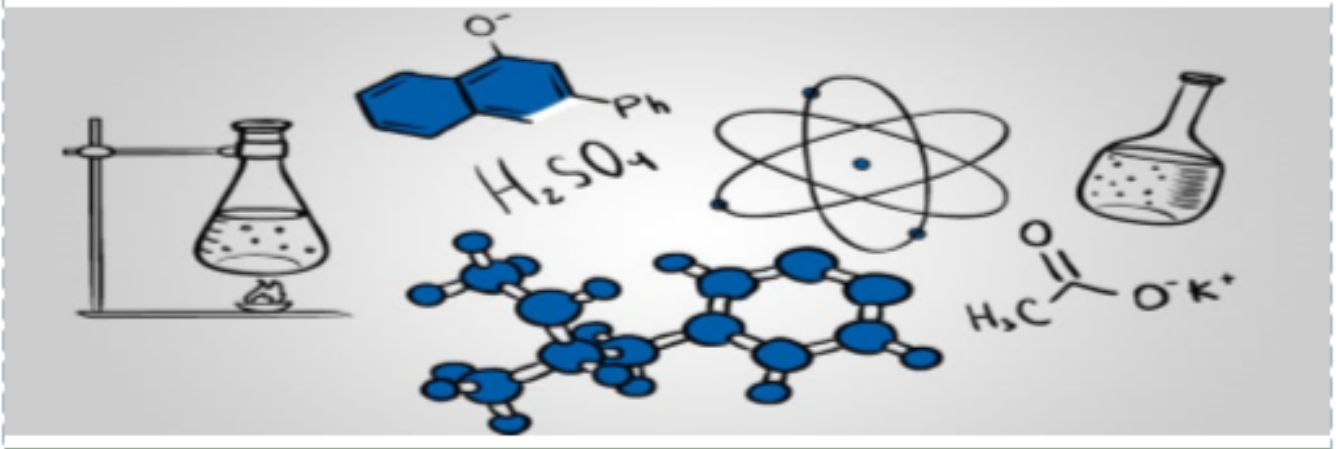
THE DUSTON SCHOOL 4-19

Knowledge Organiser

Year 11

Chemistry Paper 2

C9, C10 Chemistry of atmosphere and using resources



Knowledge Booklet: **Chemistry of atmosphere and using resources**

Big Questions and Vocabulary

- What is the atmosphere made up of and how has the atmosphere changed over time?
- What is global warming and what role have humans had to play on it?
- What is climate change and what steps can we take to reduce our carbon footprint
- How do pollutants get into the atmosphere and what harm can they cause
- Are our resources finite and how can we become more sustainable
- What processes are used to treat water to make it safe to drink or release back into environment
- How can metals be extracted other than crushing tonnes of rock?
- What must be considered when new products are in development.

Atmosphere A layer of gases surrounding the Earth	**Theory** An idea that is backed up by scientific data. Theories can evolve over time if new evidence / data is found	**Photosynthesis** A process where carbon dioxide and water is converted into glucose and oxygen
Greenhouse effect The trapping / retention of heat by the atmosphere due to presence of gases such as carbon dioxide, methane and water vapour	**Global Warming** The gradual increase in the overall temperature of the Earths atmosphere	**Climate change** A change in global / regional climate patterns. This is the general weather conditions over a long period of time
Carbon Footprint The total amount of CO_2 and other greenhouse gases emitted over the full life cycle of a product, service or event	**Combustion** An exothermic chemical reaction where an element or compound is reacted with oxygen forming new compounds	**Incomplete combustion** When there is a limited oxygen supply, so only partial oxidation is achieved, e.g when carbon monoxide forms
Sustainability Meeting the needs of today without compromising the needs of the future	**Potable water** This is water which is suitable and safe to drink. It is not pure water as it has other dissolved substances	**Fresh water** Water with low levels of dissolved substances
Desalination A process used to remove high levels of dissolved substances from water. This is typically done with distillation or reverse osmosis	**Waste water** Water containing harmful microbes, organic matter or other harmful chemical	**Phytomining** Uses plants to absorb metal compounds, which are then harvested burnt and the metal compounds isolated
Bioleaching Uses bacteria to produce leachate solutions that contain metal compounds from which metal can be isolated	**Life cycle assessments** Process used to identify the environmental impact of products over each stage in the course of its production, use and disposal	**Finite resources** Non renewable resources, once they've been used up cannot make more

