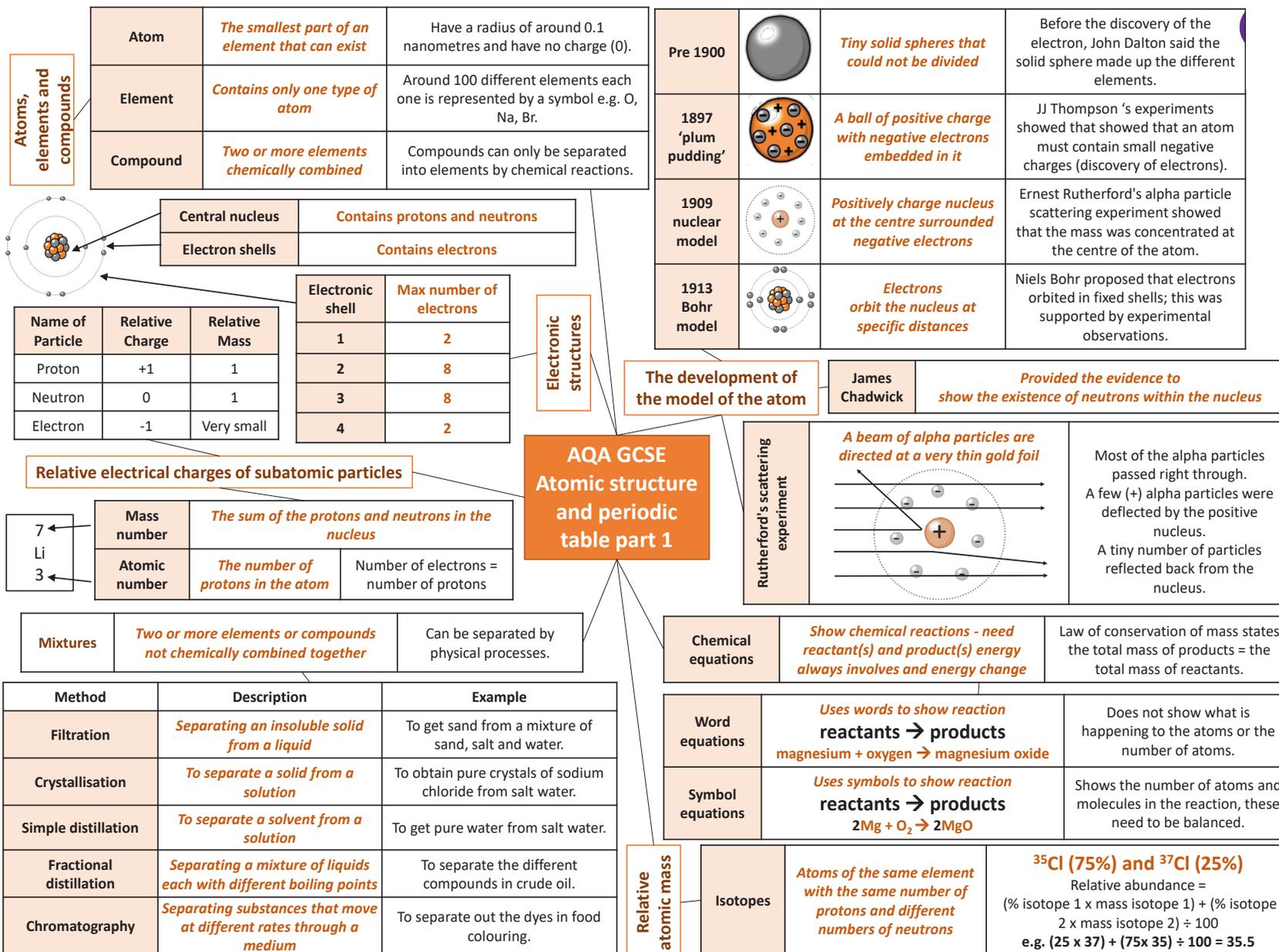
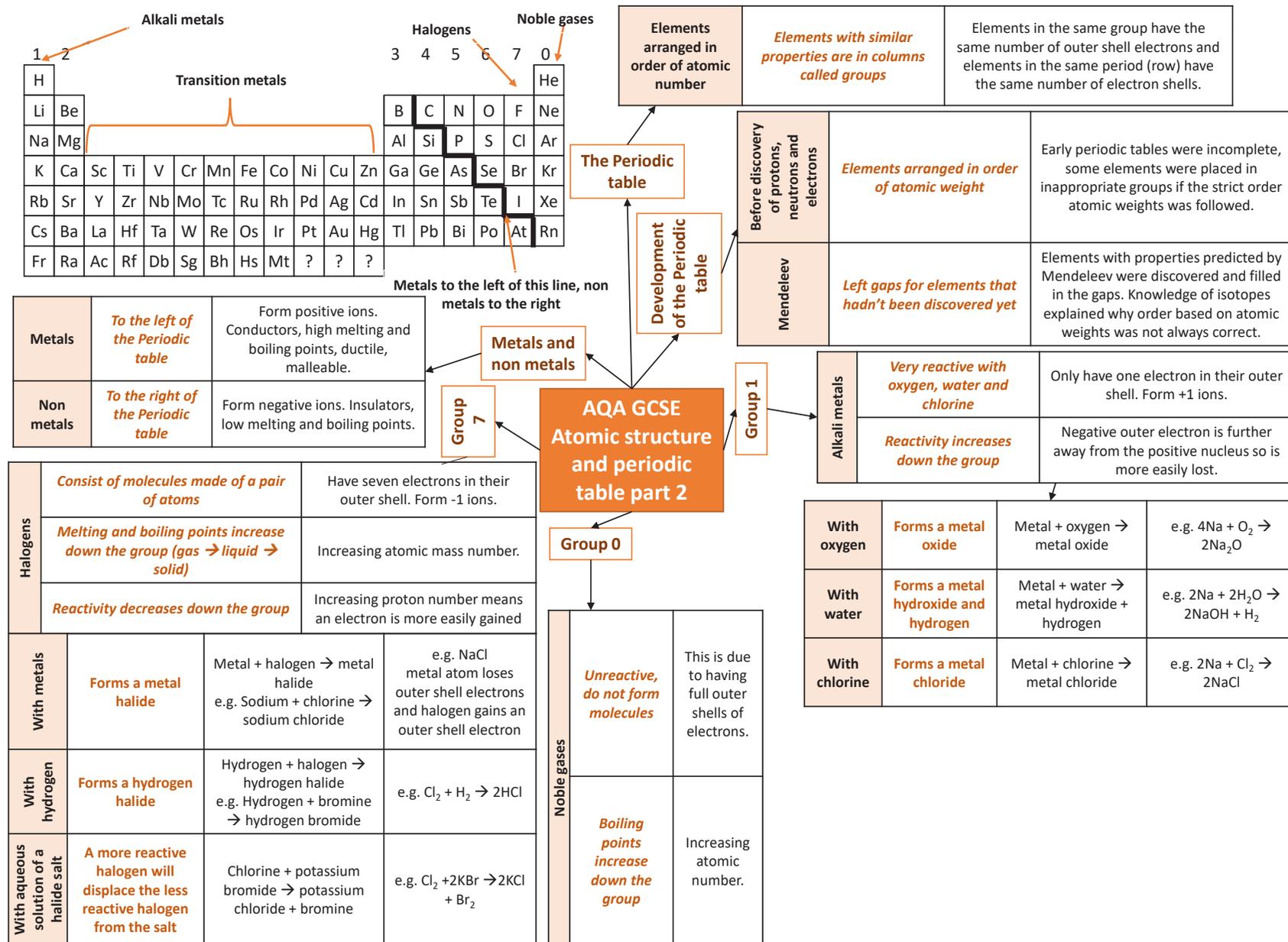


