Roger Frost's
Organic Chemistry

MAPPING TO AQA SPECIFICATION - 2008 GCSE

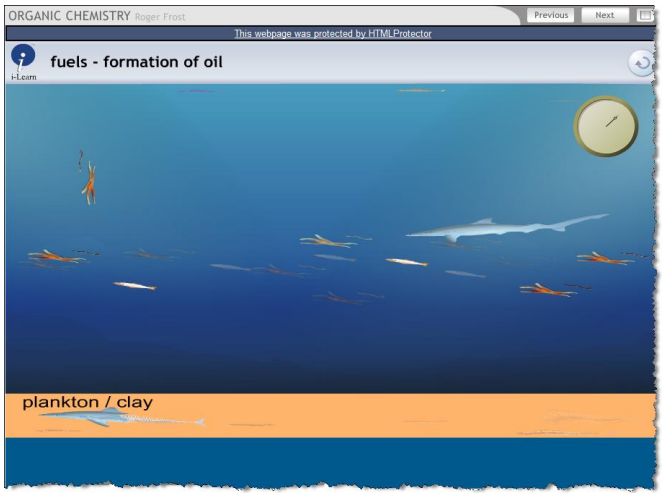
GENERAL
Use electronic resources, eg software simulations

- **cracking of hydrocarbons** (Section 11.4)
- **polymerisation** (Section 11.4)
- **chemical bonding and structure** (Section 12.1)
- **relationship between structure and properties** (Section 12.2)
- **instrumental methods of chemical analysis** (Section 13.5)

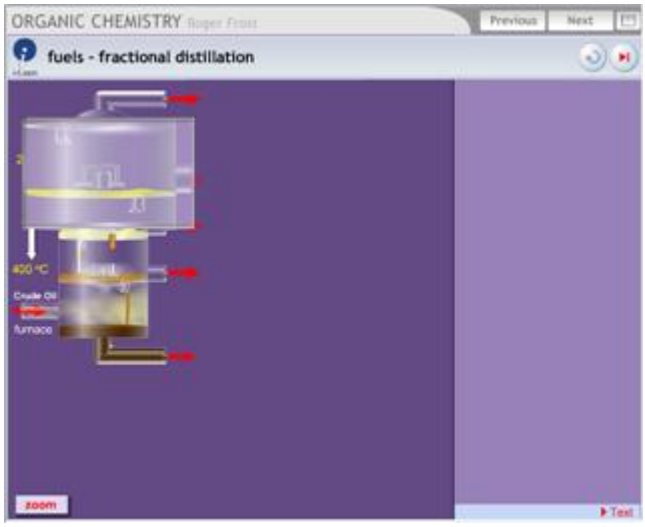
UNIT CHEMISTRY 1

11.3 HOW DO WE GET FUELS FROM CRUDE OIL?

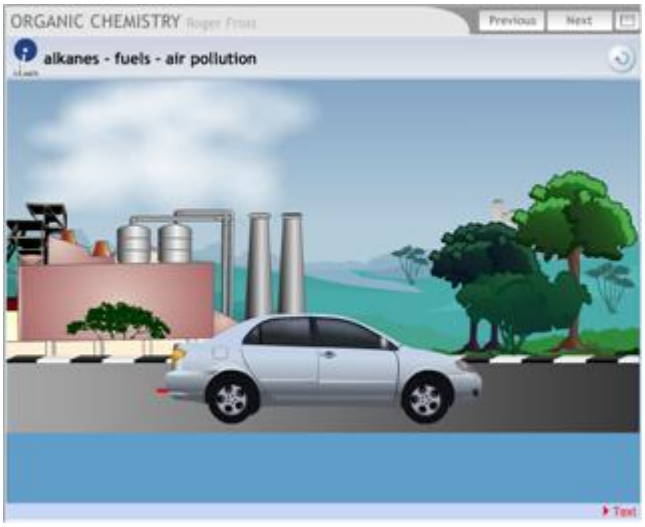
- Crude oil is an ancient biomass found in rocks from which many useful materials can be produced.



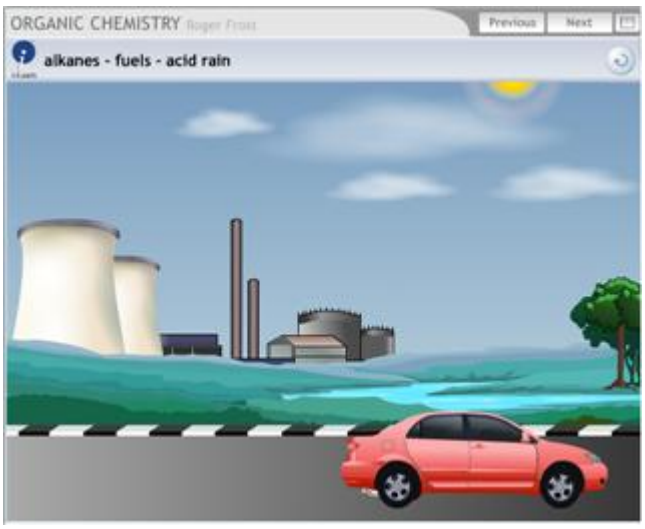
- Crude oil can be fractionally distilled. Some of the fractions can be used as fuels.



