Highsted Knowledge Organiser **High Performance Learning** **Year 11 Chemistry: Finite Resources**

What I need to know

Difference between finite and renewable resources
How we obtain potable water from fresh water and salt water
How sewage water is treated
The practical method to purify and analyse water
Steps involved in phytomining and bioleaching
What corrosion and rusting are

Key Vocabulary:

- **Finite**
- **Renewable**
- **Potable**
- **Fresh water**
- **Salt water**
- **Sewage**
- **Phytomining**
- **Bioleaching**
- **Corrosion**
- **Rusting**

Student reference point

Earth's Resources

Finite resources are those of which there is a **limited supply**, for example coal, oil and gas. These resources can be used to provide energy but, one day, their supply will run out.

Crude oil is processed through **fractional distillation** and **cracking** to produce many useful materials such as petrol, diesel and kerosene.

Renewable resources will not run out in the near future because the reserves of these resources are high. Examples of renewable resources include solar energy, wind power, hydropower and geothermal energy.

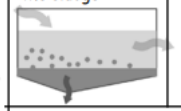
Potable water: Water that is safe to drink

Most water needs to be processed and treated to make sure it is safe to drink. Where you get the water from depends on how it gets treated:

Fresh water: rivers and lakes	Salt water: inland seas and oceans
Part 1: **filter** out debris, let large dirt **settle** to the bottom. Part 2: **sterilise** (kill off bacteria) with chlorine or ozone or UV light	Step 1: filter out large objects. Step 2: **desalinate** (remove salt) by either high temperature **distillation** or high pressure **reverse osmosis**.
Benefits: Cheaper method, less energy used, quicker to process.	Drawbacks: more expensive because high temperature and pressure use lots of energy, slower to produce

Because desalination is so much more expensive, it is used when there is no fresh water available, so countries in dry and desert areas use this method more.

Sewage water: water from human and animal waste must also be treated…

Filter out paper leaves and debris	Sedimentation of the sludge	Aerobic digestion	Sterilisation
			
	Anaerobic treatment of the **solid** waste removed		Clean water

Required Practical: Analysing and purifying water

Reproducibility and reliable results are essential. So if asked to "devise a fair test on a 100 cm^3 sample of water" you must:

1. Divide the sample into smaller volumes so you can see if your results are reproducible. Divide the sample into 10 smaller samples (e.g. 10 cm^3)
2. Always record the mass of any crucibles **before and after** to calculate the difference and find out the mass of the reside from the water sample.
3. Always use clean, dry equipment.

Type of analysis: A high pH (3-6) means acid rain, or distilled water. Low pH (8-10) means carbonate rocks and minerals dissolved in water. A boiling point of exactly 100 °C means pure water, the more impurities the lower the b.p. becomes. A freezing point of exactly 0 °C means pure water, the more impurities the lower the freezing point (this is why sea water is not frozen even at -10 °C.)

Biological Extraction Methods (Higher Tier Only)

Biological methods of extraction are needed as the resources of **metal ores** on earth are in **short supply**. Large scale **copper mining** leaves **scars on the landscape** and produces significant amounts of waste rock that must be disposed of. Biological methods have a lower impact on the environment and make use of waste containing small amounts of copper. The disadvantages of **biological extraction methods** are that they are **slow**, but they do reduce the need to obtain new ore through mining and conserve limited supplies of high-grade ore.

Phytomining

Phytomining involves the use of **plants**. Plants absorb the metal compounds found in the soil. The plants cannot get rid of the copper ions and it builds up in the leaves. The plants are then **harvested, dried** and then placed in a furnace. The ash that is produced from the burning process contains soluble metal compounds that can be extracted. The ash is dissolved in an acid such as hydrochloric or sulfuric and the copper is then extracted by electrolysis or through a **displacement reaction** with iron.

Bioleaching

Bioleaching uses **bacteria** to produce an acidic solution called **leachate** which contains **copper ions**. The disadvantage of bioleaching is that it produces **toxic substances** that are **harmful to the environment**. To process the copper, the copper undergoes a displacement reaction with iron. Iron is cheaper and a **more cost-effective** way of producing copper from the leachate.

Corrosion

Metals can corrode when **exposed** to **oxygen**; they oxidise and can form metal oxides. Some metals oxidise more quickly than others, like sodium, and some such as gold are very unreactive and do not oxidise at all.

Corrosion occurs when a metal continues to oxidise and the metal becomes weaker over time until it eventually becomes a metal oxide.

Rusting occurs when **iron or steel** reacts with **oxygen** in the **air or water**. Rusting is an example of corrosion.

iron + oxygen + water ⟶ hydrated iron(III) oxide

$4Fe + 3O_2 + 6H_2O \longrightarrow 4Fe(OH)_3$

How Can Rusting Be Prevented?

To prevent rusting, oxygen and water must be kept away from the iron or steel.

