

Alcohols

Presented by

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Alcohol

- Alcohols are compounds in which a hydroxyl(-OH group is attached to saturated carbon atom.
- Classification depending upon number of hydroxyl Group.
- Alcohols containing one such —OH group are called **Monohydric alcohol**.
- Those with two-OH groups are **Dihydric alcohols**,
- three-OH groups are **trihydric alcohols**
- Many—OH groups are known as **Polyhydric alcohols**.



ethanol
(Monohydric)



1,2 dihydroxy alkane
(Dihydric)



Glycerol
(Trihydric)

Classification of monohydric alcohol

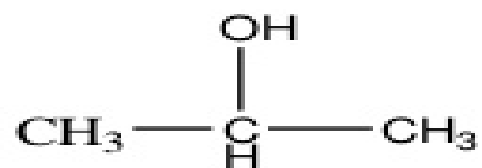
Monohydric alcohol

Primary alcohol(1°)
e.g. Ethanol,



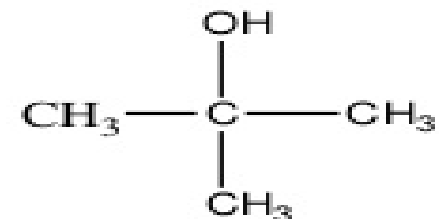
ethanol

Secondary alcohol(2°)
e.g. Isobutanol



isobutanol

Tertiary alcohol(3°)
e.g. tert- butyl alcohol



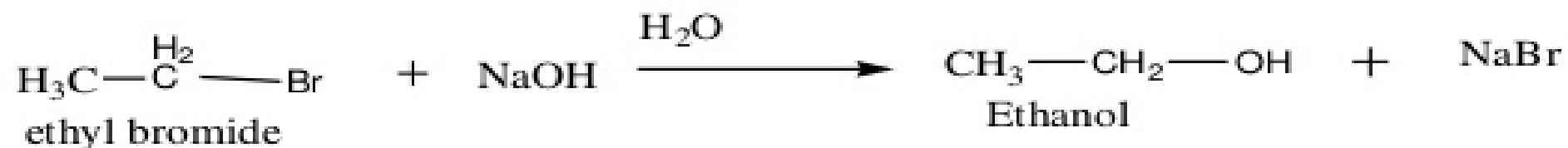
tert-butyl alcohol

Method of Preparation

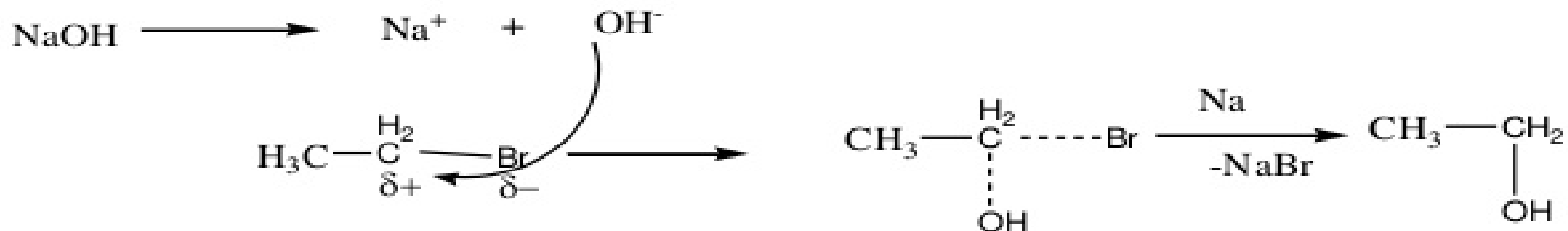
1. Hydrolysis of alkyl halides.
2. Hydration of alkenes.
3. Catalytic hydrogenation
4. From Grignard reagents.
5. Reduction of carboxylic acid
6. Reduction of acid chlorides and esters.
7. Reduction of epoxides.
8. Oxymercuration- reduction of alkenes.
9. Hydroboration- oxidation of alkenes

1. Hydrolysis of alkyl halides

- Alkyl halides react with aqueous potassium hydroxide to form alcohol.

