

University Of Basrah
College Of Pharmacy
Department Of Pharmaceutical Chemistry
2nd stage 2nd Semester
2024-2025

LABORATORY OF ORGANIC CHEMISTRY

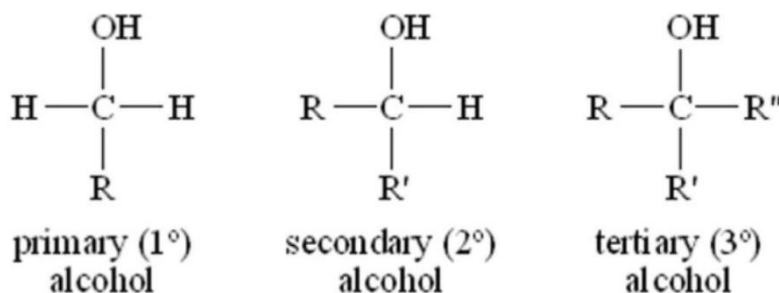
IDENTIFICATION OF ALCOHOLS



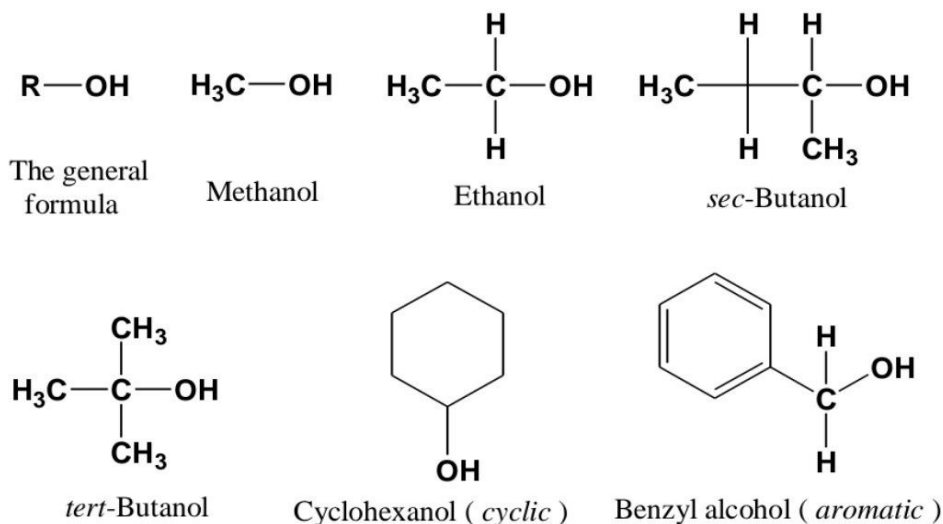
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Alcohols are organic compounds which are characterized by the presence of one, two or more hydroxyl groups (**-OH**) that are attached to the carbon atom in an alkyl group or hydrocarbon chain.

Alcohols are classified into three types- Primary, Secondary and Tertiary based on the number of carbon atoms directly attached to the carbon bonded with the -OH group. The general formula of alcohol is **ROH** , where **R** is any alkyl or substituted alkyl group.



Alkyl group may be open chain or cyclic. It may contain a halogen atom, additional hydroxyls, a double bonds or an aromatic ring.



Note: Compounds in which the -OH group is attached directly to an aromatic ring is not alcohols , they are phenols , and differ markedly from the alcohols.

Properties of alcohol:

- Alcohols are colorless liquids with a special faint odor.
- Aliphatic alcohols burn with **blue** flame (without smoke), while aromatic alcohols burn with **yellow** smoky flame.
- boiling point of alcohols are considerably high, it is increase as the molecular weight increases.

Alkane	Boiling point (°C)	Alcohol	Boiling point (°C)
Methane	-164	methanol	65
ethane	-89	ethanol	79
propane	-42	1-propanol	97
butane	-0.5	1-butanol	117
pentane	36	1-pentanol	138
hexane	69	1-hexanol	156

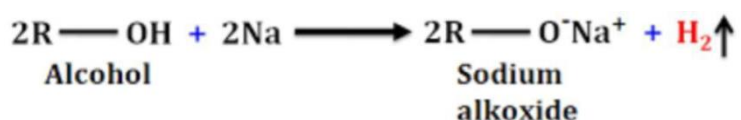
- Alcohols are polar compounds because of the presence of the hydroxyl group which is also responsible for their ability to form hydrogen bonding. The degree of the polarity depends on the size of the alkyl side chain; the polarity decreases as the size of the alkyl side chain increases.
- Alcohols are neutral compounds that don't change the color of litmus paper.
- All reactions of alcohols are related to its active hydroxyl group and are of two types:
 - a) removal of the hydroxyl itself as in the reaction with hydrogen halides to form alkyl halides or in the dehydration reaction to form a double bond.
 - b) removal of the proton only from the active hydroxyl as in the formation of esters or in the reaction with active metals such as sodium.

