5

Alcohols, Phenols and Ethers

Multiple Choice Questions (MCQs)

DIRECTIONS : *This section contains multiple choice questions. Each question has four choices (a), (b), (c) and (d) out of which only one is correct.*

1. Isopropyl alcohol is obtained by reacting which of the following alkenes with concentrated H_2SO_4 followed by boiling with H_2O?
(a) Ethylene (b) Propylene
(c) 2-Methylpropene (d) Isoprene

2. Which statement is not correct about alcohol?
(a) Molecular weight of alcohol is higher than water
(b) Alcohol of less no. of carbon atoms is less soluble in water than alcohol of more no. of carbon atoms
(c) Alcohol evaporates quickly
(d) All of the above

3. Which of the following is not true in case of reaction with heated copper at 300°C?
(a) Phenol $\longrightarrow$ Benzyl alcohol
(b) Secondary alcohol $\longrightarrow$ Ketone
(c) Primary alcohol $\longrightarrow$ Aldehyde
(d) Tertiary alcohol $\longrightarrow$ Olefin

4. When phenol is treated with excess bromine water, it gives:
(a) *m*-bromophenol (b) *o*- and *p*-bromophenol
(c) 2, 4-dibromophenol (d) 2, 4, 6-tribromophenol

5. Which of the following statements are correct ?
(i) In phenols, the —OH group is attached to sp^2 hybridised carbon of an aromatic ring
(ii) The carbon – oxygen bond length (136 pm) in phenol is slightly more than that in methanol
(iii) Partial double bond character is due to the conjugation of unshared electron pair of oxygen with the aromatic ring.
(iv) Phenol has sp^2 hybridised state of carbon to which oxygen is attached.
(a) (i), (ii) and (v) (b) (i), (ii) and (iii)
(c) (i), (iii) and (iv) (d) (i) and (iv)

6. Propene, $CH_3CH = CH_2$ can be converted into 1-propanol by oxidation. Indicate which set of reagents amongst the following is ideal to effect the above conversion?
(a) $KMnO_4$ (alkaline)
(b) Osmium tetraoxide (OsO_4/CH_2Cl_2)
(c) B_2H_6 and alk. H_2O_2
(d) O_3/Zn

7. Which of the following cannot be made by using Williamson's synthesis?
(a) Methoxybenzene
(b) Benzyl *p*-nitrophenyl ether
(c) Methyl tertiary butyl ether
(d) Di-tert-butyl ether

8. An ether is more volatile than an alcohol having the same molecular formula. This is due to
(a) dipolar character of ethers
(b) alcohols having resonance structures
(c) inter-molecular hydrogen bonding in ethers
(d) inter-molecular hydrogen bonding in alcohols

9. Which of the following has strongest hydrogen bonding?
(a) Ethyl amine (b) Ethanal
(c) Ethyl alcohol (d) Diethyl ether

10. An aromatic ether is not cleaved by HI even at 525 K. The compound is
(a) $C_6H_5OCH_3$ (b) $C_6H_5OC_6H_5$
(c) $C_6H_5OC_3H_7$ (d) Tetrahydrofuran

11. Which of the following compounds is resistant to nucleophilic attack by hydroxyl ions?
(a) Methyl acetate (b) Acetonitrile
(c) Acetamide (d) Diethyl ether

12. How many alcohols with molecular formula $C_4H_{10}O$ are chiral in nature?
(a) 1 (b) 2 (c) 3 (d) 4

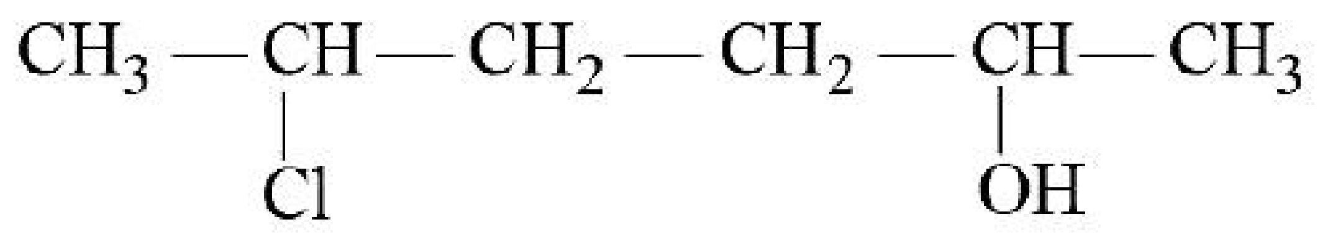
13. What is the correct order of reactivity of alcohols in the following reaction?

$$R — OH + HCl \xrightarrow{ZnCl_2} R - Cl + H_2O$$

(a) $1° > 2° > 3°$ (b) $1° < 2° < 3°$
(c) $3° > 2° > 1°$ (d) $3° > 1° > 2°$

14. The process of converting alkyl halides into alcohols involves ....
(a) addition reaction (b) substitution reaction
(c) dehydrohalogenation (d) rearrangement reaction

15. Give IUPAC name of the compound given below.



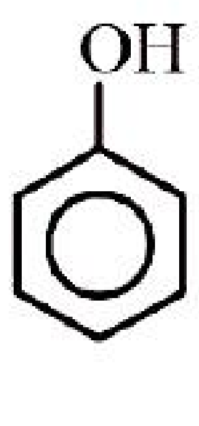
$$CH_3-\underset{\underset{Cl}{|}}{CH}-CH_2-CH_2-\underset{\underset{OH}{|}}{CH}-CH_3$$

(a) 2-chloro-5-hydroxyhexane
(b) 2-hydroxy-5-chlorohexane
(c) 5-chlorohexan-2-ol
(d) 2-chlorohexan-5-ol

16. Phenol is less acidic than ....

(a) ethanol (b) *o* - nitrophenol
(c) *o*-methylphenol (d) *o*-methoxyphenol

17. Mark the correct order of decreasing acid strength of the following compounds.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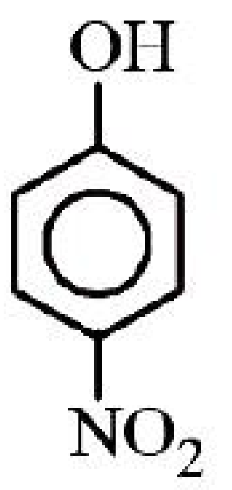
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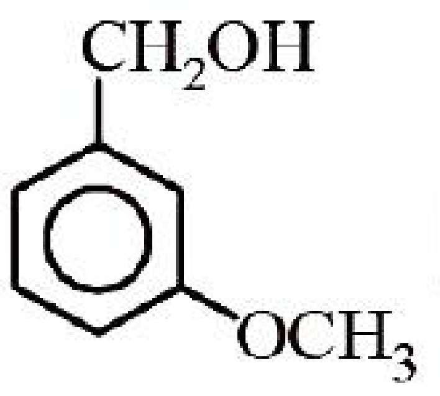
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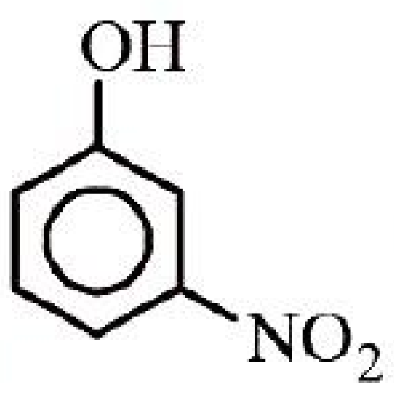
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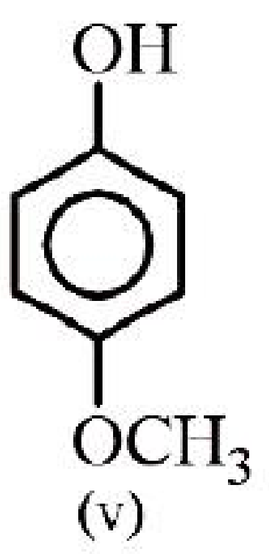

(v)

(a) V > IV > II > I > III (b) II > IV > I > III > V
(c) IV > V > III > II > I (d) V > IV > III > II > I

18. Arrange the following compounds in increasing order of boiling point.

Propan - 1- ol, butan - 1 - ol, butan - 2 - ol, pentan - 1 - ol

(a) Propan-1-ol, butan-2-ol, butan-1-ol, pentan-1-ol
(b) Propan-1-ol, butan-1-ol, butan-2-ol, pentan-1-ol
(c) Pentan-1-ol, butan-2-ol, butan-1-ol, propan-1-ol
(d) Pentan-1-ol, butan-1-ol, butan-2-ol, propan-1-ol

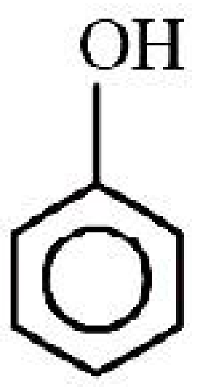
19. Monochlorination of toluene in sunlight followed by hydrolysis with aq. NaOH yields

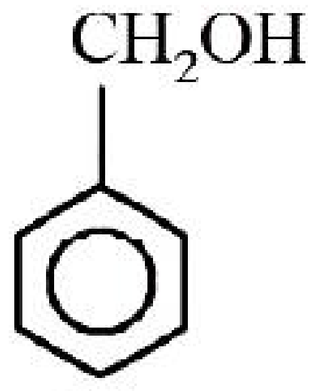
(a) *o* – cresol (b) *m* – cresol
(c) 2, 4 – dihydroxytoluene (d) benzyl alcohol

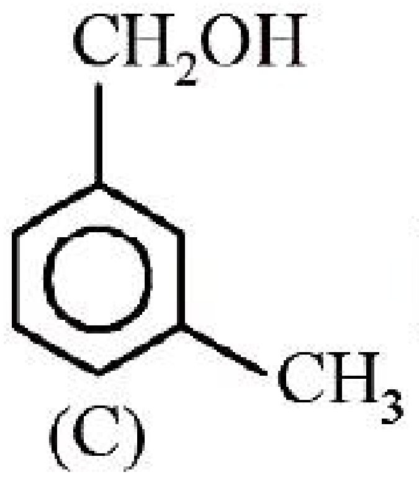
20. CH_3CH_2OH can be converted into CH_3CHO by ....

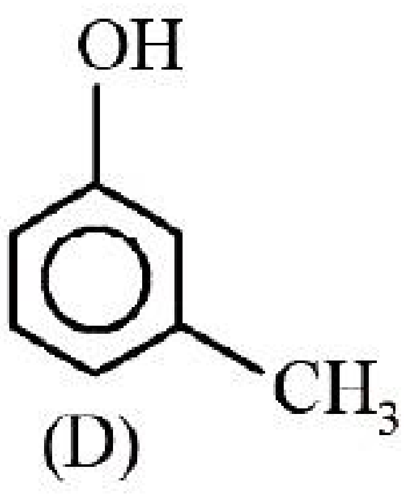
(a) catalytic hydrogenation
(b) treatment with $LiAlH_4$
(c) treatment with pyridinium chlorochromate
(d) treatment with $KMnO_4$

21. Which of the following compounds is aromatic alcohol?


(A)


(B)


(C)

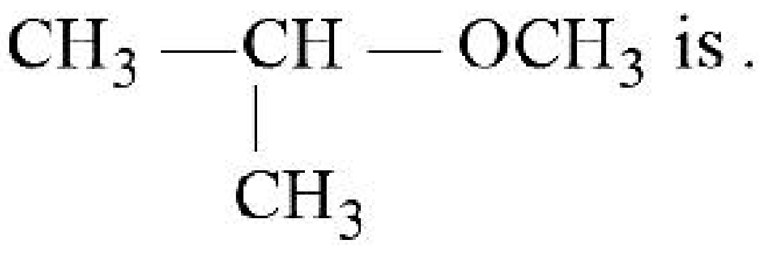

(D)

(a) A, B, C, D (b) A, D
(c) B, C (d) A

22. IUPAC name of *m*-cresol is ....

(a) 3-methylphenol (b) 3-chlorophenol
(c) 3-methoxyphenol (d) benzene-1,3-diol

23. IUPAC name of the compound

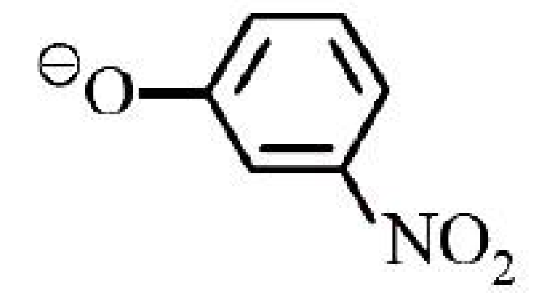


$$CH_3-\underset{\underset{CH_3}{|}}{CH}-OCH_3$$ is .

(a) 1-methoxy-1methylethane
(b) 2-methoxy-2-methylethane
(c) 2-methoxypropane
(d) isopropylmethyl ether

24. Which of the following species can act as the strongest base?

(a) $^{\ominus}OH$ (b) $^{\ominus}OR$
(c) $^{\ominus}OC_6H_5$ (d)



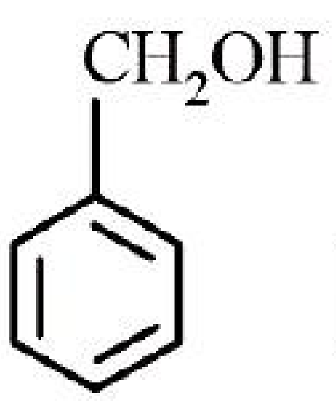
25. Which of the following compounds will react with sodium hydroxide solution in water?

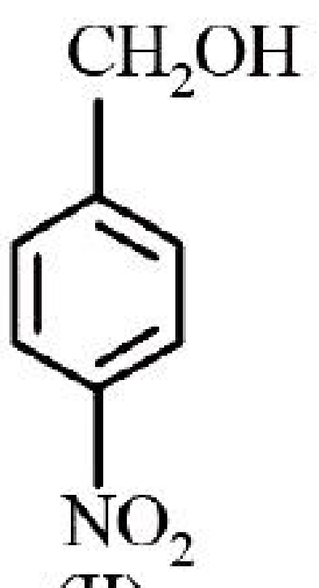
(a) C_6H_5OH (b) $C_6H_5CH_2OH$
(c) $(CH_3)_3COH$ (d) C_2H_5OH

26. Which of the following is most acidic?

(a) Benzyl alcohol (b) Cyclohexanol
(c) Phenol (d) *m*-chlorophenol

27. Mark the correct increasing order of reactivity of the following compounds with HBr/HCl.


(I)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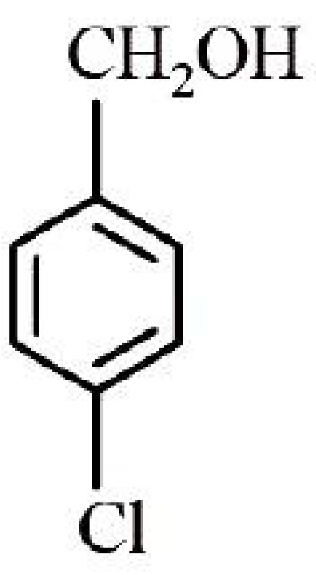

(III)

(a) I < II < III (b) II < I < III
(c) II < III < I (d) III < II < I

28. The compound which reacts fastest with Lucas reagent at room temperature is

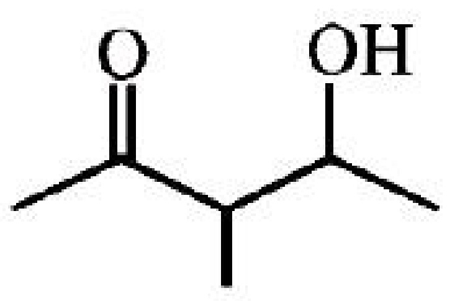
(a) butan-1-ol (b) butan-2-ol
(c) 2-methylpropan-1-ol (d) 2-methylpropan-2-ol

29. Which of the following compounds is oxidised to prepare methyl ethyl ketone?

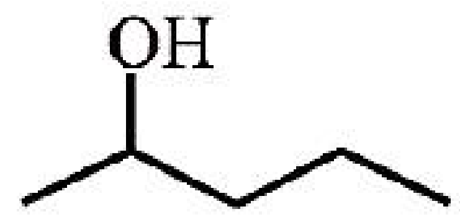
(a) 2-Propanol (b) 1-Butanol
(c) 2-Butanol (d) t-Butyl alcohol

30. Which one of the following will most readily be dehydrated in acidic conditions ?

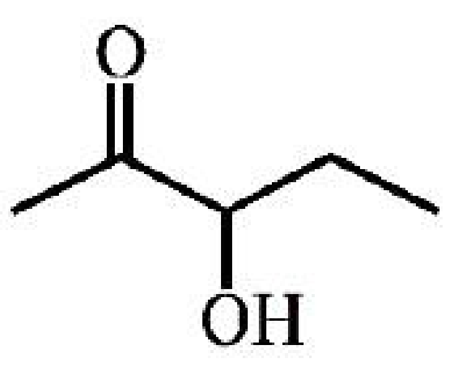
(a)



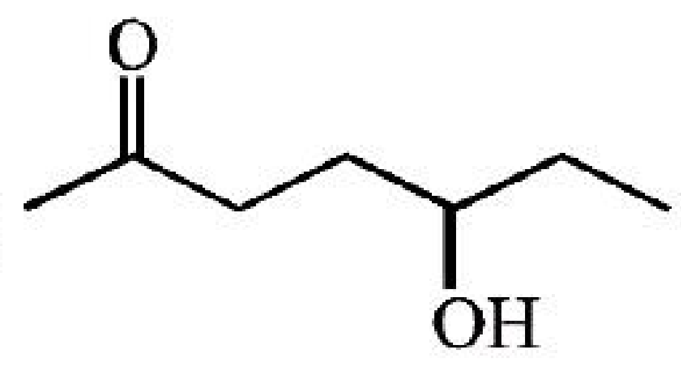
(b)



(c)



(d)



31. Methylated spirit is

(a) methanol (b) methanol + ethanol
(c) methanoic acid (d) methanamide

32. Molecular formula of amyl alcohol is

(a) $C_7H_{14}O$ (b) $C_6H_{13}O$

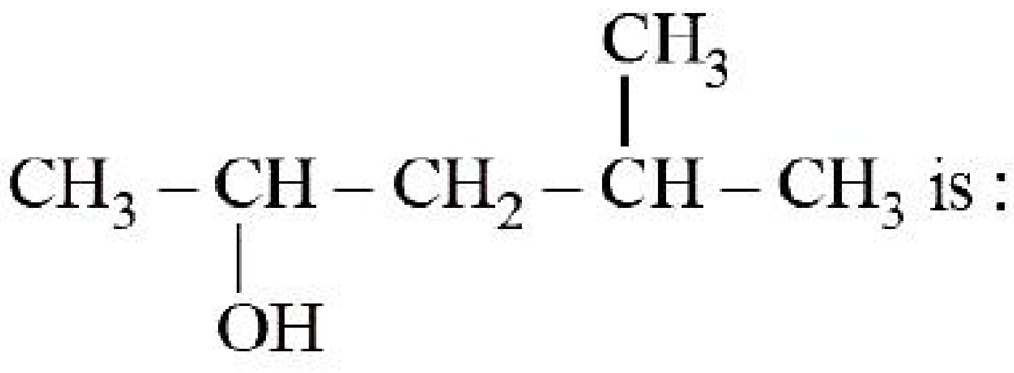
(c) $C_5H_{12}O$ (d) $C_5H_{10}O$

33. The compound $HOCH_2-CH_2OH$ is

(a) ethane glycol (b) ethylene glycol

(c) ethylidene alcohol (d) dimethyl alcohol

34. The IUPAC name of



$CH_3-\underset{\underset{OH}{|}}{CH}-CH_2-\overset{\overset{CH_3}{|}}{CH}-CH_3$ is :

(a) 1, 1-dimethyl-1, 3-butanediol

(b) 2-methyl-2-pentanol

(c) 4-methyl-2, 4-pentanediol

(d) 1, 3, 3-trimethyl-1, 3-propanediol

35. Alcoholic beverages contain :

(a) isopropyl alcohol (b) *n*-propyl alcohol

(c) ethyl alcohol (d) methyl alcohol

36. Which of the following are isomers ?

(a) Methyl alcohol and dimethyl ether

(b) Ethyl alcohol and dimethyl ether

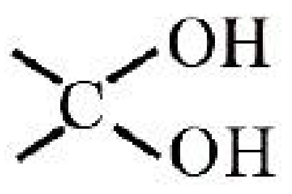
(c) Acetone and acetaldehyde

(d) Propionic acid and propanone

37. The characteristic grouping of secondary alcohols is

(a) $-CH_2OH$ (b) $>CHOH$

(c) $-\overset{|}{\underset{|}{C}}-OH$ (d)



