Republic of Iraq Ministry of Higher
Education & Scientific Research
University of Al-Maarif
College of Dentistry

Alcohols, Phenols, Ethers and Thiols

Lec(12)

First stage

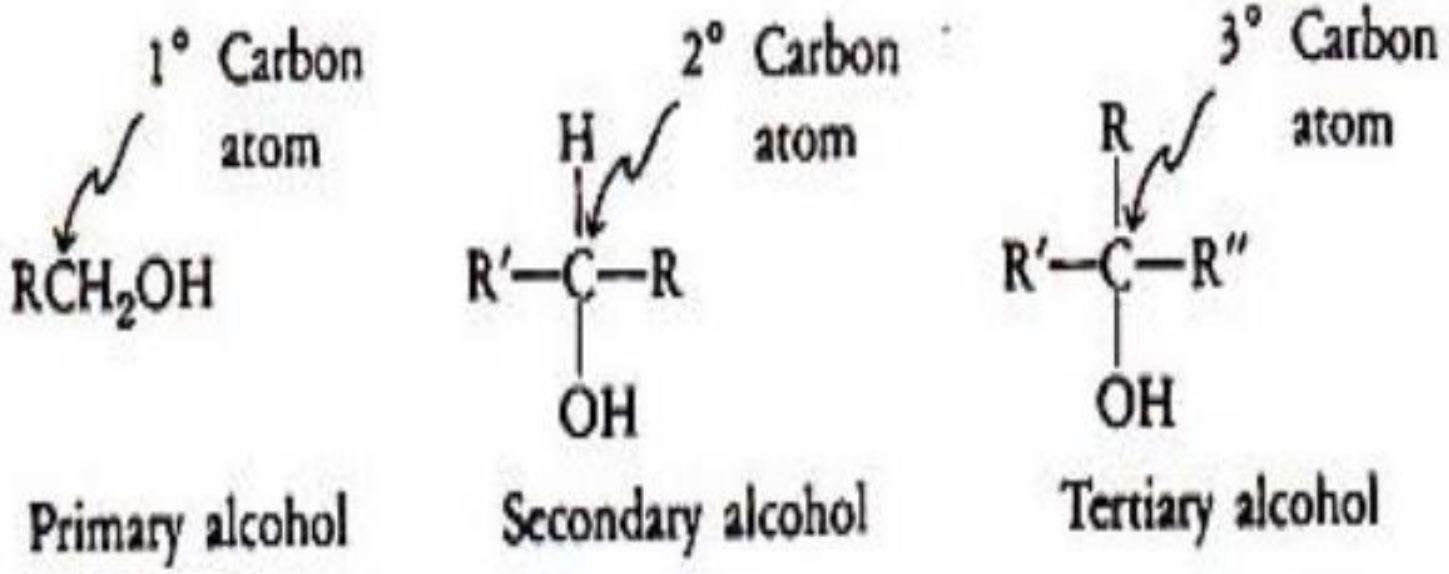
By
Qusay Abdulsattar

Alcohols,Phenols,Ethers and Thiols

Alcohols: are compounds that contain an -OH group, called a hydroxyl or hydroxy group, bonded to an alkyl group, for example: CH_3CH_2OH

Alcohols, are classified according to their structure.Thus,a **primary alcohol** is a compound in which the hydroxy group is bonded to a primary carbon.

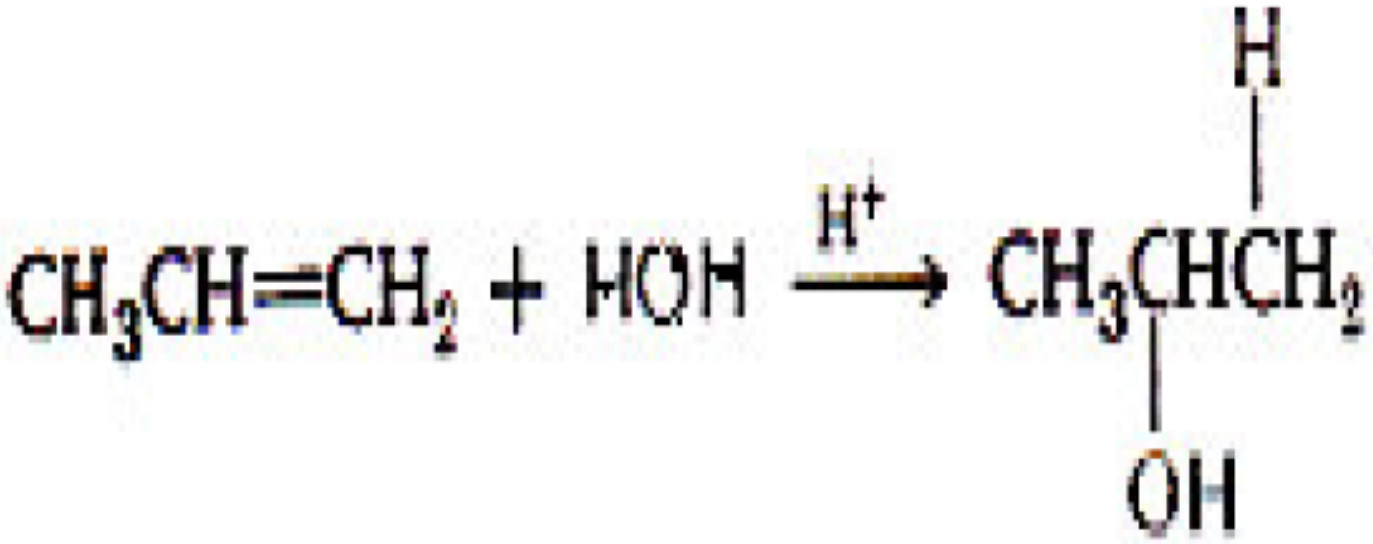
In a **secondary alcohol** the hydroxy group is bonded to a secondary carbon. In a **tertiary alcohol** the hydroxy group is bonded to a tertiary carbon.



