



Edexcel GCSE Chemistry

Topic 8: Fuels and Earth science

Fuels

Notes





8.1 Recall that...

- Hydrocarbons are compounds that contain carbon and hydrogen only

8.2 Describe crude oil as:

- A complex mixture of hydrocarbons
- Containing molecules in which carbon atoms are in chains or rings (names, formulae and structures of specific ring molecules not required)
- An important source of useful substances (fuels and feedstock for the petrochemical industry)
- A finite resource

8.3 Describe and explain the separation of crude oil into simpler, more useful mixtures by the process of fractional distillation

- Crude oil is a mixture of different hydrocarbons, different hydrocarbons have different boiling points (longer chain hydrocarbons have higher boiling points)
- The crude oil is heated in the fractionating column and the oil evaporates and condenses at a number of different temperatures.
- 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.

8.4 Recall the names and uses of the following fractions:

- Gases: domestic heating and cooking
- Petrol: fuel for cars
- Kerosene: fuel for aircraft
- Diesel oil: fuel for some cars and trains
- Fuel oil: fuel for large ships and in some power stations
- Bitumen: surface roads and roofs





8.5 Explain how hydrocarbons in different fractions differ from each other in: the number of carbon and hydrogen atoms their molecules contain, boiling points, ease of ignition, and viscosity and are mostly members of the alkane homologous series

- Some properties of hydrocarbons depend on the size of their molecules. These properties influence their use as fuels.
- Shorter the molecules, the less viscous it is. (more runny) and the longer the molecules, the more viscous it is.
- The shorter the molecules, the lower the temperature at which that fraction evaporates or condenses – and the lower its boiling point.
- The shorter the molecules – the more flammable it is, so the easier it is to ignite

8.6 Explain a homologous series as a series of compounds which:

- Have the same general formula
- Differ by CH_2 in molecular formulae from neighbouring compounds
- Show a gradual variation in physical properties, as exemplified by their boiling points
- Have similar chemical properties

8.7 Describe the complete combustion of hydrocarbon fuels as a reaction in which:

- CO_2 and H_2O are produced
- Energy is given out (exothermic)

8.8 Explain why the incomplete combustion of hydrocarbons can produce carbon and carbon monoxide

- If there's not enough oxygen, some of the fuel doesn't burn – this is partial combustion. Here, solid particles of soot (carbons) and unburnt fuel are released.
- Carbon monoxide (CO) is also released when there isn't enough oxygen to produce CO_2 instead

8.9 Explain how carbon monoxide behaves as a toxic gas

- carbon monoxide is a colourless and odourless gas which, if breathed in, prevents red blood cells carrying oxygen around your body, which leads to death





8.10 Describe the problems caused by incomplete combustion producing carbon monoxide and soot in appliances that use carbon compounds as fuels

- Carbon monoxide causes health problems
- Soot causes global dimming

8.11 Explain how impurities in some hydrocarbon fuels result in the production of sulfur dioxide

- Most fuels, including coal, contain carbon and/or hydrogen and may also contain some sulfur
- when the fuels are burnt in oxygen, this sulfur can react to form sulfur dioxide

8.12 Explain some problems associated with acid rain caused when sulfur dioxide dissolves in rain water

- Damages buildings and statues (made of limestone)
- Reduce the growth of or kill trees and crops
- Lower pH of water in lakes, killing fish

8.13 Explain why, when fuels are burned in engines, oxygen and nitrogen can react together at high temperatures to produce oxides of nitrogen, which are pollutants

- Nitrogen and oxygen from the air combine to produce nitrogen monoxide
- When this nitrogen monoxide is released from vehicle exhaust systems, it combines with oxygen in the air to form nitrogen dioxide
- nitrogen monoxide and nitrogen dioxide are pollutants

8.14 Evaluate the advantages and disadvantages of using hydrogen, rather than petrol, as a fuel in cars

- Advantages
 - Use of hydrogen – petrol is from crude oil, a finite resource
 - Only produces water – no CO₂ produced which contributes to global warming
- Disadvantages
 - Expensive
 - Difficult to transport and store hydrogen
 - Dangerous – hydrogen can be explosive





8.15 Recall that petrol, kerosene and diesel oil are...

- Non-renewable fossil fuels obtained from crude oil
- And methane is a non-renewable fossil fuel found in natural gas

8.16 Explain how cracking involves the breaking down of larger, saturated hydrocarbon molecules (alkanes) into smaller, more useful ones, some of which are unsaturated (alkenes)

- 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
 - Mixed with steam and heated to a very high temperature so that thermal decomposition reactions can occur.
- The products of cracking include alkanes and unsaturated hydrocarbons called alkenes.
 - Alkenes have the general formula C_nH_{2n}
 - The first 2 alkenes are ethene and propene.
 - they are unsaturated because they have a double bond

8.17 Explain why cracking is necessary

- Demand for smaller chained alkanes is much greater than that for longer chained alkanes
- shorter chained hydrocarbons ignite more easily and so are more useful as fuels