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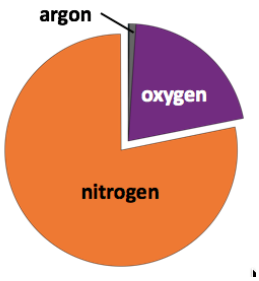
Sample Extended Questions / Practical based questions

How has the atmosphere changed since the early atmosphere
Why does burning fossil fuels lead to an increased in the global average temperature
What pollutants form during the combustion of fuels, and what effects do they have.
Compare the treatment of fresh and salt water in order to make it potable.
Using a life cycle assessment, compare the sustainability of plastic bags compared to paper bags.

The earths atmosphere as changed drastically due to the cooling of the planet, evolution of plants and animals. In recent years, human activity is starting to cause some small changes which could have a big impact tin the future



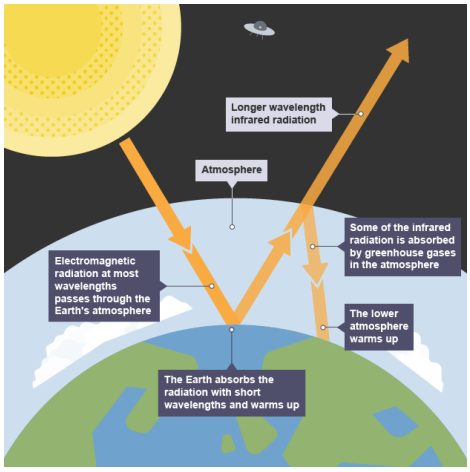
Gas	*Percentage*
Nitrogen	*~80%*
Oxygen	*~20%*
Argon	*0.93%*
Carbon dioxide	*0.04%*

The nitrogen amount has stayed stable in recent times due to the stability of the N≡N triple bond. A lot of energy is required to break it. Argon is an inert gas so doesn't easily react with anything. The CO_2 concentration has been slowly rising since industrialisation began

Volcano activity 1st Billion years	***Billions of years ago there was intense volcanic activity,*** This released gases (mainly CO_2) that formed to early atmosphere and water vapour that condensed to form the oceans when the Earth cooled
Other gases	***Released from volcanic eruptions*** Nitrogen was also released, gradually building up in the atmosphere. Small proportions of ammonia and methane were also produced.
Reducing carbon dioxide in the atmosphere	***When the oceans formed, carbon dioxide dissolved into it*** This formed carbonate precipitates, forming sediments which over time form sedimentary rocks. This reduced the levels of carbon dioxide in the atmosphere. **As algae and plants evolved, these gradually reduced the carbon dioxide levels in the atmosphere by absorbing it for photosynthesis.** This lead to increase in oxygen which allowed other forms of life to develop and evolve **Formation of fossil fuels.** Remains of biological matter falls to the bottom of oceans. Over millions of years layers of sediment settled on top of them and the huge pressures turned them into coal, oil, natural gas and sedimentary rocks. The sedimentary rocks contain carbon dioxide from the biological matter.

Algae and plants	***These produced the oxygen that is now in the atmosphere, through photosynthesis.***	carbon dioxide + water → glucose + oxygen $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$
Oxygen in the atmosphere	***First produced by algae 2.7 billion years ago.***	Over the next billion years plants evolved to gradually produce more oxygen. This gradually increased to a level that enabled animals to evolve.

