

# 2(a) ALCOHOLS

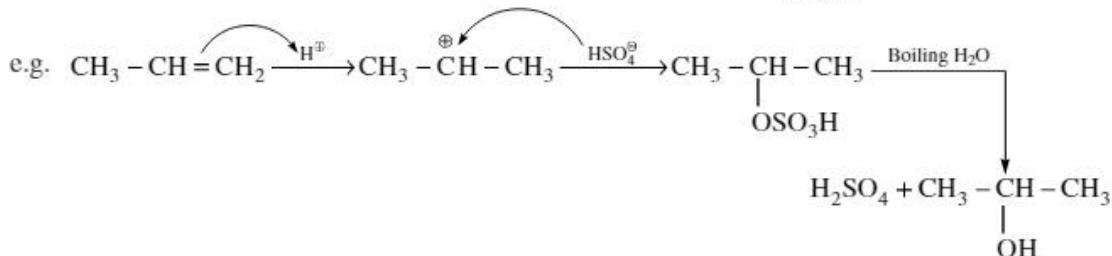
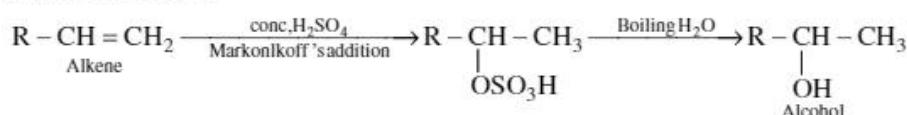
## SYNOPSIS

### PREPARATION OF ALCOHOLS

#### 1) From alkenes

a) *By acid catalyzed hydration of alkenes:* Formation of carbocation intermediate (Markovnikov addition, rearrangement possible)

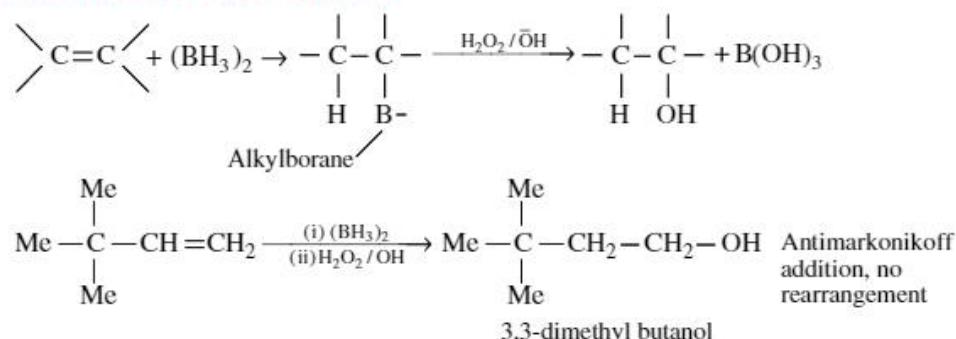
General reaction :



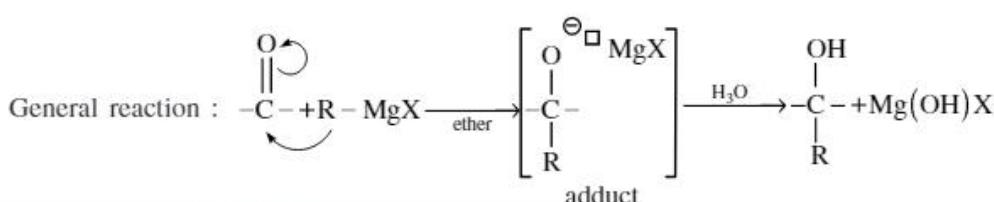
#### b) *By Oxymercuration-demercuration process:*

- Oxymercuration involves an electrophilic attack on the double bond by the positively charged mercury species. The product is a mercurinium ion, an organometallic cation containing a three-membered ring.
- In the second step, water from the solvent attacks the mercurinium ion to give (after deprotonation) an organomercurial alcohol.
- The third step is demercuration to remove the Hg. Sodium borohydride ( $\text{NaBH}_4$ , a reducing agent) replaces the mercuric acetate fragment with hydrogen.

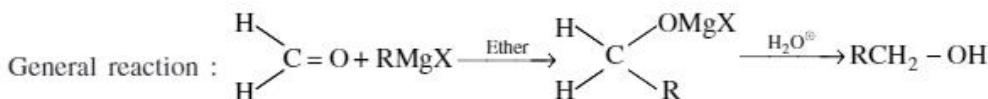
### HYDROBORATION-OXIDATION:



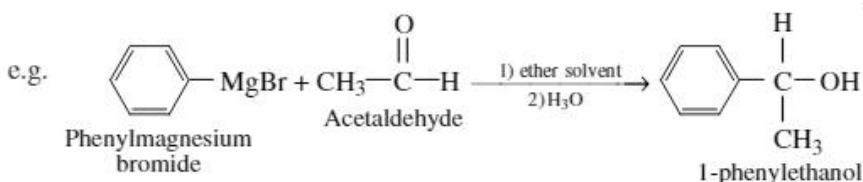
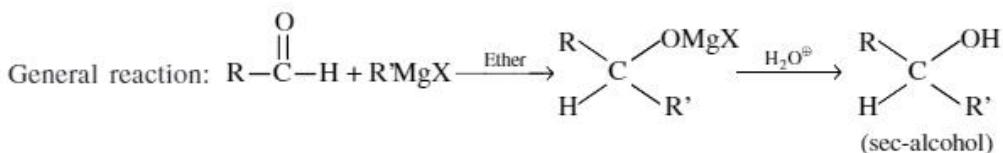
*From carbonyl compounds:* Nucleophilic addition to the carbonyl groups by Grignard reagent



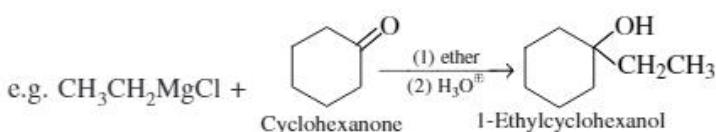
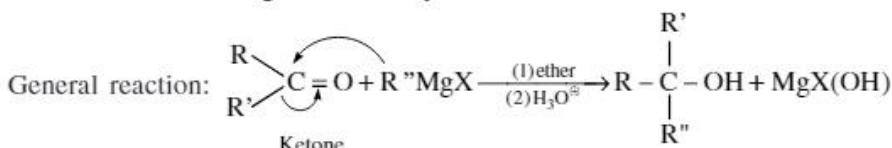
- i) Addition of formaldehyde gives a primary alcohol



- ii) Addition to an aldehyde (other than formaldehyde) gives a secondary alcohol

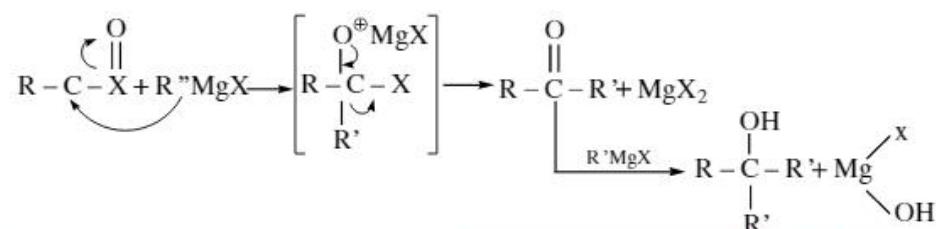
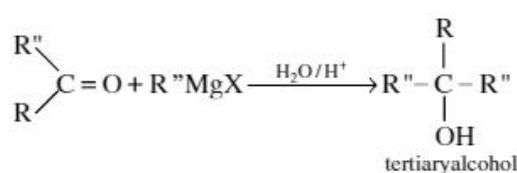
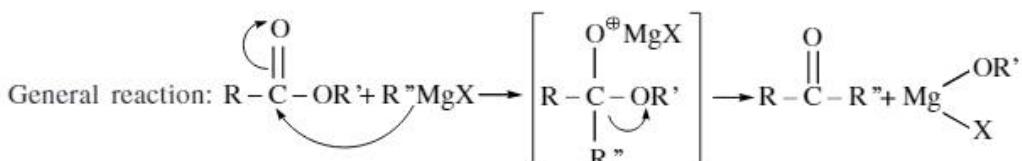


- iii) Addition to a ketone gives a tertiary alcohol



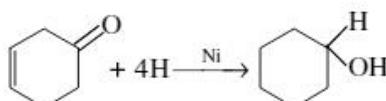
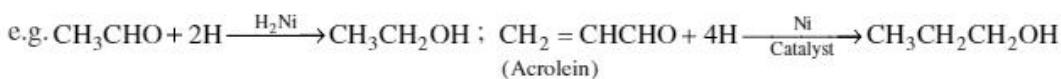
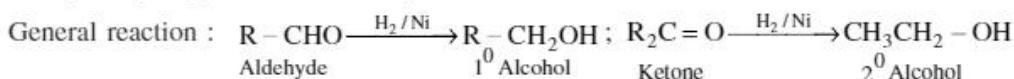
- iv) Addition to an acid halide or an ester gives a tertiary alcohol

Esters on treatment with Grignard reagent first form ketones which then react with second molecule of Grignard reagent and form tertiary alcohol.

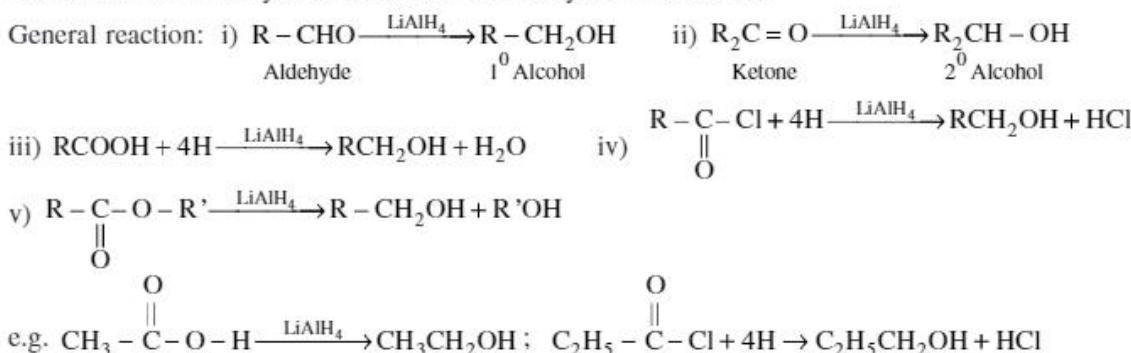


## BY REDUCTION OF CARBONYL COMPOUNDS

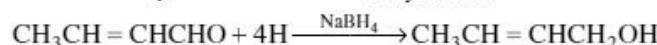
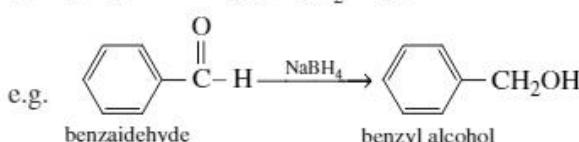
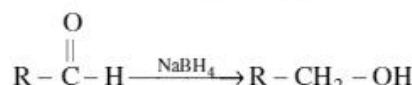
- a) Catalytic hydrogenation of aldehydes and ketones



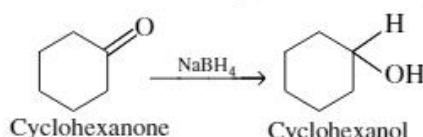
- b) Lithium aluminium hydride reduction of aldehydes and ketones



- c) By  $\text{NaBH}_4$  (sodium borohydride) : It is insoluble in ether and is used in aqueous ethanolic solution to reduce carbonyl compounds. It does not reduce esters and acids.



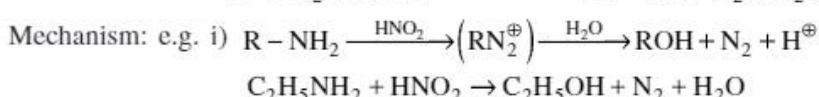
- d) Reduction of a ketone gives a secondary alcohol.

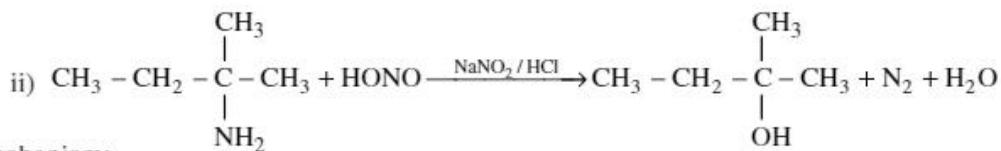


- \* LAH cannot reduce  $\text{C}=\text{C}$  but when it is in conjugation then only it is reduced LAH but sodium borohydride,  $\text{NaBH}_4$ , does not reduce carbon-carbon double bonds, even those conjugated with carbonyl groups and is thus useful for the reduction of unsaturated carbonyl compounds to unsaturated alcohols.

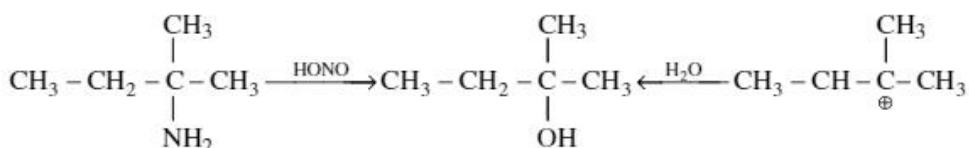
## BY REACTION OF NITROUS ACID ON ALIPHATIC PRIMARY AMINES

- i) General reaction :  $\text{R}-\text{NH}_2 + \text{HONO} \xrightarrow{\text{NaNO}_2 ? \text{HCl}} \text{R}-\text{OH} + \text{N}_2 + \text{H}_2\text{O}$



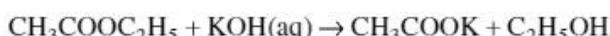
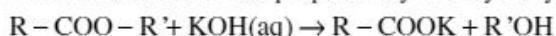


#### Mechanism:

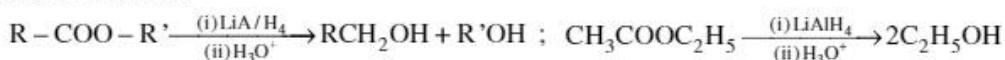


Note: In this reaction if we take ethyl amine then main product will be ethanol while if we take methyl amine, then main product will be dimethyl ether.

- ii) From esters: Alcohols are prepared by the hydrolysis of esters.



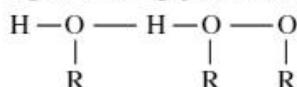
The hydrolysis of esters with alkali is called saponification. Alcohols are also obtained by the reduction of esters.



## PHYSICAL PROPERTIES

- ### 1) Boiling point:

- a) Alcohols show increase in boiling point with increase in molecular weight amongst homologues.
  - b) Alcohols have higher boiling point than hydrocarbons of the same molecular weight. The reason for higher boiling point is the intermolecular H-bonding present in alcohols.



## Intermolecular H bonds in alcohol

$$\text{M.P. & B.P.} \propto \text{Molecular Mass} \propto \frac{1}{\text{No.of branches}}$$

- ## 2) Solubility in water:

- i) As molecular weight increases solubility in water decreases. The lower alcohols are miscible with water. This is due to intermolecular hydrogen bonding between alcohol and water molecules

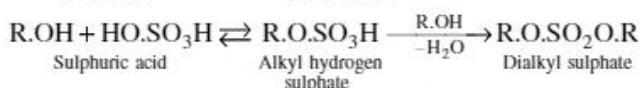
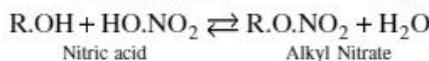
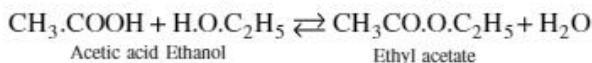
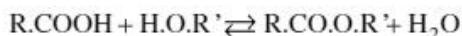
Reactivity of alcohols with active metal is in the order:

$$\text{CH}_3\text{OH} > \text{C}_2\text{H}_5\text{OH} > \text{CH}_3\text{CH}_2\text{CHOHCH}_3 > (\text{CH}_3)_3\text{COH}$$

Relative acidities:  $\text{H}_2\text{O} > \text{R}-\text{OH} > \text{HC}\equiv\text{CH} > \text{NH}_3$

Relative basicities:  $\text{HO} < \text{RO} < \text{HC} \equiv \text{C} < \text{NH}_2 < \text{R}$

- ### ii) Esterification:



The order of reactivity of the three types of alcohols in esterification reaction is primary > secondary > tertiary.

Order of reactivity of acids:  $\text{HCOOH} > \text{CH}_3\text{COOH} > \text{CH}_3\text{CH}_2\text{COOH} > (\text{CH}_3)_2\text{CHCOOH} > (\text{CH}_3)_3\text{CCOOH}$  (for a given alcohol)

Order of reactivity alcohols :  $\text{CH}_3\text{OH} > \text{CH}_3\text{CH}_2\text{OH} > (\text{CH}_3)_2\text{CHOH} > (\text{CH}_3)_3\text{COH}$  (for a given acid)

Reactivity order for esterification :  $\text{CH}_2\text{COCl} > (\text{CH}_3\text{CO})_2\text{O} > \text{CH}_3\text{COOR} > \text{CH}_3\text{CONH}_2$

Grignard reaction: Alcohols give hydrocarbons with Grignard reagent.



### REACTION INVOLVING FISSION OF C – O BOND

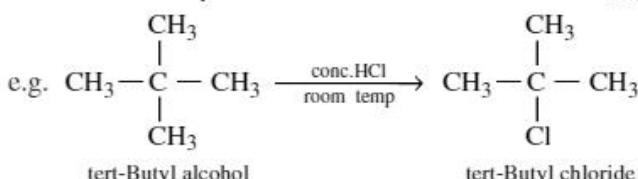
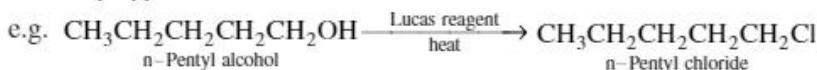
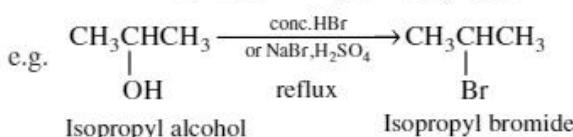
#### i) Reaction with hydrogen halides

General reaction :  $\text{R} - \text{OH} + \text{HX} \rightarrow \text{R} - \text{X} + \text{H}_2\text{O}$

Reactivity of HX :  $\text{HI} > \text{HBr} > \text{HCl}$

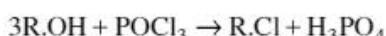
Reactivity of ROH : allyl, benzyl >  $3^0 > 2^0 > 1^0$

Mechanism :  $\text{R} - \text{OH} \xrightarrow{\text{H}^+} \text{R} - \overset{\oplus}{\text{OH}}_2 \rightarrow \text{R} - \overset{\oplus}{\text{X}} \rightarrow \text{R} - \text{X}$



#### ii) Action of phosphorous halides:

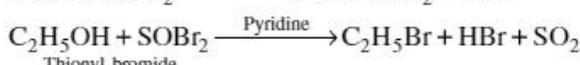
Phosphorus halides, tri or penta, when reacted with alcohols form alkyl halides.



Similar reactions occur with  $\text{PBr}_5$  and  $\text{PI}_5$  to form corresponding bromides and iodides.

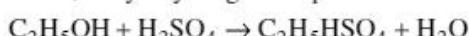
#### iii) Action of thionyl halides:

Thionyl chloride or bromide convert alcohols to alkyl chlorides or bromides.

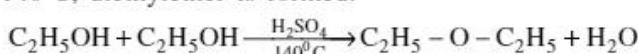


#### iv) Dehydration of alcohols

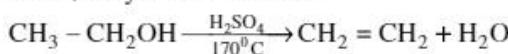
At  $100^\circ\text{C}$ , ethyl hydrogen sulphate is formed.



At  $140^\circ\text{C}$ , diethylether is formed.

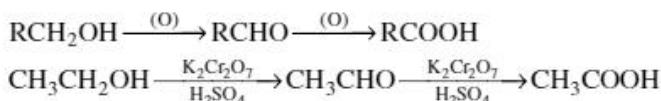


At  $170^\circ\text{C}$ , ethylene is formed.

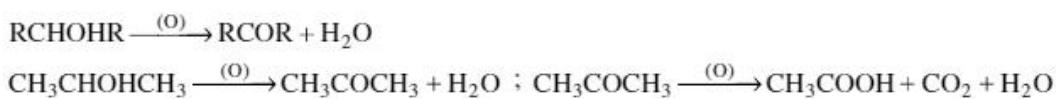


**OTHER REACTIONS:**

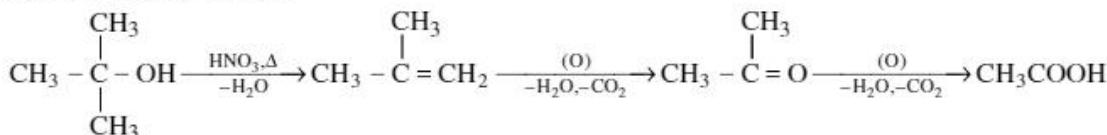
- 1. Oxidation:** Oxidation of primary alcohol with chromic acid gives aldehyde and finally an acid with the same number of carbon atoms.



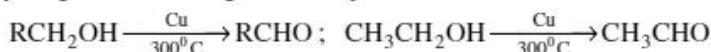
Secondary alcohol on oxidation gives ketone and finally a carboxylic acid with less number of carbon atoms.



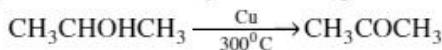
Tertiary alcohols are difficult to oxidize. However, when oxidation is carried out under drastic conditions, tertiary alcohols first undergo dehydration to form alkene. The alkene formed is then oxidized to ketone which is finally oxidized to carboxylic acid with less number of carbon atoms than the starting alcohol.



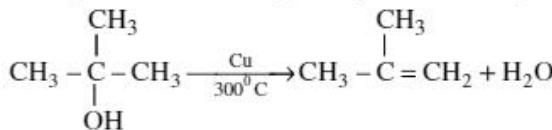
- ii) Dehydrogenation:** When passed over copper at  $300^{\circ}\text{C}$ , primary alcohols undergo catalytic dehydrogenation and give aldehydes:



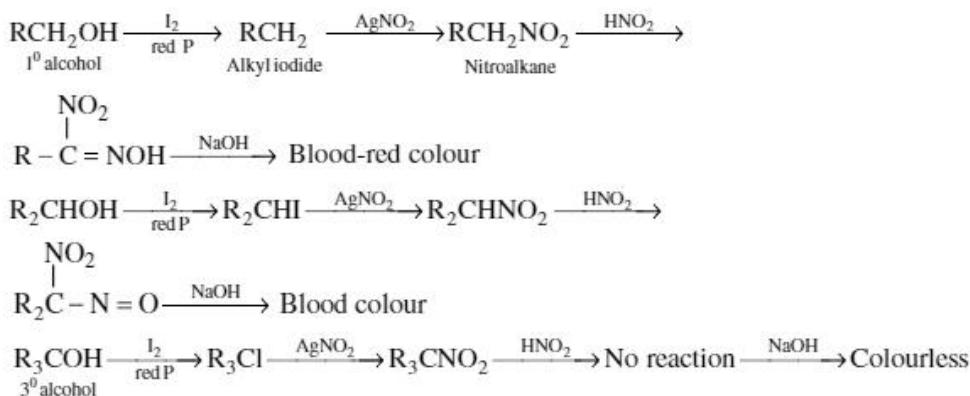
Vapours of secondary alcohols give ketones on catalytic dehydrogenation.



Tertiary alcohols undergo dehydration and give alkenes.



- iii) Victor Meyer Test :** The given alcohol is first treated with iodine and red phosphorus followed by treating with silver nitrite to produce nitroalkane. This nitroalkane is treated with nitrous acid and the mixture is then made alkaline with excess of aqueous sodium hydroxide. If the resulting solution develops a blood-red colour, the alcohol is primary; if it develops a blue colour, the alcohol is secondary and if no colour is developed, the alcohol is tertiary.



