Alcohols

Presented by
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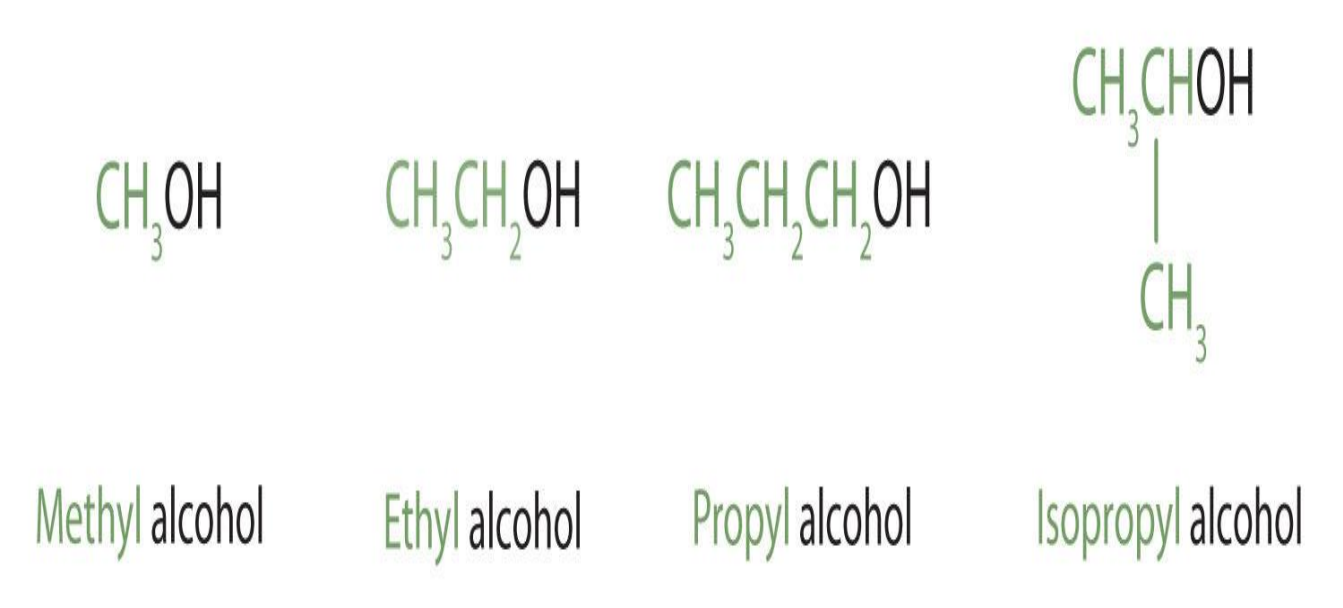
- An alcohol is an organic compound with a hydroxyl (OH) functional group on an aliphatic carbon atom. Because OH is the functional group of all alcohols, we often represent alcohols by the general formula ROH, where R is an alkyl group.

- Alcohols are common in nature. Most people are familiar with ethyl alcohol (ethanol), the active ingredient in alcoholic beverages, but this compound is only one of a family of organic compounds known as alcohols.

- Methanol (CH_3OH) and ethanol (CH_3CH_2OH) are the first two members of the homologous series of alcohols

Nomenclature of Alcohols

Alcohols with one to four carbon atoms are frequently called by common names, in which the name of the alkyl group is followed by the word *alcohol*:



According to the International Union of Pure and Applied Chemistry (IUPAC), alcohols are named by changing the ending of the parent alkane name to -*ol*. Here are some basic IUPAC rules for naming alcohols:

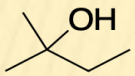
1. The longest continuous chain (LCC) of carbon atoms containing the OH group is taken as the parent compound—an alkane with the same number of carbon atoms. The chain is numbered from the end nearest the OH group.

2. The number that indicates the position of the OH group is prefixed to the name of the parent hydrocarbon, and the -*e* ending of the parent alkane is replaced by the suffix -*ol.* (In cyclic alcohols, the carbon atom bearing the OH group is designated C1, but the 1 is not used in the name.) Substituents are named and numbered as in alkanes.

