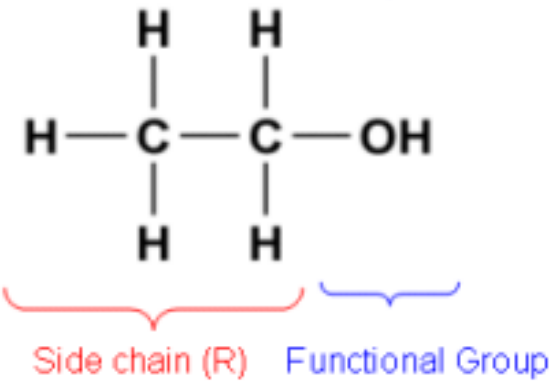
Alcohols

Any of a class of organic compounds characterized by one or more hydroxyl (—OH) groups attached to a carbon atom of an alkyl group (hydrocarbon chain). Alcohols may be considered as organic derivatives of water (H2O) in which one of the hydrogen atoms has been replaced by an alkyl group, typically represented by R in organic structures. For example, in ethanol (or ethyl alcohol) the alkyl group is the ethyl group, —CH2CH3 .

The general formula of alcohols is R-OH ,

where R represent the alkyl group may be open chain or cyclic
The general formula of alcohols is $C_nH_2n+_1OH$

The functional group of alcohols is (–OH)



Types of alcohols

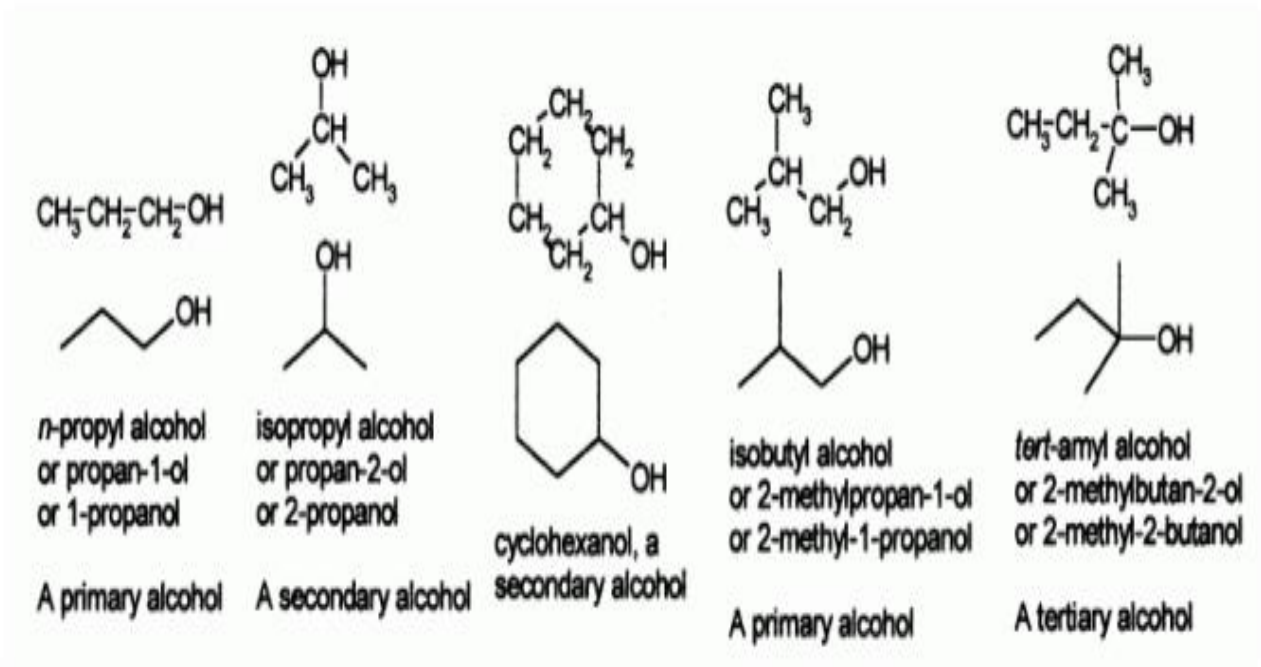
On the basis of chemical groups attached to the carbon atom,

alcohols are divided into three categories:

1. Primary alcohol: When the carbon atom attached to the hydroxyl group is bonded to only one carbon atom such type of alcohol is known as primary alcohol.

