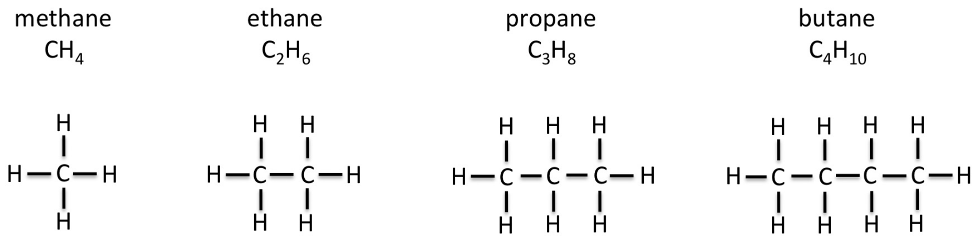
Hydrocarbons:

Compound contains carbon & hydrogen atoms ONLY

Alkanes:

Part of homologous series (react similarly)
Saturated compounds = each carbon forms 4 covalent bonds

**Alkanes $C_nH_{2n+2}$**




Chains:

Shorter chain = low viscosity, more volatile (lower bp), more flammable (can ignite)

Complete combustion of hydrocarbons:

Hydrocarbon + Oxygen -> Carbon dioxide + Water + Energy

Hydrocarbons are oxidised (so good for fuels as lots of energy is released)

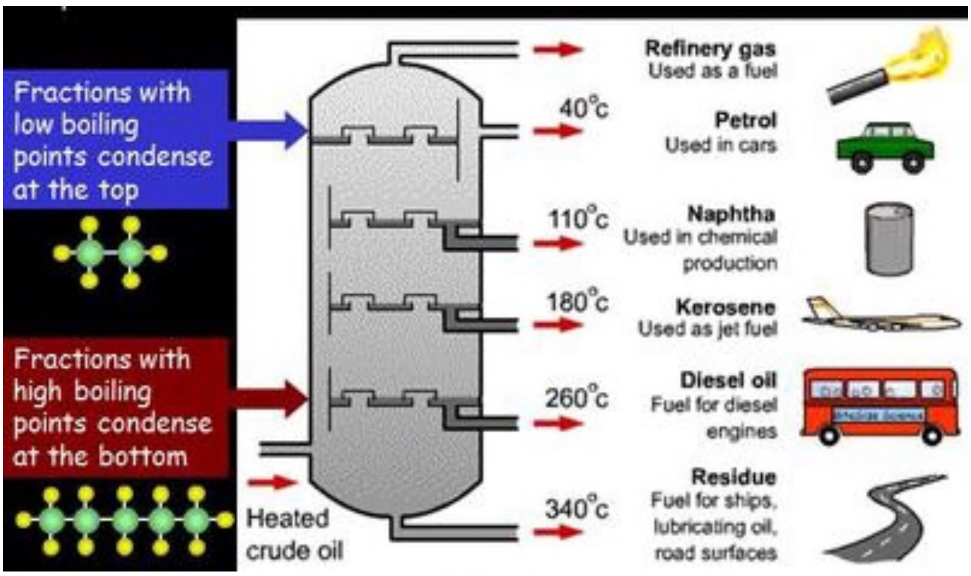
Fractional distillation:

Crude oil: a fossil fuel (from plankton remains), oil (formed under high pressure) is drilled from rocks but oil is FINITE

Crude oil = mixture of hydrocarbons

Fractional distillation method:

1. Oil heated & vaporises
2. Enters fractionating column
3. Temperature gradient means oil with high bp condenses 1st at the bottom
4. Oil with low bp condenses last at the top (it's cooler)
5. Fractions are separated based on carbon quantity (more atoms = higher bp)



Uses & Cracking of Crude oil:

Uses:

LPG, diesel & kerosene for cars, planes & trains
Feedstock to for polymers in industry

Cracking:

Splitting long chains up into shorter ones via THERMAL DECOMPOSITION
Short chains are more flammable (oxygen can get into the chain to react), thus in demand

Method:

1. Heat long chain to vaporise
2. Vapour passed over steam & aluminium oxide catalyst
3. Catalytic cracking occurs: long chains separate on the surface of the catalyst

Steam cracking:
Vaporise long chain, mix with steam, heat at high temp

E.g.