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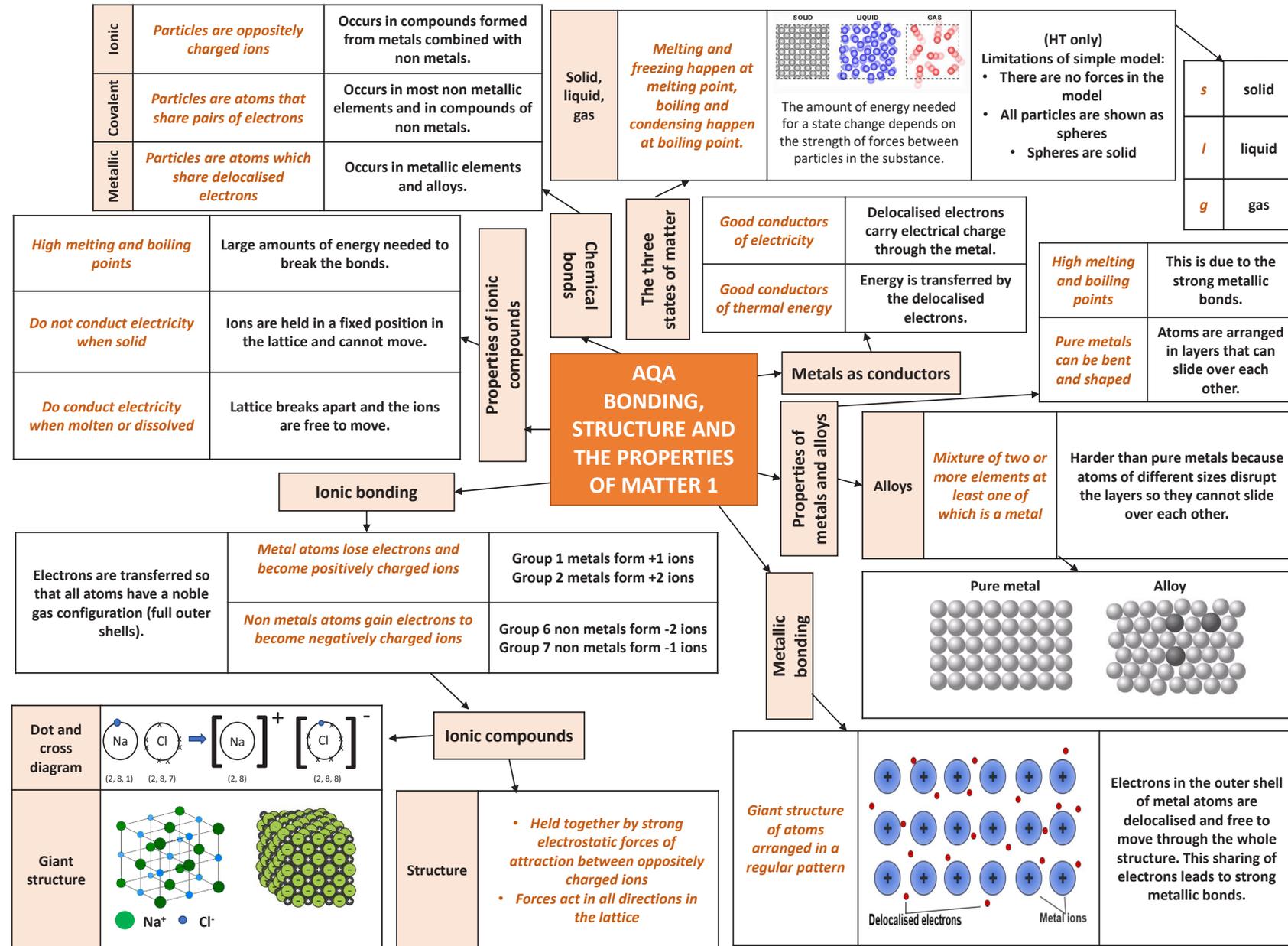
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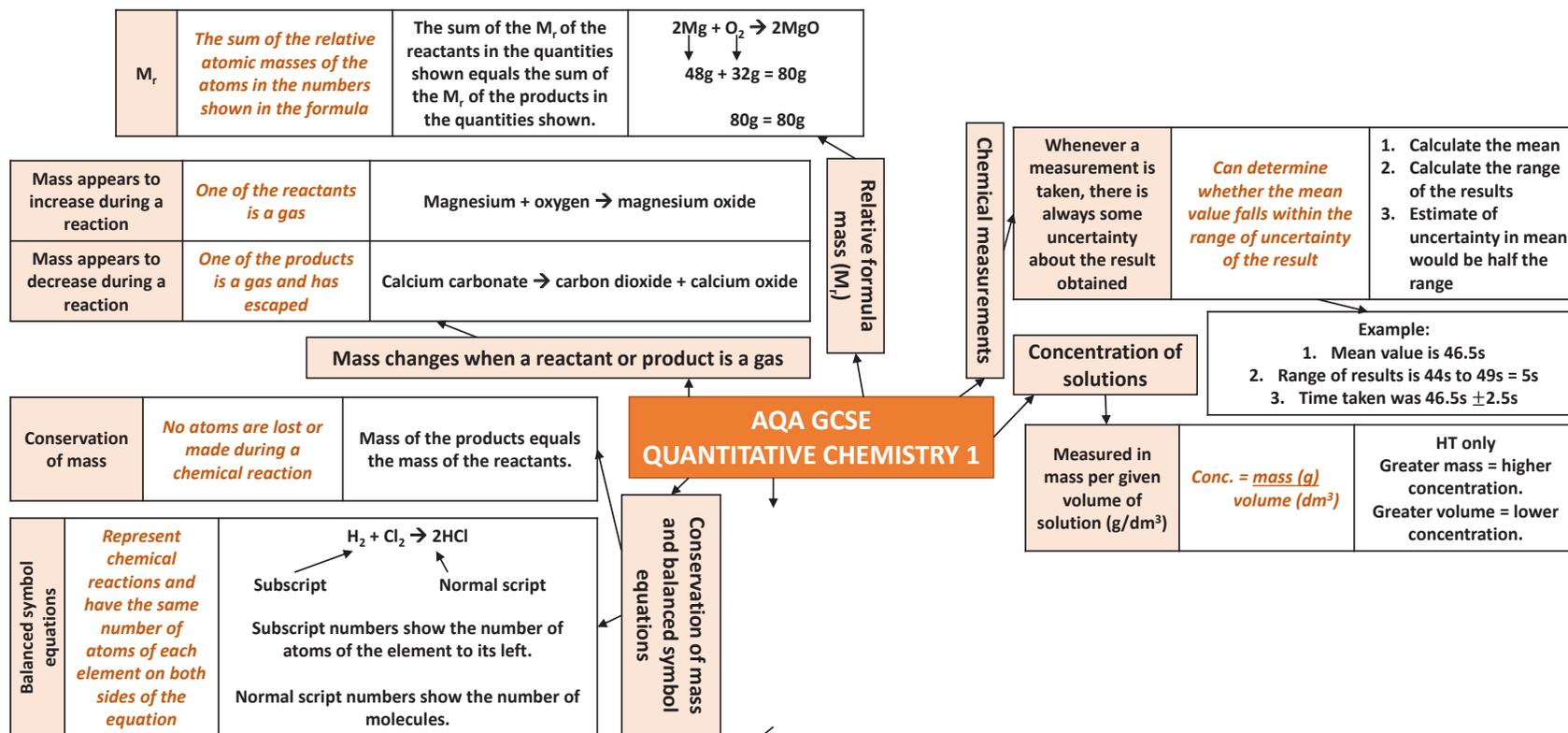
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HT ONLY: Reactions between metals and acids are redox reactions as the metal donates electrons to the hydrogen ions. This displaces hydrogen as a gas while the metal ions are left in the solution.

