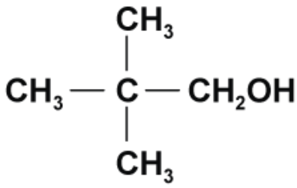
Date: 23/10/2021

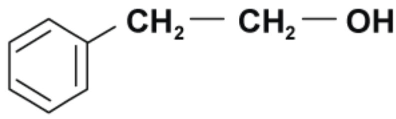
Q1. **Classify the following as primary, secondary and tertiary alcohols:**

(a) 

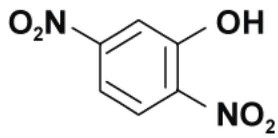
(b) $H_2C=CH-CH_2OH$

(c) $CH_3-CH_2-CH_2-OH$

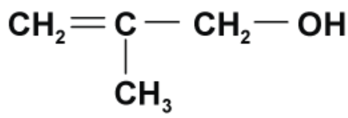
Q2. **Write the IUPAC name of the given compound:**



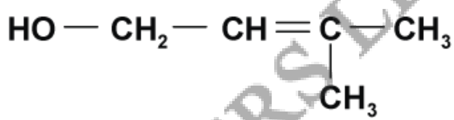
Q3. **Write the IUPAC name of the given compound:**



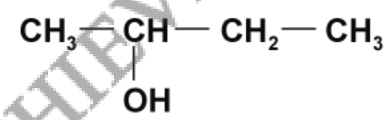
Q4. **Write the IUPAC name of the given compound:**



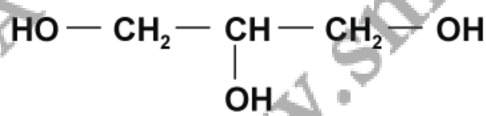
Q5. **Write the IUPAC name of the given compound:**



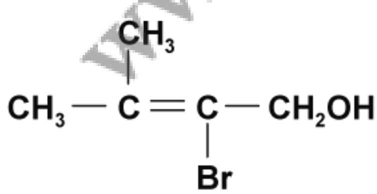
Q6. **Name the following according to IUPAC system:**



Q7. **Write the IUPAC name of the given compound:**



Q8. **Write the IUPAC name of the following:**



Q9. **Draw the structure of hex-1-en-3-ol compound.**

Q10. **Draw the structural formula of 2-Methylpropan-2-molecule.**

Q11. Give the structure and IUPAC name of the product formed when propanone is reacted with methylmagnesium bromide followed by hydrolysis.

Q12. Write the structure of the molecule of compound whose IUPAC name is 1-Phenylpropan-2-ol.

Q13. Give reason for the following: Phenol is more acidic than ethanol.

Q14. Which of the following isomers is more volatile: *o*-nitrophenol or *p*-nitrophenol?

Q15. Write the equation involved in the following reaction: Reimer – Tiemann reaction.

Q16. Write the equation involved in the following reaction: Kolbe's reaction.

Q17. Of the two hydroxy organic compounds *R*OH and *R′*OH, the first one is basic and other is acidic in behaviour. How is *R* different from *R′*?

Q18. Write the equation involved in the acetylation of Salicylic acid.

Q19. The C — O bond is much shorter in phenol than in ethanol. Give reason.

Q20. Write the IUPAC name of the following compound:

$$CH_3 - O - CH_2 - \underset{\substack{|\\ CH_3}}{CH} - CH_2 - CH_3$$

Q21. Write the structure of the following compound: 2-Methyl-2-ethoxypentane.

Q22. Write the IUPAC name of the following compound:

$$H_2C = CH - \underset{\substack{|\\ OH}}{CH} - CH_2 - CH_2 - CH_3$$

Q23. Give reasons for the followng:

Propanol has higher boiling point than that of the hydrocarbon butane.

Q24. Describe the following with an example: Kolbe's reaction.

Q25. Illustrate the following reaction giving a chemical equation: Kolbe's reaction.

Q26. Explain the following giving one example: Reimer – Tiemann reaction.

Q27. *Ortho*-nitrophenol is more acidic than *ortho*-methoxyphenol. Why?

Q28. Ilustrate the following name reaction: Reimer – Tiemann reaction.

Q29. *Ortho*-nitrophenol has lower boiling point than *p*-nitrophenol. Why?

Q30. Hou woul you convert ethanol to ethene?

Q31. How would you obtain acetophenone from phenol?

Q32. How would you obtain ethane-1, 2-diol from ethanol?

Q33. How would you account for the following: Phenols are much more acidic than alcohols.

Q34. Why do phenols not give the protonation reaction readily?

Q35. How is tolune obtained from phenol?

Q36. Give one chemical test to distinguish between the following pairs of compounds:

1-Propanol and 2-Propanol.

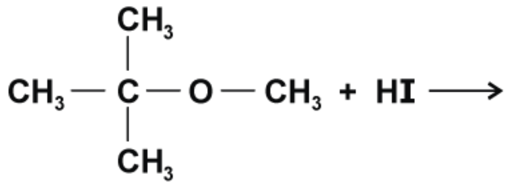
Q37. Give a chemical test to distinguish between 2-Propanol and 2-methyl-2-Propanol.

Q38. Give a chemical test to distinguish between Benzoic acid and Phenol.

Q39. Give a chemical test to distinguish between 2-Pentanol and 3-Pentanol.

Q40. Name a substance that can be used as an antiseptic as well as a disinfectant.

Q41. Write the main product(s) in the following reaction:



Q42. How is the following conversion carried out? Anisole to *p*-bromoanisole.

Q43. Write the equations involved in the following reaction: Williamson synthesis.

Q44. Explain the following with an example: Williamson ethersynthesis.

Q45. Explain the following giving one example: Friedel Craft's acetylation of anisole.

Q46. Illustrate the following name reaction: Williamson synthesis.

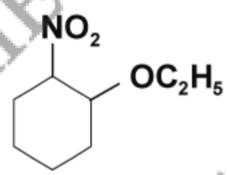
Q47. Describe the following: Unsymmertrical ether.

Q48. Phenylmethyl ether reacts with HI to give phenol and methyl iodide and not iodobenzene and methyl alcohol. Why?

Q49. Account for the following: The boiling points of ethers are lower than isomeric alcohols.

Q50. Account for the following: Preparation of ethers by acid dehydration of secondary or tertiary alcohols is not a suitable method.

Q51. Write IUPAC name of the following:



Q52. Why is the preparation of ether by acid dehydration of secondary alcohol not a suitable method?

Q53. The boiling points of ethers are much lower than those of the alcohols of comparable molar masses.

Q54. Write the main product(s) in each of the following reactions:

(a) $CH_3-CH=CH_2 \xrightarrow[\text{(ii) } 3H_2O_2/OH^-]{\text{(i) } B_2H_6}$

(b) $C_6H_5-OH \xrightarrow[\text{(ii) } CO_2, OH^+]{\text{(i) aq. NaOH}}$

Q55. Write the final product(s) in each of the following reactions:

(a) $CH_3CH_2-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3 \xrightarrow{Cu/573\ K}$

(b) $C_6H_5-OH \xrightarrow[(ii)\ H^+]{(i)\ CHCl_3\ +\ aq.\ NaOH}$

Q56. Explain the following with an example for each:

(a) Kolbe's reaction. (b) Reimer – Tiemann reaction.

Q57. Write the mechanism of the following reaction:

$$CH_3CH_2OH \xrightarrow{HBr} CH_3CH_2Br + H_2O$$

Q58. Write the mechanism of acid dehydration of ethanol to yield ethane.

Q59. Explain the mechanism of dehydration steps of ethanol:

$$CH_3CH_2OH \xrightarrow[443\ K]{H^+} CH_2=CH_2 + H_2O$$

Q60. Explain the following behaviours:

(a) Alcohols are more soluble in water than the hydrocarbons of comparable molecular masses.

(b) *Ortho*-nitrophenol is more acidic than *ortho*-methoxyphenol.

Q61. Explain the mechanism of acid catalysed hydration of an alkene to form corresponding alcohol.

Q62. Explain the mechanism of the following reaction:

$$CH_3-CH_2-OH \xrightarrow[443\ K]{H^+} CH_2=CH_2 + H_2O$$

Q63. Give the names of the reagents of bringing about the following transformations:

(a) Hexan-1-ol to hexanal. (b) Nut-2-ene to ethanol.

Q64. Account for the following:

(a) The boiling point of ethanol is higher than that of methanol.

(b) Phenol is a stronger acid than an alcohol.

Q65. Account for the following:

(a) Propanol has higher boiling point than butane.

(b) *Ortho*-nitrophenol is more acidic than *ortho*-methoxyphenol.

Q66. Write the Remer – Tiemann reaction giving an example.

Q67. Name the different reagents needed to perform the following reactions:

(a) Phenol to Benzene.

(b) Dehydration of propan-2-ol to propene.

(c) Friedel- Crafts alkylation of anisole.

(d) Dehydrogenation of ethanol to ethanal.

Q68. Name the reagents used in the following reactions:

(a) Bromination of phenol to 2, 4, 6-tribromophenol.

(b) Butan-2-one to Butan-2-ol.

(c) Friedel-Crafts alkylation of anisole.

(d) Oxidation of primary alcohol to carboxylic acid.

Q69. How are the following conversions carried out?

(a) Propene to propane-2-ol.

(b) Benzyl chloride to Benzyl alcohol.

Q70. Describe the mechanism of hydration of ethene to yield ethanol.

Q71. How are the following conversions carried out:

(a) Bebzyl chloride to benzyl alcohol.

(b) Methyl magnesium bromide to 2-methylpropan-2-ol.

