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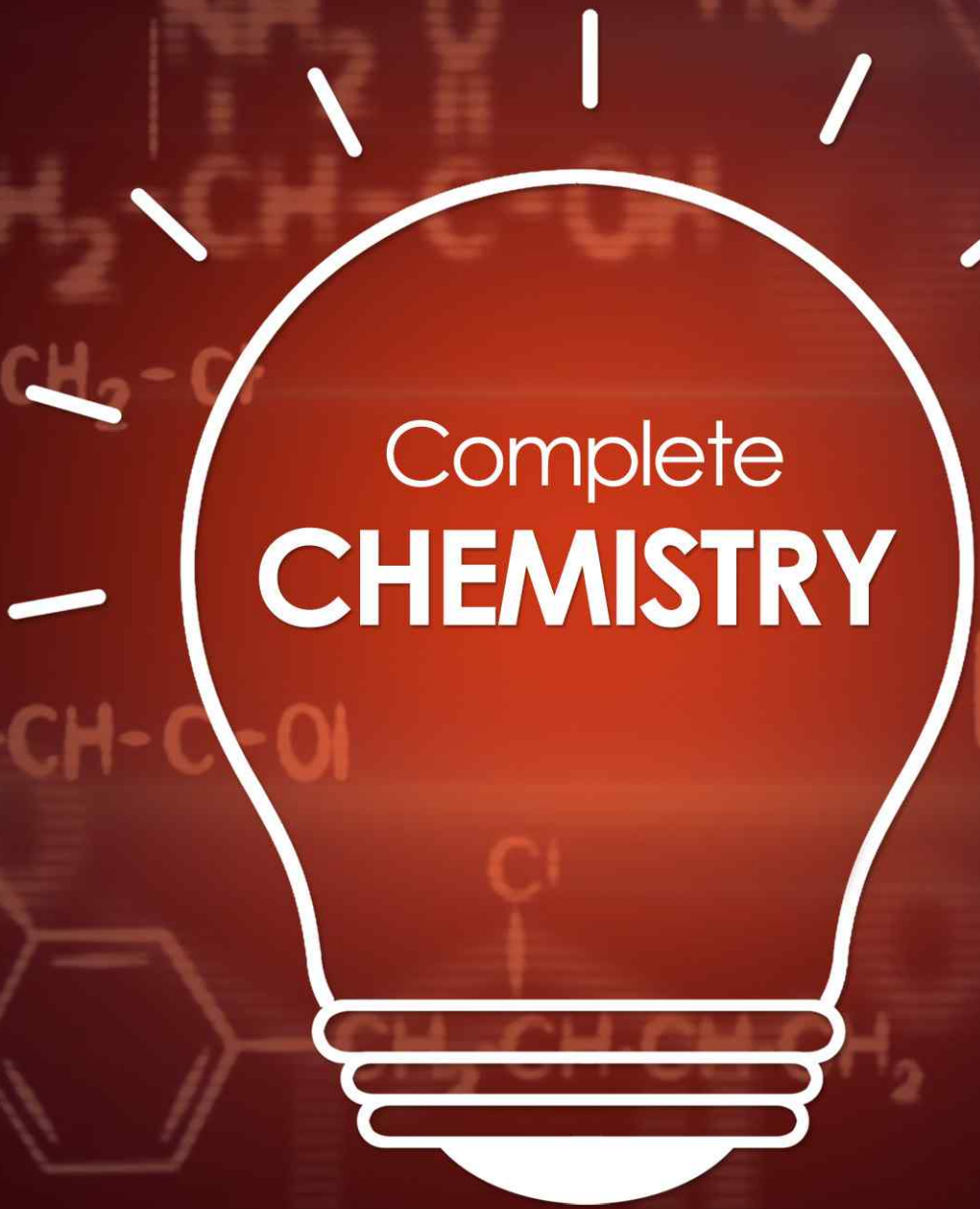