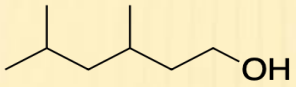
3. If more than one OH group appears in the same molecule (polyhydroxy alcohols), suffixes such as -*diol* and -*triol* are used. In these cases, the -*e* ending of the parent alkane is retained.

•Application of above rules

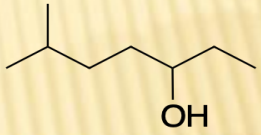
Rules 1 and 2



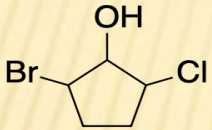
2-methylbutan-2-ol



3,5-dimethylhexan-1-ol

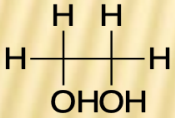


6-methylheptan-3-ol

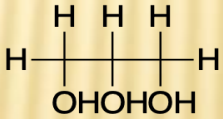


2-Bromo-5-chlorocyclopentanol

Rule 3



ethane-1,2-diol
1,2-ethanediol
(ethylene glycol)

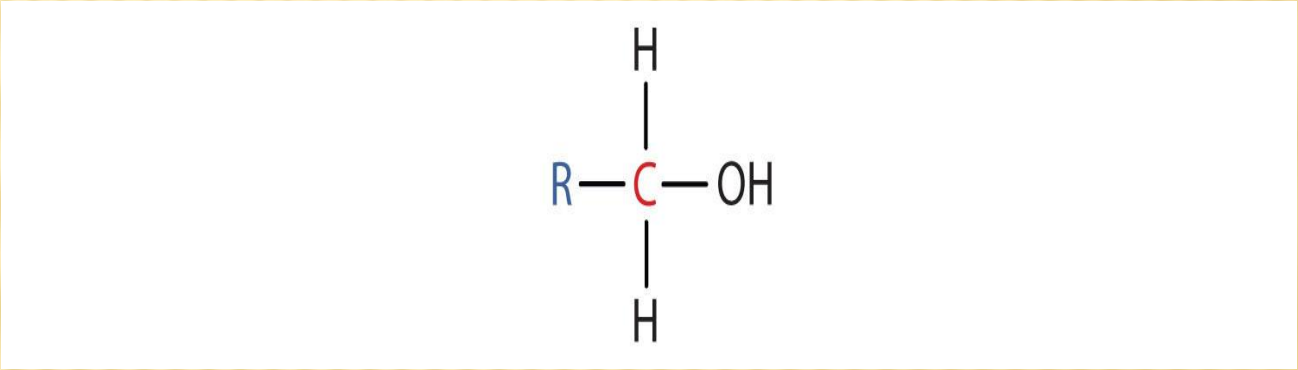


propane-1,2,3-triol
(glycerol)