Q72. How would you obtain the following:

(a) Benzoquinone from phenol.

(b) 2-Methylpropan-2-ol from methyl magnesium bromide.

(c) Propan-2-ol from propene?

Q73. How would you obtain the following:

(a) Picric acid (2, 4, 6-trinitrophenol) from phenol.

(b) 2-Methylpropene from 2-methylpropanol?

Q74. How would you obtain the following:

(a) 2-Methylpentan-2-ol from 2-methyl-1-pentene. (b) Acetophenone from phenol.

Q75. How will you convert the following:

(a) Propan-2-ol to propanone. (b) Phenol to 2, 4, 6-trinitrophenol?

Q76. How will you convert:

(a) Propene to propan-2-ol? (b) Phenol to 2, 4, 6-trinitrophenol?

Q77. How are the following conversions carried out?

(a) Propene to Propan-2-ol. (b) Ethyl chloride to Ethanol.

Q78. Name the reagents and write the chemical equations for the preparation of the following compounds by Williamson synthesis:

(a) Ethoxybenzene. (b) 2-Methyl-2-methoxypropane

Q79. How is 1-propoxypropane synthesised from propan-1-ol?

Q80. Give mechanism of preparation of ethoxy ethane from ethano.

Q81. Give reasons for the following:

(a) Boiling point of ethanol is higher in comparison to methoxymethane.

(b) $(CH_3)_3C — O — CH_3$ on reaction with HI gives CH_3OH and $(CH_3)_3C — I$ as the main products and not $(CH_3)_3C — OH$ and CH_3I.

Q82. Write the mechanism of the following reaction:

$$2CH_3CH_2OH \xrightarrow[413\ K]{Conc.\ H_2SO_4} CH_3CH_2 - O - CH_2 - CH_3.$$

Q83. Describe a chemical test each to distinguish between the following pairs:

(a) Ethanol and Phenol (b) 1-Propanol and 2-Propanol.

Q84. Give a separate chemical test to distinguish between the following pairs of compounds:

(a) Ethanol and Phenol (b) 2-Pentanol and 3-Pentanol

Q85. (a) Describe the mechanism of hydration of ethene to yeild ethanol.

(b) Write Kolbes reaction with an example.

Q86. Acid catalysed dehydration of *t*-butanol is faster than that of *n*-butanol. Explain.

Q87. (a) Describe the mechanism of acid dehydration of ethanol to yield ethene.

(b) Describe a chemical test to distinguish between ethanol and phenol.

Q88. Draw the structure and name of the product formed if the following alcohols are oxidized. Assume that an excess of oxidising agent is used.

(a) $CH_3CH_2CH_2CH_2OH$. (b) 2-butenol. (c) 2-methyl-1-propanol.

Q89. (a) Write the mechanism of the following reaction:

$$CH_2CH_2OH \xrightarrow{HBr} CH_3CH_2Br + H_2O$$

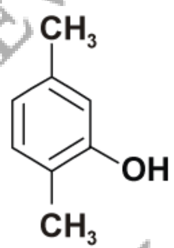
(b) Write the equation involved in Reimer – Tiemann reaction.

Q90. Predict the products of the following reactions:

(a) $CH_3 - CH = CH_2 \xrightarrow[(ii)\ 3H_2O_2\,/\,OH^-]{(i)\ B_2H_6} ?$ (b) $C_6H_5OH \xrightarrow{Br_2(aq)} ?$

(c) $CH_3CH_2OH \xrightarrow{Cu\,/\,573\ K} ?$

Q91. (a) Write the IUPAC name of the following:



(b) Give reasons for the following:

(i) Phenol is a stronger acid than alcohol.

(ii) Alcohols are comparatively more soluble in water than the corresponding hydrocarbons.

Q92. Explain the mechanism of the following reactions:

(a) Addition of Grignard's reagent to the carbonyl group of a compound forming an adduct followed by hydrolysis.

(b) Acid catalysed dehydration of an alcohol forming an alkene.

(c) Acid catalysed hydration of an alkene forming an alcohol.

Q93. (a) Give chemical tests to distinguish between the following pairs of compounds:

(i) Pentan-2-ol and Pentan-3-ol. (ii) Methanol and Phenol.

(b) o-nitro phenol is more acidic than 0-methoxy phenol. Explain why.

Q94. Name the reagents which are used in the following conversions:

(a) A primary alcohol to an aldehyde. (b) Butan-2-one to butan-2-ol.

(c) Phenol to 2, 4, 6-tribromophenol.

Q95. How would you convert the following:

(a) Phenol to benzoqinone. (b) Propanone to 2-methylpropan-2-ol.

(c) Propene to propan-2-ol.

Q96. How are the following conversions carried out?

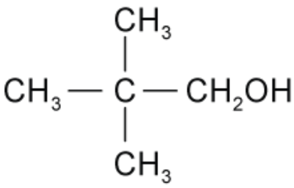
(a) Benzyl chloride to benzyl alcohol. (b) Ethyl magnesium chloride to Propan-1-ol.

(c) Propene to Propan-2-ol.

Q97. How do you convert the following?

(a) Phenol to anisole. (b) Propan-2-ol to 2-methylpropan-2-ol. (c) Aniline to phenol.

Date: 23/10/2021

S1. (a) 
Primary (1°)

(b) $H_2C = CH - CH_2OH$
Primary (1°)

(c) $CH_3CH_2CH_2OH$
Primary (1°)

S2. 2-Phenylethanol

S3. 2,5-Dinitrophenol

S4. 2-Methylprop-2-en-1-ol

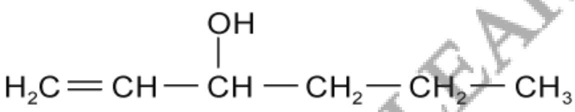
S5. 3-methylbut-2-en-1-ol

S6. Butan-2-ol

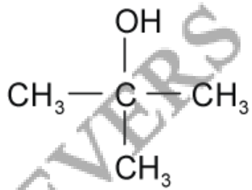
S7. Propane-1,2,3-triol

S8. 2-Bromo-3-methylbut-2-en-1-ol

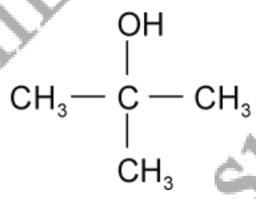
S9. Hex-1-en-2-ol



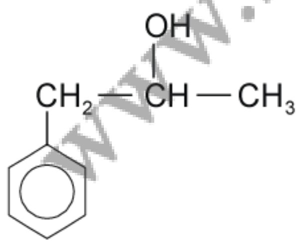
S10.



S11.

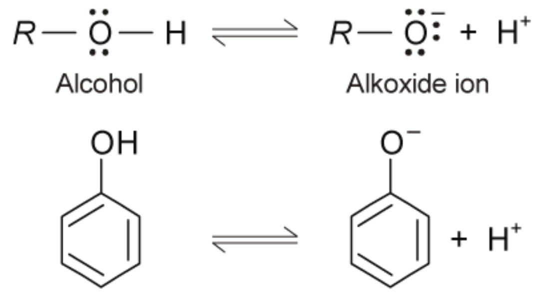


S12.



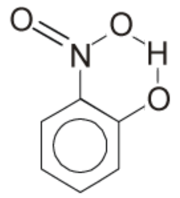
S13. Phenols are more acidic than aclohols. It can be explained on the basis that alcohol on losing H^+ ions form alkoxide ion and phenol forms phenoxide ion.

The greater acidity of phenol is due to the stability of the phenoxide ion which is resonance stabilized as shown below.

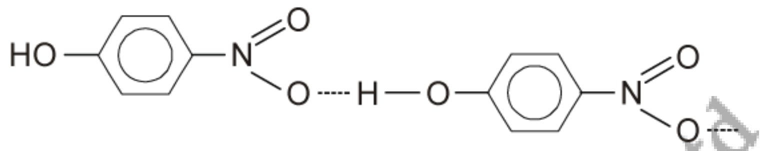


On the other hand, alkoxide ion shows no such resonance stabilisation and is unstable.

S14. *o*-Nitrophenol is more steam volatile than *p*-Nitrophenol due to the presence of intramodecular H-bonding. *p*-nitrophenol shows intermolecular H-bonding.



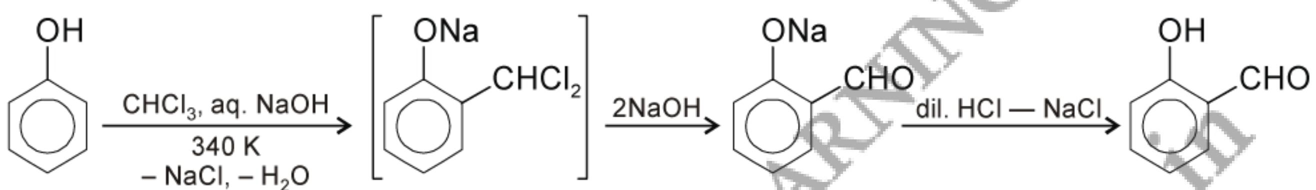
o-Nitrophenol
(intramolecular H-bonding)



p-Nitrophenol
(intermolecular H-bonding)

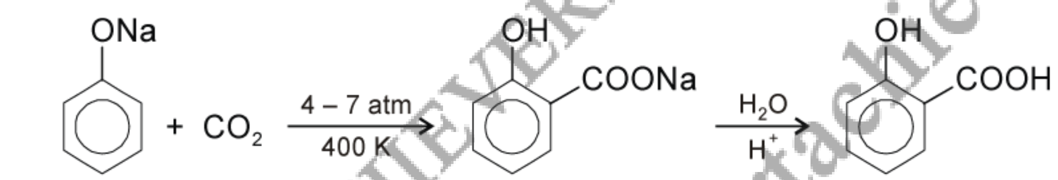
That's why *o*-nitrophenol has lower boilin point than *p*-nitrophenol.

