

Qualitative tests of Alcohols

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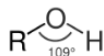
Outline

Alcohols:

- Introduction
- Alcoholic group
- Qualitative tests

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Intoduction



- **Alcohols** is any **organic compound** in which the **hydroxyl functional group (-OH)** is **bound** to a **saturated carbon atom**.
- The saturated straight chain alcohols, the general formula for which is **$C_nH_{2n+1}OH$** .
- The hydroxyl (-OH) functional group with bond angle.

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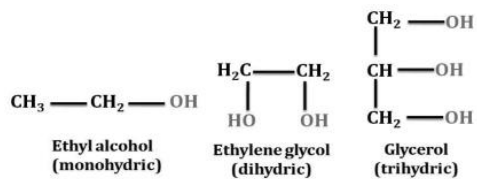
Alcoholic Group

Alcohols are compounds in which the **hydroxyl group (-OH)** is **linked to aliphatic carbon chain** or in the **side chain of an organic compound**. Depending upon the **number of hydroxyl group**, alcohols are classified as :

1. **mono** (contain only one -OH group),
2. **di** (contain two -OH groups) and
3. **trihydric** (contains three -OH groups).

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The number of hydroxyl group



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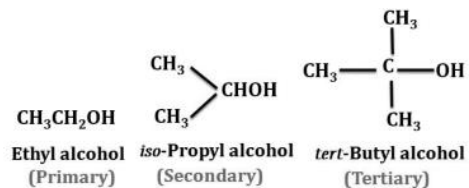
Alcoholic Group

Alcohols are further classified according to **the number carbon atom** is attached to other carbon atoms, as :

1. **primary (1°),**
2. **secondary (2°) and**
3. **tertiary (3°)**

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The number of carbon atoms



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Qualitative tests

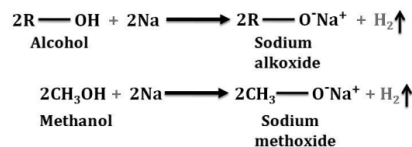
The alcoholic group can be detected by the following tests

1. Sodium metal test
2. Ester test
3. Ceric ammonium nitrate test
4. Acetyl chloride test
5. Iodoform test

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Sodium metal test

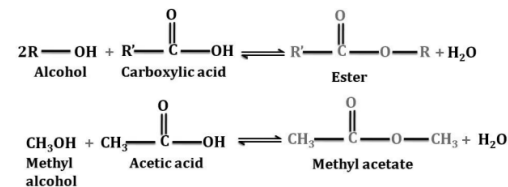
Alcohols **react** with **active metals** like sodium and **liberate hydrogen gas** that can be observed in the form of **effervescence**.



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Ester test

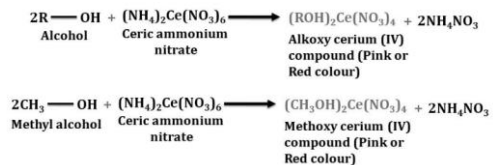
- Alcohols **react** with **carboxylic acids** to form **fruity smelling** compounds called **esters**.
- The reaction between alcohol and carboxylic acid is called **esterification** and is **catalysed** by an **acid** (e.g concentrated sulphuric acid).



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Ceric ammonium nitrate test

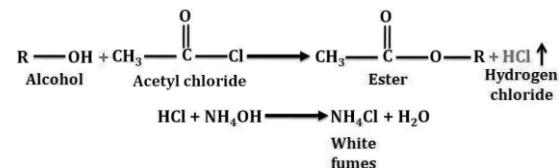
Alcohols react with **ceric ammonium nitrate** to form a **red coloured** alkoxy cerium (IV) compound.



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Acetyl chloride test

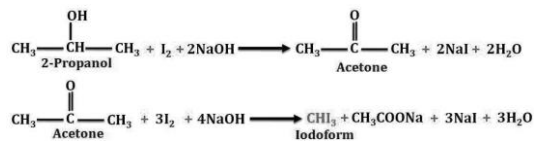
Alcohols react with **acetyl chloride** to form **esters** and gives out **hydrogen chloride gas**. The hydrogen chloride formed gives **white fumes of ammonium chloride with ammonium hydroxide**.



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Iodoform test

This test is given by **acetaldehyde**, all methyl ketones and all alcohols containing $\text{CH}_3\text{-CH-OH}$ group. When **alcohol** is **warmed** with **sodium hydroxide solution and iodine**, a **yellow precipitate of iodoform** is formed.



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Primary, Secondary and Tertiary Alcohols test

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Primary, Secondary and Tertiary Alcohols

1. Luca's Test
2. The TCICA Test for Distinguishing Primary and Secondary Alcohols
3. Victor Meyer test

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1. Luca's Test

Principle:

- Lucas reagent is a solution of ZnCl_2 in concentrated HCl \rightarrow **classify** them in accordance to **their reactivity**.
- The **reactivity of the alcohol** with **Lucas Reagent** is **measured** by the **degree of turbidity** which may vary from **colorless to turbid**.
- The **reaction** is a **substitution** reaction where the **chloride of the zinc** gets **replaced** by the **hydroxyl group** of the **alcohol**.
- This test is more often used to **categorize** the different **types of alcohols** based on **the time taken to form a turbid solution or precipitation**.

