Alcohols, Phenols and Ethers

EXERCISE [PAGES 252 - 253]

Exercise | Q 1.01 | Page 252

Choose the correct option.

Which of the following represents the increasing order of boiling points of (1), (2), and (3)?

(1) $CH_3 - CH_2 - CH_2 - CH_2 - OH$

(2) $(CH_3)_2CHOCH_3$

(3) $(CH_3)_3COH$

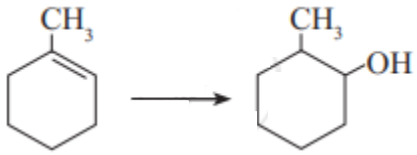
1. (1) < (2) < (3)
2. (2) < (1) < (3)
3. (3) < (2) < (1)
4. **(2) < (3) < (1)**

Solution: (2) < (3) < (1)

Exercise | Q 1.02 | Page 252

Choose the correct option.

Which is the best reagent for carrying out the following conversion?



1. $LiAlH_4$
2. Conc. H_2SO_4, H_2O
3. H_2/Pd
4. **B_2H_6, H_2O_2 -NaOH**

Solution: B_2H_6, H_2O_2 -NaOH

Exercise | Q 1.03 | Page 252

Choose the correct option.

Which of the following substrate will give ionic organic products on reaction?

1. **CH_3 - CH_2 - OH + Na**
2. CH_3 - CH_2 - OH + $SOCl_2$
3. CH_3 - CH_2 - OH + PCl_5
4. CH_3 - CH_2 - OH + H_2SO_4

Solution: CH_3 - CH_2 - OH + Na

Exercise | Q 1.04 | Page 252

Choose the correct option.

Which is the most resistant alcohol towards oxidation reaction among the following?

Options

$CH_3 - CH_2 - OH$

$(CH_3)_2CH - OH$

$(CH_3)_3C - OH$

$C_2H_5\ CH - OH$ (with CH_3 branch)

Solution: ($(CH_3)_3C - OH$

Exercise | Q 1.05 | Page 252

Choose the correct option.

Resorcinol on distillation with zinc dust gives _____.

1. Cyclohexane
2. **Benzene**
3. Toluene
4. Benzene-1, 3-diol

Solution: Resorcinol on distillation with zinc dust gives **Benzene.**

Exercise | Q 1.06 | Page 252

Choose the correct option.

Anisole on heating with concerntrated HI gives _____.

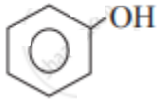
1. Iodobenzene
2. Phenol + Methanol
3. **Phenol + Iodomethane**
4. Iodobenzene + methanol

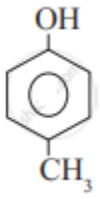
Solution: Anisole on heating with concentrated HI gives **Phenol + Iodomethane**.

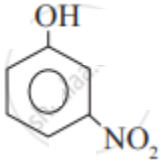
Exercise | Q 1.07 | Page 252

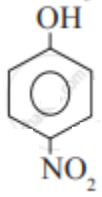
Choose the correct option.

Which of the following is the least acidic compound?

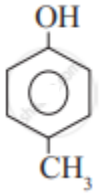
1. 

2. 

3. 

4. 

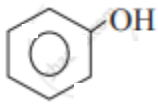
Solution:



Exercise | Q 1.08 | Page 252

Choose the correct option.

The compound incapable of hydrogen bonding with water is _____.

1. CH_3-CH_2-O-CH_3
2. **CH_3-CH_2-CH_2-CH_3**
3. 

4. CH_3-CH_2-CH_2-OH

Solution:

The compound incapable of hydrogen bonding with water is **CH_3-CH_2-CH_2-CH_3**.

Exercise | Q 1.09 | Page 253

Choose the correct option.

Ethers are kept in air tight brown bottles because _____.

1. Ethers absorb moisture
2. Ethers evaporate readily
3. **Ethers oxidise to explosive peroxide**
4. Ethers are inert

Solution:

Ethers are kept in air tight brown bottles because **Ethers oxidise to explosive peroxide.**

Exercise | Q 1.1 | Page 253

Choose the correct option.

Ethers react with cold and concentrated H_2SO_4 to form _____.

