Topic: Earth and Atmosphere

Duration: 3 lessons

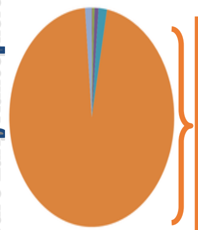
Composite:

Key vocabulary:

Earth
Volcanic
Gaseous
Eruptions
Inhospitable
Atmosphere
Stabilised
Vapour
Condensing
Absorb
Evolved
Algae
Photosynthesis
Decomposition
Nominal
Insoluble
Concentration
Radiates
Emitted
Respiration
Combustion
Sparse

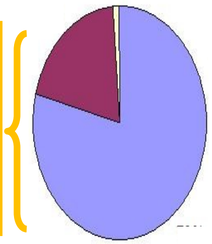
Core knowledge:

Earth's Early Atmosphere

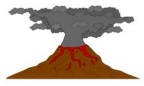


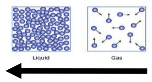
Earth's early atmosphere was mainly comprised of carbon dioxide, but there were smaller amounts of other gases.

Today's atmosphere consists of 78% nitrogen, 21% oxygen, 0.04% carbon dioxide and 0.96% other gases.

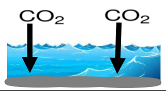


Earth's Current Atmosphere

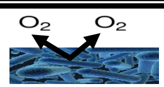
1  Volcanic eruptions release gasses that formed the Earth's early atmosphere. This is thought to have been mainly comprised of CO_2, water vapour and small traces of other gases. However, there is little or no oxygen present.

2 

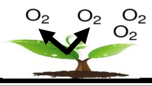
As the Earth cooled the water vapour released by volcanic eruptions cooled down and condensed. Rain fell forming the Earth's first oceans.

3 

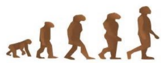
Carbon dioxide dissolved in the oceans. This reacted making insoluble carbonate compounds. These fell to the sea bed forming carbonated rocks (calcium carbonate $CaCO_3$).

4 

Photosynthetic bacteria evolved. These gave out oxygen as a waste product of photosynthesis, increasing the concentration of oxygen in the atmosphere.

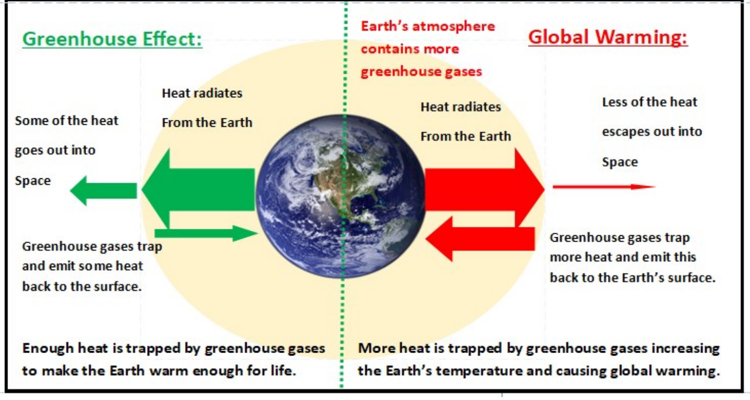
5 

Oxygen concentration reached ~10% of modern day levels. Then primitive plants started to appear which produced more oxygen through photosynthesis.

6  Oxygen concentration stabilises, making up 21% of the gases in the Earth's atmosphere a percentage which remains at this level today).

Respiration	glucose + oxygen → carbon dioxide + water	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
Photosynthesis	carbon dioxide + water → glucose + oxygen	$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$
Combustion	hydrocarbon + oxygen → carbon dioxide + water	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

Gas	Has the gas concentration increased or decreased over time?	What caused this?
Carbon dioxide	Decreased	CO_2 was absorbed in the oceans and also removed by photosynthesis (plants)
Oxygen	Increased	A by-product of photosynthesis carried out by primitive plants and algae
Water vapour	Decreased	As the Earth cooled water vapour in the early atmosphere condensed forming the oceans



Links to previous and future topics

Links to prior learning in KS3:

Most pupils will have had some experience of topics such as:

Combustion, Photosynthesis, Carbon cycle, Particle model, Renewable energy, Non-renewable energy

Links to future Learning at KS4:

Links to this content can be found in Chemistry, Biology and Physics at KS4:

Ecosystems and material cycles

Calculating angles of pie chart

States of matter

Fuels and Earth Science

Plant structures and functions

Light and the electromagnetic spectrum

Powerful knowledge:

1) Recall that the gases produced by volcanic eruptions formed the Earth's early atmosphere.