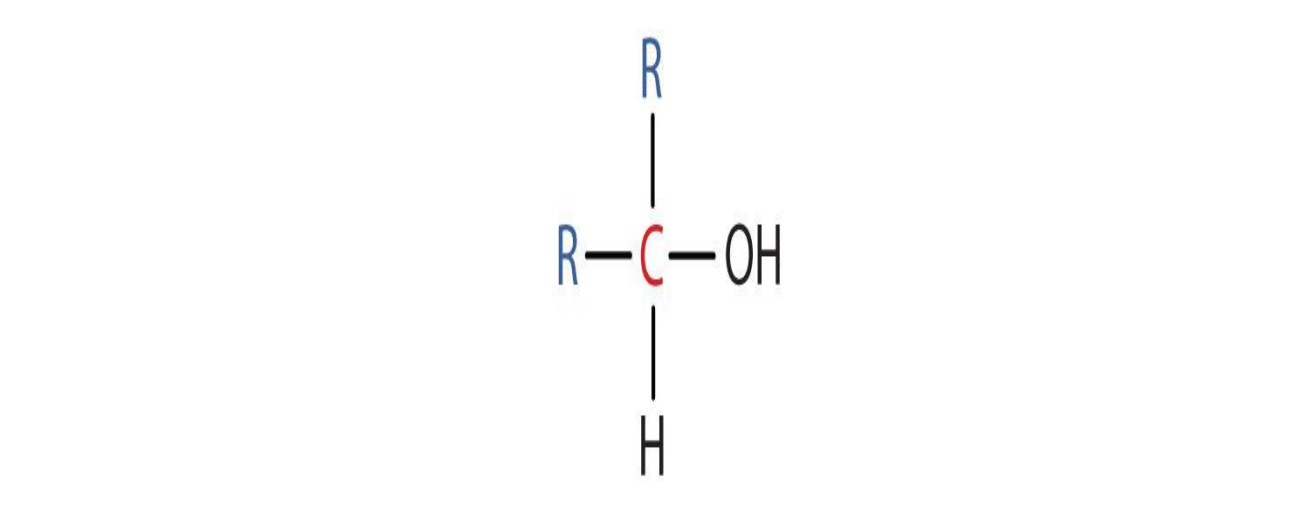
Classification of alcohols

Some of the properties of alcohols depend on the number of carbon atoms attached to the specific carbon atom that is attached to the OH group. Alcohols can be grouped into three classes on this basis.

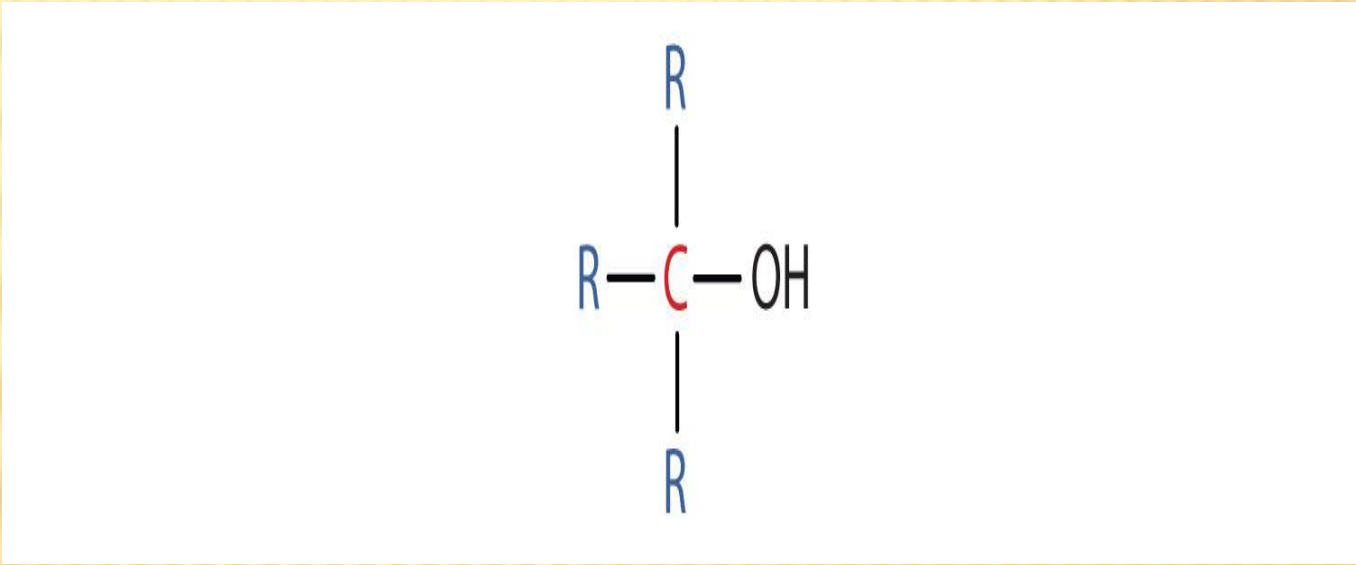
• A primary (1°) alcohol is one in which the carbon atom (in red) with the OH group is attached to *one* other carbon atom (in blue). Its general formula is RCH_2OH



• A secondary (2°) alcohol is one in which the carbon atom (in red) with the OH group is attached to *two* other carbon atoms (in blue). Its general formula is R_2CHOH.