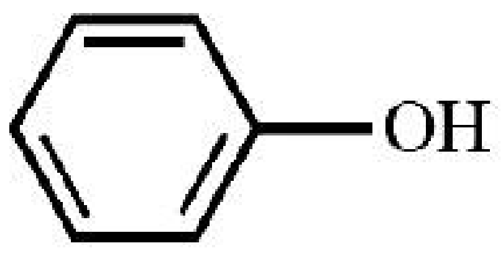
38. The C–O–H bond angle in ethanol is nearly

(a) 90° (b) 104° (c) 120° (d) 180°

39. Which is oxidized most easily?

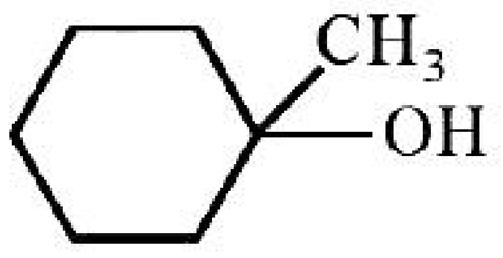
(a) $CH_3-CHOH-CH_3$

(b)



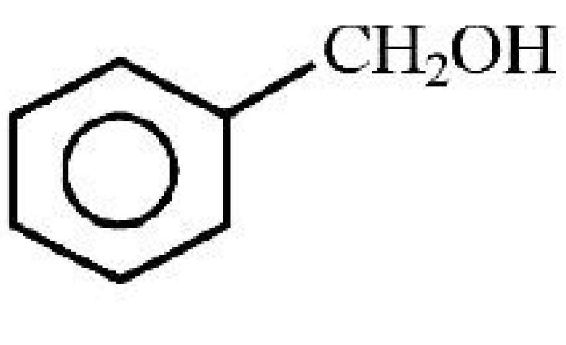
(c) $CH_3-CH_2-O-CH_2-CH_3$

(d)



40. Consider the following alcohols,

(I)



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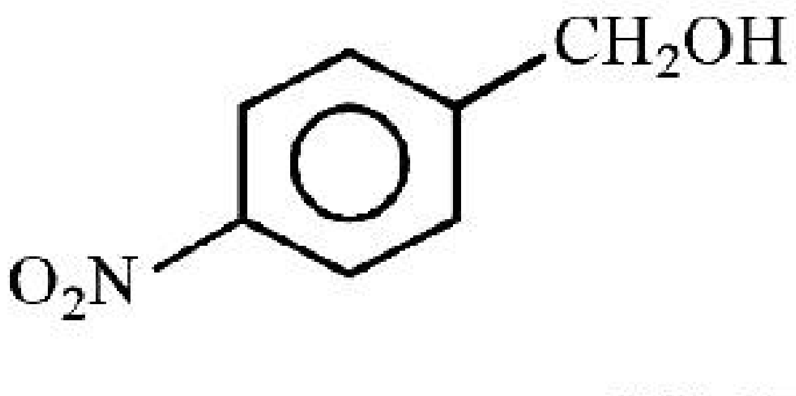
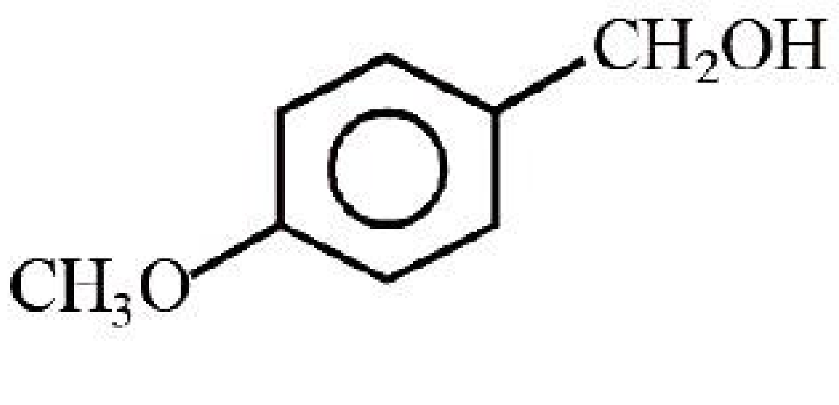


(III)



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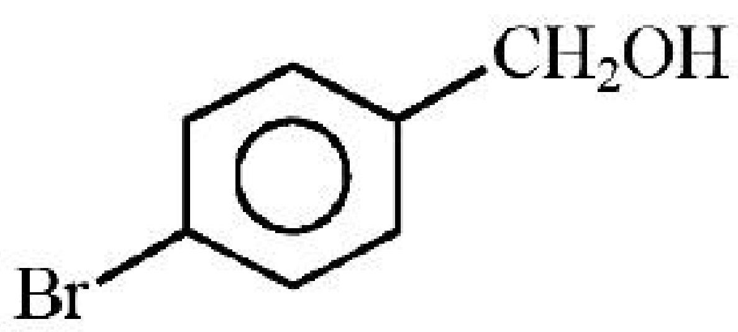
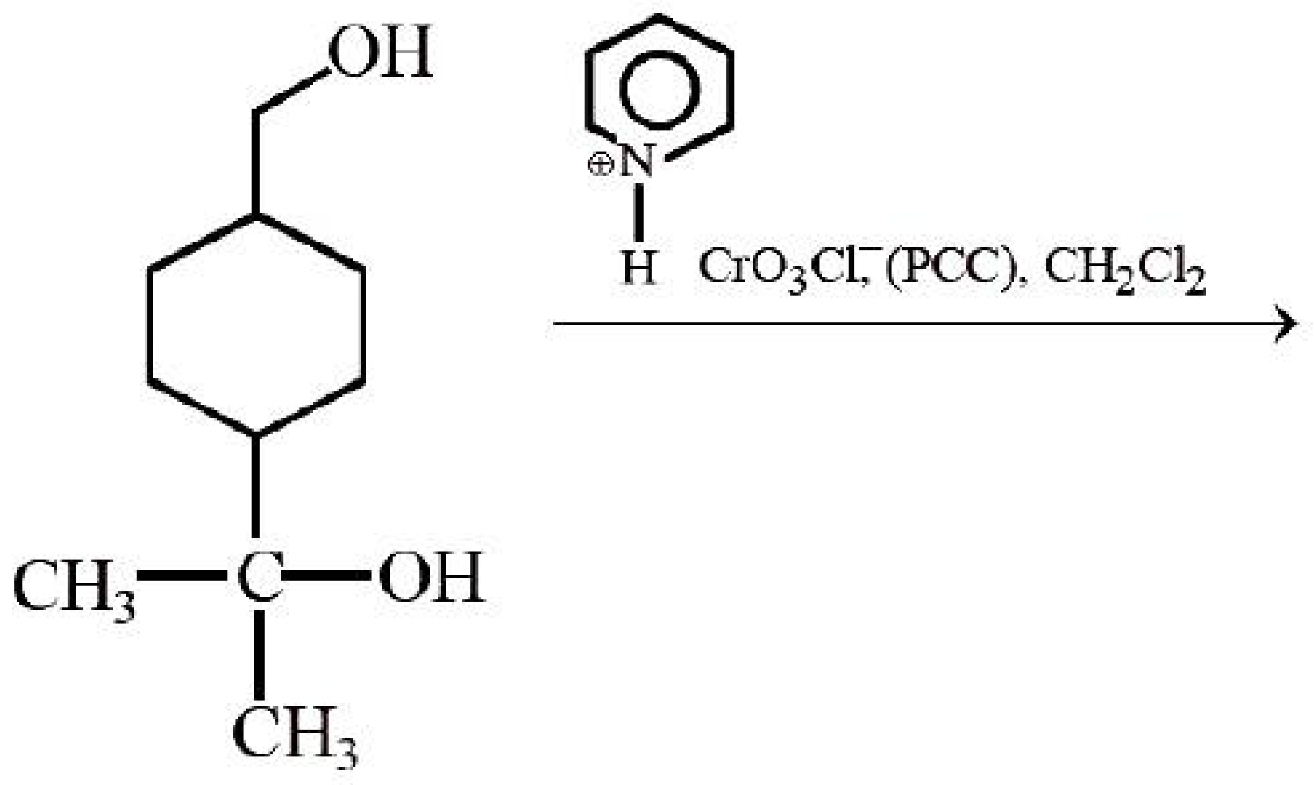


The order of decreasing reactivities of these alcohols towards nucleophilic substitution with HBr is:

(a) III > I > IV > II (b) III > I > II > IV

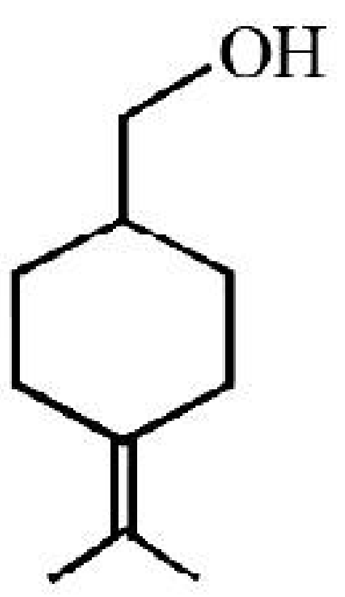
(c) I > III > IV > II (d) I > III > II > IV

41.

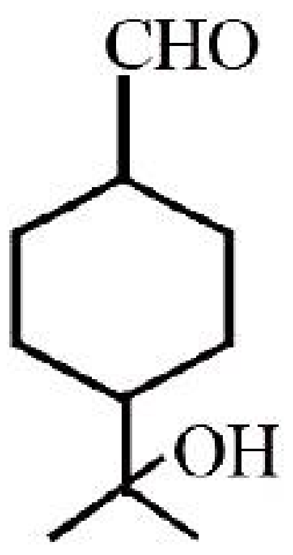


Product of the reaction is:

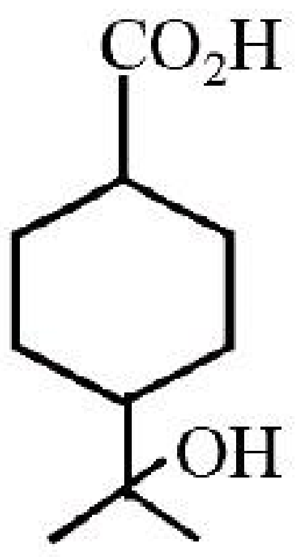
(a)



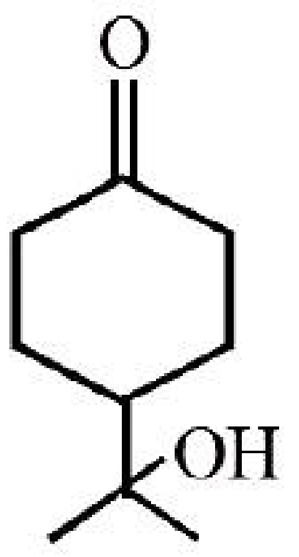
(b)



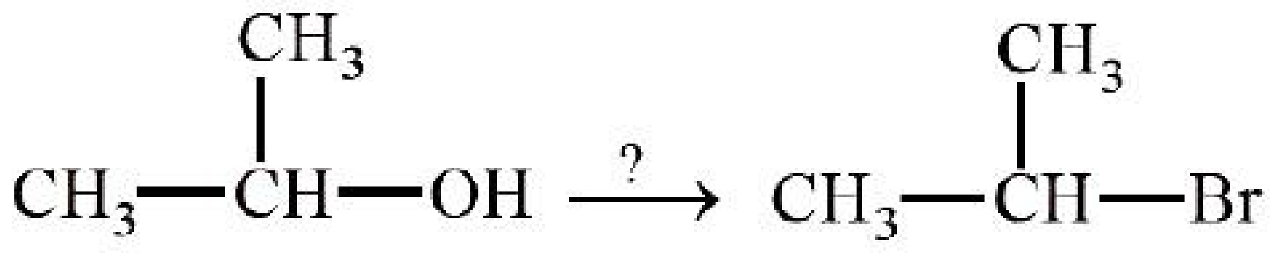
(c)



(d)



42. Which is the best reagent to convert isopropyl alcohol to isopropyl bromide?



$CH_3-\overset{\overset{CH_3}{|}}{CH}-OH \xrightarrow{?} CH_3-\overset{\overset{CH_3}{|}}{CH}-Br$

(a) HBr (b) $SOBr_2$

(c) Br_2 (c) CH_3MgBr

43. Which are not cleaved by HIO_4?

I. glycerol II. glycol

III. 1, 3 propenediol

IV. methoxy-2-propanol

(a) I, II, III, IV (b) I, II

(c) II, III (d) III, IV

44. Which of the esters shown, after reduction with $LiAlH_4$ and aqueous workup, will yield two molecules of only a single alcohol?

(a) $CH_3CH_2CO_2CH_2CH_3$ (b) $C_6H_5CO_2CH_2C_6H_5$

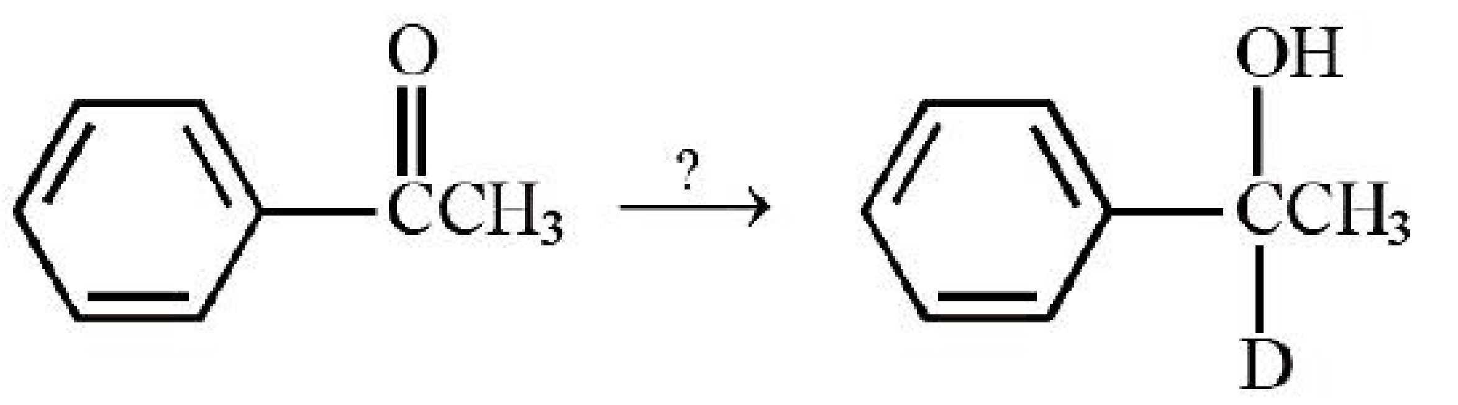
(c) $C_6H_5CO_2C_6H_5$ (d) None of these

45. For the following reaction, select the statement that best describes the change

$RCH_2OH + PCC\,[C_5H_5NH^+ClCrO_3^-] \rightarrow$

(a) The alcohol is oxidized to an acid, and the Cr(VI) is reduced
(b) The alcohol is oxidized to an aldehyde, and the Cr(VI) is reduced
(c) The alcohol is reduced to an aldehyde, and the Cr(III) is oxidized
(d) The alcohol is oxidized to a ketone, and the Cr(VI) is reduced

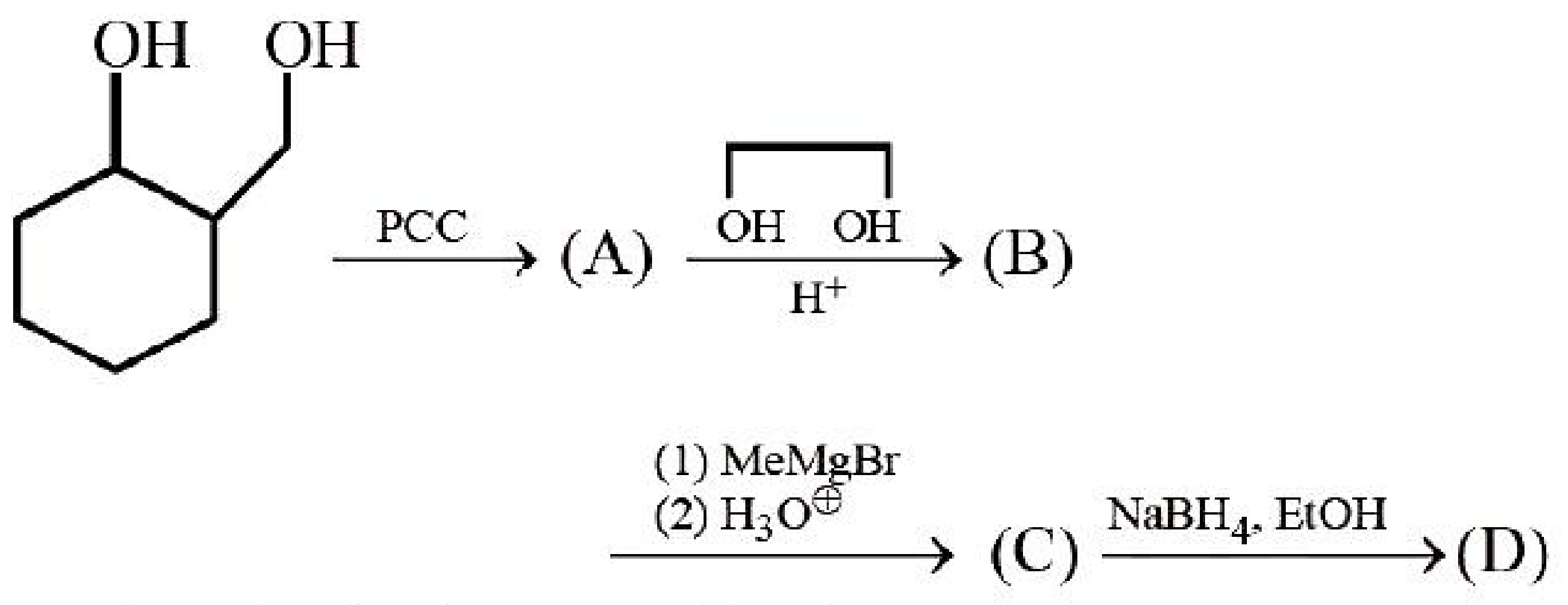
46. Which of the following reagents would carry out the following transformation? (D = ^{2}H)



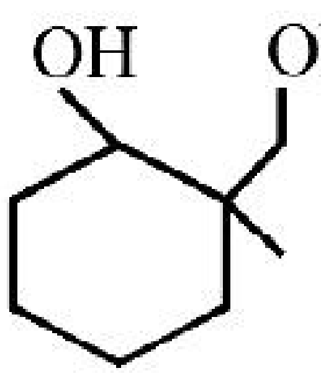
(a) $NaBD_4$ in CH_3OH (b) $LiAlH_4$, then D_2O
(c) $NaBD_4$ in CH_3OD (d) $LiAlD_4$, then D_2O

47. In which of the following group, each member gives positive iodoform test?
(a) methanol, ethanol, propanone
(b) ethanol, isopropanal, methanal,
(c) ethanol, ethanal isopropyl alcohol
(d) propanal, propanol 2, propanone

48.