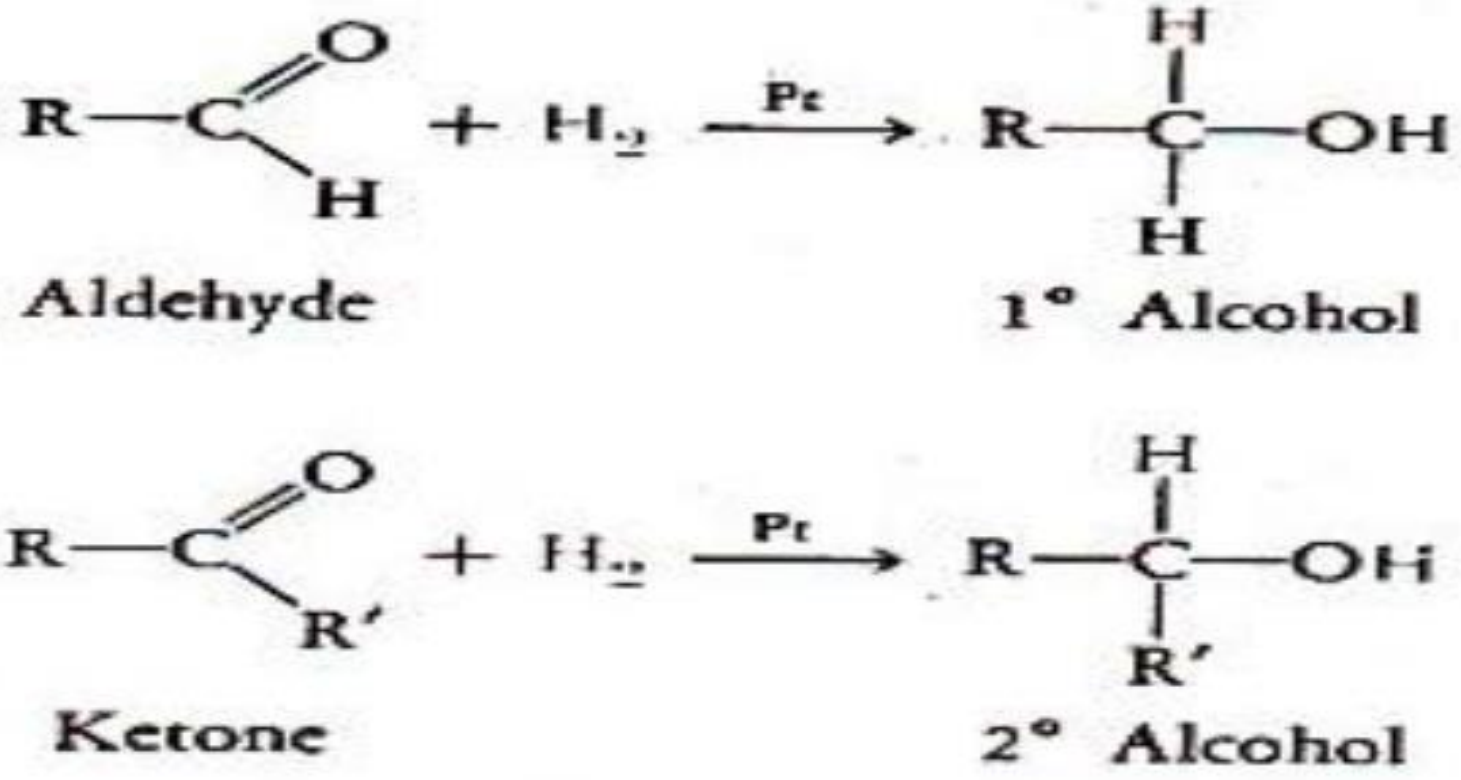
Preparing Alcohols

1)By Hydration of Alkenes

Add water to the double bond according to the Markownikoff rule.