- A tertiary (3°) alcohol is one in which the carbon atom (in red) with the OH group is attached to *three* other carbon atoms (in blue). Its general formula is R_3COH.



Preparation of Alcohols

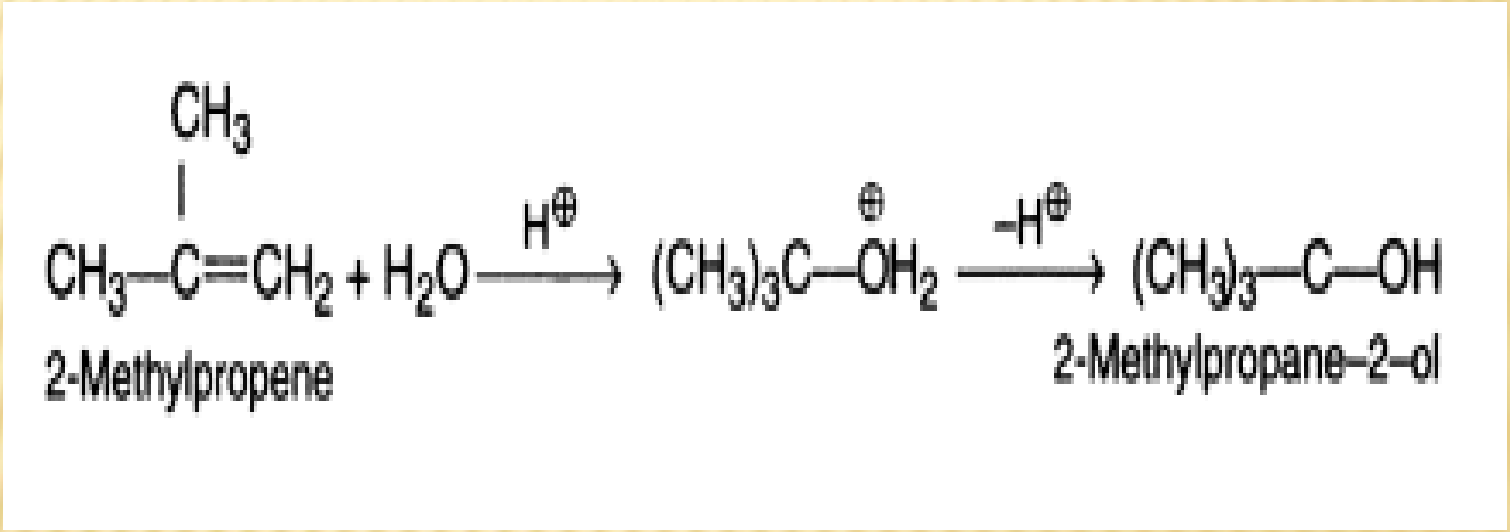
1. Hydrolysis of Halides

Alkyl halides when boiled with an aqueous solution of an alkali hydroxide give alcohol through nucleophilic substitution mechanism.