Decane -> Octane + Alkane

decane -> octane + ethene

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

Alkenes:

Have double C=C bond
So have 2 fewer hydrogens than alkanes = unsaturated
C=C bond can split into a single bond to bond = very reactive

GENERAL FORMULA

$$\boxed{C_nH_{2n}}$$

Incomplete combustion of alkenes:

Alkane + Oxygen -> Carbon + Carbon monoxide + Carbon dioxide + water + energy

Smoky yellow flame produced
Less energy released

ETHANE + OXYGEN $\longrightarrow$ CARBON DIOXIDE + WATER

$$C_2H_6 + 3\tfrac{1}{2}O_2 \longrightarrow 2CO_2 + 3H_2O$$

Reactions of Alkenes:

C=C functional group dictates reactivity

Addition reaction:
C=C bond breaks open to form single Carbon bond

Hydrogenation:

Addition of hydrogen: C=C bond breaks, Hydrogen bonds to Carbon = saturated compound (with a catalyst)

Steam + Alkane -> Alcohols:
H20 is added across the x2 bond = alcohol is formed

Ethanol made by combing steam & ethene (over a catalyst)- industrially

Then mixture condensed, ethanol & H20 have higher bp than ethene so condense (unreacted ethene recycled into reactor), alcohol is purified via fractional distillation

Halogens + Alkenes:

Bromine + Ethene -> dibromoethane
C=C bond broken, compound becomes saturated upon bonding with halogen atom

Test for Alkenes:

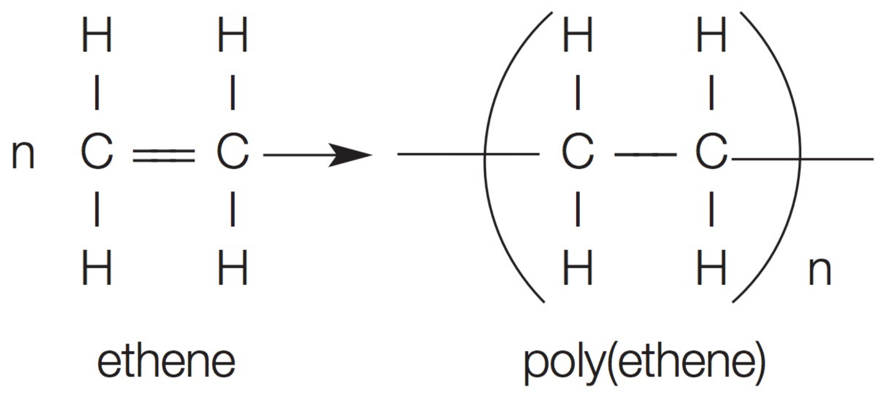
Add bromine
Saturated compound (Alkane) = orange
Unsaturated compound (Alkene) = colourless dibromo compound (bromine adds across the double bond)

Addition polymers:

Polymers= long chains of monomers formed (via polymerisation with: catalyst & steam)
Plastics = carbon-based polymers

Unsaturated monomers open up their x2 covalent bonds during addition polymerisation

Add 'poly' to the monomer to get the polymer e.g. ethene makes (poly)ethene



Alcohols:

Contain -OH group

GENERAL FORMULA

1ST 4 ALCS

Properties of Alcohols:

Flammable so undergo complete combustion

SYMBOL EQUATION DIAGRAM

Soluble in H20 with a neutral pH

Produce carboxylic acid when oxidised e.g. methanol is oxidised to form methanoic acid

Uses:

Solvents as can dissolve hydrocarbons in industry
Fuels as clean burn e.g. ethanol in spirit burners

Fermentation:

Produces ethanol for bread & beer
Uses yeast enzyme to convert sugars-> ethanol (ethanol produced is aqueous as reaction occurs in a solution)
37 degrees cel, acidic & anaerobic conditions are optimal for enzyme activity (preventing denaturing)

$$\text{glucose} \xrightarrow{\text{yeast}} \text{ethanol} + \text{carbon dioxide}$$

$$C_6H_{12}O_{6(aq)} \xrightarrow{\text{yeast}} 2C_2H_5OH_{(aq)} + 2CO_{2(aq)}$$

Carboxylic acids:

Have -COOH functional group

DIAGRAMS OF CARBOXYLIC ACIDS

Reactions:

With carbonates to produce salt & water

WORD EQUATION EXAMPLE

Dissolve in water, ionising so release H+ ions = acidic solution but not all H+ molecules released = WEAK acidic solutions
So they have higher pH's than aqueous solutions of strong acids of the same concentration

Esters:

-COO- functional group

Alcohol + Carboxylic acid -> ester + water
Using an acid catalyst
E.g. Ester ethanoate

Condensation polymers:

Polymers formed from monomers with different functional groups which react to make polymer chains

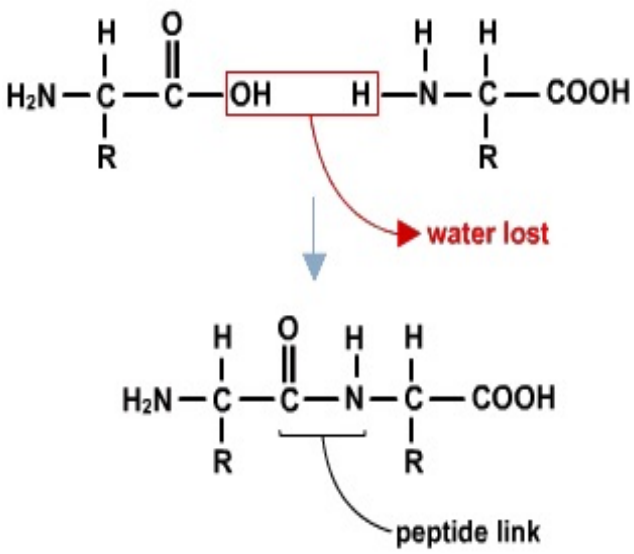
Each new bond formed releases H20 = CONDENSATION polymerisation

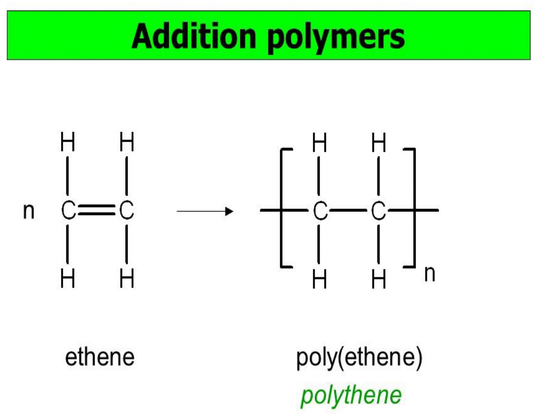
E.g. Polyester

Comparing Addition vs Condensation polymerisation:

Addition: only one monomer type with x2 bond, one product formed with a C=C bond

Condensation: 2 monomers with same functional group/1 monomer type with 2 different functional groups, products: polymer & H20, 2 reactive groups on each monomer

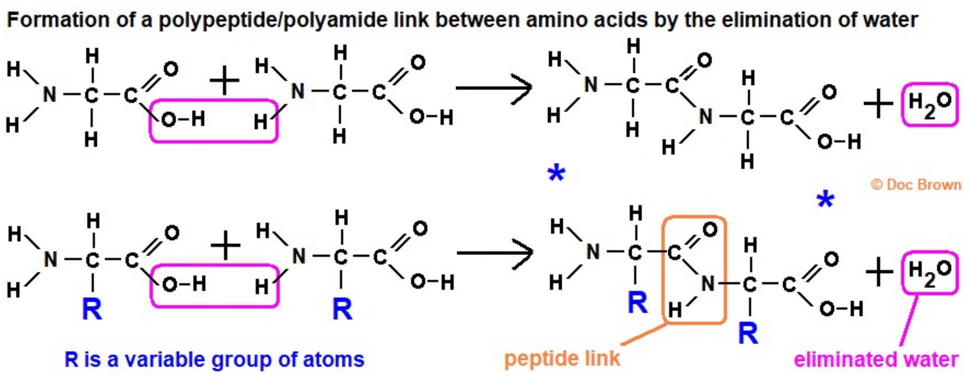


Naturally occurring polymers:

Amino acids have 2 functional groups: an NH2 & COOH group (amino & carboxyl) e.g. Glycine

Amino acids form polypeptides via condensation polymerisation
Amino group & acid group react, releasing H20
Long chain of polypeptides = proteins
E.g. catalysts, antibodies & haemoglobin
Order of amino acids dictates function




DNA:

Contains genetic info for the cell to operate
Has x2 helix structure

DNA made of 2 polymers =nucleotides which contain a base (A,T & C,G) to create cross links, order of bases code an organism's genes

Simple sugars:

Formed of carbon, oxygen & hydrogen which (via polymerisation) form large carbohydrate polymers e.g. starch for storage