2) Describe that Earth's early atmosphere was thought to consist of mainly CO_2, some water vapor and other gases.

3) Describe the composition of today's current atmosphere as 21% - O_2, 78% - N_2, 0.04% - CO_2 and 0.96% - other gases.

4) Recall the cooling of Earth led to water vapour in the early atmosphere being condensed and falling as rain over millions of years. This formed the first oceans.

5) Explain that CO_2 concentration in the early atmosphere was reduced as it was dissolved in the newly formed oceans and taken up by primitive plants and algae performing photosynthesis.

6) Describe that various gases in the atmosphere (CO_2, CH_4 and H_2O), absorb heat radiated from the Earth, subsequently releasing energy which keeps the Earth warm (the greenhouse effect).

7) Increasing the concertation of greenhouse gases (CO_2, CH_4 and H_2O) is meaning more energy is absorbed and emitted back to Earth by these gases causing global warming.

Impressive reading

For a homework you will be presented a selection of written materials linked to climate change. You will need to summarise the key points and evidence from both articles. In the following lesson you will then discuss your findings with your peers and express your opinion on the topic broached by the articles supplied.

Impressive speaking

The opinion of many World leaders appears to be very different when it comes to the subject of global warming. In your team you will plan and execute a debate that supports or disagrees with a given statement linked to current global affairs.

Impressive writing

Donald Trump has made it very clear that he believes that global warming is 'fake news'. You will write a letter to Mr Trump either supporting or disagreeing with his statement. You need to justify any statements you make with evidence and clearly explain the Science!

Resilience

There is a lot of new content in this unit. Revisiting new material for just 15-minutes following a lesson will really help firm up and secure your knowledge. This will help you apply your core knowledge to answer exam questions and interpret graphed data in exam styled questions.

Employability

Develop skills to work as part of a team and practice communicating, expressing and sharing ideas.

Debate will allow you to present your ideas and take on-board the ideas of others when making an informed decision or forming an opinion.

Occupations linked to this topic: G7, Environmental Engineer, Environmental Lawyer, Nature Conservation Officer, Marine Biologist, Recycling Officer, Waste Management Officer, Water Quality Sciences and many more!

Topic: Year 10 Chemical Changes - Acids

Duration: 7 lessons

Composite:

Key vocabulary:

- Acid
- Base
- Alkali
- Ion
- Indicator
- Neutralisation
- Burette
- Pipette
- Titration
- Ionic
- Excess
- Concentration
- Precipitate
- Strong
- Weak
- Conical flask

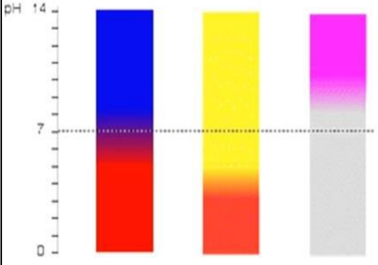
Core Knowledge in this unit:

Learn these formulae !

H_2SO_4	sulphuric acid
HCl	hydrochloric acid
HNO_3	nitric acid

Learn these formulae !

$NaOH$	sodium hydroxide
KOH	potassium hydroxide
$Ca(OH)_2$	calcium hydroxide



Litmus Methyl Orange Phenolphthalein

Solubility Rules:

All nitrates, sodium, potassium and ammonium salts are soluble.

There are extra rules for chlorides, sulfates, hydroxides and carbonates.

METAL + ACID → SALT + HYDROGEN

e.g. $Zn_{(s)} + H_2SO_{4(aq)} \rightarrow ZnSO_{4(aq)} + H_{2(g)}$

METAL OXIDE + ACID → SALT + WATER

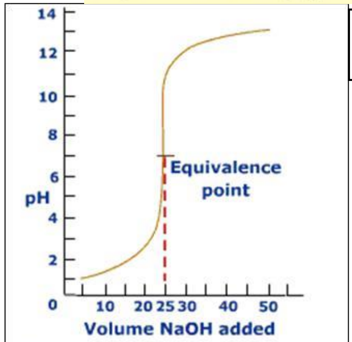
e.g. $CuO_{(s)} + H_2SO_{4(aq)} \rightarrow CuSO_{4(aq)} + H_2O_{(l)}$