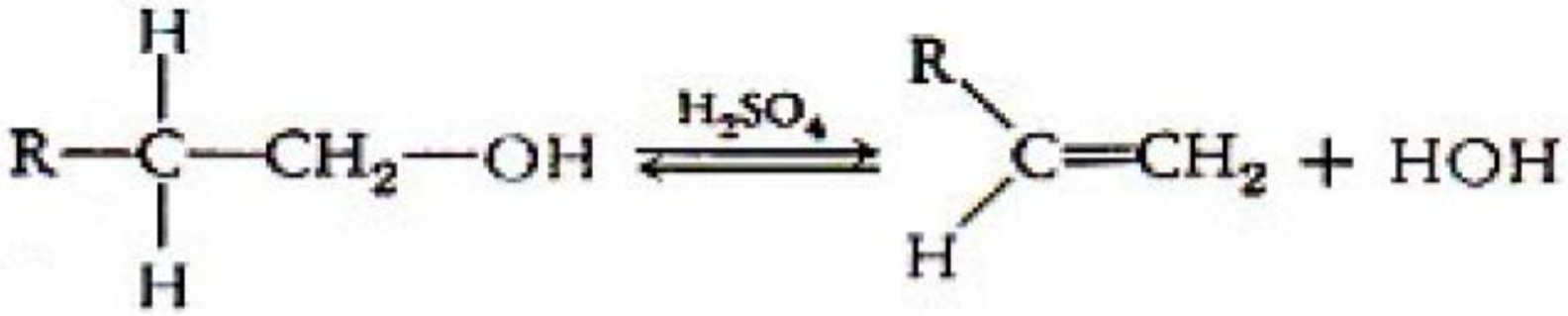


2)By Reduction of Carbonyl Compounds

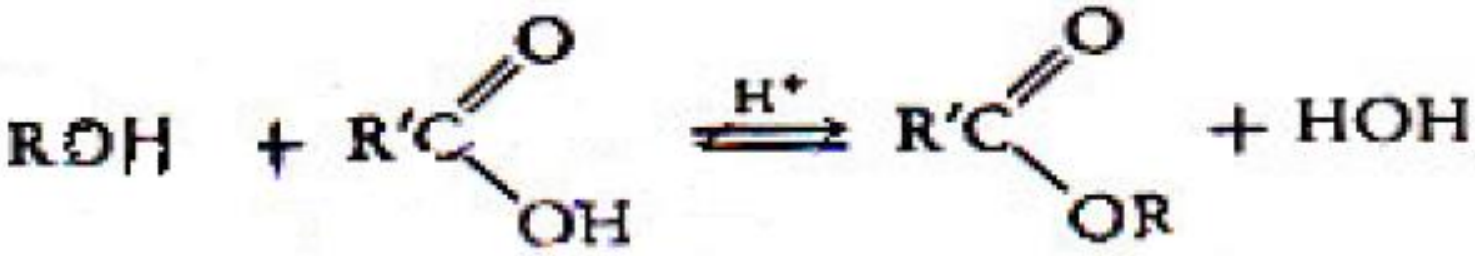


Reactions of Alcohols

1) Dehydration

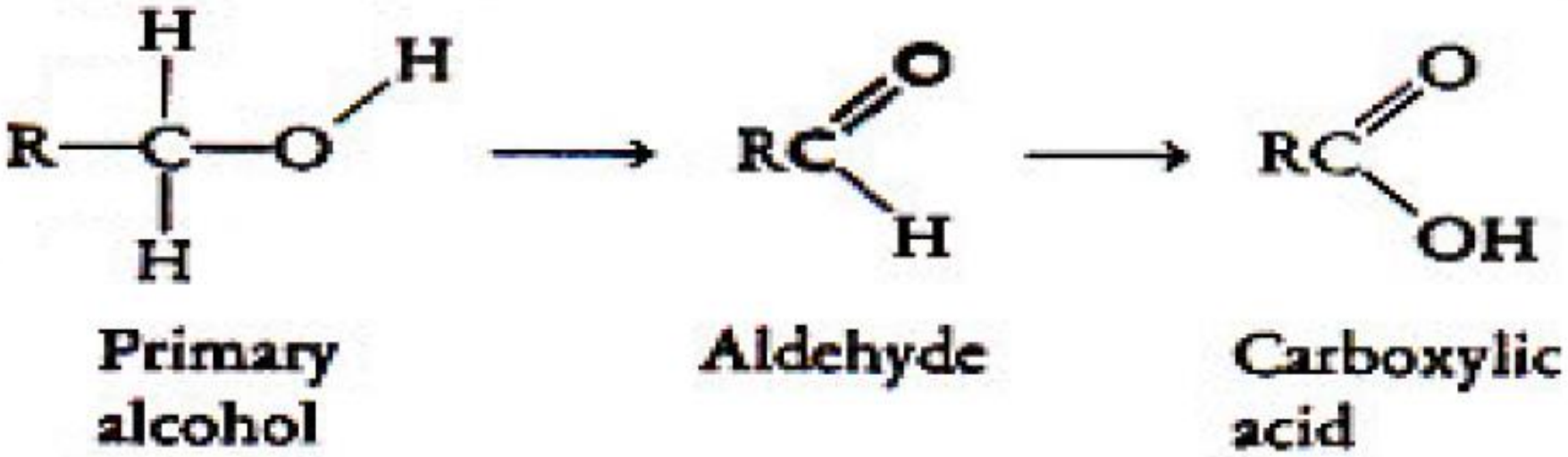


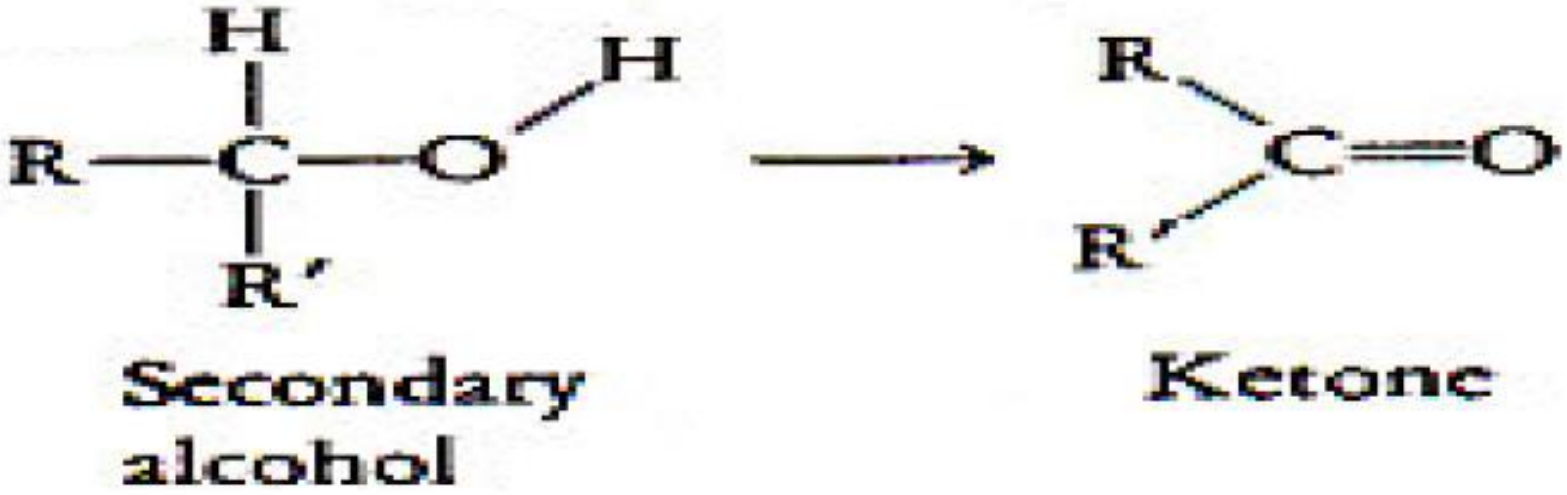
2) Ester Formation



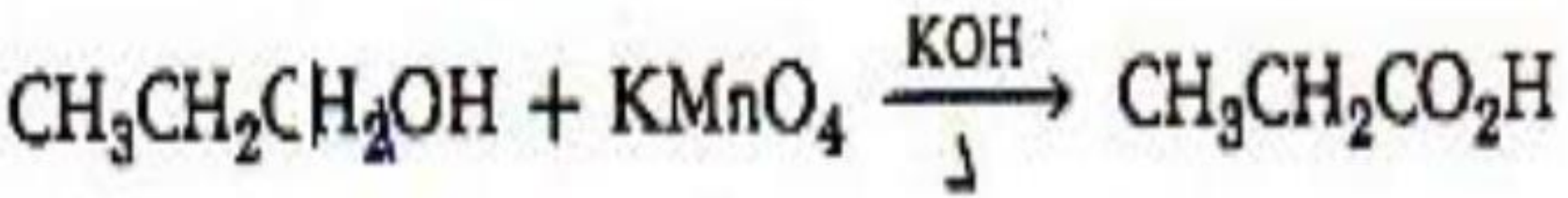
Alcohol Carboxylic acid Ester

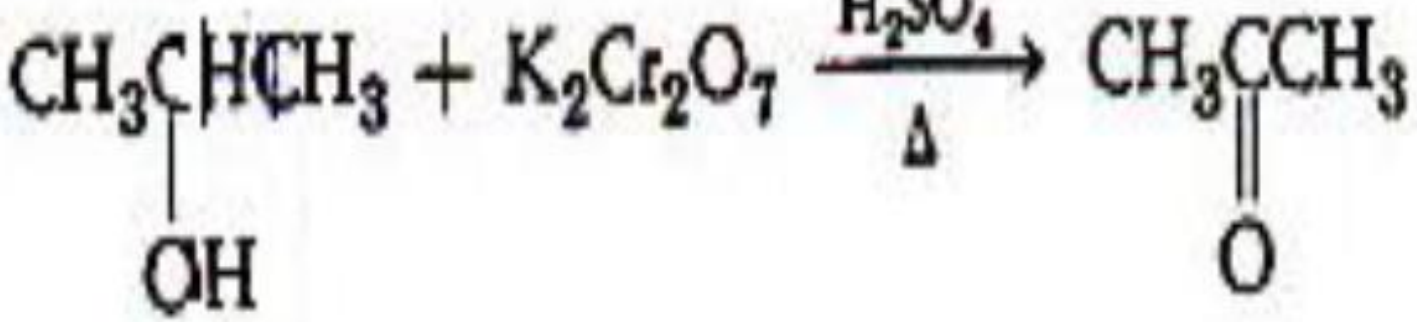
3) Oxidation


Primary alcohol
Aldehyde
Carboxylic acid


Secondary alcohol
Ketone

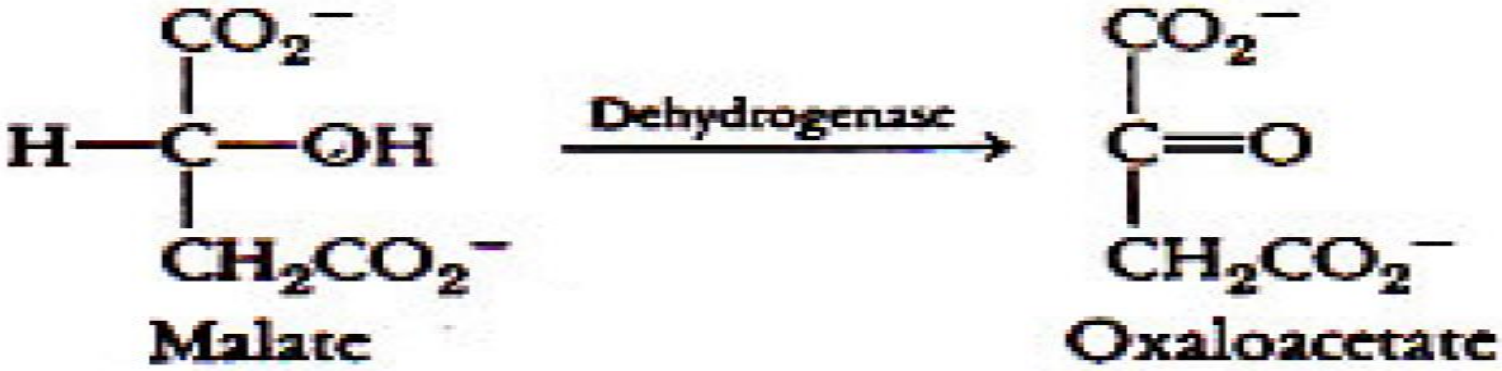