Reactions with acids	$metal + acid \rightarrow metal\ salt + hydrogen$	magnesium + hydrochloric acid \rightarrow magnesium chloride + hydrogen zinc + sulfuric acid \rightarrow zinc sulfate + hydrogen
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Acids react with some metals to produce salts and hydrogen.

Reactions of acids and metals

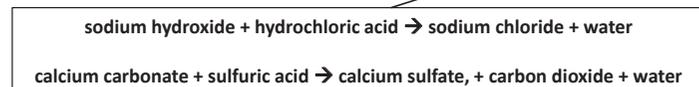
Extraction using carbon	
<i>Metals less reactive than carbon can be extracted from their oxides by reduction.</i>	For example: zinc oxide + carbon \rightarrow zinc + carbon dioxide

Extraction of metals and reduction

Unreactive metals, such as gold, are found in the Earth as the metal itself. They can be mined from the ground.

Acid name	Salt name
Hydrochloric acid	Chloride
Sulfuric acid	Sulfate
Nitric acid	Nitrate

Neutralisation of acids and salt production



Neutralisation	<i>Acids can be neutralised by alkalis and bases</i>	An alkali is a soluble base e.g. metal hydroxide. A base is a substance that neutralises an acid e.g. a soluble metal hydroxide or a metal oxide.
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Reactions of acids

AQA Chemical Changes 1

Reactivity of metals

The reactivity series

	Reactions with water	Reactions with acid
Group 1 metals	<i>Reactions get more vigorous as you go down the group</i>	<i>Reactions get more vigorous as you go down the group</i>
Group 2 metals	<i>Do not react with water</i>	<i>Observable reactions include fizzing and temperature increases</i>
Zinc, iron and copper	<i>Do not react with water</i>	<i>Zinc and iron react slowly with acid. Copper does not react with acid.</i>

Metal oxides

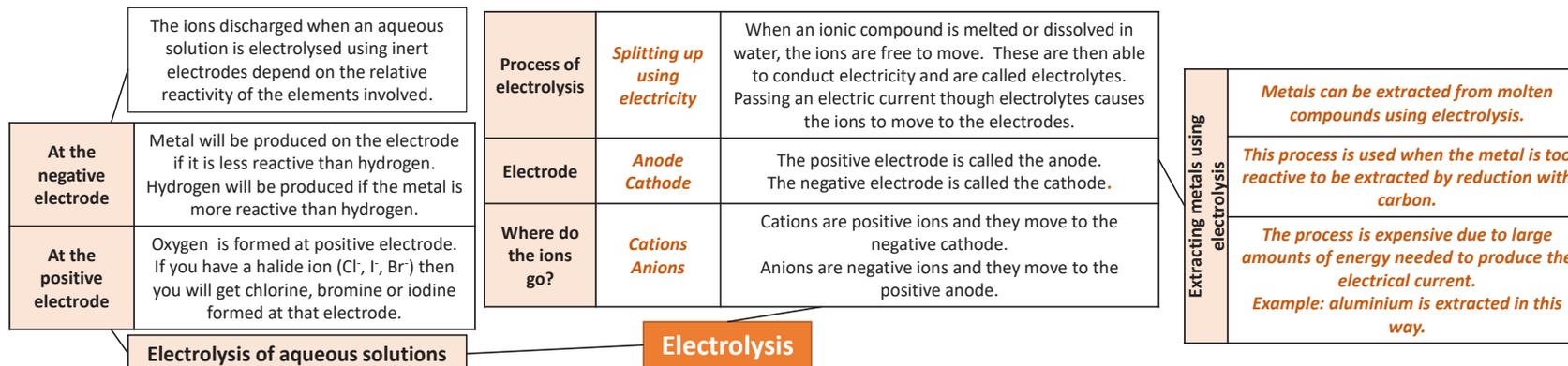
Metals form positive ions when they react	<i>The reactivity of a metal is related to its tendency to form positive ions</i>	The reactivity series arranges metals in order of their reactivity (their tendency to form positive ions).
Carbon and hydrogen	<i>Carbon and hydrogen are non-metals but are included in the reactivity series</i>	These two non-metals are included in the reactivity series as they can be used to extract some metals from their ores, depending on their reactivity.
Displacement	<i>A more reactive metal can displace a less reactive metal from a compound.</i>	Silver nitrate + Sodium chloride \rightarrow Sodium nitrate + Silver chloride

