OCR A GCSE Chemistry

Topic 6: Global challenges

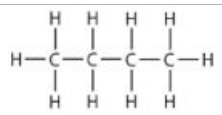
Organic chemistry

Notes

C6.2a recognise functional groups and identify members of the same homologous series

- Prefixes (beginning of the name)
  - remember the first 4 prefixes using MEPB Monkeys Eat Peanut Butter
  - Any compound with 1 carbon has the prefix of: Meth-
  - 2 carbons: Eth-
  - 3 carbons: Prop-
  - 4 carbons: But-
- The suffix of any compound refers to the functional group
  - Alkanes – ane (C-C // C-H) e.g. ethane
  - Alkenes – ene (C=C) e.g. ethene
  - Alcohols – ol (OH) e.g. ethanol
  - Carboxylic acids – anoic acid (-COOH) e.g. ethanoic acid

C6.2b name and draw the structural formulae, using fully displayed formulae, of the first four members of the straight chain alkanes, alkenes, alcohols and carboxylic acids

butane	$CH_3CH_2CH_2CH_3$	

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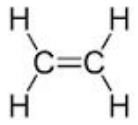
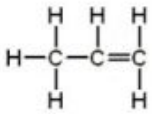
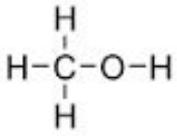
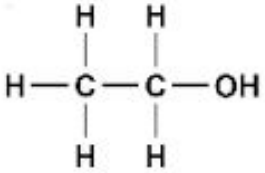
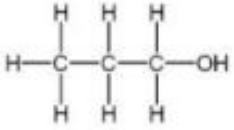
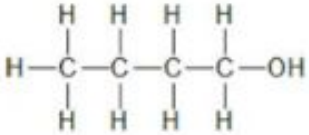
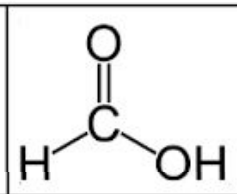
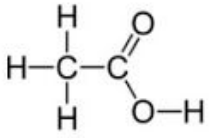
ethene	C_2H_4	
propene	C_3H_6	

methanol	CH_3OH	
ethanol	C_2H_5OH	
propanol	C_3H_7OH	
butanol	C_4H_9OH	

Carboxylic acids

- Ethanoic acid is a member of the carboxylic acids, they have the functional group –COOH.
- First four members are: methanoic acid, ethanoic acid, propanoic acid and butanoic acid:

methanoic acid	CHOOH	
ethanoic acid	CH_3COOH	

C6.2c predict the formulae and structures of products of reactions of the first four and other given members of the homologous series of alkanes, alkenes and alcohols

- Combustion of alkanes – reaction of alkanes with oxygen to produce carbon dioxide and water
- Addition of bromine – reaction of alkenes with bromine, colour change from orange to colourless (can be used as a test for C=C double bond, since alkanes cannot react with bromine in this way so the colour remains orange)
    - Addition of hydrogen – reaction of alkenes with hydrogen
- Oxidation of alcohols to carboxylic acids using potassium manganate(VII) (orange to green colour change) (reflux)

C6.2d recall the basic principles of addition polymerisation by reference to the functional group in the monomer and the repeating units in the polymer

- Polymers are large molecules built up from small units (monomers)
- Addition polymerisation involves the removal of a C=C double bond from an alkene (monomer) to produce a polymer
    - Repeat unit is just the monomer without the C=C double bond
- Addition polymerisation involves the removal of a C=C double bond to form a –C-C- bond, i.e. it joins up unsaturated molecules to form a long saturated molecule

C6.2e (HT only) explain the basic principles of condensation polymerisation

- In condensation polymerisation, a small molecule is formed as a by-product each time a bond is formed between two monomers
- diol- molecule with 2 alcohol OH functional groups
- dicarboxylic acid- molecule with 2 carboxylic acid COOH functional groups
- When you react a diol and a dicarboxylic acid, the alcohol and carboxylic acid functional groups react, losing a small molecule – water
- This is an ester – therefore a polyester is a lot of these monomers (esters)
    - the dicarboxylic acid loses the OH group off of each COOH group
    - the di-alcohol loses the H off of each OH group
    - the remaining molecules join together to make a polyester
    - the H and OH join to form water
- Functional groups that react to form condensation polymers include alcohol + carboxylic acid -> polyester // amine + carboxylic acid -> polyamide OR amino acid -> protein
- How to find a repeat unit: look for a chunk that involves each functional group only once
- To represent polymers: use block diagrams e.g. multiple squares attached, each square representing a repeat unit