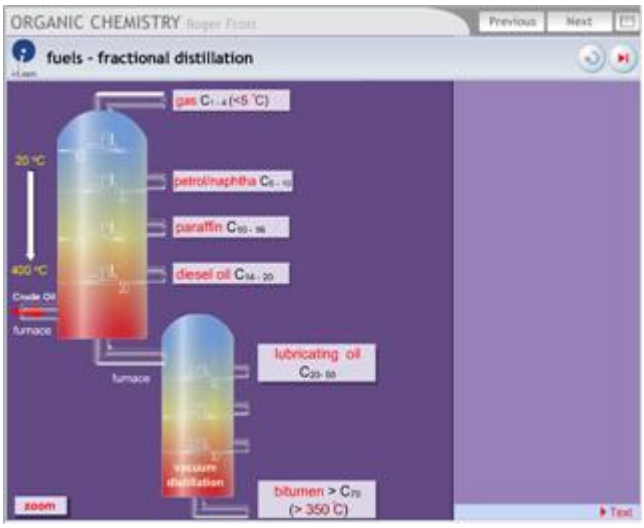
- to evaluate the impact on the environment of burning hydrocarbon fuels



- to consider and evaluate the social, economic and environmental impacts of the uses of fuels



- Crude oil is a mixture of a very large number of compounds
- A mixture consists of two or more elements or compounds not chemically combined together. The chemical properties of each substance in the mixture are unchanged. It is possible to separate the substances in a mixture by physical methods including distillation



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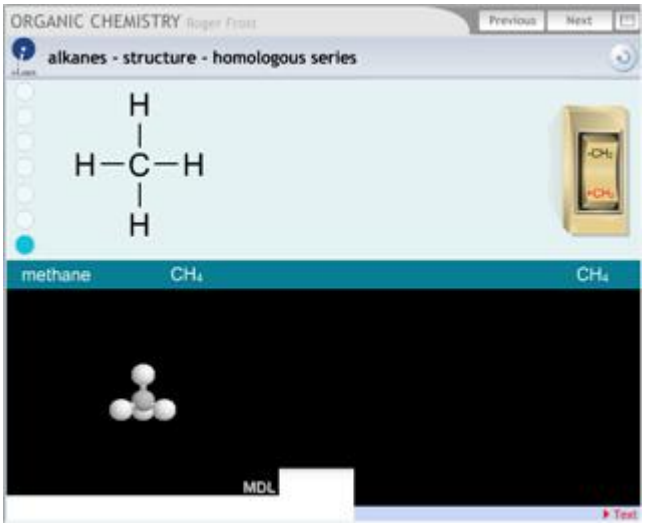
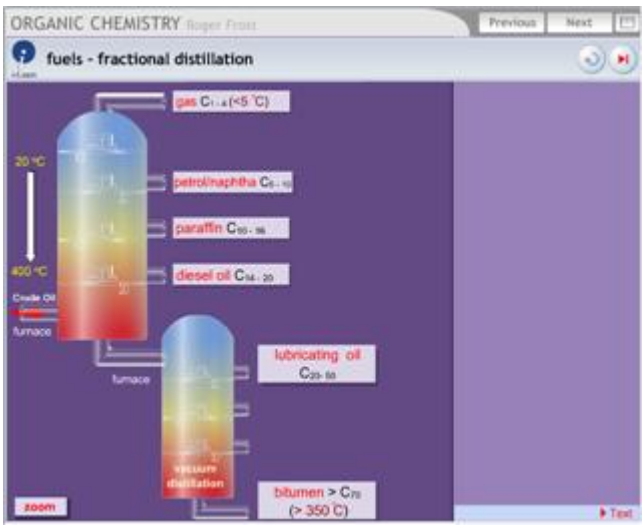
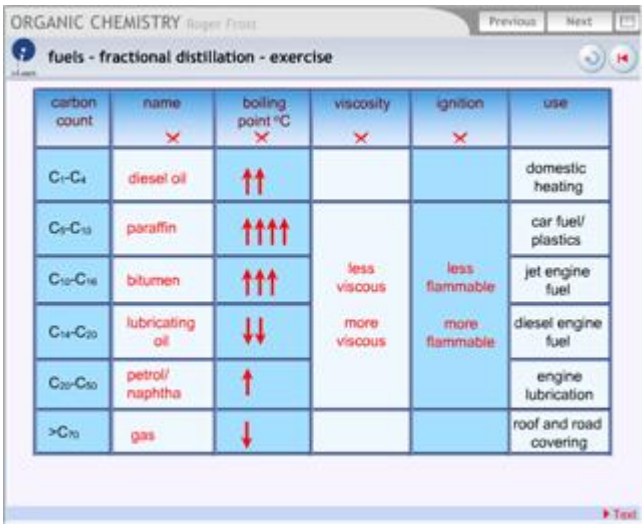
- Most of the compounds in crude oil consist of molecules made up of hydrogen and carbon atoms only (hydrocarbons). Most of these are saturated hydrocarbons called alkanes, which have the general formula CnH2n+2
- Alkane molecules can be represented in the following forms



- The many hydrocarbons in crude oil may be separated into fractions, each of which contains molecules with a similar number of carbon atoms, by evaporating the oil and allowing it to condense at a number of different temperatures. This process is fractional distillation.