 LECTURE SHEET 

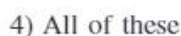
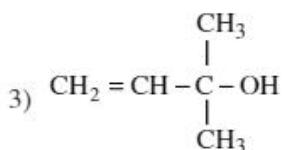
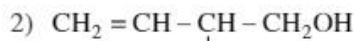
EXERCISE-I

#### **(Preparation)**

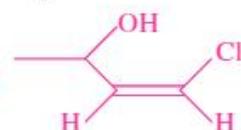
LEVEL-I (MAIN)

### **Straight Objective Type Questions**

1. Which of the following is an allyl alcohol?



- ## 2. IUPAC name of



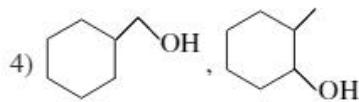
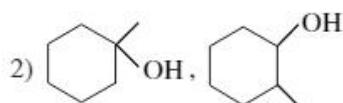
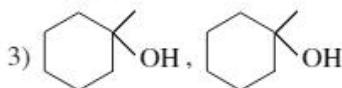
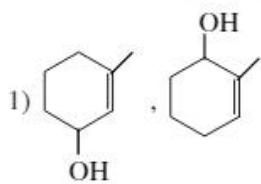
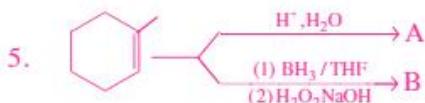
- 1) Z-2-chloro-4-hydroxy-2-butene      2) Z-4-chloro-2-butene-2-ol  
3) Z-4-chloro-3-butene-2-ol      4) Z-4-chloro-3-butene-2-ol

- ### 3. The common name of 2-methyl-1-propanol

- 1) 2-methyl-2-propanol                          2) Sec, butyl alcohol  
3) Isobutyl alcohol                                4) Tertiary butyl alcohol

4. Which of the following is correct regarding acid catalysed hydration of alkenes?

- 1) Addition takes place according to Markovnikof's rule
  - 2) The reaction is initiated by electrophilic addition of  $\text{H}^+$
  - 3) Nucleophilic attack of water on carbocation
  - 4) All the above



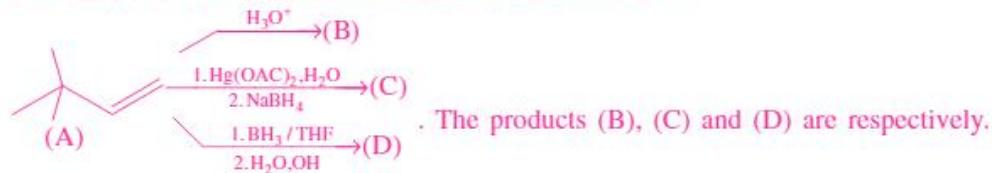
6. For a secondary alcohol to prepare which of the following combinations is most suitable

- 1)  $\text{HCOOC}_2\text{H}_5 + \text{excess RMgX}$       2)  $\text{RCOOR}' + \text{excess RMgX}$   
 3)  $\text{RCHO} + \text{excess RMgX}$       4) 1 & 3

7. In the conversion of starch to ethyl alcohol, the following enzymes are used in the order.
- 1) Invertase, Zymase, Emulsin
  - 2) Maltase, Zymase, Emulsin
  - 3) Diastase, Maltase, Zymase
  - 4) Invertase, Diastase, Zymase.
8. Which of the following alkenes give same product in HBO, Oxymercuration-demercuration and acid catalysed hydration?
- 1)
  - 2)
  - 3)
  - 4)
9. The reagent/s used to prepare alcohol from carbonyl compounds is/are
- 1) LiAlH<sub>4</sub>
  - 2) Na/C<sub>2</sub>H<sub>5</sub>OH
  - 3) NaBH<sub>4</sub>
  - 4) All
10. Consider the following sequence of reactions: A  $\xrightarrow{\text{C}_2\text{H}_5\text{Mgl}}$  X  $\xrightarrow{\text{H}^+/\text{H}_2\text{O}}$  tert-amylalcohol The compound A in the above sequence of reactions is:
- 1) 2-Butanone
  - 2) Acetaldehyde
  - 3) Acetone
  - 4) Propanal
11. A compound C<sub>6</sub>H<sub>14</sub>O contains a quaternary carbon and a secondary alcoholic group. The IUPAC name of the compound is
- 1) 2,2-dimethylbutan-3-ol
  - 2) 3,3-dimethylbutan-2-ol
  - 3) 2-hydroxy-3,3-dimethylbutane
  - 4) 3-hydroxy-2,2-dimethylbutane
12. Propan-1-ol can be prepared from propene by treating it with
- 1) H<sub>2</sub>O in presence of H<sub>2</sub>SO<sub>4</sub>
  - 2) Hg(OAc)<sub>2</sub> and water, and subsequently with NaBH<sub>4</sub>
  - 3) H<sub>2</sub>O in presence of HgSO<sub>4</sub> and H<sub>2</sub>SO<sub>4</sub>
  - 4) B<sub>2</sub>H<sub>6</sub> in THF and subsequently with H<sub>2</sub>O<sub>2</sub> and NaOH
13. Benzylamine reacts with nitrous acid to form mainly
- 1) phenol
  - 2) benzyl alcohol
  - 3) benzaldehyde
  - 4) nitrosobenzene
14. Ethyl acetate is treated with excess of methylmagnesium iodide in dry ether. The reaction mixture is then treated with water. The organic products obtained are

- 1)  $\text{CH}_3\text{CH}_2\overset{\text{OH}}{\underset{|}{\text{C}}}(\text{CH}_3)_2$  and CH<sub>3</sub>OH
- 2)  $(\text{CH}_3\text{CH}_2)_2\overset{\text{OH}}{\underset{|}{\text{C}}}\text{CH}_3$  and CH<sub>3</sub>OH
- 3) (CH<sub>3</sub>CH<sub>2</sub>)<sub>3</sub>COH and CH<sub>3</sub>CH<sub>2</sub>OH
- 4) (CH<sub>3</sub>)<sub>3</sub>COH and CH<sub>3</sub>CH<sub>2</sub>OH

15. The following reactions are carried out on the alkene (A).



. The products (B), (C) and (D) are respectively.

- 1) , and
- 2) , , and
- 3) , and
- 4) , all of them

16.  $\text{Ph}-\overset{\text{||}}{\text{C}}-\overset{18}{\text{O}}-\text{CH}_3 \xrightleftharpoons{\text{H}_3\text{O}^+} \text{O}^{18}$  is present in

- 1) Carboxylic acid
- 2) Alcohol
- 3) water
- 4) Cannot predict

Numerical Value Type Questions

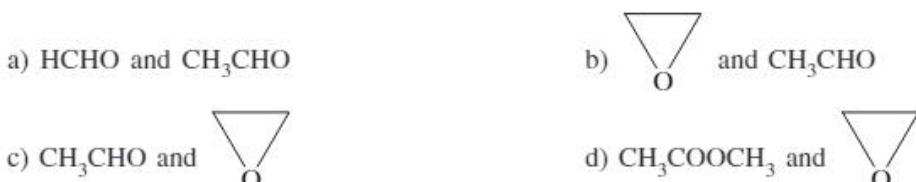
17. The numbers of primary and secondary alcohols (excluding stereoisomers) possible with the molecular formula  $C_5H_{12}O$  are respectively
18. For the complete reduction of 5.8g of acetone to isopropyl alcohol, the quantity of  $LiAlH_4$  required (assuming chemical yield to be 100%) is approximately [mass: Li = 6.9, Al = 27]

**LEVEL-II (ADVANCED)**Straight Objective Type Questions

1. In the reaction  $(CH_3)_2CH - CH = CH_2 \xrightarrow[H^+]{H_2O} A$ , A will be
- $(CH_3)_2CH - CH_2 - CH_2OH$
  - $(CH_3)_2CH - CH(OH) - CH_3$
  - $(CH_3)_2C(OH)CH_2CH_3$
  - $CH_3CH(OH)CH_2CH_2CH_3$
2. Which of the following alcohols has four stereoisomers?
- 3-Methyl-2-butanol
  - 4-Methyl-2-pentanol
  - 3-Methyl-2-pentanol
  - 3,3-Dimethyl-2-butanol
3. Which of the following carbonyl compounds on reaction with sodium borohydride will produce an alcohol as a racemic mixture?
- Pentanal
  - Cyclopentanone
  - Pentan-3-one
  - Pentan-2-one
4. Which of the following carbonyl compounds on reduction with  $LiAlH_4$  and subsequent acidification yields four stereoisomeric alcohols as two pairs of enantiomers (two racemic mixtures)?



5. For the preparation of 1-phenylethanol and 2-phenylethanol by Grignard reaction using phenylmagnesium bromide, the substrates that should be employed are respectively.

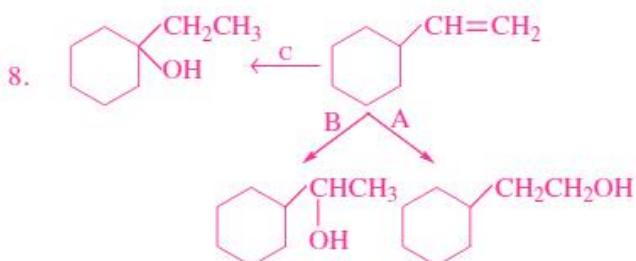


6. The following reaction is carried out.



7. The product of acid-catalysed hydration of 2-phenylpropene is

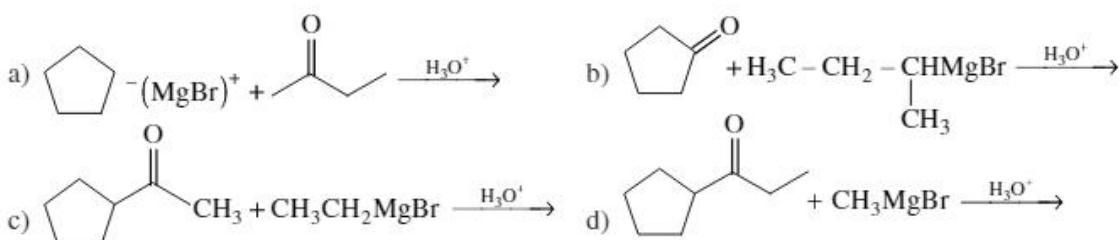
- ( $\pm$ ) -2-phenyl-1-propanol
- ( $\pm$ ) -1-phenyl-2-propanol
- 2-phenyl-2-propanol
- 3-phenyl-1-propanol

More than One correct answer Type Questions

Select schemes A, B, C out of

- I) Acid catalysed hydration II) HBO III) Oxymercuration-demercuration  
 a) I in all cases b) I, II, III c) II, III, I d) III, I, II

9. Which of the following Grignard's synthesis can result into 2-cyclopentyl-2-butanol?

Linked Comprehension Type QuestionsPassage :

A carbonyl compound [X] having molecular formula  $C_4H_8O$  on reaction with followed by hydrolysis gives a compound [Y]. The compound [Y] gives positive iodoform test. [Y] on reaction with sodium metal and iso-propyl iodide gives compound [Z].

10. The structure of compound [X] is



11. The compound [Y] is

- a) Pentan-1-ol b) Pentan-2-ol c) 2-Methylbutan-1-ol d) 2-Methylbutan-2-ol

12. Conversion of [Y] to [Z] is an example of

- a) Wurtz reaction b) Williamson synthesis c) Fitting reaction d) Ullmann reaction.

13. The structure of the compound [Z] is

Integer Type Questions

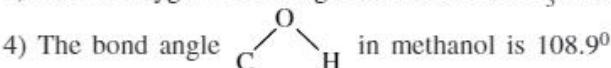
14. The minimum number of carbon atoms to be present in an alcohol to be optically active.  
 15. When 3-methyl-1-butene reacts with  $Hg(OAc)_2/THF - H_2O$  followed by reduction with  $NaBH_4$ , a compound 'X' is formed. How many stereoisomers are possible for 'X'?

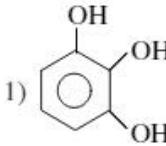
## EXERCISE-II

(Physical &amp; Chemical Properties)

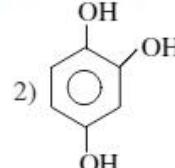
## LEVEL-I (MAIN)

*Straight Objective Type Questions*

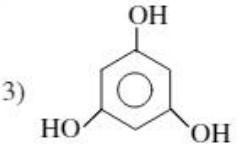
1. Which one of the following statements is not correct?
  - 1) Alcohols are weaker acids than water
  - 2) Acid strength of alcohols decreases in the following order  $\text{RCH}_2\text{OH} > \text{R}_2\text{CHOH} > \text{R}_3\text{COH}$
  - 3) Carbon-oxygen bond length in methanol,  $\text{CH}_3\text{OH}$  is shorter than that if C–O bond length in phenol.
  - 4) The bond angle  in methanol is  $108.9^\circ$
2. The alcohol which is least soluble in water is
  - 1) 1-Butanol
  - 2) Propanol
  - 3) Ethanol
  - 4) Methanol
3. Which of the following possess highest melting point?
 



1)



2)



3)

4) All possess same m.p
4. Which of the following alcohols is most reactive towards metallic sodium?
 

1)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$

2)  $\text{CH}_3-\underset{\text{OH}}{\overset{|}{\text{CH}}}-\text{CH}_3$

3)  $(\text{CH}_3)_3\text{COH}$

4)  $\text{CH}_3-\text{CH}_2-\underset{\text{OH}}{\overset{|}{\text{CH}}}-\text{CH}_3$
5. Which one of the following gases is liberated when ethyl alcohol is heated with methyl magnesium iodide?
  - 1) Methane
  - 2) Ethane
  - 3) Carbondioxide
  - 4) Propane
6. Which of the following alcohols is expected to have the lowest  $pK_a$  value?
  - 1) Ethanol
  - 2) 2-fluoro ethanol
  - 3) 2,2,2-Trifluoroethanol
  - 4) 2-Chloroethanol
7. The structural formula of alcohol that on dehydration would give 2-methylpropene as the major product is
 

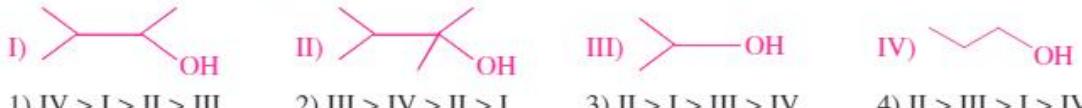
1)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$

2)  $(\text{CH}_3)_2\text{CH}-\text{CH}_2\text{OH}$

3)  $\text{CH}_3-\text{CHOH}-\text{CH}_2\text{CH}_3$

4)  $\text{CH}_3\text{CHOHCH}_3$
8. In the reaction,  $\text{C}_2\text{H}_5\text{OH} \xrightarrow[\text{(vapour)}]{\text{Al}_2\text{O}_3 \text{ at } 350^\circ\text{C}} \underline{\text{X}}$ . The molecular formula of  $\underline{\text{X}}$  is
  - 1)  $\text{C}_4\text{H}_6\text{O}$
  - 2)  $\text{C}_4\text{H}_{10}\text{O}$
  - 3)  $\text{C}_2\text{H}_4$
  - 4)  $\text{C}_2\text{H}_6$
9. Which of the following acids is reactive towards esterification with ethanol?
  - 1)  $\text{HCOOH}$
  - 2)  $\text{CHCl}_3$
  - 3)  $(\text{CH}_3)_2\text{CHCOOH}$
  - 4)  $(\text{CH}_3)_3\text{C.COOH}$
10. The correct order of relative acidic strength of phenol, ethyl alcohol and water is
  - 1) Phenol > Water > Ethyl alcohol
  - 2) Ethyl alcohol > Water > Phenol
  - 3) Ethyl alcohol > Phenol > Water
  - 4) Water > Phenol > Ethyl alcohol
11. Which of the following is most suitable method for removing the traces of water from ethanol
  - 1) Heating with Na metal
  - 2) Passing dry HCl through it
  - 3) Distilling it with  $\text{CaO}$
  - 4) Reacting with Mg

12. The order of reactivity of the following alcohols towards dehydration is



13.  $\text{C}_2\text{H}_5\text{OH} \xrightarrow{\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4} \text{A} \xrightarrow{\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4} \text{B}$ . A and B in the above reaction are

- 1) acetone and acetaldehyde      2) acetaldehyde and acetone  
3) acetic acid and acetaldehyde      4) acetaldehyde and acetic acid

14.  $\text{C}_2\text{H}_5\text{Cl} + \text{AgOH} \rightarrow \text{A} + \text{AgCl}$ ;  $\text{A} + \text{CH}_3\text{COCl} \rightarrow \text{C} + \text{HCl}$ . Here "C" is

- 1) Ethyl acetate      2) Methyl acetate      3) Butanone      4) Propanone

15. Hydrolysis of an ester gives acid "A" and alcohol "B", "A" reduces Fehling's solution and oxidation of B gives A. The ester is

- 1) Methyl formate      2) Ethyl formate      3) Methyl acetate      4) Ethyl acetate

16. In which of the following reactions, chlorine acts as an oxidizing agent?

- I)  $\text{CH}_3\text{CH}_2\text{OH} + \text{Cl}_2 \rightarrow \text{CH}_3\text{CHO} + 2\text{HCl}$       II)  $\text{CH}_3\text{CHO} + \text{Cl}_2 \rightarrow \text{CCl}_3\text{CHO} + \text{HCl}$   
III)  $\text{CH}_4 + \text{Cl}_2 \xrightarrow{\text{hv}} \text{CH}_3\text{Cl} + \text{HCl}$

The correct answer is

- 1) only I      2) only II      3) I and II      4) I,II and III

17. Haloform reaction is not given by

- 1)  $\text{CH}_3\text{COCH}_3$       2)  $\text{CH}_3\text{COC}_2\text{H}_5$       3)  $\text{C}_6\text{H}_5\text{COC}_2\text{H}_5$       4)  $\text{CH}_3\text{CHOHCH}_3$

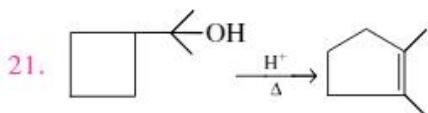
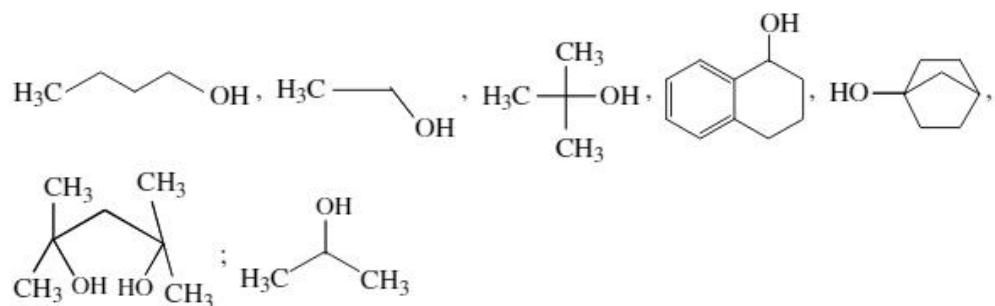
18. Which of the following compound gives ethyl methyl ketone on oxidation

- 1) Propan-2-ol      2) Butan-1-ol      3) Butan-2-ol      4) 2-Methyl butan-2-ol

#### Numerical Value Type Questions

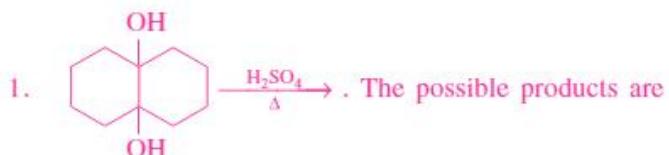
19. If the boiling point of ethanol(molecular weight = 46) is  $78^\circ\text{C}$ , what is the boiling point of diethyl ether (molecular weight = 78)

20. How many of the following will not answer Lucas test at room temperature?

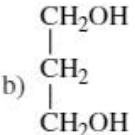


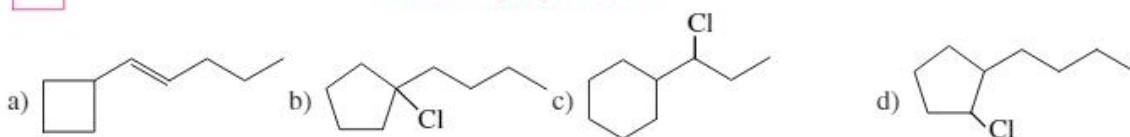
How many carbocations are involved in the above formation of product

## LEVEL-II (ADVANCED)

Straight Objective Type Questions

2. Which of the following is more volatile?

- a)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2\text{OH}$       b) 
- c) Glycerol      d)  $\text{CH}_3\text{OH}$
3.  $\text{R} - \text{OH} + \text{HX} \rightarrow \text{R} - \text{X} + \text{H}_2\text{O}$  in this reaction the reactivity of alcohols is  
 a) Tertiary > Secondary > Primary      b) Tertiary = Secondary = Primary  
 c) Tertiary > Primary > Secondary      d) Secondary > Primary > Tertiary
4.  $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow[\text{Step-1}]{\text{Cl}_2} \text{CH}_3\text{CHO} \xrightarrow[\text{Step-2}]{3\text{Cl}_2} \text{Cl}_3\text{CCHO}$ . In the above reaction the role of  $\text{Cl}_2$  in step-1 step-2 respectively is :  
 a) Oxidation, chlorination      b) Reduction, Chlorination  
 c) Oxidation, addition      d) Reduction, substitution
5. The increasing order of B.P of the following compounds is  
 I)  $\text{CH}_3\text{CH}_2\text{OH}$       II)  $\text{CH}_3\text{CH}_2\text{Cl}$       III)  $\text{CH}_3\text{CH}_3$   
 a) II < I < III      b) I < II < III      c) III < II < I      d) II < III < I

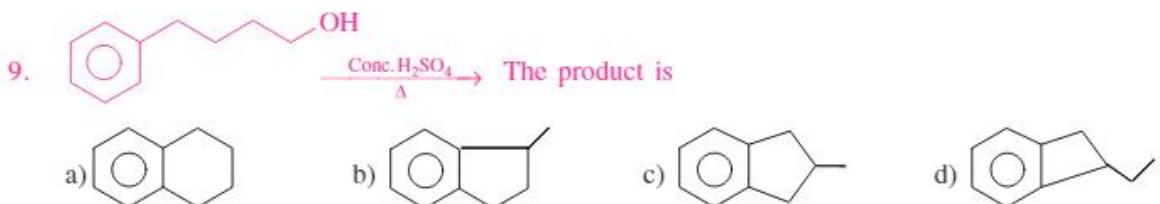


7. A chiral  $\text{C}_5\text{H}_{10}\text{O}$  alcohol is reduced by catalytic hydrogenation to an achiral  $\text{C}_5\text{H}_{12}\text{O}$  alcohol. The original alcohol is oxidized by activated  $\text{MnO}_2$  to an achiral carbonyl compound ( $\text{C}_5\text{H}_8\text{O}$ ). Which of the following might be the chiral alcohol?  
 a) penten-3-1-ol      b) 4-penten-2-ol  
 c) 3-methyl-2-buten-1-ol      d) 2-methyl-2-butane-1-ol

More than One correct answer Type Questions

8. Which reaction proceed in the forward direction

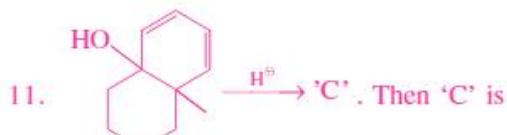
- a)  $\text{CH} \equiv \text{CNa} + \text{ROH} \rightarrow \text{CH} \equiv \text{CH} + \text{RONa}$   
 b)  $\text{NaNH}_2 + \text{ROH} \rightarrow \text{NH}_3 + \text{RONa}$   
 c)  $\text{NaOH} + \text{ROH} \rightarrow \text{H}_2\text{O} + \text{RONa}$   
 d)  $\text{C}_6\text{H}_5\text{OH} + \text{NaHCO}_3 \rightarrow \text{C}_6\text{H}_5\text{ONa} + \text{H}_2\text{O} + \text{CO}_2$

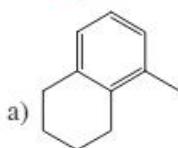
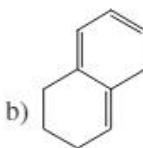
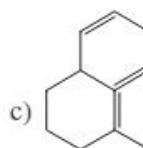
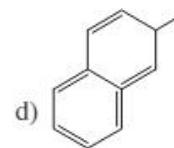
Linked Comprehension Type QuestionsPassage :

Alcohols are protonated to give carbocation intermediate and if possible rearrange to relatively stable carbocations. These rearrangements include hydride, methanide 1,2 & 1,4-shift & ring expansions.



- a) 2-methyl cyclobutanone  
 b) 3-methyl cyclobutanone  
 c) methyl cyclopropane  
 d) methyl cyclobutane



- a)   
 b)   
 c)   
 d) 

Matrix Matching Type Questions12. **Column-I**

- A) Ethanol  
 B) Acetone  
 C) Ethyl Chloride  
 D)  $\text{CH}_3 - \text{CH} = \text{CH}_2$

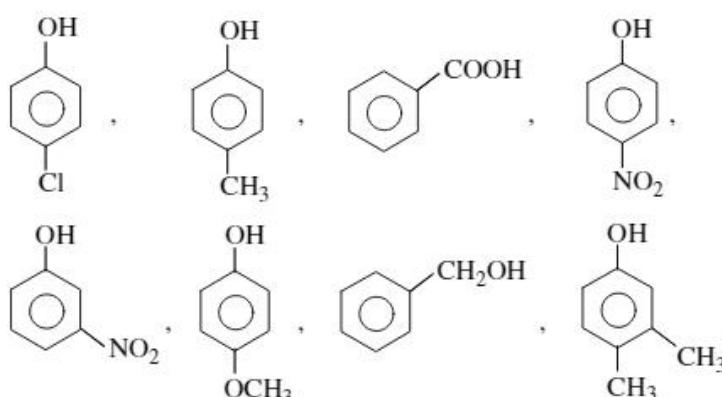
**Column-II**

- p) Reacts with bleaching powder to give  $\text{CHCl}_3$   
 q) Reduction with HI and red P give alkane  
 r) Undergo elimination with alc. KOH  
 s) Reacts with  $\text{Cl}_2/\text{hv}$

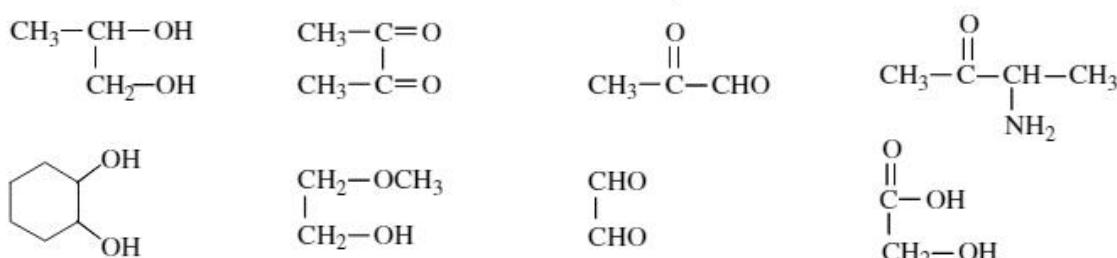
Integer Type Questions

13. Compound(A) gives positive Lucas test in 5 minutes. When 6.0 g of (A) is treated with sodium metal, 1120ml of hydrogen is evolved at STP. The molecular weight of 'A' is  $10 \times x$ . What is 'x'?

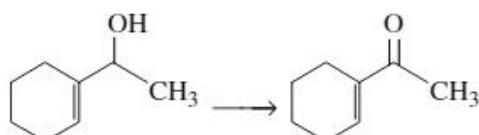
14. Isopropyl alcohol on treatment with excess of conc.  $H_2SO_4$  gives 'X' which on treatment with HBr gives 'Y' when 'Y' is dissolved in ether and treated sodium gives Z. How many carbon atoms are present 'Z'?
15.  $XC_2H_5OH + 4CrO_3 + 6H_2SO_4 \rightarrow XCH_3COOH + 9H_2O + 2Cr_2(SO_4)_3$ . The coefficient (X) in the above equation is....
16. Among  $CH_3Cl$ ,  $C_2H_2$ ,  $CH_3CH_2OH$ ,  $C_6H_5OH$ ,  $CH_3NH_2$  and  $CH_3COCl$ , the number of compounds which can react with Grignard reagent is/are
17. Which of the following are more acidic than phenol



18. A polyhydric alcohol of molecular weight 92 on benzylation gives a benzoyl derivative of molecular weight 404. The number of hydroxyl groups in alcohol are.
19. How many among compounds are not oxidized by  $HIO_4$ .