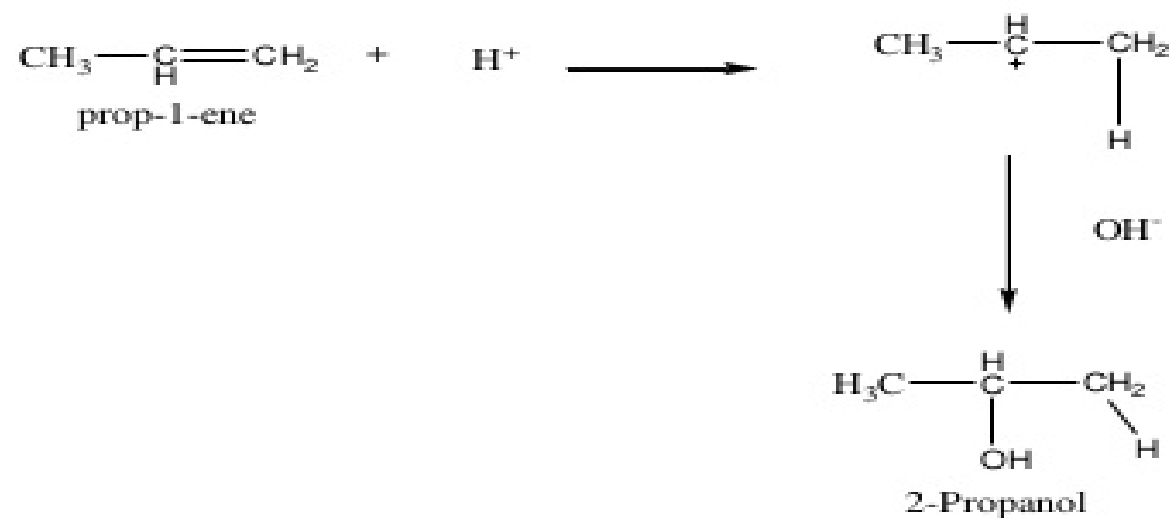
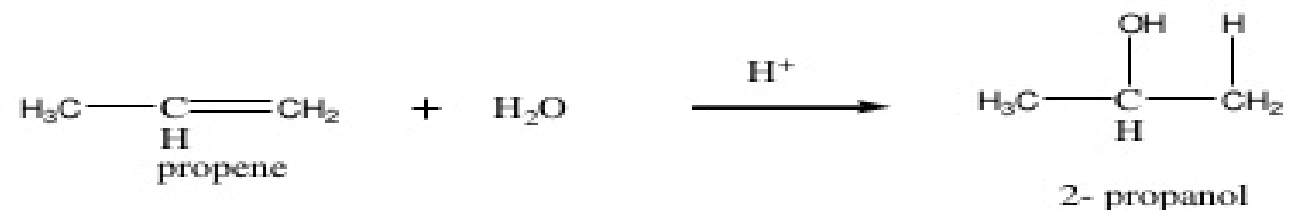


Mechanism



2. Hydration of alkenes

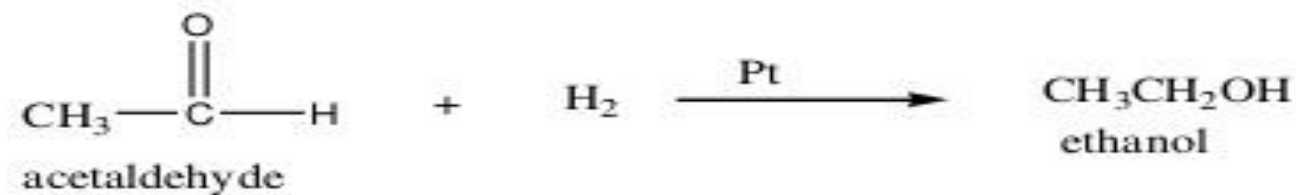
Water adds to alkene in presence of acid catalyst form alcohol