Detection of alcohols

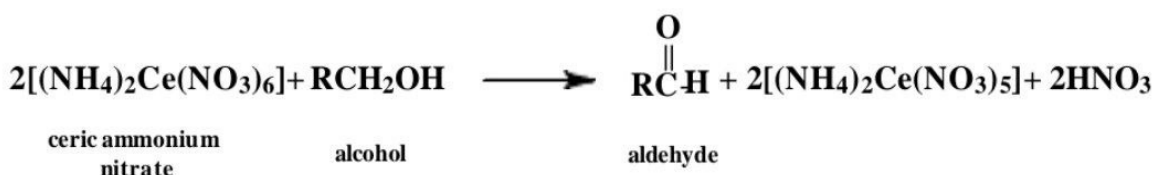
General test

a) Sodium metal test: Alcohols react with sodium metal with evolution of H_2 gas and formation colorless solution of sodium alkoxide.

In a clean dry test tube, put a small piece of sodium metal and add 1ml of alcohol, note evolution (bubbles) of colorless hydrogen gas.

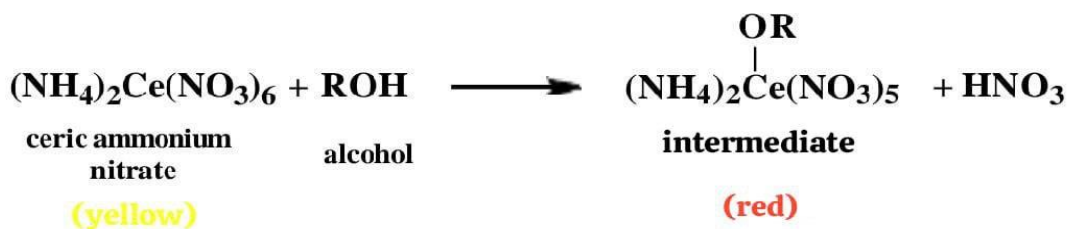


b) Ceric ammonium nitrate reagent: Ceric ammonium nitrate (yellow solution) is an oxidizing agent that reacts with alcohols to give a red complex.



Each mole of the alcohol requires two moles of the reagent.

The red colored complex is an intermediate for the oxidation of alcohols by the $Ce(IV)$ solution. This red color disappears after a reasonable time due to completing the oxidation of this intermediate and the reduction to the colorless $Ce(III)$ solution producing the corresponding aldehyde or ketone.



Procedure: **Water soluble (miscible) alcohols:** mix two drops of the alcohol with one drop of ceric ammonium nitrate solution. A **red** complex indicates a positive test.

Water insoluble (immiscible) alcohols: mix two drops of the alcohol with 0.5 ml dioxane, shake well, and add one drop of the reagent to get a positive **red** complex.

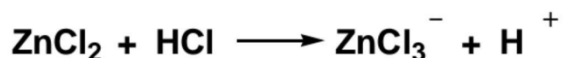
This test gives positive results with primary and secondary alcohols (up to 10 carbons).

Specific tests

a) Lucas test: Is a solution of anhydrous zinc chloride in concentrated hydrochloric acid. This solution is used to distinguish between the different types of alcohols (primary, secondary or tertiary).

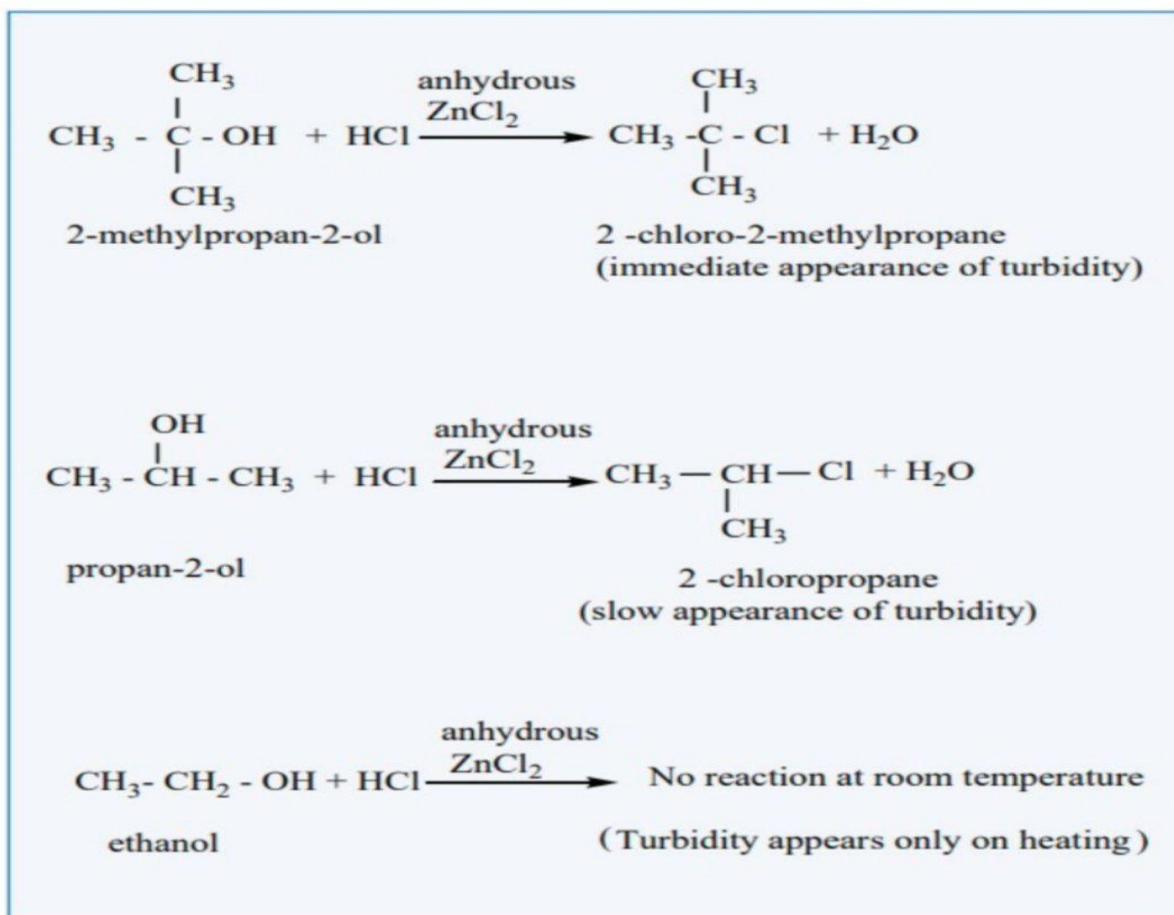
The reaction is a substitution in which the chloride replaces a hydroxyl group. A positive test is indicated by a change from clear and colorless to turbid, signalling formation of a chloroalkane.