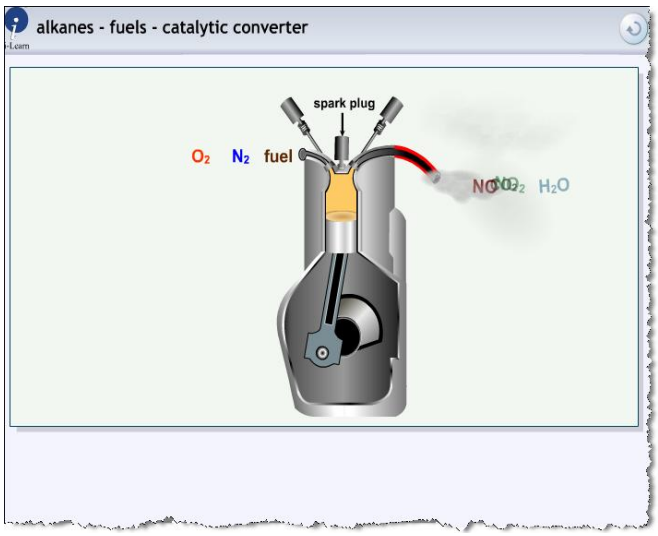


- Some properties of hydrocarbons depend on the size of their molecules. These properties influence how hydrocarbons are used as fuels.

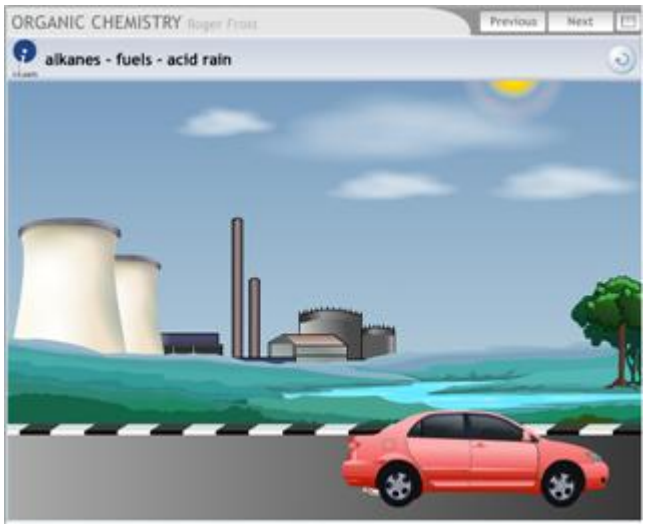


carbon count	name	boiling point °C	viscosity	ignition	use
	×	×	×	×	
C_1-C_4	diesel oil	↑↑			domestic heating
C_5-C_{10}	paraffin	↑↑↑↑	less viscous	less flammable	car fuel/ plastics
C_{10}-C_{16}	bitumen	↑↑↑			jet engine fuel
C_{14}-C_{20}	lubricating oil	↓↓	more viscous	more flammable	diesel engine fuel
C_{20}-C_{50}	petrol/ naphtha	↑			engine lubrication
>C_{70}	gas	↓			roof and road covering

- Most fuels contain carbon and/or hydrogen and may also contain some sulfur. The gases released into the atmosphere when a fuel burns may include carbon dioxide, water (vapour), carbon monoxide and sulfur dioxide. Particles may also be released.

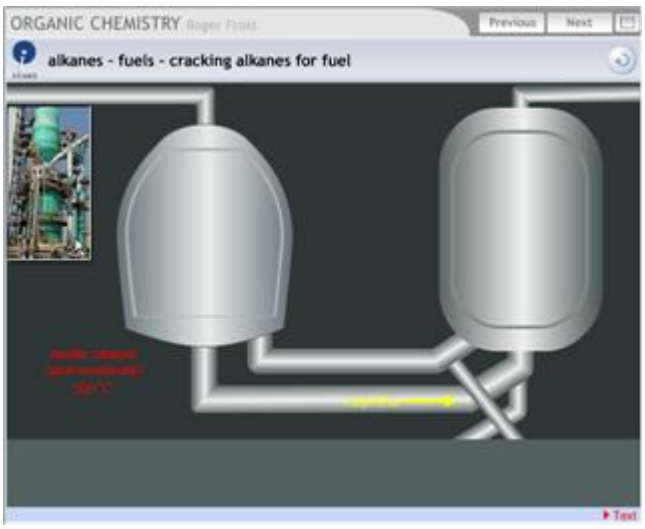


- Sulfur dioxide causes acid rain, carbon dioxide causes global warming, and particles cause global dimming.

