



Al-Mustaqbal University

Department of Medical Laboratory Techniques

Subject: - General Chemistry (1) lecture (4) –2023-2024

Course Instructor: - Assist.prof. Dr. Thamar A.A.M. Alalwami

Alcohols

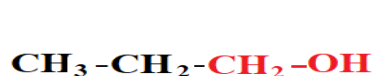
Alcohol: An organic substance formed when a hydroxyl group is substituted for a hydrogen atom in a hydrocarbon.

Classification of Alcohols

Primary alcohols:- In a primary (1°) alcohol, the carbon atom that carries the -OH group is only attached to one alkyl group.

Secondary alcohols :- In a secondary (2°) alcohol, the carbon atom with the -OH group attached is joined directly to two alkyl groups, which may be the same or different.

Tertiary alcohols: - In a tertiary (3°) alcohol, the carbon atom holding the -OH group is attached directly to three alkyl groups, which may be any combination of the same or different groups.



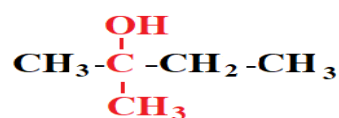
1-Propanol

Primary Alcohol (1°)



2- Butanol

Secondary Alcohol (2°)



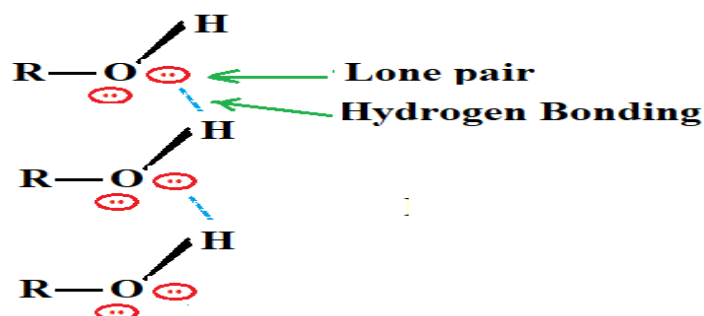
2-Methyl -2-butanol

Tertiary Alcohol (3°)

Physical Properties of Alcohol:-

1. The Boiling Point of Alcohols

Alcohols generally have higher boiling points in comparison to other **hydrocarbons** having equal molecular masses. This is due to the presence of intermolecular hydrogen bonding between hydroxyl groups of alcohol molecules.



In general, the boiling point of alcohols increases with an increase in the number of carbon atoms in the aliphatic carbon chain. On the other hand, the boiling point decreases with an increase in branching in aliphatic carbon chains the Van der Waals forces decreases with a decrease in surface area. **Thus primary alcohols have a higher boiling point.**

2. Solubility of Alcohols

The solubility of alcohol in water is governed by the hydroxyl group present. The hydroxyl group in alcohol is involved in the formation of intermolecular hydrogen bonding. Thus, hydrogen bonds are formed between water and alcohol molecules which make alcohol soluble in water.

However, the alkyl group attached to the hydroxyl group is hydrophobic in nature. Thus, the solubility of alcohol decreases with the increase in the size of the alkyl group.

This table shows that alcohols have higher boiling points and greater solubility in H₂O the alkanes with the same number of carbons. It also shows that the boiling point of alcohols increase with the number of carbon atoms.

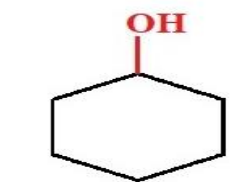
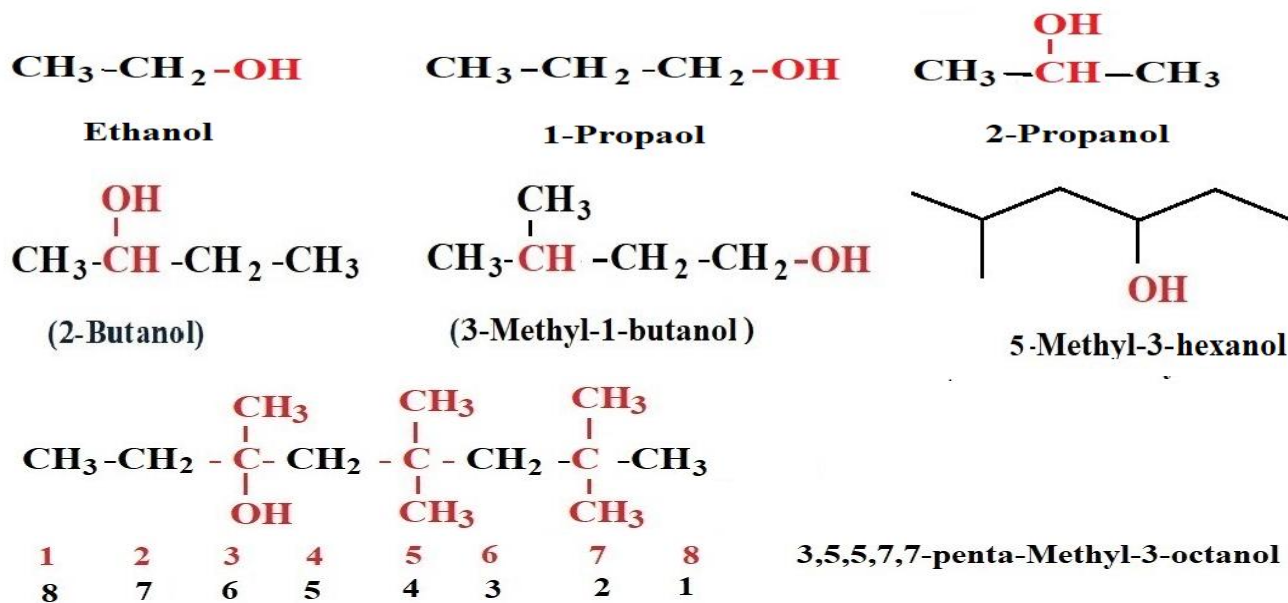
Compound	IUPAC Name	Melting Point (°C)	Boiling Point (°C)	Solubility in H ₂ O at 23°C
CH ₄	Methane	-182.5	-161.7	3.5 ml (gas)/ 100 mL
CH ₃ OH	Methanol	-97.8	65.0	Infinite
CH ₃ CH ₂ OH	Ethanol	-114.7	78.5	Infinite
CH ₃ CH ₃	Ethane	-183.3	-88.6	4.7 ml(gas)/ 100 ml
CH ₃ CH ₂ CH ₂ CH ₂ OH	1-Butanol	-89.5	117.3	8.0 g/100 ml