Product (D) in above reaction is:

(a)


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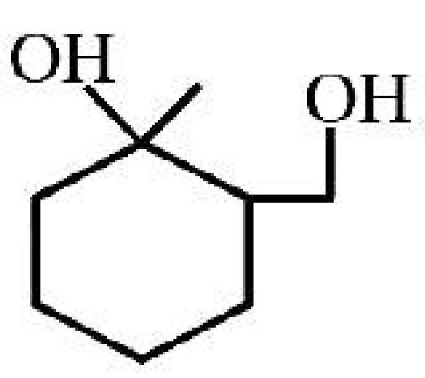

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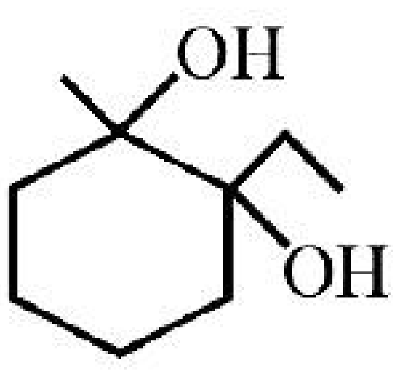

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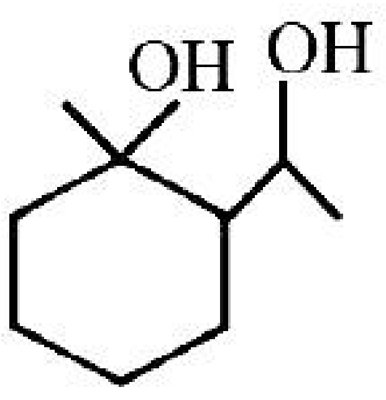

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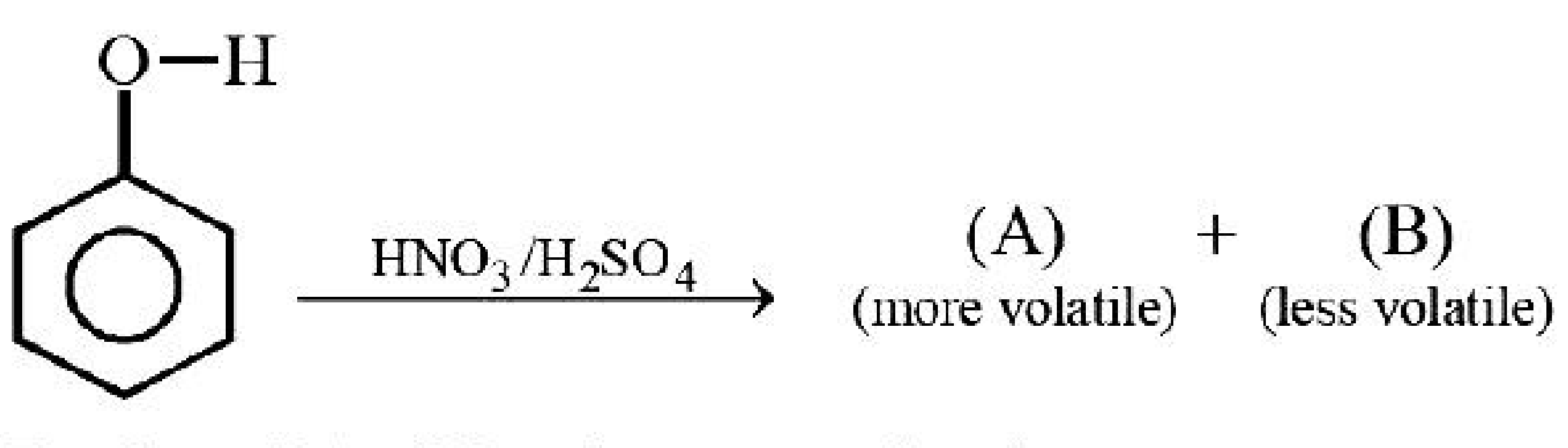
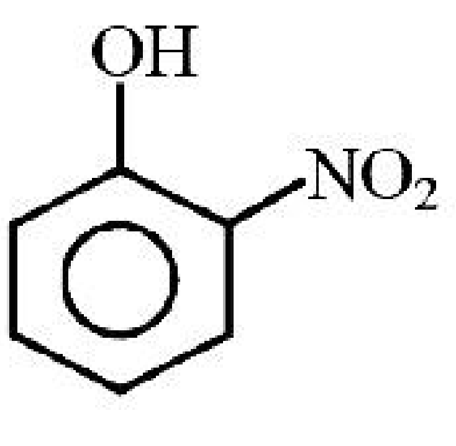


Product (A) of the above reaction is:

(a)


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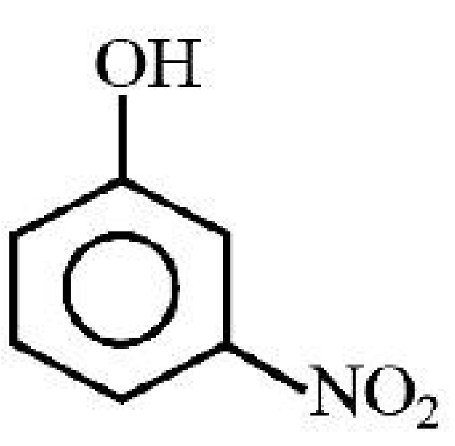
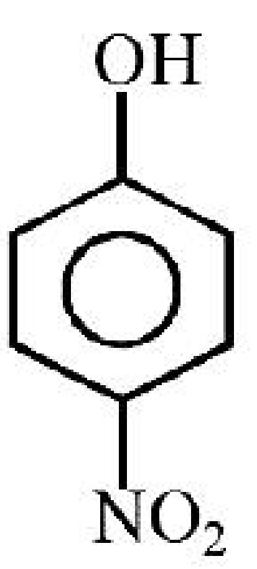
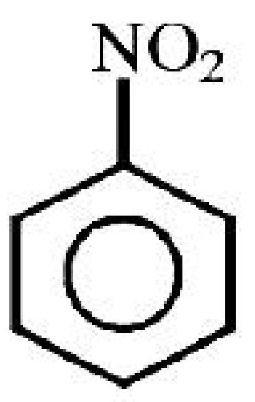
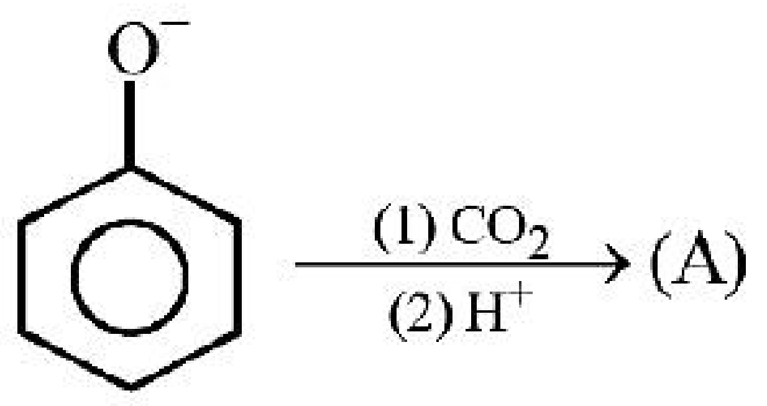


(c)


(d)


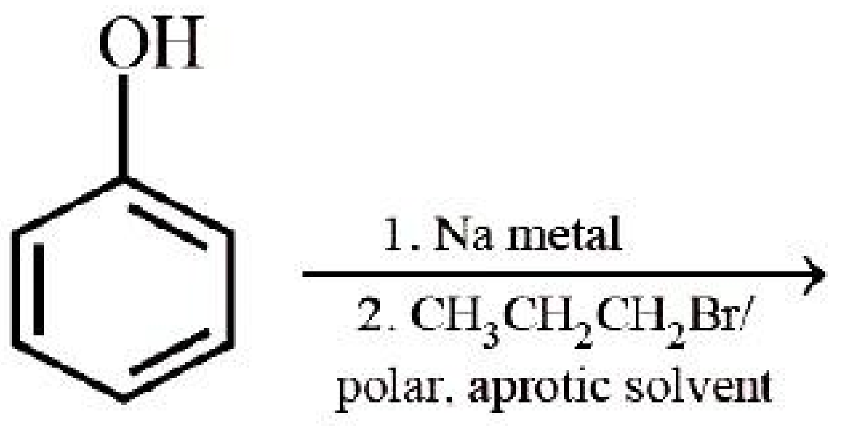
50.

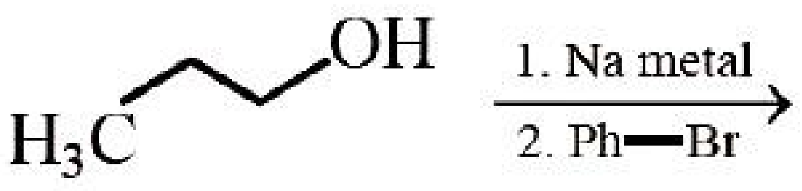


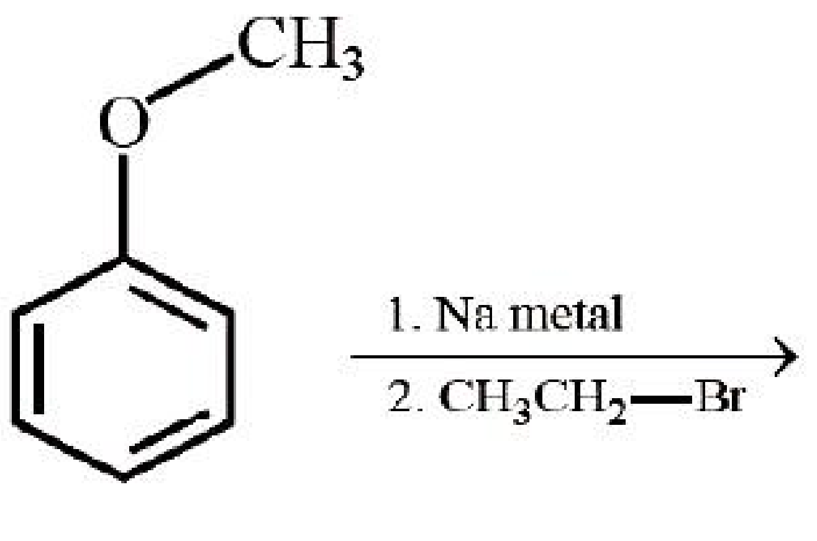
Which of the following is true statement about the reaction?
(a) Ortho isomer is major if PhONa is used
(b) Para isomer is major if PhOK is used
(c) Product formed is further used for preparation of drug aspirin
(d) All of these

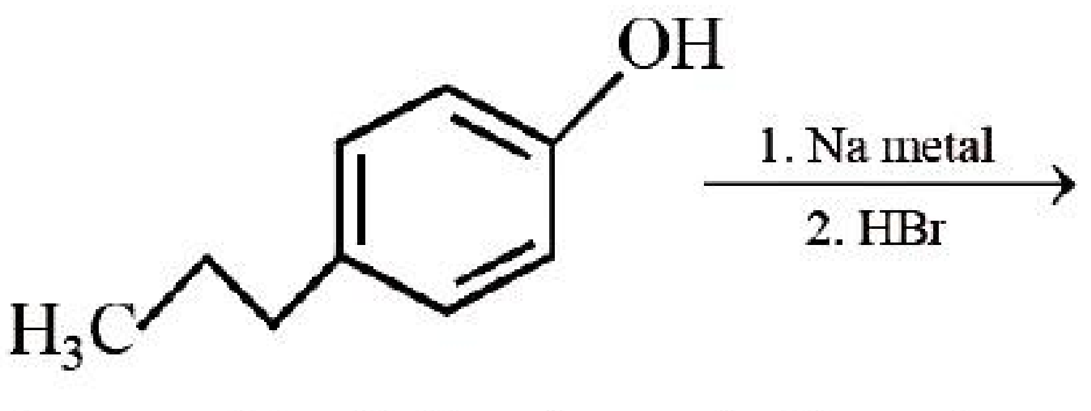
51. The major reason that phenol is a better Bronsted acid than cyclohexanol is that:
(a) it is a beter proton donor.
(b) the cyclohexyl group is an electron donating group by induction, which destabilizes the anion formed in the reaction by resonance.
(c) phenol is able to stabilize the anion formed in the reaction.
(d) the phenyl group is an electron withdrawing group by induction, which stabilizes the anion formed in the reaction.

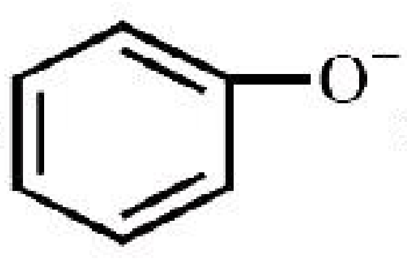
52. Choose the best synthesis of phenyl *n*-propyl ether.

(a)


(b)


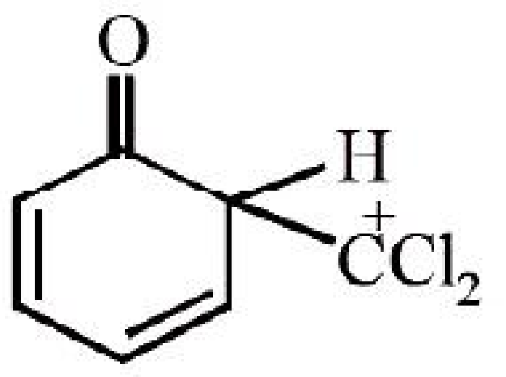
(c)


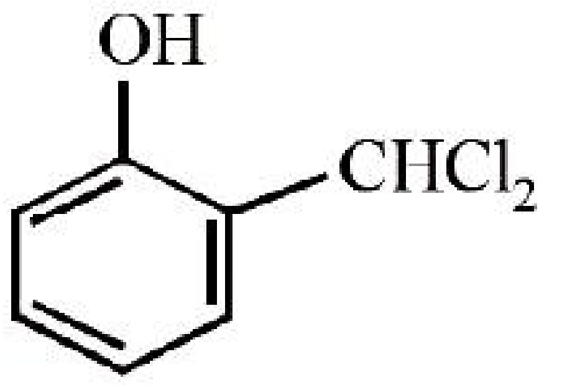
(d)


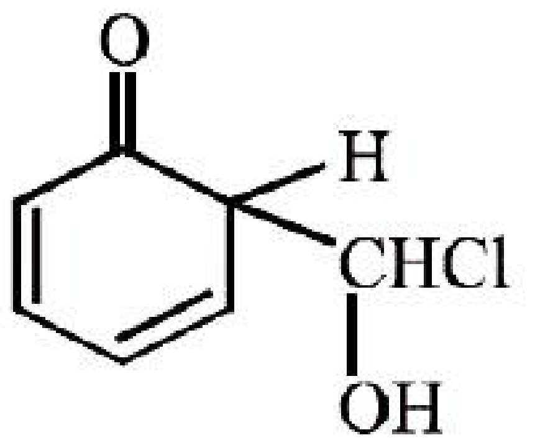
53. Which one of the following substituents at *para*-position is most effective in stabilizing the phenoxide  ion?

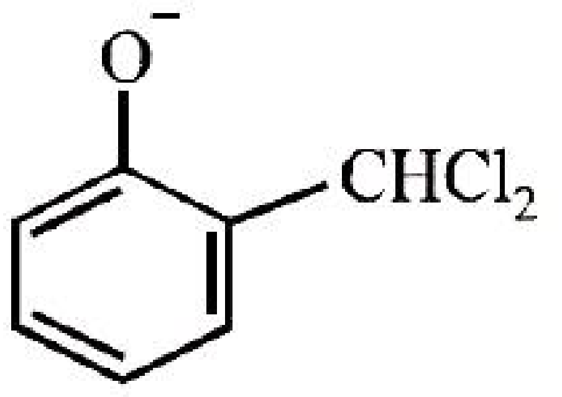
(a) $-CH_3$ (b) $-OCH_3$ (c) $-COCH_3$ (d) $-CH_2OH$

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

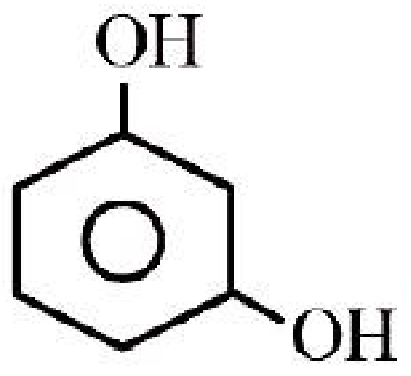
(a) 

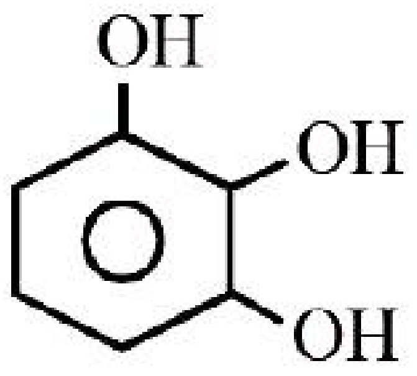
(b) 

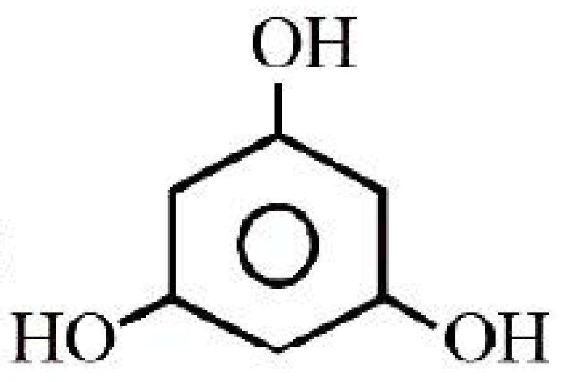
(c) 

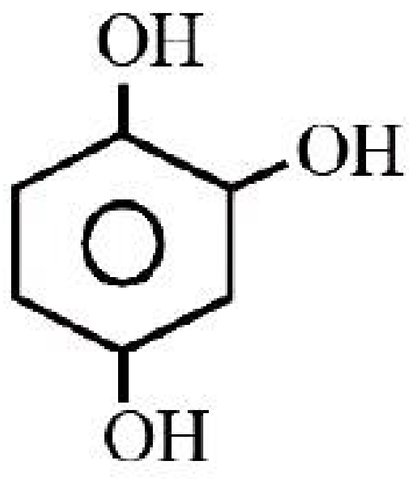
(d) 

55. Which of the following compound can react with hydroxylamine ?

(a) 

(b) 

(c) 

(d) 

56. Phenol undergoes electrophilic substitution more easily than benzene because

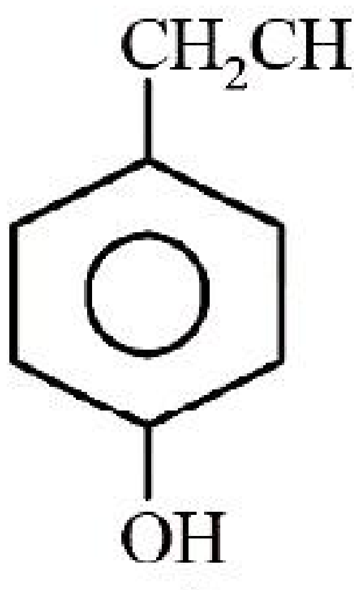
(a) –OH group exhibits +M effect and hence increases the electron density on the *o*- and *p*-positions.