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Mechanism?

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Luca's Test (con't)

Primary alcohol: Here no visible reaction is observed and the solution remains colorless e.g. 1-Pentanol

1° alcohol requires **more than an hour** to react, if it reacts at all.



1° alcohol
water soluble

➤ The rate of reaction is related to carbocation stability.

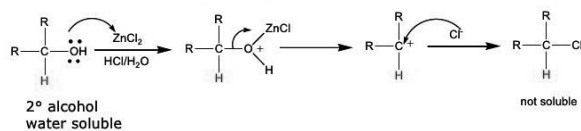
3° > 2° > 1° alcohol

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Luca's Test (con't)

Secondary alcohol: Here the solution turns turbid or cloudy in 5-20 minutes with slight heating e.g. 2-Pentanol

2° alcohol can react in **3-10 min**, but may need to be warmed.

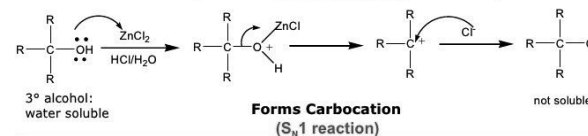


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Luca's Test (con't)

Tertiary alcohol: Here the solution turns turbid or cloudy rapidly with the formation of two separate layers at room temperature e.g. 2-Methyl-2-butanol

3° alcohol and alcohols that form resonance-stabilized carbocations react to form a cloudy mixture in **less than 30 sec** at room temperature.



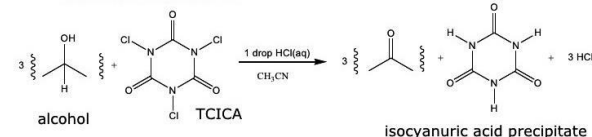
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2. The TCICA Test

- Simple **primary and secondary alcohols** can easily be distinguished by their **rate of oxidation with trichloroisocyanuric acid (TCICA)**.
- The TCICA test is conducted by **adding the unknown to a solution of TCICA in acetonitrile containing hydrochloric acid and measuring the time for a precipitate to form**.
- Primary alcohols react slowly and secondary alcohols react rapidly.

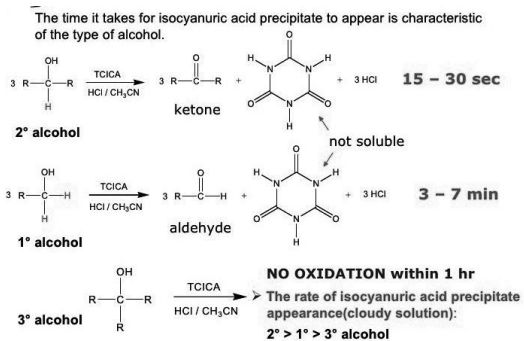
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The TCICA Test (con't)



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The TCICA Test (con't)



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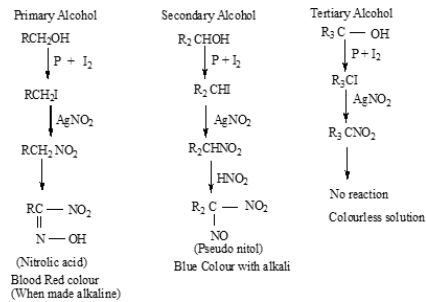
3. Victor Meyer test

The different steps involved in Victor Meyer methods are as below

- The **alcohol** is treated with **iodine** in presence of **red phosphorous** to obtain **iodoalkane**.
- Iodoalkane** so formed is allowed to react with **alcoholic silver nitrate** in order to obtain **nitroalkane**.
- The **nitroalkane** is treated with **nitrous acid** (the mixture of $\text{NaNO}_2 + \text{HCl}$) and the resulting solution is made **alkaline**.

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Victor Meyer test (con't)



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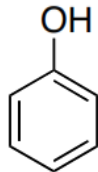
Phenol Test

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Introduction

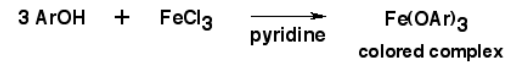
Phenol is the simplest member of a family of compounds in which an **-OH group** is **attached directly to a benzene ring**.

The structure of phenol



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Iron (III) Chloride Test for Phenols

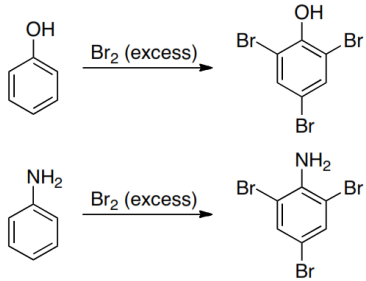
**Positive Test**

A red, blue, green, or purple color is a positive test.

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Bromine Water

This reaction tests for the presence of phenols and aromatic amines.



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Bromine Water

Interpretation:

Decolorization of the bromine, accompanied by simultaneous formation of a **white (or nearly white) precipitate**, indicates a **phenol** or **aromatic amine**.

If the unknown is a phenol, the **pH of the initial solution should be less than 7**.

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😊 Thank You 😊

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