

Chapter 10: Organic reactions

Knowledge organiser

Organic chemistry

There are lots of different 'families' of carbon-containing compounds, for example, alkanes and **alkenes**. These families are called a **homologous series**. Each compound within a homologous series has similar properties and reactions. They all contain specific atoms in specific orders, called the **functional group**.

Homologous series	Functional group	First four of homologous series	Formation	Uses	Combustion reaction	Other reactions	Other information
alkenes		 	cracking	<ul style="list-style-type: none"> formation of polymers a chemical feedstock 	<ul style="list-style-type: none"> complete combustion produces carbon dioxide and water incomplete combustion more likely, resulting in a smoky yellow flame both types of alkene combustion release less energy per mole than alkanes 	<p>Addition with halogens The two atoms from the halogen molecule are <i>added</i> across the carbon-carbon double bond.</p> $C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$ <p>Addition with hydrogen The two atoms from the hydrogen molecule are <i>added</i> across the carbon-carbon double bond to form an alkane.</p> $C_2H_4 + H_2 \rightarrow C_2H_6$ <p>Addition with steam React with steam at high temperature and pressure in the presence of a catalyst to form alcohols.</p> $C_2H_4 + H_2O \rightarrow C_2H_5OH$	Alkenes are called unsaturated because they have double bonds. As such, atoms can be added to the molecule by breaking the double bond. This contrasts with alkanes which are called saturated as there is no space to add more atoms. Alkenes have a general formula C_nH_{2n} .
alcohols	-OH	 	Ethanol can be formed from the fermentation of sugar – warm a sealed mixture of yeast and a sugar solution. glucose \rightarrow ethanol + carbon dioxide $C_6H_{12}O_6(aq) \rightarrow 2C_2H_5OH(aq) + 2CO_2(g)$	<ul style="list-style-type: none"> <i>ethanol</i> is used in alcoholic drinks first four alcohols mix easily with water, so are used as solvents for substances that don't dissolve in water common in perfumes, aftershaves and mouthwashes 	<ul style="list-style-type: none"> short alcohols are very effective fuels and combust easily, burning with a blue flame and producing carbon dioxide and water $2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$	<p>Reaction with sodium Alcohols react with sodium to release hydrogen. The product from this reaction is called an alkoxide, which if added to water forms a strongly alkaline solution.</p> <p>Oxidation Alcohols can react with oxidising agents, like potassium dichromate, to form carboxylic acids.</p>	Alcohols are highly flammable and must not be handled near naked flames.
carboxylic acids		 	oxidation of alcohols	<ul style="list-style-type: none"> ethanoic acid is used in vinegar 	<ul style="list-style-type: none"> carboxylic acids can undergo combustion, but we do not generally do this or use them as a fuel 	<p>Carboxylic acids react in the same way as other acids.</p> <p>Reaction with sodium carbonate Carboxylic acids react with bases to form salts. For example, carboxylic acids react with a metal carbonate to produce a salt, carbon dioxide, and water.</p> <p>Reaction with alcohols Carboxylic acids react with alcohols to make water and esters. The reaction requires sulfuric acid as a catalyst.</p> <p>Esters have distinctive smells and are used in perfumes and flavourings. The product of ethanol and ethanoic acid is ethyl ethanoate.</p>	(HT only) When added to water, carboxylic acids are partially ionised to form weakly acidic solutions. They are weak acids.



Key terms

Make sure you can write a definition for these key terms.

addition reaction alcohols alkene alkoxide carboxylic acid ester fermentation cracking functional group homologous series oxidation oxidising agent saturated unsaturated

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Retrieval questions

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

C10 questions

Answers

1	What is a homologous series?	Put paper here	a group of compounds with the same functional group
2	What is a functional group?	Put paper here	a group of atoms that determines the properties of a compound
3	What are alkenes?	Put paper here	a homologous series with a double carbon-carbon bond
4	What is the general formula for alkenes?	Put paper here	C_nH_{2n}
5	What is the product from an addition reaction of an alkene with a halogen?	Put paper here	a haloalkane
6	What is the product from the addition reaction of an alkene with hydrogen?	Put paper here	an alkane
7	What conditions are required for the addition reaction of an alkene with steam?	Put paper here	high temperature, high pressure, and a catalyst
8	What are alcohols?	Put paper here	a homologous series with an -OH group
9	How are alcohols produced?	Put paper here	steam with an alkene or fermentation
10	What conditions are required to produce alcohols by fermenting?	Put paper here	sugar solution with yeast mixed in, warm, sealed vessel
11	Name the first four alcohols.	Put paper here	methanol, ethanol, propanol, butanol
12	What are the products of a reaction between an alcohol and sodium?	Put paper here	hydrogen and an alkoxide
13	What is the organic product formed by the oxidation of an alcohol?	Put paper here	carboxylic acid
14	Name an oxidising agent.	Put paper here	acidified potassium dichromate
15	What are carboxylic acids?	Put paper here	a homologous series with a -COOH group
16	What do carboxylic acids form when they react with sodium carbonate?	Put paper here	salt, carbon dioxide, water
17	How are carboxylic acids produced?	Put paper here	oxidation of alcohols
18	Name the first four carboxylic acids.	Put paper here	methanoic acid, ethanoic acid, propanoic acid, butanoic acid
19	What is the organic product of a reaction between a carboxylic acid and an alcohol?	Put paper here	an ester
20	What catalyst is normally used in the formation of esters?	Put paper here	concentrated sulfuric acid
21	What occurs when pure carboxylic acids are added to water?	Put paper here	a weak acid is formed