S15. Reimer-Tiemann reaction:



Salicylaldehyde

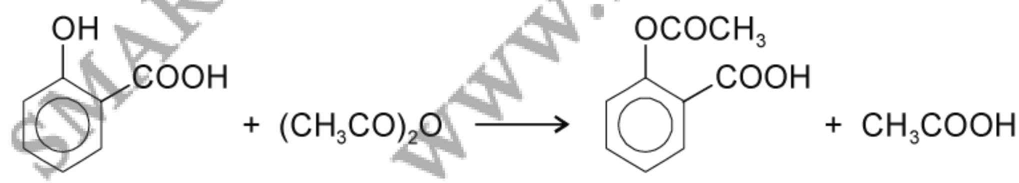
S16. Kolbe's reaction: When sodium phenoxide is heated with carbon dioxide under pressure, it gives salicylic acid.



Sod. phenoxide   Sod. salicylate   Salicylic acid

S17. *R* is alkyl group and *R′* is aryl group. *R* must be a group having more electron density than H. *i.e.*, having + *I* effect where as *R′* must be having – *I* effect.

S18.



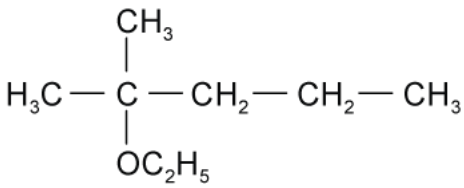
Salicylic acid   Asprin

S19. Due to resonance C — O bond acquires some partial double bond character.

So, in phenol C — O bond length is smaler than ethanol.

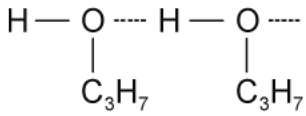
S20. 1-methoxy-2-methylbutane

S21.

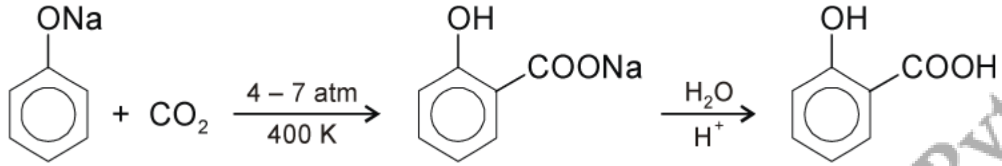


S22. Hex-1-en-3-ol

S23. The molecules of butane are held together by weak van der Waals forces of attraction while those of propanol are held together by stronger intermolecular hydrogen bonding.

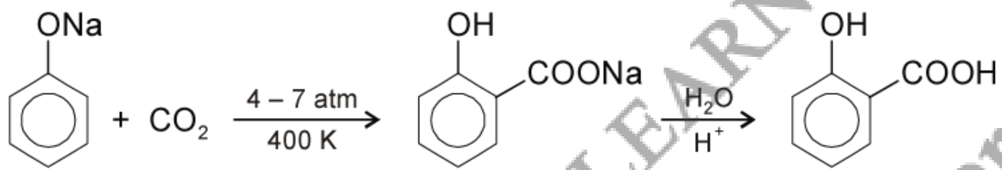


S24. **Kolbe's reaction:** When sodium phenoxide is heated with carbon dioxide under pressure, it gives salicylic acid.



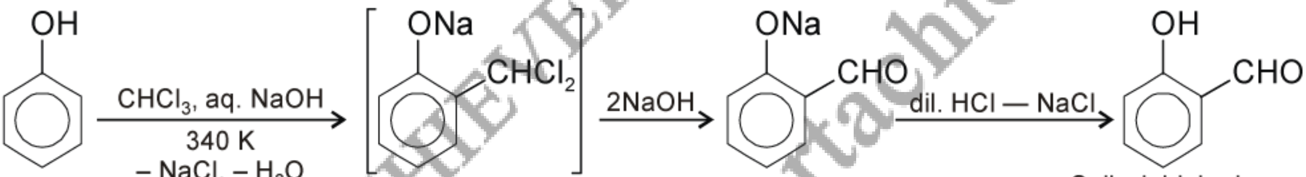
Sod. phenoxide Sod. salicylate Salicylic acid

S25. **Kolbe's reaction:** When sodium phenoxide is heated with carbon dioxide under pressure, it gives salicylic acid.



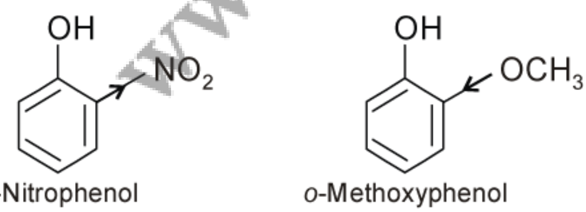
Sod. phenoxide Sod. salicylate Salicylic acid

S26. **Reimer-Tiemann reaction:**



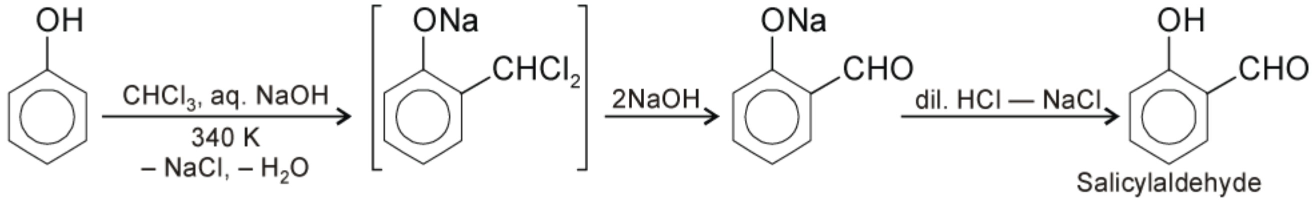
Salicylaldehyde

S27. As we know that the electron withdrawing groups enhance the acidic character of phenols because they help in the stabilisation of phenoxide ion be dispersing negative charge. Nitro group is an electron withdrawing group whereas methoxy group destabiliser the phenoxide ion by intensifying the negative charge. Thus, *o*-nitrophenol is more acidic than *o*-methoxyphenol.

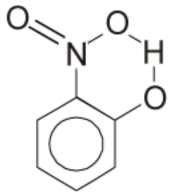


o-Nitrophenol *o*-Methoxyphenol

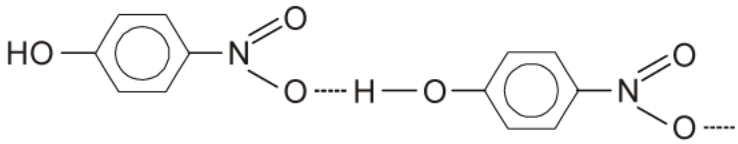
S28. Reimer-Tiemann reaction:



S29. *o*-Nitrophenol is more steam volatile than *p*-Nitrophenol due to the presence of intramodecular H-bonding. *p*-nitrophenol shows intermolecular H-bonding.



o-Nitrophenol
(intramolecular H-bonding)



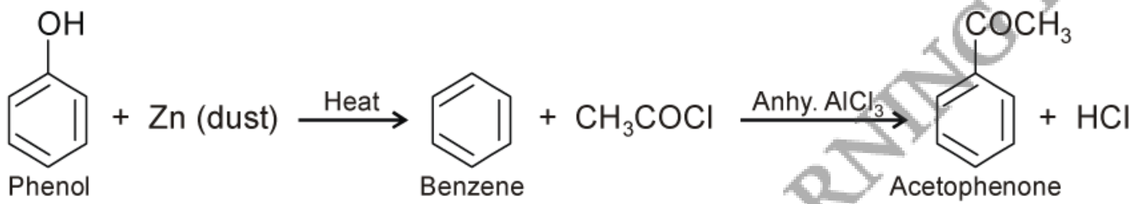
p-Nitrophenol
(intermolecular H-bonding)

That's why *o*-nitrophenol has lower boilin point than *p*-nitrophenol.

S30.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[443\text{ K}]{\text{conc. } H_2SO_4} \underset{\text{Ethene}}{CH_2{=}CH_2}$$

S31.



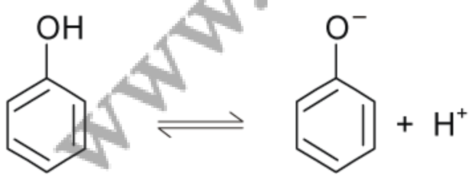
S32.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[443\text{ K}]{\text{conc. } H_2SO_4} CH_2{=}CH_2 \xrightarrow{Cl_2} \underset{Cl\quad\;\; Cl}{CH_2-CH_2} \xrightarrow{\text{aq. KOH}} \underset{\text{Ethane-1,2diol}}{\underset{OH\quad\; OH}{CH_2-CH_2}}$$

S33. Phenols are more acidic than aclohols. It can be explained on the basis that alcohol on losing H^+ ions form alkoxide ion and phenol forms phenoxide ion.

The greater acidity of phenol is due to the stability of the phenoxide ion which is resonance stabilized as shown below.