1. **oxonium salt**
2. alkene
3. alkoxides
4. alcohols

Solution:

Ethers react with cold and concentrated H_2SO_4 to form **oxonium salt.**

Exercise | Q 2.1 | Page 253

Answer in one sentence/ word.

Hydroboration-oxidation of propene gives _____.

Solution:

Hydroboration-oxidation of propene gives propan-1-ol ($CH_3CH_2CH_2OH$).

Exercise | Q 2.2 | Page 253

Answer in one sentence/ word.

Write the IUPAC name of alcohol having molecular formula $C_4H_{10}O$ which is resistant towards oxidation.

Solution:

2-Methylpropan-2-ol is tertiary alcohol having the molecular formula, $C_4H_{10}O$, and is resistant towards oxidation.

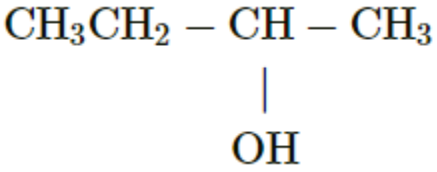
Exercise | Q 2.3 | Page 253

Answer in one sentence/ word.

Write the structure of optically active alcohol having molecular formula $C_4H_{10}O$

Solution:

The optically active alcohol having molecular formula $C_4H_{10}O$ is



Exercise | Q 2.4 | Page 253

Answer in one sentence/ word.

Write the name of the electrophile used in Kolbe's Reaction.

Solution:

Carbon dioxide

Exercise | Q 3.1 | Page 253

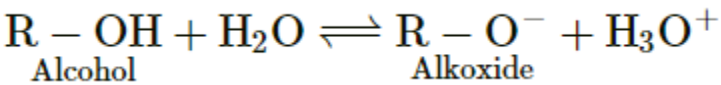
Answer in brief.

Explain why phenol is more acidic than ethyl alcohol.

Solution:

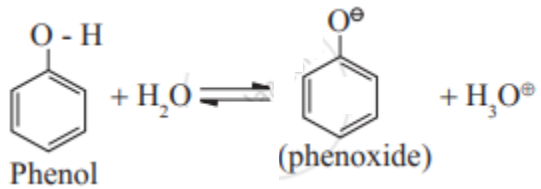
The difference in the acidic character of phenols and alcohol is due to the difference in reactivity of these compounds towards the ionization of the O–H bond. This can be explained as follows:

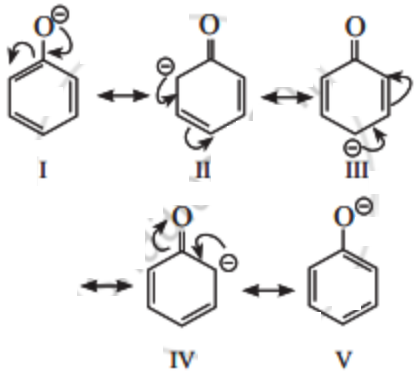
i. Ionization of alcohols is represented by the following equilibrium



The electron-donating inductive effect (+I effect) of the alkyl group destabilizes the alkoxide ion (the conjugate base of alcohol). As a result, alcohol does not ionize much in the water, and behaves like a neutral compound in an aqueous medium.

ii. Ionization of phenol is represented by the following equilibrium





Phenoxide ion, the conjugate base of phenol, is resonance stabilized by delocalization of the negative charge. Therefore, phenol ionizes in an aqueous medium to a moderate extent and thereby shows a weak acidic character.

Exercise | Q 3.2 | Page 253

Answer in brief.

Explain why p-nitrophenol is a stronger acid than phenol.

Solution:

The conjugate base of p-nitrophenol is better resonance stabilized due to six resonance structures compared to the five resonance structures of the conjugate base of phenol.

The resonance structure has a negative charge on only electronegative oxygen atoms.

Hence, p-nitrophenol is a stronger acid than phenol.

Exercise | Q 3.3 | Page 253

Answer in brief.

Write two points of difference between the properties of phenol and ethyl alcohol.