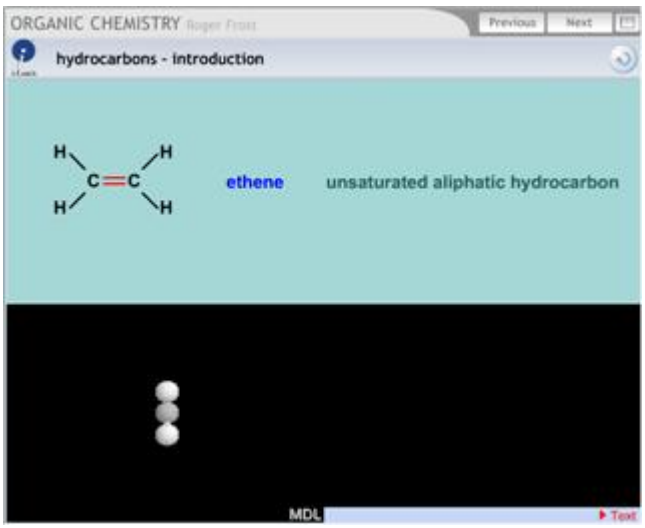


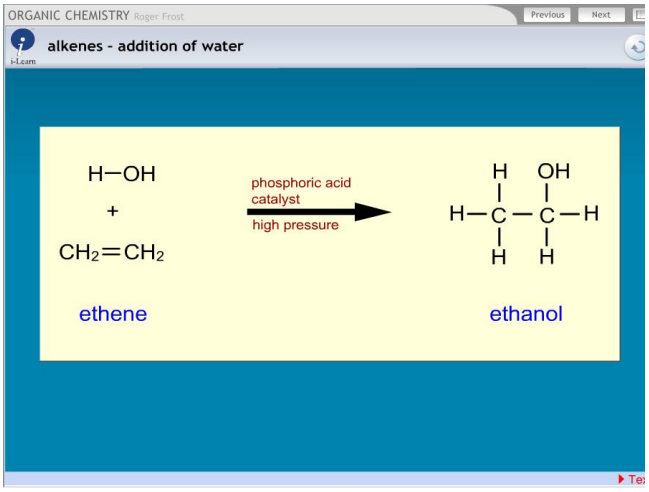
11.4 How are polymers and ethanol made from oil?

- Fractions from the distillation of crude oil can be cracked to make smaller molecules including unsaturated hydrocarbons such as ethane.



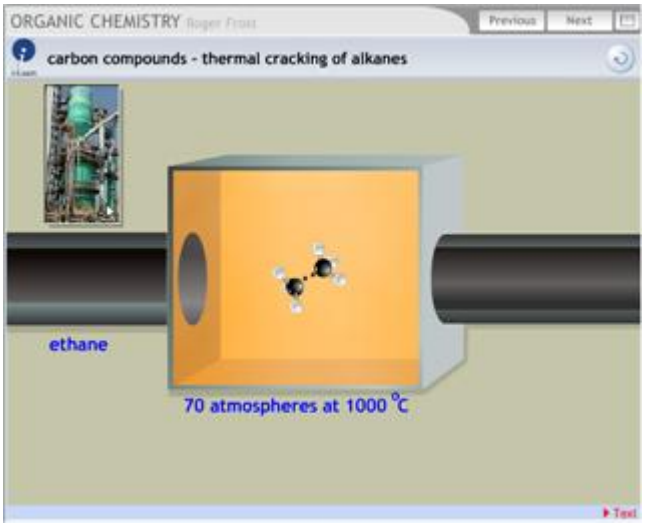
- Unsaturated hydrocarbons can be used to make polymers and ethene can be used to make ethanol.
- to evaluate the advantages and disadvantages of making ethanol from renewable and non-renewable sources.



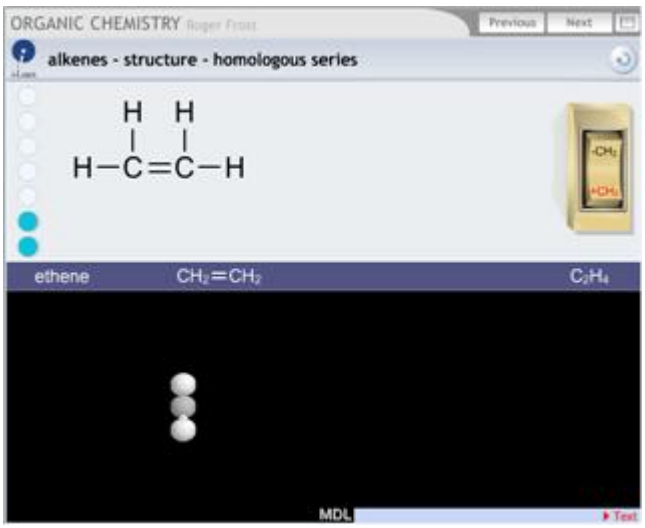


- Ethene can be reacted with steam in the presence of a catalyst to produce ethanol.

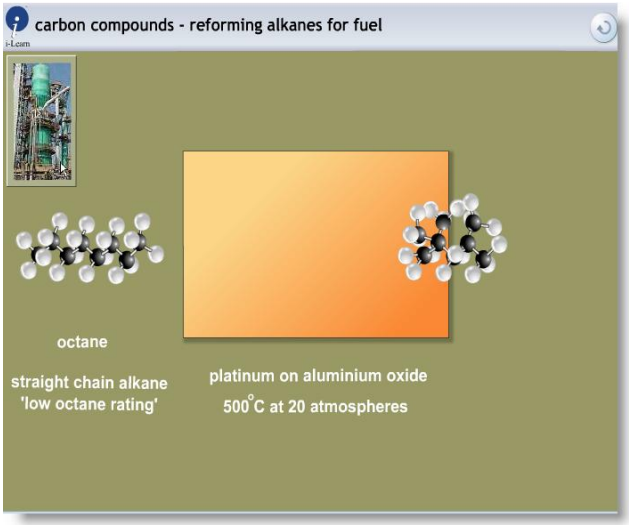
- Hydrocarbons can be broken down (cracked) to produce smaller, more useful molecules. This process involves heating the hydrocarbons to vaporise them and passing the vapours over a hot catalyst. A thermal decomposition reaction then occurs