In recent years, fossil fuels have been combusted to release energy to generate electricity. Fossil fuels are carbon rich, and carbon dioxide is one of the main products. Over recent years the average temperature has been rising due to increased CO_2 in the atmosphere. Carbon dioxide, methane and water vapour are green house gases, they are important for the greenhouse effect



1. electromagnetic radiation at most wavelengths passes through the Earth's atmosphere
2. the Earth absorbs most of the radiation and warms up
3. the Earth radiates energy as infrared radiation
4. some of the infrared radiation goes into space
5. some of the infrared radiation is absorbed by greenhouse gases in the atmosphere
6. the lower atmosphere warms up

Carbon dioxide	***Human activities that increase carbon dioxide levels include burning fossil fuels and deforestation. Natural activities, e.g volcanic also increase CO_2 levels***
Methane	***Human activities that increase methane levels include raising livestock (for food) and using landfills (the decay of organic matter released methane).***
Climate change	***There is evidence to suggest that human activities have caused the Earth's atmospheric temperature to increase, almost all scientists agree that we need to counter this.***

Effects of climate change
Rising sea levels
Extreme weather events such as severe storms
Change in amount and distribution of rainfall
Changes to distribution of wildlife species with some becoming extinct

To try and limit the effects of climate change, we need to reduce are carbon emissions to stop the temperature rise. This can be done by using alternative energy sources to limit consumption of fossil fuel, use more energy efficient devices to limit energy used in first place and ensure trees are planted to replace those cut down

Pollutants are chemicals that are added to the environment that are harmful either to us or the surroundings. Most of the pollutants released into the atmosphere come from powerstations and vehicles, i.e the emissions when fuels re combusted

Combustion of fuels	***Source of atmospheric pollutants. Most fuels may also contain some sulphur.***
Gases from burning fuels	***Carbon dioxide, water vapour, carbon monoxide, sulfur dioxide and oxides of nitrogen.***
Particulates	***Solid particles and unburned hydrocarbons released when burning fuels.***

Carbon monoxide CO	***Toxic, colourless and odourless gas. Not easily detected, can kill. Binds irreversibly with the haemoglobin in red blood cells stopping oxygen getting to your cells***
Sulfur dioxide (SO_2) and oxides of nitrogen (NO and NO_2)	***Cause respiratory problems in humans and acid rain which affects the environment, lowering the pH of water which can affect crops. Sulfur is an impurity in the fuel, the nitrogen is already in the air, the hot temperatures in engines / power stations cause the nitrogen to react.***
Particulates	***Cause global dimming and health problems in humans.***

Many of the Earth's resources are finite so need to be used considerably to ensure that there is enough for future generations, or ensure they are reusable. Those which aren't finite still need to be monitored and protected to ensure they are used sustainably.

Earth's resources	***Used to provide warmth, shelter, food and transport for humans***	Natural resources and resources from agriculture provide: timber, food, clothing and fuels.
		Finite resources from the Earth, oceans and atmosphere are processed to provide energy and materials.
Chemistry and resources	***Research and techniques improve agricultural and industrial processes***	These improvements provide new products and improve sustainability, ensuring the needs of today are met without compromising the needs of the future
Plastics	***Normally made using ethene from crude oil***	However, the raw material ethene can also be obtained from ethanol, which can be produced during fermentation. Industries are now starting to use a renewable crop for this process.

Potable water	***Water of an appropriate quality is essential for life*** Human drinking water should have low levels of dissolved salts and microbes. This is called potable water.
UK water	***Rain provides water with low levels of dissolved substances*** This water collects in the ground/lakes/rivers. To make potable water an appropriate source is chosen, which is then passed through filter beds and then sterilised. The main sterilizing techniques used are either Chlorine, Ozone or UV. Sterilisation is used to kill the majority of microbes found in the water.
Desalination	***Used when fresh water is limited and salty/sea water is only main source of water available for drinking*** This can be achieved by distillation or by using large membranes e.g. reverse osmosis. These processes require large amounts of energy which makes water a lot more expensive, and also will contribute to emissions since fossil fuels may be used to provide the heat energy needed to evaporate off the water.

Waste water	***Produced from urban lifestyles and industrial processes*** These require treatment before used in the environment. Sewage needs the organic matter and harmful microbes removed, as both could pollute fresh water supplies
Sewage treatment	***Includes many stages*** - Screening and grit removal - Sedimentation to produce sludge and effluent (liquid waste or sewage). - Anaerobic digestion of sludge - Aerobic biological treatment of effluent.

