

## Chemistry C9 - Crude Oil and Fuels

**Crude oil** is a finite (non-renewable) resource formed over millions of years. Crude oil is formed from the remains of sea life, mainly plankton, that were buried in mud and layers upon layers of rock, which created high temperatures and pressure.

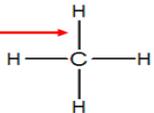
Crude oil is made up of a mixture of **hydrocarbons**.

Hydrocarbons are compounds that contain the elements **hydrogen** and **carbon ONLY**.

**Alkanes** are a type of hydrocarbon that contain single bonds only. Because of this, we say they are **saturated**.

### Methane (the simplest alkane)

Single covalent bonds

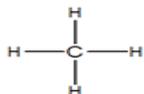


Displayed formula

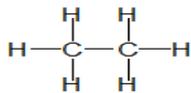


General formula for an alkane =  $\text{C}_n\text{H}_{2n+2}$

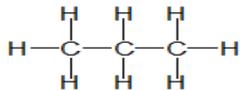
You need to know the names of the 4 simplest alkanes, as well as their displayed and molecular formulas.



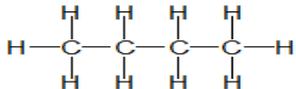
Methane,  $\text{CH}_4$



Ethane,  $\text{C}_2\text{H}_6$



Propane,  $\text{C}_3\text{H}_8$



Butane,  $\text{C}_4\text{H}_{10}$

An acronym to help remember the names from smallest to largest is:

Monkeys Eat Peanut Butter

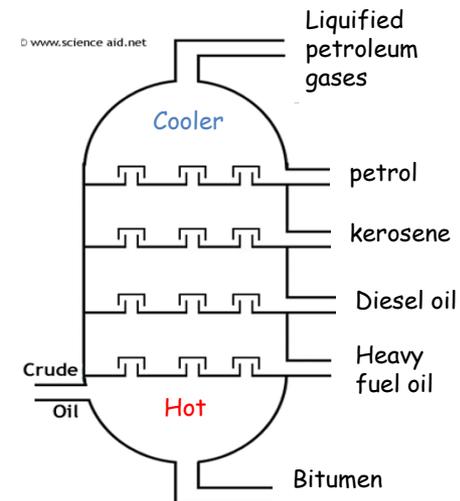
### Fractional Distillation

Crude oil is separated into **fractions** in a process called fractional distillation. Fractions are hydrocarbons with similar chain lengths (similar numbers of carbon atoms).

Crude oil is firstly **vaporised** before it goes into a **fractionating column**. The column is very hot at the bottom and gets cooler towards the top, creating a **temperature gradient**.

Short chain hydrocarbons have low boiling points and will condense only at cooler temperatures near the top of the column. Long chains have high boiling points so will condense near the bottom of the column.

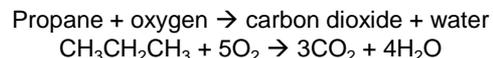
The different fractions are collected as liquids at different levels shown on the right.



	Molecular mass	Strength of intermolecular forces	Boiling point	Flammability (how easily it burns)	Viscosity (how thick it is)
Short chains	Low	Low	Low	High	Low
Long chains	High	High	High	Low	High

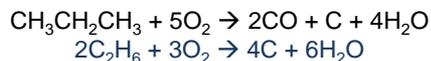
### Burning hydrocarbons: complete combustion

When fuels burn in plenty of oxygen, **complete combustion** occurs. The products are always **carbon dioxide** and **water**.



### Burning hydrocarbons: incomplete combustion

When fuels burn without enough oxygen present, **incomplete combustion** occurs. The products are water with **carbon monoxide** and/or **carbon**.



### Tests:

Carbon dioxide will turn lime water cloudy.  
 Water will turn blue cobalt chloride paper pink.  
Alkenes will decolourise orange bromine water.  
 (With alkanes bromine water will stay orange.)

### Cracking Hydrocarbons

Long chain hydrocarbons are split into shorter, more useful chain lengths in a process called cracking.

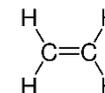
When we crack a hydrocarbon we produce an **alkane** and an **alkene**.



**Note:** The number of Hs and Cs on the left hand side is the **same** as on the right hand side.

There are two types of cracking.

- 1) **Catalytic** (high temperature + catalyst)
- 2) **Steam cracking** (Very high temperature + steam)



**Alkenes** are **unsaturated** hydrocarbons that contain a double carbon bond.

General formula for an alkane =  $\text{C}_n\text{H}_{2n}$