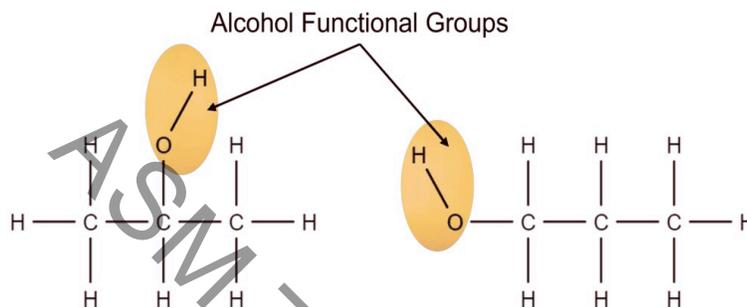


Alcohol

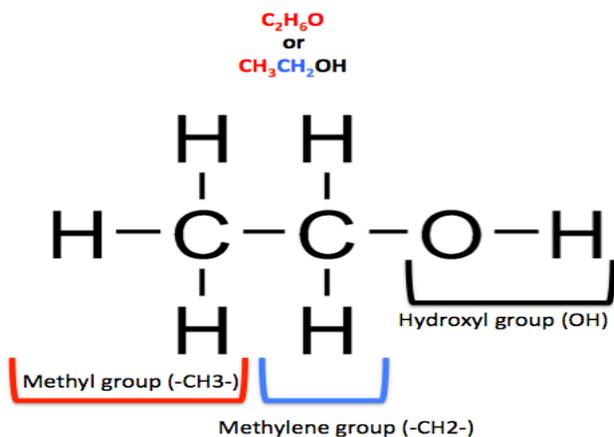
- **Alcohols** are a **homologous series** of molecules. Unlike, the **alkanes** or **alkenes**, alcohols do not contain **only** hydrogen and carbon atoms.
- Alcohols all contain an **alcohol functional group**. This group consists of an oxygen and hydrogen bonded together, with a bond between the oxygen atom and the hydrocarbon chain.



Two structural representations of alcohols.

Molecular Formulae of Alcohols

- The molecular formulae of alcohols are constructed in a different way to the formulas of alkanes and alkenes. For alcohols, **individual carbon** atoms are written separately. Take for example the alcohol **propanol**:
- The molecular formula of propanol can be given as **CH₃ CH₂ CH₂ OH**.
- This formula contains **three distinct parts**, each **corresponding to one carbon** atom from the alcohol chain.
 1. The **CH₃** group will correspond to the **end of the chain**.
 2. The **CH₂** group represents the **middle carbon atom**, bonded to two carbons either side and two hydrogens:
 3. Lastly, the **CH₂ OH** group represents the **carbon atom to which the alcohol functional group is attached**:



Representation of Alcohol

- Alcohols follow the general pattern of alkanes and alkenes when it comes to their **nomenclature**. The first four members of the series have generic prefixes, **meth-**, **eth-**, **prop-**, and **but-**, with the rest having **numerical prefixes**. Alcohols are then given the suffix **-anol**.

For example, the structure shown above contains three carbons and an alcohol functional group. Its name will therefore be **propanol**.

Alcohol	Number of carbon atoms	Molecular formula	Structural formula
Methanol	1	CH ₃ OH	$\begin{array}{c} \text{H} \\ \\ \text{H} - \text{C} - \text{OH} \\ \\ \text{H} \end{array}$
Ethanol	2	C ₂ H ₅ OH	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H} - \text{C} - \text{C} - \text{OH} \\ \quad \\ \text{H} \quad \text{H} \end{array}$
Propan-1-ol	3	C ₃ H ₇ OH	$\begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H} - \text{C} - \text{C} - \text{C} - \text{OH} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$
Propan-2-ol	3	C ₃ H ₇ OH	$\begin{array}{c} \text{H} \quad \text{OH} \quad \text{H} \\ \quad \quad \\ \text{H} - \text{C} - \text{C} - \text{C} - \text{H} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$
Butan-1-ol	4	C ₄ H ₉ OH	$\begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \quad \\ \text{H} - \text{C} - \text{C} - \text{C} - \text{C} - \text{OH} \\ \quad \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \end{array}$
Butan-2-ol	4	C ₄ H ₉ OH	$\begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \quad \\ \text{H} - \text{C} - \text{C} - \text{C} - \text{C} - \text{H} \\ \quad \quad \quad \\ \text{H} \quad \text{OH} \quad \text{H} \quad \text{H} \end{array}$

Properties and Reactions of Alcohols

► Alcohols all have **similar properties**.

1. For example, alcohols are **flammable** in air. When alcohols are burned they will produce **carbon dioxide** and **water**:



This flammability means that alcohols can be burnt as **fuels**. Unlike alkenes, alcohols burn with a relatively **clean flame**, making them much less unpleasant to use as fuels. An example of an alcohol fuel is the use of **ethanol** in a **spirit burner**.

2. Alcohols are also used as **solvents**.

3. Alcohols are able to dissolve most things that **will** dissolve in water as well as many things that **can't**.

4. Alcohols are ideal for removing **organic chemicals** such as **fats, oils, and grease**.

5. **Solubility**: The first four alcohols are all **soluble** in water, producing **neutral** solutions. These solutions are able to react with sodium to form **sodium salts** and **hydrogen gas**:



6. **Oxidation of Alcohol** :

Alcohols will also be **oxidised** by oxygen. These reactions will produce molecules from another homologous series called **carboxylic acids**.



Fermentation

► Ethanol can be made by a process called fermentation. During fermentation, sugar (glucose) from plant material is converted into ethanol and carbon dioxide. This typically takes place at temperatures of around 30°C.

► The enzymes found in single-celled fungi (yeast) are the natural catalysts that can make this process happen:



► **Yeast** is a **living organism** and so requires a certain set of conditions to effectively breakdown the sugar. To work best, the yeast requires optimum **temperature of 37°C** and a **slightly acidic** environment. If either the temperature or pH are too high or too low, the enzymes will **denature** and will no longer be able to break down sugar.

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