

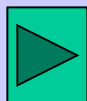
Alcohols and Carbonyls

Ethanol. Alkanol family, Aldehydes
and Ketones. Methanol and
Methanal

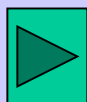


$C=O$ carbonyl group

Index



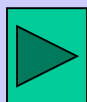
Homologous series $C_nH_{2n+1}OH$



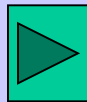
Ethanol and naming alcohols



Different types of Alcohol Structures



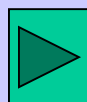
Oxidation and Dehydration of Alcohols



Manufacture and uses of Ethanol



Aldehydes and Ketones



Methanol and steam reforming



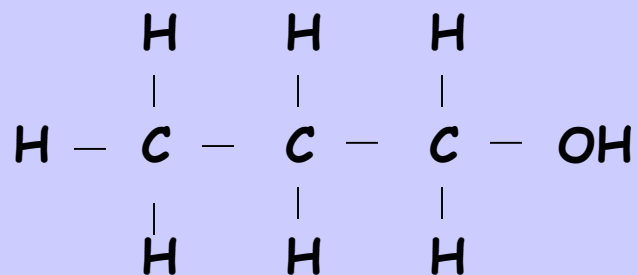
Homologous Series $C_nH_{2n+1}OH$

Functional molecular structure

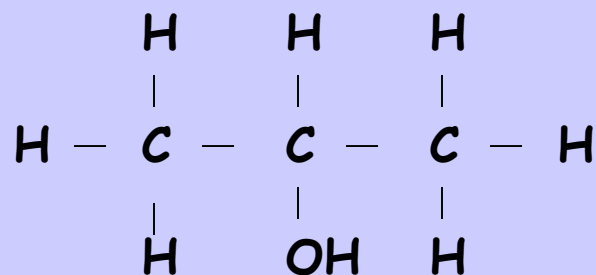
Methanol, CH_3OH ; Ethanol C_2H_5OH ; Propanol C_3H_7OH

Straight chain isomers of Alkanols

Propanol C_3H_7OH , has 2 isomers, propan-1-ol and propan-2-ol.

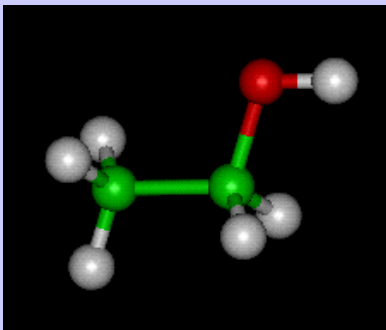


propan-1-ol



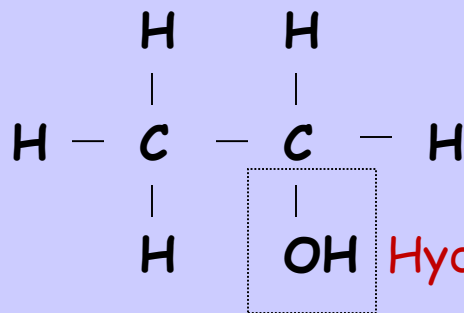
propan-2-ol





Ethanol C_2H_5OH

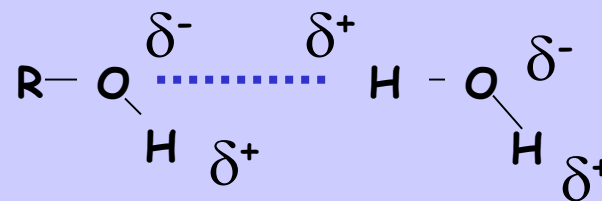
Functional group -OH



Hydrogen bonding allows ethanol to dissolve in water, (pH 7. b.p. 78 °C.)

This effect decreases in alcohols as the length of the hydrocarbon chain increases.

Ethanol is a **good solvent**, it behaves both like water and other hydrocarbon solvents.



