

ORGANIC CHEMISTRY

Key GCSE ideas

Revise the following GCSE topics:

- *Crude Oil*
- *Organic Chemistry including the instrumental methods of analysis*

Introduction

Organic Chemistry is the Chemistry of carbon compounds, an incredible range of compounds that outnumbers those of all other elements put together.

Organic chemicals mould our modern-day lives, finding use in fuels, plastics, pharmaceuticals, clothing – the list is almost endless.

The Organic Chemistry studies the structure, properties, composition, reactions and preparation of carbon-containing compounds. The vast majority of the organic materials are produced from fractions of crude oil.

Crude Oil

Crude oil is a type of **fossil fuel**. Fossil fuels are made from remains of sea creatures which died and fossilised millions of years ago. Other fossil fuels include: natural gas and coal.

Drilling for crude oil causes some environmental issues such as oil spills and destruction of marine habitats.

We use crude oil to make fuels.

Crude oil also acts as feedstock for chemical industry. (Feedstock – chemicals used to make other chemicals) Example: naphtha fraction is used to make plastics.

Crude oil is a finite resource. It is used faster than it is being made so we will run out of it in the future.

Hydrocarbons

Crude oil is a mixture of hydrocarbons.

Key definitions:

Hydrocarbon – compound/molecule made of C and H atoms only

Alkane – saturated hydrocarbon

Saturated hydrocarbon – contains maximum number of H atoms per molecule, structurally, it contains C-C single covalent bonds only

General formula of alkanes: C_nH_{2n+2}

Examples of alkanes to remember:

Number of C-atoms	Name	Molecular formula	Displayed formula
1	methane	CH ₄	<pre> H H - C - H H </pre>
2	ethane	C ₂ H ₆	<pre> H H H - C - C - H H H </pre>
3	propane	C ₃ H ₈	<pre> H H H H - C - C - C - H H H H </pre>
4	butane	C ₄ H ₁₀	<pre> H H H H H - C - C - C - C - H H H H H </pre>

Physical properties of hydrocarbons depend on the size of their molecules. The **larger** the molecule of a hydrocarbon:

- The **lower** the flammability
- The **higher** the boiling point
- The **higher** the viscosity
- The **lower** the volatility

Viscosity = how thick a substance is

Volatility = how easily it evaporates below its boiling point

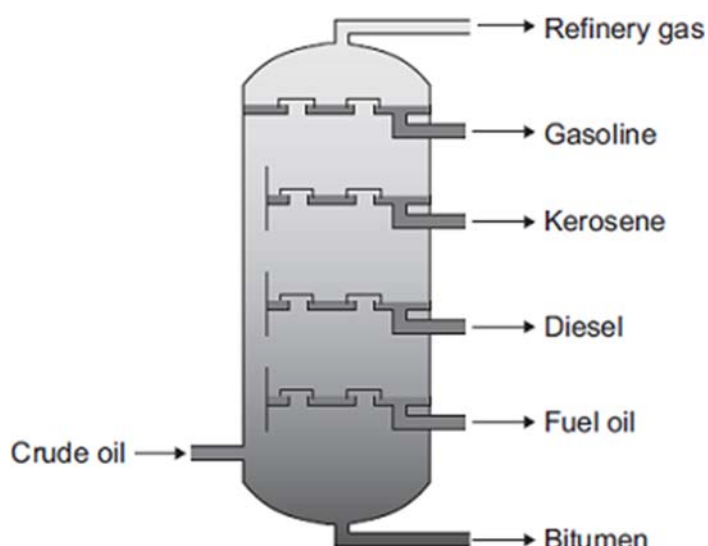
Crude oil can be separated into **fractions** using the process called **fractional distillation**.

Fraction – a group of hydrocarbons of similar size and similar boiling point

Fractions have different uses:

Fraction arranged in order of the molecular size (smallest at the top)	Use
Refinery gases	Fuels, LPG
Gasoline / Petrol	Fuel for cars
Naphtha	Fraction used in cracking and polymerisation (formation of polymers or plastics)
Diesel	Fuel for cars and lorries
Fuel oil	Fuel used in power stations and domestic boilers
Bitumen	Fraction used to make asphalt (component of road tarmac)

Fractional distillation of crude oil:



Crude oil is heated until fractions boil off or vaporise. The fractionating tower is hot at the bottom and cool at the top.

Fractions have different boiling points. The larger the molecules the higher the boiling point and the **lower down** it condenses.

Refinery gases contains the smallest molecules and it does not condense.

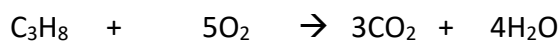
Bitumen contains the largest molecules and it does not boil off.

Combustion of hydrocarbons:

Many hydrocarbons are burned as fuels to release heat energy. There are two products of **complete combustion** of hydrocarbons: carbon dioxide and water

Example:

methane + oxygen → carbon dioxide + water



Carbon dioxide released on combustion of hydrocarbons causes global warming.

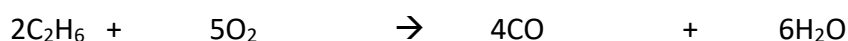
Incomplete combustion of hydrocarbons happens when the supplies of oxygen are not sufficient.

Products of incomplete combustion include: carbon monoxide and carbon particulates.

Carbon monoxide, CO is toxic.

Carbon particulates cause global dimming and respiratory problems.

Examples of equations for incomplete combustion of hydrocarbons:



Unsaturated hydrocarbons

Unsaturated hydrocarbons contain fewer than the maximum number of H atoms per molecule.

Alkenes are an example of unsaturated hydrocarbons. Their general formula is C_nH_{2n}

They contain C = C double bond in their structure.