2. Secondary alcohol: When it is bonded to two carbon atoms such type of alcohol is known as secondary alcohol.

3. Tertiary alcohol: When it is bonded to three carbon atoms such type of alcohol is known as a tertiary alcohol.



Physical properties of alcohol

1. **Color**: Alcohols are colourless liquids with a special faint odour.

2. **Burning** : Aliphatic alcohols burn with blue flame (without smoke) while aromatic alcohols burn with yellow smoky flame

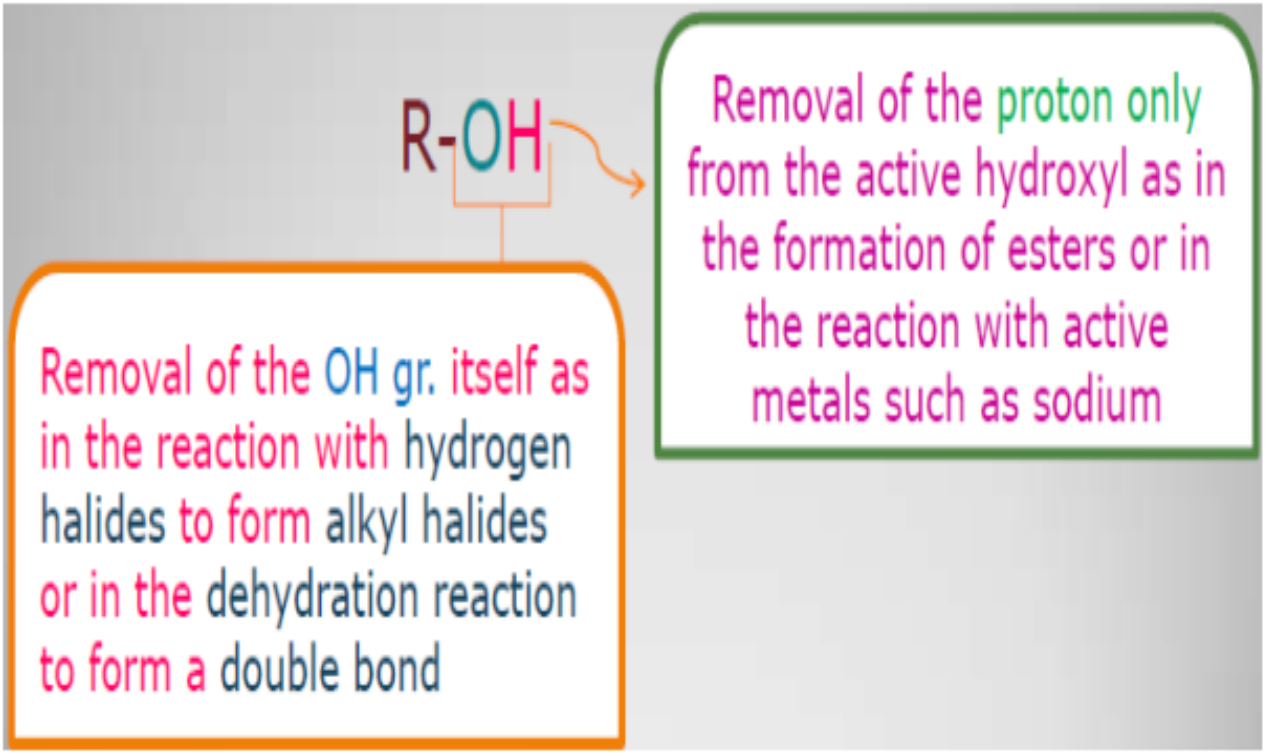
3. **Boiling point** : B.p. of alcohols are considerably high it is increase as the molecular weight increases.(alcohols has the ability to form H - bond).

4. **Solubility** : Alcohols are miscible with water except benzyl alcohol, cyclohexanol, and sec-butanol (which is very slightly soluble in water). The hydroxyl group decides the solubility of alcohol in water. The hydroxyl group in alcohol takes part in the formation of intermolecular hydrogen bonding. Thus, hydrogen bonds between water and alcohol molecules make alcohol soluble in water. The solubility of alcohol decreases with the increase in the size of the alkyl group because of the hydrophobic nature of the alkyl group.