(Zinc chloride is added to increase the ionization of hydrochloric acid)



Procedure: Mix 2-4 drops of the alcohol with few drops of Lucas reagent and observe the results:

- **tertiary alcohols:** the solution turns turbid or cloudy rapidly with the formation of two separate layers at room temperature.
- **secondary alcohols:** the solution turns turbid or cloudy in 5-20 minutes with slight heating.
- **primary alcohols:** no visible reaction is observed and the solution remains colorless.



b) Jones Reagent (Chromic acid test): Is a solution prepared by dissolving chromium trioxide (CrO_3) in aqueous sulfuric acid. The reagent is usually used for the oxidation of primary and secondary alcohols.

- A primary alcohol is first converted into an aldehyde and then into a carboxylic acid.
- A secondary alcohol will be oxidized into a ketone.
- A Tertiary alcohols cannot be oxidized.

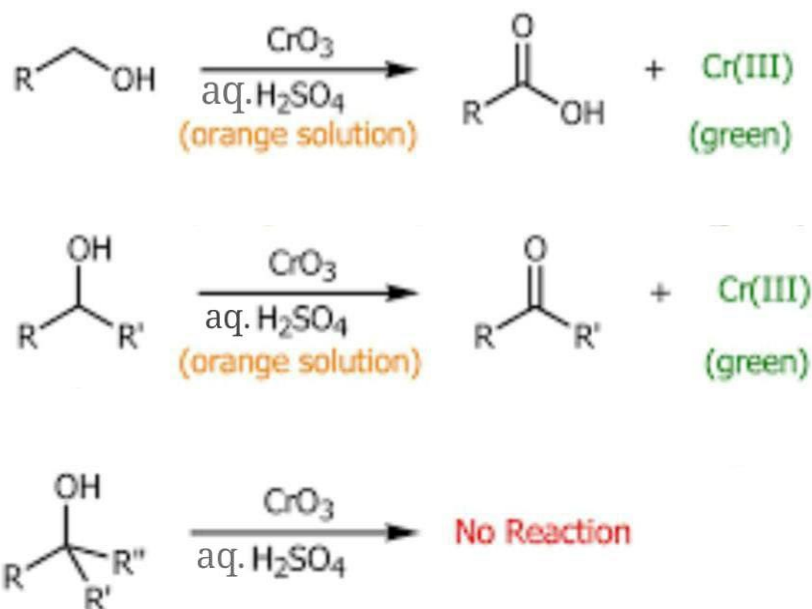
By CrO_3 Shows positive test for: 1° and 2° alcohols green colour while 3° alcohol show negative test.

The preparation of the Jones reagent:

Dissolve chromium trioxide (25 g) in water (75 mL), add concentrated sulfuric acid (25 mL) slowly with careful stirring and cooling in an ice-water bath. Keep the temperature of the solution between 0 and 5°C .

Procedure: Put 1ml of the alcohol in a test tube and add 2-3 drops of Jones reagent.

- A positive test is marked by the formation of a **green** color.
- A negative test $\longrightarrow$ **light orange** color.



Safety: Chromium compounds (especially Cr(VI)) are highly toxic. Must take necessary caution when handling.

Lecturer

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