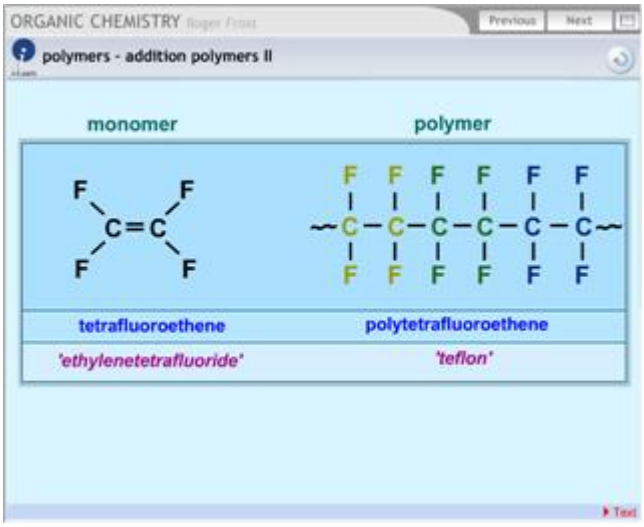
- The products of cracking include alkanes and unsaturated hydrocarbons called alkenes. Alkenes have the general formula CnH2n
- Unsaturated hydrocarbon molecules can be represented in the following forms: – C2H4



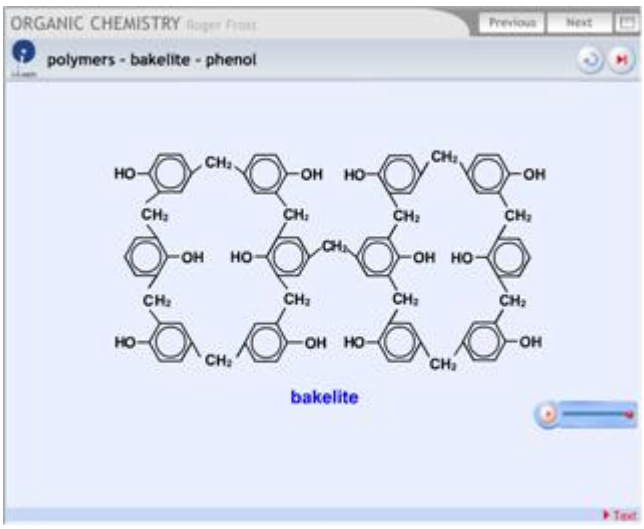
- Some of the products of cracking are useful as fuels.



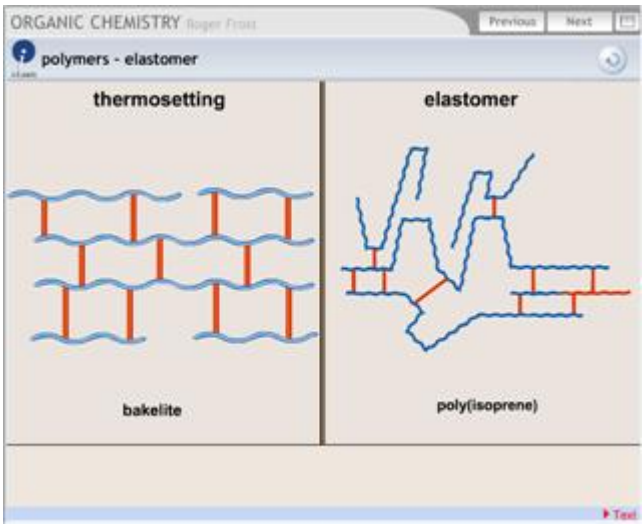
- Alkenes can be used to make polymers such as poly(ethene) and poly(propene). In these reactions, many small molecules (monomers) join together to form very large molecules (polymers).



- polymers have properties that depend on what they are made from and the conditions under which they are made.

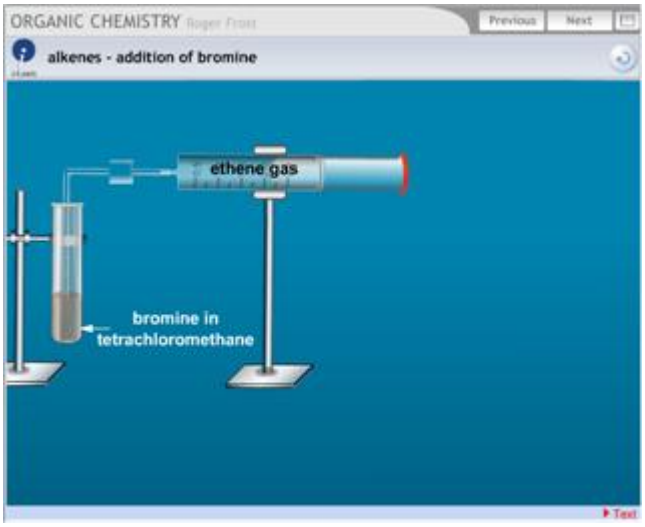


- Polymers have many useful applications and new uses are being developed, for example: new packaging materials, waterproof coatings for fabrics, dental polymers, wound dressings, hydrogels, smart materials, including shape memory polymers.

