C16 Fuels

C16a Hydrocarbons in crude oil and natural gas	
Hydrocarbon	A compound containing only hydrogen and carbon atoms.
Crude oil	A thick brown liquid made of a mixture of many different hydrocarbons found in deposits underground.
Finite resource	There is a limited amount: at some point, it will run out.
Non-renewable	A resource that will eventually run out.
Uses of crude oil	Fuel, feedstock (supply of basic chemicals) for the chemical industry.

C16b Fractional distillation of crude oil	
Fractional distillation	A type of distillation used to separate mixtures of two or more liquids due to differing boiling points.
Fractions in order	Gases, petrol, kerosene, diesel, fuel oil, bitumen: - Smallest to biggest molecules - Lowest to highest boiling point - Lowest to highest viscosity - Easiest to hardest ignition
Viscosity	How easily a fluid flows – higher viscosity = **less** runny
Ease of ignition	How easily a substance catches fire.
Gases	Used for domestic heating and cooking.
Petrol	Used as a fuel for cars.
Kerosene	Fuel for aircraft.
Diesel oil	Fuel for larger vehicles such as lorries and trains.
Fuel oil	Fuel for large ships and power stations.
Bitumen	Surfacing roads and roofs.

C16c The alkane homologous series	
Homologous series	A family of closely related compounds with molecular formulae that differ only in the number of 'CH_2's.
Physical properties in a homologous series	Vary gradually, for example the boiling point gradually increases.
Chemical properties in a homologous series	Very similar with a gradual variation.
General formula	Describes the number of each atom in any member of a homologous series.
Alkanes	Hydrocarbons containing only single bonds. The names end with '-ane'.
First three alkanes	Methane – CH_4 Ethane – C_2H_6 Propane – C_3H_8
General formula of alkanes	C_nH_{2n+2}

C16d Complete and incomplete combustion	
Combustion	When a compound reacts with oxygen producing a flame.
Complete combustion	Combustion that produces only water and carbon dioxide and releases the most possible energy. Fuel + oxygen → carbon dioxide + water E.g: Ethane + oxygen → carbon dioxide + water $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$
Carbon dioxide test	Limewater turns milky/cloudy.
Incomplete combustion	Combustion that produces a mixture of carbon dioxide, carbon monoxide, carbon and water and produces less energy.
Why incomplete combustion happens	When there is not enough oxygen for all of the reactants to be fully oxidised.
Carbon monoxide	CO. A colourless odourless a highly toxic gas.

How carbon monoxide kills	It sticks to haemoglobin in the blood, which prevents it from carrying oxygen.
Soot	The small particles of carbon produced by incomplete combustion.
Problems with soot	- Causes lung problems when breathed in. - Blackens and dirties buildings.

C16e Combustible fuels and pollution	
Sulfur dioxide	SO_2. A gas formed from the sulfur in oil and coal when it is burnt.
Acid rain	Rain with a pH lower than 5.2
Effects of acid rain	- Soil becomes too acidic for crops and plants to grow well. - Acid in rivers and lakes prevents fish eggs from hatching and kills some insects. - Acid rain increases corrosion of limestone, which damages buildings and statues.
Nitrogen oxides	NO_x. Various gases formed at high temperatures inside internal combustion engines.
Problems of nitrogen oxides	- Can dissolve in clouds to form acid rain - NO_2 causes lung damage - NO_x can cause smog to form

C16f Breaking down hydrocarbons	
Cracking	Breaking down longer less useful hydrocarbons into shorter more useful ones.
Products of cracking an alkane	An alkane and an alkene. E.g: Hexane → butane + ethene $C_6H_{14} \rightarrow C_4H_{10} + C_2H_4$
Alkene	A hydrocarbon containing a C=C double bond.
Usefulness of cracking	There is more demand for shorter hydrocarbons – such as petrol and gas – than longer ones such as bitumen. Cracking turns the less useful ones into more useful ones.

C17 Earth and Atmospheric science

C17a The early atmosphere	
The early Earth	4.5-3.5 billion years ago the Earth was extremely hot and there were many volcanoes.
The early atmosphere	Little or no oxygen, a lot of carbon dioxide, water vapour, small amounts of other gases such as nitrogen.
Origin of the early atmosphere	Gases from volcanoes.
Evidence for a lack of oxygen	The oldest rocks on Earth contain compounds such as iron pyrite that cannot form in the presence of oxygen.
Formation of the oceans	As the Earth cooled, water vapour in the air condensed to liquid water, forming the oceans.

C17b The changing atmosphere	
Changes to the atmosphere	The amount of carbon dioxide decreased, water vapour decreased, oxygen increased.
Photosynthesis and the atmosphere	Photosynthesis – by cyanobacteria and plants – consumes carbon dioxide (decreasing it) and produces oxygen (increasing it).
Oceans and carbon dioxide	Carbon dioxide dissolves in the ocean and is used by sea creatures to make their shells, enabling even more CO_2 to dissolve.
Test for oxygen	A glowing splint (stick) placed in oxygen will relight.

C17c The atmosphere today	
Greenhouse effect	Infrared radiation (heat) from the sun travels through the atmosphere and warms the ground. The ground re-emits slightly different infrared radiation that is not able to pass back through the atmosphere and is trapped by gases called greenhouse gases.
Greenhouse gases	Gases that trap re-emitted infrared radiation – including carbon dioxide, methane and water vapour.
Importance of the greenhouse effect	The greenhouse effect is extremely important; without it the average global temperature would be 32 ^{O}C lower and most life could not exist.
Increased greenhouse effect	Human activities are increasing the concentration of greenhouse gases such as carbon dioxide and methane, meaning the greenhouse effect is strong and traps more heat.
Global warming	An increase in global temperatures caused by the increased greenhouse effect.
Climate change	Change in global weather patterns caused by global warming.

C17d Climate change	
Two main causes of climate change	- Carbon dioxide produced by burning fossil fuels - Methane produced by farming (especially cows) - rice paddy fields produce significant amounts of methane
Effects of climate change	- Rising average global temperature - Increased sea level from melting ice - Increased drought in some areas and flooding in others - Increase in dangerous weather
Effect of climate change on life	Living organisms are adapted to the conditions where they live. If these conditions change, they may struggle to survive. Climate change is causing many species to struggle and some to go extinct.
Ocean acidification	The carbon dioxide we produce dissolves in the oceans, lowering the pH making it harder for many sea-creatures to build their shells.

Limiting climate change	- Reduce emissions of greenhouse gases by using renewable energy and eating less meat. - Geoengineering – perhaps placing giant mirrors in space to reflect some of the sun's heat.