METAL CARBONATE + ACID → SALT + WATER + CARBON DIOXIDE

e.g. $MgCO_{3(s)} + 2HCl_{(aq)} \rightarrow MgCl_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$

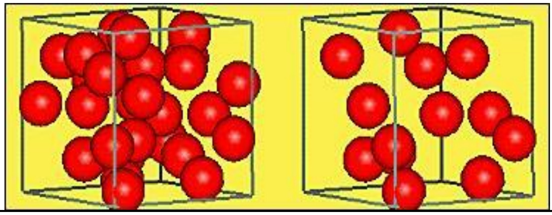
METAL HYDROXIDE + ACID → SALT + WATER

e.g. $NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$



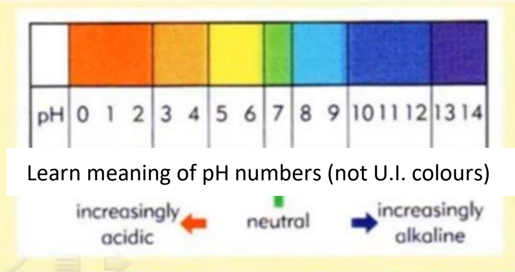
Titration curve of strong acid (HCl) with a strong base (NaOH)

The change in pH when a base is added to a strong acid.



High concentration Low concentration (dilute)

Powerful Knowledge components critical to commit to long term memory:



Learn meaning of pH numbers (not U.I. colours)

Burette

Pipette

Acid - A source of hydrogen ions in solution.

Alkali - A source of hydroxide ions in solution. A base that dissolves in water

Indicator - A substance which changes colour in acids and alkalis.

Concentration - a measure of how many particles are in a given volume.

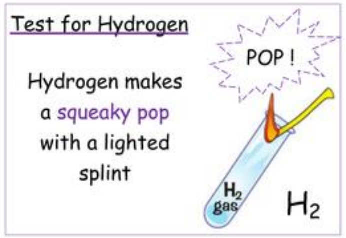
Base - the chemical opposite of an acid.

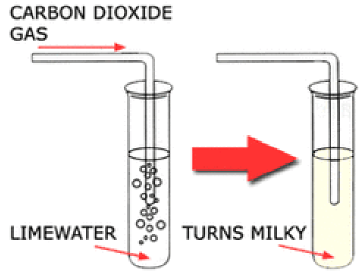
Neutralisation - reaction between an acid and a base which produces water.

Precipitate - an insoluble salt.

Strong acid/alkali – Fully dissociates in solution releasing all H^+/OH^- ions.

Weak acid/alkali – Slightly dissociates in solution not releasing all H^+/OH^- ions.





$$H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$$

Acid-alkali neutralisation ionic equation

Links to previous and future topics

- KS2 Materials
- KS3 Elements, compounds and reactivity (Yr7)
- KS3 Separations & Mixtures (Yr7)
- KS3 Particles & Solutions (Yr7)
- KS3 Solutions & Mixtures (Yr8)
- KS4 States of Matter & Mixtures (Chem)
- KS4 Chemical Changes

Impressive reading	Impressive speaking	Impressive writing	Resilience	Employability via:
Following written practical method	Collaborating with peers in practical	Describing transitions in pH curve	Questions levelled 1 to 9	Many industries use products of these reactions e.g. paints and pigments, fertilisers etc.

CULTURAL CAPITAL:

Acids and alkalis handled at home and future work can be very dangerous and need to be handled carefully following hazard symbol and instruction advice.

Newspaper article 'My face melted when drain cleaner exploded'

https://www.dailyecho.co.uk/news/8253292.my-face-melted-when-drain-cleaner-exploded/

SEND:

- Opening activity/theme is Knowledge Recall to ensure learner buy in
- Opportunities for retrieval practice and building on prior knowledge using Knowledge Recall.
- Multi-sensory approach using reading, listening, watching, doing practicals, talking, observing demonstrations…
- Repetition of key vocabulary in every lesson
- Curriculum time allocated for the explicit teaching of key vocabulary
- Skills ordered logically and sequenced with an increase in complexity

Topic: Year 10 Chemical Changes - Electrolysis

Duration: lessons

Composite:

Key Vocabulary:

Electrolyte

Electrolysis

Inert

Cathode

Anode

Cation

Cathode

Decomposition

Ion

Oxidation

Reduction

Ionic

Core Knowledge in this unit:

Oxidation

Is

Loss of electrons

Reduction

Is

Gain of electrons

Positively charged ions move to the negative electrode.

