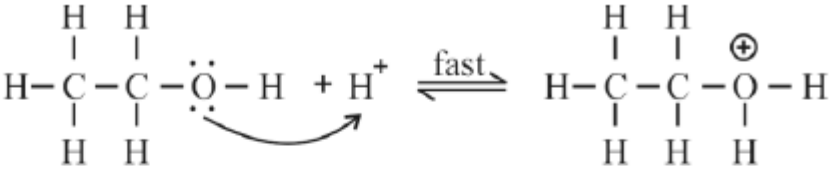
   (3) Delocalisation of negative charge in phenoxide ion makes phenoxide ion more stable than phenol favouring the ionization of phenol.

2. **Explain the mechanism of dehydration of ethanol to ethane.**

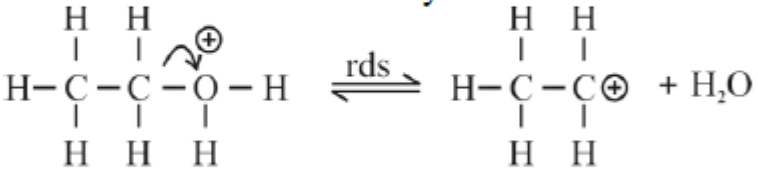
   Ans: **The dehydration of ethanol to ethane occurs in the following three steps, when heated with conc. H_2SO_4 at 443 K.**

$$CH_3-CH_2-OH \xrightarrow[443\,K]{\text{conc. } H_2SO_4} CH_2=CH_2+H_2O$$

Step-1: Protonation of alcohol



Step-2: Formation of carbocation by loss of water.



Step-3: Formation of ethene by loss of proton.