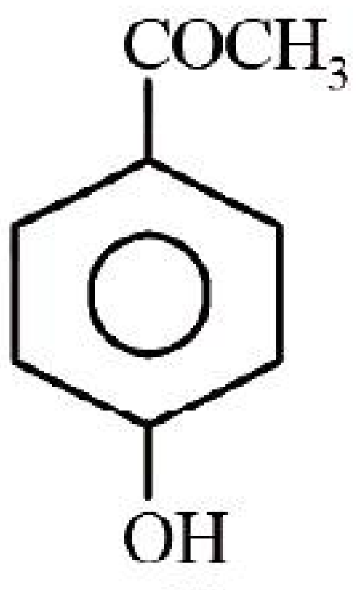
(b) oxocation is more stable than the carbocation

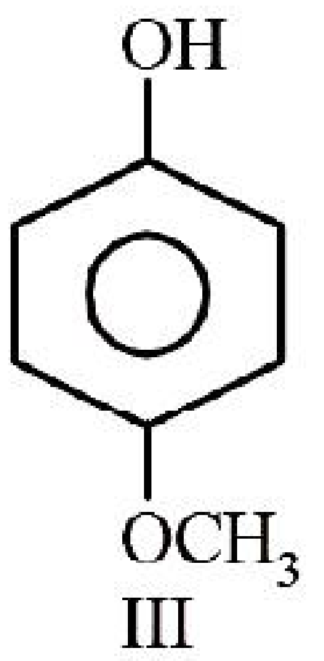
(c) both (a) and (b)

(d) –OH group exhibits acidic character

57. Which of the following is the correct order of the acidity of the three compounds ?


I

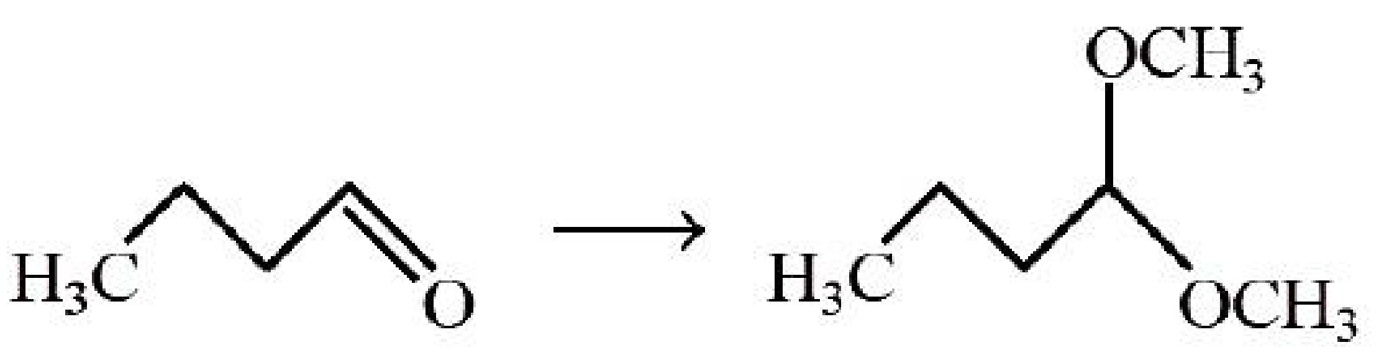

II


III

(a) II > III > I (b) III > II > I

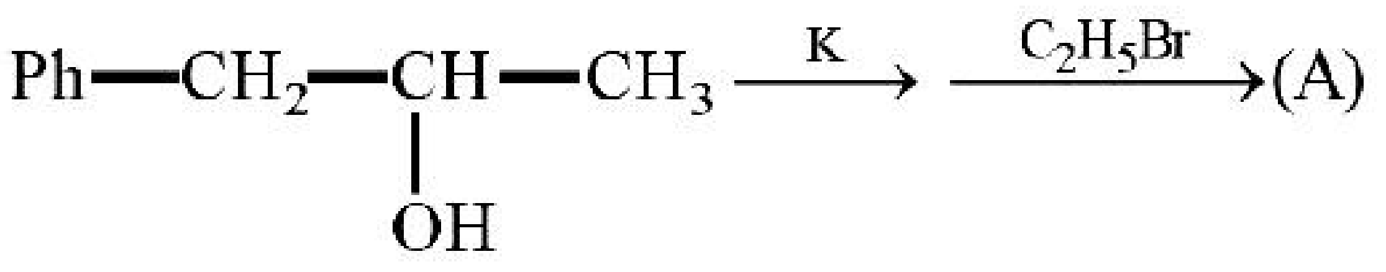
(c) II > I > III (d) III > I > II

58. Give the best conditions for this transformation:

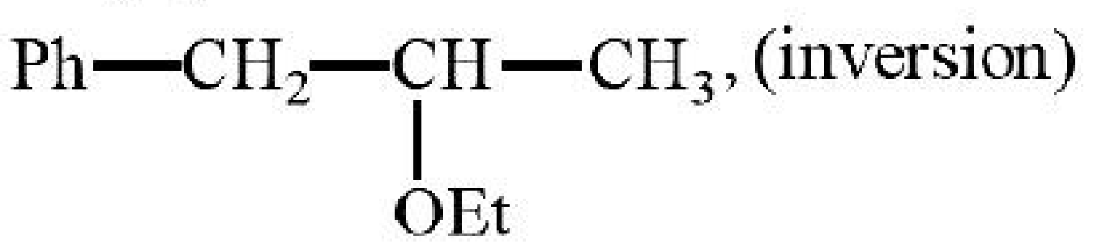


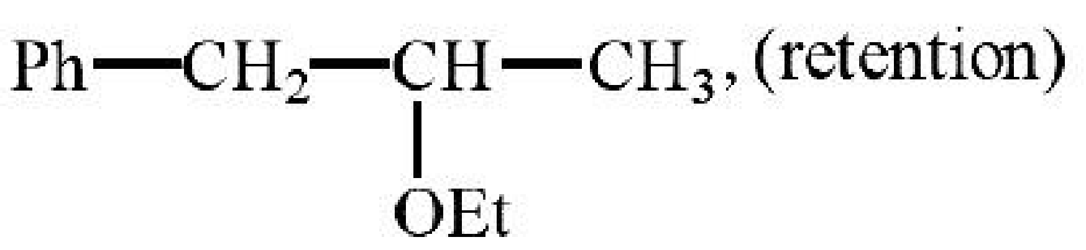
(a) CH_3OH, H^+(cat), heat (b) H_2O, H^+ (cat.), heat

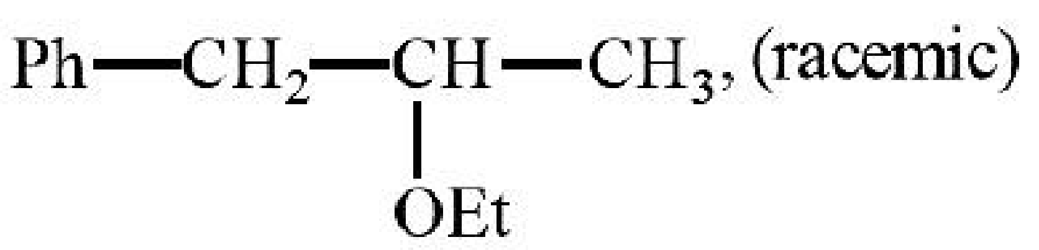
(c) Mg, ether, CH_3OH (d) $SOCl_2, CH_3OH$

59. 
$Ph-CH_2-\underset{OH}{CH}-CH_3 \xrightarrow{K} \xrightarrow{C_2H_5Br} (A)$

Product (A) in above reaction is:

(a) 
$Ph-CH_2-\underset{OEt}{CH}-CH_3$, (inversion)

(b) 
$Ph-CH_2-\underset{OEt}{CH}-CH_3$, (retention)

(c) 
$Ph-CH_2-\underset{OEt}{CH}-CH_3$, (racemic)

(d) $Ph-CH=CH-CH_3$

60. An organic compound of molecular formula $C_4H_{10}O$ does not react with sodium. With excess of HI, it gives only one type of alkyl halide. The compound is

(a) Ethoxyethane (b) 2-Methoxypropane

(c) 1-Methoxypropane (d) 1-Butanol

61. Which yields isopropyl methyl ether with little or no by products ?

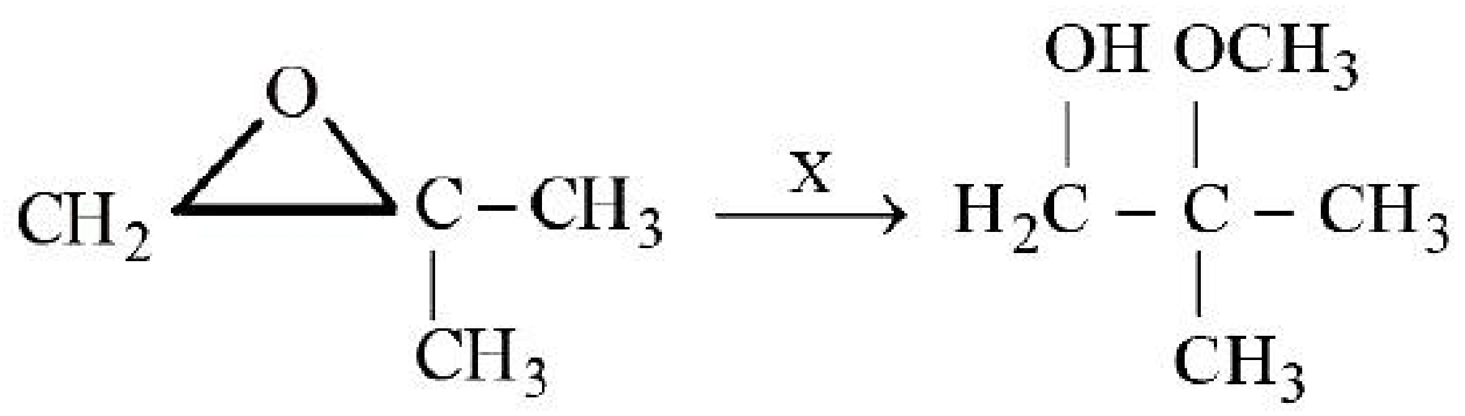
(a) $(CH_3)_2CHO^-Na^+ + CH_3I \longrightarrow$

(b) $CH_3O^-Na^+ + (CH_3)_2CHI \longrightarrow$

(c) $(CH_3)_2CHOH + CH_3OH \xrightarrow{H_2SO_4}$

(d) All of these

62. What is X in the following reaction ?



(a) CH_3OH, H_2SO_4

(b) $CH_3OH, CH_3O^- \overset{+}{Na}$

(c) H_2O / H_2SO_4 followed by CH_3OH

(d) CH_3MgBr / ether followed by H_3O^+

63. In Williamson synthesis of mixed ether having a primary and a tertiary alkyl group if tertiary halide is used, then :

(a) Rate of reaction will be slow due to slow cleavage of carbon-halogen bond.

(b) Alkene will be the main product.

(c) Simple ether will form instead of mixed ether.

(d) Expected mixed ether will be formed.

64. Allyl phenyl ether can be prepared by heating:

(a) $C_6H_5Br + CH_2 = CH - CH_2 - ONa$

(b) $CH_2 = CH - CH_2 - Br + C_6H_5ONa$

(c) $C_6H_5 - CH = CH - Br + CH_3 - ONa$

(d) $CH_2 = CH - Br + C_6H_5 - CH_2 - ONa$

65. Which of the following reactions will not result in the formation of anisole?
(a) Phenol + dimethyl sulphate in presence of a base
(b) Sodium phenoxide is treated with methyl iodide
(c) Reaction of diazomethane with phenol
(d) Reaction of methylmagnesium iodide with phenol

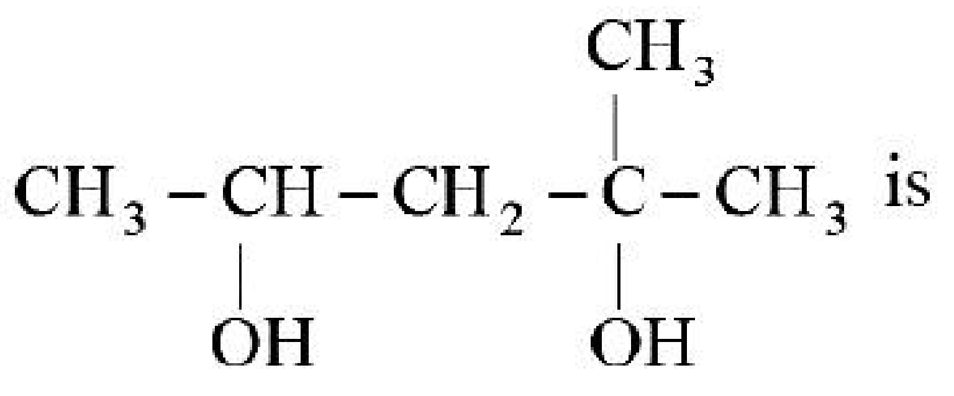
66. *tert*-Butyl ethyl ether can't be prepared by which reaction?
(a) *tert* – Butanol + ethanol $\xrightarrow{H^+}$
(b) *tert*-Butyl bromide + sodium ethoxide →
(c) Sodium *tert*-butoxide + ethyl bromide →
(d) Isobutene + ethanol $\xrightarrow{H^+}$

Case/Passage Based Questions

DIRECTIONS : *Following are the case/passage based questions.*

Case/Passage-I

Alcohols and phenols are the most important compounds used in our daily life. Alcohols are prepared by hydration of alkenes, fermentation of glucose, reduction of aldehydes, ketones, carboxylic acids, and esters. Alcohols are soluble in water. Boiling points increase with the increase in molar mass and decrease with branching. Alcohols on dehydration give alkene at 443K, follow carbocation mechanism. Excess of alcohol at 413K on dehydration with conc. H_2SO_4 also follows the carbocation mechanism but gives diethyl ether. Alcohols undergo nucleophilic substitution reactions, esterification with carboxylic acids, and derivatives like amides, acid halides, acid anhydride. Phenol is prepared from cumene, diazonium salts, anisole, and chlorobenzene. Phenol is used to prepare salicylaldehyde, salicylic acid, aspirin, methyl salicylate, *p*-benzoquinone. Phenol undergoes electrophilic substitution reaction at *o* & *p*-position.

67. The IUPAC name of 
$CH_3-\underset{OH}{CH}-CH_2-\underset{OH}{\overset{CH_3}{C}}-CH_3$ is
(a) 1, 1-dimethyl-1, 3-butanediol
(b) 2-methyl-2, 4-pentanediol
(c) 4-methyl-2, 4-pentanediol
(d) 1, 3, 3-trimethyl-1, 3-propanediol

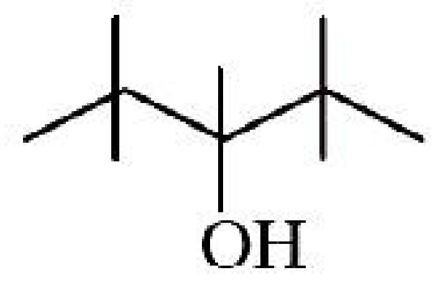
68. Acid catalyzed hydration of alkenes except ethene leads to the formation of
(a) primary alcohol
(b) secondary or tertiary alcohol
(c) mixture of primary and secondary alcohols
(d) mixture of secondary and tertiary alcohols

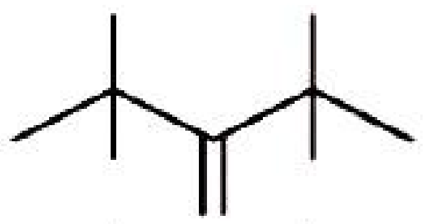
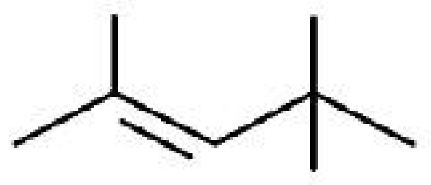
69. Which of the following statements are correct ?
(i) Alcohols react as nucleophiles in the reactions involving cleavage of O–H bond.
(ii) Alcohols react as electrophiles in the reactions involving cleavage of O–H bond.
(iii) Alcohols react as nucleophile in the reaction involving cleavage of C–O bond.
(iv) Alcohols react as electrophiles in the reactions involving C–O bond.
(a) (i) only (b) (i) and (iv)
(c) (ii) and (iii) (d) (ii) only

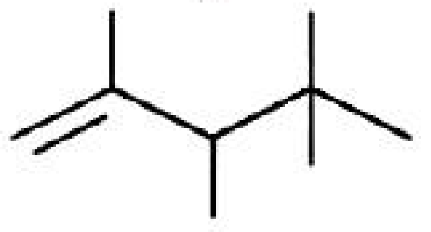
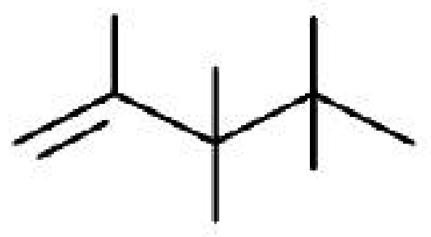
70. Consider the following reaction:

$$\text{Phenol} \xrightarrow{\text{Zn dust}} X \xrightarrow[\text{Anhydrous AlCl}_3]{CH_3Cl} Y \xrightarrow{\text{Alk. KMnO}_4} Z$$

The product Z is
(a) benzaldehyde (b) benzoic acid
(c) benzene (d) toluene

71.  $\xrightarrow[\Delta]{H^{\oplus}}$ Major product

(a)  (b) 

(c)  (d) 

Case/Passage-II

The dehydration of phenols and alkylation of phenols by alcohols over thorium were studied at 400–500 °C and atmospheric pressure. Phenol and cresols, when dehydrated gave diaryl ethers as main products. With *para*-substituted phenols such as *p*-methoxy, *p*-*t*-butyl, *p*-chloro, and *p*-nitrophenol no ether formation was noticed. All the reactions were accompanied by a considerable amount of coke formation. Alkylation of phenols by alcohols gave a mixture of O- and C-alkylated products under the same reaction conditions. O-alkylation and C-alkylation are parallel reactions.

DIRECTIONS : *Each of these questions contains an assertion followed by reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.*
(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If the Assertion is incorrect but the Reason is correct.

72. **Assertion :** Phenoxide ion is more stable than alkoxide ion.
Reason : The delocalisation of negative charge in phenols makes them more stable.

73. **Assertion :** Phenols do not react with metal carbonates and metal hydrogen carbonates.
Reason : Metal carbonates and metal hydrogen carbonates are basic in nature.

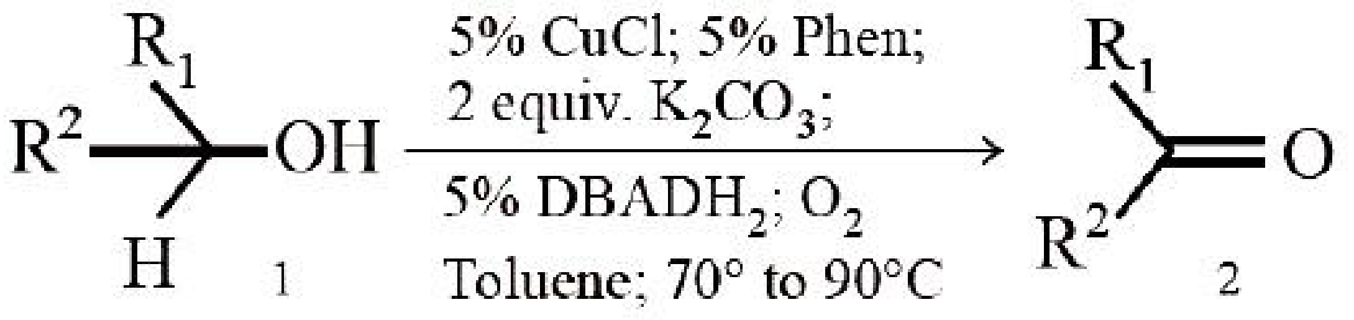
74. **Assertion :** Phenols when react directly with carboxylic acids produce ester.
Reason : Electron withdrawing groups increases the acidic character of phenols.

75. **Assertion :** *p*-Nitrophenol is less acidic than *m*-nitrophenol.
Reason : Phenol is a weaker acid than carbonic acid.

76. **Assertion :** Value of pka is higher for ethanol than phenol.
Reason : Phenoxide ion is more stable than alkoxide ion.

Case/Passage-III

An efficient, aerobic catalytic system for the transformation of alcohols into carbonyl compounds under mild conditions, copper-based catalyst has been discovered. This copper-based catalytic system utilizes oxygen or air as the ultimate, stoichiometric oxidant, producing water as the only by-product



A wide range of primary, secondary, allylic, and benzylic alcohols can be smoothly oxidized to the corresponding aldehydes or ketones in good to excellent yields. Air can be conveniently used instead of oxygen without affecting the efficiency of the process. However, the use of air requires slightly longer reaction times.

This process is not only economically viable and applicable to large-scale reactions, but it is also environmentally friendly. *(Reference: Ohkuma, T., Ooka, H., Ikariya, T., & Noyori, R. (1995). Preferential hydrogenation of aldehydes and ketones. Journal of the American Chemical Society, 117(41), 10417-10418.)* **[CBSE Sample 2021]**

77. The Copper based catalyst mention in the study above can be used to convert:
(a) propanol to propanonic acid
(b) propanone to propanoic acid
(c) propanone to propan-2-ol
(d) propan-2-ol to propanone

78. The carbonyl compound formed when ethanol gets oxidised using this copper-based catalyst can also be obtained by ozonolysis of:
(a) But-1-ene (b) But-2-ene
(c) Ethene (d) Pent-1-ene

OR

Which of the following is a secondary allylic alcohol?
(a) But-3-en-2-ol (b) But-2-en-2-ol
(c) Prop-2-enol (d) Butan-2-ol

79. Benzyl alcohol on treatment with this copper-based catalyst gives a compound 'A' which on reaction with KOH gives compounds 'B' and 'C'. Compound 'B' on oxidation with $KMnO_4$ - KOH gives compound 'C'. Compounds 'A', 'B' and 'C' respectively are :
(a) Benzaldehyde, Benzyl alcohol, potassium salt of Benzoic acid
(b) Benzaldehyde, potassium salt of Benzoic acid, Benzyl alcohol
(c) Benzaldehyde, Benzoic acid, Benzyl alcohol
(d) Benzoic acid, Benzyl alcohol, Benzaldehyde

80. An organic compound 'X' with molecular formula C_3H_8O on reaction with this copper based catalyst gives compound 'Y' which reduces Tollen's reagent. 'X' on reaction with sodium metal gives 'Z'. What is the product of reaction of 'Z' with 2-chloro-2-methylpropane?
(a) $CH_3CH_2CH_2OC(CH_3)_3$ (b) $CH_3CH_2OC(CH_3)_3$
(c) $CH_2=C(CH_3)_2$ (d) $CH_3CH_2CH=C(CH_3)_2$

Assertion & Reason

DIRECTIONS : *Each of these questions contains an assertion followed by reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.*
(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If the Assertion is incorrect but the Reason is correct.