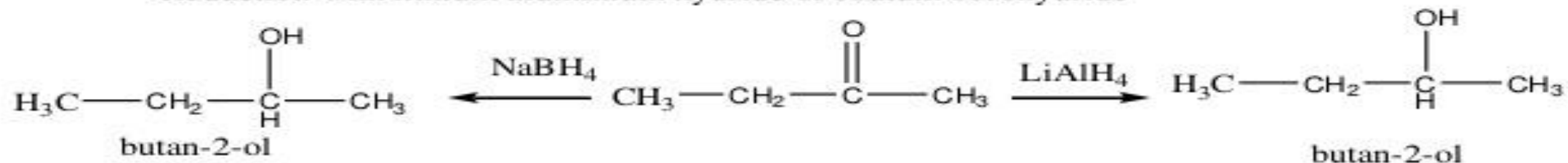
3 . Catalytic hydrogenation of aldehydes and ketones

- Reduction of aldehyde and ketone to form alcohol.

Catalytic hydrogenation

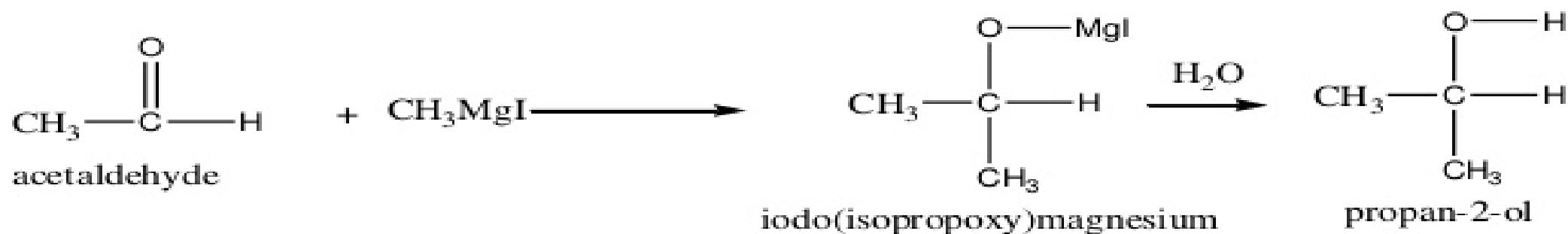


Reduction with lithium aluminium hydride or sodium borohydride



4. From aldehyde and ketone using Grignard reagents

- Aldehydes and ketones react with Grignard reagents to give an addition product which can be hydrolyzed to give alcohol.

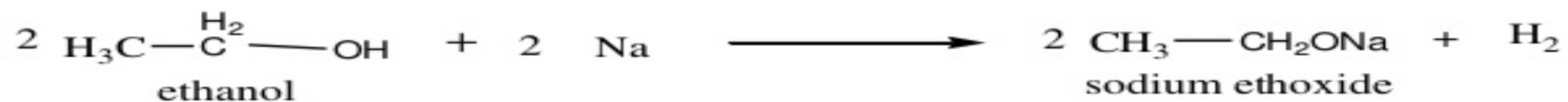


Reactions of alcohols

1. Formation of salt with active metals.
2. Formation of alkyl halides.
3. Formation of esters.
4. Formation of carboxylic acid.
5. Formation of alkenes.
6. Formation of alkanes.
7. Formation of ketones.
8. Formation of aldehydes.
9. Formation of ethers.

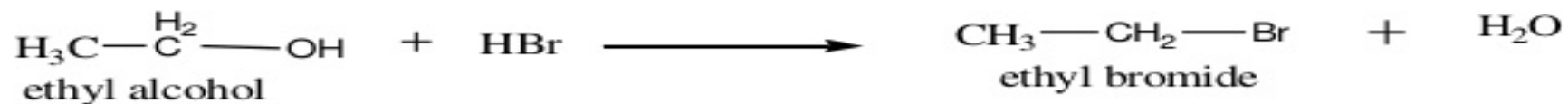
1. Reaction with Metals to form salt.

- Alcohols react with Li, Na, K to liberate hydrogen and metal oxides.



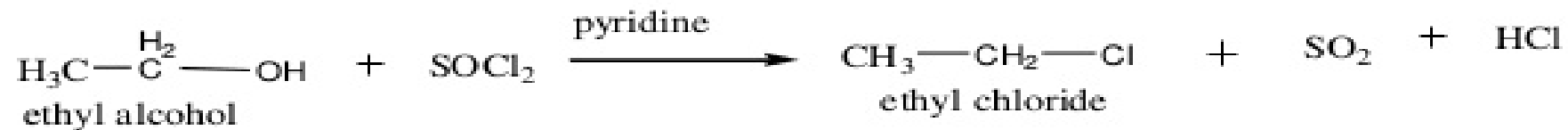
2. Formation of alkyl halides

- Alcohols react with HBr or HI to produce alkyl bromides or alkyl halides.

