Crude Oil

Crude oils is a mixture of chemicals called hydrocarbons. These are chemicals that contain **hydrogen and carbon only. It made from ancient biomass, mainly plankton.** Crude oil straight out of the ground is not much use, as there are too many substances in it, all with **different boiling points**.

Before we can use crude oil we have to separate it into its different substances. We do this by fractional distillation.

<u>How does fractional distillation work?</u>

- Crude oil is heated and vaporises/boils.
- Vapours rise up the column, gradually cooling and condensing.
- Hydrocarbons with different size molecules condense at different levels/temperatures
- The crude oil is separated into a series of fractions with similar numbers of carbon atoms and boiling points. These are called fractions.

As the number of carbon atoms increases:

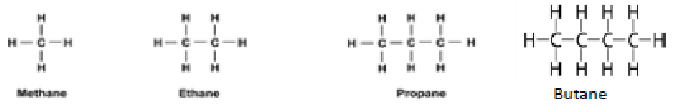
- Molecules become larger and heavier
- Boiling point increases
- Flammability decreases (catches fire less easily)
- Viscosity increases (liquid becomes thicker)

Alkanes

Crude oil is largely made up of a family of hydrocarbons called alkanes; these contain only a single (covalent) carbon to carbon bond.
You can either represent alkanes with a **molecular formula**, e.g.:

CH_4	C_2H_6	C_3H_8	C_4H_{10}
Methane	Ethane	Propane	Butane

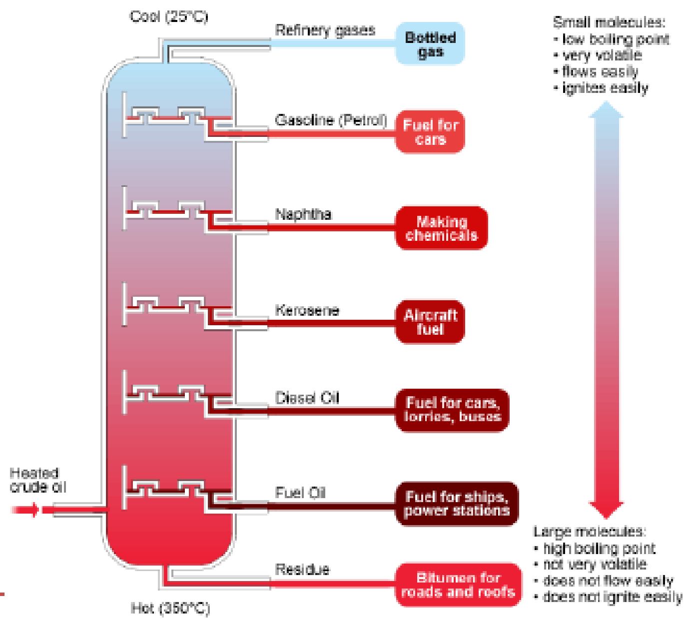
Or a **displayed formula**:



[H = Hydrogen, C = Carbon, - indicates a chemical bond between atoms]

Fractional Distillation Column

Below is a diagram of a fractionating column; you need to know the uses but not the names of each fraction:



Cracking

Smaller hydrocarbons make better fuels as they are easier to ignite. However, crude oil contains a lot of longer chain hydrocarbons. To break a longer chain hydrocarbon down into a smaller one we use a process known as **cracking**.

<u>Cracking</u>

So large/long alkanes get CRACKED, which means they get broken in two.
- They are heated, turned into a vapour and passed over a hot catalyst
- Cracking produces two molecules:

1. One shorter (useful as a fuel) alkane
2. One alkene (used to make polymers).

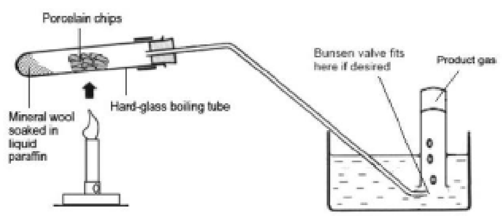
<u>Summary</u>

Long Chain Alkane → Short Chain Alkane + Alkene

$C_{10}H_{22} \rightarrow C_8H_{18} + C_2H_4$

Cracking

Experimental set up for cracking:

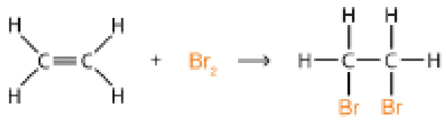


Alkenes

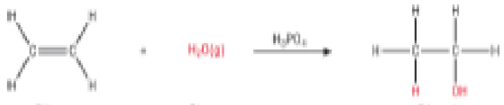
These hydrocarbons have at least one double bonds between the carbon atom. The general formula for alkenes is C_nH_{2n}
Alkenes are more reactive than alkanes. They react with <u>bromine water</u> and make it go from orange to colourless.
Alkanes do not have a double bond so the bromine water stays orange.

Alkenes

Alkenes undergo **addition** reactions, this is where another element or compound is added across the double bond.
Below is an example of bromine being added across a double bond:



Bromine could be replaced in this equation with another halogen, hydrogen or water. The same type of reaction would take place, however the products formed would be different. For example, the reaction of ethene with water.



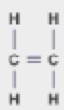
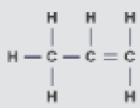
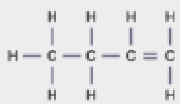
Reagent	Conditions	Product
Hydrogen	Nickel catalyst, 60ºC.	Alkane
Water	Steam, high temperature, high pressure. Phosphoric acid catalyst	Alcohol
Halogen	Halogens in solution for example bromine water	Haloalkane

Alkenes

A second family of hydrocarbons is alkanes; these contain at least one double (covalent) carbon to carbon bond. The general formula for alkenes is C_nH_{2n}
Alkenes are **unsaturated** as there is room for 2 more hydrogens around some of the carbons. You need to know the names and structures of the first 4 alkenes.
You can either represent alkanes with a **molecular formula**, e.g.:

C_2H_4	C_3H_6	C_4H_8	C_5H_{10}
Ethene	Propene	Butene	Propene

Or a **displayed (structural) formula**:

Name	Molecular formula	Full structural formula
Ethene	C_2H_4	
Propene	C_3H_6	
Butene	C_4H_8	
Pentene	C_5H_{10}