Metal ions and hydrogen ions are positively charged, so metals or hydrogen gas are produced at the negative electrode.

Negatively charged ions move to the positive electrode.

Non-metal ions such as oxide ions and chloride ions are negatively charged, so gases such as oxygen or chlorine are produced at the positive electrode.

Method for working out what is produced:

- Split the substance into its ions and the water present if in solution
- Hydrogen is only produced at the cathode when a more reactive metal is present
- If a halogen is present then that is always produced at the anode
- If no halogen is present the water produces oxygen instead

Powerful Knowledge components critical to commit to long term memory:

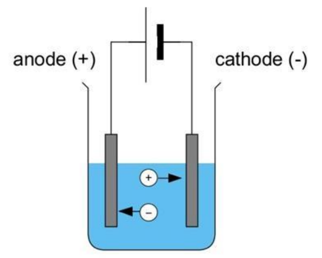
Electrolyte – ionic compounds in the molten state or in solution

Electrolysis – a process in which direct current is used to decompose (break apart) an electrolyte

Cations – positively charged ions

Anions – negatively charged ions

Inert - unreactive



Ions are attracted to an oppositely charged electrode

Links to previous and future topics

KS2 Materials

KS3 Elements, compounds and reactivity (Yr7)

KS3 Separations & Mixtures (Yr7)

KS3 Particles & Solutions (Yr7)

KS3 Solutions & Mixtures (Yr8)

KS4 States of Matter & Mixtures

KS4 Chemical Changes

KS4 Obtaining and using metals

KS4 Transition metals, alloys and corrosion

KS5 Acid-Base Redox Reactions

KS5 Redox and Electrode Potentials

Electrolyte	Electrodes	Reduction Reaction at Cathode (-)	Oxidation Reaction at Anode (+)
Copper chloride solution	Carbon	$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	$2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$
Sodium chloride solution	Carbon	$2H^+(aq) + 2e^- \rightarrow H_2(g)$	$2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$
Sodium sulphate solution	Carbon	$2H^+(aq) + 2e^- \rightarrow H_2(g)$	$4OH^-(aq) \rightarrow 2H_2O(l) + O_2(g) + 4e^-$
Water acidified with sulfuric acid	Carbon	$2H^+(aq) + 2e^- \rightarrow H_2(g)$	$4OH^-(aq) \rightarrow 2H_2O(l) + O_2(g) + 4e^-$
Molten lead bromide	Carbon	$Pb^{2+}(l) + 2e^- \rightarrow Pb(s)$	$2Br^-(l) \rightarrow Br_2(l) + 2e^-$
Copper sulfate solution	Carbon	$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	$4OH^-(aq) \rightarrow 2H_2O(l) + O_2(g) + 4e^-$
Copper sulfate solution	Copper	$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	$Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$

Impressive reading	Impressive speaking	Impressive writing	Resilience	Employability via:
CULTURAL CAPITAL:				
SEND				

KS4 Chemistry: Fuels

Composite topic test

Keywords:

Hydrocarbon
Ignition
Combustion
Alkane
Alkene
Unsaturated
Saturated
Viscosity
Volatility
Cracking
Fractions
Fractional
Distillation
Vaporised
Catalyst
Finite
Renewable
Non-renewable
Homologous
Carbon monoxide
Haemoglobin
Impurities
Carbon dioxide
Sulfur dioxide
Nitrogen oxides
Incomplete
Excess
Toxic

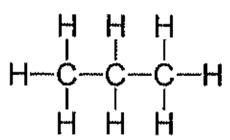
Core Knowledge

Homologous Series - a series of compounds with the same general formula, with each successive member differing by a $-CH_2$ (i.e. They get bigger).

Members of a series show <u>similar chemical properties</u> and a <u>trend in physical properties.</u>

e.g. Boiling points increase with molecular size.

For example, the general formula for the alkanes is $\mathbf{C_nH_{2n+2}}$ (where n is the number of carbon atoms in the molecule).