Solution:

	Phenol	**Ethyl alcohol**
i.	Phenol is a low melting solid.	Ethyl alcohol is liquid.
ii.	The aqueous solution of phenol turns blue litmus to red, i.e., phenol is weakly acidic.	The aqueous solution of ethyl alcohol is neutral to litmus, i.e, ethyl alcohol is neutral.
iii.	Phenol reacts with aqueous NaOH to form sodium phenoxide.	Ethyl alcohol does not react with aqueous NaOH.
iv.	Phenol reacts with neutral ferric chloride solution to give deep purple colouration of ferric phenoxide	Ethyl alcohol does not react with neutral ferric chloride

Exercise | Q 3.4 | Page 253

Answer in brief.

Give the reagents and conditions necessary to prepare phenol from Chlorobenzene

Solution:

Reagents and conditions required to prepare phenol from:

Chlorobenzene

Reagents: NaOH, dil HCl

Conditions: Temperature 623 K and Pressure 150 atm

Exercise | Q 3.4 | Page 253

Answer in brief.

Give the reagents and conditions necessary to prepare phenol from Benzene sulfonic acid.

Solution:

Reagents and conditions required to prepare phenol from:

Benzene sulfonic acid

Reagents: NaOH, Solid NaOH, dil HCl

Conditions: Temperature 573 K

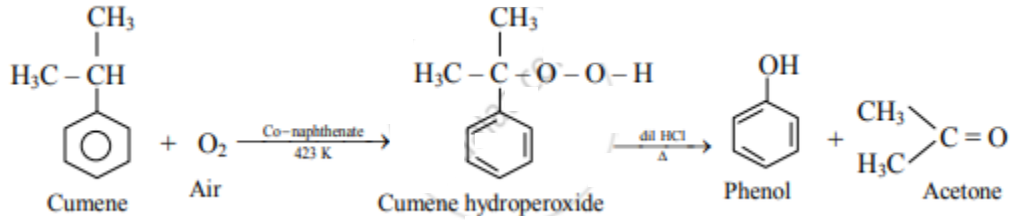
Exercise | Q 3.5 | Page 253

Answer in brief.

Give the equations of the reactions for the preparation of phenol from isopropyl benezene.

Solution:

Cumene: This is the commercial method of preparation of phenol. Cumene (isopropylbenzene) on air oxidation in presence of Conaphthenate gives cumene hydroperoxide, which on decomposition with dilute acid gives phenol with acetone as a valuable by-product.



Exercise | Q 3.6 | Page 253

Answer in brief.

Give a simple chemical test to distinguish between ethanol and ethyl bromide.

Solution:

i. Ethanol on reaction with a very strong base like alkali metal Na or K gives sodium or potassium ethoxide with the liberation of hydrogen gas.

$$2\,CH_3CH_2 - OH + 2\,Na \longrightarrow 2\,CH_3CH_2O^-Na^+ + H_{2\,(g)} \uparrow$$

ii. Ethyl bromide on reaction with sodium metal does not liberate hydrogen gas.

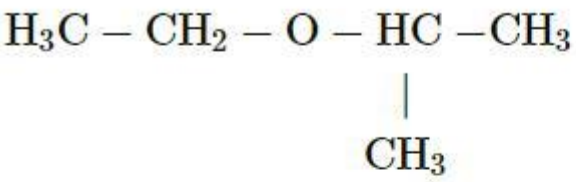
$$2\,CH_3CH_2Br + 2\,Na \longrightarrow CH_3CH_2 - CH_2CH_3 + 2\,NaBr$$

Exercise | Q 4 | Page 253

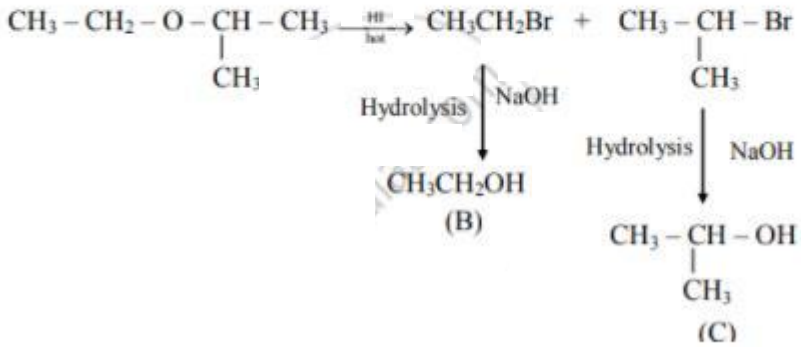
An ether (A), $C_5H_{12}O$, when heated with excess of hot HI produce two alkyl halides which on hydrolysis form compound (B) and (C), oxidation of (B) gave and acid (D), whereas oxidation of (C) gave a ketone (E). Deduce the structural formula of (A), (B), (C), (D), and (E).