20. The number of reagents among the following which effect the given conversion is



PCC, PDC,  $K_2Cr_2O_7/Conc.H_2SO_4$ ,  $Br_2/NaOH$  Alk.KMnO<sub>4</sub>

21. An unknown compound (A) having molecular formula  $C_6H_{12}O_6$  on acetylation gives acylated product whose molecular weight is 390. How many number of hydroxyl groups present in A?
22. 0.092g of a compound with molecular formula  $C_3H_8O_3$  on reaction with an excess of  $CH_3MgI$  gives 67.00 ml methane at STP. The number of active hydrogen atoms present in a molecule of compound is

## KEY SHEET (LECTURE SHEET)

## EXERCISE-I

## LEVEL-I

- 1) 4      2) 4      3) 3      4) 4      5) 2      6) 4      7) 3      8) 3  
 9) 4      10) 3      11) 2      12) 4      13) 2      14) 4      15) 1      16) 2  
 17) 3 and 2      18) 2

## LEVEL-II

- 1) c      2) c      3) d      4) b      5) c      6) b      7) c      8) ad  
 9) acd      10) d      11) b      12) b      13) d      14) 4      15) 2

## EXERCISE-II

## LEVEL-I

- 1) 3      2) 1      3) 3      4) 1      5) 1      6) 3      7) 2      8) 3  
 9) 1      10) 1      11) 3      12) 3      13) 4      14) 1      15) 1      16) 4  
 17) 3      18) 3      19)  $34^{\circ}\text{C}$  20) 3      21) 3

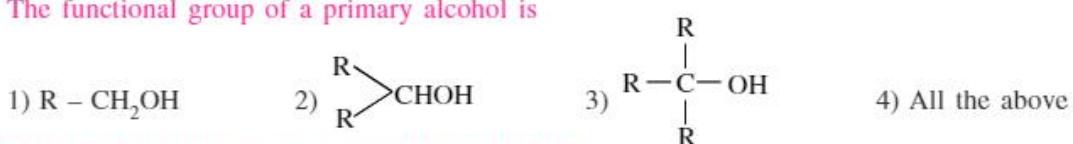
## LEVEL-II

- 1) a      2) d      3) a      4) a      5) c      6) b      7) a      8) ab  
 9) ab      10) a      11) a      12) A-pq; B-pq; C-qr; D-qs      13) 6  
 14) 6      15) 3      16) 6      17) 4      18) 3      19) 6      20) 3      21) 5  
 22) 3

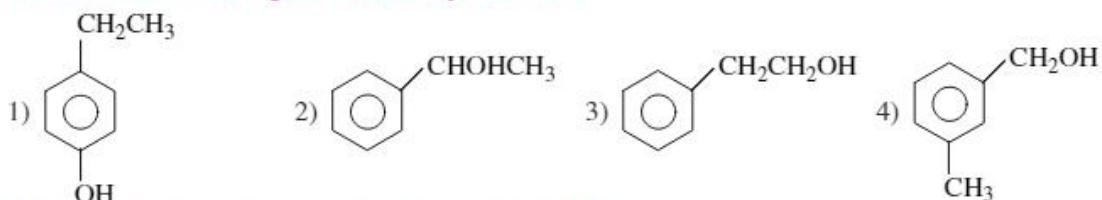
## PRACTICE SHEET

EXERCISE-I  
(Preparation)  
LEVEL-I (MAIN)Straight Objective Type Questions

1. The functional group of a primary alcohol is



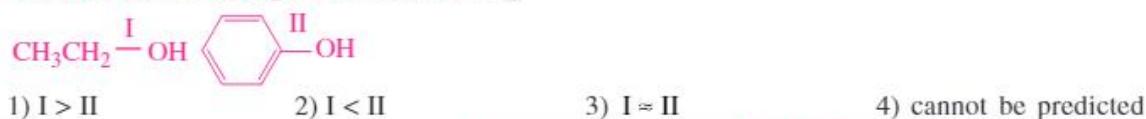
2. Which of the following is a secondary alcohol ?



3. The hybridization of oxygen atom in an alcohol is

- 1)  $\text{sp}^3$       2)  $\text{sp}^2$       3)  $\text{sp}$       4) unhybridised

4. Consider the bond lengths of the following



5. Which of the following is the isomer of 1-Butanol  
 1) 1-Methoxypropane 2) Ethoxyethane 3) 2-Methyl-2-propanol 4) All
6. IUPAC name of carbinol is  
 1) Ethanol 2) Methyl alcohol 3) Methanol 4) 2-Propanol
7. Hydroboration means  
 1) Addition of HBr to an alkene 2) Addition of  $\text{BH}_3$  to an alkene  
 3) Addition of  $\text{Br}_2$  to an alkene 4) All the above
8. Acid catalysed hydration of which of the alkenes takes place at a fastest rate.
- 1)  $\text{CH}_2 = \text{CH}_2$  2)  $\text{CH}_3 - \text{CH} = \text{CH}_2$  3)  $\text{CH}_3 - \overset{\text{CH}_3}{\underset{|}{\text{C}}} = \text{CH}_2$  4) cannot be predicated
9. Which of the following alkenes when passed through conc.  $\text{H}_2\text{SO}_4$  followed by hydrolysis with boiling water would give tert-butyl alcohol?  
 1) Ethylene 2) Isobutylene 3) Propylene 4) 1-Butene.
10. To prepare 2-propanol from methylmagnesium bromide, the chemical required is  
 1)  $\text{HCHO}$  2)  $\text{CH}_3\text{CHO}$  3)  $\text{C}_2\text{H}_5\text{OH}$  4)  $\text{CH}_3\text{COCH}_3$
11.  $\text{C}_2\text{H}_5\text{Cl} \xrightarrow{\text{A}} \text{C}_2\text{H}_5\text{OH} \xleftarrow{\text{B}} \text{C}_2\text{H}_5\text{Cl}$   
 1) A = aqueous KOH, B =  $\text{AgOH}$  or moisture  $\text{Ag}_2\text{O}$   
 2) A = alcoholic KOH, B = aqueous NaOH  
 3) A = aqueous NaOH, B =  $\text{AgNO}_2$   
 4) A =  $\text{AgNO}_2$ ; B =  $\text{KNO}_2$
12. Basic hydrolysis of ethyl acetate gives acetate ion and....  
 1) Ethyl alcohol 2) Ethoxide ion 3) Acetaldehyde 4) Acetone
13.  $\text{X} \xrightarrow[\text{AlCl}_3]{\text{HCl}} \text{Y} \xrightarrow{\text{KOH(aq)}} \text{C}_2\text{H}_5\text{OH}$ . In the above reaction 'X' is  
 1)  $\text{C}_2\text{H}_5\text{Cl}$  2)  $\text{C}_2\text{H}_2$  3)  $\text{C}_2\text{H}_4$  4)  $\text{C}_2\text{H}_5\text{Br}$
14.  $\text{CH}_2 = \text{CH}_2 + \text{H}_2\text{SO}_4 \xrightarrow[75-80^\circ\text{C}]{\text{H}_2\text{O}} \text{A} \xrightarrow{\text{warm}} \text{B}$ . Here A and B in the reaction are  
 1)  $\text{C}_2\text{H}_5\text{OH}; \text{C}_2\text{H}_5\text{HSO}_4$  2)  $(\text{C}_2\text{H}_5)_2\text{SO}_4; \text{C}_2\text{H}_5\text{OH}$   
 3)  $\text{C}_2\text{H}_5\text{HSO}_4; \text{C}_2\text{H}_5\text{OH}$  4)  $\text{C}_2\text{H}_5\text{OH}; (\text{C}_2\text{H}_5)_2\text{SO}_4$
15. In the reaction  $(\text{CH}_3)_2\text{CH} - \text{CH}_2\text{Cl} \xrightarrow{\text{aq.KOH}} \text{A}$  (Major); A will be  
 1)  $(\text{CH}_3)_2\text{CH} - \text{CH}_2\text{OH}$  2)  $(\text{CH}_3)_3\text{C(OH)}$   
 3)  $\text{CH}_3 - \text{CH}(\text{OH}) - \text{CH}_2\text{CH}_3$  4)  $(\text{CH}_3)_2\text{C} = \text{CH}_2$

**Numerical Value Type Questions**

16. Glycerol does not contain... alcoholic group
17. The total number of alcohols (including stereoisomers) of molecular formula  $\text{C}_4\text{H}_{10}\text{O}$  is
18. How many isomeric alcohols having molecular formula  $\text{C}_5\text{H}_{11}\text{OH}$  would give positive iodoform test?

## LEVEL-II (ADVANCED)

Straight Objective Type Questions

1. The following conversion  $\text{CH}_3\text{CH}=\text{CHCOOH} \rightarrow \text{CH}_3\text{CH}=\text{CHCH}_2\text{OH}$ . Can be accomplished by  
 a)  $\text{NaBH}_4$       b)  $(\text{Me}_2\text{CHO})_3\text{Al}, \text{Me}_2\text{CHOH}$       c)  $\text{H}_2, \text{Ni}$       d)  $\text{LiAlH}_4$
2.  $\text{LiH} + \text{BCl}_3 \xrightarrow[\text{dry ether}]{} \text{P}, \xrightarrow{\text{CH}_3-\text{CH}=\text{CH}_2} \text{Q}, \xrightarrow{\text{OH} / \text{H}_2\text{O}_2} \text{R}, \text{R}'$   
 a)  $\text{B}(\text{CH}_2\text{CH}_2\text{CH}_3)_3$       b)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$   
 c)  $\text{CH}_3\text{CHOHCH}_3$       d)  $\text{CH}_2\text{OH}-\text{CHOHCH}_2\text{OH}$
3. A chiral  $\text{C}_5\text{H}_{10}\text{O}$  alcohol is reduced by catalytic hydrogenation to an achiral  $\text{C}_5\text{H}_{12}\text{O}$  alcohol. The original alcohol is oxidized by activated  $\text{MnO}_2$  to an achiral carbonyl compound ( $\text{C}_5\text{H}_8\text{O}$ ). Which of the following might be the alcohol?  
 a) 1-penten-3-ol      b) 4-penten-2-ol  
 c) 3-methyl-2-buten-1-ol      d) 2-methyl-2-buten-1-ol

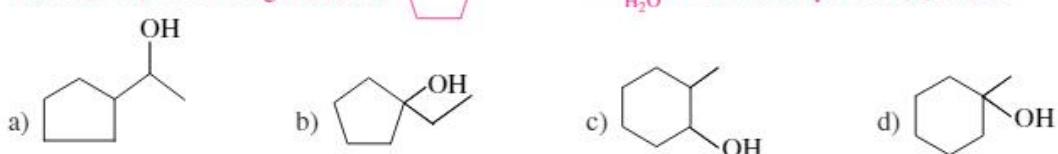
More than One correct answer Type Questions

4. In the following reaction,  $\text{CH}_3-\overset{\text{CH}_3}{\underset{\text{C}_6\text{H}_5}{\underset{|}{\text{C}}}}-\text{CH}=\text{CH}_2 + \text{H}_2\text{SO}_4 \text{ (dil.)} \xrightarrow{\text{Boil}}$  The alcohol(S) formed in significant yield is/are
- a)  $\text{CH}_3-\overset{\text{CH}_3}{\underset{\text{C}_6\text{H}_5}{\underset{|}{\text{C}}}}-\text{CH}-\text{CH}_3$       b)  $\text{C}_6\text{H}_5-\overset{\text{OH}}{\underset{\text{CH}_3}{\underset{|}{\text{C}}}}-\text{CH}-\text{CH}_3$   
 c)  $\text{CH}_3-\overset{\text{OH}}{\underset{\text{CH}_3}{\underset{|}{\text{C}}}}-\text{CH}-\text{C}_6\text{H}_5$       d)  $\text{CH}_3-\overset{\text{OH}}{\underset{\text{H}}{\underset{|}{\text{C}}}}-\text{CH}-\overset{\text{CH}_3}{\underset{\text{CH}_3}{\underset{|}{\text{C}}}}-\text{C}_6\text{H}_5$
5. In the reaction given below,  $\text{CH}_3-\text{CH}_2-\overset{\text{O}}{\underset{\parallel}{\text{C}}}-\text{CH}_3 + \text{LiAlD}_4 \rightarrow \xrightarrow{\text{H}_3\text{O}^+}$

The correct statement regarding the outcome of the above reaction is/are

- a) a pure enantiomer of alcohol is formed  
 b) racemic mixture of alcohol is formed  
 c) product alcohol has deuterium attached to oxygen  
 d) product alcohol has deuterium attached to  $\alpha$ -carbon

6. Consider the following reaction,



7. The reagent/s used to prepare alcohol from carbonyl compounds is/are

- a)  $\text{LiAlH}_4$       b)  $\text{Na}/\text{C}_2\text{H}_5\text{OH}$       c)  $\text{NaBH}_4$       d)  $\text{CH}_3\text{MgBr}$

8. The combination/s used in the preparation of primary alcohols is/are  
 a)  $\text{CH}_3\text{CHO}, \text{Na}/\text{C}_2\text{H}_5\text{OH}$       b)  $\text{HCHO}, \text{CH}_3\text{MgBr}, \text{H}_2\text{O}/\text{H}^+$   
 c)  $\text{HCOOC}_2\text{H}_5, \text{LiAlH}_4$       d)  $\text{CH}_3\text{COOC}_2\text{H}_5, \text{CH}_3\text{MgBr}, \text{H}_2\text{O}/\text{H}^+$
9. Tertiary alcohol cannot be prepared by using.  
 a)  $\text{CH}_3\text{CH}_2\text{Cl}, \text{aq KOH}$       b)  $\text{HCOOC}_2\text{H}_5, \text{Na}/\text{C}_2\text{H}_5\text{OH}$   
 c)  $(\text{CH}_3)_2\text{C} = \text{CH}_2, \text{H}_2\text{O}/\text{H}^+$       d)  $(\text{CH}_3)_2\text{C} = \text{CH}_2, \text{BH}_3/\text{THF}, \text{H}_2\text{O}_2/\text{OH}^-$
10. Which of the following give tertiary alcohol on reaction with two equivalents of Grignard reagent followed by hydrolysis?  
 a)  $\text{RCOCl}$       b)  $(\text{RCO})_2\text{O}$       c)  $\text{RCOOR}'$       d)  $\text{RCO NH}_2$

Linked Comprehension Type QuestionsPassage :*For the molecular formula  $\text{C}_5\text{H}_{11}\text{OH}$  weight isomeric alcohols are possible.*

11. Which of these alcohols can be prepared by reaction of Grignard reagent with a ketone, followed by hydrolysis?  
 a) 2-Methyl-1-butanol    b) 2-Methyl-2-butanol    c) 3-Methyl-2-butanol    d) 3-Methyl-1-butanol
12. The alcohol which has lowest value of  $pK_a$  is  
 a) Pentan-2-ol      b) 2-Methylbutan-1-ol      c) Pentan-1-ol      d) 2-Methylbutan-2-ol

Matrix Matching Type Questions

- | 13. Column-I   | Column-II                                       |
|--|---|
| A) $\text{LiAlH}_4$ , ether followed by $\text{H}_2\text{O}$                 | p) Alcohols are converted into alkanes          |
| B) $\text{HI} & \text{Red P}$  | q) Hydration of alkenes                         |
| C) (i) $\text{BH}_3, \text{THF}$ $\text{H}_2\text{O}_2$ ; (ii) $\text{NaOH}$ | r) Reduction of aldehydes & ketones to alcohols |
| D) (i) $\text{NaBH}_4$ ; (ii) hydrolysis                                     | s) Reduction of esters to alcohols              |

Integer Type Questions

14. How many structurally isomeric alcohols are possible for  $\text{C}_5\text{H}_{12}\text{O}$ ?

**EXERCISE-II**  
*(Physical & Chemical Properties)*
**LEVEL-I (MAIN)**Straight Objective Type Questions

- Which of the following alcohols possess lowest boiling point?  
 1) 1-Butanol      2) 2-Butanol  
 3) 2-Methyl-1-propanol      4) 2-Methyl-2-propanol
- Which of the following react with  $\text{NaOH}$  solution to form salt?  
 1)  $\text{C}_3\text{H}_7\text{OH}$       2)  $\text{C}_6\text{H}_5\text{OH}$       3)  $\text{CH}_3\text{CH}_2\text{OH}$       4) all the above
- When equal weights of methyl alcohol and ethyl alcohol react with excess of sodium metal the volume of  $\text{H}_2$  liberated is more in the case of  
 1)  $\text{C}_2\text{H}_5\text{OH}$       2)  $\text{CH}_3\text{OH}$       3) Equal in both      4)  $\text{H}_2$  do not liberate

4. Which of the following alcohols is the strongest acid?  
 1)  $\text{CH}_3\text{OH}$       2)  $\text{CH}_3\text{CH}_2\text{OH}$       3)  $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$       4)  $(\text{CH}_3)_3\text{COH}$
5. When 2-butanol is heated with an excess of concentrated sulphuric acid, the main product is  
 1) 1-Butene      2) 2-Butene      3) 2-Methyl propene      4) 2-Methyl-2-butene
6.  $\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \xrightarrow[\text{heat}]{\text{Conc. H}_2\text{SO}_4} \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$ . The above reaction is known as  
 1) Hydrolysis      2) Esterification      3) Soaponification      4) Dehydration
7. A mixture of anhydrous  $\text{ZnCl}_2$  + conc.  $\text{HCl}$  is known as  
 1) Fehling's reagent      2) Lucas reagent      3) Tollen's reagent      4) Benedict's reagent
8. Which is formed when ethanol reacts with acetic acid?  
 1)  $\text{CH}_3\text{COOC}_2\text{H}_5$       2)  $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$       3)  $\text{CH}_3\text{OCH}_3$       4)  $\text{CH}_3\text{CH}_2\text{CHO}$
9.  $\text{C}_2\text{H}_5\text{OH} + \text{SOCl}_2 \xrightarrow{\text{Pyridine}} \text{X} + \text{Y} + \text{Z}$ . In this reaction X, Y and Z respectively are  
 1)  $\text{C}_2\text{H}_4\text{Cl}_2$ ,  $\text{SO}_2$ ,  $\text{HCl}$       2)  $\text{C}_2\text{H}_5\text{Cl}$ ,  $\text{SO}_2$ ,  $\text{HCl}$       3)  $\text{C}_2\text{H}_4\text{Cl}$ ,  $\text{SOCl}_2$ ,  $\text{HCl}$       4)  $\text{C}_2\text{H}_4$ ,  $\text{SO}_2$ ,  $\text{Cl}_2$
10. The compound that reacts with  $\text{CH}_3\text{MgBr}$  to yield methane as one of the products is  
 1)  $\text{CH}_3\text{CHO}$       2)  $\text{CH}_3\text{COCH}_3$       3)  $\text{CH}_3\text{COOCH}_3$       4)  $\text{CH}_3\text{CH}_2\text{OH}$
11. The correct order of reactivity of hydrogen halides with ethyl alcohol is  
 1)  $\text{HF} > \text{HCl} > \text{HBr} > \text{HI}$       2)  $\text{HCl} > \text{HBr} > \text{HF} > \text{HI}$   
 3)  $\text{HBr} > \text{HCl} > \text{HI} > \text{HF}$       4)  $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$
12. Which of the following compounds will react with sodium hydroxide?  
 1)  $\text{CH}_3\text{OH}$       2) 1 & 3      3)  $\text{C}_6\text{H}_5\text{OH}$       4)  $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$
13. Which of the following is the strongest Lewis base?  
 1)  $\text{H}_2\text{O}$       2)  $\text{CH}_3\text{OH}$       3)  $\text{CH}_3\text{OCH}_3$       4)  $\text{C}_6\text{H}_5\text{OH}$
14. Which is a more volatile liquid?  
 1)  $\text{C}_2\text{H}_5\text{OH}$       2)  $\text{CH}_3\text{COOH}$       3)  $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$       4)  $\text{C}_6\text{H}_6$
15. What is the product formed when Ethyl alcohol is treated with PCC?  
 1) Acetic acid      2) Acetaldehyde      3) Ethyl acetate      4) Dimethyl ether
16. What is the final product obtained when chlorine reacts with ethyl alcohol in KOH?  
 1)  $\text{CHCl}_3$       2)  $\text{CCl}_3\text{CHO}$       3)  $\text{CH}_3\text{Cl}$       4) None
17. In the following reaction X and Y respectively are  
 1)  $\text{CH}_3\text{OH}; \text{C}_2\text{H}_5\text{OH}$       2)  $\text{CH}_3\text{CHO}; \text{CH}_3\text{OH}$   
 3)  $\text{CH}_2 = \text{CH}_2; \text{CH}_3\text{COOH}$       4)  $\text{CH}_3\text{COOH}; \text{C}_2\text{H}_5\text{OH}$
18. In  $\text{CH}_3\text{CH}_2\text{OH}$ , the bond that undergoes heterolytic change most readily in reaction with 'Na' is  
 1) C – C      2) O – H      3) C – H      4) C – O
19. Which of the following metals is most reactive with alcohol?  
 1) Al      2) Zn      3) Hg      4) Fe
20. The order of reactivity of methyl alcohol (I), isopropyl alcohol (II) tertiary butyl alcohol (III) and ethyl alcohol (IV) for esterification in decreasing order will be:  
 1) I > II > III > IV      2) IV > III > II > I      3) I > IV > II > III      4) I > IV > III > II

21. Lucas reagent is used for distinguishing  $1^0$ ,  $2^0$ ,  $3^0$  alcohol. The reagent is  
 1)  $\text{H}_2\text{O}_2$ ,  $\text{FeCl}_2$       2)  $\text{ZnCl}_2$ , Conc.  $\text{H}_2\text{SO}_4$     3)  $\text{AlCl}_3$ ,  $\text{HCl}$       4)  $\text{ZnCl}_2$ , Conc.  $\text{HCl}$
22. In the Victor-Meyer's test, the colour given by  $1^0$ ,  $2^0$  and  $3^0$  alcohols are respectively  
 1) Red, Colourless, blue    2) Red, blue, colourless    3) Colourless, red, blue    4) Red, blue, violet
23. Which of the following alcohols give immediate turbidity with Lucas reagent?  
 1) 2-Methyl-1-propanol      2) 3-Methyl-2-butanol  
 3) 2-Methyl-2-butanol      4) 2-Methyl-1-butanol

**Numerical Value Type Questions**

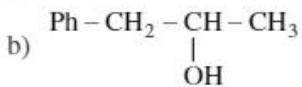
24. How many cyclic isomers including stereo isomers exist, with the formula  $\text{C}_3\text{H}_6\text{O}$ ?  
 25. The minimum number of carbon atoms that an aliphatic alcohol should have to be optically active is

**LEVEL-II (ADVANCED)****Straight Objective Type Questions**

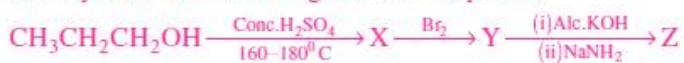
1. Among the isomeric compounds given below, which possess lowest B.P  
 a) 1-Pentanol      b) Methyl butyl ether      c) 2-Pentanol      d) Isopentyl alcohol
2. 3 moles of ethanol reacts with one mole of phosphorous tribromide to form 3 moles of bromo ethane and one mole of X. Which of the following is "X"?  
 a)  $\text{H}_3\text{PO}_4$       b)  $\text{H}_3\text{PO}_2$       c)  $\text{HPO}_3$       d)  $\text{H}_3\text{PO}_3$
3. What are X and Y respectively in the following reaction  $\text{X} \xrightarrow{\text{PBr}_3} \text{C}_2\text{H}_5\text{Br} \xrightarrow{\text{AgOH(Ag)}} \text{Y}$ ?  
 a)  $\text{CH}_3\text{OH}; \text{C}_2\text{H}_6$       b)  $\text{C}_2\text{H}_5\text{OH}; \text{C}_2\text{H}_5\text{Br}$   
 c)  $\text{CH}_3\text{COOH}; \text{CH}_3\text{CH}_2\text{OH}$       d)  $\text{C}_2\text{H}_5\text{OH}; \text{C}_2\text{H}_5\text{OH}$
4.  $(\text{CH}_3)_2\text{CHOH} \xrightarrow{\text{mild oxidation}} \text{X} \xrightarrow[\text{(ii)}]{\text{H}_2\text{O}} \text{Y}$ . Here 'Y' is  
 a) Iso butyl alcohol      b) Iso butylenes      c) Sebutyl alcohol      d) Tert butyl alcohol
5. The order of boiling point of the following alcohols is  
 (I)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$  (II)  $(\text{CH}_3)_2-\text{CH}_2\text{CH}_2\text{OH}$  (III)  $(\text{CH}_3)_3-\text{COH}$   
 a) III > II > I      b) III > I > II      c) II > I > III      d) I > II > III
6. Alcohols can be distinguished from Ethers by  
 a) Sodium metal      b) Sodium hydroxide      c) Sodium bicarbonate      d) All the above
7. Alcohols react with acids to give esters which bond in alcohol is broken  
 a) C – O      b) O – H      c) C – H      d) Any of the above
8. Which of the following alcohols is most suitable to destroy a piece of sodium metal from the point of view of safety  
 a)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$       b)  $\text{CH}_3-\underset{\text{OH}}{\underset{|}{\text{CH}}}-\text{CH}_3$       c)  $(\text{CH}_3)_3\text{COH}$       d) any of the above
9.  $\text{HO}-\text{CH}_2-\text{CH}_2-\text{OH} \xrightarrow{\text{NaBr}} \text{X}$ . This reaction fails because  
 a) –OH group is not good leaving group      b)  $\text{Br}^-$  is not a good nucleophile  
 c) both a & b      d) neither 'a' nor 'b'

10.  $\text{Ph}-\text{CH}_2-\text{CH}=\text{CH}_2 \xrightarrow{\text{dil. H}_2\text{SO}_4} \text{A}$ , Then "A" is

- a)  $\text{Ph}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{OH}$
- b)  $\text{Ph}-\text{CH}-\text{CH}_2-\text{CH}_3$
- c)  $\text{Ph}-\overset{|}{\underset{\text{OH}}{\text{CH}}}-\text{CH}_2-\text{CH}_3$
- d)  $\text{Ph}-\text{CH}_2-\text{OH}$



11. Identify Z in the following reaction sequence:



- a)  $\text{CH}_3-\text{CH}(\text{NH}_2)-\text{CH}_2\text{NH}_2$
- b)  $\text{CH}_3-\text{CHOH}-\text{CH}_2\text{OH}$
- c)  $\text{CH}_3-\text{C}(\text{OH})=\text{CH}_2$
- d)  $\text{CH}_3-\text{C}\equiv\text{CH}$

12. An unknown alcohol when subjected to Lucas test forms turbidity after 10 min. If this alcohol is subjected to Victor Mayer's test, it would give

- a) Red coloration
- b) Blue coloration
- c) Yellow coloration
- d) No coloration

13. 1-propanol and 2-propanol can be distinguished by

- a) Oxidation with  $\text{KMnO}_4$  followed by reaction with Fehling solution
- b) Oxidation with acidic dichromate followed by reaction with Fehling solution
- c) Oxidation by heating with copper followed by reaction with Fehling solution
- d) Oxidation with concentrated  $\text{H}_2\text{SO}_4$  followed by reaction with Fehling solution

#### More than One correct answer Type Questions

14.   $\xrightarrow{\text{Conc. H}_2\text{SO}_4}$  The possible products are



15. Reagent that convert propan-2-ol to 2-chloropropane is/are

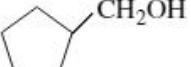
- a)  $\text{Cl}_2$
- b)  $\text{NaCl(aq)}$
- c) con. $\text{HCl}/\text{anhyd. ZnCl}_2$
- d)  $\text{PCl}_3$

16.  $\text{C}_2\text{H}_5\text{OH}$  can be converted in to propane nitrile by

- a)  $\text{CH}_3\text{CH}_2\text{OH} + \text{KCN} \rightarrow$
- b)  $\text{CH}_3\text{CH}_2\text{OH} + \text{HCN} \rightarrow$
- c)  $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow[\text{Pyridine}]{\text{TsCl}} \text{CH}_3\text{CH}_2\text{OTs} \xrightarrow{\text{KCN}} \text{d) } \text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{PCl}_5} \text{A} \xrightarrow{\text{NaCN}} \text{...}$

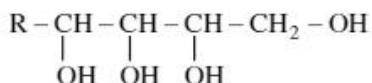
#### Integer Type Questions

17. What volume of hydrogen gas in litres at STP is evolved when 20.536 gm of ethyl alcohol reacts with 10.267 gm sodium metal?