The usual reagents used for the oxidation of alcohols are hot acidic potassium dichromate or a hot alkaline solution of potassium permanganate.





Oxidation of Alcohols In Living Systems

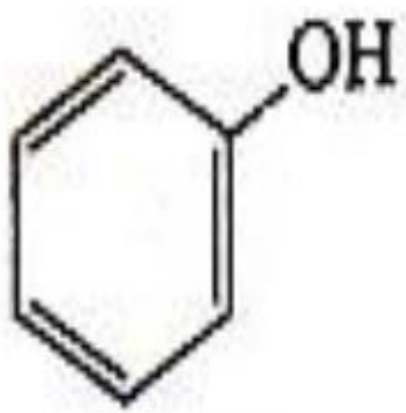
The oxidation of alcohols is an important reaction in living systems. Enzymes called **dehydrogenase** catalyze these reactions. One example is the oxidation of **malate** to **oxaloacetate**, which occurs in the citric acid cycle.



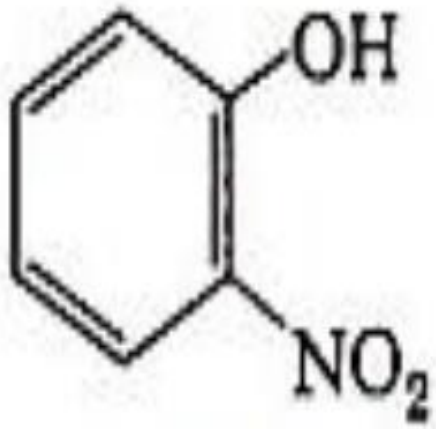
Phenols

Phenols are compounds that contain a hydroxy group bonded to a benzene ring.

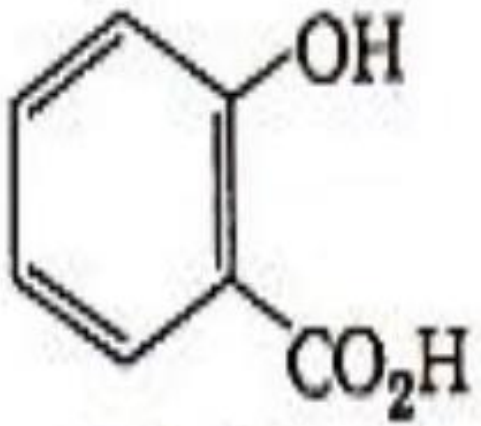
*Examples:



Phenol

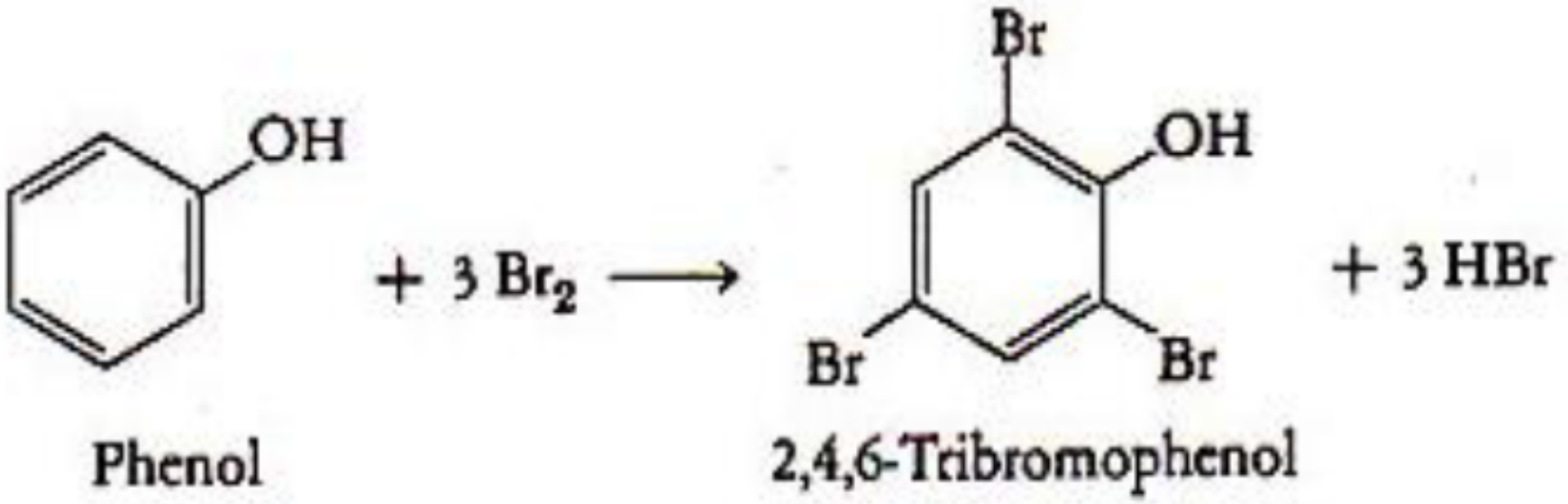


2-Nitrophenol

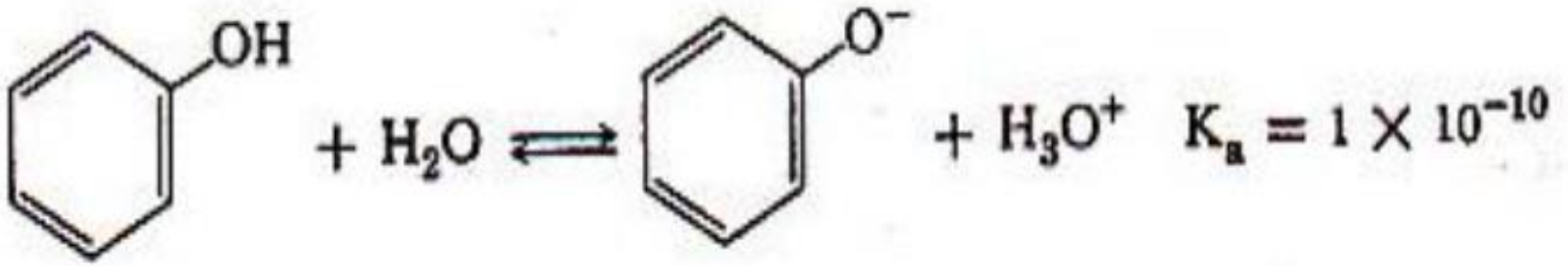


Salicylic acid

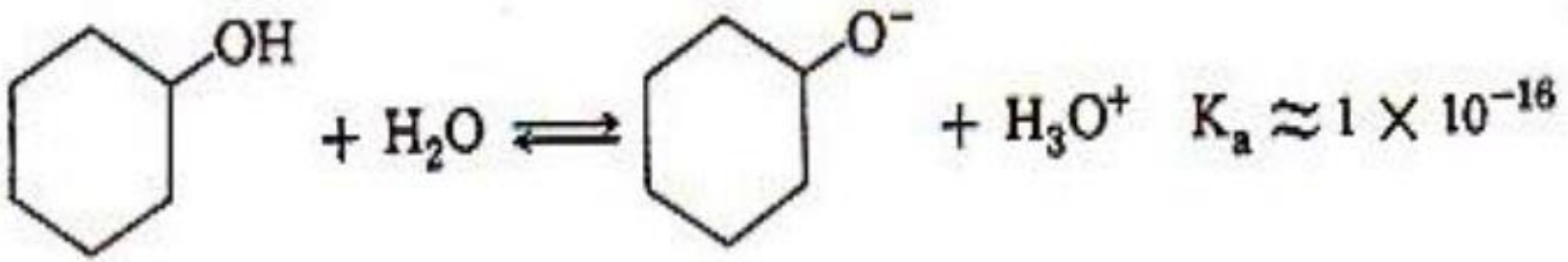
Phenols undergo aromatic **substitution** reactions. The **hydroxy group** is strongly activating and **ortho-para** directing, For **example**, phenol reacts with bromine without catalyst to form 2,4,6-tribromophenol



- **Phenols** are **much stronger acids** than are **alcohols**. This fact is evident from their acid ionization constants:

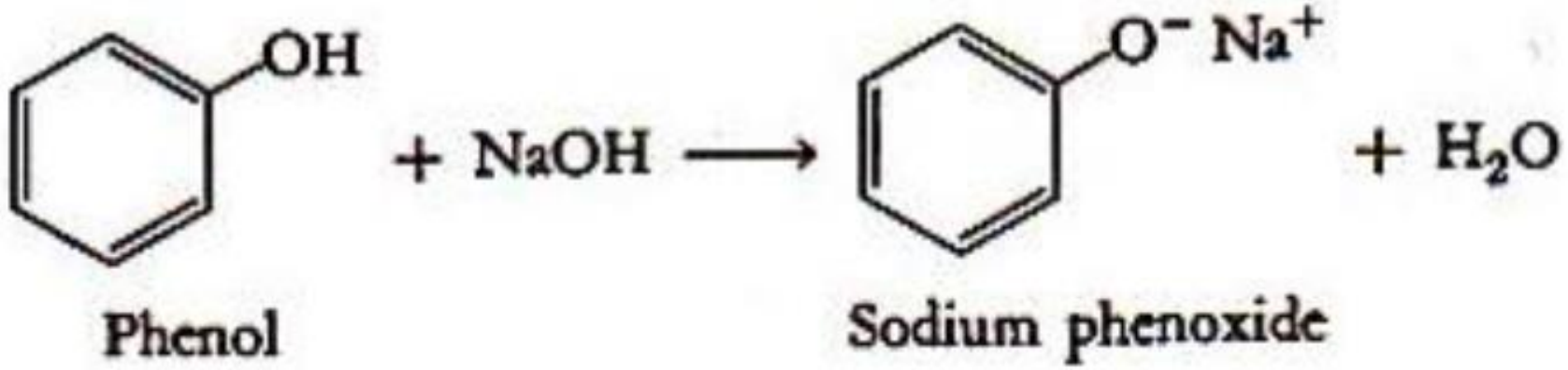


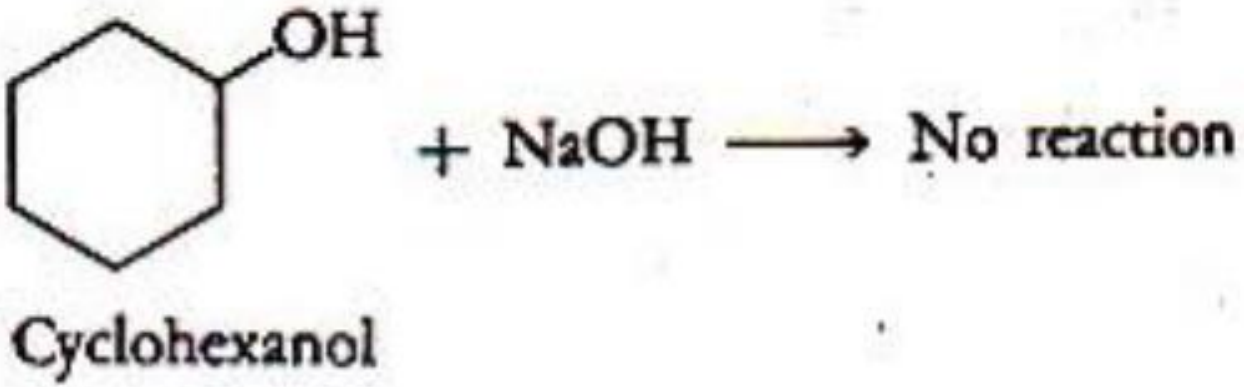
Phenol



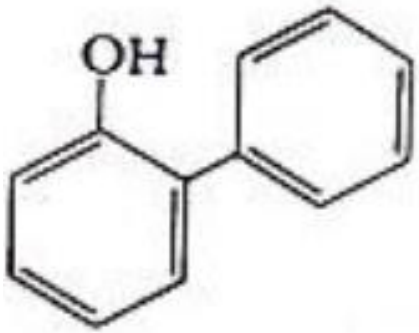
Cyclohexanol

Phenol reacts with **bases** such as hydroxide ion, whereas cyclohexanol does not :