Solution:

i. The ether (A) with molecular formula $C_5H_{12}O$ is



ii. Reacts with hot HI to produce two alkyl halides as follows:



iii. Oxidation of (B) gives acid

$$CH_3 - CH_2 - OH \xrightarrow{[O]} \underset{(D)}{CH_3COOH}$$

iv. Oxidation of (C) gives ketone

$$CH_3 - \underset{\underset{CH_3}{|}}{CH} - OH \xrightarrow{[O]} \underset{(E)}{CH_3 - \underset{\underset{CH_3}{|}}{C} = O}$$

Hence, structural formulae of compounds (A) to (E) are

(A)

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

(2-Ethoxypropane)

(B)

CH_3CH_2–OH (Ethanol)

(c)

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

(Propan-2-ol)

(D)

CH_3COOH (Ethanoic acid)

(E)

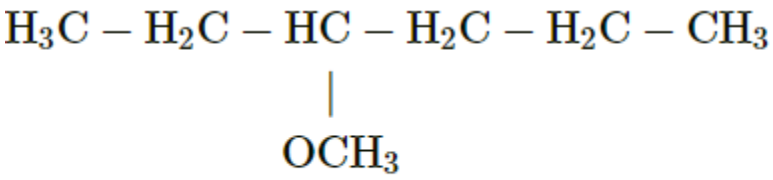
$$CH_3 - \underset{\underset{CH_3}{|}}{C} = O$$

(Propanone)

Exercise | Q 5.1 | Page 253

Write structural formulae for 3-Methoxyhexane

Solution:



3-Methoxyhexane

Exercise | Q 5.2 | Page 253

Write structural formulae for Methyl vinyl ether.

Solution:

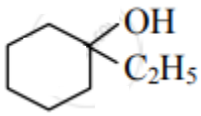
$CH_3OCH = CH_2$

Methyl vinyl ether

Exercise | Q 5.3 | Page 253

Write structural formulae for 1-Ethylcyclohexanol.

Solution:

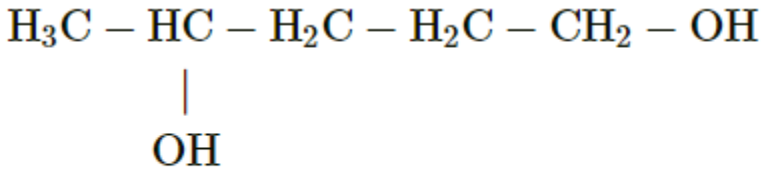


1-Ethylcyclohexanol

Exercise | Q 5.4 | Page 253

Write structural formulae for Pentane-1,4-diol

Solution:

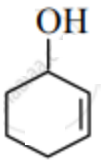


Pentane-1,4-diol

Exercise | Q 5.5 | Page 253

Write structural formulae for Cyclohex-2-en-1-ol.

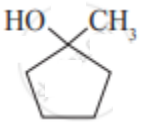
Solution:



Cyclohex-2-en-1-ol

Exercise | Q 6.1 | Page 253

Write IUPAC name of the following

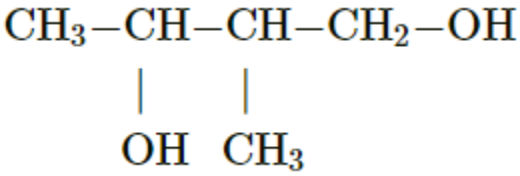


Solution:

1-Methylcyclopentanol

Exercise | Q 6.2 | Page 253

Write IUPAC name of the following

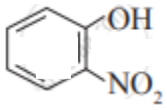


Solution:

2-Methylbutane-1,3-diol

Exercise | Q 6.3 | Page 253

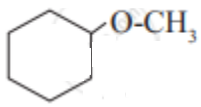
Write IUPAC names of the following



Solution: 2-Nitrophenol

Exercise | Q 6.4 | Page 253

Write IUPAC names of the following



Solution: Methoxycyclohexane