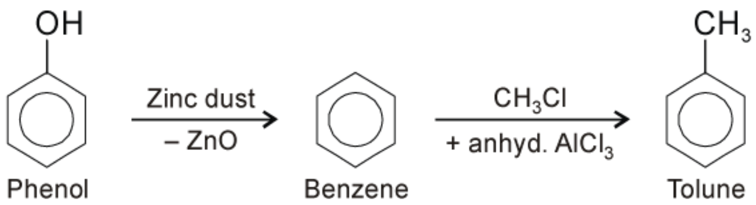
$$\underset{\text{Alcohol}}{R-\ddot{\underset{..}{O}}-H} \rightleftharpoons \underset{\text{Alkoxide ion}}{R-\ddot{\underset{..}{O}}{:}^-} + H^+$$



On the other hand, alkoxide ion shows no such resonance stabilisation and is unstable.

S34. Due to electron withdrawing effect of phenyl group the electron density on the oxygen atom of — OH group in phenol is less. Hence, phenols do not undergo protonation.

S35.



S36. On adding I_2 and NaOH, 2-Propanol will give yellow ppt. of iodoform, whereas 1-Propanol will not give yellow ppt.

S37. 2-propanol will give yellow precipitate of iodoform on addition of I_2 and NaOH while 2-methyl-2-propanol will not.

S38. Benzoic acid gives brisk effervescence of CO_2 on addition of $NaHCO_3$ while phenol does not.

S39. On adding I_2 and NaOH, 2-pentanol will give yellow precipitate of iodoform whereas 3-pentanol will not give yellow precipitate.

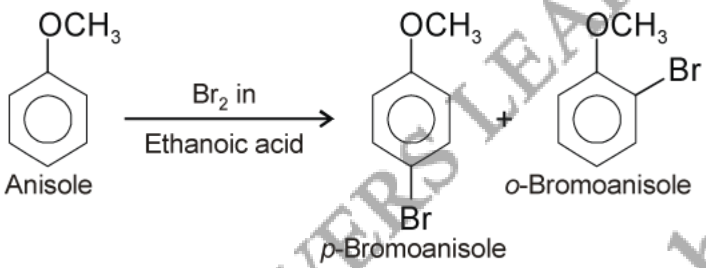
$$CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_2CH_2CH_3 \xrightarrow{I_2 + NaOH} \underset{\text{Yellow ppt.}}{CHI_3} + CH_3CH_2CH_2COONa$$

S40. Phenol: 0.2% solution of phenol is an antiseptic while 2% solution is used as disinfectant.

S41.

$$CH_3-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-OCH_3 + HI \longrightarrow CH_3-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-I + CH_3OH$$

S42.



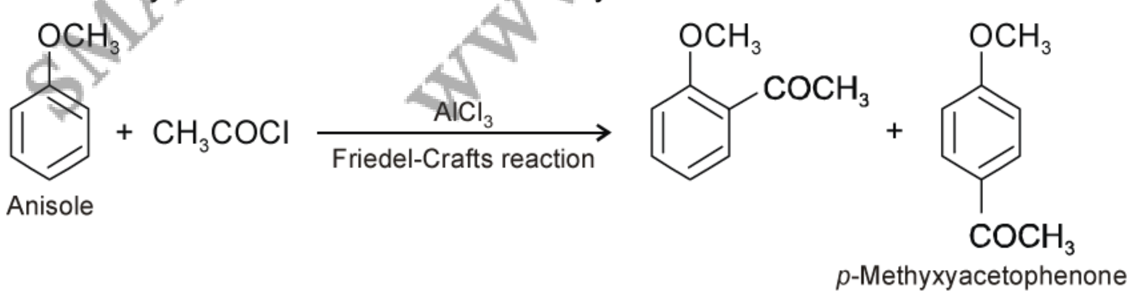
S43. **Williamson ether synthesis:** Alkyl halide when treated with sodium alkoxide gives dialkyl ether.

$$C_2H_5ONa + C_2H_5Cl \longrightarrow C_2H_5-O-C_2H_5 + NaCl.$$

S44. **Williamson ether synthesis:** Alkyl halide when treated with sodium alkoxide gives dialkyl ether.

$$C_2H_5ONa + C_2H_5Cl \longrightarrow C_2H_5-O-C_2H_5 + NaCl.$$

S45. **Reagents:** Acetyl chloride and Lewis acid catalyst.

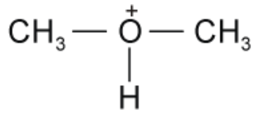


S46. **Williamson ether synthesis:** Alkyl halide when treated with sodium alkoxide gives dialkyl ether.

$$C_2H_5ONa + C_2H_5Cl \longrightarrow C_2H_5-O-C_2H_5 + NaCl.$$

S47. Unsymmetrical ether: Ethers in which two alkylgroups are different are known as unsymmetrical ether. *e.g.*, $CH_3OCH_2CH_3$ Methoxyethane.

S48. Protonation of anisole (Phenyl methyl ether) gives methyl phenyl oxonium ion.



In this ion, the stronger bond is O — C_6H_5. Therefore, attack by I^- ion exclusively breaks the weaker O — CH_3 bond forming methyl iodide and pheno. The phenol formed does not react further to give aryl halides.

S49. The boiling points of ethers are much lower than, those of alcohol of comparable molar masses because like alcohols they cannot form intermolecular hydrogen bonds.

Intermolecular hydrogen bond Dipole-dipole interaction

S50. Acid dehydration of 2° and 3° alcohols give alkenes rather than ethers.

Due the steric hindrance the nucleophilic attack by the alcohol molecule on the protonated alcohol molecule does not occur.

The protonated 2° and 3° alcohols lose water molecules to form stable 2° and 3° carbocations.

S51. 1-Ethoxy-2-nitrocyclohexane.

S52. Acid dehydration of 2° and 3° alcohols give alkenes rather than ethers.

Due the steric hindrance the nucleophilic attack by the alcohol molecule on the protonated alcohol molecule does not occur.

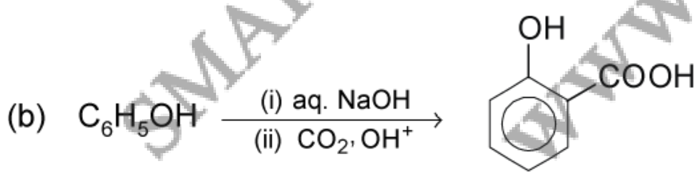
The protonated 2° and 3° alcohols lose water molecules to form stable 2° and 3° carbocations.

S53. The boiling points of ethers are much lower than, those of alcohol of comparable molar masses because like alcohols they cannot form intermolecular hydrogen bonds.

Intermolecular hydrogen bond Dipole-dipole interaction

S54. (a) $CH_3 — CH = CH_2 \xrightarrow[\text{(ii) } 3H_2O_2 / OH^-]{\text{(i) } B_2H_6} CH_3CH_2CH_2OH$
Propanol

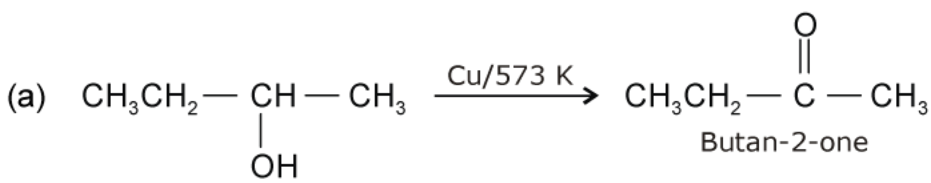
(b)



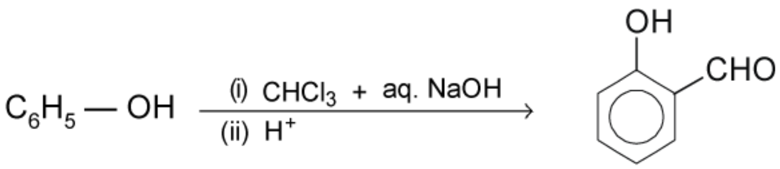
Salicylic acid

S55.

(a)

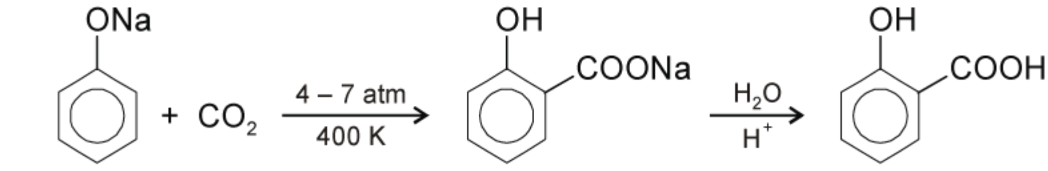


Butan-2-one

(b) 

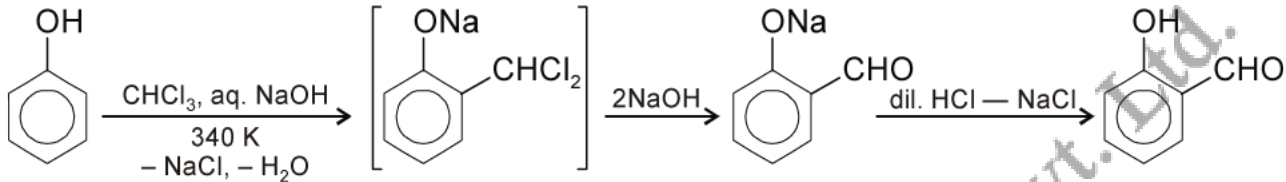
Salicylaldehyde

S56. (a) **Kolbe's reaction:** When sodium phenoxide is heated with carbon dioxide under pressure, it gives salicylic acid.