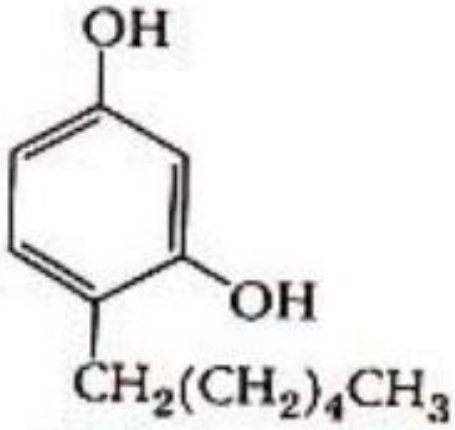




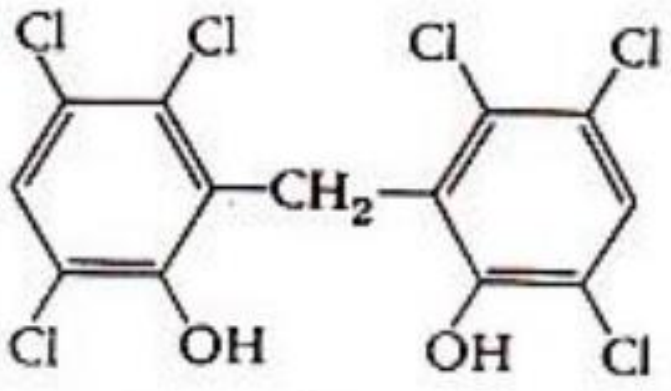
Phenol, or carbolic acid as it is sometimes called, has antiseptic properties in dilute solution. All phenolic compounds appear to have germicidal properties and it used in mouthwashes, germicidal soaps, some toothpastes, and deodorants, For example:



o-Phenylphenol

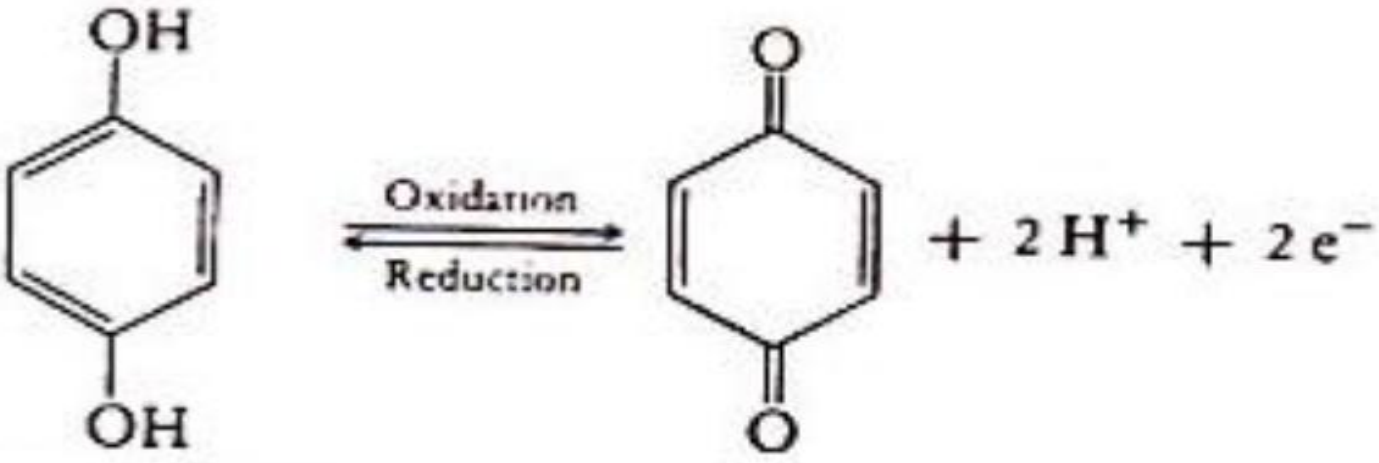


n-Hexylresorcinol



Hexachlorophene

Aromatic 1,2- and 1,4- dihydroxy compounds are phenols that undergo an important **oxidation-reduction** reaction. For **example**, **hydroquinone** is easily oxidized to **quinone**. This reaction is **reversible**, because quinone is easily reduced to hydroquinone, this reaction is important in the respiratory system.