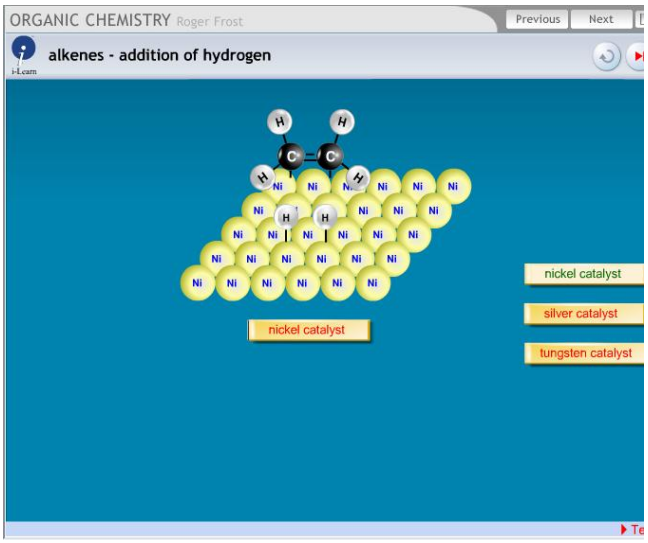


11.5 How can plant oils be used?

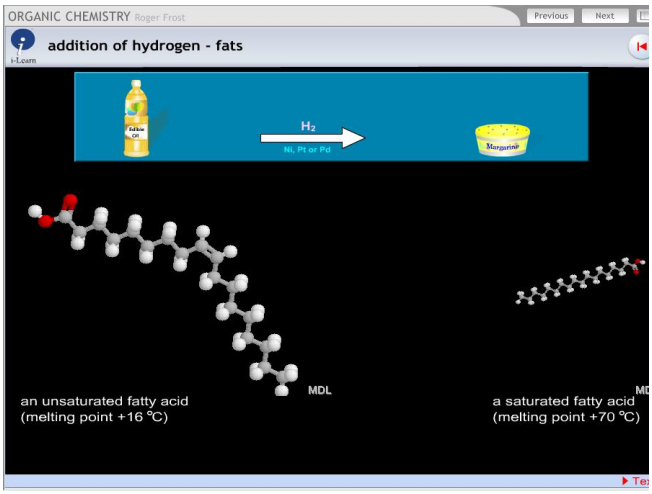
- Vegetable oils that are unsaturated contain double carbon carbon bonds. These can be detected by reacting with bromine or iodine.



- Vegetable oils that are unsaturated can be hardened by reacting them with hydrogen in the presence of a nickel catalyst at about 60 °C.
- Many plants produce useful oils which can be converted into consumer products including processed foods. Vegetable oils can be hardened to make margarine.

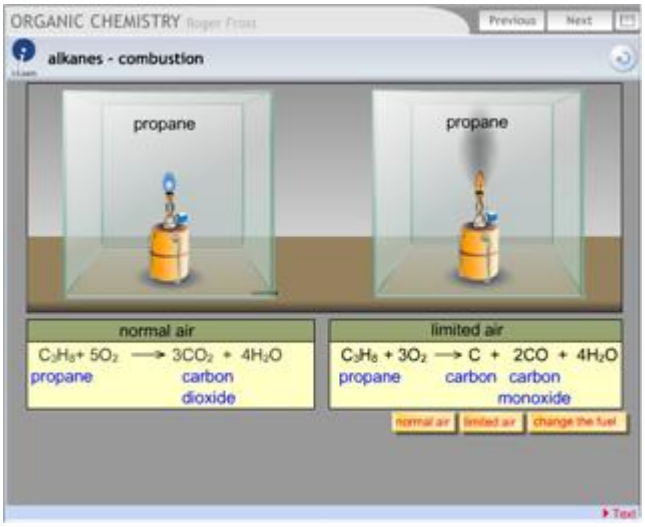


- The hydrogenated oils have higher melting points so they are solids at room temperature, making them useful as spreads and in cakes and pastries



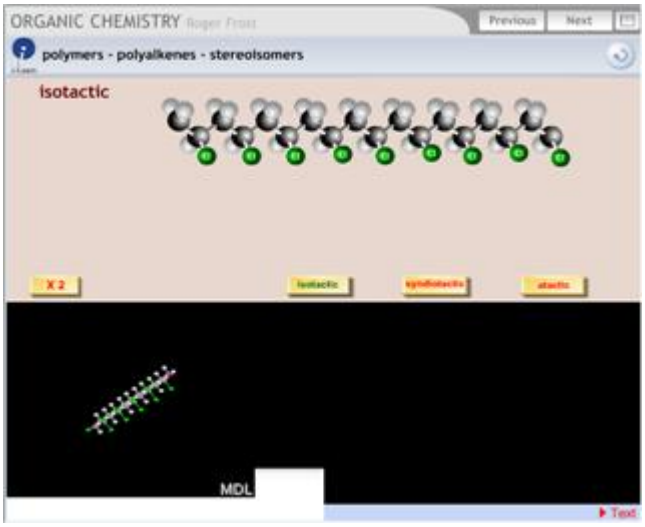
11.6 What are the changes in the Earth and its atmosphere?

- Nowadays the release of carbon dioxide by burning fossil fuels increases the level of carbon dioxide in the atmosphere.