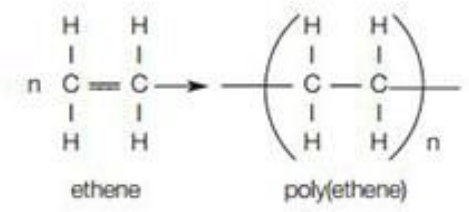
C6.2f (HT only) describe practical techniques to make a polymer by condensation

- Condensation polymer is formed by removal of a small molecule, such as water in the examples discussed above
- Polyester: heat together alcohol + carboxylic acid in presence of an acid catalyst

C6.2g deduce the structure of an addition polymer from a simple alkene monomer and vice versa

- Addition polymer from a simple alkene monomer: remove C=C to get repeat unit and then just repeat this a few times, then put brackets around the molecule with a small n outside the brackets on the bottom right
    - Reverse this to find the monomer

e.g.



C6.2h recall that DNA is…

- A polymer made from four different monomers called nucleotides and that other important naturally-occuring polymers are based on sugars and amino-acids
- The four nucleotides
    - Adenine (A), Cytosine (C), Guanine (G) and Thymine (T)

C6.2i recall that it is the…

- Generality of reactions of functional groups that determine the reactions of organic compounds

C6.2j describe the separation of crude oil by fractional distillation

- The oil is heated in the fractionating column and the oil evaporates and condenses at a number of different temperatures.
- The many hydrocarbons in crude oil can be separated into fractions each of which contains molecules with a similar number of carbon atoms
- The fractionating column works continuously, heated crude oil is piped in at the bottom. The vaporised oil rises up the column and the various fractions are constantly tapped off at the different levels where they condense.
- The fractions can be processed to produce fuels and feedstock for the petrochemical industry.

C6.2k explain the separation of crude oil by fractional distillation

**refer to C6.2j above*

- Longer chained alkanes are collected towards the bottom, due to their high boiling points – since they have more and stronger intermolecular forces

C6.2l describe the fractions as…

- Largely a mixture of compounds of formula C_nH_{2n+2}, which are members of the alkane homologous series

C6.2m recall that crude oil is a…

- Main source of hydrocarbons and is a feedstock for the petrochemical industry

C6.2n explain how modern life is crucially dependent upon hydrocarbons and recognise that crude oil is a finite resource

- There are many uses of each fraction obtained from the fractional distillation of crude oil, such as...
    - Refinery gas for bottled gas for heating and cooking
    - Gasoline fraction for fuel (petrol) in cars
    - Naphtha fraction for making chemicals
    - Kerosene/paraffin fraction for jet fuel
    - Diesel oil/gas oil for fuel in diesel engines
    - Fuel oil fraction for fuel for ships and home heating systems
    - Lubricating fraction for lubricants, waxes and polishes
    - Bitumen for making roads

C6.2o describe the production of materials that are more useful by cracking

- Hydrocarbons can be cracked to produce smaller, more useful molecules. This process involved heating the hydrocarbons to vaporise them.

The vapours are:

- Either passed over a hot catalyst (silica or alumina)
- Mixed with steam and heated to a very high temperature (temperature in the range of 600-700˚C) so that thermal decomposition reactions can occur.

- The products of cracking include alkanes and alkenes (or hydrogen)

C6.2p recall that a chemical cell…

- Produces a potential difference until the reactants are used up

C6.2q evaluate the advantages and disadvantages of hydrogen/oxygen and other fuel cells for given uses

- Hydrogen/oxygen
    - Advantages
        - Greater efficiency than other fuel cells
        - Only emits water – does not add to carbon footprint by emitting carbon dioxide in this way
    - Disadvantages
        - Production of the cell involves the use of finite resources such as crude oil
        - Transport and storage is difficult
        - Explosive and therefore dangerous
- Overall reaction of the cell: $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$