C_3H_8 where n = 3

Hydrogen as a Fuel Compared with Petrol in Cars

<u>Advantages</u>

When hydrogen burns in oxygen, only water is produced and no pollution.

Hydrogen + Oxygen → Water

Hydrogen can be produced from water which is plentiful.

<u>Disadvantages</u>

Hydrogen is a gas and is therefore more difficult to contain than liquid petrol.

There is no national system for filling a car with hydrogen whereas petrol can be obtained from fuel stations across the country.

Hydrogen is a flammable gas.

Powerful Knowledge

CRUDE OIL - is a <u>complex mixture</u> of molecules called hydrocarbons (which are molecules made of hydrogen and carbon atoms <u>only</u>) and they can be chains or rings in shape but crude oil is not useful in this form. To make it useful, it needs to be sorted into groups of molecules of similar size called <u>fractions</u> using a technique called <u>fractional distillation</u>.

Crude oil can be burned as a fuel or used as a chemical feedstock to make many other useful things e.g. Plastics.

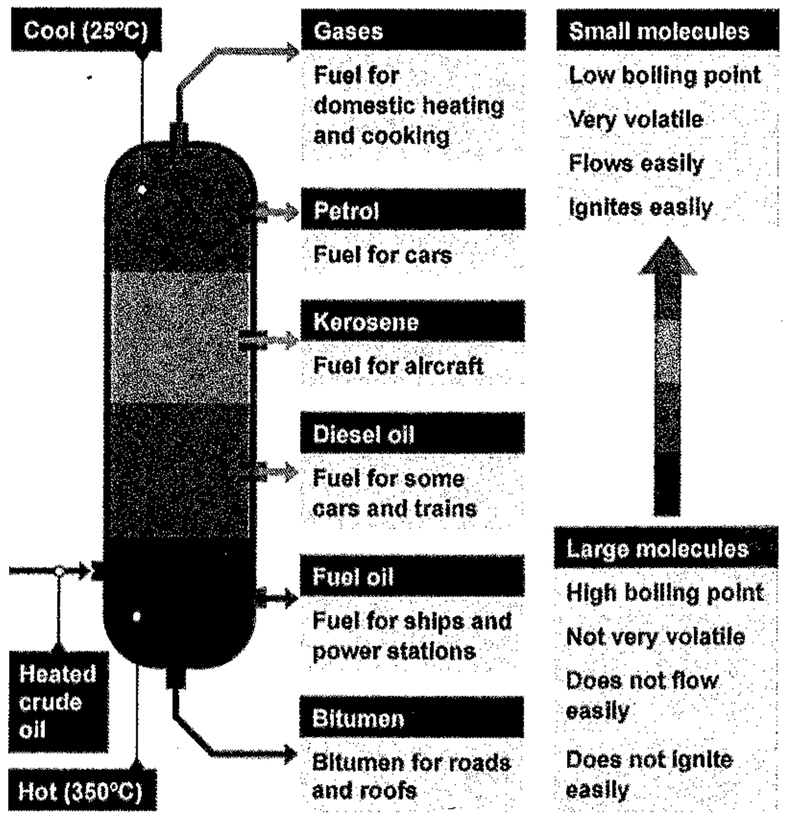
This is the process of FRACTIONAL DISTILLATION which produces simpler more useful mixtures of molecules from crude oil.

- The crude oil is first heated to turn most of it into a vapour.
- The vapour rises up the column.
- The molecules cool and condense at their different boiling points producing groups of molecules of similar size

Petrol, kerosene and diesel are non-renewable fuels produced from fossil fuels, whereas, methane is a non-renewable fuel produced from natural gas.

Non-renewable fuels took millions of years to form and therefore cannot be replaced.

Fractional Distillation



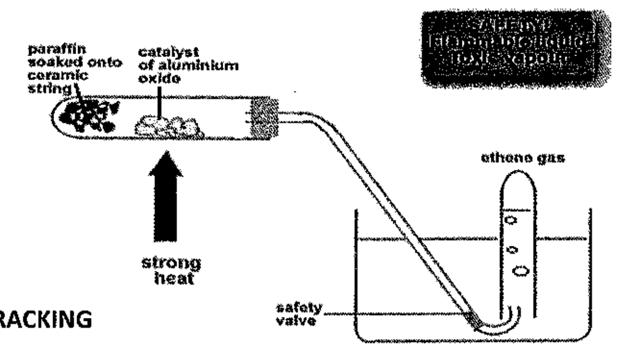
<u>Problems with Burning Fuels:</u>

In the presence of excess oxygen (COMPLETE COMBUSTION), hydrocarbons react with oxygen to make only water and carbon dioxide, but carbon dioxide is a greenhouse gas which causes climate change.