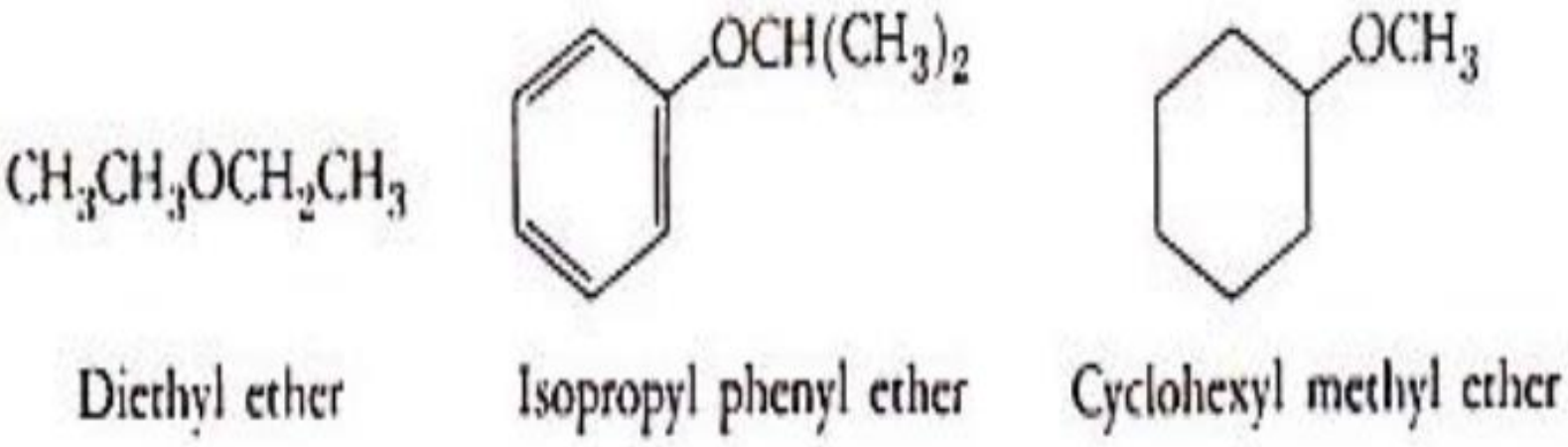


Hydroquinone

Quinone

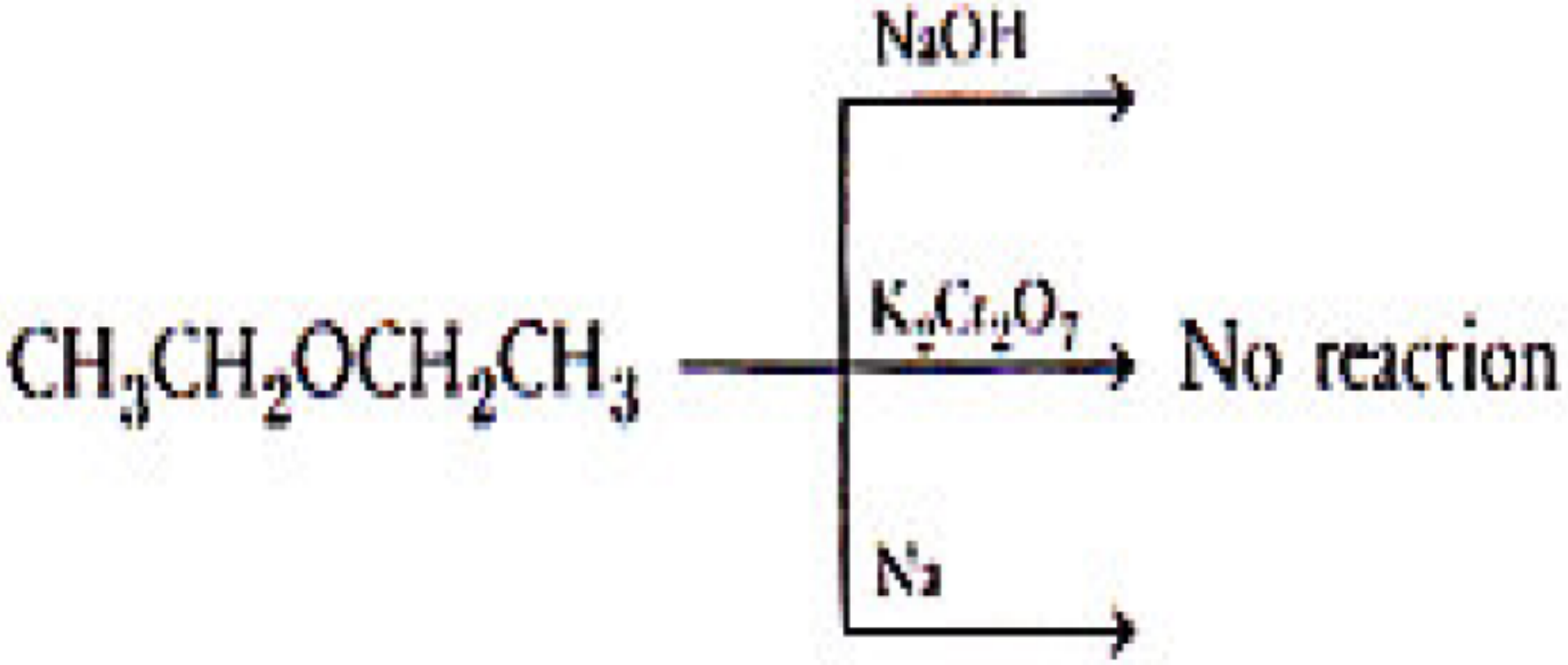
Ethers

Ethers are compounds that contain an **oxygen atom** bonded to **two alkyl groups**, **two aryl groups**, or one aryl and one alkyl group. For examples:

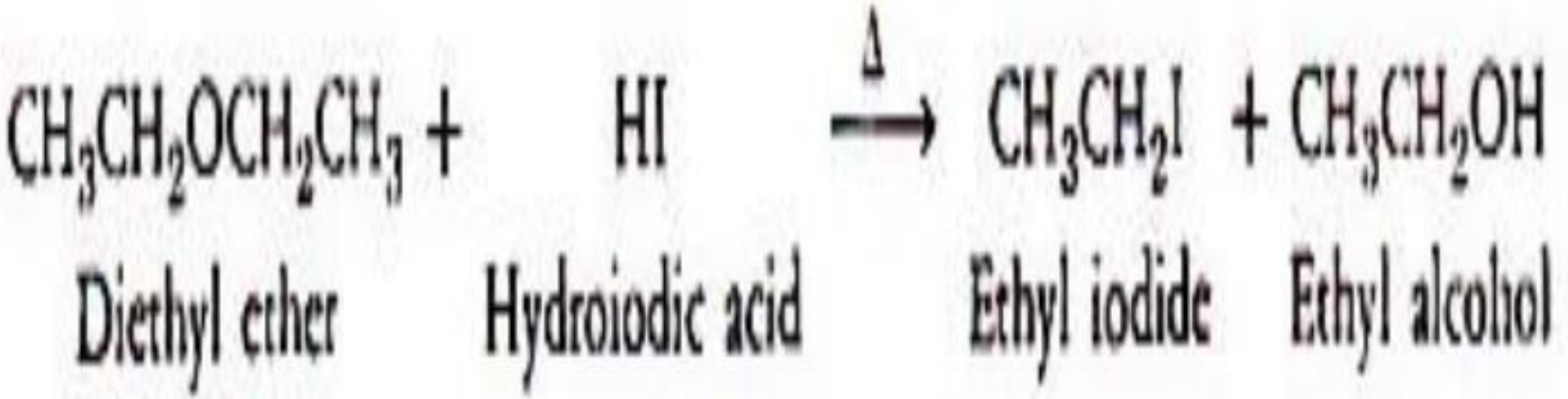


Ethers are quite unreactive.