potassium	most reactive	K
sodium		Na
calcium		Ca
magnesium		Mg
aluminium		Al
carbon		C
zinc		Zn
iron		Fe
tin		Sn
lead		Pb
hydrogen		H
copper		Cu
silver		Ag
gold		Au
platinum	least reactive	Pt

Metals and oxygen	<i>Metals react with oxygen to form metal oxides</i>	magnesium + oxygen \rightarrow magnesium oxide $2Mg + O_2 \rightarrow 2MgO$
Reduction	<i>This is when oxygen is removed from a compound during a reaction</i>	e.g. metal oxides reacting with hydrogen, extracting low reactivity metals
Oxidation	<i>This is when oxygen is gained by a compound during a reaction</i>	e.g. metals reacting with oxygen, rusting of iron

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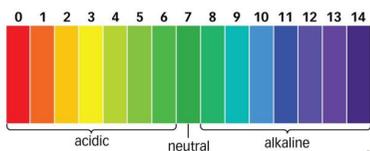
AQA Chemical Changes 2

Reactions of acids

Soluble salts	<i>Soluble salts can be made from reacting acids with solid insoluble substances (e.g. metals, metal oxides, hydroxides and carbonates).</i>
Production of soluble salts	<i>Add the solid to the acid until no more dissolves. Filter off excess solid and then crystallise to produce solid salts.</i>

Soluble salts

The pH scale and neutralisation



You can use universal indicator or a pH probe to measure the acidity or alkalinity of a solution against the pH scale.

In neutralisation reactions, hydrogen ions react with hydroxide ions to produce water:
 $H^+ + OH^- \rightarrow H_2O$

Acids	<i>Acids produce hydrogen ions (H⁺) in aqueous solutions.</i>
Alkalis	<i>Aqueous solutions of alkalis contain hydroxide ions (OH⁻).</i>

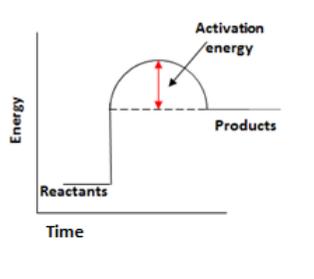
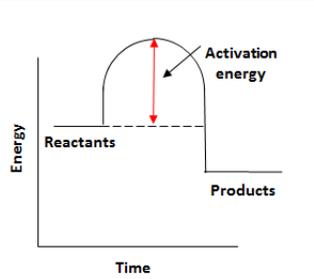
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Endothermic	<i>Energy is taken in from the surroundings so the temperature of the surroundings decreases</i>	<ul style="list-style-type: none"> • Thermal decomposition • Sports injury packs
Exothermic	<i>Energy is transferred to the surroundings so the temperature of the surroundings increases</i>	<ul style="list-style-type: none"> • Combustion • Hand warmers • Neutralisation