In the presence of insufficient oxygen (INCOMPLETE COMBUSTION), hydrocarbons react with oxygen to make water, carbon monoxide (which is toxic) and/or carbon/soot (which makes things look dirty and can block jets in boilers).

Acid rain can form when sulfur impurities in the fuel burn and react with oxygen to make sulfur dioxide which then dissolves in rain water.

When fuels are burnt at very high temperatures, such as in aeroplane engines, nitrogen and oxygen are able to react with one another forming oxides of nitrogen which can cause also cause acid rain and brown photochemical smog.



CRACKING

Cracking allows the breaking down of larger saturated, hydrocarbons molecules (alkanes containing only single covalent bonds) into smaller, more useful hydrocarbon molecules, some of which are unsaturated (alkenes containing carbon-carbon double bonds).
This helps supply to meet demand.
Cracking is an example of <u>thermal decomposition</u> as heat is used to break bonds in molecules.

Links to other topics

<u>Links to Key Stage 2:</u>

There may be limited links with basic ideas of combustion, plastics and pollution/climate change.

<u>Links to Key stage 3:</u>

There are a number of topics where links can be made to your prior knowledge:

Incomplete Combustion
Complete Combustion.
Renewable and Non-renewable fuels
Climate Change
Carbon Cycle
Earth and Atmosphere
Balancing Equations
Writing Formula

<u>Links to Key stage 4:</u>

There are a number of links to key stage four content:

<u>Biology:</u>

Carbon Cycle
Respiratory System
Circulatory System
Cellular Respiration

<u>Chemistry:</u>

Balancing Equations
Empirical Formula
Molecular Formula
Covalent Bonding
Global Warming
Greenhouse Effect
Acid Rain
Polymers
Hydrocarbons

Topic: KS4: Topic 4 Extracting metals and Equilibria – Obtaining and using metals (C)

Duration: 4 lessons

Composite: Unit test

Key vocabulary:

Reactivity, Displacement, Tendency, Salt, Electrons, Ions, Cations, Oxidised, Reduction, Ore, Extraction, Electrolysis, Recycling, Lifetime assessment (LTA) Reversible, Reactants, Products, Dynamic equilibrium, Rate, Haber Process, Catalyst, Temperature, Pressure

Core knowledge Components

Powerful knowledge components crucial to commit to long term memory (in red box)

1. Know the products of a reaction between metal and water. Products are a metal hydroxide (forming an alkaline solution) and hydrogen gas.

   Metal + water -> metal hydroxide + water

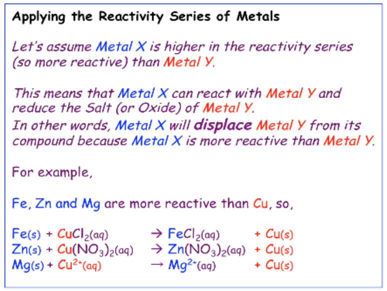
2. Recall that fairly reactive metals react with acids to produce a salt and hydrogen gas.

   Acid + metal → salt + hydrogen

3. Know that the more reactive metals will react with oxygen more quickly and recall the word equation for metals reacting with oxygen:

   Metal + oxygen -> metal oxide

4. Explain how displacement reactions can show which metal is the most reactive.



Applying the Reactivity Series of Metals

Let's assume Metal X is higher in the reactivity series (so more reactive) than Metal Y.

This means that Metal X can react with Metal Y and reduce the Salt (or Oxide) of Metal Y.
*In other words, Metal X will **displace** Metal Y from its compound because Metal X is more reactive than Metal Y.*

For example,

Fe, Zn and Mg are more reactive than Cu, so,

$Fe_{(s)} + CuCl_{2(aq)} \rightarrow FeCl_{2(aq)} + Cu_{(s)}$
$Zn_{(s)} + Cu(NO_3)_{2(aq)} \rightarrow Zn(NO_3)_{2(aq)} + Cu_{(s)}$
$Mg_{(s)} + Cu^{2+}_{(aq)} \rightarrow Mg^{2+}_{(aq)} + Cu_{(s)}$

5. Recall that: most metals are extracted from ores found in the Earth's crust, and unreactive metals are found in the Earth's crust as the uncombined elements.