18.   $\xrightarrow{\text{H}^+, \Delta}$  the number of products formed is

19. Number of alkenes formed in acid catalysed dehydration of neopentyl alcohol

20. The number of alcohols of  $C_5H_{12}O$  which give positive iodoform reaction is  
 21. How many moles of HCOOH is formed, due to the oxidation with  $HIO_4$  of



## KEY SHEET (PRACTICE SHEET)

## EXERCISE-I

## LEVEL-I

- |                    |       |       |       |       |       |       |       |
|--------------------|-------|-------|-------|-------|-------|-------|-------|
| 1) 3               | 2) 1  | 3) 3  | 4) 4  | 5) 1  | 6) 1  | 7) 3  | 8) 1  |
| 9) 2               | 10) 2 | 11) 1 | 12) 1 | 13) 3 | 14) 3 | 15) 2 | 15) 2 |
| 16) 3 <sup>0</sup> | 17) 5 | 18) 5 |       |       |       |       |       |

## LEVEL-II

- |        |       |       |       |                         |         |        |        |
|--------|-------|-------|-------|-------------------------|---------|--------|--------|
| 1) b   | 2) a  | 3) ab | 4) bd | 5) abcd                 | 6) abcd | 7) abc | 8) abd |
| 9) abc | 10) a | 11) b | 12) c | 13) A-rs; B-p; C-q; D-r |         |        | 14) 8  |

## EXERCISE-II

## LEVEL-I

- |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|
| 1) 2  | 2) 2  | 3) 2  | 4) 1  | 5) 2  | 6) 2  | 7) 2  | 8) 1  |
| 9) 2  | 10) 4 | 11) 4 | 12) 2 | 13) 3 | 14) 3 | 15) 2 | 16) 1 |
| 17) 4 | 18) 2 | 19) 1 | 20) 4 | 21) 4 | 22) 2 | 23) 3 | 24) 4 |
| 25) 4 |       |       |       |       |       |       |       |

## LEVEL-II

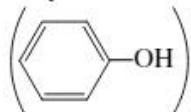
- |       |       |       |       |       |         |        |        |
|-------|-------|-------|-------|-------|---------|--------|--------|
| 1) b  | 2) d  | 3) d  | 4) d  | 5) d  | 6) a    | 7) b   | 8) c   |
| 9) a  | 10) c | 11) d | 12) b | 13) c | 14) abc | 15) cd | 16) cd |
| 17) 5 | 18) 3 | 19) 2 | 20) 2 | 21) 2 |         |        |        |

## 2(b). PHENOLS

### SYNOPSIS

#### NOMENCLATURE, ISOMERISM, PREPARATION METHODS & GENERAL PROPERTIES

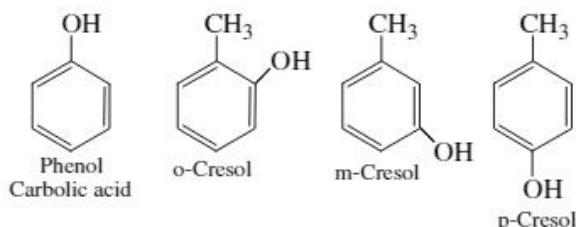
- \* Aromatic hydroxyl compounds in which –OH is directly attached to benzene ring are called phenols. Hydroxy benzene is the specific name for the compound phenol



In a case when –OH is attached to side chain are called aromatic. Alcohols i.e., aryl substituted aliphatic alcohols (aryl alkyl alcohols).

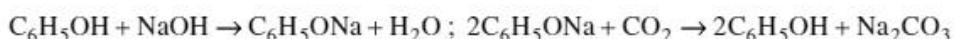
- \* Depending upon the number of –OH groups attached to ring, these are called as monohydric (one –OH), dihydric (two –OH groups) and trihydric (three –OH groups) phenols. A few examples are as follows:

#### Monohydric phenols:



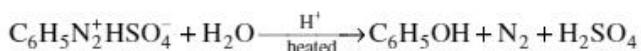
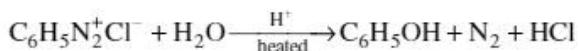
#### Methods of Preparation of Phenols

1. **From Coal-tar:** The middle oil fraction of coal-tar is suddenly cooled when naphthalene crystallizes out. The remaining liquid having phenol and cresols is treated with dilute sodium hydroxide solution when phenols dissolve forming sodium salts. These are decomposed by passing CO<sub>2</sub> gas to regenerate phenols.

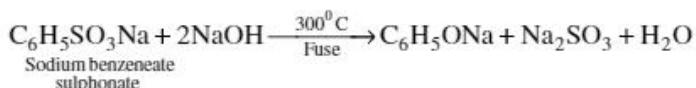


The aqueous layer having Na<sub>2</sub>CO<sub>3</sub> is removed and the rest on fraction gives phenol.

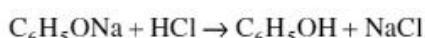
2. **By hydrolysis of diazonium salts:** A diazonium salt solution is slowly added to an excess of warm dilute H<sub>2</sub>SO<sub>4</sub> solution when phenol is obtained as a result of hydrolysis.



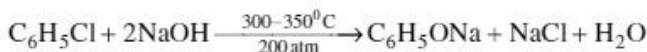
3. **Fusion of sulphonates with alkali:**



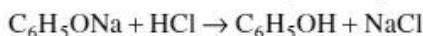
Sodium phenoxide (phenate) on acidification yields phenol.



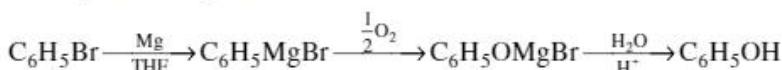
4. **From chlorobenzene (Dow's process):** In Dow's process chlorobenzene, obtained by Rasching's method is fused with 10% NaOH solution or  $\text{Na}_2\text{CO}_3$  at  $300\text{-}350^\circ\text{C}$  under a pressure of 200 in the presence of 10% diphenyl ether to stop the side reactions.



The mixture is acidified to get free phenol.



5. **From Grignard reagents:**

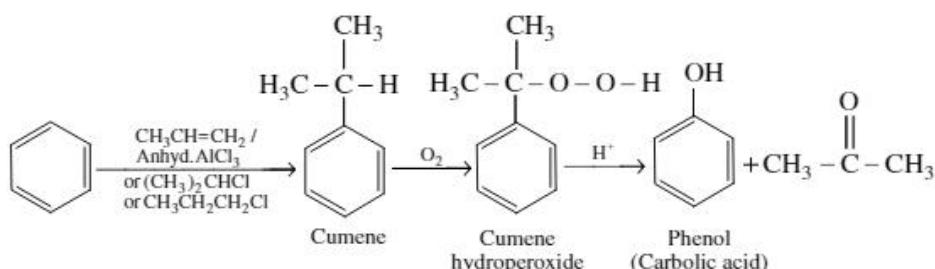


6. **Sulphonation process from benzene (Manufacture):** The different steps involved are:

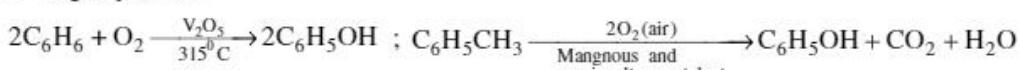
- $\text{C}_6\text{H}_6 + \text{H}_2\text{SO}_4 \xrightarrow[\text{(conc)}]{} \text{C}_6\text{H}_5\text{SO}_3\text{H} + \text{H}_2\text{O}$
- $2\text{C}_6\text{H}_5\text{SO}_3\text{H} + \text{Na}_2\text{SO}_3 \rightarrow 2\text{C}_6\text{H}_5\text{SO}_3\text{Na} + 2\text{SO}_2 + 2\text{H}_2\text{O}$
- $\text{C}_6\text{H}_5\text{SO}_3\text{Na} + 2\text{NaOH} \xrightarrow{\text{Fuse}} \text{C}_6\text{H}_5\text{ONa} + \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$
- $2\text{C}_6\text{H}_5\text{ONa} + \text{SO}_2 + \text{H}_2\text{O} \rightarrow 2\text{C}_6\text{H}_5\text{OH} + \text{Na}_2\text{SO}_3$

$\text{SO}_2$  generated in step (ii) can be converted to sulphuric acid and so the process is continuous.

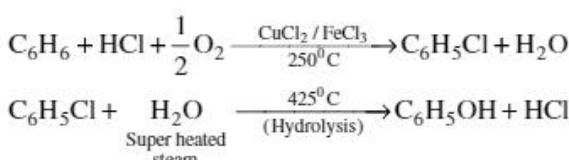
7. **Cumene process (synthesis):** Cumene (isopropyl benzene) is oxidised by passing oxygen through it to form cumene hydroperoxide which on addition of an acid breaks to give phenol and acetone.



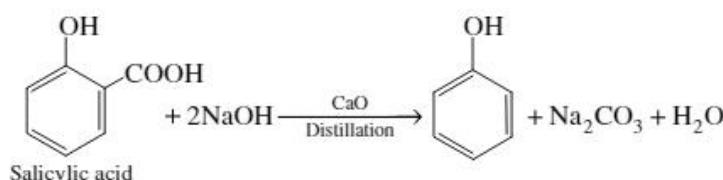
8. **Direct oxidation of benzene and toluene:** A mixture of benzene and air is passed over  $\text{V}_2\text{O}_5$  at  $315^\circ\text{C}$  to get phenol.



9. **Raschig method:**



10. **From Phenolic acids:**



## CHEMICAL PROPERTIES OF PHENOLS

## Chemical Properties of Phenols

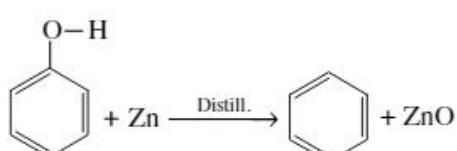
## (A) Reactions of the Phenolic-OH group:

- \* Since phenol does not decompose carbonates and bicarbonates so it is a weaker acid than carbonic acid.
- \* Phenol in aqueous solution turns blue litmus red due to the presence of  $H^+$  ions produced as a result of ionization.
- \* Since phenol is a weaker acid than  $H_2CO_3$ , it may be separated from carboxylic acid making the solutions alkaline with NaOH solution and then passing  $CO_2$  gas. Phenols is liberated from its sodium salt and so can be extracted with ether, the sodium carboxylates are not decomposed by  $CO_2$ .

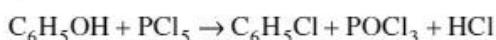
## 1. Reaction with ferric chloride:

- \* Phenol gives a violet colour with  $FeCl_3$  solutions, this reactions is specific of all compounds having the grouping  $-C(OH)=C$ .
- \* All phenols give some colour with  $FeCl_3$  solutions, It is a specific test for phenolic  $-OH$  group.
- \* This reaction is not given by alcohols.

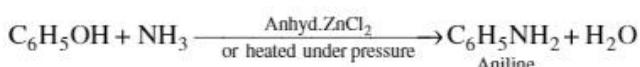
## 2. Distillation with zinc dust gives benzene:



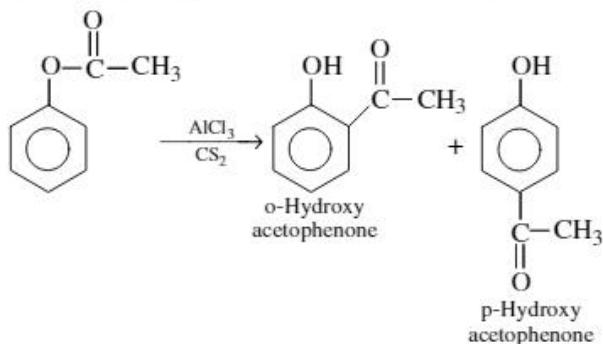
- \* This reaction is not given by alcohols.

3. Reaction with  $PCl_5$ : Only a small amount of chlorobenzene is formed, the main product is triphenyl phosphate.

## 4. Reaction with ammonia:



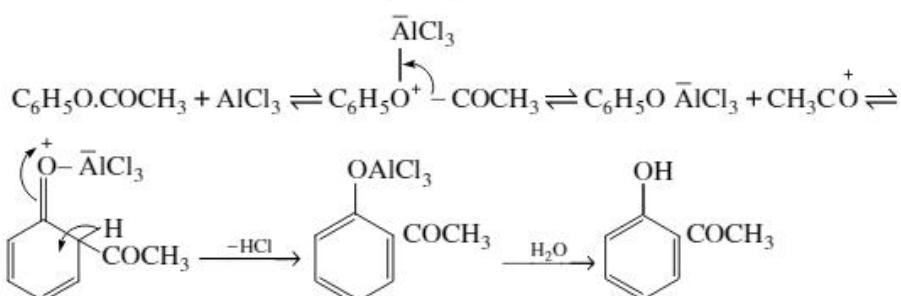
- \* Fries rearrangement or reaction or migration:



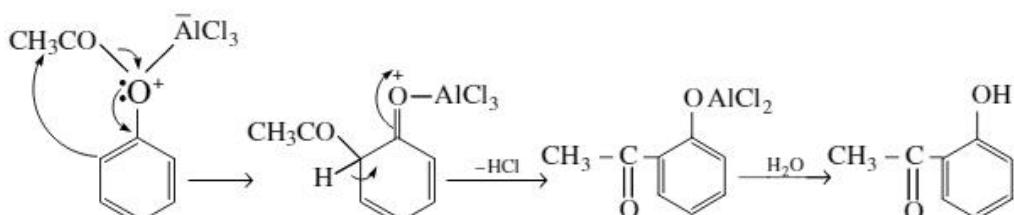
- \* Generally low temperature ( $60^\circ\text{C}$  or less) favour the formation of p-isomer, whereas a high temperatures (above  $160^\circ\text{C}$ ) favour the formation of o-isomer.

**Mechanism:**

- (i) **Intermolecular:** In it acylium ion  $\left( \text{RCO}^+ \right)$  is formed which attacks phenol to give the product.

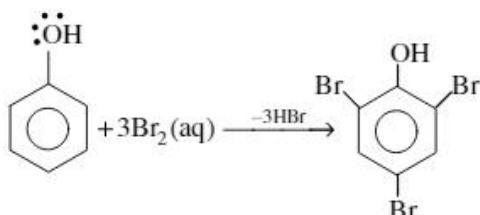


- (ii) **Intramolecular:**

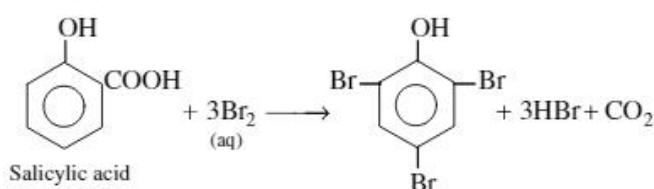
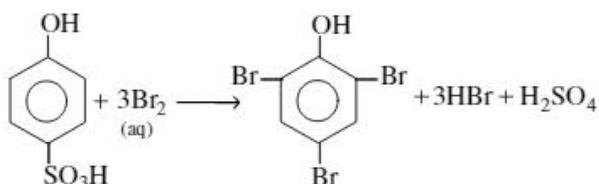


The o- and p-hydroxy ketones can be separated because the o-hydroxy ketone is steam volatile due to intramolecular hydrogen bonding (Chelation) whereas the p-hydroxy ketone is not steam volatile due to intermolecular H-bonding.

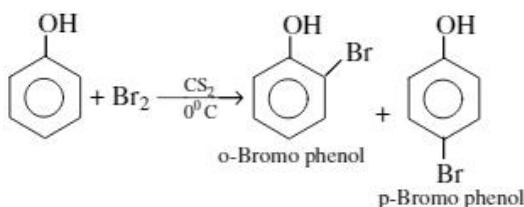
5. **Halogenation:** Phenol ring is so highly activated that it is polyhalogenated even by the addition of aqueous solution of halogens. When bromine water is added to phenol a precipitate of 2,4,6-tribromo phenol.



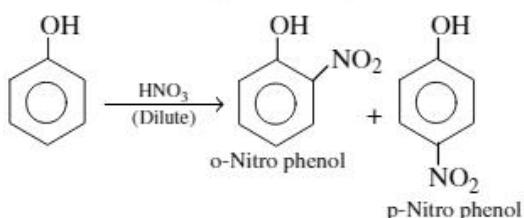
- \* Even substituents like  $-\text{SO}_3\text{H}$ ,  $-\text{NO}_2$ ,  $-\text{COOH}$  etc., if present m, o-and p-positions are replaced by halogens.



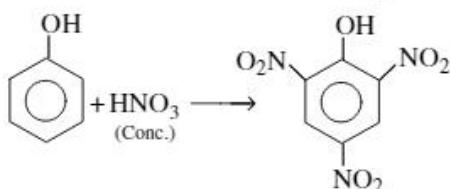
- If only ortho and para halophenols are needed, halogenations is carried out at low temperature and in any non-polar solvent like  $\text{CCl}_4$  or  $\text{CS}_2$ .



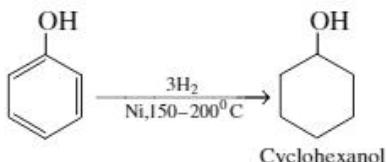
- Nitration:** Phenol is so highly reactive that it can be nitrated even with dilute  $\text{HNO}_3$  to give a mixture of ortho and para nitro phenols.



o-Nitrophenol is more volatile due to intramolecular hydrogen bond than para nitrophenol (intermolecular hydrogen bonding) hence the two isomers may be separated by steam distillation. Nitration with conc.  $\text{HNO}_3$  yields 2,4,6-trinitrophenol (picric acid), but the yield is low due to oxidation of phenol by conc.  $\text{HNO}_3$  and therefore, picric acid is prepared indirectly.

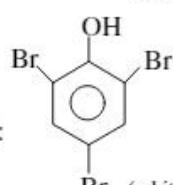


- Hydrogenation:**

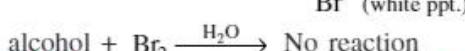


#### DISTINCTION BETWEEN: (A) ALCOHOLS AND PHENOLS:

- Litmus test: Phenol turns blue litmus red but not alcohols.
- $\text{FeCl}_3$  : Phenol  $\xrightarrow{\text{neutral FeCl}_3}$  blue, violet
- Coupling reaction:  
Phenol + diazonium salt  $\xrightarrow[\text{medium}]{\text{weakly basic}}$  yellow or orange coloured dye  
diazonium salt + alcohol  $\xrightarrow[\text{medium}]{\text{weakly basic}}$  no reaction



- Bromine water test:

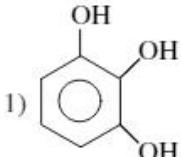


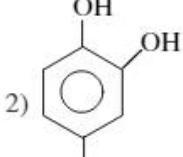
 **LECTURE SHEET** 
 **EXERCISE-I** 

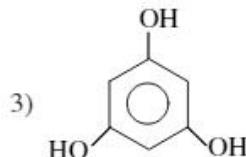
*(Nomenclature, Isomerism, Preparation Methods & General Properties)*

**LEVEL-I (MAIN)**
**Straight Objective Type Questions**

1. Which does not have a carboxyl group?
  - 1) Benzoic acid
  - 2) Ethanoic acid
  - 3) Picric acid
  - 4) Aspirin
2. Phenol is less acidic than :
  - 1) ethanol
  - 2) methanol
  - 3) o-nitrophenol
  - 4) p-methyl phenol
3. Among the three isomers of nitrophenol, the one that is least soluble in water is
  - 1) o-nitrophenol
  - 2) p-nitrophenol
  - 3) m-nitrophenol
  - 4) none of these
4. Consider the bond lengths of the following  $\text{CH}_3\text{CH}_2-\overset{\text{I}}{\underset{\text{II}}{\text{OH}}} \text{C}_6\text{H}_4-\overset{\text{II}}{\underset{\text{I}}{\text{OH}}}$ 
  - 1) I > II
  - 2) I < II
  - 3) I ≈ II
  - 4) cannot be predicted
5. Which of the following possess highest melting point
 


  
1)


  
2)


  
3)

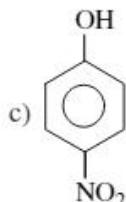
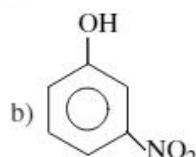
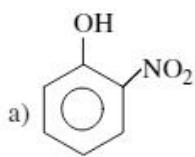
4) All possess same m.p
6. The byproduct obtained in the preparation of phenol from cumene is
  - 1) Propanol
  - 2) Propanone
  - 3) Propanal
  - 4) Propane
7. The acidic character of phenol is due to
  - 1) Greater resonance stabilization of phenoxide ion over phenol
  - 2) Greater resonance stabilization of phenol over phenoxide ion
  - 3) Because of tautomerism occurring in phenol
  - 4) Because oxygen is more electronegative than hydrogen
8. The correct order of relative acidic strength of phenol, ethyl alcohol and water is
  - 1) Phenol > Water > Ethyl alcohol
  - 2) Ethyl alcohol > Water > Phenol
  - 3) Ethyl alcohol > Phenol > Water
  - 4) Water > Phenol > Ethyl alcohol

**Numerical Value Type Questions**

9. 1.34 g of ether with molecular weight 134 gives 7.04 g of AgI in ziesel's estimation. How many methoxy groups it has?

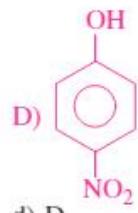
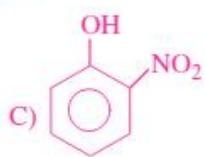
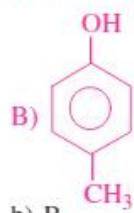
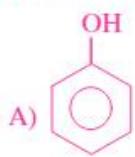
**LEVEL-II (ADVANCED)*****Straight Objective Type Questions***

1. Which of the following phenols is least soluble in water?



d) All have same solubility

2. Which of the following has the least value of pKa?



a) A

b) B

c) C

d) D

3. Which of the following is incorrect?

- a) Phenols liberate H<sub>2</sub> on reaction with sodium
- b) Phenols react with NaOH to form salt
- c) Phenols liberate CO<sub>2</sub> on reaction with NaHCO<sub>3</sub>
- d) Phenols turns blue litmus to red

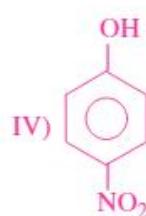
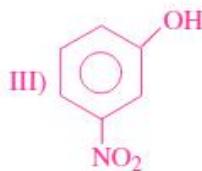
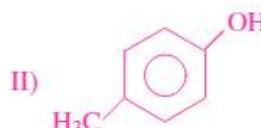
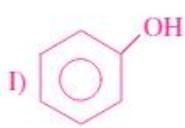
4. Which one of the following compounds will not be soluble in sodium bicarbonate?

- |                         |                           |
|-------------------------|---------------------------|
| a) 2,4,6-Trinitrophenol | b) Benzoic acid           |
| c) o-Nitrophenol        | d) Benzene sulphonic acid |

5. In which of the following reaction phenol or sodium phenoxide is not formed?

- |   |  |
|---|--|
| a) C <sub>6</sub> H <sub>5</sub> N <sub>2</sub> Cl + KOH(alcohol) | b) C <sub>6</sub> H <sub>5</sub> COCl + NaOH   |
| c) C <sub>6</sub> H <sub>5</sub> N <sub>2</sub> Cl + NaOH(aq.)    | d) C <sub>6</sub> H <sub>5</sub> N <sub>2</sub> Cl $\xrightarrow[\text{Boil}]{\text{H}_2\text{O}}$ |

6. In the following compounds the order of acidic strength is :



- a) IV > II > I > III      b) III > IV > II > I      c) I > II > III > IV      d) None of these

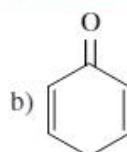
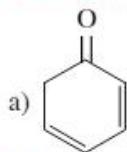
7. The increasing order of acidity among phenol, p-methyl phenol, m-nitrophenol and p-nitrophenol is :

- a) m-nitrophenol < p-nitrophenol < phenol < p-methyl phenol
- b) p-methyl phenol < m-nitrophenol < phenol < p-nitrophenol
- c) p-methyl phenol < phenol < m-nitrophenol < p-nitrophenol
- d) phenol < p-methyl phenol < p-nitrophenol < m-nitrophenol

8. Which of the following forms intramolecular hydrogen bond?

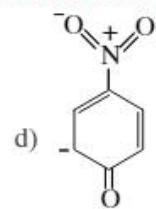
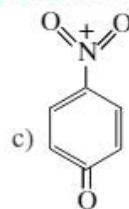
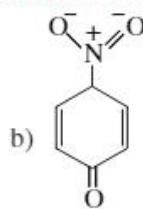
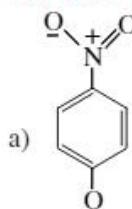
- a) o-nitrophenol      b) o-hydroxy benzaldehyde  
c) o-acetophenone      d) all of the above

9. The tautomeric form of phenol is:



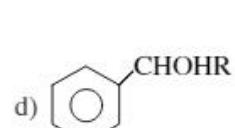
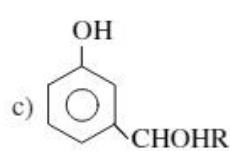
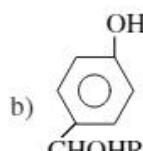
- c) both (a) and (b)      d) none of these

10. The most unlikely representation of resonance structures of p-nitrophenoxide ion is:

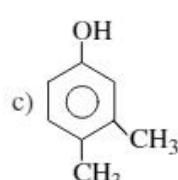
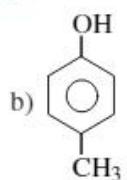
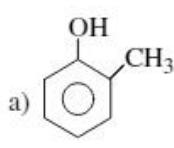


11. + RCHO  $\xrightarrow{\text{OH}^-}$ ,  $\xrightarrow{\text{H}^+}$  The product is

- a) No reaction



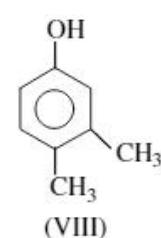
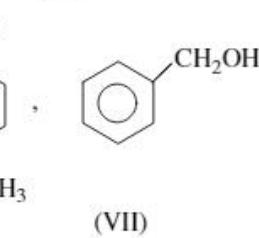
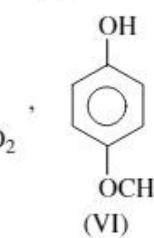
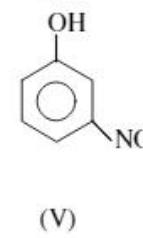
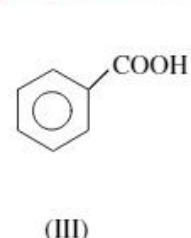
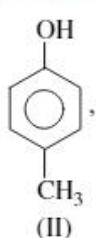
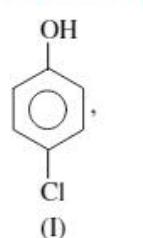
12. Which of the following give a dibromo derivative on reaction with bromine-water?



