AQA GCSE Chemistry (Combined Science) Unit 7: Organic Chemistry Knowledge Organiser

Crude Oil

Hydrocarbons are compounds that are made up of the elements **hydrogen** and **carbon** only.

Crude oil is a **non-renewable resource**, **a fossil fuel**. Crude oil is made up of a mixture of compounds, most of which are long- and short-chain hydrocarbons.

Most of the compounds in crude oil are hydrocarbons called **alkanes**. The alkanes form a **homologous series**. This is a family of hydrocarbons that all share the **same general formula** and have **chemical properties** that are **similar**.

Alkanes are held together by **single bonds**.

The general formula for an alkane is C_nH_{2n+2}.

They differ from the neighbouring alkane with the addition of a CH_2.

Alkanes are **saturated hydrocarbons**. This means that all their bonds are taken up and they cannot bond to any more atoms.

Alkanes have **similar chemical properties** but have **different physical properties** due to differences in chain length. The longer the chain, the higher the boiling point of the hydrocarbon.

The first four alkanes are: methane, ethane, propane and butane.

A mnemonic to help you remember the order of the alkanes: **m**ice **e**at **p**aper **b**ags.

Fractional Distillation

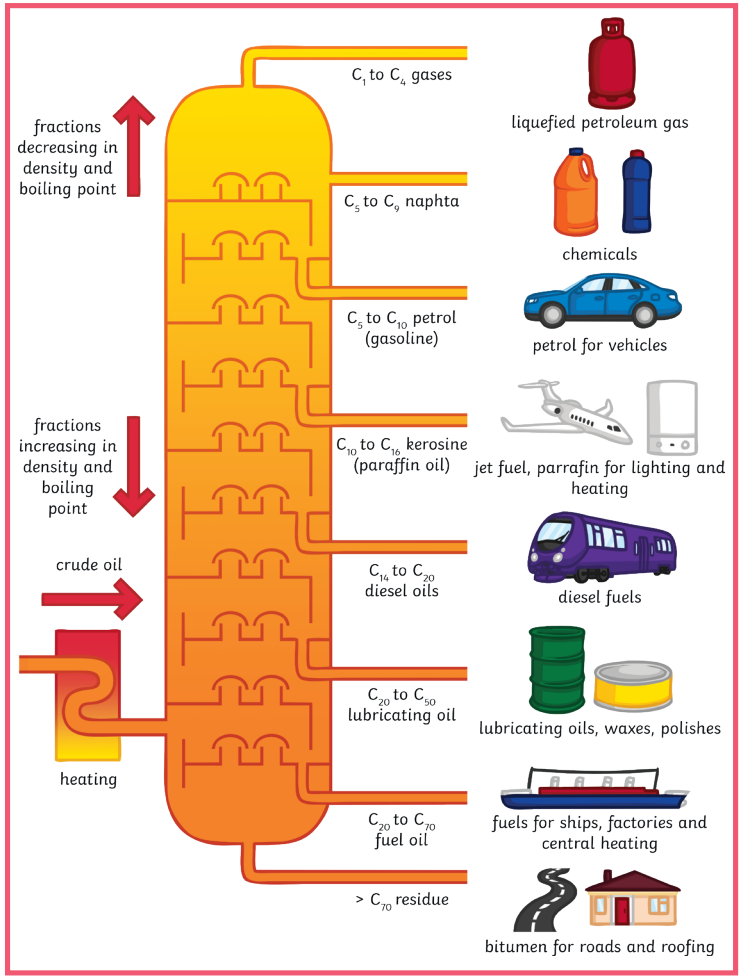
Fractional distillation is used to **separate** a mixture of long-chain hydrocarbons in crude oil into smaller, more useful fractions.

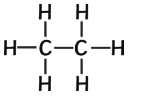
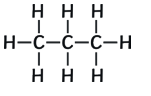
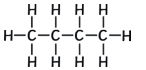
Hydrocarbons have different boiling points depending on their chain length. **Each fraction contains hydrocarbons of a similar chain length**. These fractions will boil at different temperatures due to the difference in sizes of the molecules. The different parts of crude oil are called fractions because they are a small part of the original mixture.

Crude oil is heated and enters at all column called a **fractioning column**. The column is **hot at the bottom** and decreases in temperature toward the top. As the crude oil is heated, it begins to evaporate and its vapours begin to rise up through the column. These vapours condense at the different fractions.

Short-chain hydrocarbons are found at the **top** of the column. This is because shorter chain molecules are held together by **weak intermolecular forces** resulting in low boiling points. These shorter chain hydrocarbons leave the column as gas.

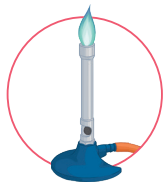
Long-chain hydrocarbons are found at the bottom of the column and are held together by **strong intermolecular forces**, resulting in high boiling points.