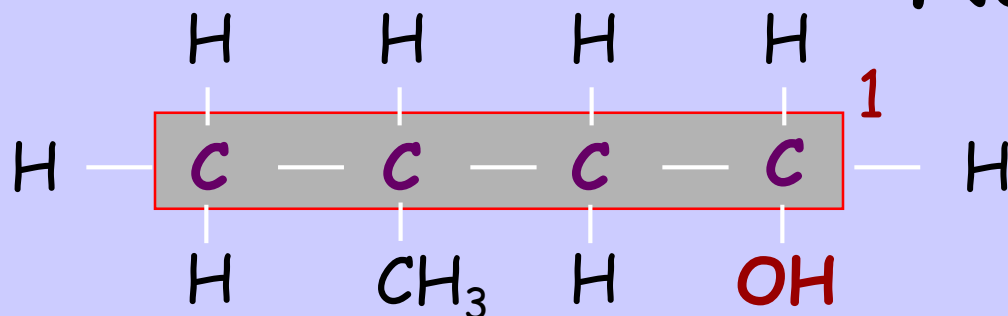
Combustion of ethanol



Ethanol can be used as a fuel in cars.



Naming alcohols



1. Decide on the type of compound (ie. consider functional group)

alcohol (alkanol)

2. Select the longest chain

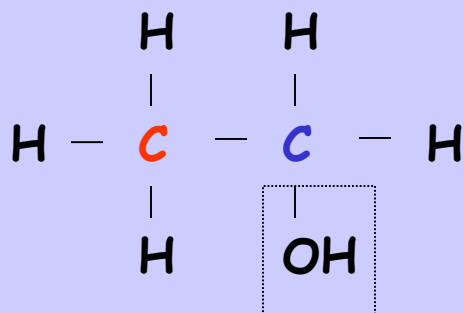
4 C's ∴ butanol

3. Name the compound with the branched chains in ascending order.

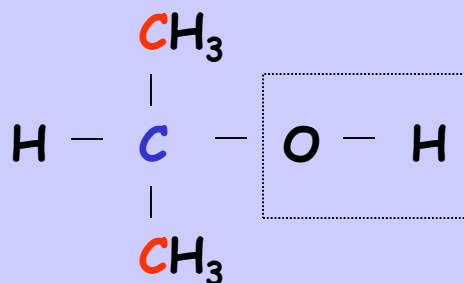
3-methylbutan-1-ol



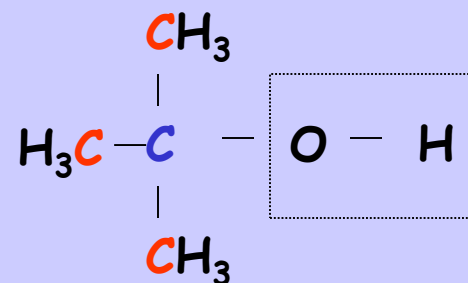
Different types of alcohol



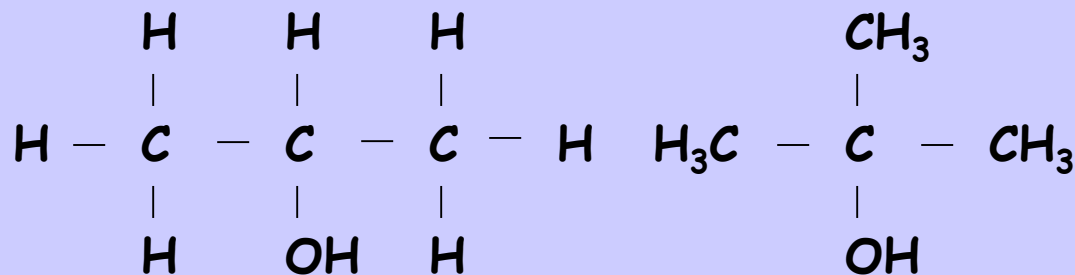
Primary alcohol,
ONE C joined to the
C bonded to
the OH group