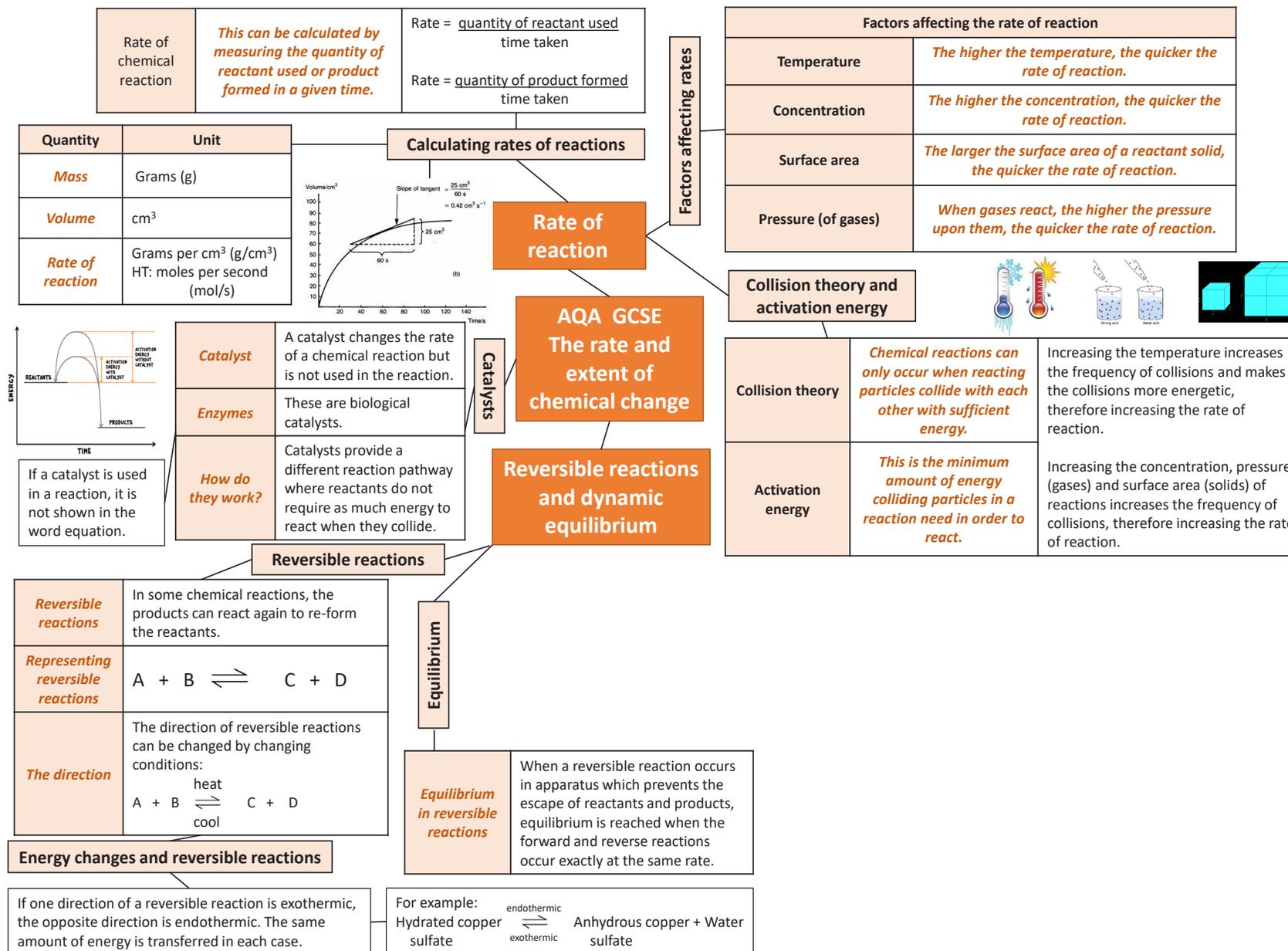
Types of reaction

AQA GCSE
Energy changes

Reaction profiles	<p>Activation energy</p> <p><i>Chemical reactions only happen when particles collide with sufficient energy</i></p> <p>The minimum amount of energy that colliding particles must have in order to react is called the activation energy.</p>
Endothermic	 <p>Products are at a higher energy level than the reactants. As the reactants form products, energy is transferred from the surroundings to the reaction mixture. The temperature of the surroundings decreases because energy is taken in during the reaction.</p>
Exothermic	 <p>Products are at a lower energy level than the reactants. When the reactants form products, energy is transferred to the surroundings. The temperature of the surroundings increases because energy is released during the reaction.</p>