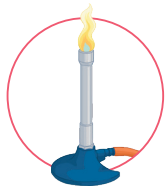
Name of Alkane	Structural Formula	Molecular Formula
methane		CH_4
ethane		C_2H_6
propane		C_3H_8
butane		C_4H_{10}

Combustion

Complete combustion occurs when there is **enough oxygen** for a fuel to burn. A hydrocarbon will react with oxygen to produce carbon dioxide and water.



Incomplete combustion occurs when there **isn't enough oxygen** for a fuel to burn. The products in this reaction are water and poisonous **carbon monoxide**.



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Cracking

Cracking is an example of a **thermal decomposition reaction. Long-chain** hydrocarbons can be **broken** down into **shorter**, more useful hydrocarbon chains.

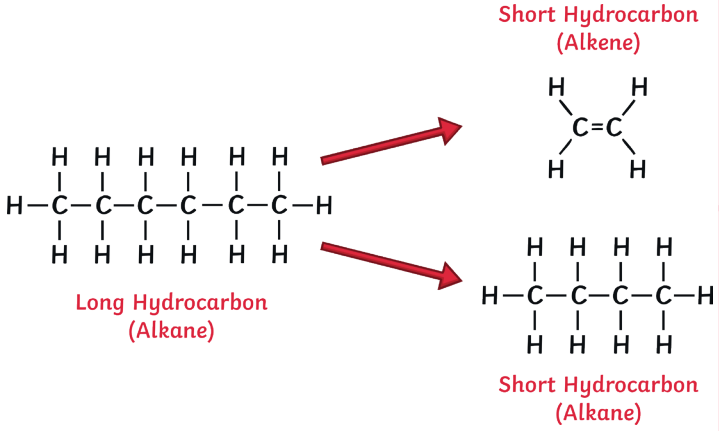
Cracking can be carried out with a catalyst in **catalytic cracking** or with steam in **steam cracking**.

Catalytic cracking involves heating a hydrocarbon to a high temperature (550°C) and passing over a hot catalyst.

Cracking of a long-chain hydrocarbon **produces** a **short-chain alkane** and an **alkene**.

Alkenes are another type of hydrocarbon that is double bonded. The general formula for an alkene is C_nH_{2n}.

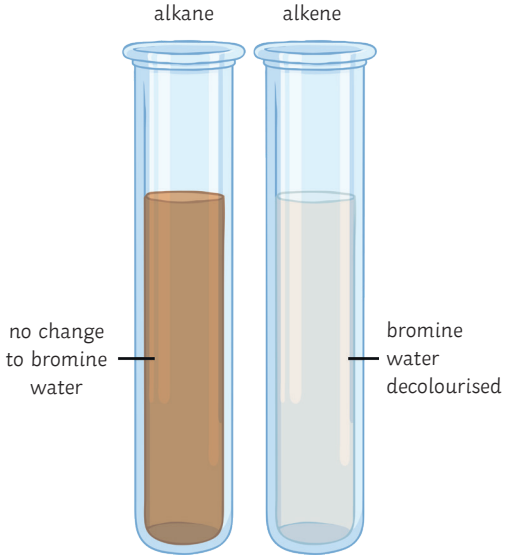
Alkenes are **unsaturated hydrocarbons**. In a chemical reaction, the double bond of the alkenes can break. This allows other atoms to bond to it.



Test for Alkanes

Bromine, when added to an **alkane**, will **remain brown/orange**. Alkanes are saturated hydrocarbons, they have no double bonds which could be broken to accept the bromine molecule and so remain orange.

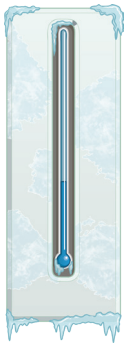
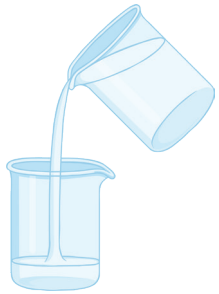
Bromine, when added to an **alkene**, will **change from brown/orange to colourless**. This is because alkenes are unsaturated hydrocarbons. The double bond breaks and the bromine molecule is accepted.



Making Polymers

The fractional distillation of crude oil and cracking produces an array of hydrocarbons that are key to our everyday lives.

Alkenes are used to produce plastics such as poly(ethene) which is used to make plastic bags, drinks bottles and dustbins. Poly(propene), another polymer, forms very strong, tough plastic.

Short-Chain Molecules	Increasing Chain Length	Long-Chain Molecules
	As chain length increases, the **boiling point** of the hydrocarbon chains also increases.	
thin 	**Viscosity** describes how easily a substance can flow e.g. treacle is very viscous; it is thick.	thick 
	**Flammability** is a measure of how easily a substance burns.