AQA Chemistry 1b - Oils, Earth and Atmosphere

12.4 How are polymers and ethanol made from oil?

Fractions from the distillation of crude oil can be cracked to make smaller molecules including unsaturated hydrocarbons such as ethane. Unsaturated hydrocarbons can be used to make polymers and ethene can be used to make ethanol.

You should be able to:

- evaluate the social and economic advantages and disadvantages of using products from crude oil as fuels or as raw materials for plastic and other chemicals
- evaluate the social, economic and environmental impacts of the uses, disposal and recycling of polymers
- evaluate the advantages and disadvantages of making ethanol from renewable and non-renewable sources.

You should know that:

- Hydrocarbons can be broken down (cracked) to produce smaller, more useful molecules. This process involves heating the hydrocarbons to vaporise them and passing the vapours over a hot catalyst. A thermal decomposition reaction then occurs.
- The products of cracking include alkanes and unsaturated hydrocarbons called alkenes. Alkenes have the general formula CnH2n
- Some of the products of cracking are useful as fuels.
- Ethene can be reacted with steam in the presence of a catalyst to produce ethanol.
- Alkenes can be used to make polymers such as poly(ethene) and poly(propene). In these reactions, many small molecules (monomers) join together to form very large molecules (polymers).
- Polymers have properties that depend on what they are made from and the conditions under which they are made. For example, slime with different viscosities can be made from poly(ethenol).
- Polymers have many useful applications and new uses are being developed, for example: new packaging materials, waterproof coatings for fabrics, dental polymers, wound dressings, hydrogels, smart materials, including shape memory polymers.
- Many polymers are not biodegradable, so they are not broken down by microorganisms and this can lead to problems with waste disposal.

12.5 How can plant oils be used?

Many plants produce useful oils which can be converted into consumer products including processed foods. Vegetable oils can be hardened to make margarine. Biodiesel fuel can be produced from vegetable oils.

You should be able to:

- evaluate the effects of using vegetable oils in foods and the impacts on diet and health
- evaluate the benefits, drawbacks and risks of using vegetable oils to produce fuels
- evaluate the use, benefits, drawbacks and risks of ingredients and additives in foods.

You should know that:

- Some fruits, seeds and nuts are rich in oils that can be extracted. The plant material is crushed and the oil removed by pressing or in some cases by distillation. Water and other impurities are removed.
- Vegetable oils are important foods and fuels as they provide a lot of energy. They also provide us with nutrients.

- Oils do not dissolve in water. They can be used to produce emulsions. Emulsions are thicker than oil or water and have many uses that depend on their special properties. They provide better texture, coating ability and appearance, for example in salad dressings and ice creams.
- Vegetable oils that are unsaturated contain double carbon carbon bonds. These can be detected by reacting with bromine or iodine.
- Vegetable oils that are unsaturated can be hardened by reacting them with hydrogen in the presence of a nickel catalyst at about 60 °C. The hydrogenated oils have higher melting points so they are solids at room temperature, making them useful as spreads and in cakes and pastries.
- Processed foods may contain additives to improve appearance, taste and shelf-life. These additives must be listed in the ingredients and some permitted additives were given E-numbers.
- Chemical analysis can be used to identify additives in foods. Artificial colours can be detected and identified by chromatography.

12.6 What are the changes in the Earth and its atmosphere?

The Earth and its atmosphere provide everything we need. The Earth has a layered structure. Large-scale movements of the Earth's crust can cause changes in the rocks. The Earth's atmosphere was originally very different from what it is today. It has been much the same for the last 200 million years and provides the conditions needed for life on Earth. Recently human activities have produced further changes.

You should be able to:

- explain why the theory of crustal movement (continental drift) was not generally accepted for many years after it was proposed
- explain why scientists cannot accurately predict when earthquakes and volcanic eruptions will occur
- explain and evaluate theories of the changes that have occurred and are occurring in the Earth's atmosphere
- explain and evaluate the effects of human activities on the atmosphere.

Know that:

- The Earth consists of a core, mantle and crust.
- Scientists once thought that the features of the Earth's surface were the result of the shrinking of the crust as the Earth cooled down following its formation.
- The Earth's crust and the upper part of the mantle are cracked into a number of large pieces (tectonic plates). Convection currents within the Earth's mantle, driven by heat released by natural radioactive processes, cause the plates to move at relative speeds of a few centimetres per year.
- The movements can be sudden and disastrous. Earthquakes and/or volcanic eruptions occur at the boundaries between tectonic plates.
- For 200 million years, the proportions of different gases in the atmosphere have been much the same as they are today: about four-fifths (80%) nitrogen, about one-fifth (20%) oxygen, small proportions of various other gases, including carbon dioxide, water vapour and noble gases.
- The noble gases are in Group 0 of the periodic table. They are all chemically unreactive gases and are used in filament lamps and electric discharge tubes. Helium is much less dense than air and is used in balloons.
- During the first billion years of the Earth's existence there was intense volcanic activity. This activity released the gases that formed the early atmosphere and water vapour that condensed to form the oceans.
- Some theories suggest that during this period, the Earth's atmosphere was mainly carbon dioxide and there would have been little or no oxygen gas (like the atmospheres of Mars and Venus today). There may also have been water vapour and small proportions of methane and ammonia.
- Plants produced the oxygen that is now in the atmosphere.

- Most of the carbon from the carbon dioxide in the air gradually became locked up in sedimentary rocks as carbonates and fossil fuels.
- Nowadays the release of carbon dioxide by burning fossil fuels increases the level of carbon dioxide in the atmosphere.