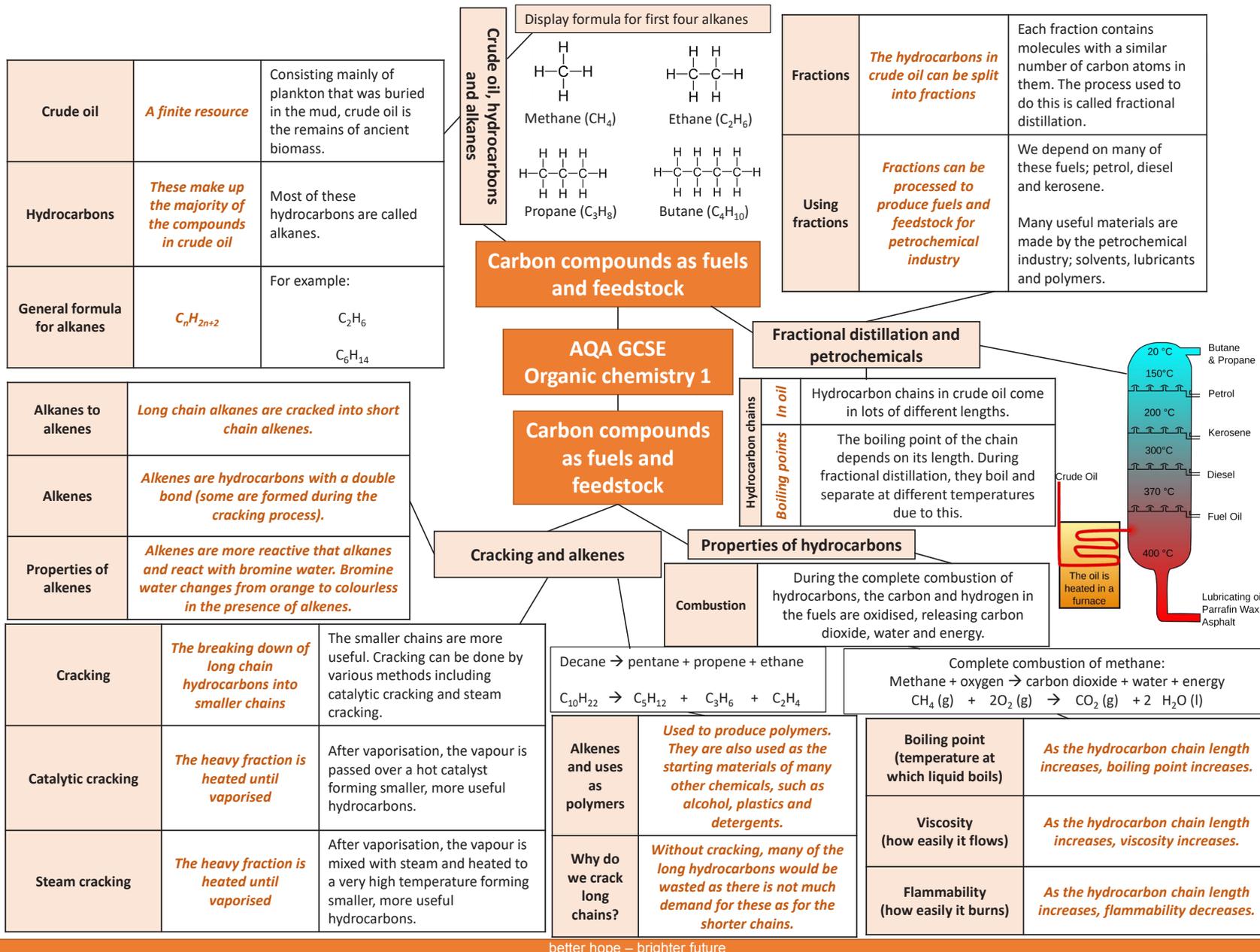
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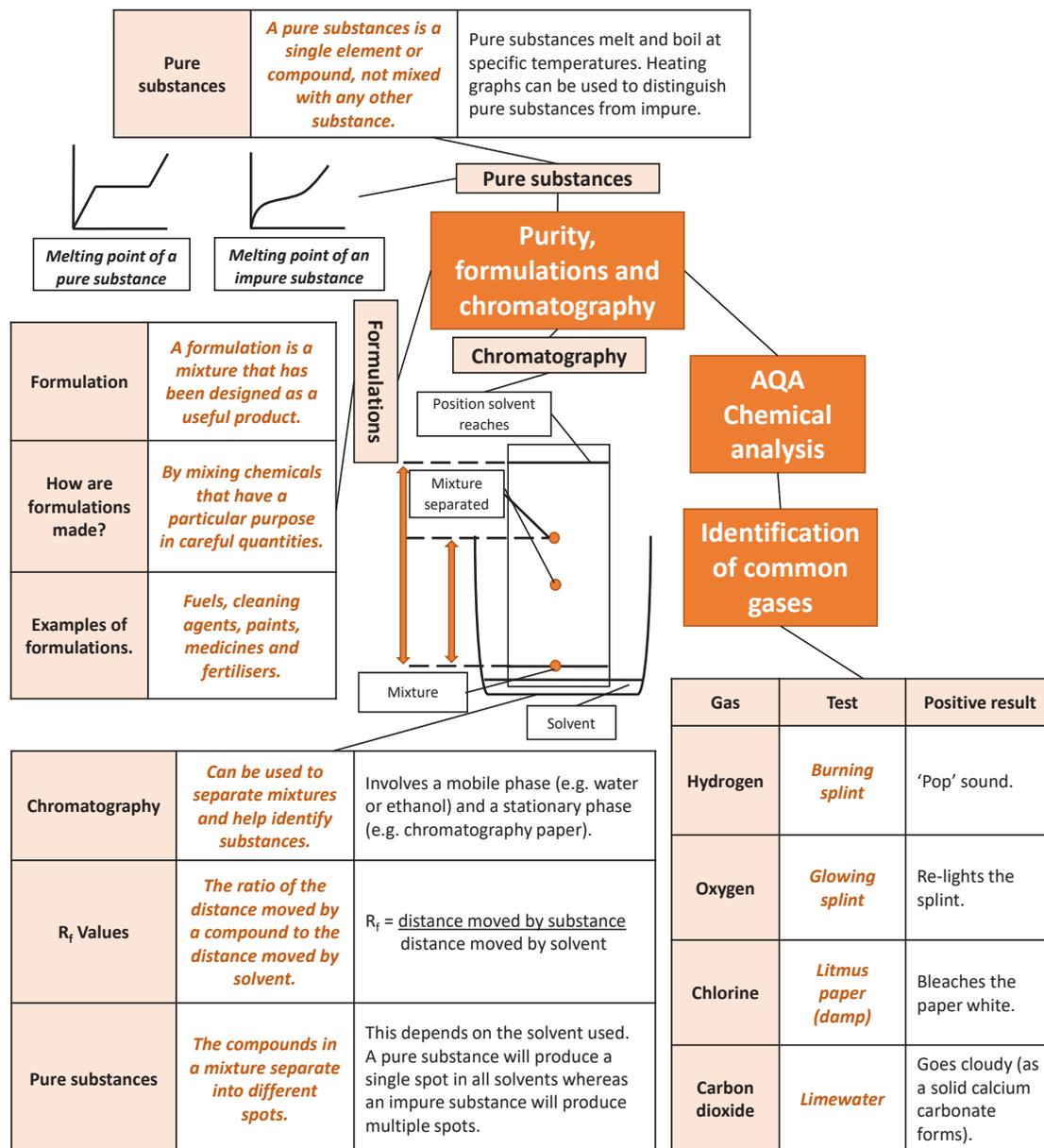
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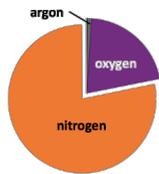
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Gas	Percentage
Nitrogen	~80%
Oxygen	~20%
Argon	0.93%
Carbon dioxide	0.04%