- Most metals are found as compounds that require chemical reactions to extract the metal but gold is very unreactive and can be found in the Earth as itself.

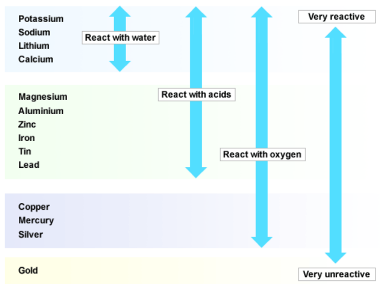
6. Recall that the extraction of metals involves reduction of ores

- Metals less reactive than carbon.
- Can be extracted from their oxides by reduction with carbon

Red box:

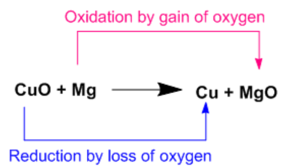
1. **Deduce the relative reactivity of some metals, by their reactions with water, acids and salt solutions.**

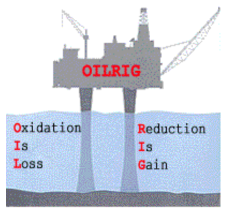
2. **Explain the reactivity series of metals (potassium, sodium, calcium, magnesium, aluminium, (carbon), zinc, iron, (hydrogen), copper, silver, gold) in terms of the reactivity of the metals with water and dilute acids and that these reactions show the relative tendency of metal atoms to form cations.**



- **When metals react with other substances, metal atoms form positive ions (they lose electrons to become cations)**
- **Reactivity of a metal is related to its tendency to form positive ions (cations) more reactive metals can form cations more easily**

3. **Explain oxidation as the gain of oxygen and reduction as the loss of oxygen.**





4. **Explain why the method used to extract a metal from its ore is related to its position in the reactivity series and the cost of the extraction process, illustrated by heating with carbon (including iron) and electrolysis.**

Links to previous and future topics

KS3: Elements and compounds, The Periodic Table, Separation Techniques, Metals and Reactivity

KS4: Obtaining & Using Metals, The Periodic Table

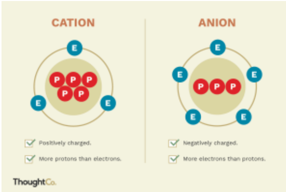
KS3: Elements and compounds, The Periodic Table, Separation Techniques, Metals and Reactivity

KS4: Obtaining & Using Metals, The Periodic Table, Dynamic Equilibria

7. Recall the general word equation for extracting a metal compound from its ore and give an example of a symbol equation.

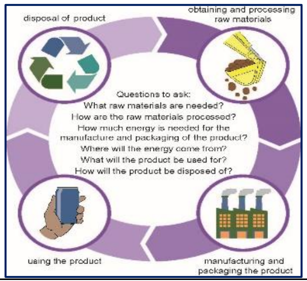
- Metal compound + carbon → metal + carbon dioxide
- $2Fe_2O_3$ (s) + 3C(s) -> 4Fe(l) + $3CO_2$ (g)

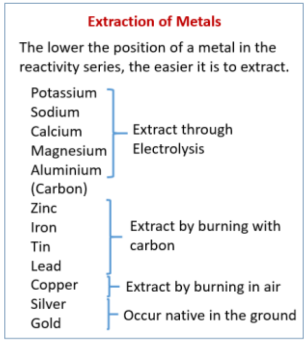
8. Explain how cations and anions are formed.



9. Describe that a life time assessment for a product involves the consideration of the effect on the environment of obtaining the raw materials, manufacturing the product, using the product and disposing of the product when it is no longer useful.