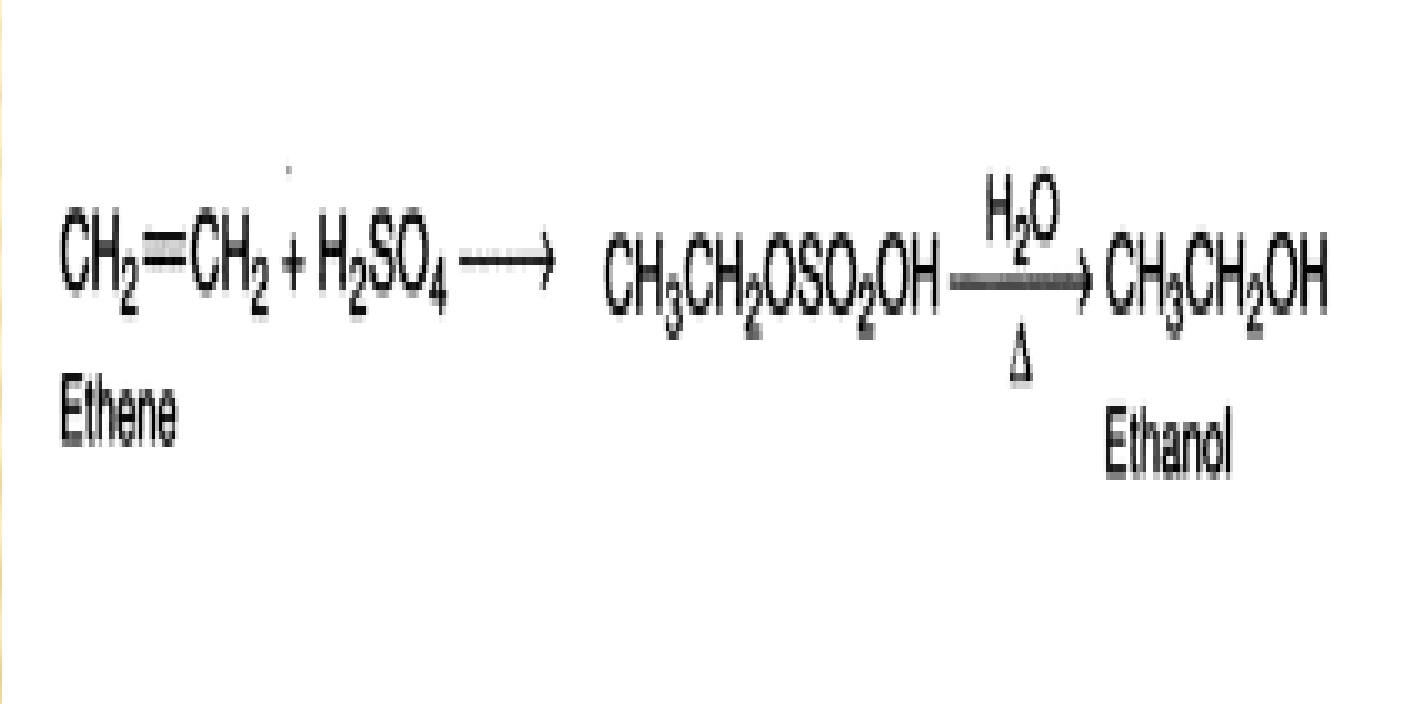
$$\mathbf{R\text{-}X + KOH \rightarrow R\text{-}OH + KX}$$

2. Hydration of Alkenes

Direct hydration takes place by adding water in the presence of a catalyst.



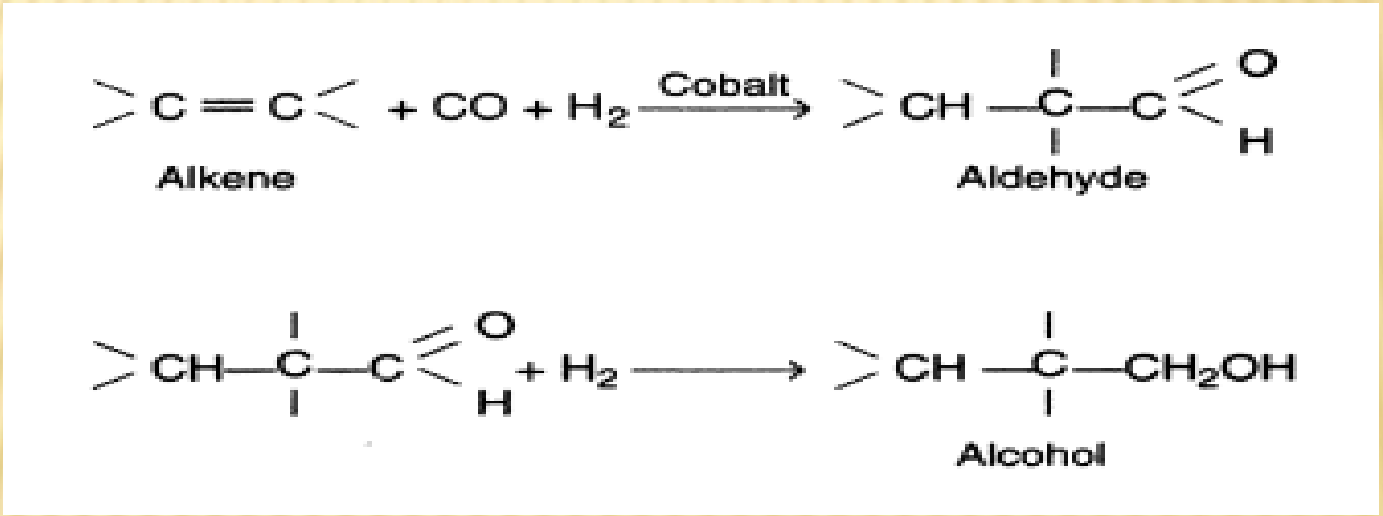
Indirect hydration is achieved by the addition of sulphuric acid to alkane followed by hydrolysis of the alkyl hydrogen sulfate.