Chemical properties of alcohols

1. Alcohols are neutral compounds that don’t change the colour of litmus paper.

2. All reactions of alcohols are related to its active hydroxyl group and are of two types



General test of Alcohols

The general test of the hydroxyl group (-OH) is Ceric ammonium nitrate reagent (NH4)2Ce(NO3)6 . Ceric ammonium nitrate (yellow soluion) is an oxidizing agent that reacts with alcohols to give a red complex.

ROH + (NH4)2Ce(NO3)6 $\longrightarrow$ [(NH4)2Ce(NO3)5(O-R)] + HNO3

Procedure : To 1 mL of the ceric ammonium reagent add 4 to 5 drops of a liquid unknown. Mix thoroughly and note if the yellow color of the reagent changes to red.

Specific Test Of Alcohols

1. Lucas Test

Lucas' reagent is a solution of anhydrous zinc chloride in concentrated hydrochloric acid. This solution is used to classify alcohols of low molecular weight. The reaction is a substitution in which the chloride replaces a hydroxyl group. This test is more often used to categorize the different types of alcohols based on the time taken to form a turbid solution or precipitation using the Lucas Reagent namely:

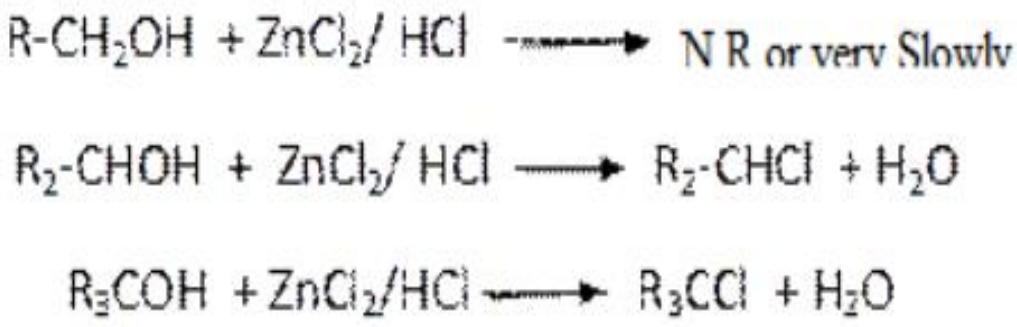
- **Primary alcohol:** Here no visible reaction is observed and the solution remains colorless e.g. 1-Pentanol

- **Secondary alcohol:** Here the solution turns turbid or cloudy in 5-20 minutes with slight heating e.g.

2-Pentanol

- **Tertiary alcohol:** Here the solution turns turbid or cloudy rapidly with the formation of two separate layers at room temperature e.g. 2-Methyl-2-butanol

In Lucas test, Zinc Chloride acts as catalyst. The classification of the alcohols is usually done based on the difference in reaction with concentrated hydrochloric acid



Procedure :

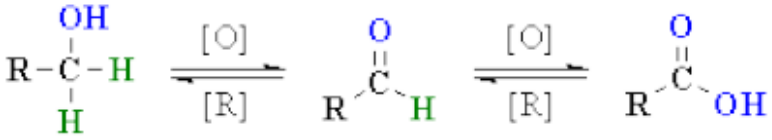
1. Take a test tube and put 0.5 ml of alcohols

2. Add 1 ml of Lucas reagent and observe the result .

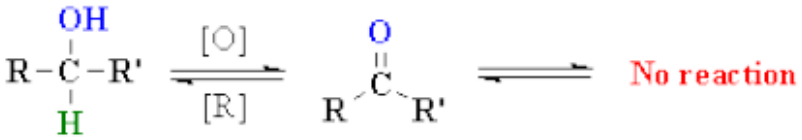
2. Oxidation Of Alcohols

Primary alcohols can be oxidized to either aldehydes or carboxylic acids, depending on the reaction conditions. Secondary alcohols are oxidized to ketones - and that's it. Tertiary alcohols are not oxidized

- 1^{o} alcohol → Carboxylic acid
- 2^{o} alcohol → Ketone
- 3^{o} alcohol → No reaction



$$2KMnO_4 + 3C_2H_5OH \rightarrow 2MnO_2 + 3CH_3CHO + 2KOH + 2H_2O$$



$$2KMnO_4 + 3CH_3CHOHR \rightarrow 2MnO_2 + 3CH_3COR + 2KOH + 2H_2O$$