Secondary alcohol,
TWO C's joined to the
C bonded to
the OH group



Tertiary alcohol,
THREE C's joined to
the **C** bonded to
the OH group



propan-2-ol

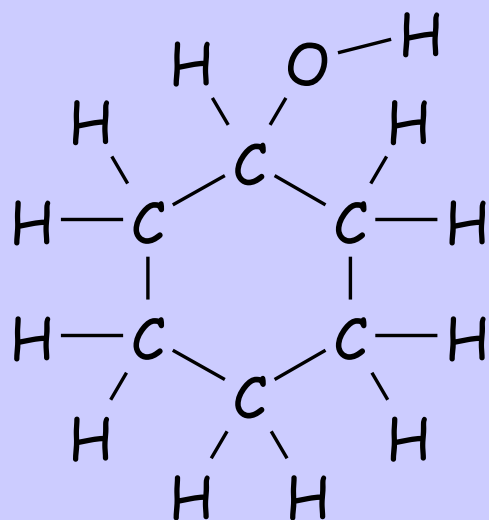
2-methylpropan-2-ol



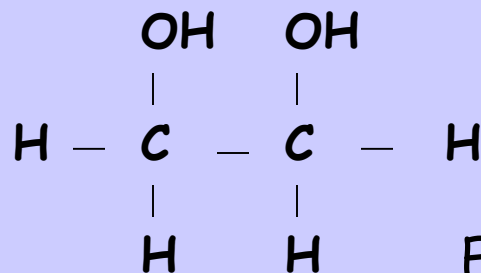
Other Alcohols

1. Cycloalkanol

Cyclohexanol is a secondary alcohol



2. Diols (dihydric)



Ethane-1,2-diol
(Anti freeze)

3. Triols (trihydric)

e.g. propane -1,2,3,triol or glycerol is used in cosmetics, paints and nitroglycerine explosives.

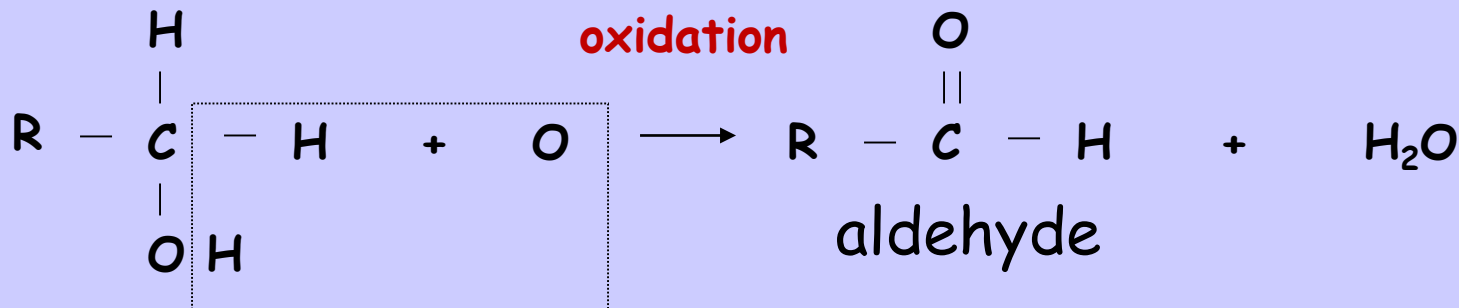


Oxidation of Alcohols

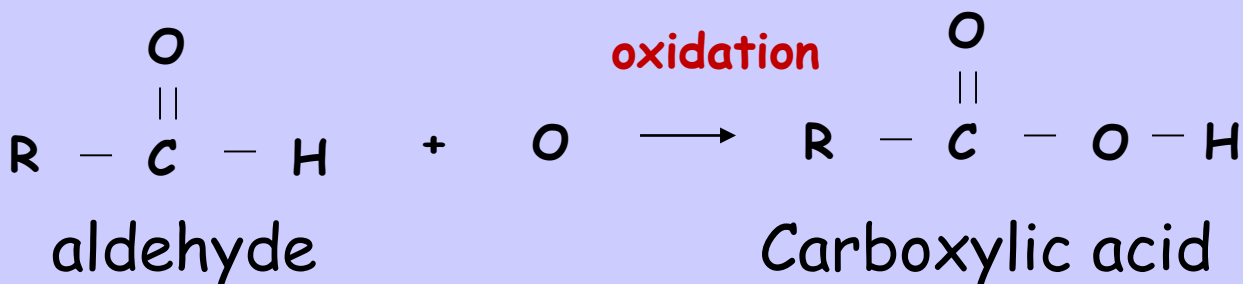
Primary alcohols can be **oxidised** by a number of oxidising agents, in two stages, **1st** Stage - **Hydrogen** is lost; **2nd** Stage - **oxygen** is gained.