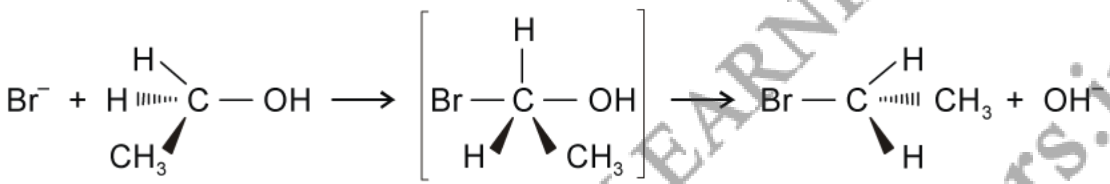
Sod. phenoxide Sod. salicylate Salicylic acid

(b) **Reimer-Tiemann reaction:**



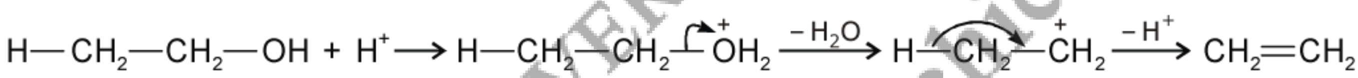
Salicylaldehyde

S57. The reaction proceeds through nucleophilic substitution biomolecular (S_N2) mechanism, as shown below:



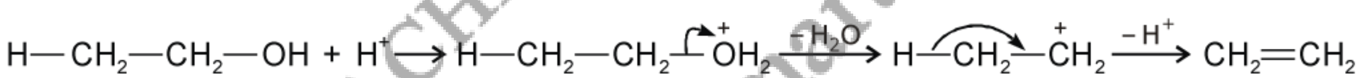
Transition state

S58. Acid catalysed dehydration of alcohols at high temperature takes place with formation of an alkene.



Ethanol Ethene

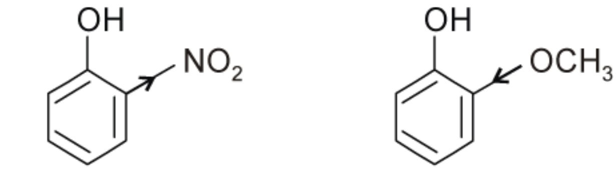
S59. Acid catalysed dehydration of alcohols at high temperature takes place with formation of an alkene.



Ethanol Ethene

S60. (a) The solubility of alcohols in water is due to their ability to form hydrogen bonds with water molecules. Hydrocarbons cannot form such hydrogen bonds, hence they are insoluble in water.

(b) As we know that the electron withdrawing groups enhance the acidic character of phenols because they help in the stabilisation of phenoxide ion be dispersing negative charge. Nitro group is an electron withdrawing group whereas methoxy group destabiliser the phenoxide ion by intensifying the negative charge. Thus, *o*-nitrophenol is more acidic than *o*-methoxyphenol.



o-Nitrophenol *o*-Methoxyphenol

S61. $$\underset{\text{Ethene}}{H_2C{=}CH_2} + H^+ \rightleftharpoons H_3C-\overset{+}{C}H_2 \xrightarrow{H_2O} H_3C-\underset{\underset{{}^{+}OH_2}{|}}{CH_2} \xrightarrow{-H^+} \underset{\text{Ethanol}}{H_3C-CH_2-OH}$$

S62. Acid catalysed dehydration of alcohols at high temperature takes place with formation of an alkene.

$$\underset{\text{Ethanol}}{H-CH_2-CH_2-OH} + H^+ \longrightarrow H-CH_2-CH_2-\overset{+}{O}H_2 \xrightarrow{-H_2O} H-CH_2-\overset{+}{C}H_2 \xrightarrow{-H^+} \underset{\text{Ethene}}{CH_2{=}CH_2}$$

S63. (a) CU at 573 K.

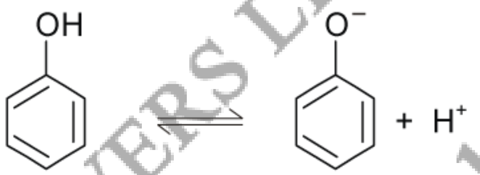
(b) $$\underset{\text{But-2-ene}}{H_3C-CH{=}CH-CH_3} \xrightarrow{\text{Ozonolysis}} 2CH_3CHO \xrightarrow{H_2/Ni} \underset{\text{Ethanol}}{2CH_3CH_2OH}$$

S64. (a) It is due to higher molecular weight, more surface area, more van der Wasl's forces of attraction in C_2H_5OH than CH_3OH.

(b) Phenols are more acidic than aclohols. It can be explained on the basis that alcohol on losing H^+ ions form alkoxide ion and phenol forms phenoxide ion.

The greater acidity of phenol is due to the stability of the phenoxide ion which is resonance stabilized as shown below.

$$\underset{\text{Alcohol}}{R-\ddot{\underset{..}{O}}-H} \rightleftharpoons \underset{\text{Alkoxide ion}}{R-\ddot{\underset{..}{O}}{:}^-} + H^+$$

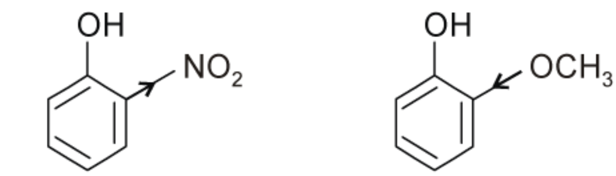


On the other hand, alkoxide ion shows no such resonance stabilisation and is unstable.

S65. (a) The molecules of butane are held together by weak van der Waals forces of attraction while those of propanol are held together by stronger intermolecular hydrogen bonding.

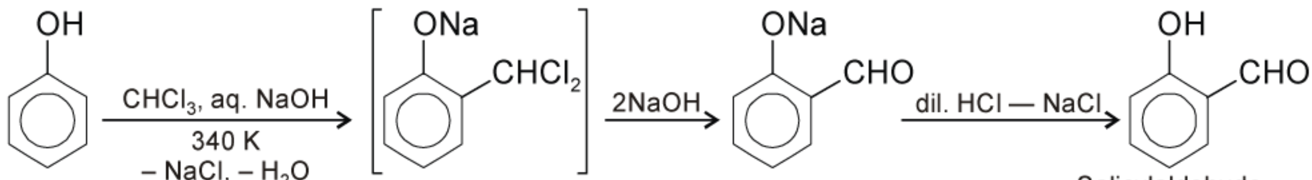
$$H-\underset{\underset{C_3H_7}{|}}{O}\cdots\cdots H-\underset{\underset{C_3H_7}{|}}{O}\cdots\cdots$$

(b) As we know that the electron withdrawing groups enhance the acidic character of phenols because they help in the stabilisation of phenoxide ion be dispersing negative charge. Nitro group is an electron withdrawing group whereas methoxy group destabiliser the phenoxide ion by intensifying the negative charge. Thus, *o*-nitrophenol is more acidic than *o*-methoxyphenol.



o-Nitrophenol *o*-Methoxyphenol

S66. Reimer-Tiemann reaction:



Salicylaldehyde

S67. (a) Zinc dust.

(b) Concentrated H_2SO_4.

(c) Alkyl halide in the presence of anhydrours aluminium chloride, CH_3Cl and $AlCl_3$ (anhy.).

(d) Cu/573 K.

S68. (a) Bromine water, (Br_2(aq)).

(b) Lithium aluminium hydride, ($LiAlH_4$) or H_2/Ni.

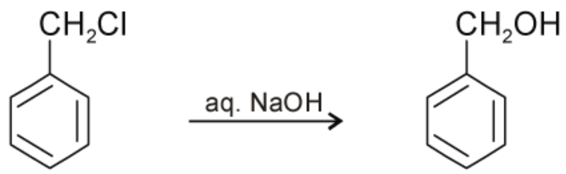
(c) Alkyl halide in the presence of anhydrours aluminium chloride, CH_3Cl and $AlCl_3$ (anhy.).

(d) Acidified potassium permangante, $KMnO_4$, H_3O^+.

S69.

(a) $$\underset{\text{Propene}}{CH_3CH=CH_2} \xrightarrow[H_2SO_4]{H_2O} \underset{\text{Propan-2-ol}}{CH_3-\overset{OH}{\overset{|}{CH}}-CH_3}$$

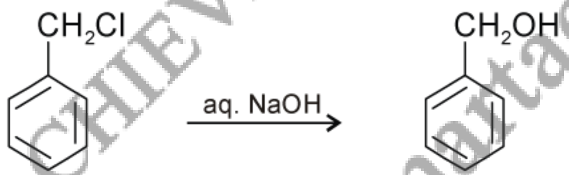
(b)



Benzyl chloride Benzyl alcohol

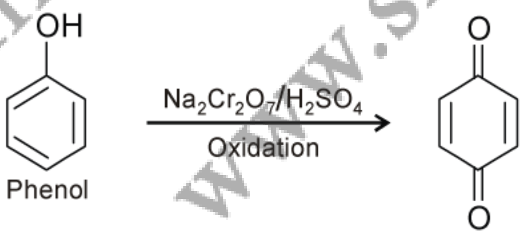
S70. $$\underset{\text{Ethene}}{CH_2=CH_2} + H^+ \rightleftharpoons CH_3-\overset{+}{C}H_2 \xrightarrow{-H_2O} CH_3-CH_2 \xrightarrow{-H^+} \underset{\text{Ethanol}}{CH_3-CH_2-OH}$$

S71. (a)



Benzyl chloride Benzyl alcohol

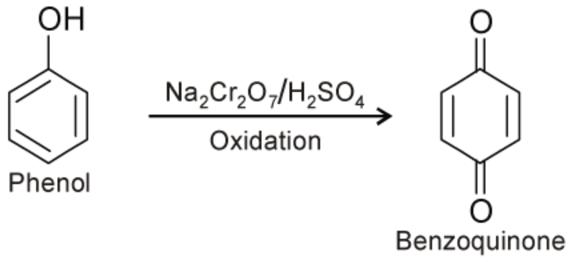
(b)



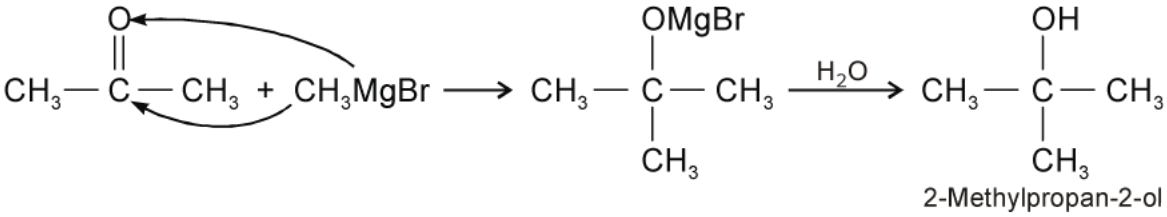
Phenol Benzoquinone

S72.