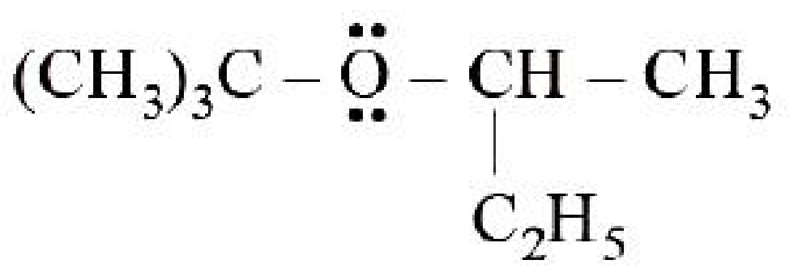
81. **Assertion :** Small armount of ingestion of methanol causes blindness and death.
Reason : This is because methanol is oxidised first to methanal and then to methanoic acid which may cause blindness and death.

82. **Assertion :** Lower alcohols are soluble in water.
Reason : Lower alcohols do not form hydrogen bonding with water molecules.

83. **Assertion :** Lucas reagent [HCl + $ZnCl_2$ (anhydrous)] on reaction with tertiary alcohols immediately produces turbidity.
Reason : This is because tertiary alcohols easily form halides which are immiscribe in water.

84. **Assertion :** Symmetric and unsymmetric ethers can be prepared by Williamson's synthesis.
Reason : Williamson's synthesis is an example of nucleophilic substitution reaction.

85. **Assertion :** When alkyl aryl ethers react with excess of hydrogen halides, phenol and alkyl halide are produced.
Reason : Alkyl aryl ethers are cleaved at the alkyl-oxygen due to more stable aryl-oxygen bond.

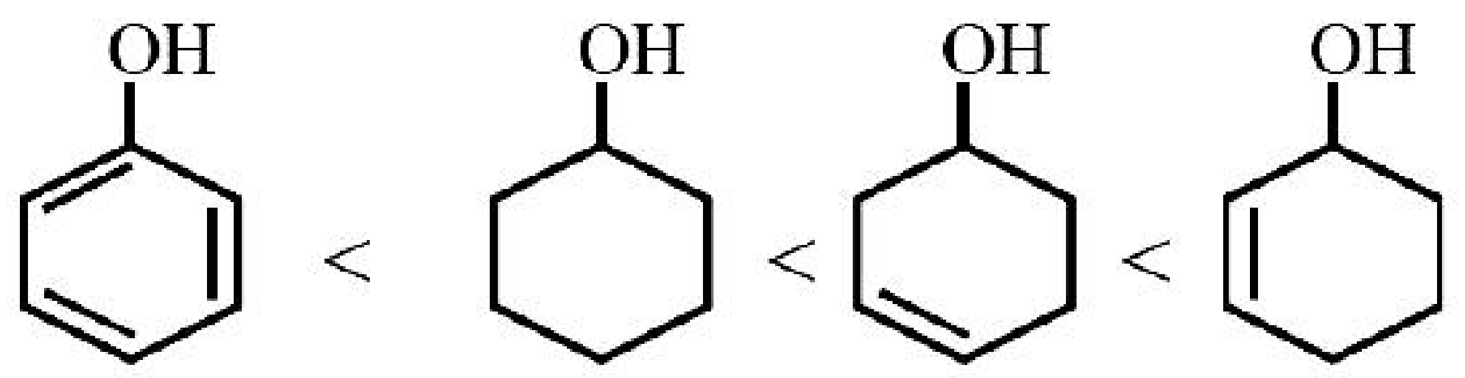
86. **Assertion :**

$(CH_3)_3C-\ddot{\underset{\cdot\cdot}{O}}-\underset{\underset{C_2H_5}{|}}{CH}-CH_3$

cannot be prepared by Williamson's synthesis.
Reason : Only primary alkyl halide reacts with sodium alkoxide (1°, 2° or 3°) to give ether.

87. **Assertion :** *p*-nitrophenol is more acidic than phenol.
Reason : Nitro group helps in the stabilisation of the phenoxide ion by dispersal of negative charge due to resonance.

88. **Assertion :** *o*-nitrophenol is less soluble in water than the *m* and *p*-isomers.
Reason : *m* and *p*-nitrophenols exist as associated molecules.

89. **Assertion:** The ease of dehydration of the following alcohols is



Reason: Alcohols leading to conjugated alkenes are dehydrated to a greater extent.

90. **Assertion:** *ter*-butyl methyl ether is not prepared by the reaction of *ter*-butyl bromide with sodium methoxide.
Reason: Sodium methoxide is a strong nucleophile.

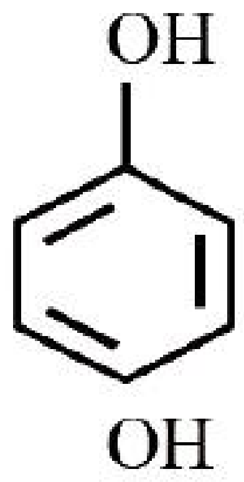
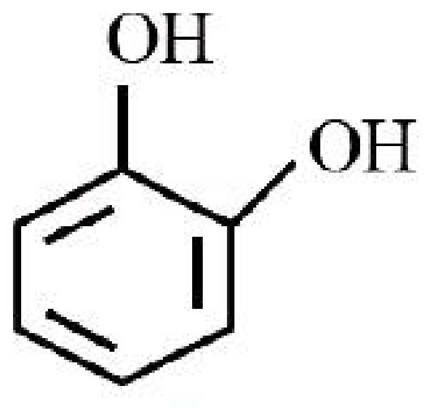
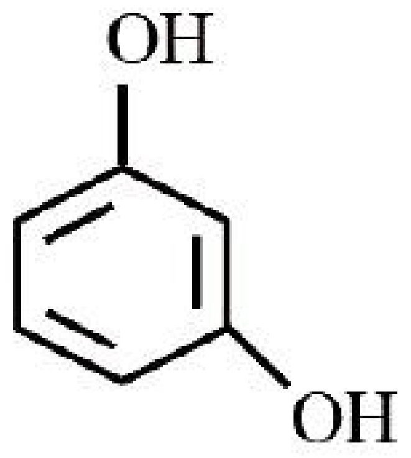
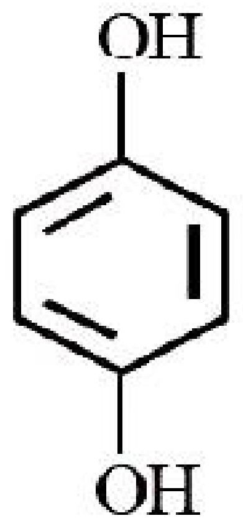
91. **Assertion:** Carboxylic acids are more acidic than phenols.
Reason: Phenols are ortho and para directing.
[CBSE Sample 2021]

92. **Assertion:** Methoxy ethane reacts with HI to give ethanol and iodomethane
Reason: Reaction of ether with HI follows S_N2 mechanism
[CBSE Sample 2021]

Match the Following

DIRECTIONS : *Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in column-I have to be matched with statements (p, q, r, s) in column-II.*

93. Match the columns

	Column-I		Column-II
(A)		(p)	Quinol
(B)		(q)	Phenol
(C)		(r)	Catechol
(D)		(s)	Resorcinol

(a) A – (q), B – (p), C – (s), D – (r)
(b) A – (r), B – (p), C – (s), D – (q)
(c) A – (s), B – (q), C – (p), D – (r)
(d) A – (q), B – (r), C – (s), D – (p)

Fill in the Blanks

DIRECTIONS : *Complete the following statements with an appropriate word / term to be filled in the blank space(s).*

94. The common reagent used for dehydration of an alcohol is ______.

95. Ethanol and dimethyl ether form a pair of functional isomers. The boiling point of ethanol is higher than that of dimethyl ether, due to the presence of ______.

96. Carbolic acid is 5% aqueous solution of _______.

97. Alcohols react as _______ in the reactions involving C – O bond.

98. Williamson's synthesis is used for the preporation of ________.

True / False

DIRECTIONS : *Read the following statements and write your answer as true or false.*

99. Phenol undergo Kolbe reaction, ethanol does not.

100. Phenoxide ion is more basic than ethoxide ion.

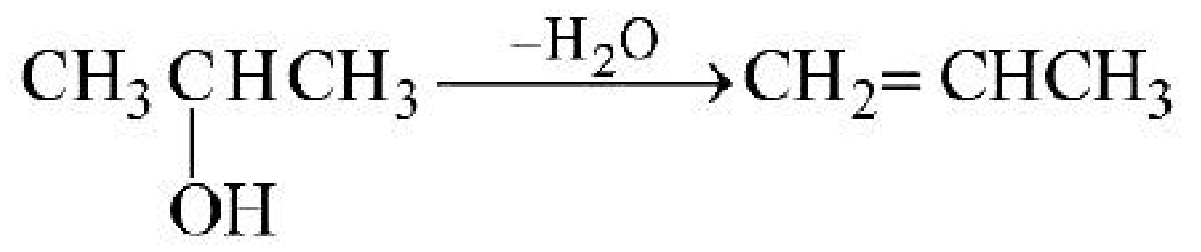
101. Boiling points of alcohols and ethers are high.

102. Alcohols can form intermolecular hydrogen-bonding.

103. Cresols are less acidic than phenols.

ANSWER KEY & SOLUTIONS

1. **(b)** Since the compound is formed by hydration of an alkene, to get the structure of alkene remove a molecule of water from the alcohol.



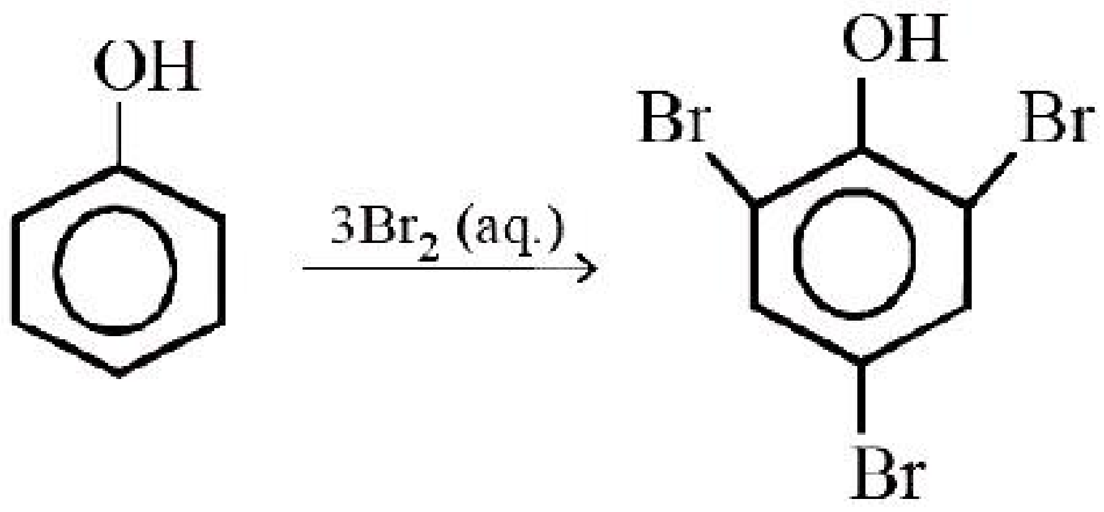
$$\underset{\text{OH}}{CH_3\underset{|}{C}HCH_3} \xrightarrow{-H_2O} CH_2=CHCH_3$$

Isopropyl alcohol Propylene

2. **(b)** The solubility of alcohols depend on number of C-atoms of alcohols. The solubility of alcohols in water decreases with the increase in number of C-atoms of alcohol. As resulting molecular weight increases, the polar nature of – OH bond decreases and hence strength of hydrogen bond decreases.

3. **(a)** When primary (1°) alcohols are treated with copper at 300°C, then aldehydes are obtained by dehydrogenation of alcohols. Similarly secondary (2°) alcohols form ketone and alkene is obtained by dehydration of tertiary (3°) - alcohols. But phenol does not respond to this test.

4. **(d)**



2, 4,6-Tribromophenol

Note : The –OH group in phenol, being activating group, facilitates substitution in the *o*- and *p*-positions.

5. **(c)** The C — O bond length (136 pm) in phenol is slightly less than that in methanol (142 pm).

6. **(c)** $KMnO_4$ (alkaline) and OsO_4 / CH_2Cl_2 are used for hydroxylation of double bond while O_3 /Zn is used for ozonolysis. Therefore, the right option is (c), i.e.,

$$3CH_3CH=CH_2 \xrightarrow{BH_3 \text{ in THF}} (CH_3CH_2CH_2)_3B$$

$$\xrightarrow[NaOH]{3H_2O_2} \underset{\text{1-propanol}}{3CH_3CH_2CH_2OH} + H_3BO_3$$

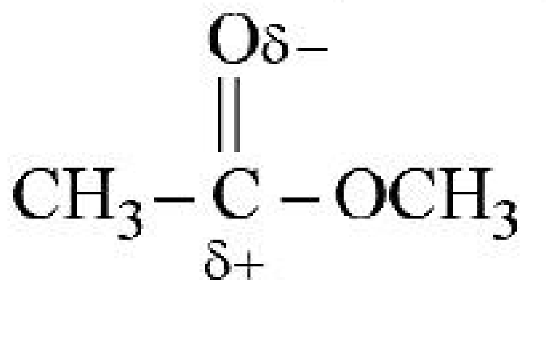
7. **(d)** The two components should be $(CH_3)_3CONa$ + $(CH_3)_3CBr$. However, tert-alkyl halides tend to undergo elimination reaction rather than substitution leading to the formation of an alkene, $Me_2C=CH_2$

8. **(d)** Due to inter-molecular hydrogen bonding in alcohols boiling point of alcohols is much higher than ether.

9. **(c)** Ethyl alcohol has strongest hydrogen bonding due to large electronegativity difference.

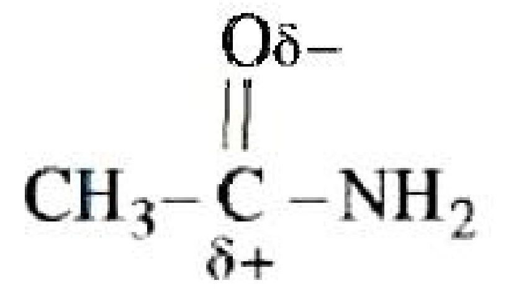
10. **(b)** Due to greater electronegativity of sp^2-hybridized carbon atoms of the benzene ring, diaryl ethers are not attacked by nucleophiles like I^-.

11. **(d)** Diethyl ether, being a Lewis base, is not attacked by nucleophiles, while all others contain electrophilic carbon, hence attacked by nucleophiles like OH^- ions.



$$CH_3-\underset{\delta+}{\overset{\overset{O\delta-}{||}}{C}}-OCH_3$$

$$CH_3-\overset{\delta+}{C}\equiv\overset{\delta-}{N}$$



$$CH_3-\underset{\delta+}{\overset{\overset{O\delta-}{||}}{C}}-NH_2$$

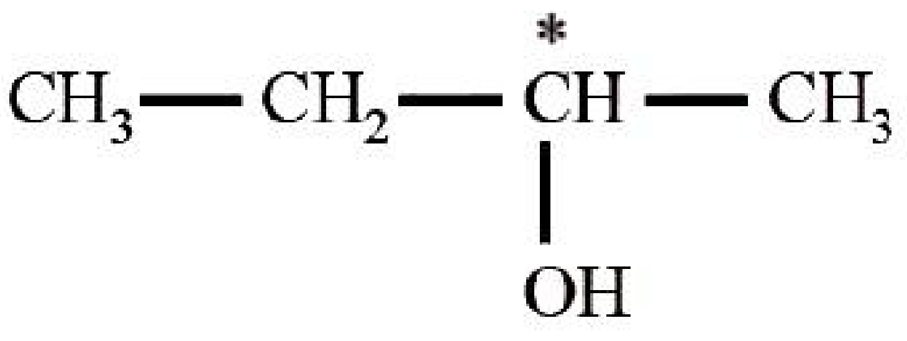
$$C_2H_5-\ddot{O}-C_2H_5$$

12. **(a)** Following are the three possible isomers of butanol

(i) $CH_3CH_2—CH_2—CH_2OH$

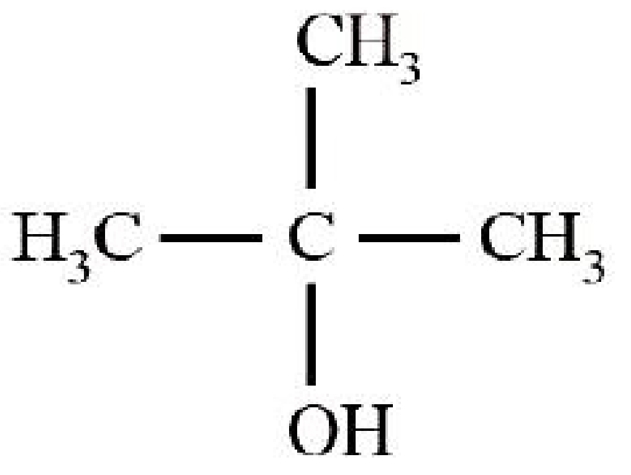
Butan-1-ol
no chiral carbon

(ii)



Butan-2-ol
1-Chiral Carbon

(iii)



2 – methylpropan – 2 – ol

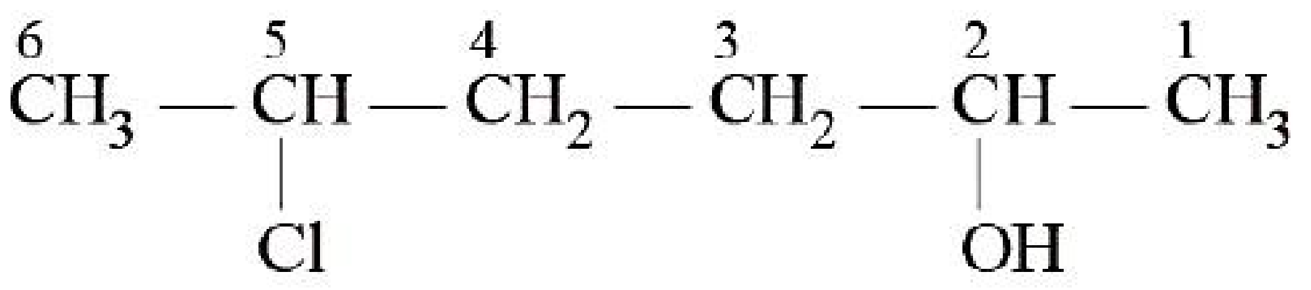
No Chiral Carbon

13. **(c)** HCl + An. $ZnCl_2$ is known as lucas reagent. It is used to determine degree of an alcohol. The reaction follow nucleophilic substitution reaction in which — OH group is replaced by — Cl. In this reaction carbocation is formed as intermediate. Higher the stability of intermediate carbocation higher will be the reactivity of reactant molecule. Since 3° carbocation is more stable than 2° carbocation as well as 1° carbocation, so the order of reactivity of alcohols is 3° > 2° > 1°.

14. **(b)** The process of conversion of alkyl halides into alcohols involves substitution reaction.

$$\underset{\text{Alkyl halide}}{R—X} \xrightarrow{OH^-} \underset{\text{Alcohol}}{R—OH}$$

15. **(c)**



$$\overset{6}{CH_3}—\underset{Cl}{\overset{5}{C}H}—\overset{4}{CH_2}—\overset{3}{CH_2}—\underset{OH}{\overset{2}{C}H}—\overset{1}{CH_3}$$

5-Chlorohexan-2-ol

16. **(b)** Presence of electron withdrawing group at ortho position increase the acidic strength. In *o*-nitrophenol, nitro group is present at ortho position. On the other hand, in *o*-methylphenol and in *o*-methoxyphenol, electron releasing group (—CH_3, —OCH_3) are present. Presence of these groups at ortho and para positions of phenol decreases the acidic strength of phenols. So, phenol is less acidic than *o*-nitrohenol.