When applied to carbon compounds, oxidation results in an increase in the oxygen to hydrogen ratio.

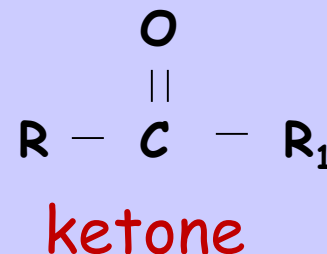
1st



2nd

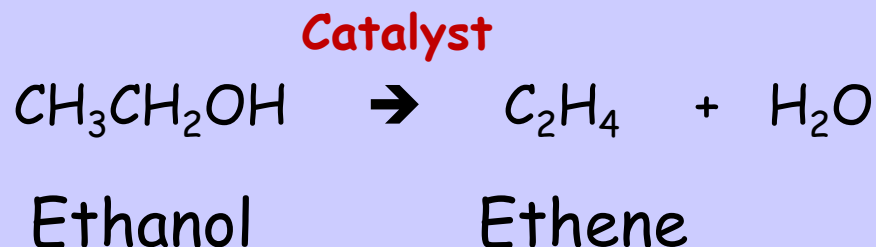


Secondary alcohols can be **oxidised** to form **ketones**,
Tertiary alcohols **do not** undergo oxidation.



Dehydration of ethanol

Dehydration is the removal of water from a reactant



When hot ethanol is passed over **aluminium oxide**, ethene gas is produced.

Heating ethanol with concentrated H_2SO_4 will also result in the formation of ethene.

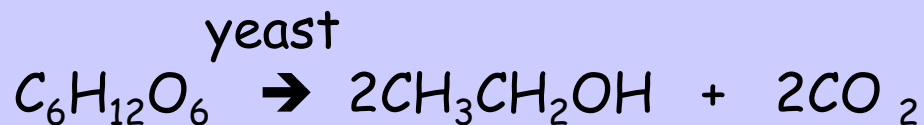
Ethene is an important chemical, it is a **feedstock** for many other chemicals. e.g. Polythene, antifreeze, P.V.C., and polystyrene.



Ethanol C_2H_5OH

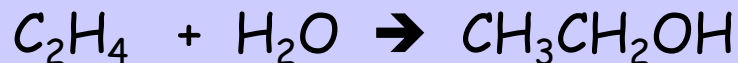
Industrial manufacture of Ethanol

- 1. Fermentation** Fermentation is used to make all alcohol based drinks. Any vegetable matter containing carbohydrates can be used.



Ethanol produced this way, only makes up 15% of the fermenting Mixture. So the mixture needs distilling.

- 2. Hydration of Ethene with steam**



Reaction Conditions:

300°C , High pressure 60 Atmospheres, phosphoric acid catalyst.

Ethene comes from the cracking of fractions from crude oil. This is a relatively cheap process to make ethene. (but more expensive than making petrol)



Uses of Ethanol

Drinks

Ethanol is a natural product of fermentation. Ethanol cannot be more than 15% of the fermentation mixture, as ethanol is a poison and will kill the yeast. In the UK 8 g of ethanol is 1 UNIT.

Solvent

In varnishes (as it evaporates easily), dyes, perfumes and drugs.

Chemical feedstock

In the production of vinegar, ether, chloroform and ethyl esters and ethene.

Fuel

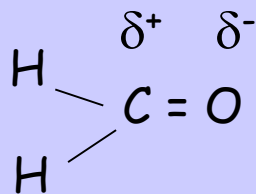
Increasingly seen as an important fuel. Meths is ethanol with added methanol. Cars can use ethanol as a fuel.

