

Chemistry C10 - Organic Reactions

You must know how to balance equations for the reactions of alkenes and the combustion of alcohol, but no other reactions in this series.

| | Alkene | Alcohol | Carboxylic acid | Ester |
|---------------------|-------------|------------------|---------------------------------|-------------------------------|
| General formula | C_nH_{2n} | $C_nH_{2n+1}OH$ | $C_nH_{2n-1}OOH$ (not required) | $C_nH_{2n}O_2$ (not required) |
| Functional group | C=C | -OH | -COOH | -COO- |
| Example formula | C_3H_6 | $CH_3CH_2CH_2OH$ | CH_3CH_2COOH | $CH_3COOCH_2CH_3$ |
| Name of example | Propene | Propanol | Propanoic acid | Ethyl ethanoate |
| Solubility in water | Not soluble | Very soluble | Very soluble | Not soluble |

Reaction of alkenes

Alkenes are described as "unsaturated". This means they have room to add two more atoms because they have a double bond **and** two fewer hydrogen atoms than the alkane with the same number of carbon atoms.

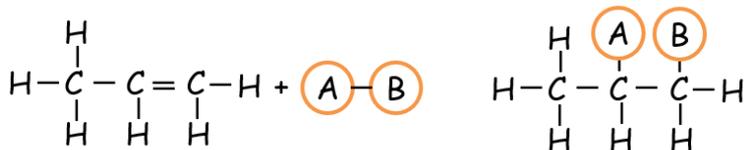
Combustion: (reaction with oxygen by burning). Compared to an alkane, alkenes are not as good fuels as they undergo **incomplete** combustion:

- Releases less energy
- Produce a smokier and orange flame

Addition of hydrogen H_2 needs a catalyst and heat about 300 °C. It produces an alkane.

Addition of a halogen Cl_2 or Br_2 or I_2 react easily at room temperature. Both atoms of the halogen add to the double bond. This is the TEST for an alkene - reacting bromine water (orange colour) with an alkene will form a colourless product.

Addition of steam H_2O needs a catalyst and heat. It produces an alcohol because an OH adds to one of the carbon atoms, and H adds to the other. This reaction is reversible \rightleftharpoons



For hydrogen A=H and B=H, for bromine A=Br and B=Br. For water A=OH B=H and the reaction arrow must be a reversible arrow!

Uses: Alkenes are turned into polymers, plastics, medicines and make-up

Formation and Reaction of alcohols

Two ways of making alcohols:

1. from alkenes which come from crude oil. (Non-renewable)
2. from fermentation of sugar. (Renewable)



Conditions: warm (25 - 30°C) and NO oxygen allowed (anaerobic) - the yeast will die when too much alcohol is made (about 15 %). A limewater test will find this happens by detecting if CO_2 is still being produced.

Sodium will react with alcohol just like it does with water. The Na replaces the H on the oxygen atom, forming hydrogen gas (H_2) and $-O^-Na^+$

Combustion of alcohol: Alcohols burn with a smokeless blue flame, the O atom in the alcohol means it burns with complete combustion.

Oxidation of alcohol: This turns the alcohol into a carboxylic acid. A reagent called potassium dichromate is used. Adding oxygen is shown by an O atom in square brackets [O]. Colour change orange to green.

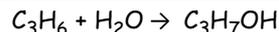
Uses: Alcohols are used as solvents (they dissolve substances and can also mix well with water) and are used in perfumes and hand sanitisers.

Reaction of alcohol with carboxylic acids: This forms an ester.
 $\text{carboxylic acid} + \text{alcohol} \rightleftharpoons \text{ester} + \text{water}$

pH of carboxylic acids - weak acids [higher content only]

Carboxylic acids will fizz gently with carbonates (e.g. $CaCO_3$). They have a pH of 4 to 5, meaning they are weak acids. (A weak acid is only partially ionised, whereas a strong acid is completely ionised).

Addition of steam to an alkene



Combustion example : Alcohol

