# 7) Organic

## Crude oil

•Crude oil is a **finite** resource found in rocks.
•Crude oil is the remains of an ancient biomass consisting mainly of **plankton** that was buried **in mud**.
• Crude oil is a **mixture** of a very large number of compounds.
•Most of the compounds in crude oil are **hydrocarbons**, which are molecules made up of **hydrogen and carbon** atoms only.

## Fractional distillation

•The many hydrocarbons in crude oil may be separated into **fractions**, each of which contains molecules with a **similar number of carbon atoms**, by fractional distillation.
• The fractions can be processed to produce **fuels** and **feedstock** for the petrochemical industry.
• Many useful materials on which modern life depends are produced by the petrochemical industry, such as solvents, lubricants, polymers, detergents.

## Properties of hydrocarbons

•Some properties of hydrocarbons depend on the **size** of their molecules, including **boiling point**, **viscosity** and **flammability**.
•These properties influence how hydrocarbons are used as **fuels**.
•The combustion of hydrocarbon fuels releases **energy**.
• During combustion, the carbon and hydrogen in the fuels are oxidised.
•The **complete combustion** of a hydrocarbon produces **carbon dioxide and water.**

## Alkanes

• Most of the hydrocarbons in crude oil are hydrocarbons called **alkanes**.
•The general formula for the homologous series of alkanes is $C^nH_{2n+2}$.
•The first four members of the alkanes are methane, ethane, propane and butane.

## Cracking

•Hydrocarbons can be broken down (**cracked)** to produce **smaller**, more useful molecules.
•Cracking can be done by various methods including **catalytic cracking and steam cracking.**
The products of cracking include **alkanes** and another type of hydrocarbon called **alkenes.**

## Alkenes

•Alkenes are more reactive than alkanes and decolorise **bromine water**, which is used as a test for alkenes.
• There is a high demand for fuels with small molecules and so some of the products of cracking are useful as fuels.
•Alkenes are used to produce **polymers** and as starting materials for the production of many other chemicals.

## Triple only

### Alkenes

- Alkenes are hydrocarbons with a **double carbon-carbon** bond.
- The general formula for the homologous series of alkenes is $C_nH_{2n}$
- Alkene molecules are **unsaturated** because they contain two fewer hydrogen atoms than the alkane with the same number of carbon atoms.
- The first four members of the homologous series of alkenes are ethene, propene, butene and pentene.
- Alkenes are hydrocarbons with the functional group C=C.
- Alkenes react with oxygen in combustion reactions in the same way as other hydrocarbons, but they tend to burn in air with **smoky flames because of incomplete combustion**.
- Alkenes react with hydrogen, water and the halogens, by the addition of atoms across the carbon-carbon double bond so that the double bond becomes a single carbon-carbon bond.
- The addition of hydrogen to an alkene (unsaturated) takes place in the presence of a catalyst to produce the corresponding alkane (saturated).
- The addition of water to an alkene takes place by reaction with **steam** in the presence of a **catalyst** to produce an **alcohol**.
- Addition of a halogen to an alkene produces a saturated compound with two halogen atoms in the molecule.

### Alcohols

- Alcohols contain the functional group –**OH**.
- Methanol, ethanol, propanol and butanol are the first four members of a homologous series of alcohols.
- Aqueous solutions of ethanol are produced when sugar solutions are fermented using **yeast**.

Alcohols react by:

- dissolving in **water** to form a **neutral solution**
- reacting with **sodium** to produce **hydrogen**
- burning in air
- **oxidising** to produce **carboxylic acids**
- use as **fuels** and solvents.

### Carboxylic acids

- Carboxylic acids have the functional group –**COOH**.
- The first four members of a homologous series of carboxylic acids are methanoic acid, ethanoic acid, propanoic acid and butanoic acid.
- Carboxylic acids react by:
- dissolving in **water** to produce **acidic solutions**
- reacting with **carbonates** to produce **carbon dioxide**
- not ionising completely when dissolved in water (they are **weak acids**)
- reacting with **alcohols** in the presence of an **acid catalyst** to produce **esters**, for example ethanoic acid reacts with ethanol to produce ethyl ethanoate and water.

## Triple only

**Addition polymers**

•**Alkenes** can be used to make **polymers** such as poly(ethene) and poly(propene) by addition polymerisation.

• In addition polymerisation reactions many small molecules (**monomers)** join together to form very large molecules **(polymers)**.

•In addition polymers the repeating unit has the same atoms as the monomer because **no other molecule is formed in the reaction**.

**DNA**

•DNA **(deoxyribonucleic acid**) is a large molecule essential for life. DNA encodes **genetic** instructions for the development and functioning of living organisms and viruses.

•Most DNA molecules are **two polymer chains**, made from four different monomers called **nucleotides**, in the form of **a double helix**.

•Other naturally occurring polymers important for life include **proteins, starch and cellulose**.

**Amino acids (HT ONLY)**

•Amino acids have **two different functional groups** in a molecule. Amino acids react by **condensation polymerisation** to produce **polypeptides**.

• Different amino acids can be combined in the same chain to produce **proteins**.

**Condensation polymers (HT ONLY)**

•Condensation polymerisation involves monomers with **two functional groups**. When these types of monomers react they join together, usually **losing small molecules** such as **water**, and so the reactions are called condensation reactions.

•The simplest polymers are produced from two different monomers with two of the same functional groups on each monomer. For example polyester.

**Definitions**

**Monomer** - small molecules that join together to make a polymer

**Polymer** - a long chain formed form many repeating units (monomers)

**Condensation polymerisation** – When monomers with 2 functional groups combine with the elimination of a small molecule.

**Addition polymerisation** – When monomers combine without generating another unit through their double (or triple) bonds.

**Functional group** – specific grouping in a molecule that are responsible for the chemical reactions.

**Unsaturated** – molecules with carbon–carbon double or triple bonds and therefore not containing the greatest possible number of hydrogen atoms.

**Incomplete combustion** - when the supply of air or oxygen is poor. Water is still produced, but carbon monoxide and carbon are produced instead of carbon dioxide.

**Complete combustion-** when there is a good supply of air. Carbon and hydrogen atoms in the hydrocarbon fuel react with oxygen in an exothermic reaction: carbon dioxide and water are produced. energy is given out.

**Acid -** produce hydrogen ions ($H^+$) in aqueous solutions.