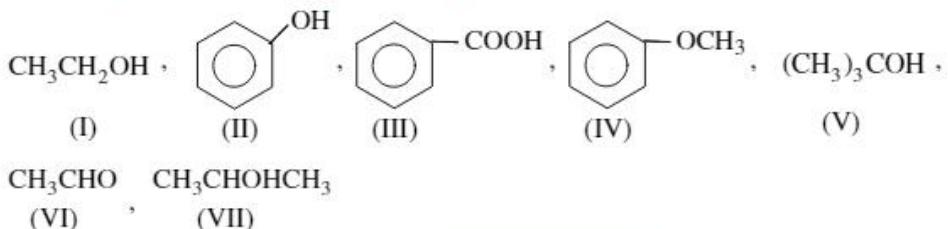
- d) All the above

#### Integer Type Questions

13. Which of the following are more acidic than phenol?



14. How many of the following liberate H<sub>2</sub> on reaction with sodium?



**EXERCISE-II**

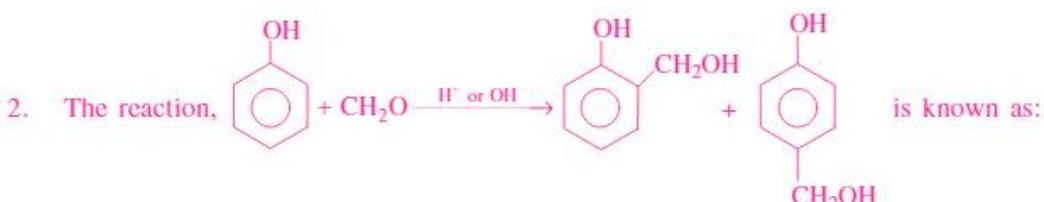
*(Chemical Properties, Distinguish Test & Uses)*

**LEVEL-I (MAIN)**

***Straight Objective Type Questions***

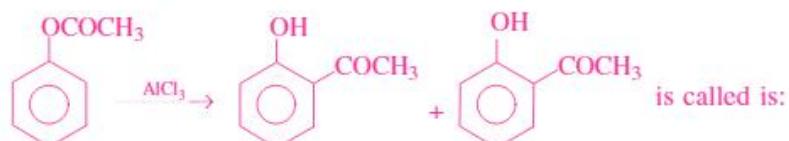
1. 1,3,5-trihydroxy benzene reacts with H<sub>2</sub>NOH to give a trioxime. It is because of:

- 1) metamerism      2) stereoisomerism      3) tautomerism      4) none of these

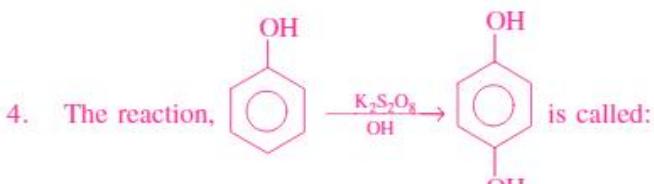


- 1) Lederer Manasse reaction      2) Libermann reaction  
 3) Nef reaction      4) Fries reaction

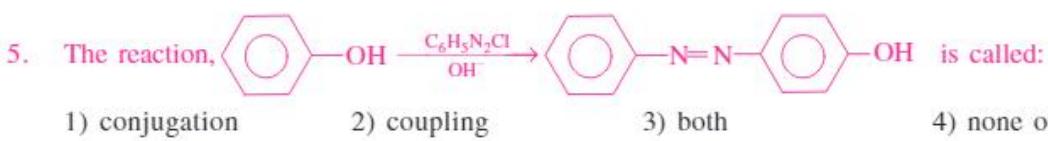
3. The following reaction:



- 1) Beckmann reaction      2) Haworth reaction      3) Fries reaction      4) Martius reaction



- 1) Elbs persulphate oxidation      2) Pondorff oxidation  
 3) Fries oxidation      4) Fractional oxidation



- 1) conjugation      2) coupling      3) both      4) none of these

6. Benzene diazonium chloride on reaction with phenol in a weakly basic solution gives:  
 1) diphenyl ether                            2) p-hydroxyazobenzene  
 3) chlorobenzene                            4) benzene
7. What are the organic products formed in the following reaction  $C_6H_5COOCH_3 \xrightarrow[(ii) H_2O]{(i) LiAlH_4} \dots$   
 1)  $C_6H_5COOH$  and  $CH_4$                             2)  $C_6H_5CH_2OH$  and  $CH_4$   
 3)  $C_6H_5CH_3$  and  $CH_3OH$                             4)  $C_6H_5CH_2OH$  and  $CH_3OH$
8. Which of the following would be reactive towards bromine?  
 1) Nitrobenzene                            2) Phenol  
 3) Anisole                                    4) Chlorobenzene

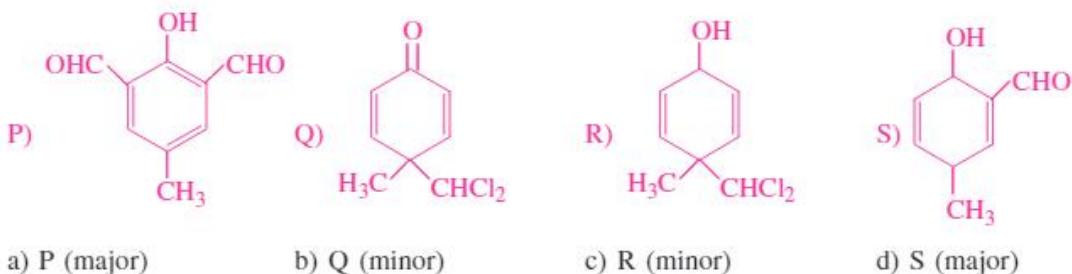
Numerical Value Type Questions

9. 0.92 g of a compound with molecular weight 92 releases 0.672 lit of methane at STP when treated with  $CH_3MgI$ . The number of OH groups it has is
10. Phenol  $\xrightarrow[\text{Dust}]{Zn} X \xrightarrow[\text{Anhydrous AlCl}_3]{C_2H_5Cl} Y$ ; Number of structural isomers of Y are :

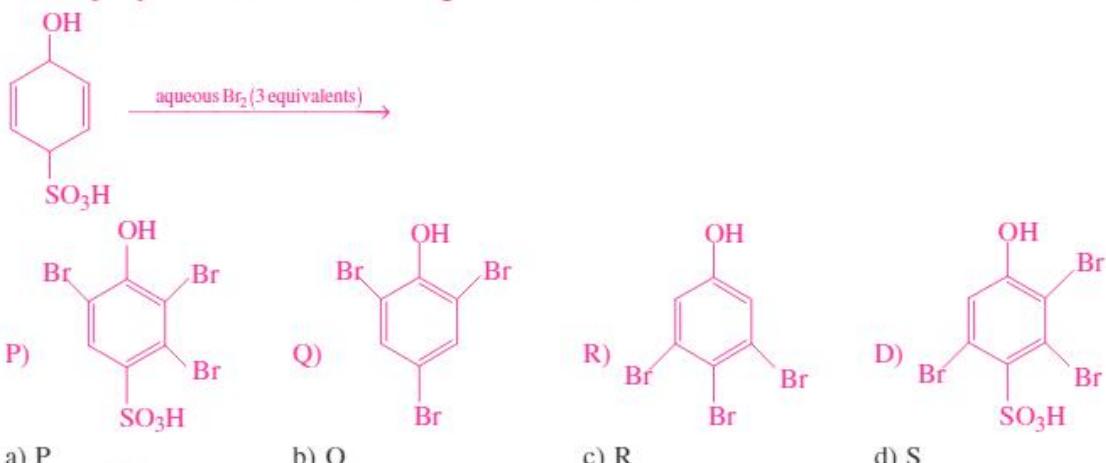
**LEVEL-II (ADVANCED)**Straight Objective Type Questions

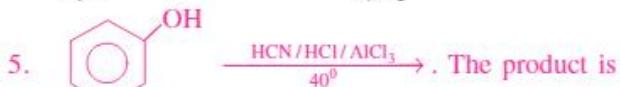
1.  +  $C_2H_5I \xrightarrow[C_2H_5OH]{C_2H_5O^\ominus} X$ ; X is :  
 a)  $C_6H_5OC_2H_5$                             b)  $C_2H_5OC_2H_5$   
 c)  $C_6H_5OC_6H_5$                             d)  $C_6H_5I$
2. Phenol chloroform and caustic potash are heated, the compound formed is:  
 a) salicylic acid                            b) p-hydroxy benzaldehyde  
 c) m-hydroxy benzaldehyde                d) salicyladehyde

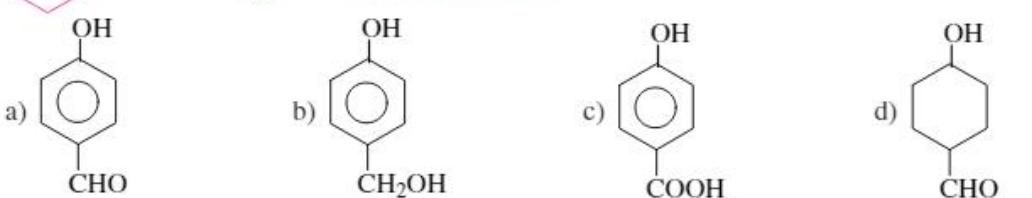
3. In the following reaction the product(s) formed is(are)   $\xrightarrow[\text{OH}]{CHCl_3}$



4. The major product(s) of the following reaction is(are)



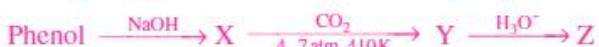
5.  The product is



6. Which of the following compounds would not evolve  $\text{CO}_2$  when treated with aq.  $\text{NaHCO}_3$  solution?

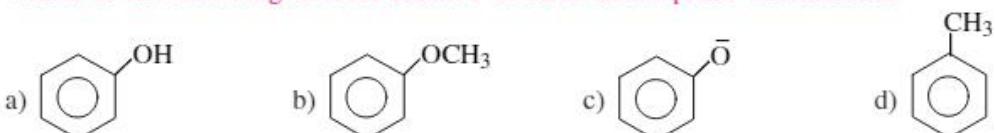
- a) Phenol      b) Benzoic acid  
c) 2,4-Dinitrophenol      d) 2,4,6-Trinitrophenol

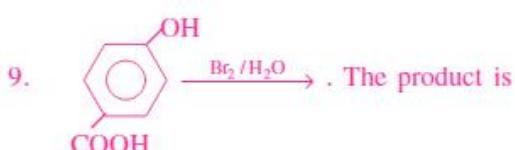
7. Identify the product Z in the following sequence of reactions:

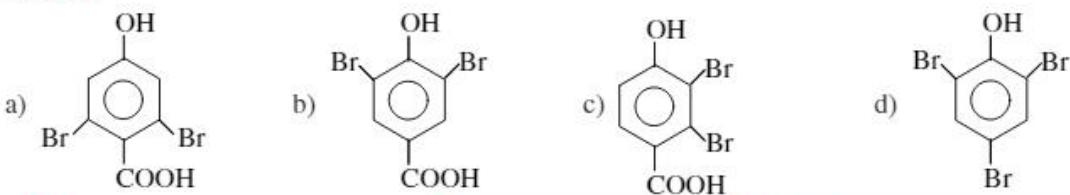


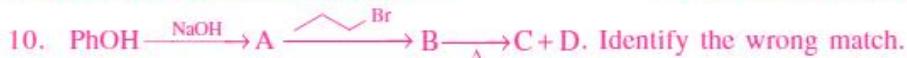
- a) Aspirin      b) Salicylaldehyde      c) Benzoic acid      d) Salicylic acid

8. Which of the following is more reactive towards electrophilic substitution?



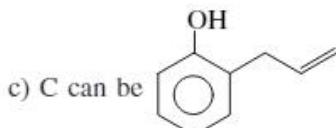
9.  The product is





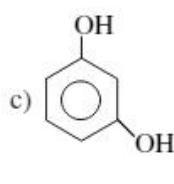
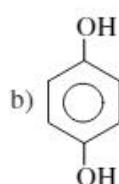
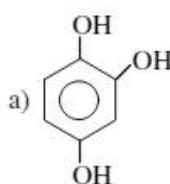
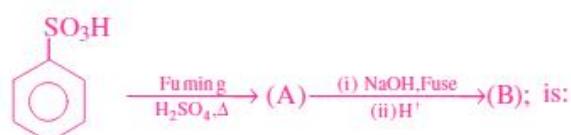
a) A is  $\text{Ph}-\text{O}^- - \text{Na}^+$

b) B is  $\text{Ph}-\text{O}-\text{CH}_2-\text{CH}_2-\text{CH}_2\text{Br}$



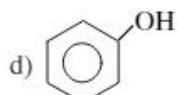
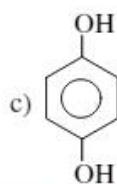
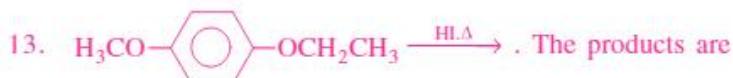
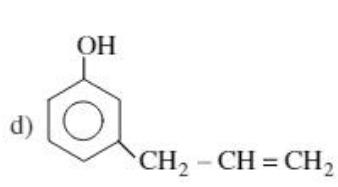
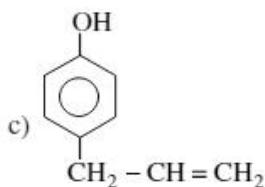
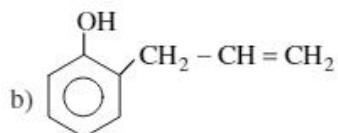
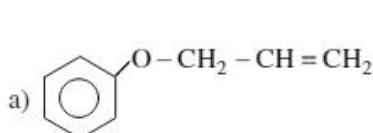
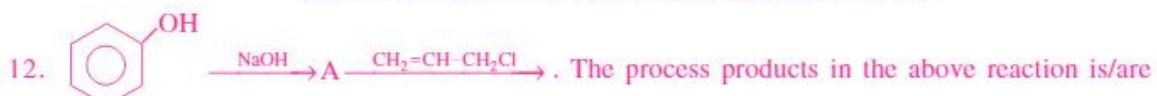
d) Conversion B to (C+D) Involve Carbocation intermediate

11. The final product (B) of the following reaction

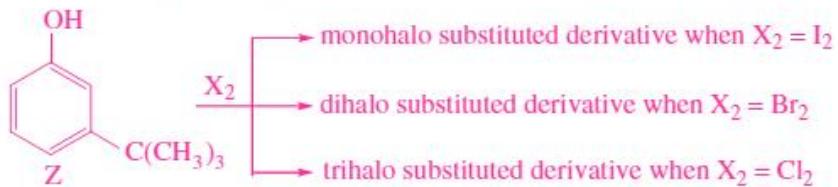


d) None of these

More than One correct answer Type Questions



14. The reactivity of compound Z with different halogens under appropriate conditions is given below



The observed pattern of electrophilic substitution can be explained by

- a) the steric effect of the halogen
- b) the steric effect of the tert-butyl group
- c) the electronic effect of the phenolic group
- d) the electronic effect of the tert-butyl group

15. The ether, when treated with HI gives:

- a) b) c) d)

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

- a) b) c) d)

17. p-cresol, chloroform and caustic potash are heated, the compounds formed are:

- a) b) c) d)

#### Linked Comprehension Type Questions

##### Passage-I :

An organic compound 'X' on reaction with  $CHCl_3$  & KOH gave two compounds Y & Z. Both Y & Z on oxidation give mono carboxylic acids which on heating with sodalime give phenol.

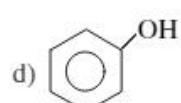
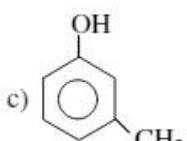
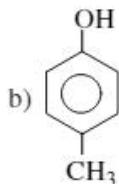
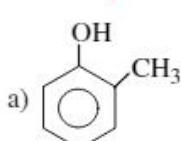
18. Compound Y and Z are

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>a)  &amp;  </li> <li>c)  ,  </li> </ul> | <ul style="list-style-type: none"> <li>b)  ,  </li> <li>d)  ,  </li> </ul> |
|--|--|

19. Compounds obtained by oxidation of Y, Z give following reactions

- a) Liberate H<sub>2</sub> on reaction with Na metal
- b) Reacts with two mole of NaOH
- c) Liberate CO<sub>2</sub> on reaction with NaHCO<sub>3</sub>
- d) All the above

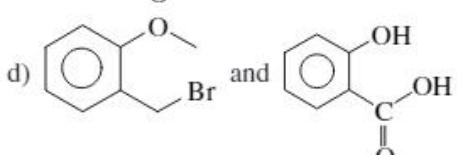
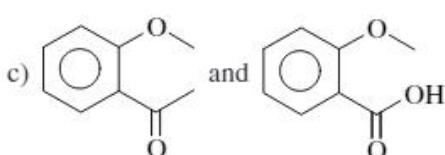
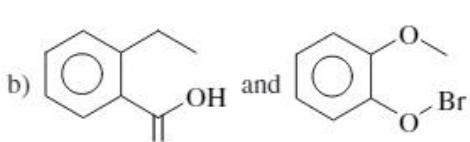
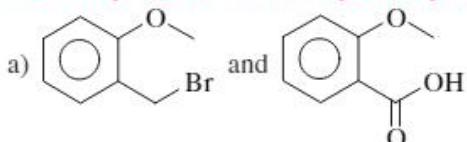
20. The compound 'X' is



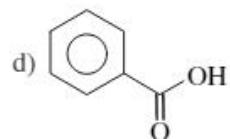
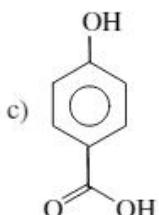
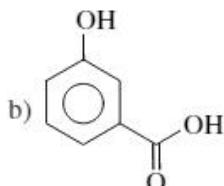
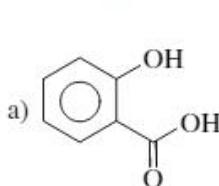
Passage-II :

Compound (A) C<sub>8</sub>H<sub>9</sub>OBr, is treated with hot alkaline KMnO<sub>4</sub> to produce compound (B), C<sub>8</sub>H<sub>8</sub>O<sub>3</sub> when (B) reacts with hot con. HI compound (C), C<sub>7</sub>H<sub>6</sub>O<sub>3</sub>, is formed. Compound (A) is soluble in cold conc. H<sub>2</sub>SO<sub>4</sub> and does not decolorize a dilute, neutral KMnO<sub>4</sub> solution or Br/CCl<sub>4</sub>. Compound (C) is a hydroxybenzoic acid about 100 times stronger than benzoic acid

21. The compound A and B respectively are:



22. The compound C is:



23. Which of the compounds from the above comprehension can prepared by Kolbe reaction?

- a) A
- b) C
- c) B
- d) none of these

Matrix Matching Type Questions

24. **Column-I**

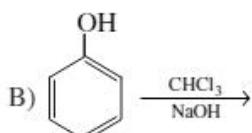
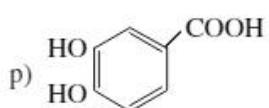
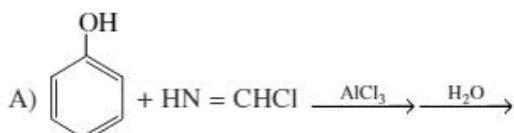
- A) Phenol & C<sub>2</sub>H<sub>5</sub>OH
- B) CH<sub>3</sub>COCH<sub>3</sub> & CH<sub>3</sub>CH<sub>2</sub>CHO
- C) Phenol & Formic acid
- D)
- &

**Column-II**

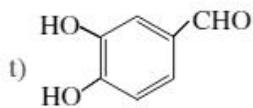
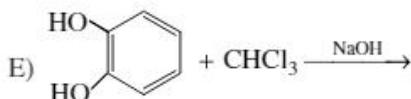
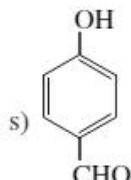
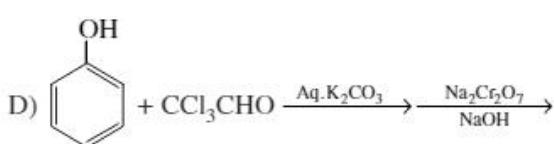
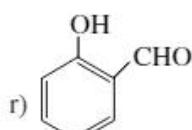
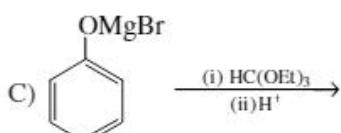
- p) Neutral ferric chloride
- q) I<sub>2</sub> & NaOH
- r) NaHCO<sub>3</sub>
- s) Sodium metal

## 25. Column-I (Reaction)

## Column-II (Product)



q) Gattermann's reaction



u) Reimer-Tiemann reaction

## KEY SHEET (LECTURE SHEET)

## EXERCISE-I

<b>LEVEL-I</b>	1) 3	2) 3	3) 1	4) 1	5) 3	6) 2	7) 1	8) 1
	9) 3							

<b>LEVEL-II</b>	1) a	2) d	3) c	4) c	5) b	6) a	7) c	8) d
	9) c	10) c	11) b	12) d	13) 4	14) 5		

## EXERCISE-II

<b>LEVEL-I</b>	1) 3	2) 1	3) 3	4) 1	5) 2	6) 2	7) 4	8) 2
	9) 3	10) 4						
<b>LEVEL-II</b>	1) a	2) d	3) b	4) b	5) a	6) a	7) d	8) c
	9) d	10) d	11) c	12) abc	13) abc	14) abc	15) ad	16) ad
	17) ab	18) b	19) d	20) d	21) a	22) a	23) b	
	24) A-pq; B-q; C-pr; D-qs			25) A-qr; B-ru; C-r; D-s; E-t				


**PRACTICE SHEET**

**EXERCISE-I**

(Nomenclature, Isomerism, Preparation Methods & General Properties)

**LEVEL-I (MAIN)**
**Straight Objective Type Questions**

1. Which of the following is known as carbolic acid



2. Phenol is prepared commercially from



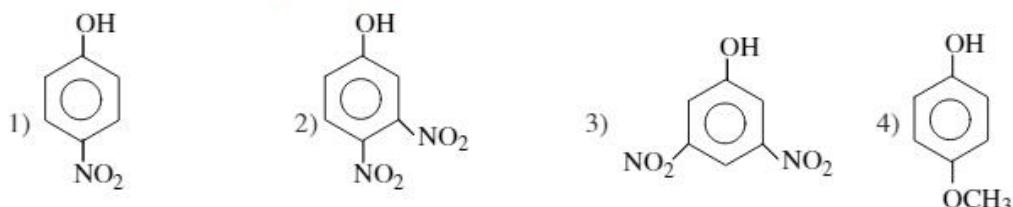
3. Which of the following compounds when dissolved in water, gives a solution with pH less than seven?