3. **Hydroformylation of Alkenes**

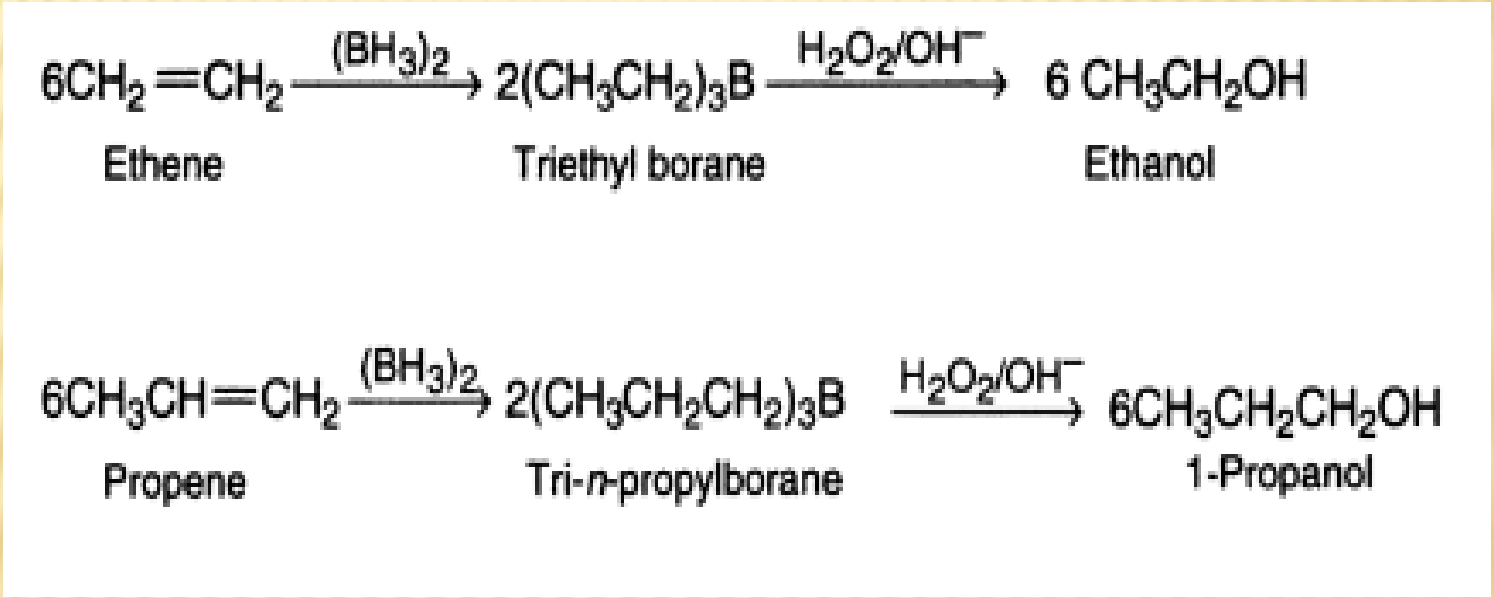
Lower molecular weight olefins react with carbon monoxide and hydrogen in the presence of a catalyst in a reaction called hydroformylation or the oxo reaction.