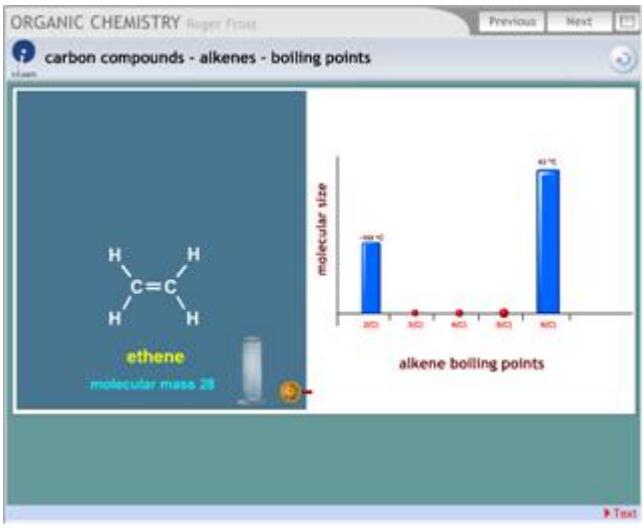


UNIT CHEMISTRY 2
12.2 HOW DO STRUCTURES INFLUENCE THE PROPERTIES AND USES OF SUBSTANCES?

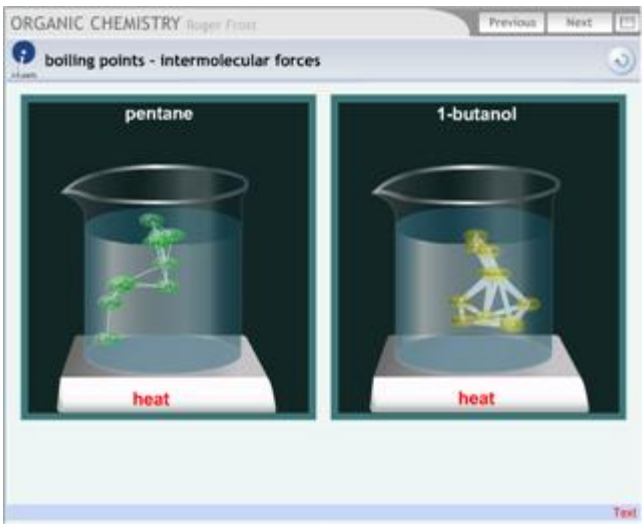
- to relate the properties of substances to their uses to suggest the type of structure of a substance given its properties



- Substances that consist of simple molecules are gases, liquids or solids that have relatively low melting points and boiling points.

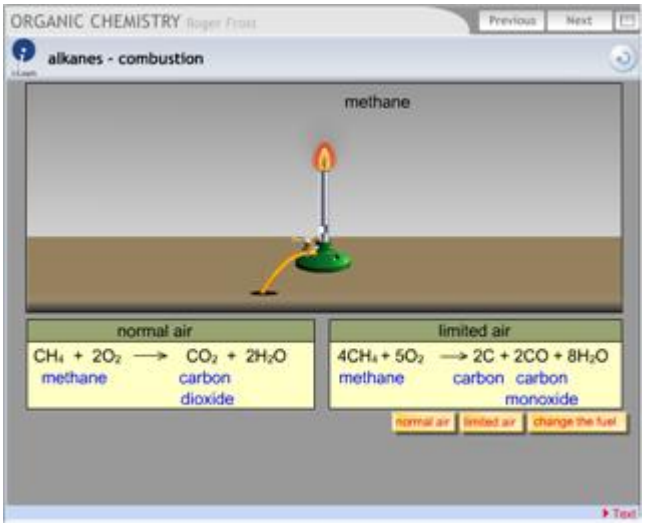


- Substances that consist of simple molecules have only weak forces between the molecules (intermolecular forces). It is these intermolecular forces that are overcome, not the covalent bonds, when the substance melts or boils



12.5 Do chemical reactions always release energy?

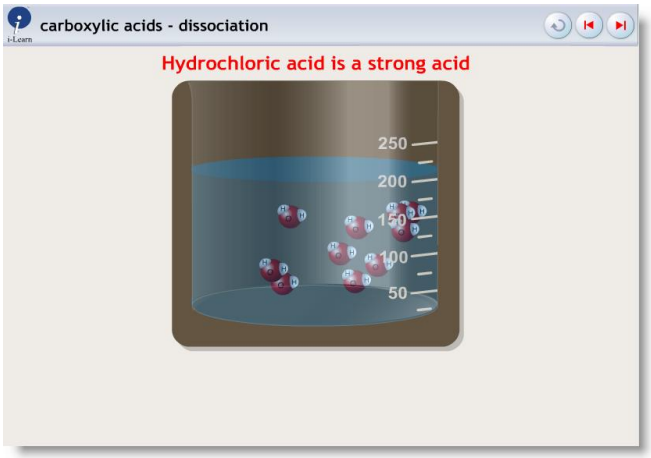
- An exothermic reaction is one that transfers energy, often as heat, to the surroundings. Examples of exothermic reactions include combustion, many oxidation reactions and neutralisation.



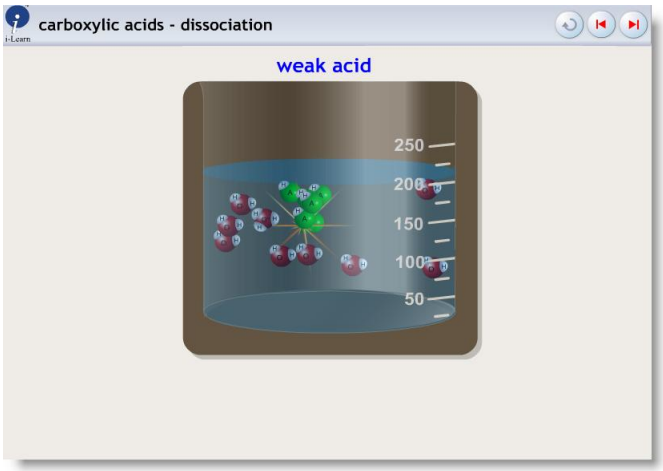
Unit Chemistry 3

13.2 What are strong and weak acids and alkalis? How can we find the amounts of acids and alkalis in solutions?

- Acids and alkalis are classified by the extent of their ionisation in water.
- A strong acid or alkali is one that is completely ionised in water. Examples of strong acids are hydrochloric, sulfuric and nitric acids. Examples of strong alkalis are sodium and potassium hydroxide.