4. Which of the following phenols posses highest  $K_a$  value



5. Which of the following is highly acidic?



6. The most suitable method if the separation of 1:1 mixture of o-and p-nitrophenol is :



7. Phenol is:

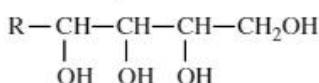


8. Sodium salicylate on distilling with soda lime gives:


**Numerical Value Type Questions**

9. How many isomeric benzene derivatives exist with the formula  $\text{C}_7\text{H}_8\text{O}$ ?

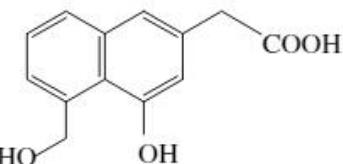
10. How many moles of  $\text{HCOOH}$  is formed, due to the oxidation with  $\text{HgO}_4$  of,



LEVEL-II (ADVANCED)

## **Integer Type Questions**

1. The number of resonance structures possible for phenoxide ion is



Number of moles of NaOH react with one mole of the give compound is

3. The number of unshared pair of electrons in the electrophile involved in conversion of phenol to salicylaldehyde using  $\text{CHCl}_3/\text{KOH}$  is

**EXERCISE-II**

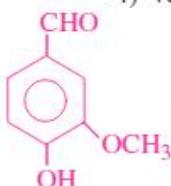
(Chemical Properties, Distinguish Test & Uses)

LEVEL-I (MAIN)

### **Straight Objective Type Questions**

1. Rate of electrophilic substitution reaction in phenol is

- 1) Equal to that to benzene      2) Faster than that of benzene  
3) Slower than that of benzene      4) Very slower than that Nitrobenzene



2. The compound given is called Vanillin which statement about Vanillin is false

- 1) It is a secondary alcohol  
2) It has an ether functional group  
3) It gives positive test with Tollen's reagent  
4) It reacts with aqueous solution of sodium hydroxide

3. The product formed by heating sodium phenoxide with  $\text{CO}_2$  at  $140^\circ\text{C}$  on treatment with HCl gives:  
1) Phenyl acetic acid    2) Cinnamic acid    3) Benzoic acid    4) Salicylic acid

4. A spirin is an acetylation product of :

- 1) o-hydroxyl benzoic acid      2) o-dihydroxy benzoic acid  
3) p-bromo aniline      4) p-dihydroxy benzene

5. On distilling with Zn dust phenol, one gets:



6. What is the name of reaction when benzaldehyde changes into benzyl alcohol?

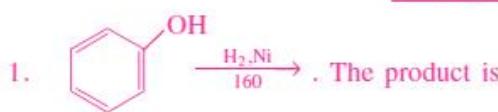
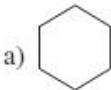
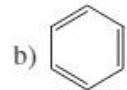
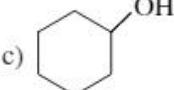
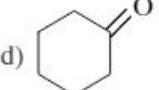
- 1) Friedel-Crafts reaction      2) Kolbe reaction  
3) Wurtz reaction      4) Cannizzaro's reaction

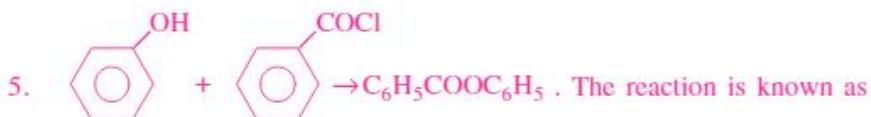
7. Phenol is heated with  $\text{CCl}_4$  and alc. KOH to give salicylic acid, this reaction is known as :

- 1) Friedel-Crafts reaction      2) Reimer-Tiemann reaction  
3) Clemmensen reduction      4) Rosenmund reaction

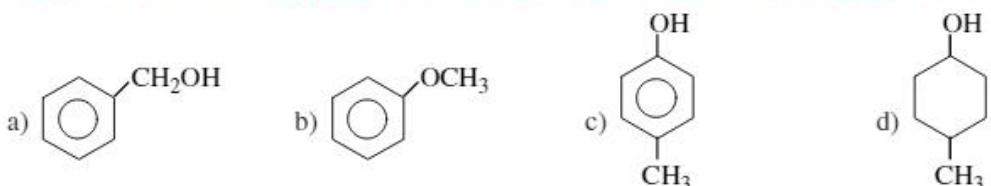
8. Aspirin is:  
 1) o-acetoxy benzoic acid      2) m-acetoxy benzoic acid  
 3) 2-hydroxy benzoic acid      4) none of the above
9. Electrophilic substitution in phenol takes place at:  
 1) o- and p-positions    2) o-position    3) p-position    4) m-position
10. Which of the following reagents is useful in separating benzoic acid from phenol?  
 1) dil. HCl      2) dil.  $H_2SO_4$       3) 5% aq. NaOH      4) 5% aq.  $NaHCO_3$
11. Bakelite is a condensation polymer of phenol and:  
 1)  $HCOOH$       2)  $HCOOCH_3$       3)  $HCHO$       4)  $CH_3COOH$
12. Benzyl alcohol and phenol can be distinguished to give:  
 1)  $FeCl_3$       2) Na      3) Lucas reagent      4) none of these
13. Phenol reacts with bromine in carbon disulphide to give:  
 1) m-bromophenol      2) p-bromophenol      3) o- and p-phenol      4) 2,4,6-tribromophenol
14. When phenol is treated with excess  $Br_2$  water, it gives:  
 1) m-bromophenol      2) o- and p-bromophenols  
 3) 2,4,6-tribromophenol      4) none of the above
15. Phenol when condensed with phthalic anhydride in presence of conc.  $H_2SO_4$  yields:  
 1) methyl orange      2) phenolphthalein      3) phenyl red      4) congo red
16. Picric acid is a yellow coloured compound. Its chemical name is :  
 1) phloroglucinol      2) pyrogallol  
 3) 2,4,6-trinitrophenol      4) none of the above

**LEVEL-II (ADVANCED)*****Straight Objective Type Questions***

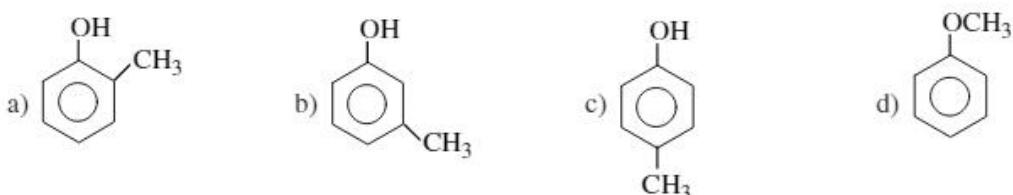
1.  . The product is
- a)       b)       c)       d) 
2. Phenol is converted into Salicylaldehyde by  
 a) Kolbe's reaction      b) Cannizaro reaction  
 c) Reimer-Tiemann reaction      d) Kolbe Schmidt reaction
3. The compound that does NOT liberate  $CO_2$ , on treatment with aqueous sodium bicarbonate solution is  
 a) Benzoic acid      b) Benzenesulphonic acid  
 c) Salicylic acid      d) Carboxylic acid (phenol)
4. Electrophilic substitution in phenol takes place at  
 a) ortho and para-positions      b) meta-position  
 c) ortho-position      d) para-position



- The reaction is known as
- Shiemann reaction
  - Schotten-Baumann reaction
  - Sand meyer reaction
  - Swarts reaction
6. Which of the following give characteristic colour reaction with neutral  $\text{FeCl}_3$  solution?



7. The compound 'y' ( $\text{C}_7\text{H}_8\text{O}$ ) is insoluble in dil  $\text{HCl}$  and aq  $\text{NaHCO}_3$  but it is soluble in dilute  $\text{NaOH}$ . When y is treated with bromine water, it is rapidly converted into a compound  $\text{C}_7\text{H}_5\text{OBr}_3$ . Identify the compound 'y'

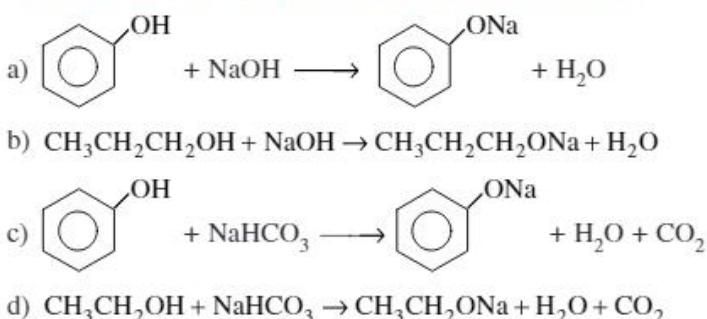


8. An organic compound with molecular formula  $\text{C}_7\text{H}_8\text{O}$  dissolves in  $\text{NaOH}$  and gives characteristic colour with  $\text{FeCl}_3$  on treatment with  $\text{Br}_2$  it gives tribromo product  $\text{C}_7\text{H}_5\text{OBr}_3$ . The compound is
- O-cresol
  - Anisol
  - m-cresol
  - p-cresol

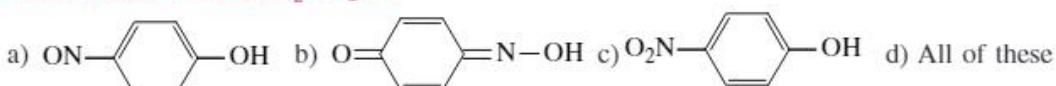
9. Paracetamol ( $\text{HO}-\text{C}_6\text{H}_4-\text{NHCOCH}_3$ ) is an:
- antibiotic
  - antipyretic
  - antimalarial
  - analgesic

***More than One correct answer Type Questions***

10. Which of the following reactions is/are not feasible?



11. Phenol reacts with  $\text{HNO}_2$  to give



12. Phenol can be converted into salicylic acid by using

- a)  $\text{CO}_2$  and alkali under pressure
- b)  $\text{CCl}_4$  and alkali at 340k
- c)  $\text{CHCl}_3$  and alkali at 340 k followed by oxidation
- d)  $\text{CHCl}_3$  and alkali at 340 k followed by reduction

13. In the reaction the intermediate(s) is (are):

- a)
- b)
- c)
- d)

14. The following properties of  $\text{C}_6\text{H}_5\text{COOH}$  and  $\text{C}_6\text{H}_5\text{OH}$  are similar:

- a) both are weaker acids and do not decompose bicarbonates
- b) both are acidic in nature
- c) both liberate hydrogen with metallic sodium
- d) both given ester with alcohol

15. Reaction between phenol and  $\text{NaNO}_2 + \text{dil. H}_2\text{SO}_4$  below  $10^\circ\text{C}$  gives:

- a)
- b)
- c)
- d)

#### Linked Comprehension Type Questions

##### Passage-I :

An organic compound (A) gives positive Libermann's nitroso reaction and on treatment with  $\text{CHCl}_3/\text{KOH}$  followed by hydrolysis gives (B) and (C). Compound (B) gives pink colour with Schiff's reagent but not (C) which is steam volatile. (C) on treatment with  $\text{LiAlH}_4$  gives (D) ( $\text{C}_7\text{H}_8\text{O}_2$ ) which on oxidation gives (E). (E) reacts with acetic anhydride and gives compound (F).

16. The compound (B) is

- a)
- b)
- c)
- d)

17. In the Libermann nitroso reaction the compound formed is \_\_\_\_\_ which gives red colour with phenol.

- a) Aspirin
- b) Salicylic acid
- c) Azo dye to phenol
- d)

18. The molecular weight of compound (F) is  
 a) 100                    b) 180                    c) 120                    d) 90

**Passage-II :**

*Alcohols, phenols and ethers are three classes of compounds having distinct properties. These compounds require different reactions to identify them in the laboratory. The reactions carried out and results obtained by test tube experiments are useful to distinguish between these classes of compounds.*

19. Which of the following reagents is useful to identify phenol in the laboratory?  
 a) Neutral ferric chloride                    b)  $I_2$  & NaOH  
 c) Reaction with metallic Na                d) Any of the above

20. Which reagent is useful to distinguish between  &  ?

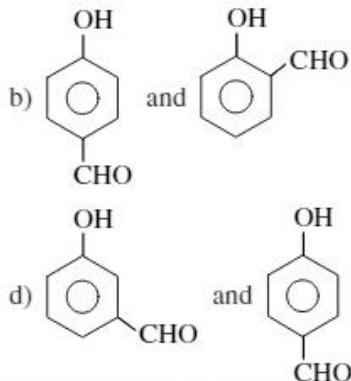
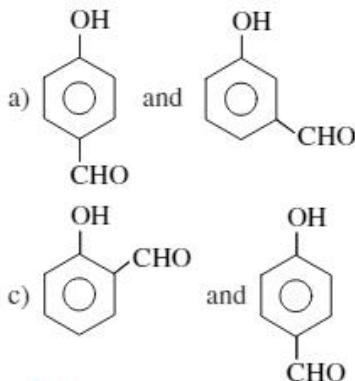
- a)  $I_2$  & NaOH  
 b) Oxidation with  $KMnO_4$  followed by  $NaHCO_3$   
 c) Reaction with metallic sodium  
 d) Any of the above
21. Which reagent is useful to distinguish between methanol and phenol?  
 a) Sodamide                    b)  $NaHCO_3$                     c) NaOH                    d)  $I_2 + NaOH$

**Passage-III :**

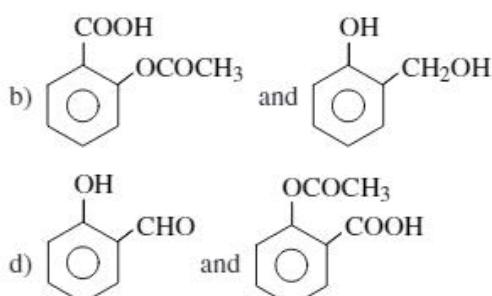
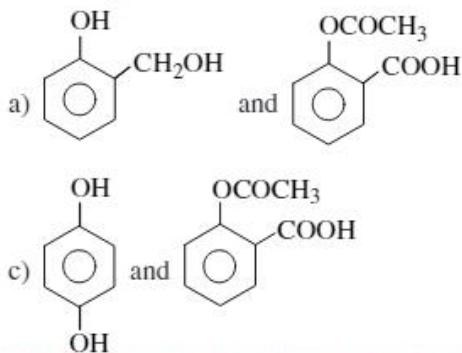
*An organic compound (A) gives positive libermann's nitroso reaction and on treatment with  $CHCl_3/KOH$  followed by hydrolysis gives (B) on (C). Compound (B) gives colour with schiff's reagent but not (C), which is steam volatile. (C) on treatment with  $LiAlH_4$  gives (D),  $C_7H_8O_2$  which on oxidation gives (E), Compound (E) on reaction with acetic anhydride and acetic acid gives a pain reliever (F).*

22. The compound A is :  
 a) phenol                    b) catechol  
 c) resorcinol                d) O-hydroxy benzoic acid

23. The compound B and C are:



24. The compound C, D and F are:



25. The name reaction involved in the conversion of A into B and C is/are:

- a) Reimer – Tiemann reaction
- b) Kolbe reaction
- c) Cannizzaro's reaction followed by benzoin condensation
- d) Reimer – Tiemann reaction followed by Kolbe reaction

#### Matrix Matching Type Questions

26. **Column-I**

A) Phenol + Neutral  $\text{FeCl}_3$

B) Phenol +  $\text{Br}_2$ (aq)

C) Identification of  $1^\circ$ ,  $2^\circ$ ,  $3^\circ$  alcohols

D) Picric acid +  $\text{NaHCO}_3$

**Column-II**

p) Victor meyer test

q) Violet colour

r) White ppt

s)  $\text{CO}_2$  gas evolved

t) Brown ppt

#### KEY SHEET (PRACTICE SHEET)

##### EXERCISE-I

<b>LEVEL-I</b>	1) 3	2) 2	3) 2	4) 3	5) 2	6) 1	7) 3	8) 3
	9) 5	10) 2						

<b>LEVEL-II</b>	1) 5	2) 2	3) 7
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##### EXERCISE-II

<b>LEVEL-I</b>	1) 2	2) 1	3) 4	4) 1	5) 3	6) 4	7) 2	8) 1
	9) 1	10) 4	11) 3	12) 1	13) 3	14) 3	15) 2	16) 3
<b>LEVEL-II</b>	1) c	2) c	3) d	4) a	5) b	6) c	7) b	8) c
	9) b	10) bcd	11) ab	12) abc	13) abc	14) bc	15) cd	16) b
	17) d	18) b	19) a	20) a	21) c	22) a	23) b	24) a
	25) a	26) A-q; B-r; C-p; D-s						

## 2(c). ETHERS

SYNOPSIS

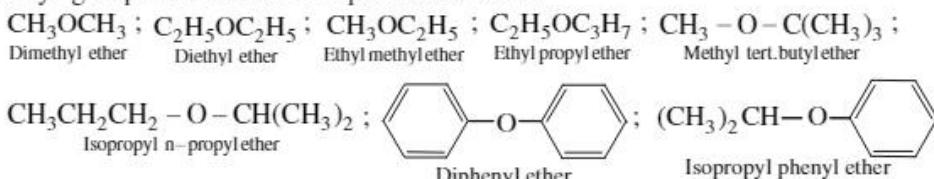
## **INTRODUCTION & PREPARATIONS :**

- Ethers are a class of compounds which contain one divalent oxygen atom bonded to two monovalent alkyl groups (same or different).
  - When both the alkyl groups are same, they are designated as simple or symmetrical ethers and then both are different, they are called mixed or unsymmetrical ethers.  
Symmetrical (or) Simple Ethers :  $\text{R} - \text{O} - \text{R}$  ;  $\text{CH}_3 - \text{O} - \text{CH}_3$  ;  $\text{C}_2\text{H}_5 - \text{O} - \text{C}_2\text{H}_5$   
Unsymmetrical (or) Mixed Ethers :  $\text{R} - \text{O} - \text{R}'$  ;  $\text{CH}_3 - \text{O} - \text{C}_2\text{H}_5$  ;  $\text{C}_2\text{H}_5 - \text{O} - \text{C}_3\text{H}_7$
  - Structure: The oxygen atom in ethers is  $\text{sp}^3$ -hybridised. Two of the hybrid orbitals overlap with hybrid orbitals (one each) of two carbon atoms to form sigma bonds.

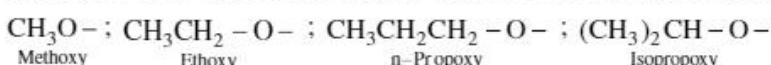


## NOMENCLATURE

- Common names: In this system, ethers are named after the alkyl groups attached to oxygen atom and adding the word ether.
  - When both the alkyl group are same, the prefix di-is used. In case of unsymmetrical ethers two alkyl groups are named in alphabetical order.



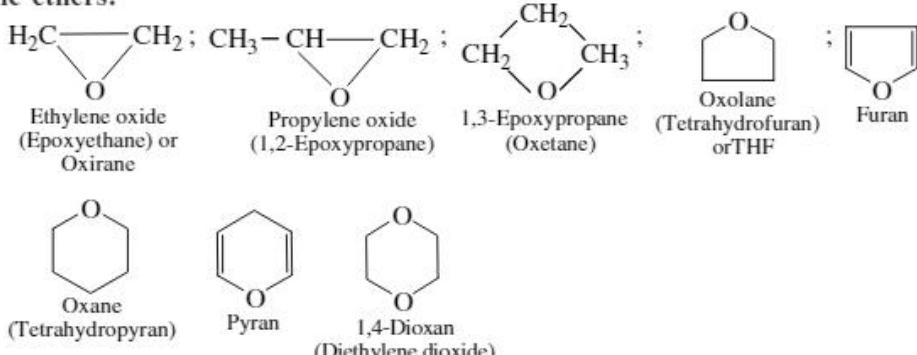
7. IUPAC system: In this system, ethers are named as alkoxy alkanes. The smaller alkyl group plus the oxygen atom is called an alkoxy substituent, in case of mixed ethers, the ethereal oxygen is taken with the smaller alkyl group and forms a part of the alkoxy group while the larger alkyl group is considered to be part of the alkane. Names of some common alkoxy groups are:



The name of the alkane is prefixed by the name of alkoxy group and position number:

Formula	IUPAC	Formula	IUPAC
$\text{CH}_3\text{OCH}_3$	Methoxy methane	$\begin{array}{c} \text{CH}_2\text{CH}_3 \\   \\ \text{CH}_3\text{OCH} \\   \\ \text{CH}_3 \end{array}$	2-Methoxy butane
$\text{CH}_3\text{OC}_2\text{H}_5$	Methoxy ethane		Methoxy benzene (Anisole)
$\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$	Ethoxy ethane		Ethoxy benzene (Phenetole)
$\text{C}_2\text{H}_5\text{OC}_3\text{H}_7$	Ethoxy propane		

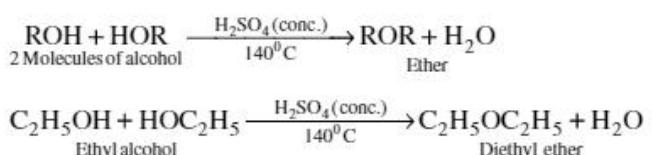
### Cyclic ethers:



## GENERAL METHODS OF PREPARATION:

- 1. Dehydration of alcohols:** When an excess of alcohol is heated at  $140^{\circ}\text{C}$  in presence of protic acids, ( $\text{H}_2\text{SO}_4$ ,  $\text{H}_3\text{PO}_4$ , i.e., concentrated sulphuric acid or phosphoric acid) two molecules of alcohol eliminate one molecule of water to form symmetrical ether. Lower ethers are prepared industrially by this method.

a) Acid catalysed dehydration:

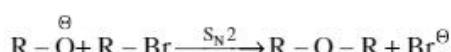


### b) Catalytic dehydration:

Dehydration of a primary alcohol is also affected by passing vapours of alumina or thoria at 250°C under pressure.

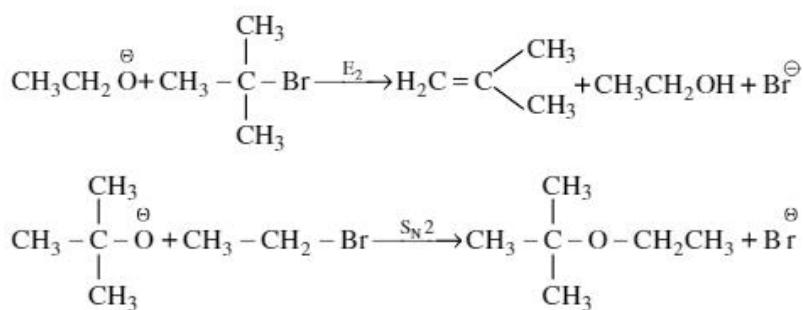


2. **Williamson's ether synthesis:** Ethers are synthesized by the reaction of alkyl halide with an alkoxide ion.

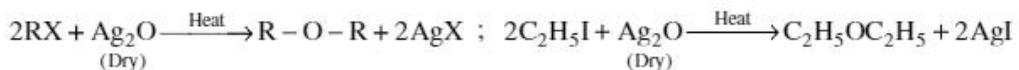


The alkoxide ion for the Williamson ether synthesis is prepared by using sodium metal or sodium hydride ( $\text{NaH}$ ) to remove a proton from an alcohol.

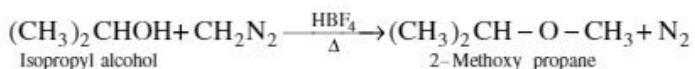
$3^0$  Halide can not be used for Williamson ether synthesis because  $3^0$  halides do not give  $S_N2$  reaction; they give elimination reaction, on reaction with alkoxide ion.



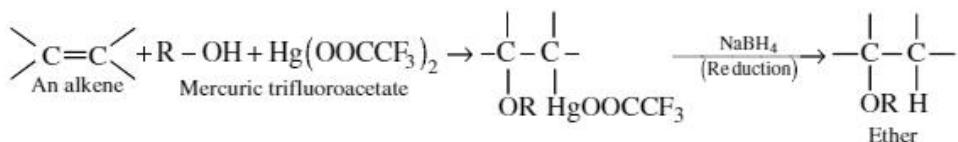
3. **Heating alkyl halides with dry silver oxide:** Symmetrical ethers can be prepared by heating alkyl halides with dry silver oxide.



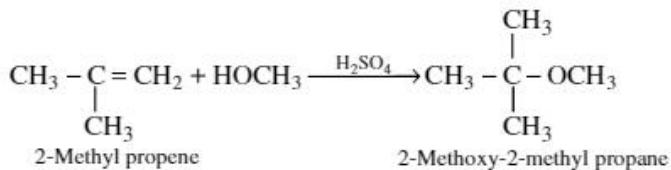
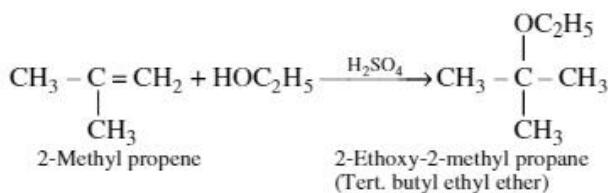
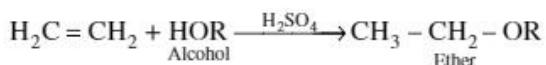
- 4. Action of diazomethane on alcohols:** Methyl ethers can be formed by heating diazomethane with alcohols in presence of a catalyst, boron trifluoride or  $\text{HBF}_4$  (tetrafluoroboric acid).



- ## 5. Alkoxy mercuration-demercuration:



6. **Addition of alcohols to alkenes:** Ethers may be prepared by the direct addition of alcohols to alkenes in the presence of acid, eg.,

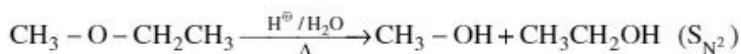
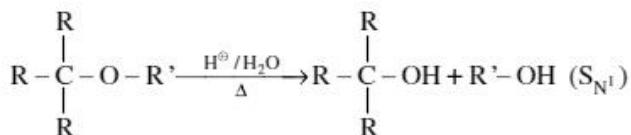
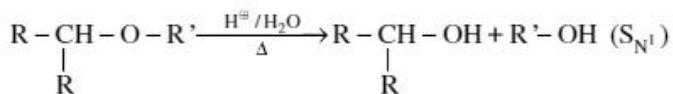
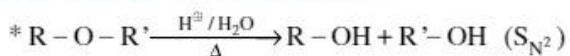


## GENERAL CHARACTERISTICS OF ETHERS

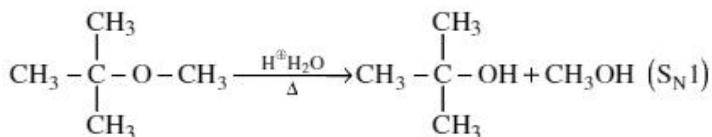
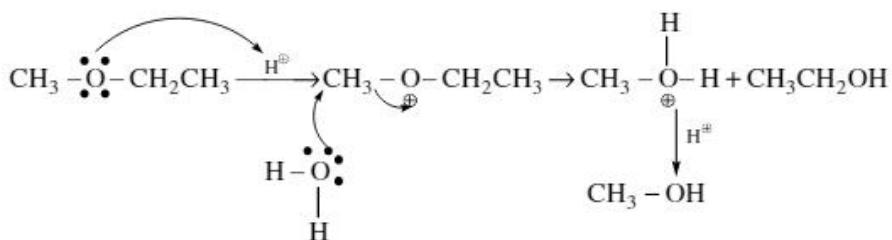
**Chemical properties:** Ethers are chemically less reactive as they do not have any active functional group. They do not react with bases, reducing agents, oxidizing agents and active metals, etc., under ordinary conditions.

## Reactions Involving Cleavage of Carbon-Oxygen Bond

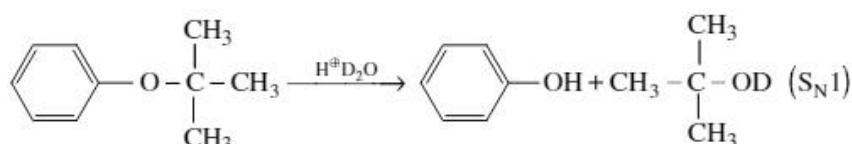
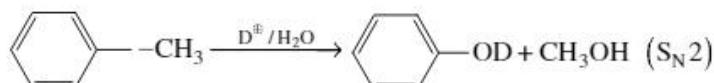
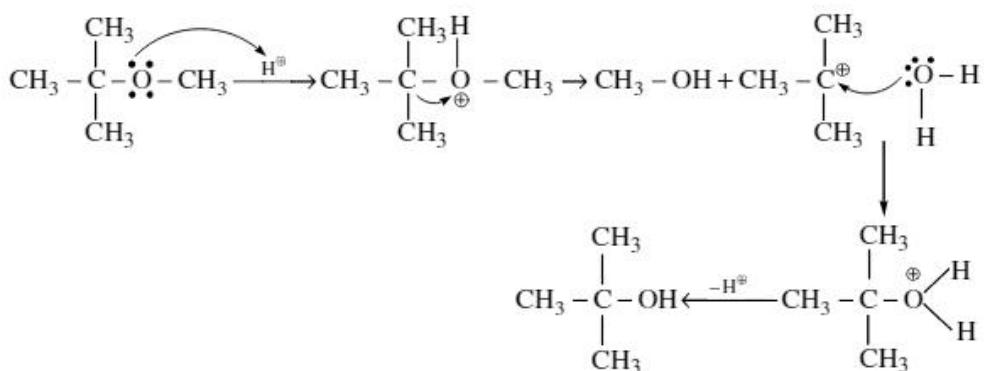
- i) **Hydrolysis:** Ethers when treated with dilute acid at high temperature and pressure, ethers are hydrolysed to the corresponding alcohols.