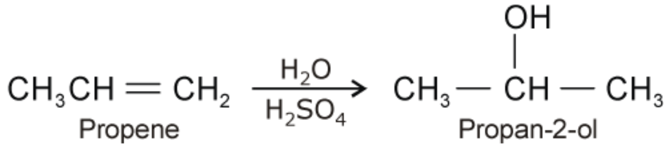
(a)



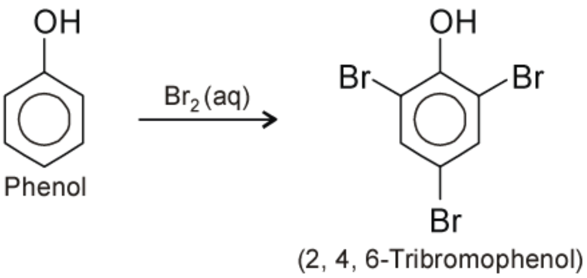
(b)



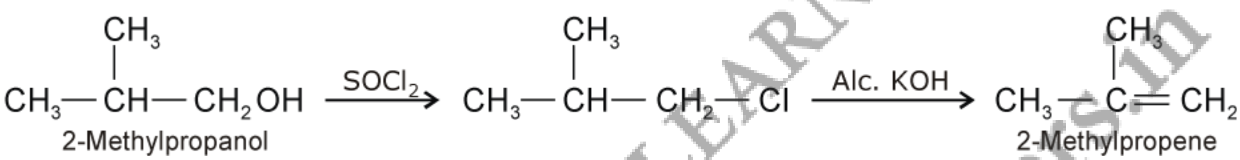
(c)



S73. (a)

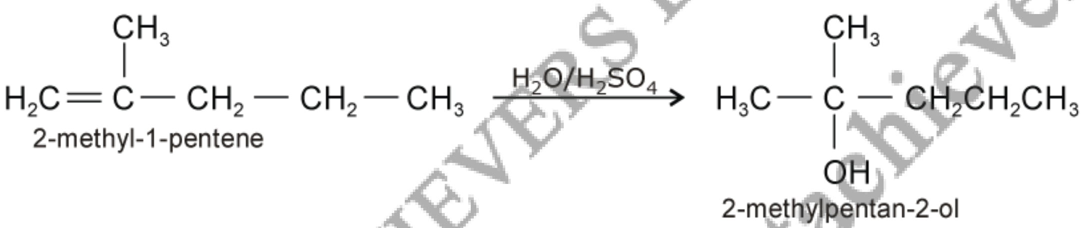


(b)

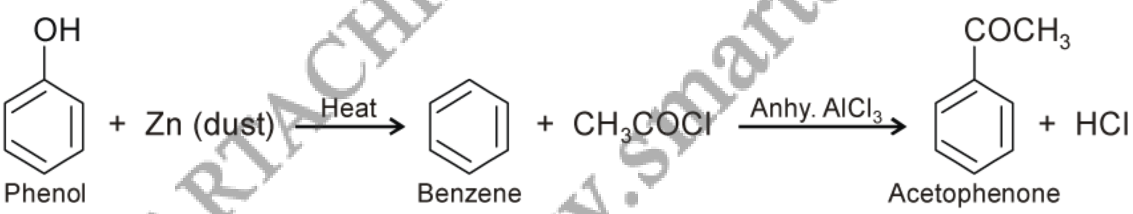


S74.

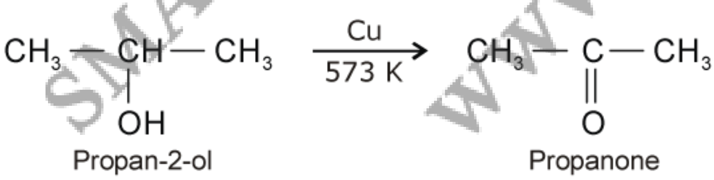
(a)



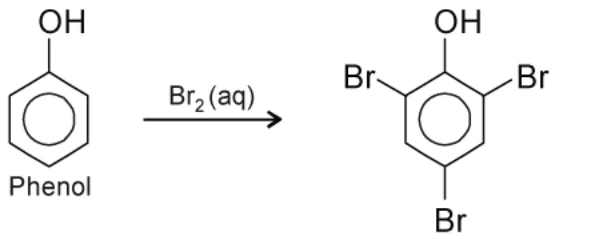
(b)



S75. (a)



(b)



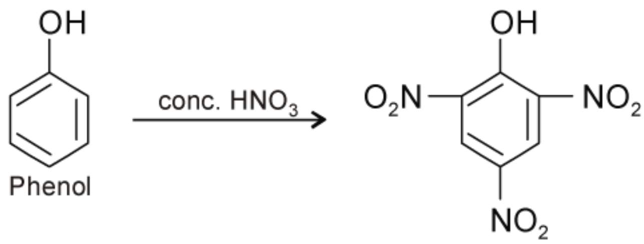
(2, 4, 6-Tribromophenol)

S76.

(a) $CH_3CH=CH_2 \xrightarrow[H_2SO_4]{H_2O} CH_3-\underset{|}{\overset{OH}{CH}}-CH_3$

Propene → Propan-2-ol

(b)



Picric acid
(2, 4, 6-Trinitrophenol)

S77.

(a) $CH_3CH=CH_2 \xrightarrow[H_2SO_4]{H_2O} CH_3-\overset{OH}{CH}-CH_3$

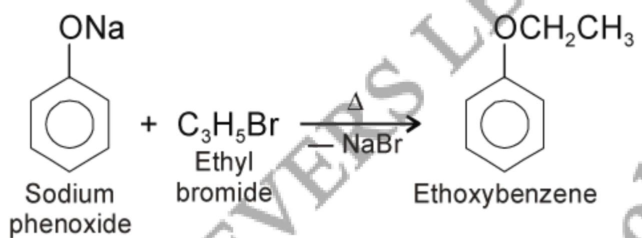
Propene → Propan-2-ol

(b) $CH_3CH_2Cl + KOH(aq) \longrightarrow CH_3CH_2OH \xrightarrow[573\ K]{Cu} CH_3-\overset{O}{\overset{\|}{C}}-H$

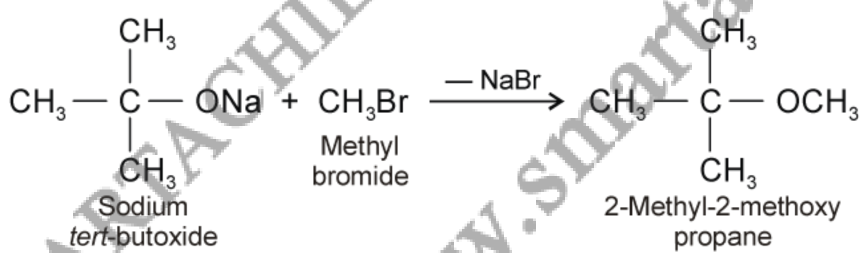
Ethyl chloride → Ethanol → Ethanal

S78.

(a)



(b)



S79. Propan-1-ol on treatment with conc. H_2SO_4 at 413 K would yield 1-propoxypropane. In this method, the alcohol is continuously added to keep its concentration in exces.

$$2CH_3-CH_2-CH_2-OH + H_2SO_4 \xrightarrow{413\ K} CH_3-CH_2-CH_2-O-CH_2-CH_2-CH_3$$

Propan-1-ol → 1-Propoxypropane

Mechanism:

$$CH_3-CH_2-CH_2-OH + H^+ \rightleftharpoons CH_3-CH_2-CH_2-\underset{|}{\overset{+}{O}}-H$$
$$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad H$$

Propan-1-ol

$$CH_3-CH_2-CH_2-\overset{+}{O}(H)-H \rightleftharpoons CH_3-CH_2-\overset{+}{C}H_2 + H_2O$$

$$\underset{\text{Propan-1-ol}}{CH_3-CH_2-CH_2-\ddot{O}-H} + CH_3-CH_2-\overset{+}{C}H_2 \xrightarrow{H^+} CH_3-CH_2-CH_2-O-CH_2-CH_2-CH_3$$

S80. Mechanism: The formation of ether is nucleophilic bimolecular reaction.