Systematic Names IUPAC Nomenclature of Alcohols

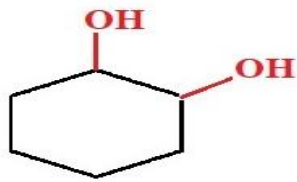
1-Find the longest chain containing the hydroxyl group (OH). If there is a chain with more carbons than the one containing the OH group, it will be named as a substituent.

2-Place the OH on the lowest possible number for the chain.

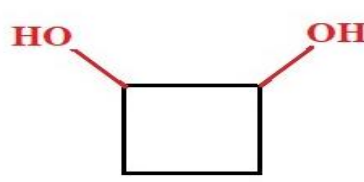
3-Remove the final e from the parent **alkane** chain and add -ol. When multiple alcohols are present use di, tri, etc before the ol, after the parent name.



Cyclohexanol



Cyclohexane-1,2-diol

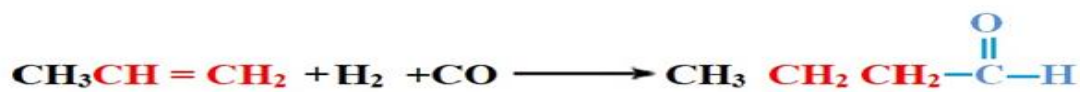
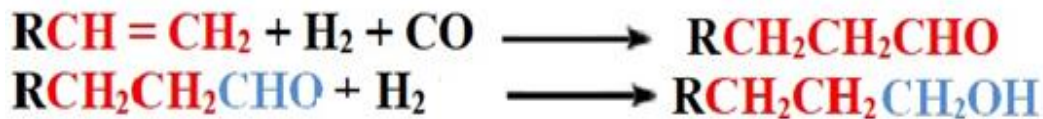


Cyclobutane-1,2-diol

Preparation of Alcohols: -

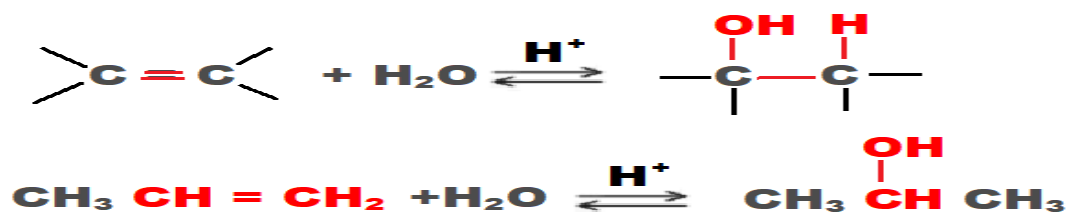
1-Hydroformylation of Alkenes: -

Many higher alcohols are produced by hydroformylation of alkenes followed by hydrogenation. When applied to a **terminal alkene**, as is common, one typically obtains a linear alcohol; -



2- Hydration of Alkenes:-

This is electrophilic addition of H₂O to alkenes.



3-Substitution ;-

Primary alkyl halides react with aqueous NaOH or KOH mainly to primary alcohols in nucleophilic aliphatic substitution. (Secondary and especially tertiary alkyl halides will give the elimination (alkene) product instead).