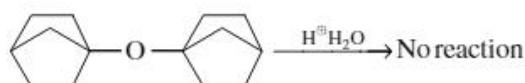
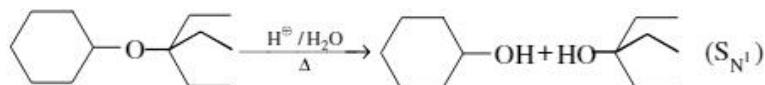
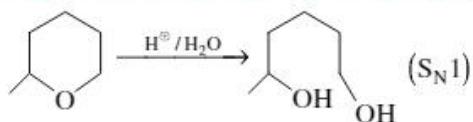


Mechanism:

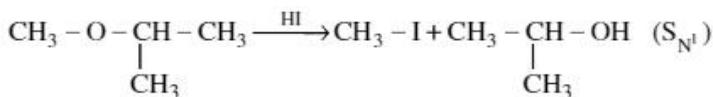
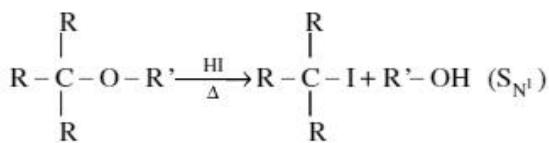
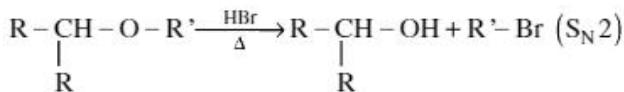
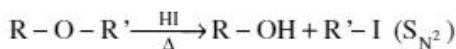


Mechanism:

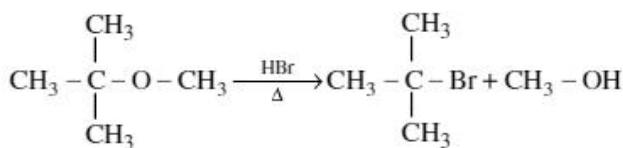




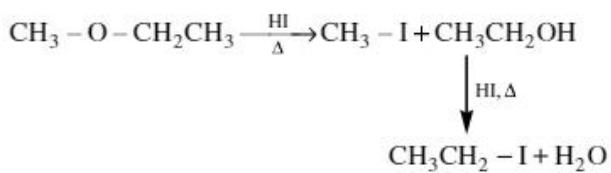
- ii) **Action of HBr and HI :** In the presence of high concentration of HBr or HI, ether undergo a nucleophilic substitution reaction, the reaction of ethers with hydrogen halide is slow and the reaction mixture must be heated in order for the reaction to occur at reasonable rate.



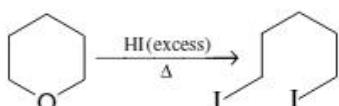
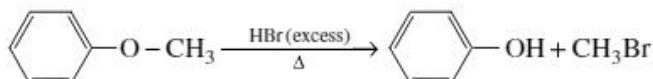
**Mechanism:**



If excess HI is used, the product alcohol will be converted into alkyl halide



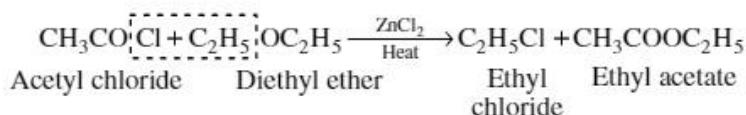
The order of hydrogen halide reactivity is  $\text{HI} > \text{HBr} \gg \text{HCl}$



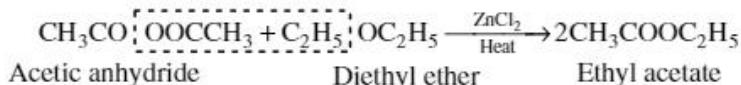
- iii) **Action of  $\text{PCl}_5$ :** On heating with  $\text{PCl}_5$ , alkyl chlorides are formed. There is no reaction in cold conditions



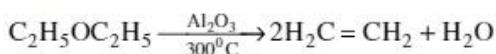
- iv) **Reaction with acetyl chloride:** Ethers when heated with acetyl chloride in the presence of anhydrous zinc chloride or  $\text{AlCl}_3$  to form alkyl halide and ester.



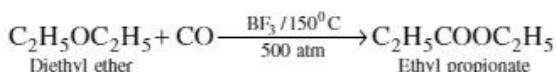
With acid anhydride, esters are formed in presence of  $\text{ZnCl}_2$ .



- v) **Dehydration:** When ether vapours are passed over heated alumina, dehydration of ethers occur to form alkenes.

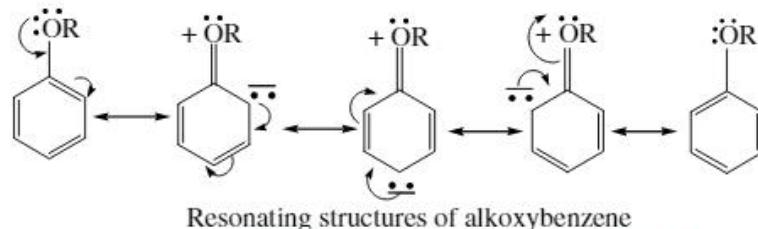


- vi) **Reaction with carbon monoxide:** Under suitable conditions ethers react with carbon monoxide to form esters.



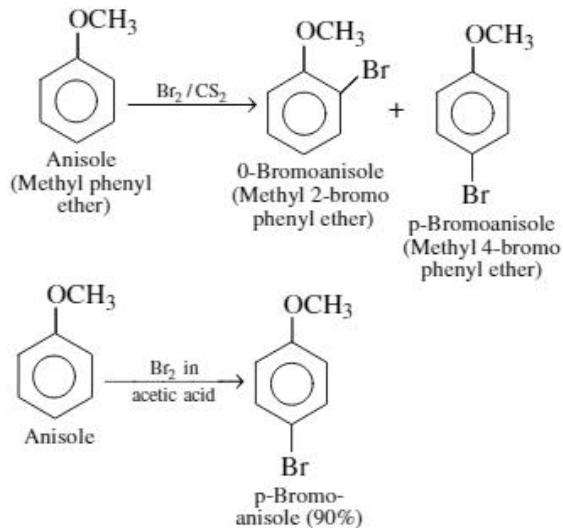
#### Ring substitution in aromatic ethers:

Like phenols, the alkoxy group ( $-\text{OR}$ ) in aromatic ethers is ortho and para directing and activates the ring towards electrophilic substitution reactions.

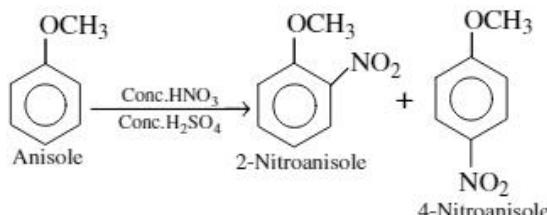


Examples are:

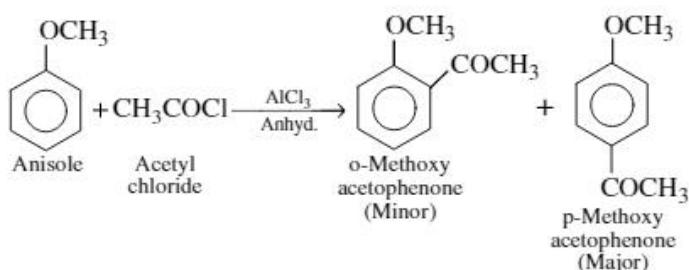
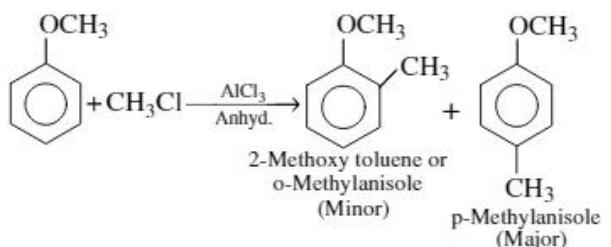
i) Halogenation:



ii) Nitration:



iii) Friedel-Crafts reaction:



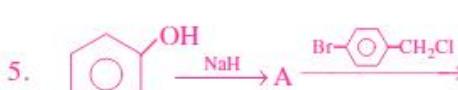
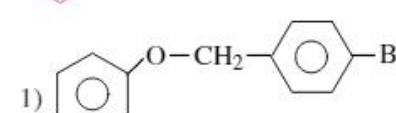
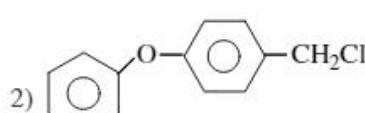
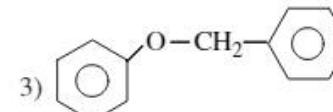
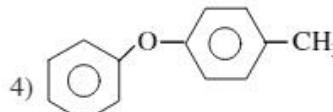
 LECTURE SHEET 

## EXERCISE-I

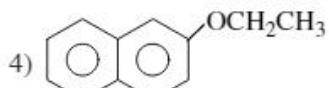
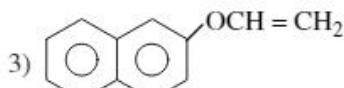
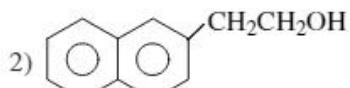
(Introduction &amp; Preparations)

## LEVEL-I (MAIN)

Straight Objective Type Questions

1. The general formula of ethers is  
 1)  $C_nH_{2n}O$       2)  $C_nH_{2n+1}O$       3)  $C_nH_{2n+2}O$       4)  $C_nH_{2n}OC_nH_{2n}$
2. The IUPAC name of  $C_2H_5 - O - CH(CH_3)_2$   
 1) 1-Ethoxy propane      2) 1,1-dimethyl ether  
 3) 2-Ethoxy isopropane      4) 2-Ethoxy propane
3. The reaction,  $RX + R - ONa \rightarrow R - O - R + NaX$  is called  
 1) Wurtz reaction      2) Williamson's synthesis  
 3) Kolbe's reaction      4) Hofmann bromamide reaction
4. To prepare  . Which of the following combination is most suitable?  
 1)  $Me - C_6H_5 - Cl + \text{C}_6H_4\left(\text{NO}_2\right)_2^-$   
 2)  $Me - C_6H_5 - \bar{O}^- + \text{C}_6H_4\left(\text{NO}_2\right)_2Cl$   
 3) Both are equally suitable      4) None of them are suitable
5.  . The structure of the product 'B' is  
 1)   
 2)   
 3)   
 4) 
6. Find out correct product of following reaction:  $\text{CH}_3\text{CH}_2\text{Br} \xrightarrow[\Delta]{\text{Ag}_2\text{O, dry}}$   
 1)   
 2)  $\text{CH}_2 = \text{CH}_2$       3)   
 4)  $\text{CH}_3\text{CH}_2\text{OH}$
7. In the reaction  $\text{PhSH} + \text{NaOH} + n\text{-BuBr} \rightarrow$  the product is:  
 1)  $\text{PhOH}$       2)  $\text{PhOBu}$       3)  $\text{PhSBu}$       4)  $\text{PhSOBu}$

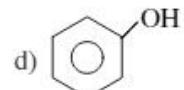
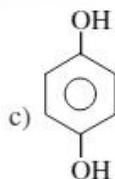
8. In the reaction sequence   $\xrightarrow{\text{NaOH}}$  A  $\xrightarrow{\text{CH}_3\text{CH}_2\text{I}}$  B. The product (B) is :



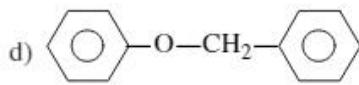
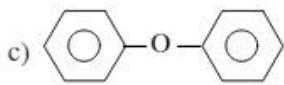
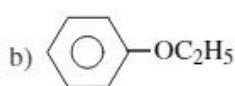
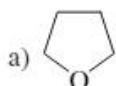
## LEVEL-II (ADVANCED)

More than One correct answer Type Questions

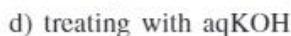
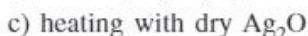
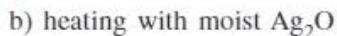
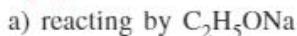
1.  $\text{H}_3\text{CO}-\text{C}_6\text{H}_4-\text{OCH}_2\text{CH}_3 \xrightarrow{\text{HI}, \Delta}$ . The products are



2. Which of the following compound can be prepared by a Williamson ether synthesis?



3.  $\text{C}_2\text{H}_5\text{Br}$  can be converted into  $\text{C}_2\text{H}_5-\text{O}-\text{C}_2\text{H}_5$  by:



## EXERCISE-II

## (Properties of Ethers)

## LEVEL-I (MAIN)

Straight Objective Type Questions

1. If the boiling point of ethanol (molecular weight = 46) is  $78^0\text{C}$ , what is the boiling point of diethyl ether? (molecular weight = 78)
- 1)  $100^0\text{C}$       2)  $78^0\text{C}$       3)  $86^0\text{C}$       4)  $34^0\text{C}$
2.  $\text{C}_2\text{H}_5-\text{O}-\text{C}_2\text{H}_5 + \text{PCl}_5 \rightarrow \text{C}_2\text{H}_5\text{Cl} + \text{X}$ , here 'X' is
- 1)  $\text{PCl}_3$       2)  $\text{H}_3\text{PO}_3$       3)  $\text{PO}_3\text{Cl}$       4)  $\text{POCl}_3$
3. The organic compound which gives peroxy compound on exposure to atmospheric air in the presence of sunlight is
- 1)  $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$       2)  $\text{CHCl}_3$       3)  $\text{CH}_3\text{CH}_2\text{OH}$       4)  $\text{CH}_3\text{CHO}$

4. Sometimes explosion occurs while distilling ethers. It is due to the presence of

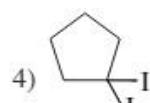
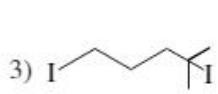
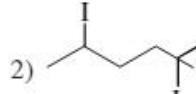
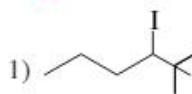
1) Oxides

2) Ketones

3) Aldehydes

4) Peroxides

5.   $\xrightarrow[\text{(2 Equivalents)}]{\text{HI}}$  Product. The product is



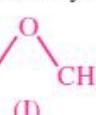
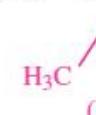
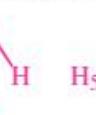
6. Alcohols can be distinguished from Ethers by

1) Sodium metal

2) Sodium hydroxide

3) Sodium bicarbonate

4) All the above

7. The order of solubility of    In water is:

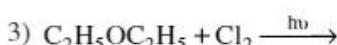
1) I > II > III

2) I < II < III

3) II > III > I

4) II > I > III

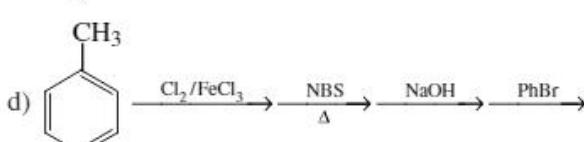
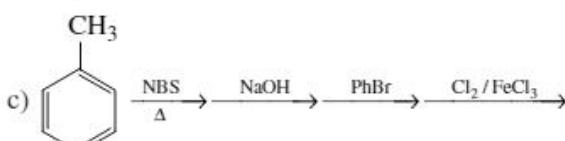
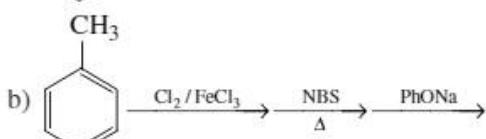
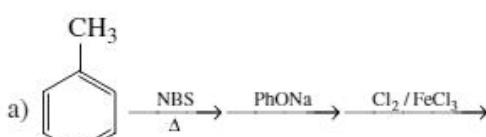
8. In which of the following reactions, ethyl chloride is not formed?

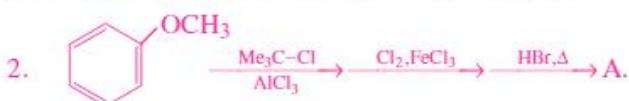


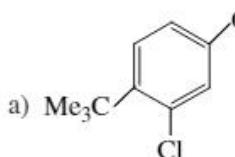
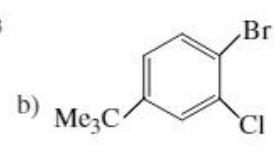
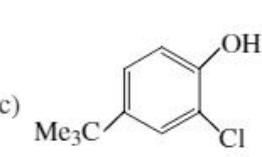
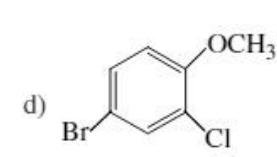
### LEVEL-II (ADVANCED)

#### Straight Objective Type Questions

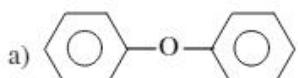
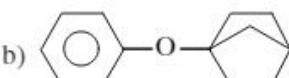
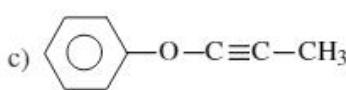
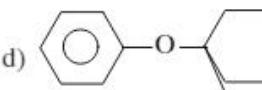
1. Starting with toluene, which of the following is the best method to make the ether shown below? (Assume that you can separate ortho and para isomers)





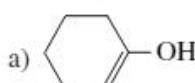
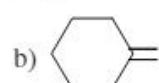
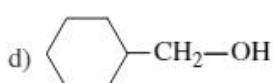
- a)  b)  c)  d) 

3. Which of the following ethers will get hydrolysed by  $H^+ / H_2O$ ?

- a)  b)   
 c)  d) 

More than one correct answer Type Questions

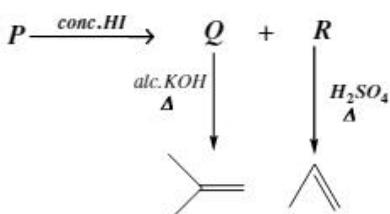
4. In the given reaction 

- a)  b)  c)  d) 

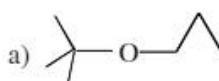
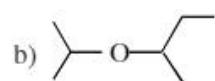
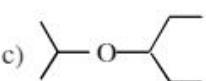
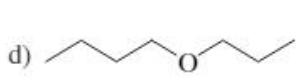
Linked Comprehension Type Questions

Passage :

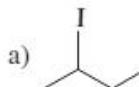
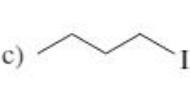
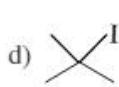
A organic compound P on reaction with concentrated HI gives products Q and R. Both compound Q and R gives alkene on reaction with respectively alcoholic KOH and concentrated  $H_2SO_4$  (followed by heating).



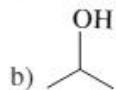
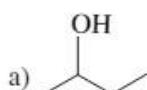
5. Structure of compound P will be:

- a)  b)  c)  d) 

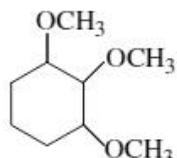
6. Structure of compound Q will be:

- a)  b)  c)  d) 

7. Structure of compound R will be:



Integer Type Questions



8. How many moles of 'HI' will react with

9. The number of ethers possible for  $C_4H_{10}O$

KEY SHEET (LECTURE SHEET)

EXERCISE-I

LEVEL-I

- 1) 3    2) 4    3) 2    4) 2    5) 1    6) 3    7) 3    8) 4

- 1) abc    2) abd    3) ac

EXERCISE-II

LEVEL-I

- 1) 4    2) 4    3) 1    4) 4    5) 3    6) 1    7) 3    8) 3

- 1) b    2) c    3) d    4) abd    5) a    6) d    7) c    8) 6

9) 3

PRACTICE SHEET

EXERCISE-I

(Introduction & Preparations)

LEVEL-I (MAIN)

Straight Objective Type Questions

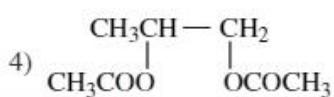
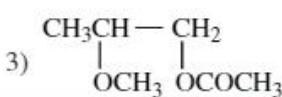
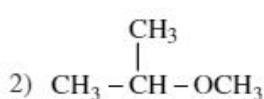
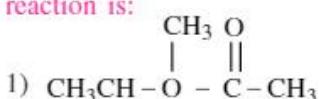
1. Ally phenyl ether can be prepared by heating:

- 1)  $C_6H_5Br + CH_2 = CH - CH_2 - ONa \rightarrow$     2)  $CH_2 = CH - CH_2 - Br + C_6H_5ONa \rightarrow$   
 3)  $C_6H_5 - CH = CH - Br + CH_3 - ONa \rightarrow$     4)  $CH_2 = CH - Br + C_6H_5 - CH_2 - ONa \rightarrow$

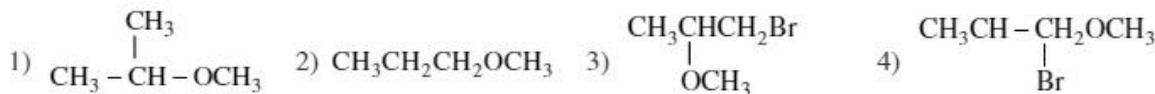
2.  $CH_3CH = CH_2 \xrightarrow{HCl} X \xrightarrow[Heat]{Dry Ag_2O} Y$ . The product Y in the above sequence is

- 1) Di isopropyl ether    2) Di n-propyl ether    3) 2-Propanol    4) 1,2-Epoxypropane

3. Consider the following reaction  $CH_3CH = CH_2 \xrightarrow[2.NaBH_4]{1.(CH_3COO)_2Hg, CH_3OH}$ . The product formed in the reaction is:



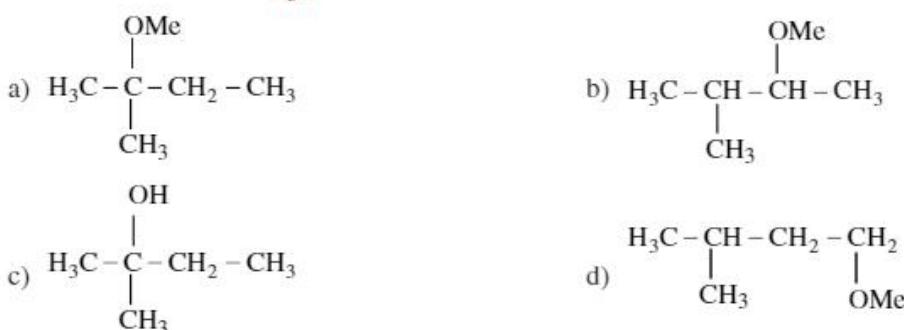
4. Consider the following reactions.  $\text{CH}_3\text{CH}=\text{CH}_2 \xrightarrow[\text{(C}_6\text{H}_5\text{CO})_2\text{O}_2]{\text{HBr}} \text{A} \xrightarrow{\text{CH}_3\text{ONa}} \text{B}$ . The major end product (B) is:



**LEVEL-II (ADVANCED)**

*Straight Objective Type Questions*

1. In the given reaction  $\begin{array}{c} \text{H}_3\text{C} \\ | \\ \text{C}=\text{CH}-\text{CH}_3 \\ | \\ \text{H}_3\text{C} \end{array} \xrightarrow[\text{(ii) NaBH}_4]{\text{(i) Hg(OAc)}_2/\text{CH}_3\text{OH}} [\text{X}]$ , [X] will be



*More than One correct answer Type Questions*

2.  $\text{C}_2\text{H}_5\text{Br}$  can be converted into  $\text{C}_2\text{H}_5-\text{O}-\text{C}_2\text{H}_5$  by:  
 a) reacting by  $\text{C}_2\text{H}_5\text{ONa}$     b) heating with moist  $\text{Ag}_2\text{O}$   
 c) heating with dry  $\text{Ag}_2\text{O}$     d) treating with  $\text{C}_2\text{H}_5\text{MgBr}$

3. The ether  when treated with HI produces



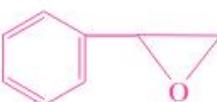
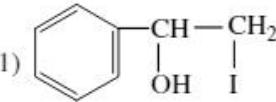
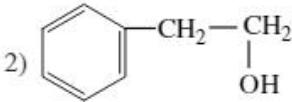
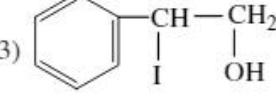
◆ EXERCISE-II ◆

*(Properties of Ethers)*

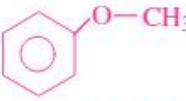
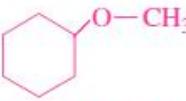
**LEVEL-I (MAIN)**

*Straight Objective Type Questions*

1. In the reaction  $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5 + \text{CO} \xrightarrow[150^\circ\text{C}]{\text{BF}_3, 500\text{atms}} \text{X}$ . What is X?  
 1) Diethyl carbonate    2) Ethyl carbonate    3) Diethyl peroxide    4) Ethyl propionate
2. When diethyl ether is heated with dil.  $\text{H}_2\text{SO}_4$  under pressure, it forms  
 1) Propanoic acid    2) Acetic acid  
 3) Ethyl alcohol    4) Ethyl hydrogen sulphate
3. Grignard reagent are prepared in  
 1) Benzene    2) Chloroform    3) Alcohols    4) Ethers

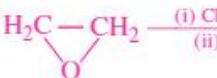
4. Regarding diethyl ether, the wrong statement is  
 1) It is slightly soluble in water  
 2) In cold condition, ether does not react with alkali and dilute acids  
 3) Ethers have active hydrogen  
 4) Ethers do not react with Na metal
5. C – O – C bond in ethers can be cleaved by  
 1)  $\text{H}_2\text{SO}_4$       2)  $\text{LiAlH}_4$       3)  $\text{KOH}$       4)  $\text{HI}$
6. In the reaction:  $\text{Me}_3\text{C}-\text{O}-\text{CH}_2\text{CH}_3 + \text{HI} \xrightarrow[\text{(1 Mole)}]{\Delta}$   
 1)  $\text{Me}_3\text{C}-\text{OH} + \text{CH}_3\text{CH}_2\text{I}$       2)  $\text{Me}_3\text{C}-\text{I} + \text{CH}_3\text{CH}_2\text{OH}$   
 3)  $\text{Me}_3\text{C}-\text{I} + \text{CH}_3\text{CH}_2\text{I}$       4)  $\text{Me}_3\text{C}-\text{OH} + \text{CH}_3\text{CH}_2\text{OH}$
7.  + HI  $\longrightarrow$  (C); C is:  
 1)   
 2)   
 3)   
 4) None of these
8. Anisole on treatment with  $\text{Br}_2/\text{CS}_2$  gives:  
 1) bromobenzene      2) methyl-2-bromophenyl ether  
 3) o-and p-bromoanisole      4) phenol

Numerical Value Type Questions

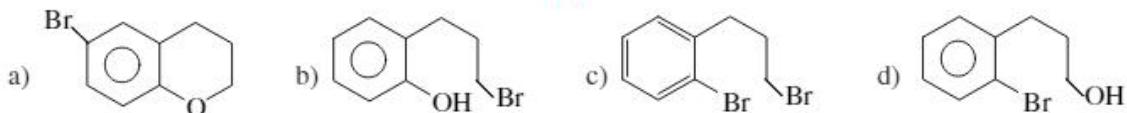
9.   $\xrightarrow{\text{Conc.HI}}$  x mole of HI is consumed
-   $\xrightarrow{\text{Conc.HI}}$  y mole of HI is consumed

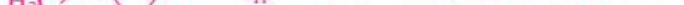
Sum of (x + y = ?) :

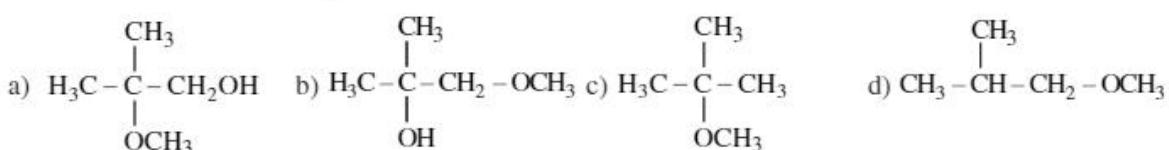
**LEVEL-II (ADVANCED)**Straight Objective Type Questions

1.  $\text{CH}_3-\text{CH}_2-\text{O}-\text{CH}_2-\text{CH}_3 \xrightarrow[\text{(excess)}]{\text{Conc.HI}} ?$  Major product of the reaction is:  
 a) 2EtOH      b) 2EtI      c) EtOH, EtI      d)  $2\text{H}_2\text{C}=\text{CH}_2$
2.   $\xrightarrow[\text{(ii) H}_2\text{O}]{\text{(i) } \text{CH}_3\text{MgCl}}$  X . The product obtained in this reaction is:  
 a)  $\text{CH}_3\text{CH}_2\text{OH}$       b)  $(\text{CH}_3)_2\text{CHOH}$   
 c)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$       d)  $\text{HO}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{OH}$

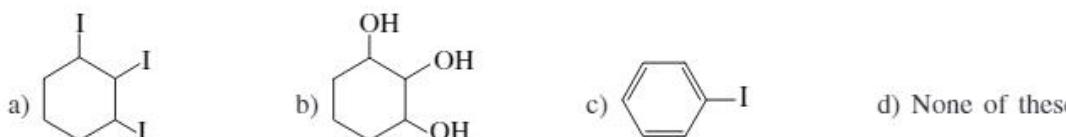
3. Find out correct product of reaction:



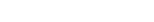
4. In the reaction,  The product (X) has the structure:



5. 