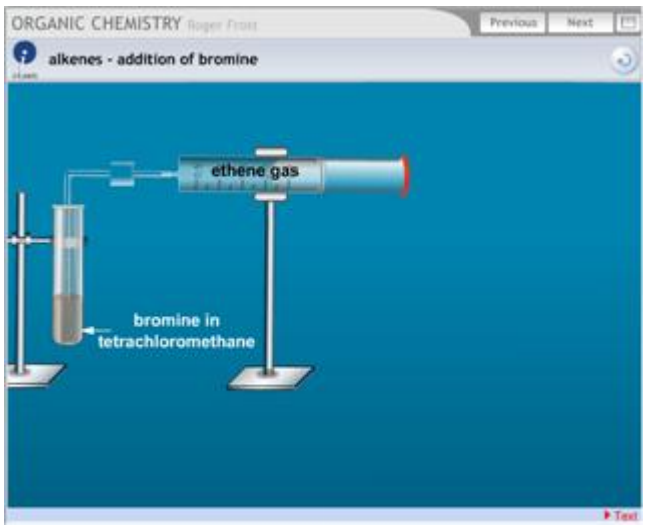


- A weak acid or alkali is only partially ionised in water. Examples of weak acids are ethanoic, citric and carbonic acids.
- An example of a weak alkali is ammonia solution

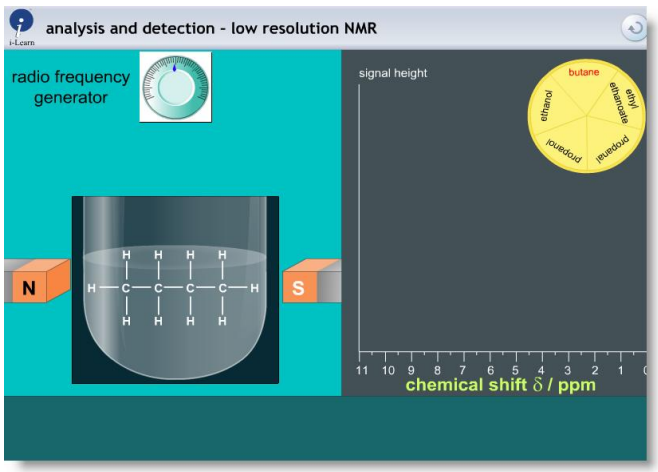


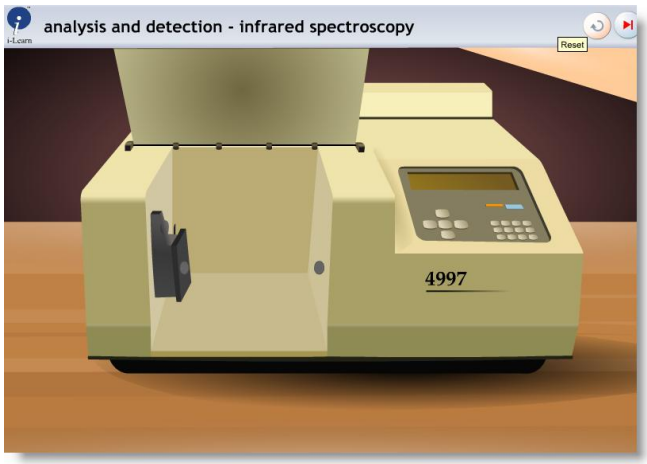
13.5 How do we identify and analyse substances?

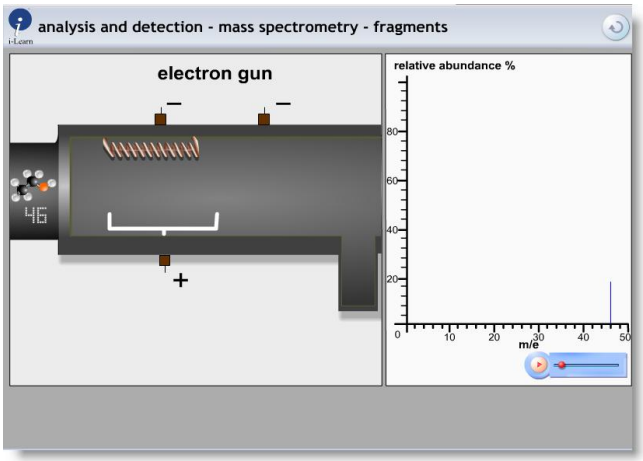
- Unsaturated organic compounds containing double carbon-carbon bonds decolourise bromine water.



- Some instrumental methods are suited to identifying elements, such as atomic absorption spectroscopy used in the steel industry.
- Other instrumental methods are suited to identifying compounds, such as infrared spectrometry, nuclear magnetic resonance spectroscopy.





- Some methods can be adapted for elements or compounds, such as mass spectrometry. (Details of how the instruments work are

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