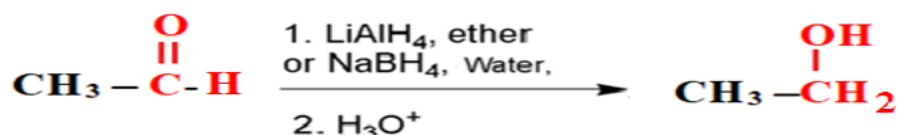
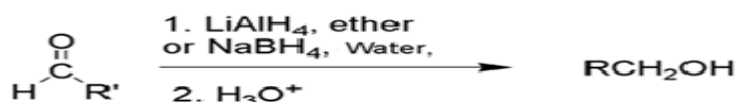


4-Reduction of Classes of Organic Compounds: -

In this type of reaction the alcohols can be prepared by reducing a number of classes of organic compounds as follows: -

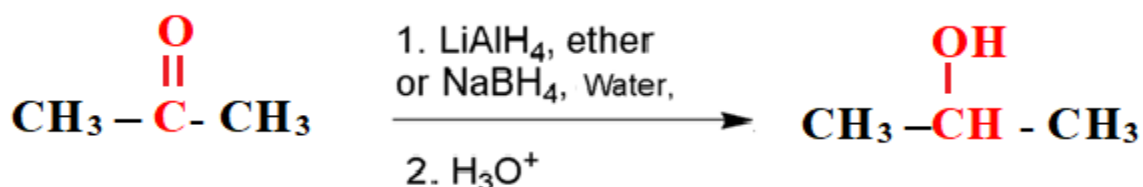
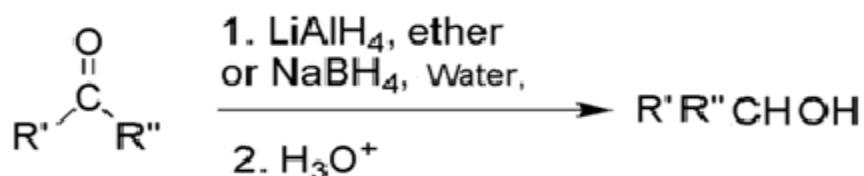
a-From Aldehydes: -

Synthesis of alcohol from an aldehyde by reduction.

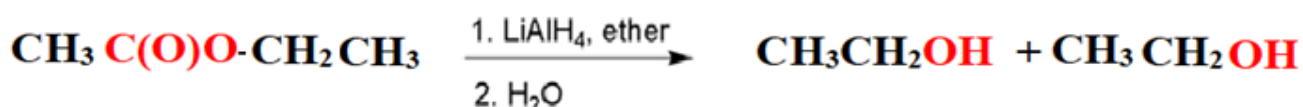
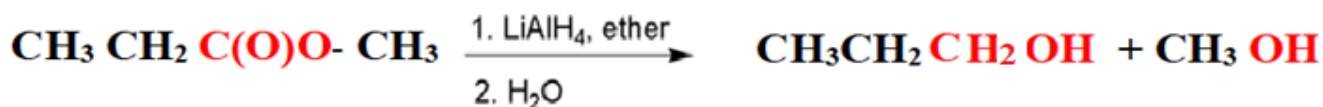
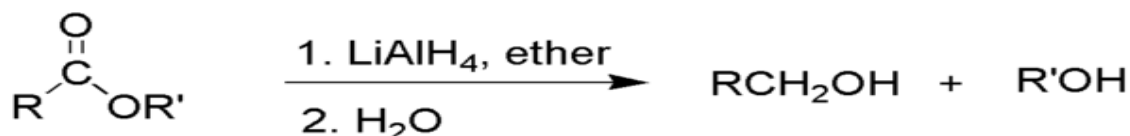


b- From Ketones: -

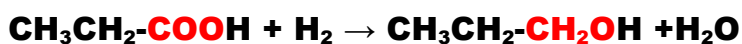
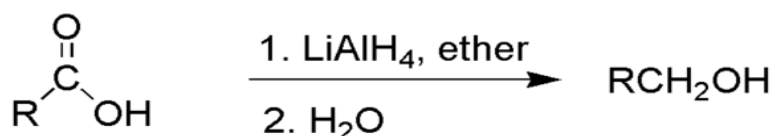
The synthesis of an alcohol from a ketone by reduction reaction.



c- From Esters: -



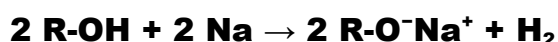
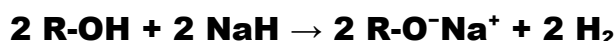
d-From Carboxylic Acids:-



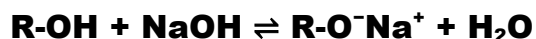
Reactions Of Alcohols: -

1-Deprotonation Of Alcohols: -

Alcohols behave as weak acids, undergoing deprotonation, but strong bases are required. The deprotonation reaction to produce an alkoxide salt is performed with a strong base such as sodium hydride or sodium metal.



Water is similar in pK_a to many alcohols so with sodium hydroxide an equilibrium exists, which usually lies to the left:



The acidity of alcohols is strongly affected by solvation. In the gas phase, alcohols are more acidic than is water.

2-Dehydration Of Alcohols: -

This is a diagram of acid catalyzed dehydration of ethanol to produce ethane .