● These are carried out to assess the environmental impact of products in each of these stages:
o Extracting and processing raw materials
o Manufacturing and packaging
o Use and operation during its lifetime
o Disposal at the end of its useful life, including transport and distribution at each stage
● Use of water, resources, energy sources and production of some wastes can be fairly easily quantified
● Allocating numerical values to pollutant effects is less straightforward and requires value judgements, so LTA (life time assessment) is not a purely objective process
● Selective or abbreviated LTAs can be devised to evaluate a product but these can be misused e.g. in support of claims for advertising purposes





● Can only be extracted by reduction of carbon if metal is less reactive - carbon displaces the metal from the ore
● If more reactive than carbon, electrolysis can be used (metals less reactive than carbon can also be extracted this way)
● Electrolysis is expensive due to large amounts of energy needed to melt the compounds and to produce the electrical current (so you wouldn't extract a metal using electrolysis if it could be done more cheaply using carbon)

5. Explain how a metals' relative resistance to oxidation is related to its position in the reactivity series.
● Relative resistance to oxidation is the same as relative resistance to losing electrons / forming positive metal ions
● Less reactive a metal is, the more resistant it is to oxidation, because for a metal to react, it forms a positive metal ion by losing electrons (loss of electrons=oxidation)

6. Evaluate the advantages of recycling metals, including economic implications and how recycling can preserve both the environment and the supply of valuable raw materials.
● Recycling is important to achieve sustainable development
o Requires less energy to melt and remould metals than it does to extract new metals from their ores
o Mining ores is bad for the environment as large quarries are created, which produce noise pollution and dust
o Also, recycling allows for waste metals to be reused, saving money, helping the environment and the supply of valuable raw materials (meaning metal ores will last longer).

7. Evaluate data from a life cycle assessment of a product.

1. Recall that chemical reactions are reversible, the use of the symbol ⇌ in equations and that the direction of some reversible reactions can be altered by changing the reaction conditions.

- **The direction of the reaction can be changed by changing the conditions E.g. if the forwards reaction takes place in hot conditions, lowering the temperature can allow the reverse reaction to take place**

2. Explain what is meant by dynamic equilibrium.

<table>
<tr>
<td></td>
<td>1. Recall that the ⇌ symbol is used to show that a reaction is reversible.
• E.g. The Haber Process: nitrogen + hydrogen ⇌ ammonia
2. Describe the connection between reactants and products during dynamic equilibrium.
• During the reaction, the same percentage of reactants and products are formed at the same rate.
3. Identify where the products of the Haber process come from.
• nitrogen - extracted from the air
• hydrogen - obtained from natural gas
4. Recall the conditions for the Haber process.
• The purified gases (nitrogen and hydrogen) are passed over a catalyst of iron at:
• a high temperature (about 450 °C) and
• a high pressure (about 200 atmospheres).</td>
<td colspan="2">3. Describe the formation of ammonia as a reversible reaction between nitrogen and hydrogen and that it can reach a dynamic equilibrium.
• Ammonia is manufactured using the Haber process. It is used to make nitrogen-based fertilisers. This is a reversible reaction between nitrogen (from the air) and hydrogen (from natural gas) that can reach dynamic equilibrium. The reaction is illustrated below:
Word equation: Nitrogen + hydrogen ⇌ ammonia
Formula equation: N_2 (g) + $3H_2$ (g) ⇌ $2NH_3$ (g)</td>
<td></td>
</tr>
<tr>
<td>Impressive reading</td>
<td>Impressive speaking</td>
<td>Impressive writing</td>
<td>Resilience</td>
<td>Employability via:</td>
</tr>
<tr>
<td>1 lesson.
Reading for information</td>
<td>Able to explain models of dynamic equilibrium.
Explain the need for fertilisers and impact on food availability (culture capital)</td>
<td>Structured answers.
Plastic bags vs Paper bags</td>
<td>Explaining how conditions push reverse changes in line with Chataliers principle (simple terms)</td>
<td>Product Design involving plastics, ceramics, polymers and composites; material scientist, engineering: composite, chemical, polymer; mining, artist, architect</td>
</tr>
<tr>
<td colspan="5">SEND
• Opening activity/theme is opening slide to ensure learner buy in
• Opportunities for retrieval practice and building on prior knowledge: knowledge recall slide
• Multi-sensory approach using reading, listening, practical work, watching videos, dual-coding, practical work, paired working, observing teacher demonstrations
• Repetition of key vocabulary in every lesson
• Curriculum time allocated for the explicit teaching of key vocabulary
• Skills ordered logically and sequenced with an increase in complexity
• Links to prior learning explicitly highlighted to support non-verbal reasoning
• Texts used/alternative texts available with a consideration to reading age</td>
</tr>
</table>