As much of the Earths natural ores have already been quarried, alternative methods of extracting metals / metal compounds need to be used in order to meet demand

Metals ores	***These resources are limited*** Copper ores especially are becoming sparse. New ways of extracting copper from low-grade ores are being developed.
Phytomining	***Plants absorb metal compounds*** These plants are then harvested and burned; their ash contains the metal compounds.
Bioleaching	***Bacteria is used to produce leachate solutions that contain metal compounds*** The metal compounds can be processed to obtain the metal from it e.g. copper can be obtained from its compounds by displacement or electrolysis.

LCAS	***Life cycle assessments are carried out to assess the environmental impact of products***	They are assessed at these stages: - **Extraction and processing raw materials** These typically come from the earths crust, atmosphere or oceans, they impact on the environment by using up limited resources of damaging habitats - **Manufacturing and packaging** The issues with this is the land used up for factories and the pollutants produced during production. Energy also required for transportation - **Use and operation during lifetime** Impact depends on product, could have no impact (wooden toy) or require large amounts of energy e.g a car. - **Disposal** Most rubbish ends up in landfill sites, is incinerated or recycled, each which has own problems in terms of harm to environment
Values	***Allocating numerical values to pollutant effects is difficult***	Value judgments are allocated to the effects of pollutants so LCA is not a purely objective process.

In order to increases sustainability, it is desirable that most products can be reused / recycled rather they just being disposed of at the end of their life.

Reduce, reuse and recycle	***This strategy reduces the use of limited resources*** This, therefore, reduces energy sources being used, reduces waste (landfill) and reduces environmental impacts.
Limited raw materials	***Used for metals, glass, building materials, plastics and clay ceramics*** Most of the energy required for these processes comes from limited resources. Obtaining raw materials from the Earth by quarrying and mining causes environmental impacts.
Reusing and recycling	***Metals can be recycled by melting and recasting/reforming*** Glass bottles can be reused. They are crushed and melted to make different glass products. Products that cannot be reused are recycled.

(a) The amount of carbon dioxide in the Earth's early atmosphere decreased because it was used by plants and algae for photosynthesis, dissolved in the oceans and formed fossil fuels.

Give **one** other way that the amount of carbon dioxide in the Earth's early atmosphere decreased.

_____

_____

(1)

(b) Carbon dioxide is a greenhouse gas.

Describe the greenhouse effect.

_____

_____

_____

_____

_____

_____

_____

(4)

4 marks, so need to ensure talk about 4 key points.

What type of radiaton arrives at the Earth. (long or short wavelength?)

What happens to this radiation.

What type of radiation does the Earth emit

What happens in the atmosphere?

(b) (i) The complete combustion of petrol produces carbon dioxide, water vapour and sulfur dioxide.

Name **three** elements petrol must contain.

1. _____

2. _____

3. _____

(3)

Oxygen is found in the air so that wont be part of fuel

(ii) The exhaust gases from cars can contain oxides of nitrogen.

Complete the sentence.

Nitrogen in the oxides of nitrogen comes from _____ .

(1)

What is the most abundant gas in the atmosphere?

(iii) The sulfur dioxide and oxides of nitrogen from cars cause an environmental problem.

Name the problem and describe **one** effect of the problem.

Name of problem _____

Effect of problem _____

_____

(2)

Acid rain / breathing problems, what impact do these have?

Useful Websites

https://www.bbc.com/bitesize/topics/zysvv9q https://www.bbc.com/bitesize/topics/zptnng8

https://www.youtube.com/watch?v=t1Z3GlNldLA&list=PL9IouNCPbCxVv0kvofC7GTUcqhUBddgWL

https://www.youtube.com/watch?v=1UQnUQR0tTo https://www.youtube.com/watch?v=KyVf2bVLl08

Wider Reading

Revision guide chapter C9 and C10 **BBC bitesize** **Youtube videos of the topics**

Homework Tasks

1. **Complete C9 and C10 in workbook**