6.   $\xrightarrow{H^+}$

a)  b)  c)  d) 

### ***More than One correct answer Type Questions***

7.  $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$  and   $\text{OH}$  can be distinguished by:

- a) aq.  $\text{FeCl}_3$       b) Na metal      c) Tollen's reagent      d)  $\text{K}_2\text{Cr}_2\text{O}_7$

8. 
$$\text{Cyclohexanol} \xrightarrow{\text{excess concHCl}} \text{A} \xrightarrow[\text{(ii) CO}_2, \text{H}^+ / \text{H}_2\text{O}]{\text{(i) Mg, ether}} \text{B}$$

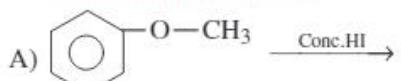
$$\text{Cyclohexanol} \xrightarrow{\text{aq. KOH}} \text{C} \xrightarrow{\text{HOI, KMnO}_4} \text{D}$$

- a) A is b) B is c) C is d) D is

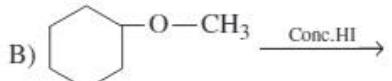
*Matrix Matching Type Questions*

## 9. Column-I (Reaction)

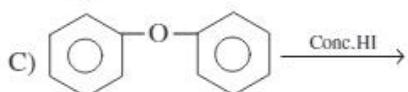
## Column-II (Moles of HI consumed)



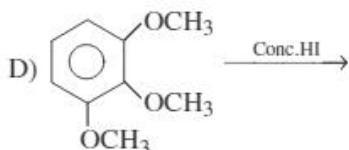
p) No reaction



q) 1



r) 2



s) 3

## KEY SHEET (PRACTICE SHEET)

## EXERCISE-I

<b>LEVEL-I</b>	1) 2	2) 1	3) 2	4) 2
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<b>LEVEL-II</b>	1) a	2) ac	3) ad
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## EXERCISE-II

<b>LEVEL-I</b>	1) 4	2) 3	3) 4	4) 3	5) 4	6) 2	7) 3	8) 3
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9) 3

<b>LEVEL-II</b>	1) b	2) c	3) b	4) a	5) a	6) c	7) bd
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8) abcd 9) A-q; B-r; C-p; D-s

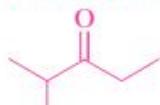
## ADDITIONAL PRACTICE EXERCISE

(Alcohols, Phenols and Ethers)

LEVEL-I (MAIN)

Straight Objective Type Questions

1. Which sequence of steps describes the best synthesis of 2-methyl-3-pentanone?



- 1) I) 1-propanol +  $(\text{CH}_3)_2\text{CHMgBr}$ , diethyl ether ; II)  $\text{H}_3\text{O}^+$  ; III) PDC,  $\text{CH}_2\text{Cl}_2$
- 2) I) 1-propanol +  $\text{Na}_2\text{CrO}_7$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{O}$ , Heat ; II)  $\text{SOCl}_2$  ; III)  $(\text{CH}_3)_2\text{CHCl}$ ,  $\text{AlCl}_3$
- 3) I) 1-propanal + PCC,  $\text{CH}_2\text{Cl}_2$  ; II)  $(\text{CH}_3)_2\text{CHLi}$ , diethyl ether; III)  $\text{H}_3\text{O}^+$ ;
- IV)  $\text{Na}_2\text{Cr}_2\text{O}_7$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{O}$ , Heat
- 4) I) 2-propanol +  $\text{Na}_2\text{Cr}_2\text{O}_7$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{O}$ , Heat II)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Li}$ , dimethyl ether  
III)  $\text{H}_3\text{O}^+$ ; IV) PCC,  $\text{CH}_2\text{Cl}_2$

2. Which of the following sets of reagents would accomplish the following conversion?

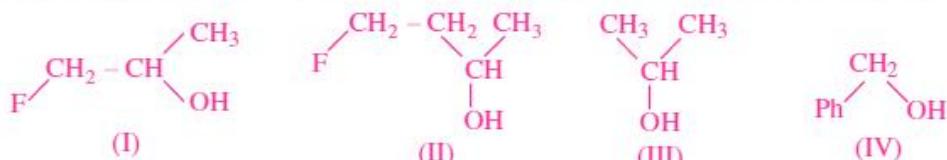


- 1)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{MgBr}; \text{H}_3\text{O}^+; \text{PCC}, \text{CH}_2\text{Cl}_2$
- 2)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{MgBr}; \text{H}_3\text{O}^+; \text{H}_2\text{SO}_4, \Delta; \text{PCC}, \text{CH}_2\text{Cl}_2$
- 3)  $(\text{C}_6\text{H}_5)_3\text{P}-\bar{\text{C}}\text{HCH}_2\text{CH}_3; \text{B}_2\text{H}_6; \text{H}_2\text{O}_2, \text{OH}^-$
- 4)  $(\text{C}_6\text{H}_5)_3\text{P}-\bar{\text{C}}\text{HCH}_2\text{CH}_3; \text{H}_2\text{SO}_4; \text{H}_2\text{O}$

3. An organic compound A(molecular formula,  $\text{C}_6\text{H}_{12}\text{O}$ ) doesn't decolourise the Bayer's reagent and, doesn't change the colour of acidic dichromate solution, Compound A on treatment with  $\text{H}_2\text{SO}_4$  produces alkene, which on oxidative ozonolysis gives a molecule ( $\text{C}_6\text{H}_{10}\text{O}_3$ ), which gives the positive iodoform test. The most appropriate molecular structure of A, is



4. The correct order of reactivities of the following alcohols towards conc. HCl is

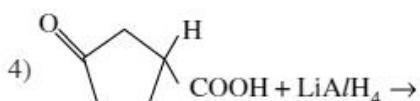
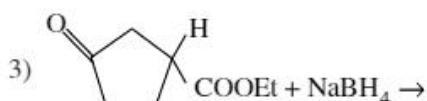
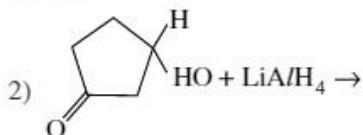
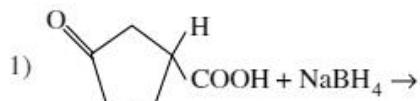


- 1) I > II > III > IV
- 2) IV > III > II > I
- 3) IV > II > III > I
- 4) IV > III > I > II

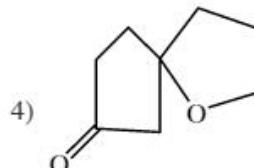
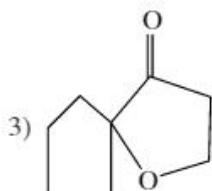
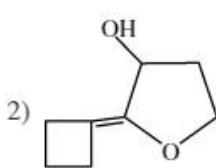
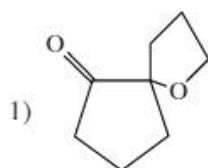
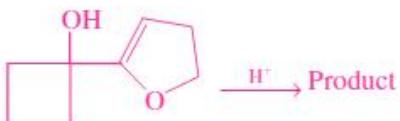
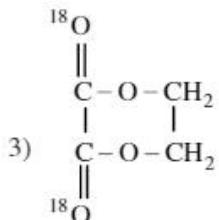
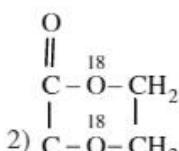
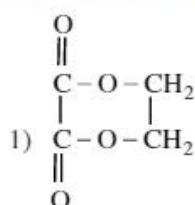
5. The above hydration can be carried out by

- 1) acid catalysed hydration
- 2) oxymercuration-demercuration
- 3) hydroboration-oxidation
- 4) None of the above

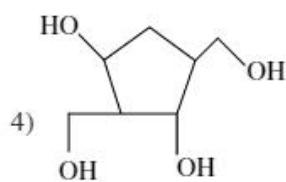
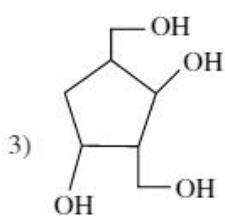
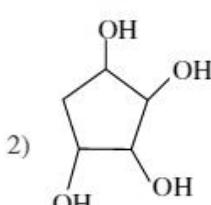
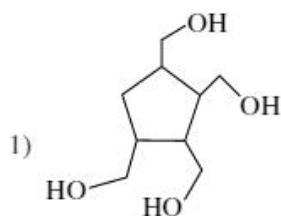
6. The compound X is prepared from

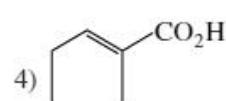
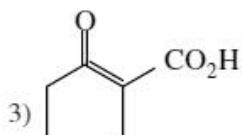
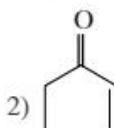
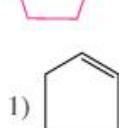
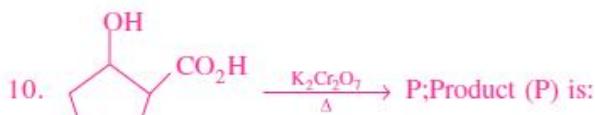


7. Identify the major product,

8.  $\text{CO}_2\text{H} + \text{CH}_2 - \overset{18}{\text{OH}} \text{H} \xrightarrow[\Delta]{\text{H}^+} (\text{A})$ . Product (A) is:9.  $\text{C}_6\text{H}_6 + \text{CH}_2 = \text{CH}-\text{CO}_2\text{H} \xrightarrow[\Delta]{\text{OSO}_4} (\text{A}) \xrightarrow{\text{NaIO}_4} (\text{B}) \xrightarrow{\text{LiAlH}_4 \text{ [excess]}} (\text{D})$ .

Product (D) in above reaction sequence is:



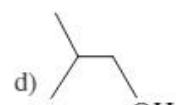
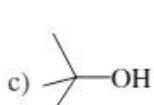
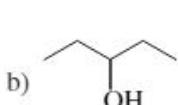
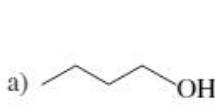


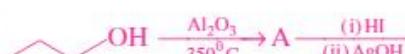
## LEVEL-II

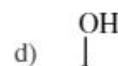
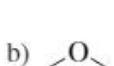
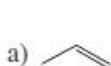
## LECTURE SHEET (ADVANCED)

Straight Objective Type Questions

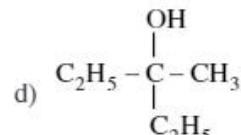
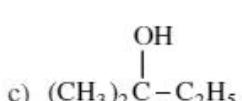
1. The alcohol,  $C_4H_9OH$  when treated with a mixture of anhydrous  $ZnCl_2$  and conc.  $HCl$  gave an immediate oily layer. It will be



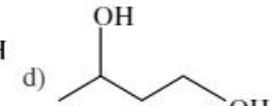
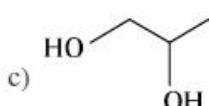
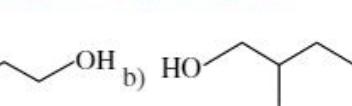
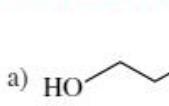
2. Consider the following reaction:  The product B is

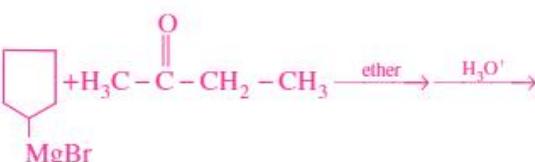


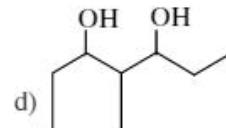
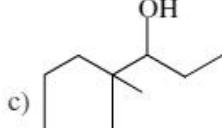
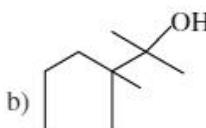
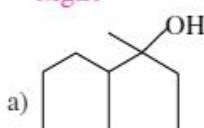
3.  +  $2CH_3MgBr \rightarrow A$ , A is



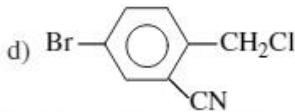
4. Of the following diols that which reacts with  $CrO_3$  in aqueous  $H_2SO_4$  and yield products that readily undergo decarboxylation on heating, is



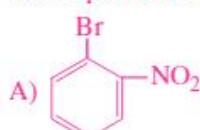
5. 



6. The product obtained from the reaction is: Br--CH<sub>2</sub>Cl + NaCN  $\xrightarrow{\text{DMSO}}$



7. Rank the following in the order of decreasing rate of reaction with alkoxide ion ( $\text{CH}_3\text{CH}_2\text{O}^-$ ) in a nucleophilic aromatic substitution reaction:



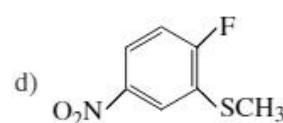
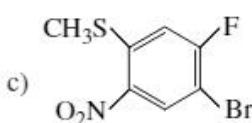
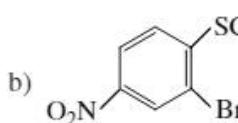
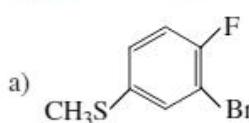
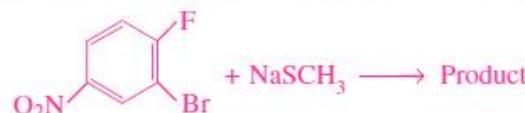
a) C > D > A > B

b) C > D > B > A

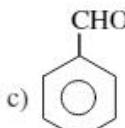
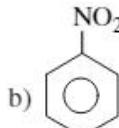
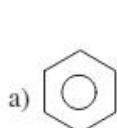
c) B > A > D > C

d) D > C > B > A

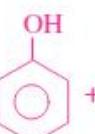
8. Identify the principal organic product of the following reaction.

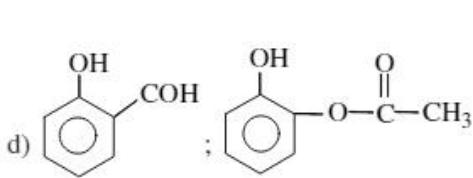
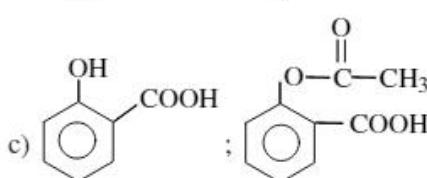
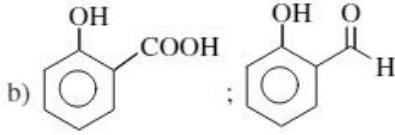
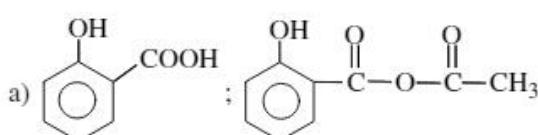


9. Which of the following compound will not undergo Reimer-Tiemann reaction?

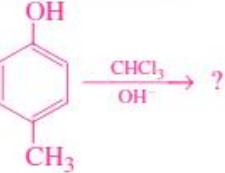


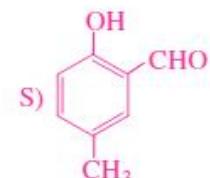
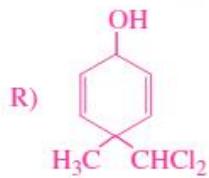
d) all of these

10.  + CO<sub>2</sub>  $\xrightarrow[2)\text{H}^+]{1)\text{NaOH}}$  (A)  $\xrightarrow{\text{CH}_3-\overset{\text{O}}{\parallel}\text{C}-\text{O}-\overset{\text{O}}{\parallel}\text{C}-\text{CH}_3}$  (B). Product (A) and (B) respectively are

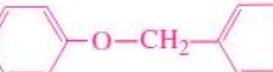


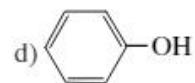
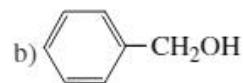
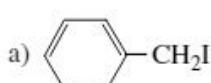
More than One correct answer Type Questions

11. In the following reaction, the product (s) formed is (are): 

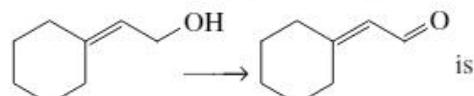


- a) P (major)      b) Q (minor)      c) R (minor)      d) S (major)

12. The following ether, when treated with HI produces  + HI →

Integer Type Questions

13. The number of reagents among the following which can effect the conversion



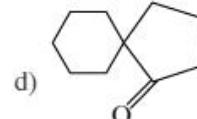
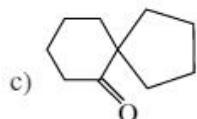
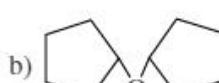
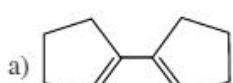
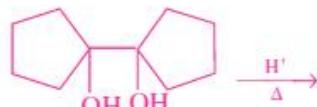
- (a) Cu, 573 K    (b) MnO<sub>2</sub>    (c) PCC    (d) PDC    (e) CrO<sub>3</sub>-Acetone (anhydrous)    (f) Br<sub>2</sub>/H<sub>2</sub>O

14. If 1-methylcyclopentanol is heated with concentrated H<sub>2</sub>SO<sub>4</sub> dehydration takes place. How many different dehydration products would be formed?

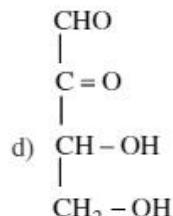
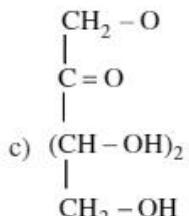
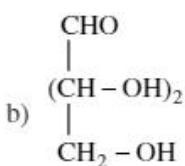
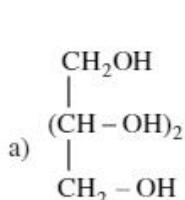
15. An organic compound (X) has molecular formula C<sub>7</sub>H<sub>6</sub>O<sub>2</sub> and it does not effervesces with NaH. 'X' on treatment with excess of HBr<sub>(aq)</sub> gives Y(C<sub>6</sub>H<sub>6</sub>O<sub>2</sub>) and CH<sub>2</sub>Br<sub>2</sub>. Y forms a violet coloured solution with FeCl<sub>3</sub>. If X is treated with Br<sub>2</sub>/Fe how many different monobromination product would result?

**PRACTICE SHEET (ADVANCED)**Straight Objective Type Questions

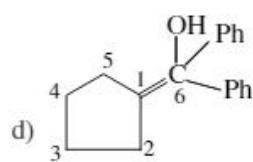
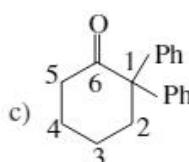
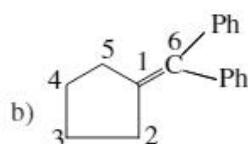
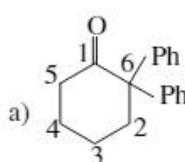
1. The structure of the product formed in the reaction given below is



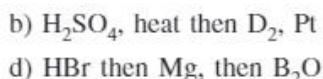
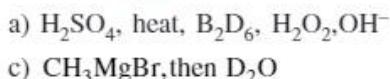
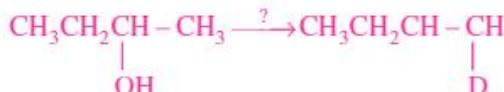
2. Which of the following compound gives  $2\text{HCHO}, \text{CO}_2, \text{HCO}_2\text{H}$  when oxidised by periodic acid?



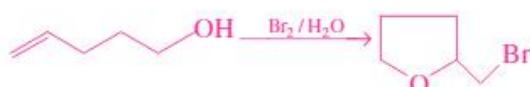
3. ; Unknown (P) of the reaction is:



4. Which sequence of reagents would carry out the following conversion?



5. When 4-penten-1-ol is treated with aqueous bromine, a cyclic bromo substituted ether is formed rather than the expected bromohydrin. select the explanation that best accounts for this result.



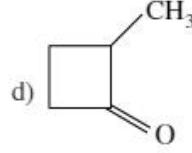
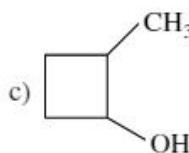
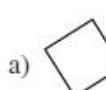
a) The ether is the result of hydride shift in the initially formed carbocation.

b) The ether is formed in the intramolecular nucleophile attack on initially formed bromonium ion.

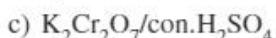
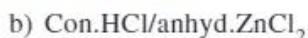
c) The reaction is initiated by protonation of  $\pi$ -bond.

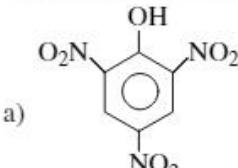
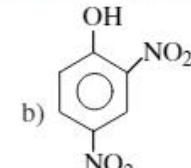
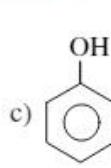
d) The initially formed bromonium ion undergoes an alkyl shift to form new C – O bond.

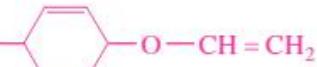
6. 5-bromo-2-pentanone  $\xrightarrow[\text{THF}]{\text{Mg}}$ . The product of the above reaction is:

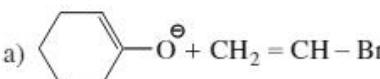
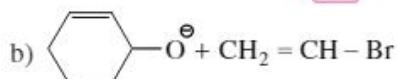
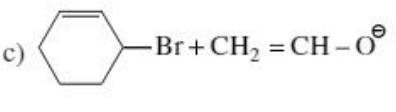
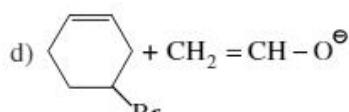


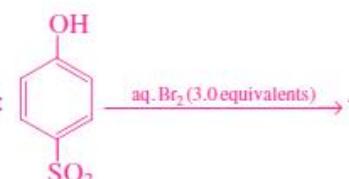
7. Ethanol and propan-2-ol may be distinguished using the reagent

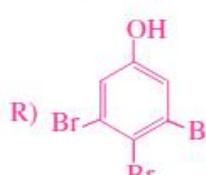


8. The ether in which all atoms may exist in one plane is  
 a) Dimethyl ether      b) Methyl vinyl ether      c) Divinyl ether      d) Allyl ethyl ether
9. Which of the following does not react with  $\text{NaHCO}_3$ ?  
 a)       b)       c)       d) both b & c

10. The best method for synthesis of given ether by Williamson's synthesis is 

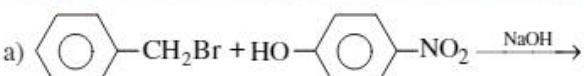
- a)       b) 
- c)       d) 

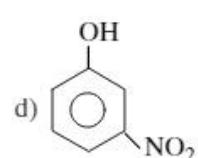
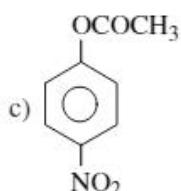
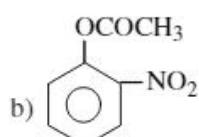
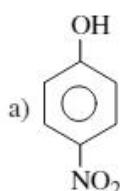
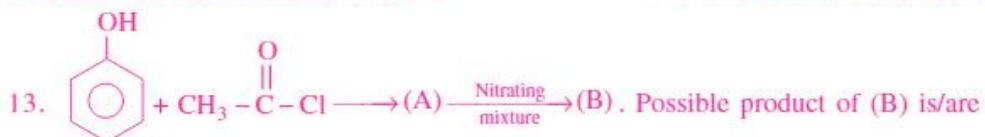
11. The product(s) of the following reaction is (are): 

- P)       Q)       R)       S) 
- a) P      b) Q      c) R      d) S

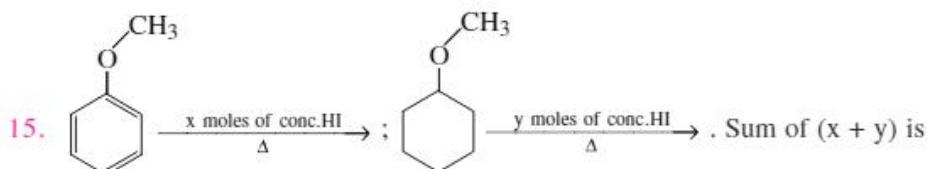
***More than One correct answer Type Questions***

12. Which of the following gives ether successfully?

- a)       b)  $\text{C}_2\text{H}_5\text{ONa} + (\text{CH}_3)_2\text{SO}_4 \rightarrow$
- c)  $\text{CH}_3\text{ONa} + \text{CH}_3\text{CH}_2\text{OSO}_2-\text{C}_6\text{H}_4-\text{CH}_3 \longrightarrow$
- d)  $(\text{CH}_3)_3\text{CBr} + \text{C}_2\text{H}_5\text{ONa} \rightarrow$

Integer Type Questions

14. The number of -OH groups in aspirin is



## ♦♦♦ KEY SHEET (ADDITIONAL PRACTICE EXERCISE) ♦♦♦

## LEVEL-I (MAIN)

1) 3    2) 3    3) 2    4) 2    5) 3    6) 1    7) 1    8) 2    9) 1    10) 2

## LEVEL-II

## LECTURE SHEET (ADVANCED)

1) c    2) b    3) b    4) c    5) a    6) a    7) a    8) b    9) d    10) c  
 11) bd    12) ad    13) 5    14) 2    15) 2

## PRACTICE SHEET (ADVANCED)

1) c    2) d    3) a    4) b    5) c    6) b    7) b    8) c    9) c    10) c  
 11) b    12) abc    13) bc    14) 0    15) 3