17. **(b)** Electron withdrawing substituents increase the acidic strength of phenols. so, *p*-nitrophenol (II) and *m*-nitrophenol (IV) are stronger acid than phenol (I).

If — NO_2 group is present at *p*-position, then it exerts both — I and — R effect, but if it is present at meta position, then it exerts only–I effect. Therefore, *p*-nitrophenol is stronger than *m*-nitrophenol.

On the other hand, electron releasing substituents decreases the acidic strength of phenol. If — OCH_3 group is present at meta position, it will exert – I effect only.

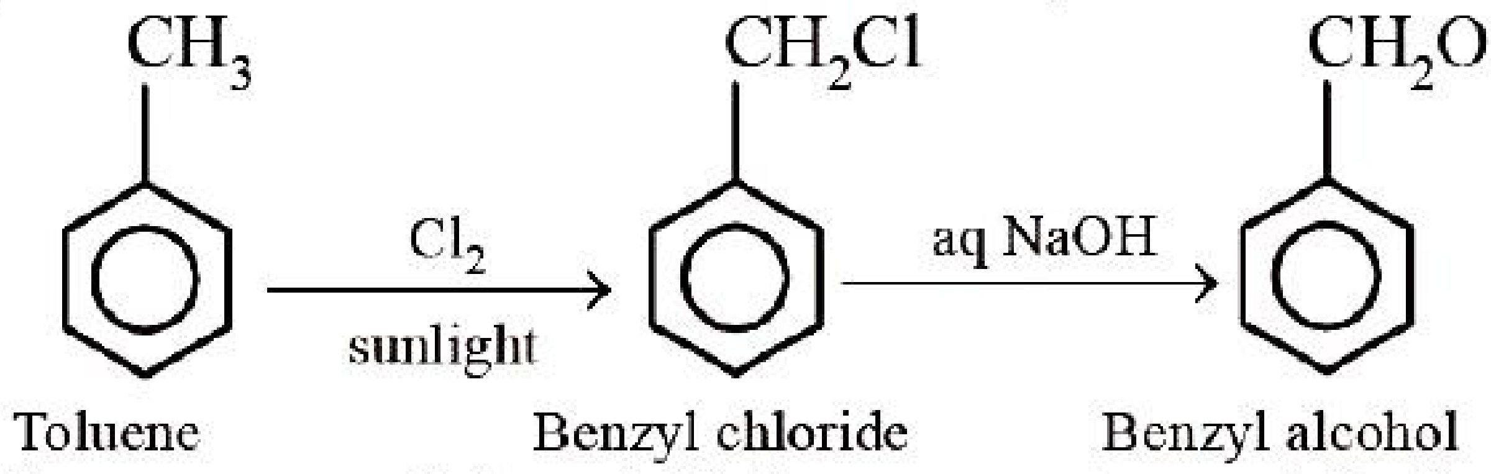
But, if it is present at para position, it will exert + R and – I effect. Thus, *m* - methoxybenzyl alcohol is more acidic than *p*- methoxy phenol. Hence, the correct order of decreasing acidic strength will be : II > IV > I > III > V.

18. **(a)** With increase in molecular mass boiling point increases. Thus the b.p. of pentan-1-ol will be more than other given compounds. Now, among isomeric alcohols 1° alcohols have higher boiling points than 2° alcohols due to higher surface area in 1° alcohols.

Hence, increasing order of b.p. will be

Propan-1-ol < butan-2-ol < butan-1-ol < pentan-1-ol.

19. **(d)**



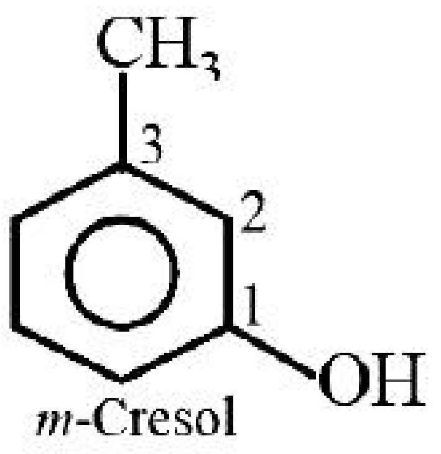
20. **(c)** Less powerful oxidizing agent, pyridinium chlorochromate $\left(C_5H_5\overset{+}{N}HCl\overset{-}{C}rO_3\right)$ oxidises primary alcohols to aldehydes.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow{\text{PCC}} \underset{\text{Ethanal}}{CH_3CHO}$$

21. **(c)** Compounds (A) and (D) are phenols.

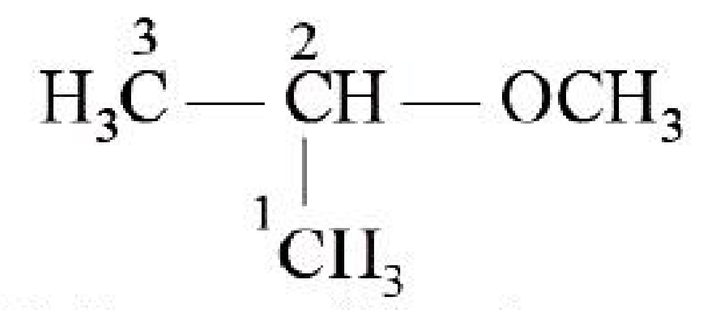
On the other hand, in compounds (B) and (C), — OH group is bonded to sp^3 hybridised carbon which in turn is bonded to benzene ring. Hence, these are considered as aromatic alcohols.

22. **(a)**



Its IUPAC name is 3-methylphenol.

23. **(c)**



$$\overset{3}{H_3C} — \overset{2}{C}H — OCH_3$$
$$|$$
$$\overset{1}{C}H_3$$

IUPAC name of the above compund is 2-methoxypropane.

24. **(b)** Weakest acid has the strongest conjugate base. Among all these acids, ROH is the weakest acid. Therefore, the strongest base is RO^-.

25. **(a)** Phenol, being more acidic in nature, reacts with sodium hydroxide solution gives phenoxide ion. This phenoxide ion is resonance stabilised.

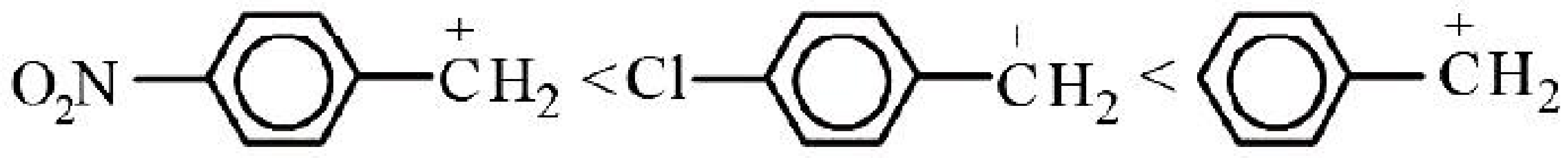
26. **(d)** Presence of electron withdrawing group increases the acidic strength. So, *m*-chlorophenol is most acidic among all the given compounds.

27. **(c)** Nucleophilic substitution reaction depend upon the stability of carbocation. As, presence of electron withdrawing group decreases the stability of carbocation in compounds (II) and (III), therefore, will give less stable carbocation than (I).

Further NO_2 group is a stronger EWG than — Cl.

Thus, $p\text{-}NO_2 — C_6H_4 — \overset{+}{C}H_2$ will be less stable than $p\text{Cl} — C_6H_4 — \overset{+}{C}H_2$

Hence, the order of stability of carbocations, and thus reactivity of parent alcohol will be:



28. **(d)** The order of reactivity of alcohol with Lucas reagent is *tert.* > *sec.* > *pri.*

29. **(c)** Secondary alcohols oxidise to produce kenone.

$$\underset{\text{2-Butanol}}{CH_3CHOHCH_2CH_3} \xrightarrow{(O)} \underset{\text{Ethyl methyl ketone}}{CH_3COCH_2CH_3}$$

30. **(a)**

31. **(b)** 5-10 % methanol and remaing ethanol is called methylated spirit. It is also known as denatured alcohol because it is unfit for drinking.

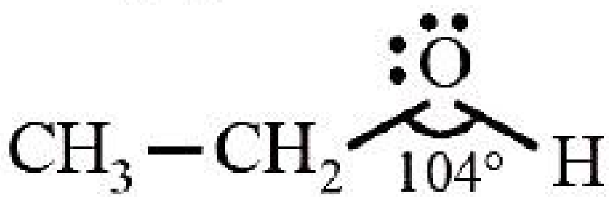
32. **(c)** **33.** **(b)** **34.** **(b)**

35. **(c)** Alcoholic beverages contain ethyl alcohol (C_2H_5OH) which is drinking alcohol. CH_3OH is poisonous alcohol.

36. **(b)** C_2H_5OH and $CH_3 – O – CH_3$ are isomers.

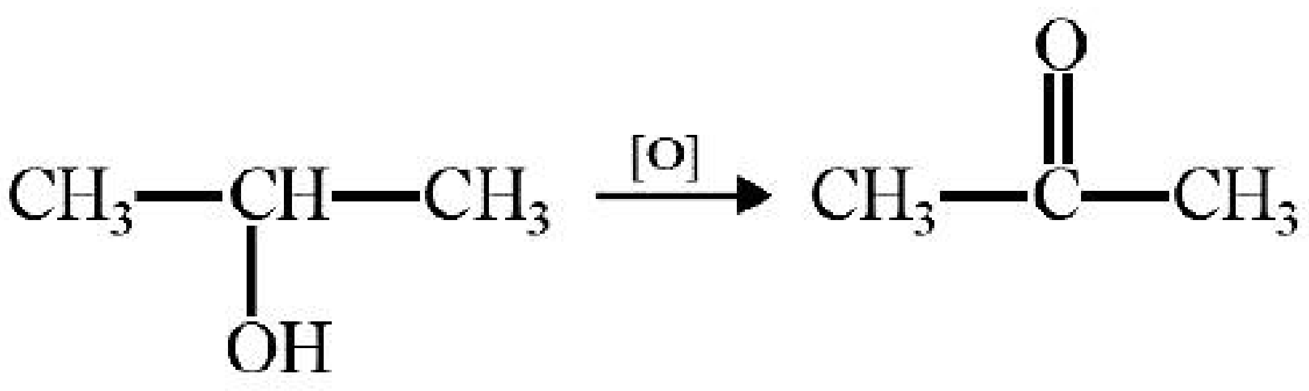
37. **(b)**

38. **(b)** In C_2H_5OH,



Due to presence of lone pair of electrons on oxygen, there occurs a small decrease in bond angle from the normal tetrahedral bond angle (109°28′).

39. **(a)**

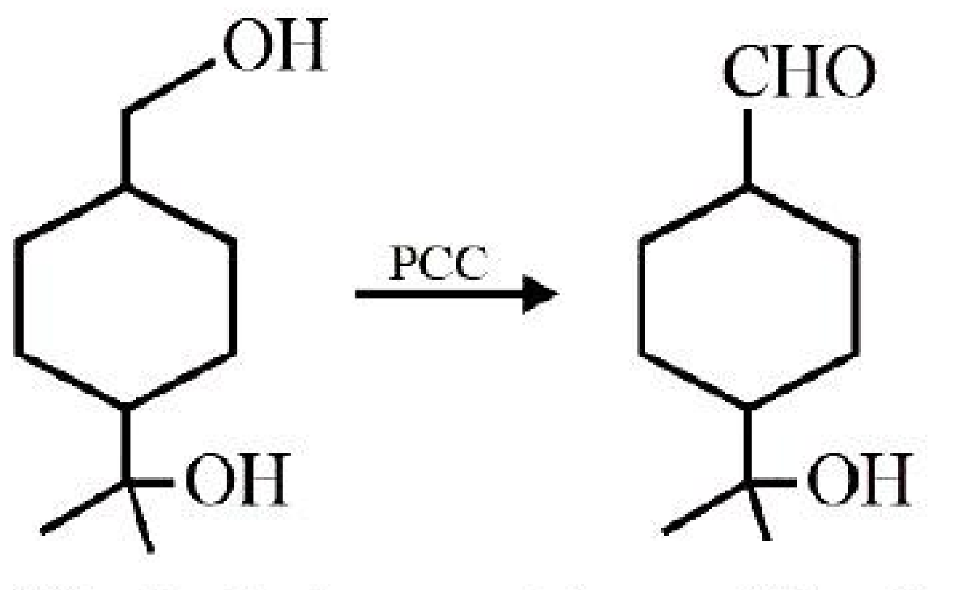


$$CH_3—\underset{\underset{OH}{|}}{CH}—CH_3 \xrightarrow{[O]} CH_3—\overset{\overset{O}{\|}}{C}—CH_3$$

2° alcohol more easily oxidised than 3° alcohol.

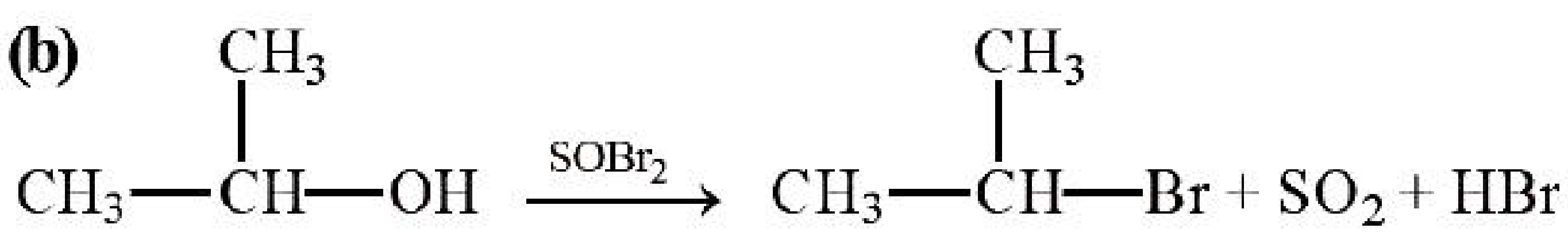
40. **(a)** More stable carbocation more is the rate toward HBr (acid).

41. **(b)**



(3° alcohol cannot be oxidized)

42. **(b)**



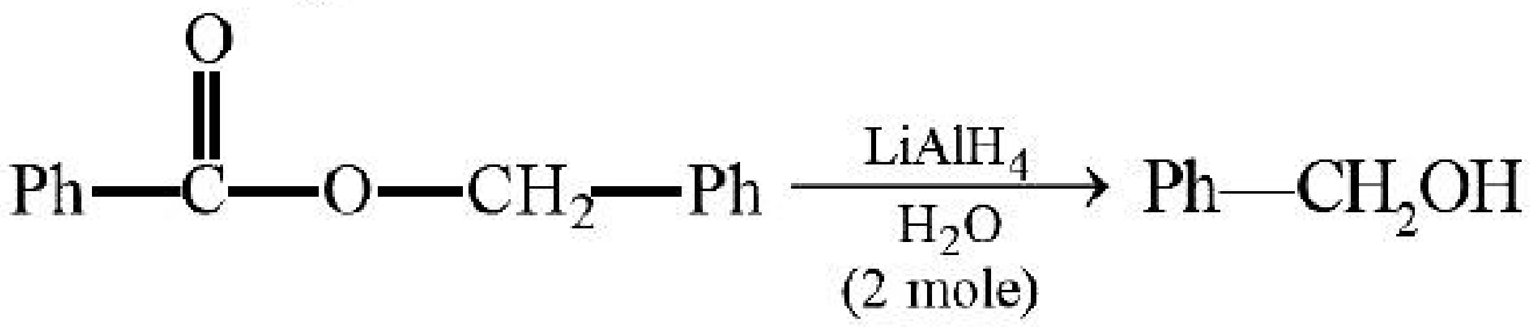
$$CH_3—\overset{\overset{CH_3}{|}}{C}H—OH \xrightarrow{SOBr_2} CH_3—\overset{\overset{CH_3}{|}}{C}H—Br + SO_2 + HBr$$

Side products are gases.

In case of HBr elimination also favours to produce alkene.

43. **(d)** HIO_4 will not oxidise, diol from 1, 3 atom and not used for cleavage of ether.

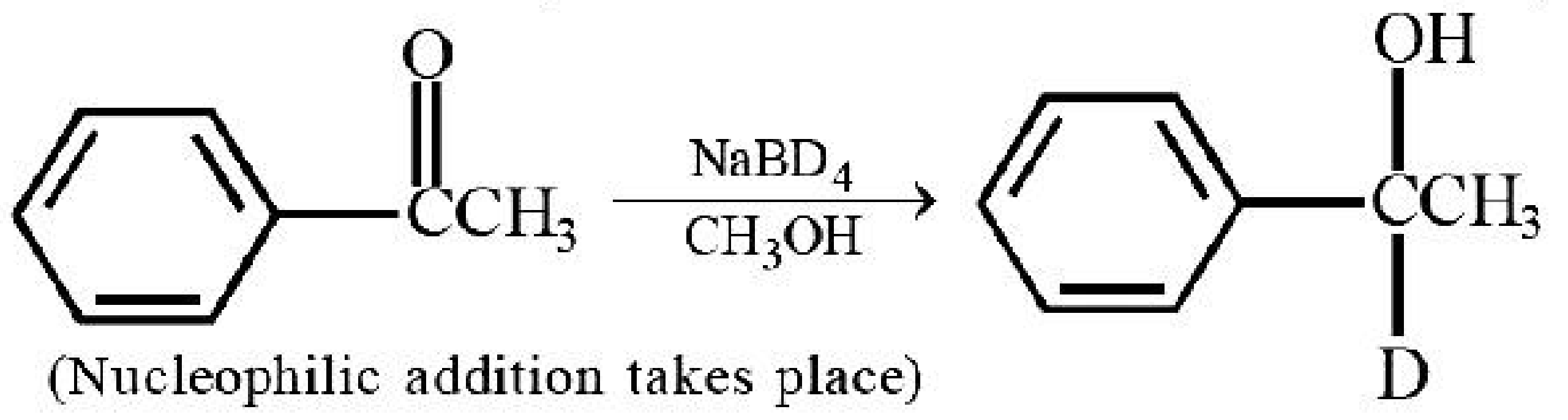
44. **(b)**



$$Ph—\overset{\overset{O}{\|}}{C}—O—CH_2—Ph \xrightarrow[\substack{H_2O \\ (2\text{ mole})}]{LiAlH_4} Ph—CH_2OH$$

45. **(b)** $Cr^{6+} \longrightarrow Cr^{3+}$ (PCC oxidises 1° alcohol to aldehyde)