Proportions of gases in the atmosphere

Algae and plants	<i>These produced the oxygen that is now in the atmosphere, through photosynthesis.</i>	carbon dioxide + water → glucose + oxygen $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
Oxygen in the atmosphere	<i>First produced by algae 2.7 billion years ago.</i>	Over the next billion years plants evolved to gradually produce more oxygen. This gradually increased to a level that enabled animals to evolve.

Volcano activity 1 st Billion years	<i>Billions of years ago there was intense volcanic activity</i>	This released gases (mainly CO ₂) that formed to early atmosphere and water vapour that condensed to form the oceans.
Other gases	<i>Released from volcanic eruptions</i>	Nitrogen was also released, gradually building up in the atmosphere. Small proportions of ammonia and methane also produced.
Reducing carbon dioxide in the atmosphere	<i>When the oceans formed, carbon dioxide dissolved into it</i>	This formed carbonate precipitates, forming sediments. This reduced the levels of carbon dioxide in the atmosphere.

The Earth's early atmosphere

How oxygen increased
How carbon dioxide decreased

Composition and evolution of the atmosphere

AQA GCSE Chemistry of the atmosphere

Common atmospheric pollutants

Reducing carbon dioxide in the atmosphere	<i>Algae and plants</i>	These gradually reduced the carbon dioxide levels in the atmosphere by absorbing it for photosynthesis.
Formation of sedimentary rocks and fossil fuels	<i>These are made out of the remains of biological matter, formed over millions of years</i>	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.

CO₂ and methane as greenhouse gases

Greenhouse gases

Carbon dioxide, water vapour and methane	<i>Examples of greenhouse gases that maintain temperatures on Earth in order to support life</i>
The greenhouse effect	<i>Radiation from the Sun enters the Earth's atmosphere and reflects off of the Earth. Some of this radiation is re-radiated back by the atmosphere to the Earth, warming up the global temperature.</i>

Carbon footprints
The total amount of greenhouse gases emitted over the full life cycle of a product/event. This can be reduced by reducing emissions of carbon dioxide and methane.

Global climate change

Atmospheric pollutants from fuels

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

Properties and effects of atmospheric pollutants

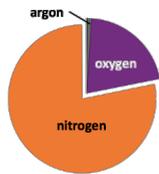
Carbon monoxide	<i>Toxic, colourless and odourless gas. Not easily detected, can kill.</i>
Sulfur dioxide and oxides of nitrogen	<i>Cause respiratory problems in humans and acid rain which affects the environment.</i>
Particulates	<i>Cause global dimming and health problems in humans.</i>

Human activities and greenhouse gases

Carbon dioxide	<i>Human activities that increase carbon dioxide levels include burning fossil fuels and deforestation.</i>
Methane	<i>Human activities that increase methane levels include raising livestock (for food) and using landfills (the decay of organic matter released methane).</i>
Climate change	<i>There is evidence to suggest that human activities will cause the Earth's atmospheric temperature to increase and cause climate change.</i>
Effects of climate change	<ul style="list-style-type: none"> 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

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