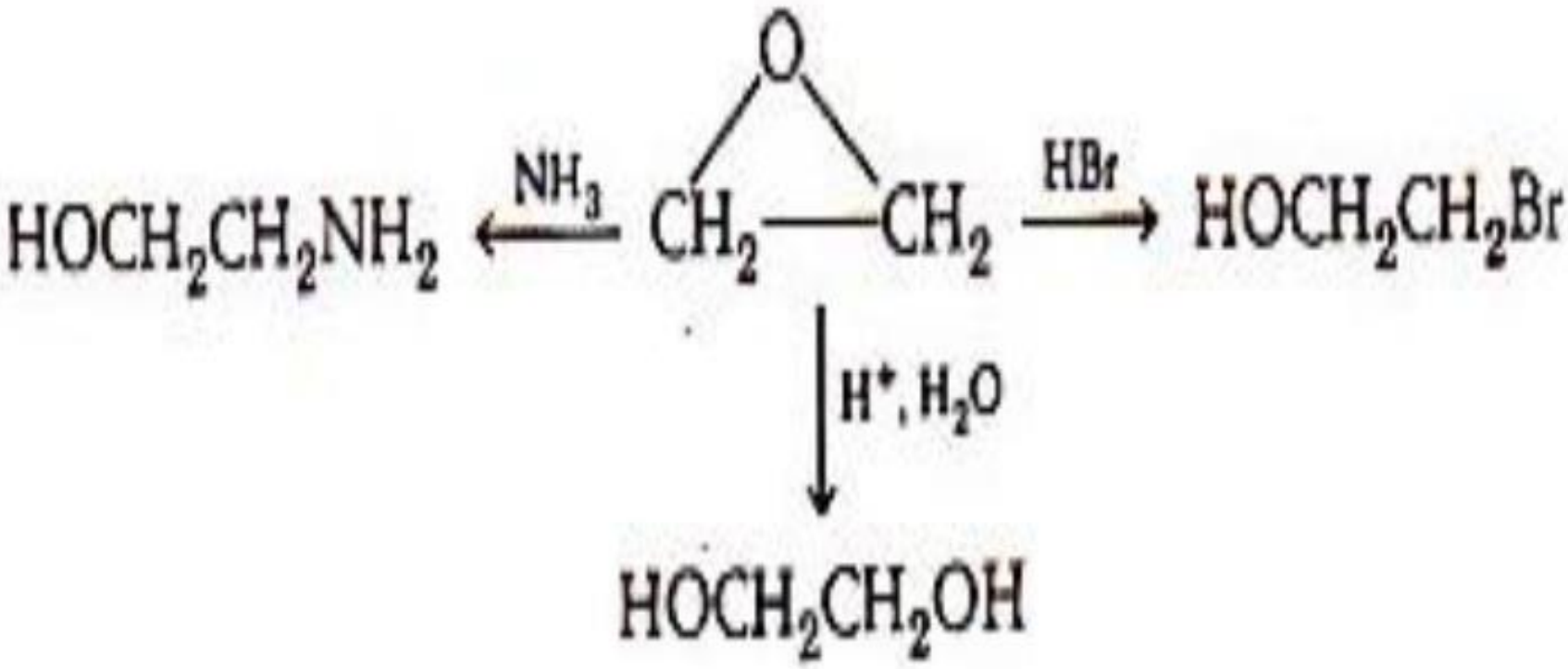
For example, they do not react with bases, most oxidizing reagent, or metals such as sodium or magnesium.



- **Ethers react with acids**. The products of the reaction with hydroiodic acid (HI) are an alkyl iodide and an alcohol.
  For example:
- A similar reaction occurs with hydrobromic acid (HBr)



* **Epoxides**,classified as ethers and are more reactive than are typical ethers.Epoxides is easily opened by both acids and bases.

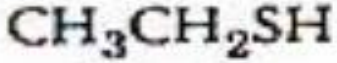


Thiols

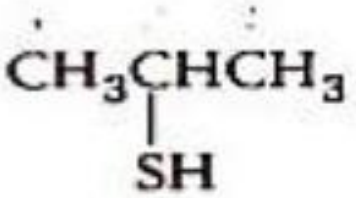
- Thiols are the sulfur analogues of alcohols

and contain the -- C – SH functional group.

Examples:



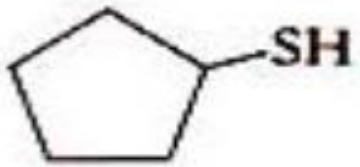
Ethanethiol
(ethyl mercaptan)



2-Propanethiol
(isopropyl mercaptan)

Ethanedithiol

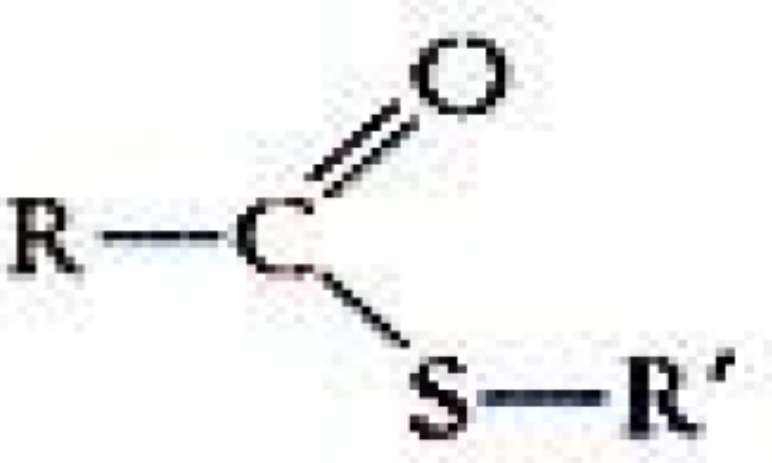
2-Mercapto-1-propanol



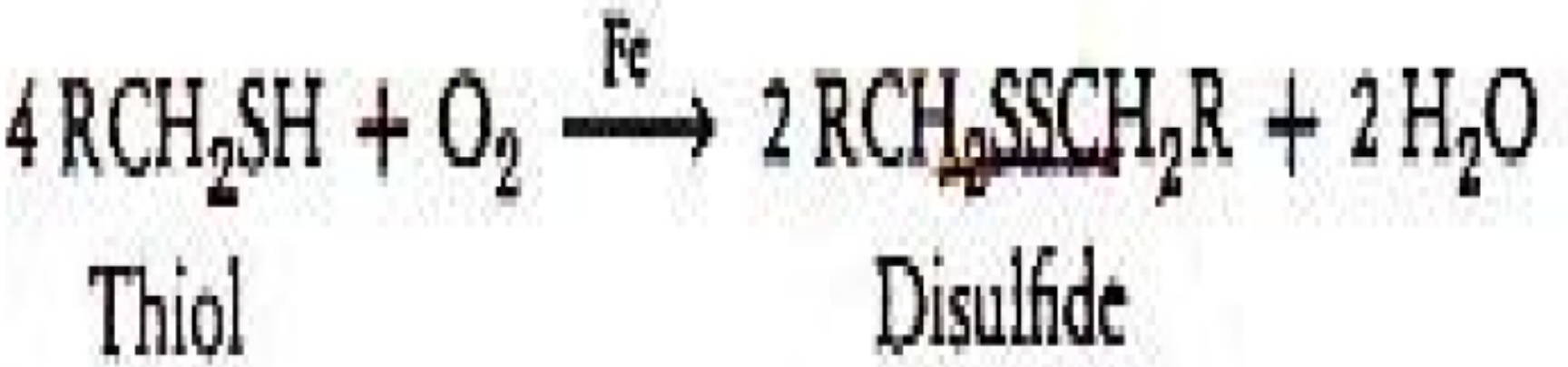
Cyclopentanethiol

- Thiols,like alcohols, react with carboxylic acids to form compounds called thioesters,

Which have the following structure:



- Many of the reactions of alcohols and thiols are similar , but thiols are more easily oxidized. In the presence of mild oxidizing reagents such as oxygen , iodine , and hydrogen peroxide form disulfides from thiols. For example:



* This oxidation of thiols to disulfides is important in the biological activity of protein.