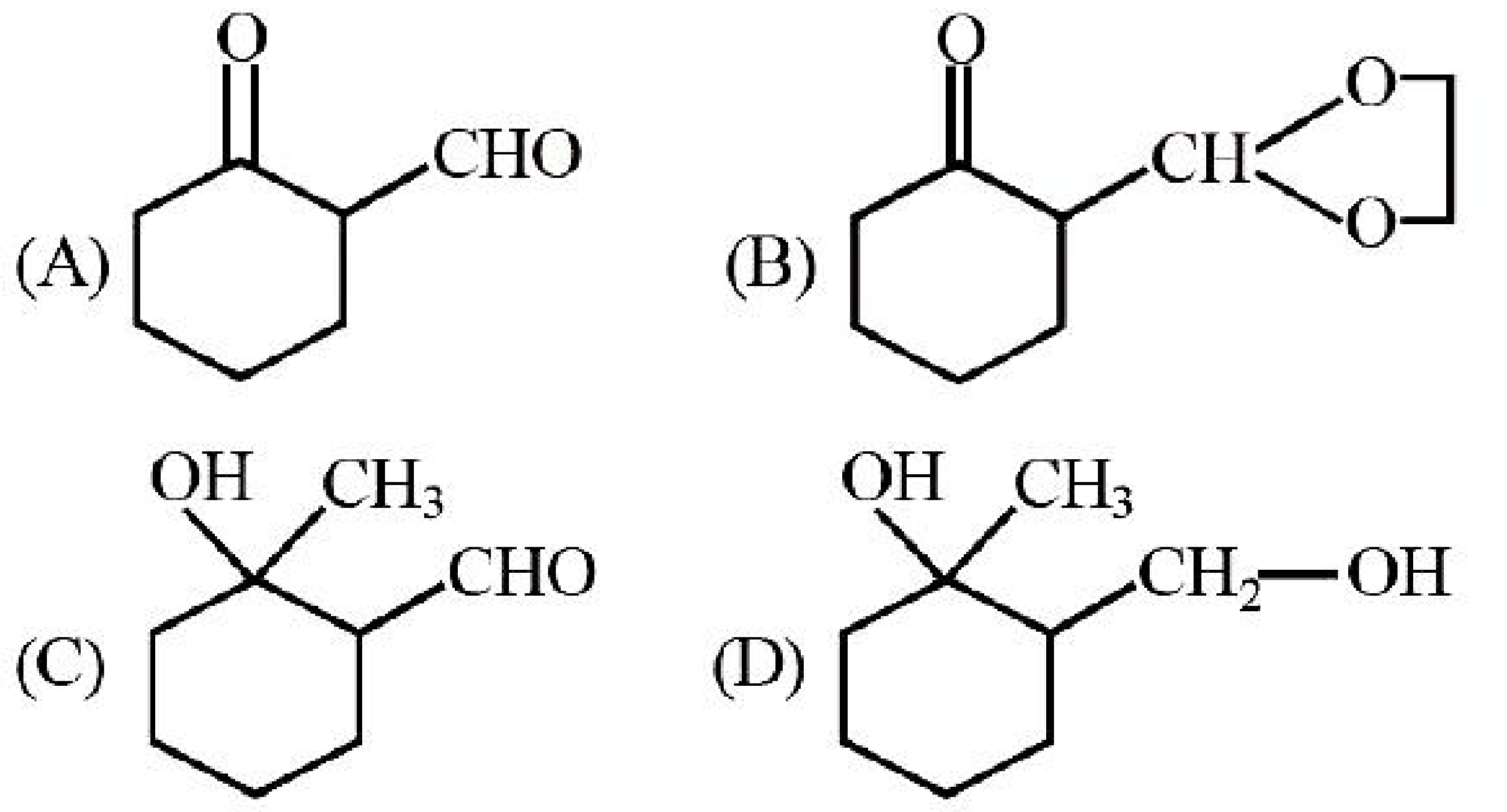
46. **(a)**



(Nucleophilic addition takes place)

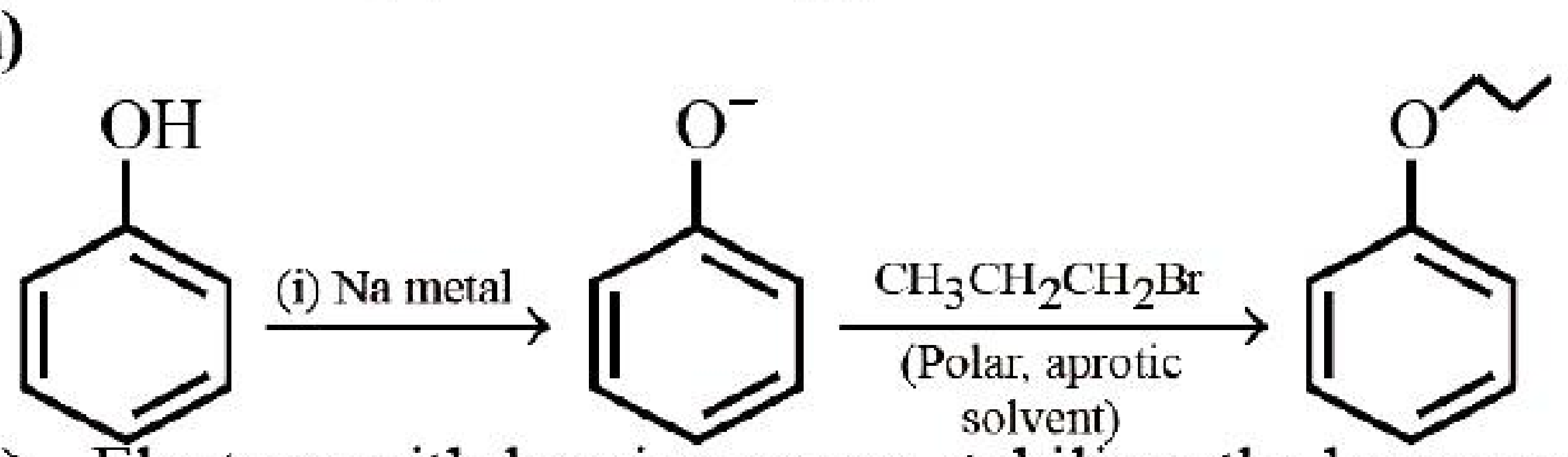
47. **(c)**

48. **(b)**



49. **(a)** **50.** **(d)** **51.** **(d)**

52. **(a)**



53. **(c)** Electron withdrawing group stabilises the benzene ring due to delocalisation of charge.

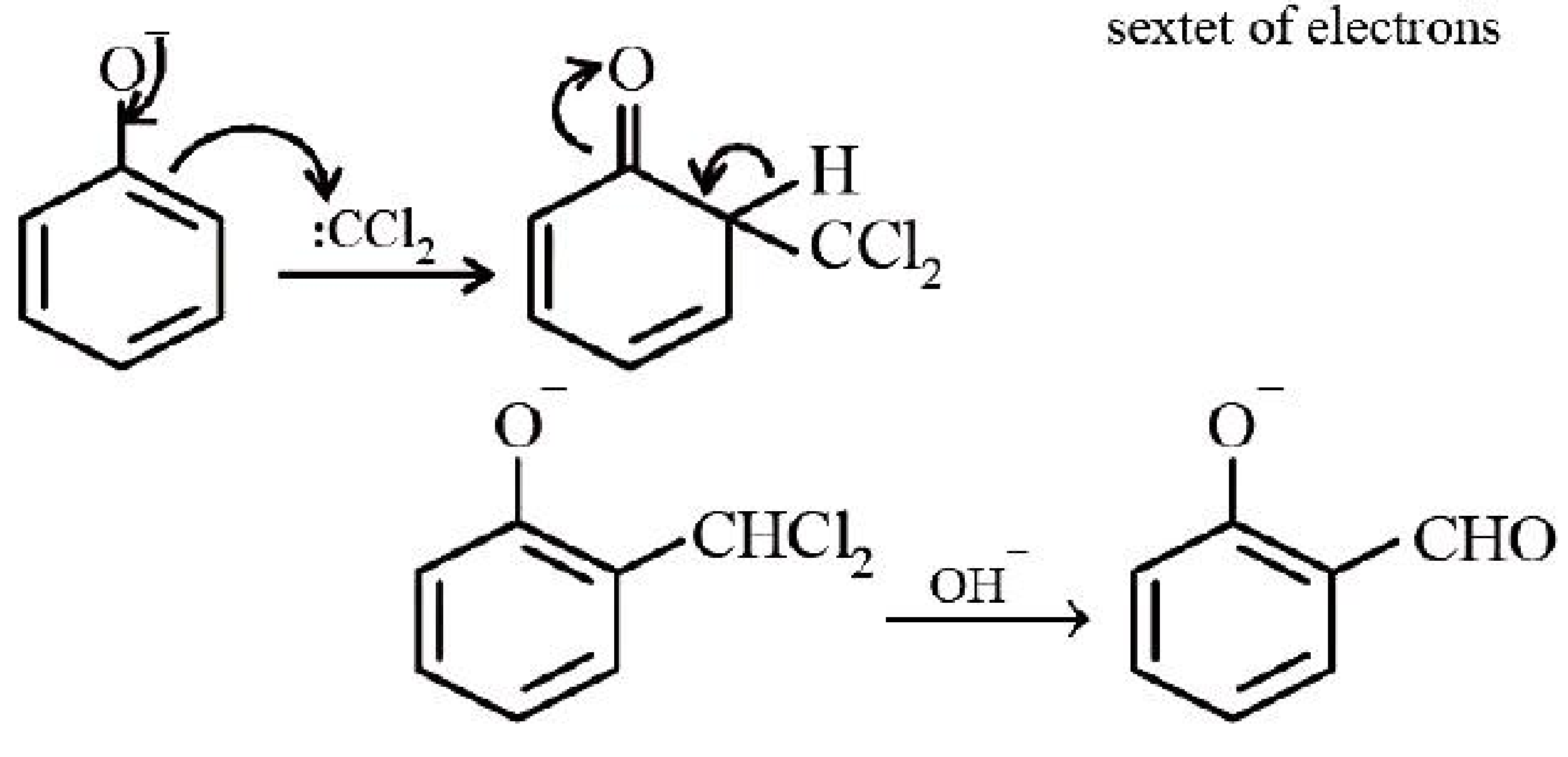
$-CH_3$ and $-CH_2OH$ are electron donating group and hence decrease the stability of benzene ring $-OCH_3$ is weaker electron withdrawing group than $-COCH_3$. Hence $-COCH_3$ group more stabilize the phenoxide ion at *p*-position.

54. **(d)** Riemer-Tiemann reaction involves electrophilic substitution on the highly reactive phenoxide ring.

$$HCCl_3 + OH^- \longrightarrow H_2O + :\bar{C}Cl_3$$

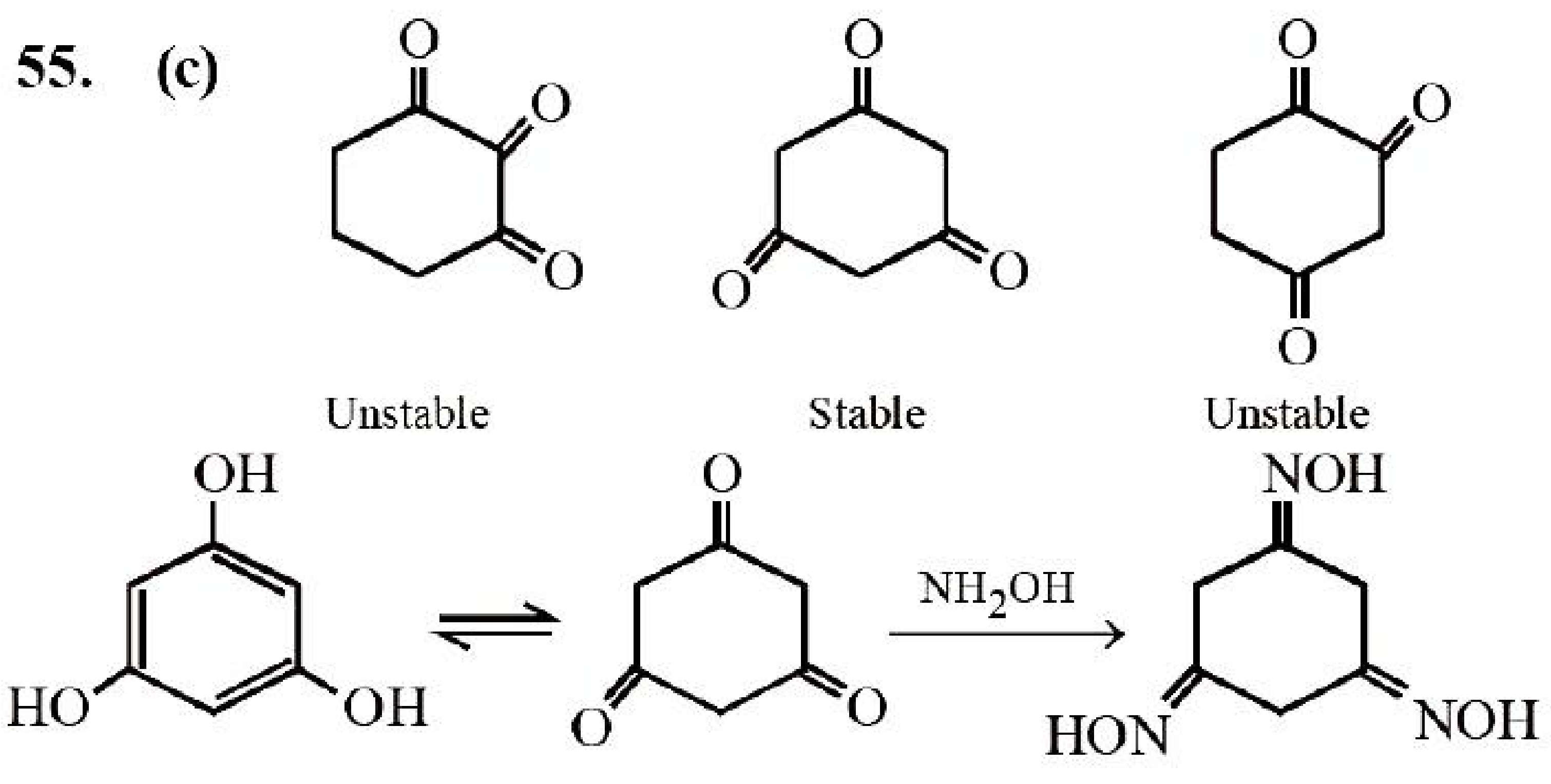
$$:\bar{C}Cl_3 \longrightarrow Cl^- + \ :CCl_2$$

Note the C has only a sextet of electrons

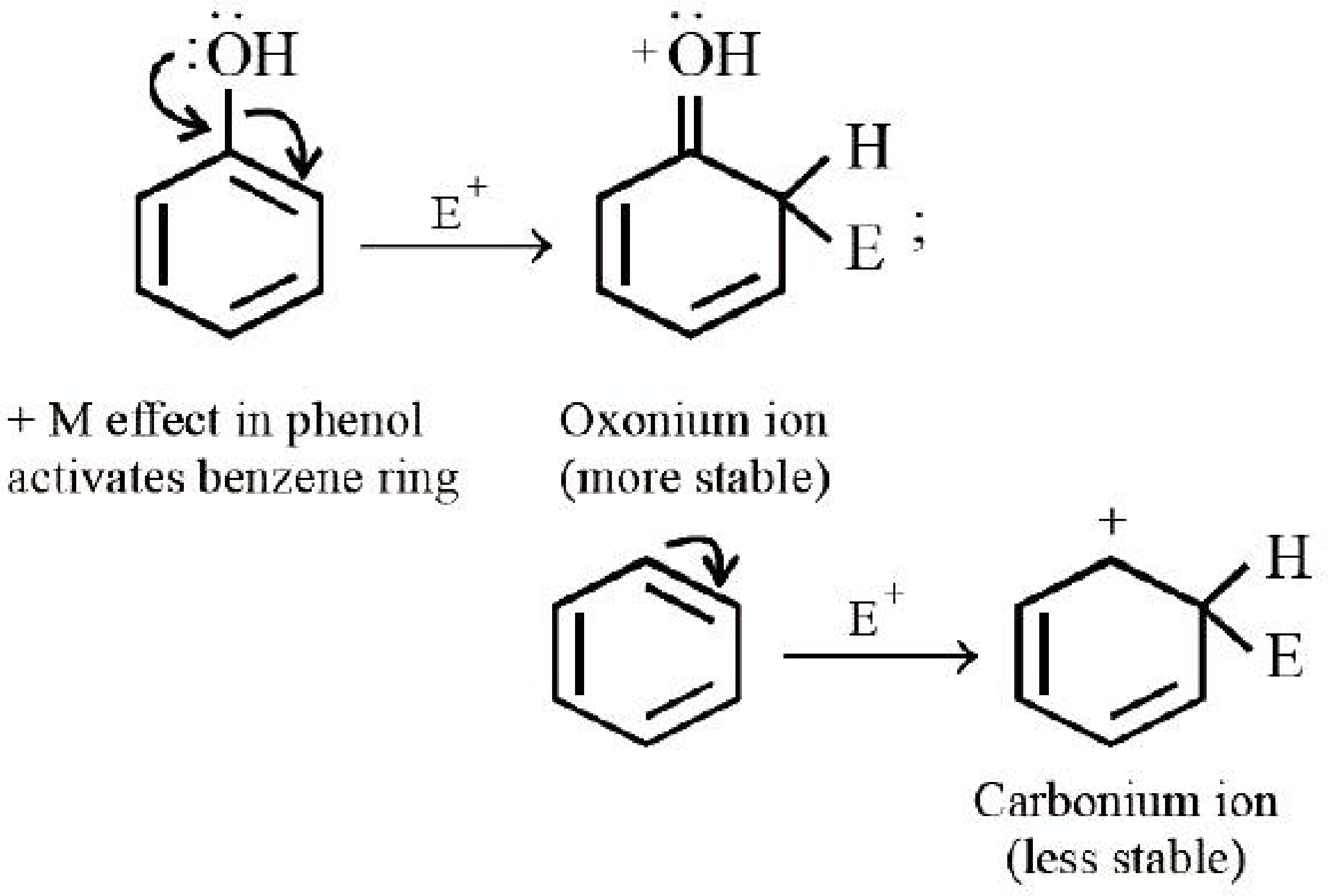


A benzal chloride

55. **(c)**



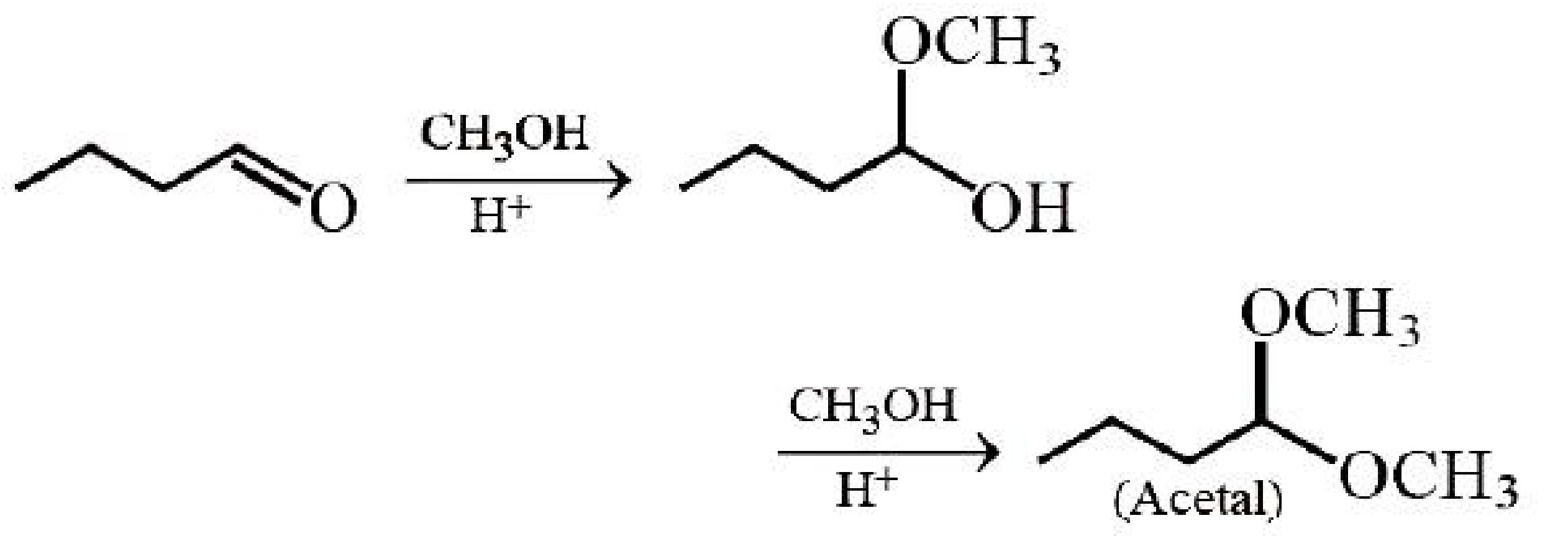
56. **(c)**



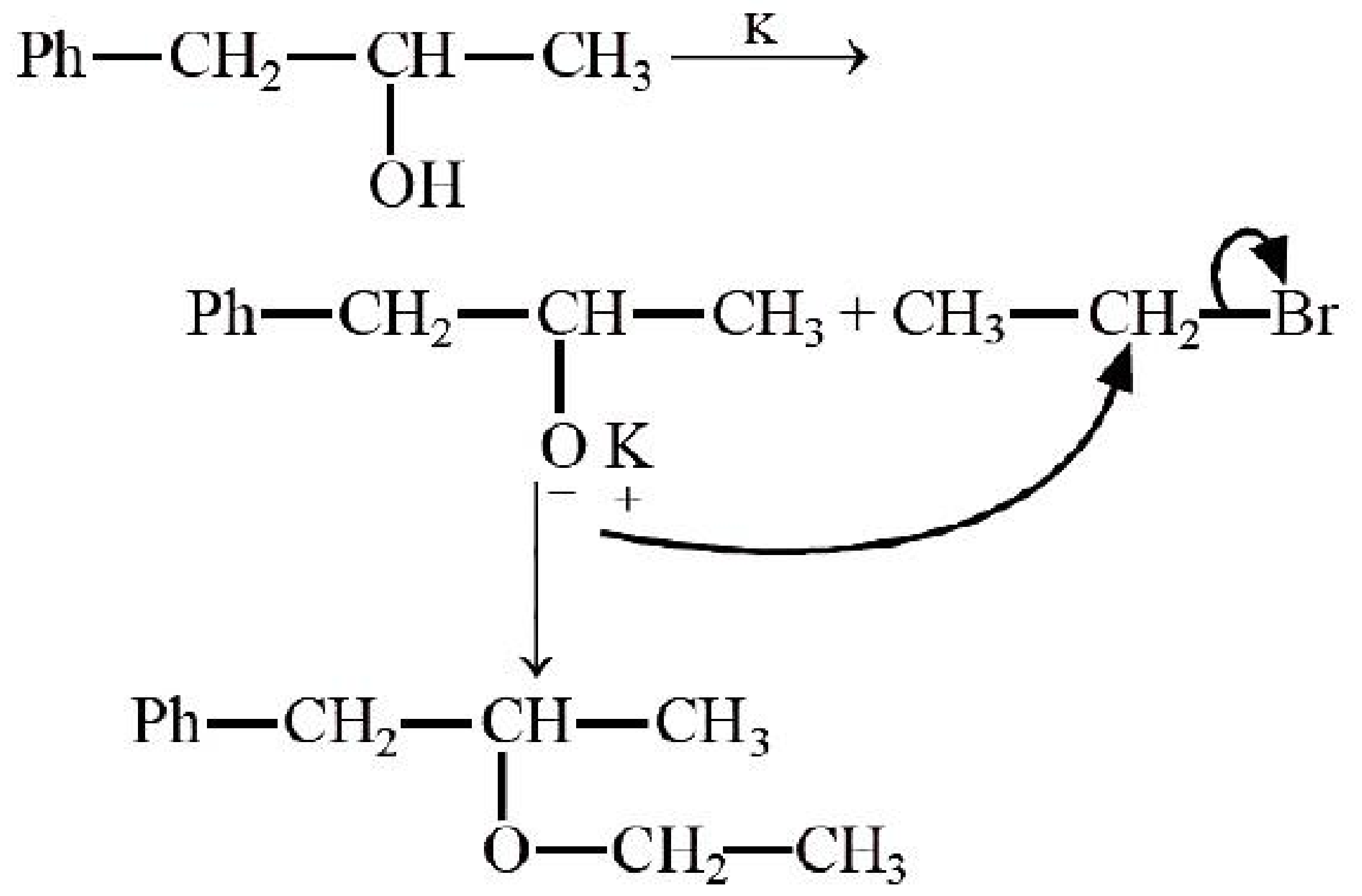
High stability of oxonium ion (oxocation) is because here every atom (except H) has a complete octet of electrons, while in carbocations, carbon bearing positive charge is having six electrons.

