

Edexcel IGCSE Flashcards

Section 4: Organic Chemistry

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What is the empirical formula? How is it related to molecular formula?



What is the empirical formula? How is it related to molecular formula?

Simplest whole-number ratio of atoms of different elements in the compound.

The two are related by some numerical constant.

E.g. the empirical formula for heptene, C_7H_{14} , is CH_2 . Multiplying the empirical formula by a numerical constant (7) would yield the molecular formula of heptene.



What is crude oil?



What is crude oil?

Crude oil is a mixture of compounds; a fossil fuel consisting of the remains of ancient biomass.

Finite resource - cannot be replaced as it is used up.



What is a hydrocarbon?



What is a hydrocarbon?

A compound made up exclusively of hydrogen and carbon atoms.



What are alkanes?



What are alkanes?

Saturated hydrocarbons of a general formula C_nH_{2n+2}



What is a homologous series?



What is a homologous series?

Series of compounds with same general formula, same functional groups and similar chemical properties.



Describe the combustion of hydrocarbons



Describe the combustion of hydrocarbons

Exothermic reaction occurring when hydrocarbons are reacted with oxygen.

Complete combustion produces carbon dioxide and water (carbon and hydrogen atoms are completely oxidised).

Incomplete combustion produces carbon or carbon monoxide and water.



Describe the physical properties of alkanes



Describe the physical properties of alkanes

- First few in series are gases, then change to liquids, then to solids.
- In general, boiling points and viscosity increase as molecules get bigger; volatility and flammability decrease as molecules get bigger.
- Poor reactivity.



Explain how fractional distillation of crude oil takes place



Explain how fractional distillation of crude oil takes place

- Crude oil is heated and vaporised.
- Vapor rises up the fractionating column (tower).
- The column is hotter at the bottom and cooler at the top.
- Hydrocarbons cool as they go up the column and condense at different heights, as they have different boiling points.
- Large molecules, high boiling points - collected at the bottom.
- Small molecules, low boiling points - collected at the top.
- This gives fractions, which can be used in various ways.



What is cracking?



What is cracking?

When large hydrocarbons are thermally broken down into smaller and useful molecules.



What type of reaction is cracking?



What type of reaction is cracking?

Thermal decomposition.



What are the conditions for cracking?



What are the conditions for cracking?

Reactant heated to vapor, passed over a hot catalyst (catalytic cracking) or heated to vapor, mixed with steam and heated to high temperatures (steam cracking).



How are the products of cracking used?



How are the products of cracking used?

The products are alkanes and alkenes – used as polymers and starting materials for synthesis.



What is an alkene?



What is an alkene?

Unsaturated hydrocarbon. Contains at least one C=C bond. General formula for alkenes is: $C_n H_{2n}$.



What is the test for alkenes?



What is the test for alkenes?

Add bromine water. Colour change occurs from orange to colourless.



Describe the combustion of alkenes



Describe the combustion of alkenes

They burn with smoky flames due to incomplete combustion.



Describe addition reactions of alkenes



Describe addition reactions of alkenes

Addition atoms across the carbon-carbon double bond so that the double bond becomes a single carbon-carbon bond.

- With hydrogen - hydrogenation; requires a higher temperature and a nickel catalyst
- With steam - hydration; requires high temperature, pressure, and concentrated phosphoric acid (H_3PO_4) as a catalyst
- With $\text{Br}_2/\text{Cl}_2/\text{I}_2$ - addition of halogens



What is an alcohol?



What is an alcohol?

An organic compound that contains an -OH functional group.



State characteristics of methanol, ethanol, propanol and butanol



State characteristics of methanol, ethanol, propanol and butanol

- Dissolve in water to form a neutral solution.
- React with sodium to form hydrogen.
- Burn in oxygen.
- React with carboxylic acids in presence of acid catalyst to form esters.



Oxidation of the alcohols leads to...?



Oxidation of the alcohols leads to...?

Carboxylic acids.



What are some uses of alcohols?



What are some uses of alcohols?

Fuels, solvents, drinks.



State the conditions required for fermentation of glucose and state the equation of the reaction



State the conditions required for fermentation of glucose and state the equation of the reaction

30 degrees Celsius, aqueous solution of the glucose, absence of air, yeast added;



What are carboxylic acids?



What are carboxylic acids?

Organic compounds that contain a -COOH functional group.