Storing the metal in an atmosphere containing unreactive argon prevents it from reacting with oxygen.

A substance such as calcium chloride can be used to absorb water vapour and keep the metal dry.

Challenge question: Describe the differences in how potable water is obtained from fresh water and salt water (6 marks)

Suggested reading: Using resources - Revise and tests - AQA Separate Chemistry - BBC bitesize

Key Assessment Information You will be assessed on the content using 1-6 mark questions

Highsted Knowledge Organiser Chemistry: Earth's Atmosphere

What I need to know

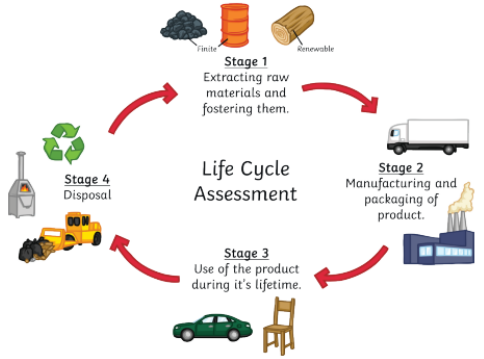
How life cycle assessments are carried out to compare products and why they are used
Advantages and disadvantages of recycling
The Haber process and how different conditions affect it
NPK fertilisers

Key Vocabulary:

- **Life cycle assessment**
- **Recycling**
- **Haber process**
- **Ammonia**
- **Equilibrium**
- **Temperature**
- **Pressure**
- **Catalyst**
- **Fertiliser**

Student reference point

Life Cycle Assessment: evaluating the impact on the environment	
You must be able to compare and evaluate two products that are made from two different types of resource that are made for the same purpose, for example a paper bag and a plastic bag. You must consider the following steps:	
Stage:	**Possible consequences:**
Extracting and processing raw material.	Does it use lots of land, does it need lots of energy, does it pollute, is it dangerous?
Manufacturing and packaging	Does it use lots of energy, does it produce large amounts of waste?
Use and operating over the life time of the product	Can it be used many times over, does it need electricity or fossil fuels?
Disposal of the product	Can it be recycled easily, does it take a long time to decompose, is it natural?
Transport of the product throughout each stage	Heavy items (wood and metal) cost more to move than light (plastic).



There are both advantages and disadvantages to recycling materials.

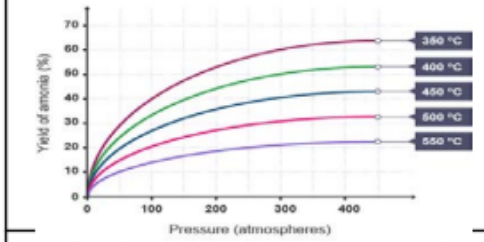
Advantages

- Fewer resources such as **mines** and **quarries** are needed to remove raw, finite materials from the ground. For example, copper.
- Crude oil, the raw material used in the production of plastics, does not need to be extracted. This, in turn, **avoids** high energy cost processes such as fractional distillation and cracking. If more items are recycled, less would end up in landfill sites.
- The amount of greenhouse gases would reduce as the energy cost of recycling is a lot **less** than making a new product.

Disadvantages

- Recycling items require collection and transport of the goods to the organisation. This involves using staff, vehicles and the use of fuel.
- Some materials, such as **metals**, can be **difficult to sort**; the amount of sorting is dependent on the purity of the materials or metals and the level of purity required for the final product. For example, copper used in electrical appliances must have a high purity. To achieve this, the copper needs to be processed and then melted down again to make copper wiring.
- Steel that is used in the construction industry does not require such high purity. Often scrap iron is added to the furnace when steel is made. This reduces the need for as much iron ore and reduces the cost of making steel.

Haber Process : production of ammonia	
Raw materials	Nitrogen collected by cooling air (until it becomes liquid) & hydrogen from the electrolysis of water.
Conditions	450°C 200 atmospheres of pressure Iron catalyst (this speeds up both forward and backwards reactions equally so does not help make just ammonia.) Unreacted H_2/N_2 are re-used.
Reversible	The reaction is reversible, so changing the conditions changes how much ammonia is made:
Increase pressure	Makes more ammonia
Increase temp.	Makes less ammonia because the reaction is exothermic, so by adding heat, the reaction will go in the endothermic direction and make N_2 and H_2



NPK fertilisers refer to the elements in the fertiliser. Ammonia is added to a range of acids to make ammonium compounds:

Ammonium nitrate	Ammonia + nitric acid
Potassium phosphate	Phosphate rock is insoluble, so is dissolved in nitric acid to form a salt that is soluble

Challenge question: Describe how life cycle assessments are carried out and why you should be cautious when using them (6 marks)

Suggested reading: Using resources - Revise and tests - AQA Separate Chemistry - BBC bitesize

