Chemistry Knowledge Organiser
C9 - Crude oil and fuels

Key Terms	Definitions
Hydrocarbon	A compound which contains only hydrogen and carbon (covalently bonded)
Fractional Distillation	The process where crude oil is separated into different compounds through evaporation
Viscosity	The ability of a liquid to flow

Neutralisation Reaction

When a salt is made in a neutralisation reaction, it will either be **soluble** or **insoluble**. For example, sulphuric acid can be neutralised with copper oxide to make copper sulphate and water. The **copper sulphate is soluble in water.**

The steps outlined below can be used to make copper sulphate:

1. Add several spatulas of copper oxide to sulphuric acid in a **conical flask**
2. Stir until all the sulphuric acid has reacted
3. Filter off any excess copper oxide
4. Place solution in evaporating basin
5. Allow water to evaporate and blue crystals of copper oxide should be left

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.

How does fractional distillation work?

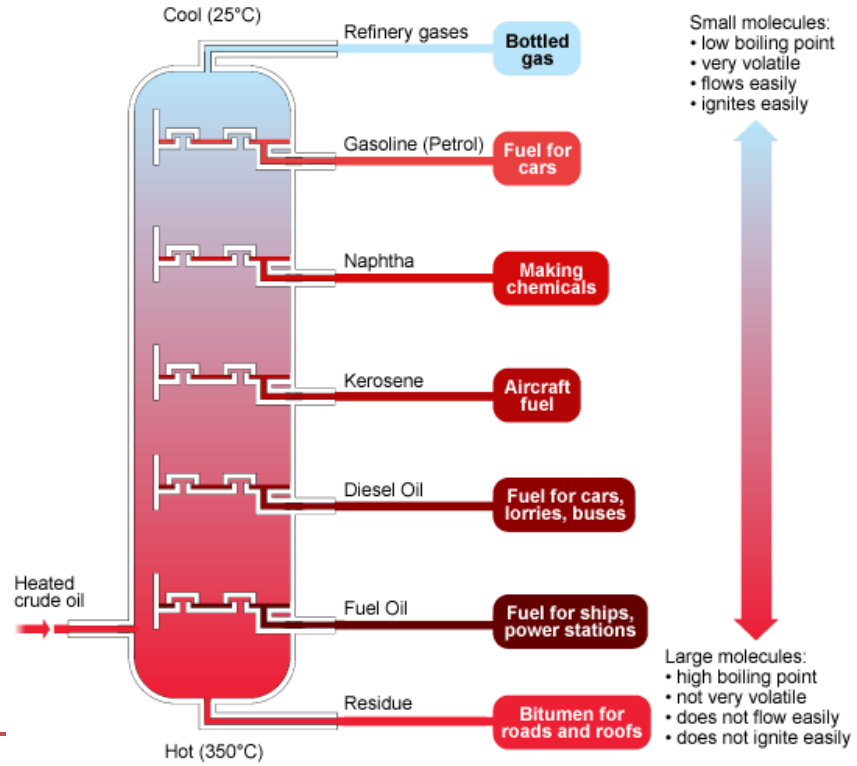
· Crude oil is heated and vaporises/boils.
· Vapours rise up the column, gradually cooling and condensing.
· Hydrocarbons with different size molecules condense at different levels/temperatures
· The crude oil is separated into a series of fractions with similar numbers of carbon atoms and boiling points.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

Fractional Distillation Column

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



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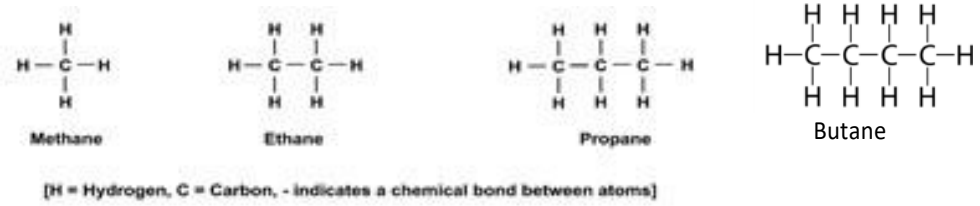
Key Terms	Definitions
Alkane	A hydrocarbon that contains only carbon to carbon single bonds
Cracking	A process where longer chain hydrocarbons are broken down into smaller more useful ones.
Alkene	A hydrocarbon that contains at least one carbon to carbon double bond.

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]

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.**

Cracking

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).

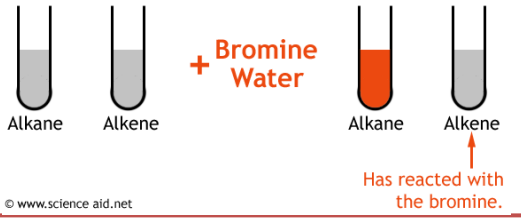
Summary

Long Chain Alkane → Short Chain Alkane + Alkene

$C_{10}H_{22}$ → C_8H_{18} + C_2H_4

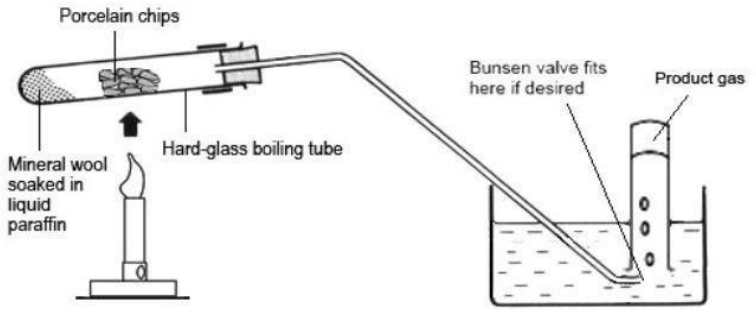
Alkenes

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



Cracking

Experimental set up for cracking:



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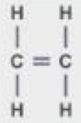
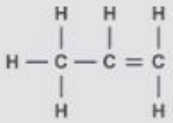
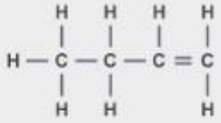
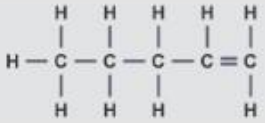
Alkenes

A second family of hydrocarbons is alkanes; these contain at least one double (covalent) carbon to carbon bond. The general formula for alkenes is $\mathbf{C_nH_{2n}}$

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}	

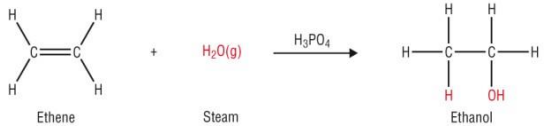
Key Terms	Definitions
Alkene	A hydrocarbon that contains at least one carbon to carbon double bond.
Unsaturated	A compound that contains at least one carbon to carbon double bond. An alkene is an example of something that is unsaturated.
Addition Reaction	A chemical reaction where an element or compound is added across a a double bond.

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

TESTING FOR COMMON GASES

	Test	Result
O_2	glowing splint	re-lights
H_2	burning splint	squeaky pop
CO_2	bubble through limewater	limewater goes cloudy
Cl_2	damp litmus paper	bleached