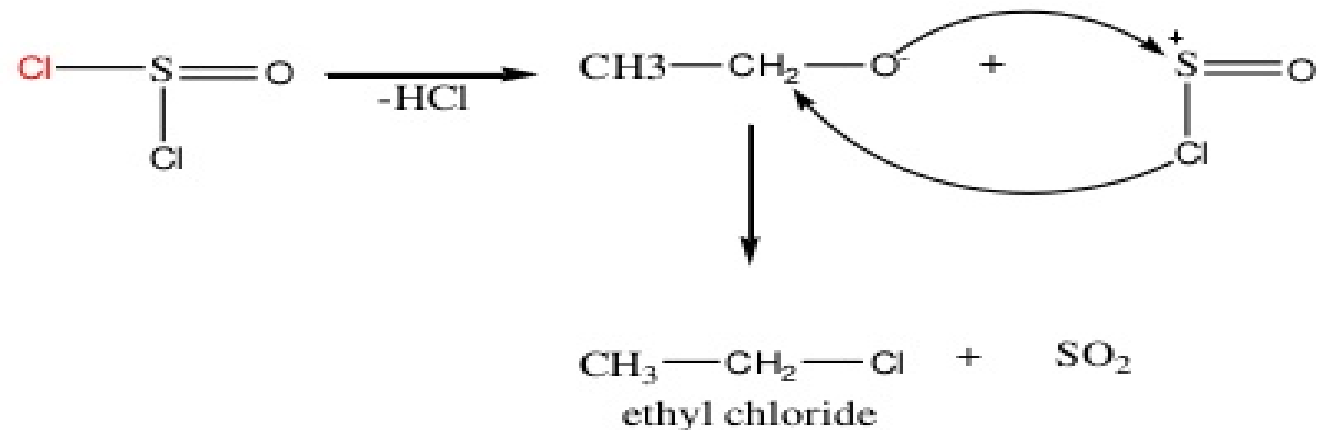
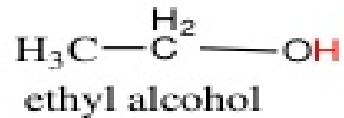


2.C Action of thionyl chloride on alcohol(Formation of alkyl halides)

- Alcohols react with thionyl chloride in the presence of pyridine to produce alkyl halides.