Highsted Knowledge Organiser Chemistry: Earth's Atmosphere

What I need to know

How to prevent corrosion
What an alloy is and examples of alloys
The structure of sodalime glass, borosilicate glass and ceramics
The structure and properties of low and high density polyethene
The structure and properties of thermosetting and thermosoftening polymers

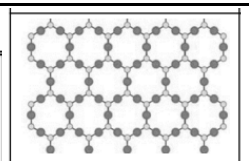
Key Vocabulary:

- **Corrosion**
- **Sacrificial protection**
- **Alloy**
- **Composite**
- **Glass**
- **Ceramic**
- **Polymer**
- **Thermosetting**
- **Thermosoftening**

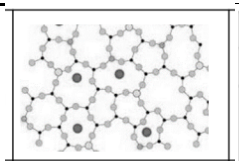
Student reference point

Corrosion is the destruction of materials by chemical reactions with substances in the environment. An example is the rusting of iron when iron reacts with oxygen and water.

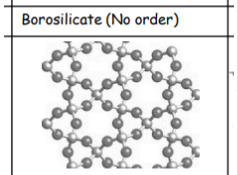
Method of prevention	How it works
Coat metal (paint, oil, grease, plastic)	Provides a barrier between metal and/or oxygen and water.
Store in an **anhydrous** compound	The compound absorbs the water from the air so it can't react with metal.
Store in boiled water with stopper / oil	Boiling water releases dissolved O_2 gas and the oil stops it returning.
Sacrificial protection (galvanisation)	Coat a metal with a more reactive metal. Zinc protects iron by reacting with the oxygen instead.



Ceramic (matrix)



Borosilicate (No order)



Silica (No order)

Composites : mixed materials to give beneficial properties

Glass is made mostly of sand (SiO_2) plus:

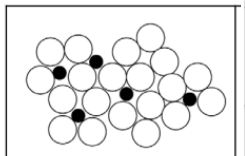
Sodalime glass	Sodium carbonante (the soda) and calcium carbonate (lime). Used for milk bottles and jars.
Borosilicate glass	Boron trioxide is added. This adds heat resistance. Used for boiling tubes and oven dishes. Does not melt as easily.

Both of these structures have NO order of the arrangement of the atoms in their giant structure.
Ceramics and clays that are also made with sand DO have an ordered to the atoms in their giant structures called a matrix. This means they are highly brittle but are excellent heat and electrical resistors. Used in bricks and crockery.

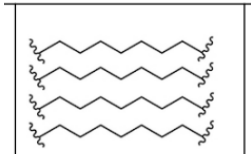
Alloys :
A metal mixed with another metal or carbon to give beneficial properties, often increased strength or corrosion resistance. The other element distorts the regular pattern of metal atoms, So atoms can't slide easily in rows.

Alloy	Elements	Use
Bronze	Cu & Sn	Statues
Brass	Cu & Zn	Door handles
Steel	Fe & C	Construction, buildings
Stainless steel	Fe, C, Cr & Ni	Cutlery, Surgical equipment does not rust

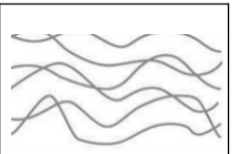
Aluminium alloys are low density so used in aircraft. Gold alloys are measured in carats, 24-carat is 100% gold, 18-carat is 75%.



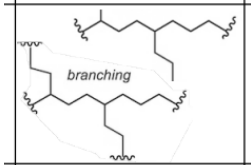
Alloy



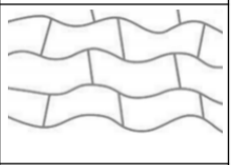
HDPE



Thermosoftening



LDPE



Thermosetting

Polymers : hydrocarbon chains that include all plastics

Poly(ethene) can be made into two types of plastic due to the way it is manufactured:

LDPE : low density	Very high pressure. The polymer chains form fast and randomly creating lots of side chains called branches. This prevents the individual poly chains packing together closely. Used for carrier bags and wire insulation as it bends
HDPE : high density	Lower pressure and a catalyst. The polymer chains form much more regular lines that pack closer together. A stronger, heavier polymer is formed. Used in pipes and plastic plates.

All polymers fall into one of two categories

Thermo softening	Remoulded easily with heat because the polymer chains are not connected and have weak intermolecular forces between them. Great for recycling. Used for bottles.
Thermo setting	The polymer chains are covalently bonded together to form a much bigger lattice that cannot melt. Cannot be recycled but does provide strength. Used where the plastic will get hot: hairdryers, engines & remains strong.

Challenge question: Describe different ways you can prevent a bike from rusting (3 marks). Describe the differences between the structures of HDPE and LDPE and how this influences their prodperties (4 marks)

Suggested reading: Earth's atmosphere - Summary notes, mind maps and practice questions - AQA Separate Chemistry - Physics and maths tutore