57. **(c)**

58. **(a)**



59. **(b)**



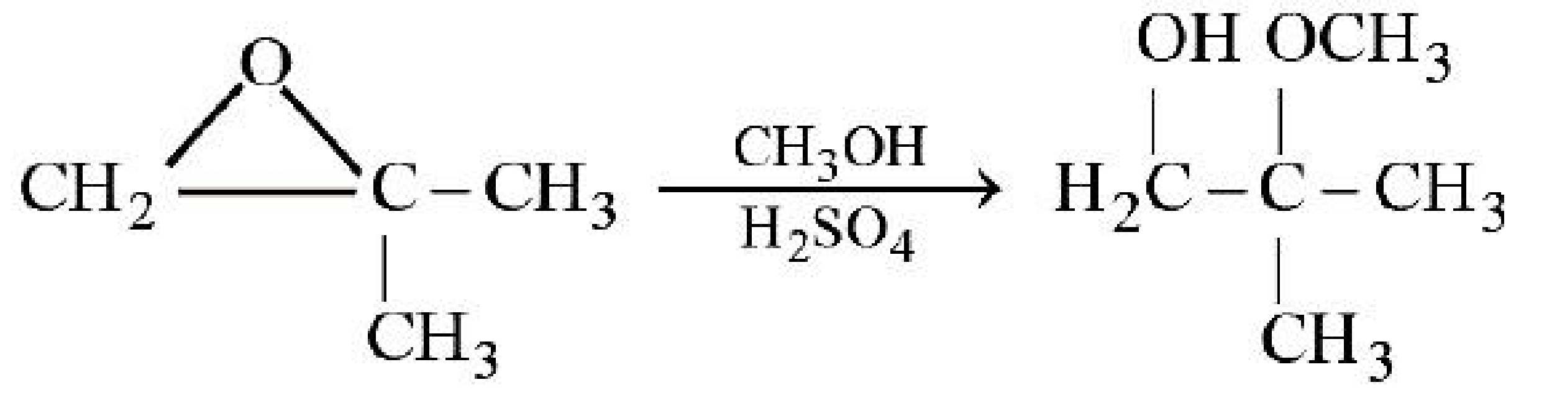
60. **(a)** $C_4H_{10}O \xrightarrow{\text{excess of HI}}$ only RI

Since the compound ($C_4H_{10}O$) does not react with sodium, oxygen must be in the form of ether (R–OR). Further since a single alkyl halide is formed, the two alkyl groups must be same, hence ether is $C_2H_5OC_2H_5$.

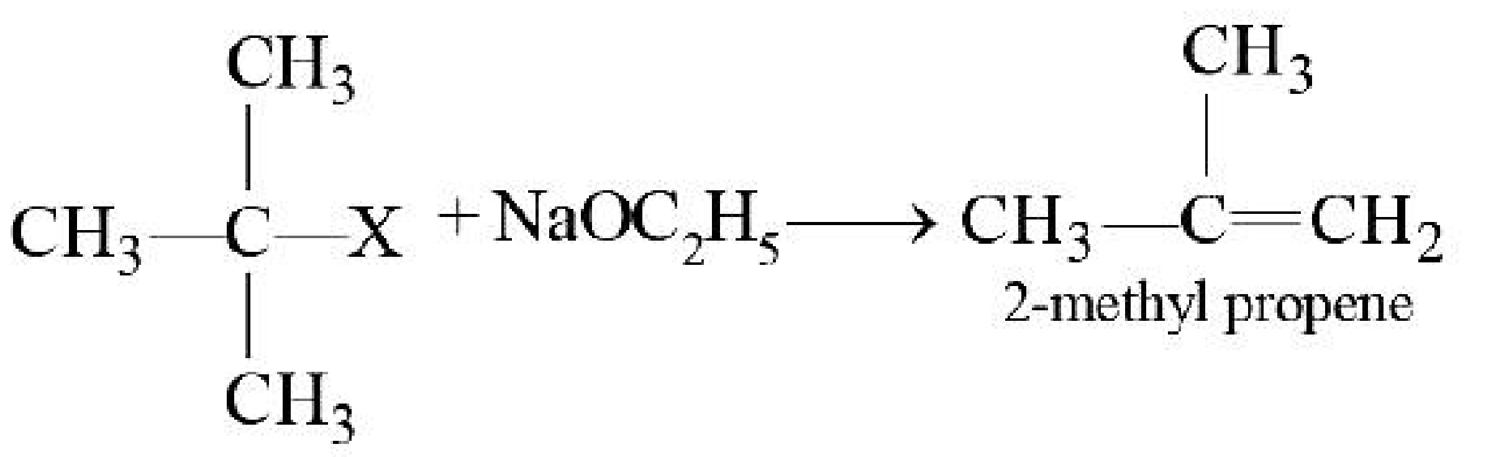
61. **(a)** $(CH_3)_2CHO^- \overset{+}{Na} + CH_3I \longrightarrow$

$(CH_3)_2CH\ \ O\ \ CH_3 + NaI$

62. **(a)**



63. **(b)** The tertiary alkyl halide undergo elimination reaction to give alkenes



$$CH_3-\underset{CH_3}{\overset{CH_3}{C}}-X + NaOC_2H_5 \longrightarrow CH_3-\overset{CH_3}{C}=CH_2$$

2-methyl propene

64. **(a)** $C_6H_5Br + NaO - CH_2 - CH = CH_2 \longrightarrow$

$C_6H_5 - O - CH_2 - CH = CH_2 + NaBr$

Allyl phenyl ether

65. **(d)** Phenol has active (acidic) hydrogen so it reacts with CH_3MgI to give CH_4, and not anisole

$$C_6H_5OH + CH_3MgI \longrightarrow CH_4 + C_6H_5OMgI$$

66. **(b)** $(CH_3)_3CBr + NaOC_2H_5$ can't be applied for synthesising the ether because sod. ethoxide, being a strong base, will preferentially cause elimination reaction.

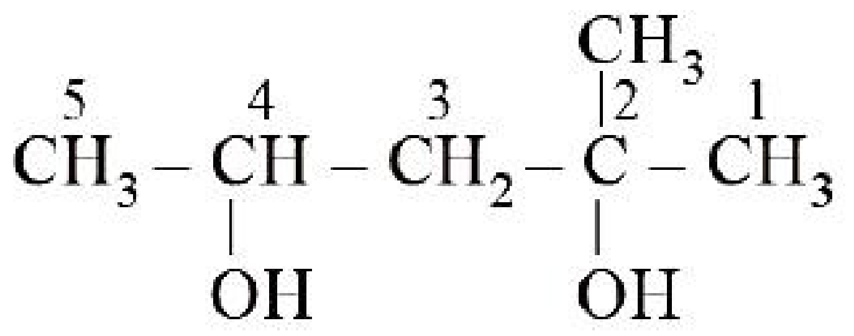
$$(CH_3)_3CBr \xrightarrow{^-OC_2H_5} (CH_3)_2C = CH_2 + HBr$$

In isobutene + ethanol, isobutene will form *tert*-butyl cation which reacts with ethanol, a nucleophile to form ether.

$$(CH_3)_2C = CH_2 \xrightarrow{H^+} (CH_3)_2\overset{+}{C}CH_3$$

$$\xrightarrow[\text{(ii) } -H^+]{\text{(i) } CH_3CH_2OH} (CH_3)_3COCH_2CH_3$$

67. **(b)**



$$\overset{5}{CH_3} - \underset{OH}{\overset{4}{CH}} - \overset{3}{CH_2} - \underset{OH}{\overset{CH_3}{\overset{|2}{C}}} - \overset{1}{CH_3}$$

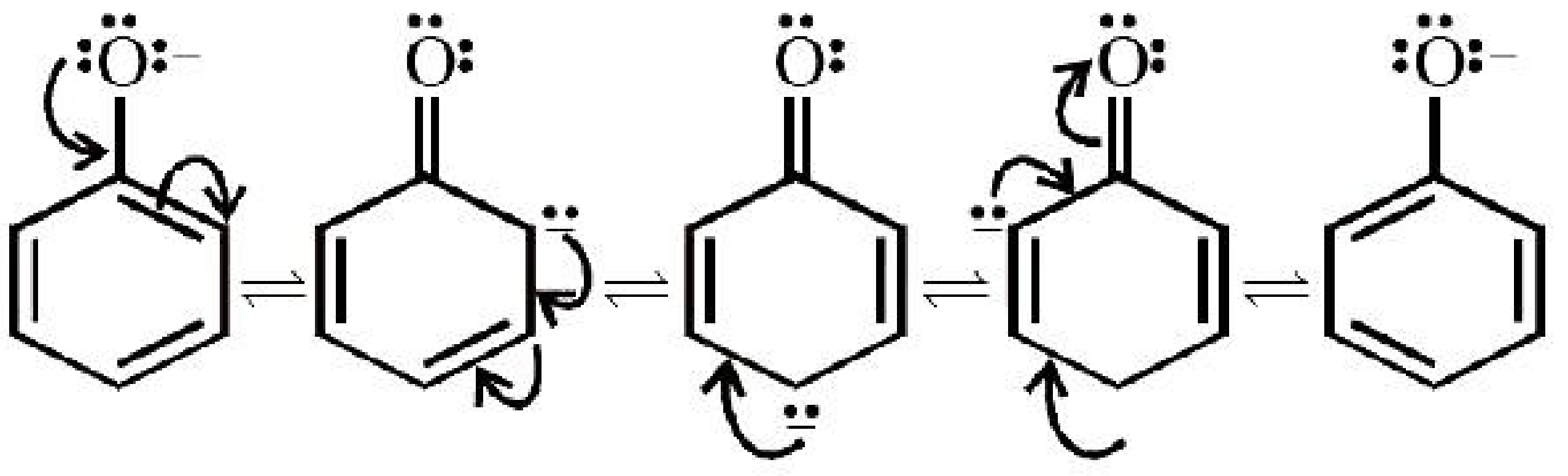
2-Methyl-2, 4-pentanediol.

68. **(b)**

69. **(b)** Alcohols are versatile compounds. They react both as nucleophiles and electrophiles. The bond between

70. **(b)** **71.** **(d)**

72. **(a)** In alkoxides, the R → O^- ion is unstable due to high charge density on oxygen atom (+ *I* effect) and sp^3 hybridisation. This phenoxide io ($C_6H_5 - O^-$) is stabilised by resonance and sp^2 hybridisation of the carbon atom, therefore, it is more stable due to less charge density on oxygen atom.



73. **(b)** Phenols are weaker acids (K_a = 1.3 × 10^{-10}) than carboxylic acids ($K_a = 10^{-5}$) and carbonic acids ($K_a = 10^{-7}$). Therefore, phenols do not react with carbonates and bicarbonates.

74. **(d)** Phenols cannot react directly with carboxylic acid and does not form ester, as oxygen of phenoxide ion has less charge density due to resonance, hence, the phenoxide ion ($C_6H_5 - O^-$) is stable and does not favour esterification. electron withdrawing character increases acidic nature of phenol.

75. **(d)** *p*-Nitrophenol is more acidic than *m*-nitrophenol due to – I, and – m character of NO_2 group. At m-position only -I effect is considered.

76. **(a)** **77.** **(d)** **78.** **(b)** **OR** **(a)**

79. **(a)** **80.** **(c)**

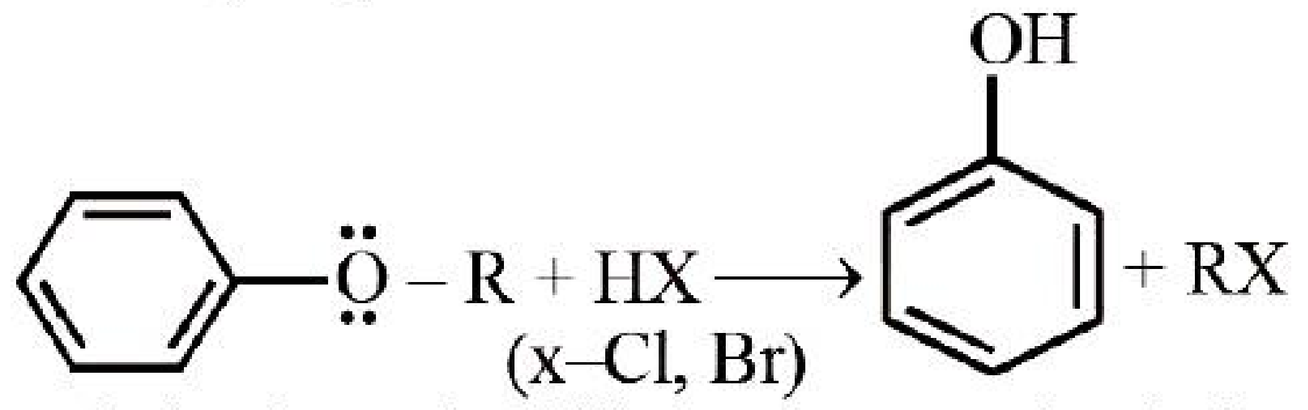
81. **(a)** Methanol is injurious to the nervous system. It mainly damages central nervous system and optic nerve, therefore, ingestion of small amount of methanol cause blindness and death.

82. **(c)** Alcohols are highly polar in nature, threfore, they show intermolecular hydrogen bonding and are miscribe with water.

83. **(a)**

84. **(b)** In Williamson's synthesis, only primary alkyl halides (RX) react with sodium alkoxide (RONa 1° or 2° or 3°) giving ether, therefore, both symmetrical and unsymmetrical ethers can be prepared.

85. **(a)** Aryl-oxygen bond is highly stable due to stabilisation of lone pair of electrons on oxygen atom due to resonance effect and sp^2 hybridization of the carbon atom.



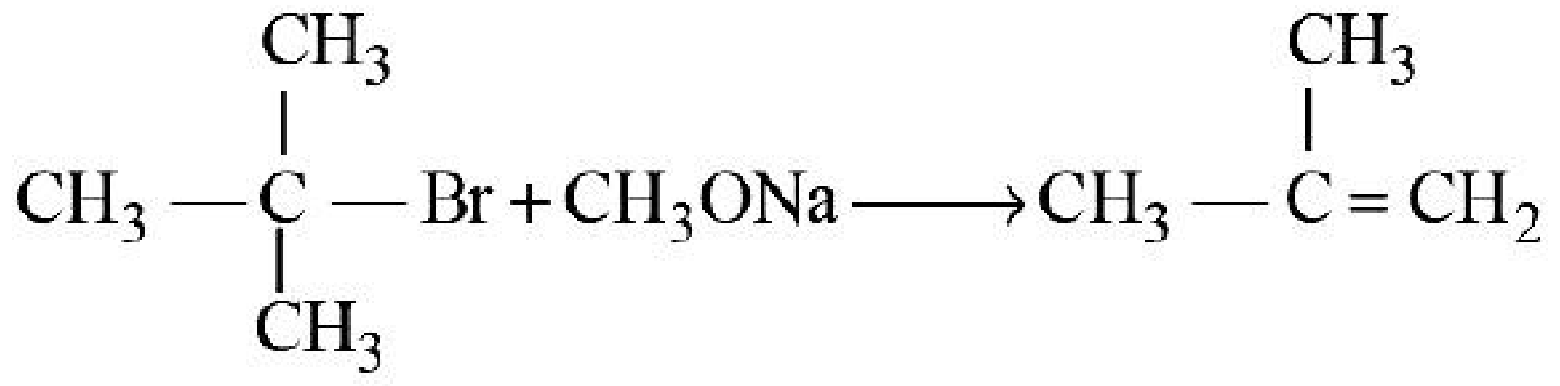
86. **(a)** Limitation of Williamson's synthesis is that only primary alkyl halide reacts with 1° or 2° or 3° sodium alkoxide to give ethers.

87. **(a)** *p*-nitrophenol is more acidic than phenol because nitro group helps in the stabilisation of the phenoxide ion by dispersal of negative charge due to resonance.

88. **(b)** Due to the presence of intramolecular hydrogen bonding. *o*-nitrophenol does not form hydrogen bonds with H_2O but m and *p*-nitrophenol form hydrogen bonds with water.

89. **(a)** 2-Cyclohexenol is dehydrated more readily than 3-cyclohexenol because the carbocation formed from the former is more stable than the latter.

90. **(b)** *Ter*-butyl bromide and sodium methoxide reacts to form 2-methylpropene and ethanol (elimination reaction).



$$CH_3 - \underset{CH_3}{\overset{CH_3}{C}} - Br + CH_3ONa \longrightarrow CH_3 - \overset{CH_3}{C} = CH_2$$

91. **(b)** **92.** **(a)** **93.** **(d)**

94. aluminium oxide

$$CH_2 = CH_2 \xleftarrow[650\,K]{Al_2O_3} CH_3CH_2OH \xrightarrow[525\,K]{Al_2O_3}$$

$$CH_3CH_2OCH_2CH_3$$

So, aluminium oxide is used for dehydration.

95. H-bonding

Due to H-bonding, the boiling point of ethanol is much higher than that of the isomeric diethyl ether.

96. phenol

5% aqueous solution of phenol at room temperature is called as carbolic acid.

97. electrophile

98. ethers; This method is suitable for the preparation of a wide variety of unsymmetrical ethers. The nucleophilic substitution of halides with alkoxide leads to desired product.

99. **True** **100. False**

101. **False;** Boiling points of alcohols are higher than that of ethers of comparable molecular mass.

102. **True;** Alchols can form intermalecular hydrogen bonding while ethers.

103. **True;** Alkyl group present on the cresols does not favour the formation of phenoxide ion.