Complete CHEMISTRY

IIT-JEE · NEET · CBSE eBOOKS

CLASS 11&12th

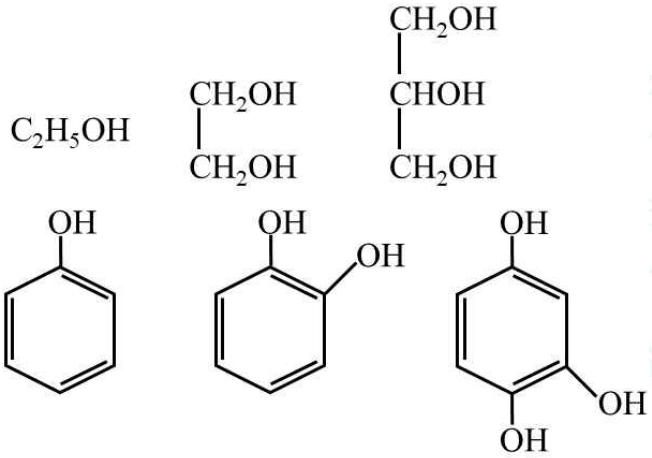
CLASS 12th

Alcohol, Phenol and Ether

01. Alcohol and Phenols

In an organic compound if –OH group is not directly attached to the benzene ring, it is called an alcohol. On the other hand, if –OH group is directly attached to the benzene ring, it is called a phenol.

Classification : Alcohols and phenols may be classified as mono-, di-, tri- or polyhydric compounds depending on whether they contain one, two, three or many hydroxyl groups respectively in their structures as given below :



Monohydric Dihydric Trihydric

Monohydric alcohols may be further classified according to the hybridisation of the carbon atom to which the hydroxyl group is attached.

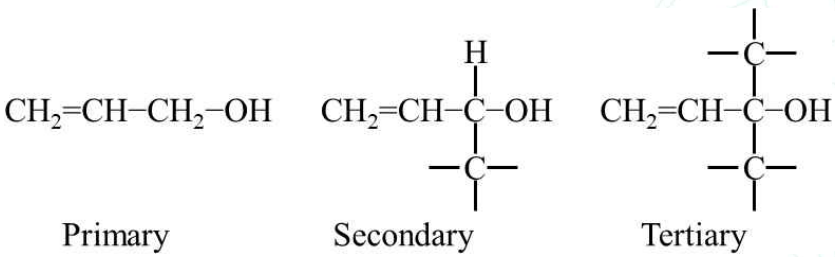
(i) **Compounds containing $C_{sp^3}-OH$ bond :** In this class of alcohols, the –OH group is attached to an sp^3-hybridised carbon atom of an alkyl group. They are further classified as follows :

Primary, secondary and tertiary alcohols : In these three types of alcohols, the –OH group is attached to primary, secondary and tertiary carbon atom, respectively as shown below :

Primary (1°) Secondary (2°) Tertiary (3°)

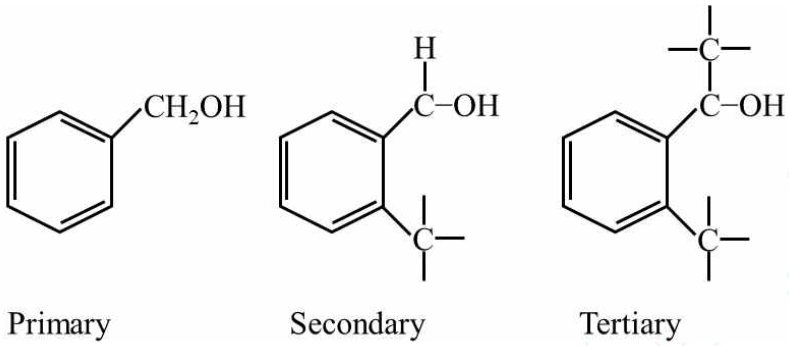
Allylic alcohols : In these alcohols, the –OH group is attached to a sp^3-hybridised carbon next to the carbon-carbon double bond, that is, to an allylic carbon.

For example,



Primary Secondary Tertiary

Benzylic alcohols : In these alcohols, the –OH group is attached to a sp^3-hybridised carbon atom next to an aromatic ring. For example,



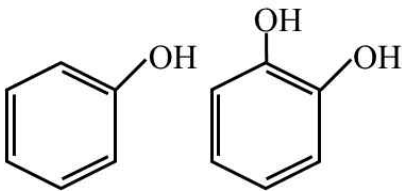
Primary Secondary Tertiary

Allylic and benzylic alcohols may be primary, secondary or tertiary.