State characteristics of carboxylic acids



State characteristics of carboxylic acids

- Dissolve in water to form an acidic solution (contains H^+ ions).
- React with metal carbonates to form carbon dioxide.
- React with alcohols with an acid catalyst to produce esters.
- React with metals to give off hydrogen gas.



What type of acid is
carboxylic acid?



What type of acid is carboxylic acid?

It is a weak acid.



Explain why carboxylic acids are weak acids?

Higher tier only



Explain why carboxylic acids are weak acids?

They are partially dissociated in water, thus the pH of a carboxylic acid in solution is not as low as a solution of a strong acid of the same concentration.

Higher tier only



What is an ester and how is it formed? What is characteristic about this class of compounds?



What is an ester and how is it formed?

An organic compound containing a -COO- functional group, formed from carboxylic acid and alcohol in presence of a sulfuric acid catalyst.

Fruity smell.



What is a polymer? How do molecules containing C=C bond form polymers?



What is a polymer? How do molecules containing C=C bond form polymers?

A polymer is a long chain molecule which is made by lots of smaller molecules joining together.

C=C bonds open up and many smaller molecules (monomers) join together to form a chain (a polymer). No other products are made.

It is called an “addition polymerisation” reaction.



Give 3 examples of addition polymers and their uses.



Give 3 examples of addition polymers and their uses.

Polyethene - plastic bags

(Poly)tetrafluoroethene (PTFE) - teflon surfaces, for use in non-stick kitchenware

(Poly)chloroethene (polyvinylchloride, PVC) - water pipes



What is a repeating unit of a polymer?



What is a repeating unit of a polymer?

It is a smallest structure which, upon numerous translations, yields the structure of the polymer.

In addition polymers: to draw it, take a monomer, change $C=C$ to $C-C$ and show additional single bonds extending away from these carbons.



What is a condensation polymer? How is it made?
There are 2 main groups -
name them and give industrially
relevant examples.

Higher tier only



What is a condensation polymer?

It is a polymer made in condensation polymerisation.

In this reaction, many molecules join together; the polymer is formed, but also a small molecule is released, e.g. H_2O , HCl .

Polyesters, e.g. terylene.

Polyamides, e.g. Nylon.

Higher tier only



What is the arrangement of C-H bonds in methane?



What is the arrangement of C-H bonds in methane?

Tetrahedral.



Why are alkanes considered unreactive?



Why are alkanes considered unreactive?

They exclusively contain relatively strong C-C and C-H bonds; these are quite difficult to break.



Alkanes can undergo
halogenation reactions.
Describe this process.



Alkanes can undergo halogenation reactions. Describe this process.

The reaction involves substituting hydrogen atoms with halogen atoms in the alkane molecule.

It requires UV radiation. This radiation breaks up the halogen molecules into free atoms (e.g. Cl_2 becomes 2Cl).

Sample equation: $\text{CH}_4 + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{HCl}$ (forms chloromethane)



How can ethanol be oxidised? What are the products?



How can ethanol be oxidised? What are the products?

- a) Heating with acidified (H_2SO_4) orange potassium dichromate (VI) solution with ethanol leads to oxidation to ethanoic acid, CH_3COOH . The solution turns green over the course of reaction (reduction of Cr (VI) to Cr^{3+})

- b) Microbial oxidation; when ethanol is exposed to air, it will slowly be oxidised to ethanoic acid with the help of bacteria



Name the ester made from
the acid catalysed
esterification of
 $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ and
 CH_3OH



Name the ester made from the acid catalysed esterification of $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ and CH_3OH

Butanoic acid and methanol will form **methyl butanoate** and water.



What are isomers? How many isomers of C_5H_{12} are there?



What are isomers? How many isomers of C_5H_{12} are there?

Isomers are compounds of the same molecular formula having different structural formulae.

Three - try to draw them; if you can't, google "isomers of C_5H_{12} "



Addition polymerisation
requires an additive - what's
its name and role?



Addition polymerisation requires an additive - what's its name and role?

An initiator.

It's a chemical that initiates the addition polymerisation by helping one of the C=C bonds to break.



What are biopolyesters?



What are biopolyesters?

These are a special type of polyesters that degrade upon prolonged exposure to microbes, O_2 and water (contrary to normal polyesters, which are resistant to decomposition under these conditions).