Mechanism

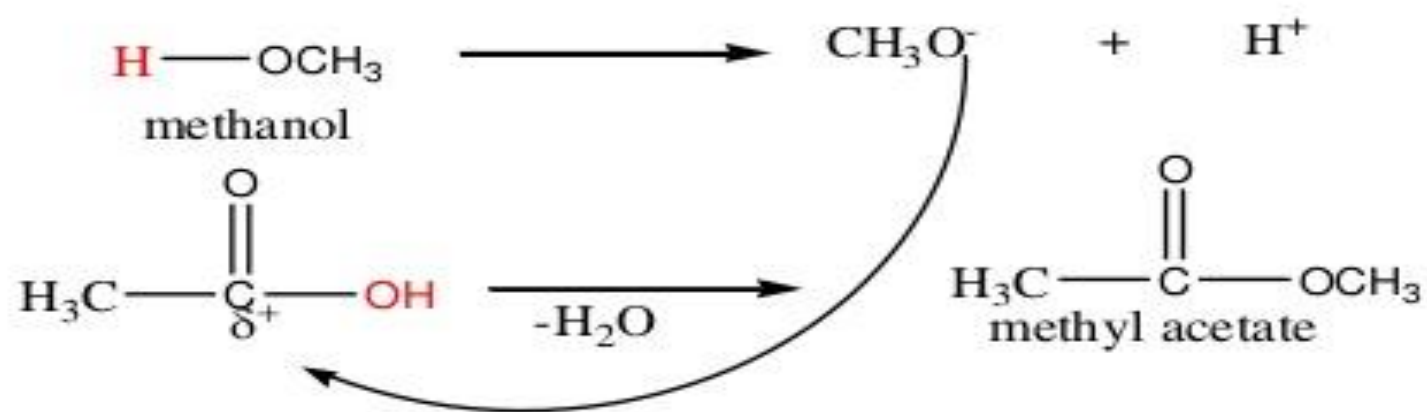


3. Formation of ester

Alcohol react with carboxylic acid in the presence of strong acid to form esters

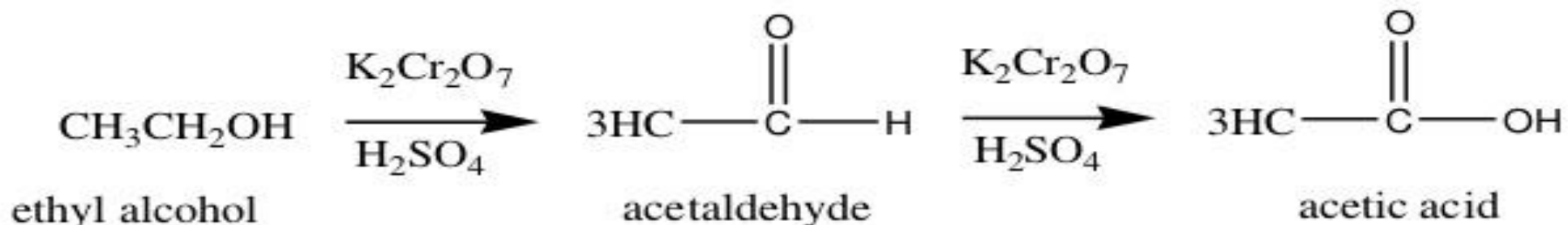
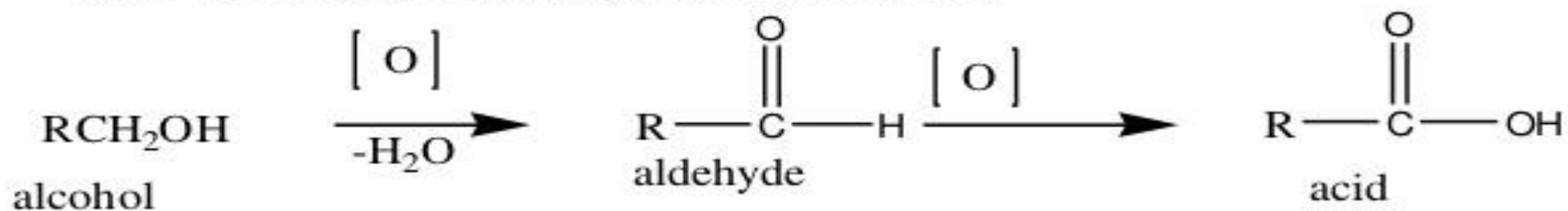