(ii) **Compounds containing $C_{sp^2}-OH$ bond :** These alcohols contain –OH group bonded to a carbon-carbon, double bond i.e., to a vinylic carbon or to an aryl carbon. If –OH group is attached to a vinylic carbon it is known as vinylic alcohol. If –OH group is attached to benzene ring (aryl carbon) it is known as phenol.

Vinylic alcohol : $CH_2 = CH-OH$

Phenols :

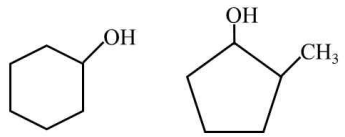


Nomenclature

(i) **Alcohols :** The common name of an alcohol is derived from the common name of the alkyl group and adding the word alcohol to it, For example, CH_3OH is methyl alcohol. According to IUPAC system, the name of an alcohol is derived from the name of the alkane from which the alcohol is derived by substituting 'e' of alkane with the suffix 'ol'. The position of substituents are indicated by numerals. For this, the longest carbon chain (parent chain) is numbered starting at the end nearest to the hydroxyl group. The positions of the –OH group and other substiuents are indicated by using the numbers of carbon atoms to which these are attached. For naming polyhydric alcohols, the 'e' of alkane is retained and the ending 'ol' is added. The number of –OH groups is indicated by adding the multiplicative prefix, di, tri etc. before 'ol'. The positions of –OH groups are indicated by appropriate locants.

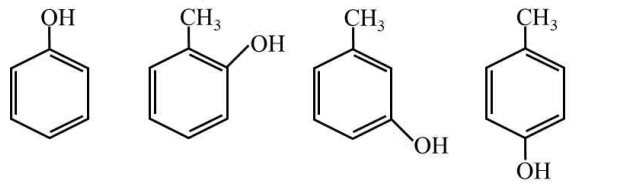
Compound	Common name	IUPAC name
$CH_3–OH$	Methyl alcohol	Methanol
$CH_3–CH_2–CH_2–OH$	*n*-Propyl alcohol	Propan-1-ol
$CH_2(OH)–CH(OH)–CH_3$	Isopropyl alcohol	Propan-2-ol
$CH_3–CH_2–CH_2–CH_2–OH$	*n*-Butyl alcohol	Butan-1-ol
$CH_3–CH(OH)–CH_2–CH_3$	*sec*-Butyl alcohol	Butan-2-ol
$CH_3–CH(OH)–CH_2–CH_3$	Isobutyl alcohol	2-Methylpropan-1-ol
$CH_3–C(CH_3)(CH_3)–OH$	*tert*-Butyl alcohol	2-Methylpropan-2-ol
$OH–CH_2–CH_2–OH$	Ethylene glycol	Ethane-1, 2-diol
$CH_2(OH)–CH(OH)–CH_2(OH)$	Glycerol	Propane-1, 2, 3-triol

Cyclic alcohols are named using the prefix cyclo and considering the –OH group attached to C-1.



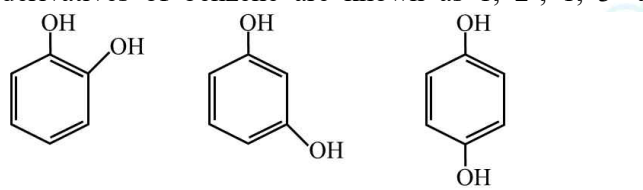
Cyclohexanol 2-Methylcyclopentanol

(ii) **Phenols :** The simplest hydroxy derivative of benzene is phenol. It is its common name and also an accepted IUPAC name. As structure of phenol involves a benzene ring, in its substituted compounds the terms ortho (1, 2-disubstituted), meta (1, 3-disubstituted) and para (1, 4-disubstituted) are often used in the common names.



Phenol *o*-Cresol 2-Methylphenol *m*-Cresol 2-Methylphenol *p*-Cresol 4-Methylphenol

Dihydroxy derivatives of benzene are known as 1, 2-, 1, 3- and 1, 4-benzenediol.



Catechol Benzene-1, 2-diol Resorcinol Benzene-1, 3-diol Hydroquinone *or* Quinol Benzene-1, 4-diol

Caution : In general, if more than one –OH group is attached to the same carbon atom, the compound formed is unstable. It loses a molecule of water to give an aldehyde or ketone as follows :