Others

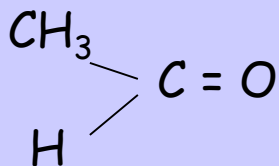
In thermometers (cheaper and safer than Hg) and de-icers.



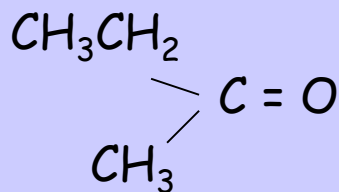
Aldehydes and Ketones



Methanal, 40% in water is formalin, and is used to make polymers

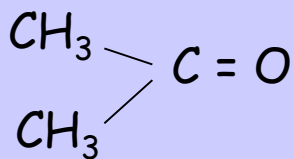


Ethanal, It's trimer $(\text{CH}_3\text{CHO})_3$ is used as a sleep inducing drug. It also causes a hangover



Butanone, is a solvent used to make VHS tapes.

Butan-2-one $\text{C}_4\text{H}_8\text{O}$



Propanone, nail varnish remover and is used in the making of perspex



Aldehydes and Ketones

Distinguishing tests (Using mild oxidising agents.)

Aldehydes are **oxidised to** carboxylic acids

Ketones **do not react** with mild oxidising agents

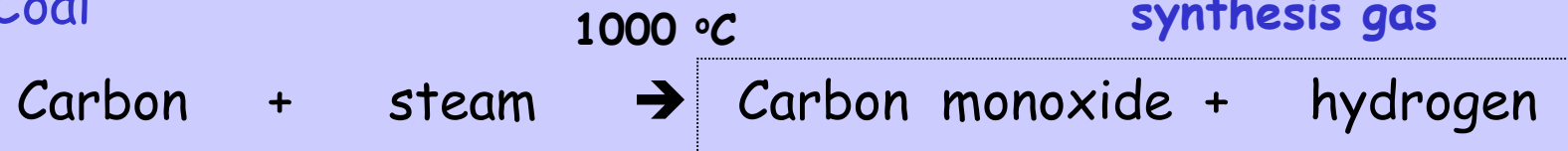
1. **Fehlings** solution contains Cu^{2+} ions (blue) which form Cu^+ ion (orange-red) in the presence of aldehydes.
2. **Tollen's** reagent contains Ag^+ ions, which form Ag in the presence of aldehydes (silver mirror test)
3. **Acidified Potassium Dichromate** orange $\text{Cr}_2\text{O}_7^{2-}(\text{aq})$ to green $\text{Cr}^{3+}(\text{aq})$



Methanol, Steam Reforming

The steam used must be pure.

1. Coal



2. Natural Gas (UK)



Methanol is oxidised into **methanal**, either by:

1. Zinc/Chromium oxide catalysts 350-450°C and 200-300 Atm.
2. Cu/Zn/Al oxide catalysts 175-300°C and 40-100 Atm.



Uses for Methanol and Methanal, both important feedstocks

Methanol

Methanal

Fuel

Added to ethanol to make meths, cleaner flame than hydrocarbons.

Added to petrol octane number 114. MTBE (Methyl Tertiary Butyl Ester)

Can be converted into petrol using Zeolite.

Drugs and Fabrics

Formalin,

preserve biological specimens

Polymers

Polymethanal, machine parts

Melamine, Electrical insulators

Phenol methanal, heat resistant and **all of the above** are thermosetting plastics.



How to work out a unit!

Country	1 Unit of ethanol	Men units /week	Women units /week
Australia	10 g	28	14
France	12 g beer 8 g wine	140 g	140 g
Ireland	8 g	21	14
Italy	12 g	24-36	12-24
Portugal	14 g	28-42	14-28
UK	8 g	21	14
US	14 g	14	7
Norway	Situational	Abstinence	

$$\text{The number of units} = \frac{\text{Volume of drink (ml)} \times \% \text{ alcohol}}{1000}$$