Mechanism



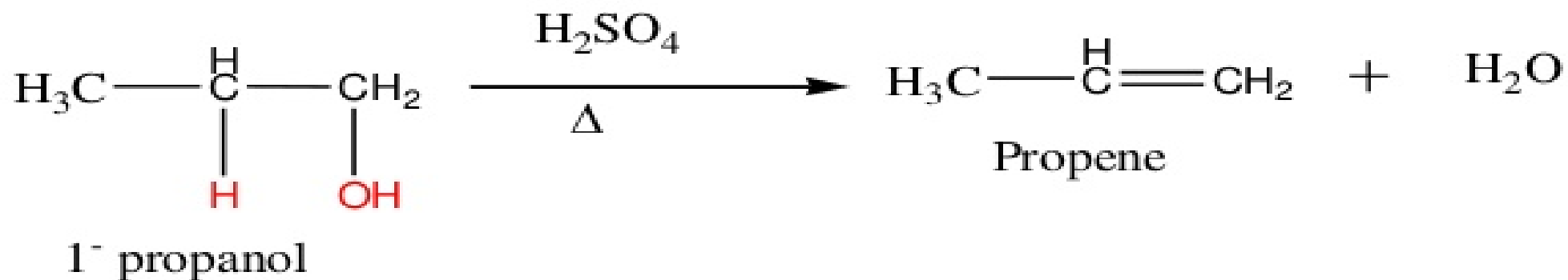
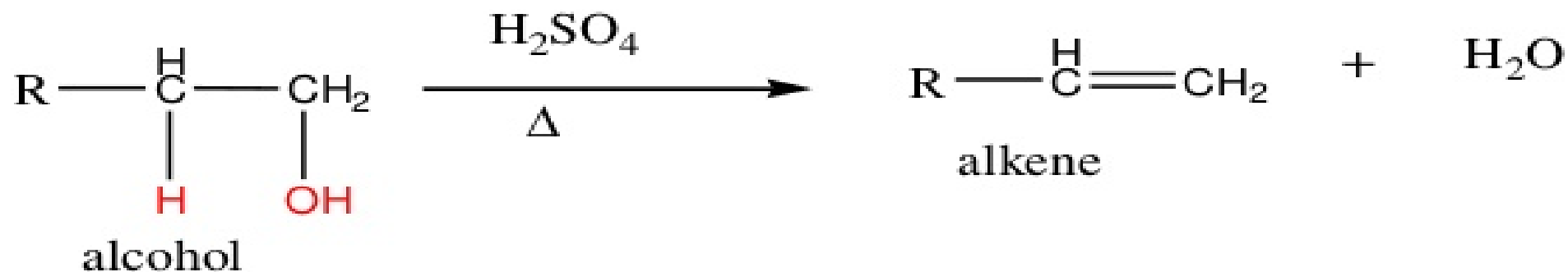
4. Formation of carboxylic acid

Oxidation of primary alcohols and aldehydes: Primary alcohols and aldehydes on oxidation with sodium or potassium dichromate and sulphuric acid, or potassium permanganate, give the corresponding carboxylic acids.



5. Dehydration of alcohol

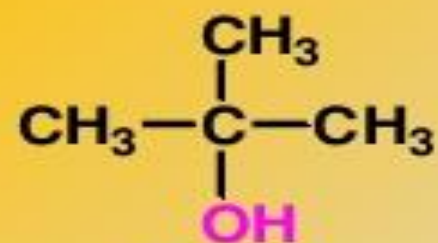
- When alcohol is heated in the presence of sulphuric acid to form alkene by elimination of water



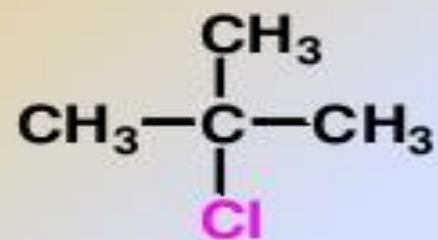
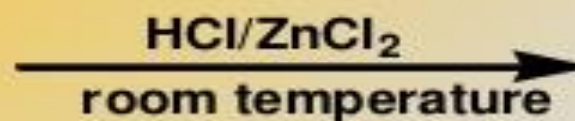
TESTS TO DISTINGUISH CLASSES OF ALCOHOLS

1) Lucas Test

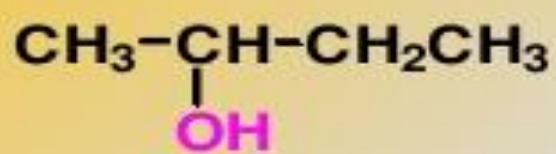
- The alcohol is shaken with Lucas reagent (a solution of ZnCl_2 in concentrated HCl).
- Tertiary alcohol - Immediate cloudiness (due to the formation of alkyl chloride).
- Secondary alcohol - Solution turns cloudy within about 5 minutes.
- Primary alcohol - No cloudiness at room temperature.