Step 1: $CH_3-CH_2-\ddot{O}-H + H^+ \longrightarrow CH_3-CH_2-\overset{+}{O}(H)-H$

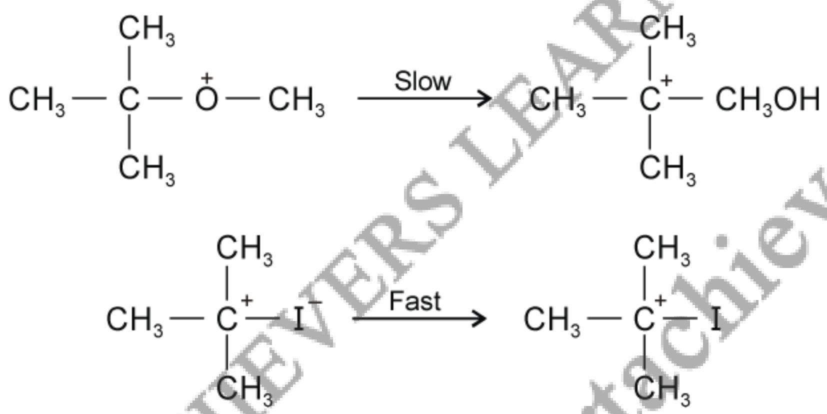
Step 2: $CH_3-CH_2-\ddot{O}-H + CH_3-CH_2-\overset{+}{O}(H)-H \xrightarrow{-H_2O} CH_3-CH_2-\overset{+}{O}(H)-CH_2-CH_3$

Step 3: $CH_3-CH_2-\overset{+}{O}(H)-CH_2-CH_3 \longrightarrow CH_3-CH_2-O-CH_2-CH_3 + H^+$

S81. (a) Ethanol has higher boiling point because of strong intermolecular hydrogen bonding whereas in methoxymethane, molecules are held by dipole-dipole interaction.

(b) When one alkyl group is a tertiary group the halide formed is tertiary halide.

In step II the departure of leacing group (CH_3 — OH) creates a more stable carbocation (3°) and the reaction follows S_N1 mechanism.



S82. Mechanism: The formation of ether is nucleophilic bimolecular reaction.

Step 1: $CH_3-CH_2-\ddot{O}-H + H^+ \longrightarrow CH_3-CH_2-\overset{+}{O}(H)-H$

Step 2: $CH_3-CH_2-\ddot{O}-H + CH_3-CH_2-\overset{+}{O}(H)-H \xrightarrow{-H_2O} CH_3-CH_2-\overset{+}{O}(H)-CH_2-CH_3$

Step 3: $CH_3-CH_2-\overset{+}{O}(H)-CH_2-CH_3 \longrightarrow CH_3-CH_2-O-CH_2-CH_3 + H^+$

S83. (a) Distinction between ethanol and phenol.

$FeCl_3$ test: Phenol gives a violet colouration with $FeCl_3$ solution while ethanol does not.

$$\underset{\text{Phenol}}{3C_6H_5OH} + FeCl_3 \longrightarrow \underset{\text{Violet colouration}}{(C_6H_5O)_3Fe} + 3HCl$$

$$C_2H_5PH + FeCl_3 \longrightarrow \text{No viloet colouration.}$$

(b) On adding I_2 and NaOH, 2-Propanol will give yellow ppt. of iodoform, whereas 1-Propanol will not give yellow ppt.

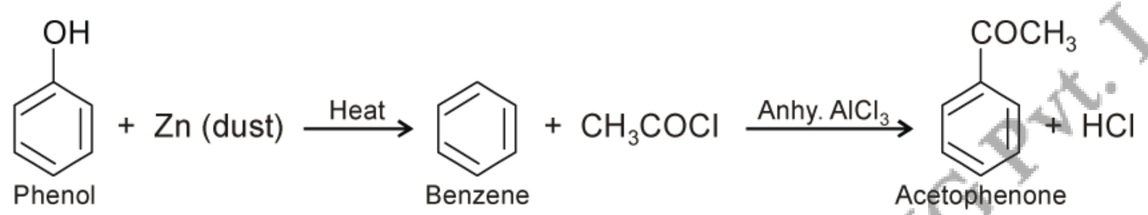
S84. (a) Distinction between ethanol and phenol.

$FeCl_3$ test: Phenol gives a violet colouration with $FeCl_3$ solution while ethanol does not.

$$\underset{\text{Phenol}}{3C_6H_5OH} + FeCl_3 \longrightarrow \underset{\text{Violet colouration}}{(C_6H_5O)_3Fe} + 3HCl$$

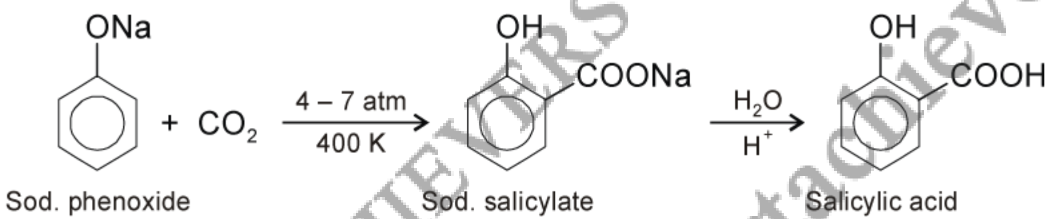
$$C_2H_5PH + FeCl_3 \longrightarrow \text{No viloet colouration.}$$

(b)



S85. (a) $$\underset{\text{Ethene}}{H_2C{=}CH_2} + H^+ \rightleftharpoons H_3C-\overset{+}{C}H_2 \xrightarrow{H_2O} H_3C-\underset{\overset{|}{^+OH_2}}{CH_2} \xrightarrow{-H^+} \underset{\text{Ethanol}}{H_3C-CH_2-OH}$$

(b) **Kolbe's reaction:** When sodium phenoxide is heated with carbon dioxide under pressure, it gives salicylic acid.



S86. Acid catalysed dehydration of alcohols follows carbocation mechanism.

Hence, dehydration of *t*-butanol which form 3° carbocation is faster than *n*-butanol which form primary carbocation.

$$CH_3-\underset{CH_3}{\overset{CH_3}{C}}-OH + H^+ \longrightarrow CH_3-\underset{CH_3}{\overset{CH_3}{C}}-\underset{H}{\overset{+}{O}}-H \xrightarrow{-H_2O} \underset{3^\circ\text{ (more stable)}}{CH_3-\underset{CH_3}{\overset{CH_3}{C^+}}}$$

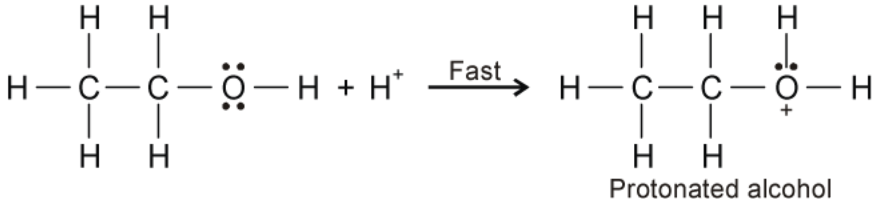
$$CH_3CH_2CH_2CH_2OH + H^+ \longrightarrow CH_3CH_2CH_2\overset{+}{O}H_2 \xrightarrow{-H_2O} \underset{1^\circ\text{ (less stable)}}{CH_3CH_2CH_2\overset{+}{C}H_2}$$

S87. (a) Ethanol undergoes dehydration by heating it with concentrated H_2SO_4 at 453 K.

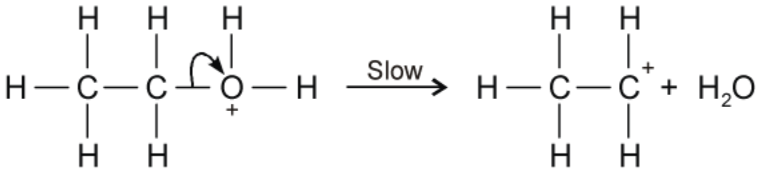
$$C_2H_5OH \xrightarrow[453\ K]{H_2SO_4} CH_2 = CH_2 + H_2O$$

Mechanism: The dehydration of ethanol involves the following steps:

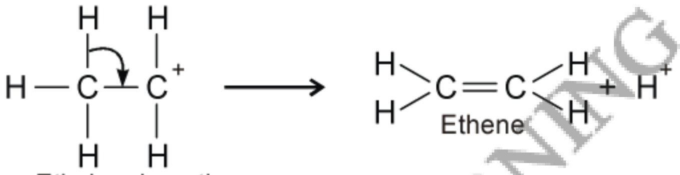
(i) Formation of protonated alcohol.



(ii) Formation of carbocation.



(iii) Formation of ethene.



(b) Distinction between ethanol and phenol.

$FeCl_3$ test: Phenol gives a violet colouration with $FeCl_3$ solution while ethanol does not.

$$\underset{\text{Phenol}}{3C_6H_5OH} + FeCl_3 \longrightarrow \underset{\text{Violet colouration}}{(C_6H_5O)_3Fe} + 3HCl$$

$$C_2H_5PH + FeCl_3 \longrightarrow \text{No viloet colouration.}$$

S88. (a) $CH_3CH_2CH_2CH_2OH \xrightarrow{\text{Oxidation}} \underset{\text{Butanoic acid}}{CH_3 - CH_2CH_2COOH}$

(b) $CH_3 - CH = CH - CH_2OH \longrightarrow \underset{\text{Butanoic}}{CH_3CH = CH - COOH}$

(c) $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_3OH \longrightarrow \underset{\text{2-Methylpropanoic acid}}{CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - COOH}$

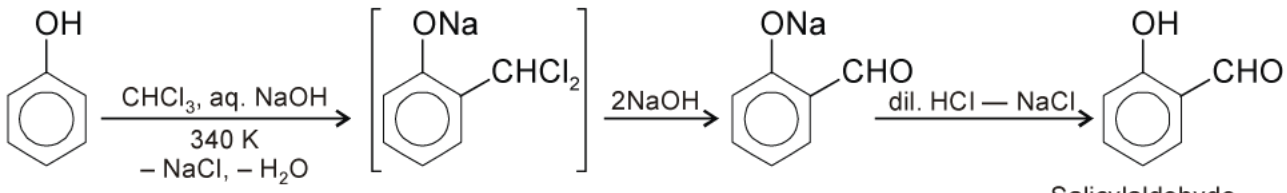
S89. (a) (i) Bromine water, ($Br_2(aq)$).