The resulting aldehyde is subsequently hydrogenated to form an alcohol.



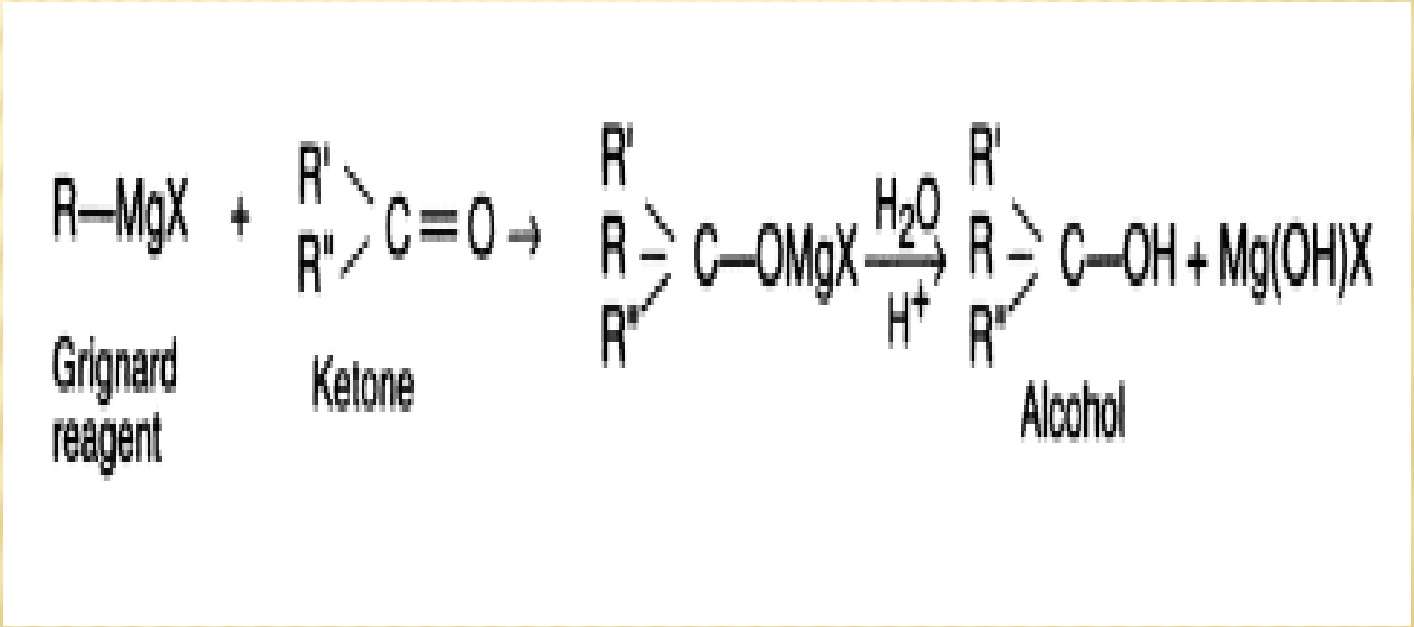
4. Hydroboration of Alkenes

Alkenes, when treated with diborane, give alkyl boranes, R3B. Alkylboranes on oxidation with alkaline hydrogen peroxide give alcohol.



5. Grignard Synthesis

All three types of alcohol (primary, secondary and tertiary) can be prepared from the Grignard reagents by interaction with suitable carbonyl compounds.



The reaction of the Grignard reagent with formaldehyde leads to primary alcohols, that with aldehydes other than formaldehyde yield secondary alcohols and that with ketones give tertiary alcohols.