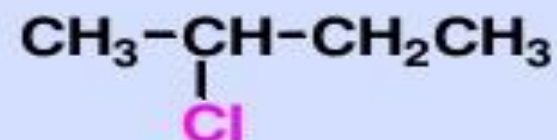
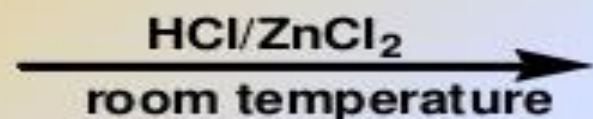
3° alcohol



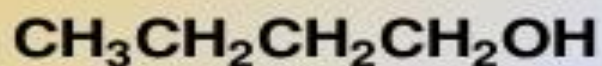
(cloudy solution almost immediately)



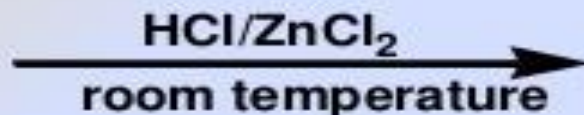
2° alcohol



(cloudy solution within 5 minutes)



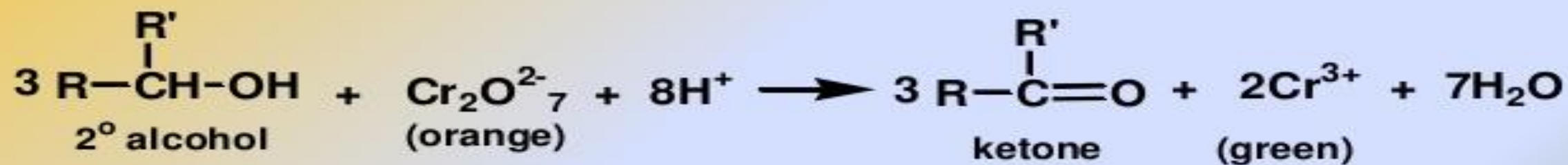
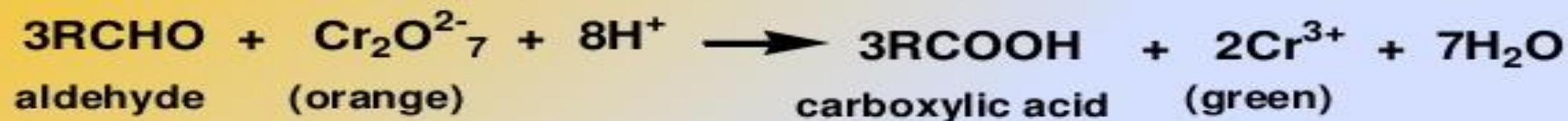
1° alcohol



no reaction

2) Oxidation of alcohols

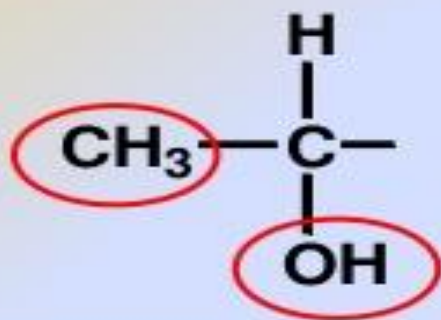
- only primary and secondary alcohols are oxidised by hot acidified KMnO_4 or hot acidified $\text{K}_2\text{Cr}_2\text{O}_7$ solution.
- the alcohol is heated with KMnO_4 or $\text{K}_2\text{Cr}_2\text{O}_7$ in the presence of dilute H_2SO_4 .
- 1° or 2° alcohol:
 - the **purple colour** of KMnO_4 solution **disappears**.
 - the colour of the $\text{K}_2\text{Cr}_2\text{O}_7$ solution changes from **orange to green**.
- 3° alcohol do not react with KMnO_4 or $\text{K}_2\text{Cr}_2\text{O}_7$.



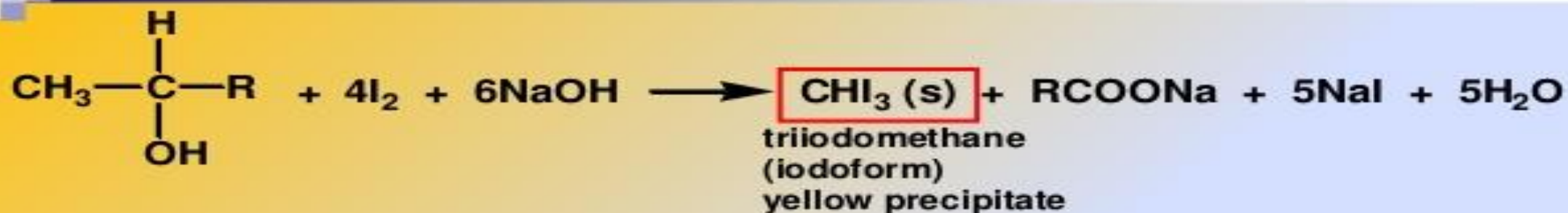
HALOFORM TEST TO IDENTIFY METHYL ALCOHOL GROUP

1) Iodoform:

- Ethanol and secondary alcohols containing the group **methyl alcohol group** which react with alkaline solutions of iodine to form **triiodomethane (iodoform, CHI_3)**.
- **Triiodomethane** – a pale yellow solid with a characteristic smell.

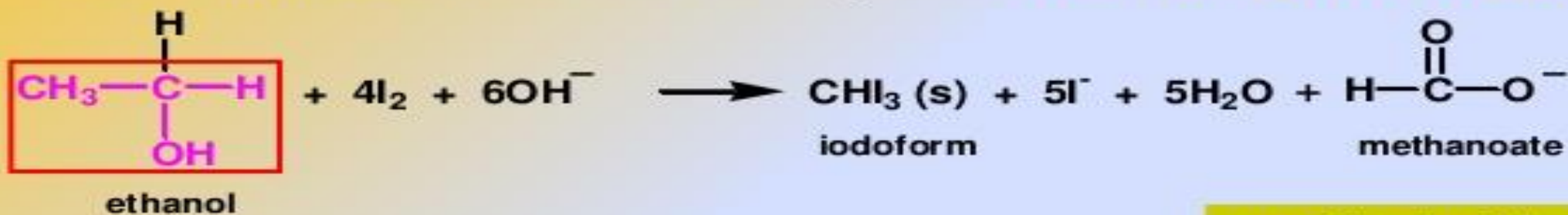


(methyl alcohol group)



where R = hydrogen, alkyl or aryl group

- The iodoform test can distinguish **ethanol from methanol**

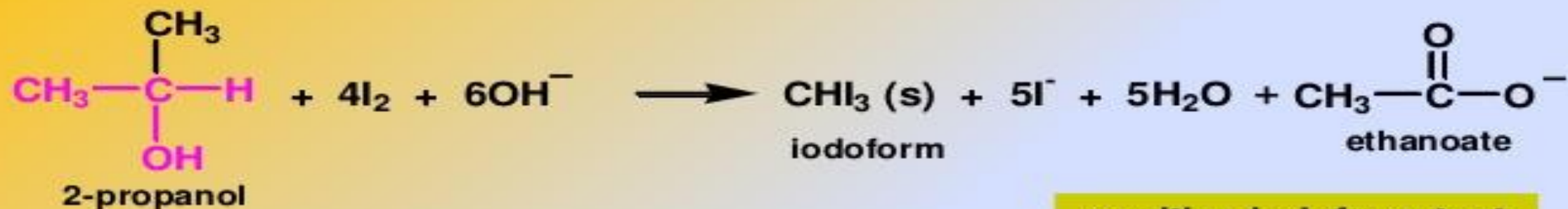


positive iodoform test



negative iodoform test

- The iodoform test can distinguish **2-propanol** from **1-propanol**



*** TERTIARY ALCOHOLS DO NOT GIVE POSITIVE IODOFORM TEST**

Victor Meyer method.

OH^- group is attached with primary, secondary and tertiary alcohols with primary, secondary and tertiary carbon atoms respectively. In Victor Meyer method when these alcohols are treated with HI , AgNO_2 , and NaOH respectively they produce red, blue and colourless solution respectively.

Victor Meyer's method : (i) The given alcohol is converted into an iodide by concentrated HI or red phosphorous and iodine.

(ii) The iodide is treated with silver nitrite to form nitroalkane.

(iii) Nitroalkane is finally treated with nitrous acid ($\text{NaNO}_2 + \text{H}_2\text{SO}_4$) and made alkaline with KOH

If a blood red colour is obtained, the original alcohol is primary.

If a blue colour is obtained, the alcohol is secondary.

If no colour is produced, the alcohol is tertiary.