(ii) Lithium aluminium hydride, ($LiAlH_4$) or H_2/Ni.

(iii) Alkyl halide in the presence of anhydrours aluminium chloride, CH_3Cl and $AlCl_3$ (anhy.).

(iv) Acidified potassium permangante, $KMnO_4$, H_3O^+.

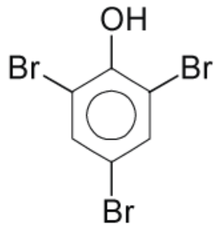
(b) **Reimer-Tiemann reaction:**



Salicylaldehyde

S90. (a) $CH_3 - CH = CH_2 \xrightarrow[\text{(ii) } 3H_2O_2/OH^-]{\text{(i) } B_2H_6} CH_3CH_2CH_2OH.$

(b) $C_6H_5OH \xrightarrow{Br_2(aq)}$



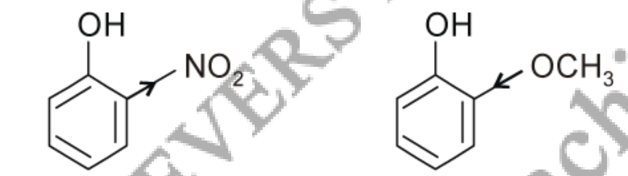
2,4,6-Tribromophenol

(c) $CH_3CH_2OH \xrightarrow{Cu/573\text{ K}} CH_3CHO.$

S91. (a) (i) Copper at 573 K.

(ii) The solubility of alcohols in water is due to their ability to form hydrogen bonds with water molecules. Hydrocarbons cannot form such hydrogen bonds, hence they are insoluble in water.

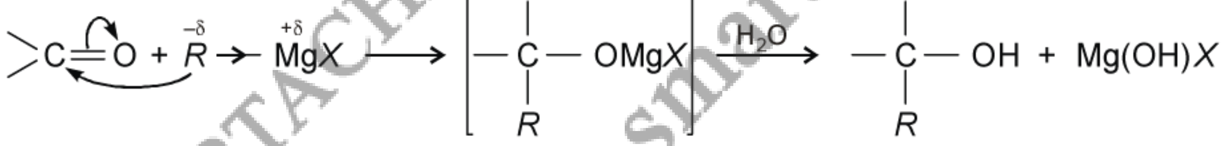
(b) As we know that the electron withdrawing groups enhance the acidic character of phenols because they help in the stabilisation of phenoxide ion be dispersing negative charge. Nitro group is an electron withdrawing group whereas methoxy group destabiliser the phenoxide ion by intensifying the negative charge. Thus, *o*-nitrophenol is more acidic than *o*-methoxyphenol.



o-Nitrophenol *o*-Methoxyphenol

S92.

(a)



Adduct Alcohol

(b) Acid catalysed dehydration of alcohols at high temperature takes place with formation of an alkene.

$$\underset{\text{Ethanol}}{H-CH_2-CH_2-OH} + H^+ \longrightarrow H-CH_2-CH_2-\overset{+}{O}H_2 \xrightarrow{-H_2O} H-CH_2-\overset{+}{C}H_2 \xrightarrow{-H^+} \underset{\text{Ethene}}{CH_2=CH_2}$$

(c) $$\underset{\text{Ethene}}{H_2C=CH_2} + H^+ \rightleftharpoons H_3C-\overset{+}{C}H_2 \xrightarrow{H_2O} H_3C-\underset{\overset{|}{^{+}OH_2}}{CH_2} \xrightarrow{-H^+} \underset{\text{Ethanol}}{H_3C-CH_2-OH}$$

S93. (a) (i) On adding I_2 and NaOH, 2-pentanol will give yellow precipitate of iodoform whereas 3-pentanol will not give yellow precipitate.

$$CH_3-\underset{\large OH}{\underset{|}{C}H}-CH_2CH_2CH_3 \xrightarrow{I_2 + NaOH} \underset{\text{Yellow ppt.}}{CHI_3} + CH_3CH_2CH_2COONa$$

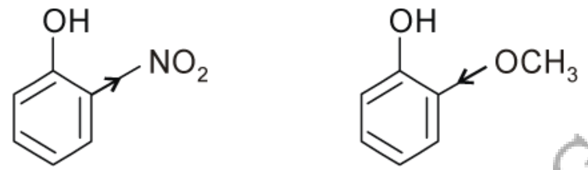
(ii) Distinction between ethanol and phenol.

$FeCl_3$ test: Phenol gives a violet colouration with $FeCl_3$ solution while ethanol does not.

$$\underset{\text{Phenol}}{3C_6H_5OH} + FeCl_3 \longrightarrow \underset{\text{Violet colouration}}{(C_6H_5O)_3Fe} + 3HCl$$

$$C_2H_5PH + FeCl_3 \longrightarrow \text{No viloet colouration.}$$

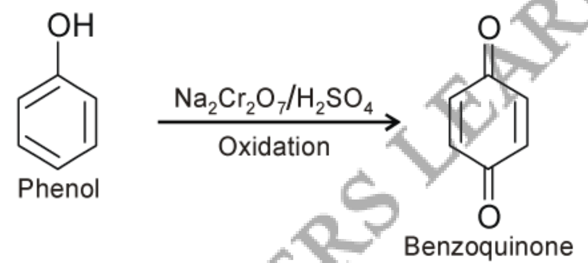
(b) As we know that the electron withdrawing groups enhance the acidic character of phenols because they help in the stabilisation of phenoxide ion be dispersing negative charge. Nitro group is an electron withdrawing group whereas methoxy group destabiliser the phenoxide ion by intensifying the negative charge. Thus, *o*-nitrophenol is more acidic than *o*-methoxyphenol.



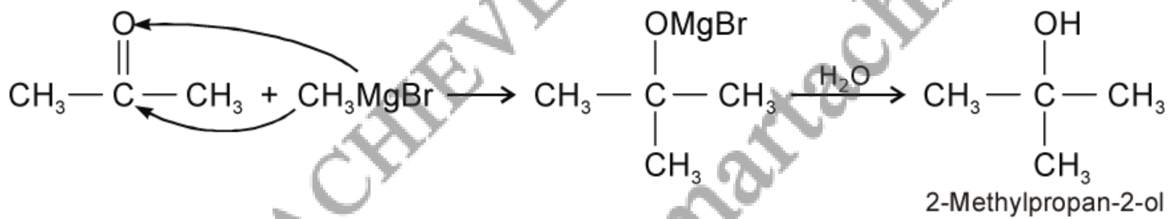
o-Nitrophenol *o*-Methoxyphenol

S94. (a) Copper at 573 K (b) Sodium borohydride ($NaBH_4$) (c) Bromine water ($Br_2(aq)$).

S95. (a)



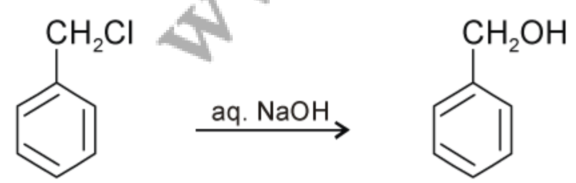
(b)



(c)

$$\underset{\text{Propene}}{CH_3CH=CH_2} \xrightarrow[H_2SO_4]{H_2O} \underset{\text{Propan-2-ol}}{CH_3-\overset{\large OH}{\overset{|}{C}H}-CH_3}$$

S96. (a)



Benzyl chloride Benzyl alcohol

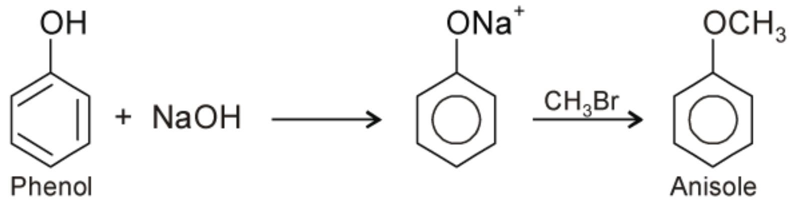
(b) Ethyl magnesium chloride on addition to formaldehyde followed by hydrolysis gives propan-1-ol.

$$\underset{\text{Ethyl magnesium chloride}}{CH_3-CH_2MgCl} + H-\overset{\overset{O}{\|}}{C}-H \xrightarrow{\text{Dry ether}} CH_3-CH_2-CH_2-OMgCl \xrightarrow{H_2O^+} \underset{\text{Propan-1-ol}}{CH_3-CH_2-CH_2-OH}$$

(c)

$$\underset{\text{Propene}}{CH_3CH=CH_2} \xrightarrow[H_2SO_4]{H_2O} \underset{\text{Propan-2-ol}}{CH_3-\overset{\overset{OH}{|}}{CH}-CH_3}$$

S97. (a) Phenol to anisole



(b) Propan-2-ol to 2-methylpropan-2-ol

$$\underset{\text{Propan-2-ol}}{CH_3-\underset{\underset{OH}{|}}{CH}-CH_3} \xrightarrow{K_2Cr_2O_7/H_2SO_4} CH_3-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow[\text{(ii) } H^+/H_2O]{\text{(i) } CH_3MgBr} \underset{\text{2-Methylpropan-2-ol}}{CH_3-\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_3}$$

(c) Aniline to phenol