Revision Guide

AQA GSCE Triple Chemistry Paper 2 Higher

Name: Class:

10 Minutes on….

Calculating Rates of Reaction

Key Term	Definition
Rate of Reaction	The speed at which a chemical reaction occurs.

Equations that you could use to calculate the rate of reaction.

Rate of Reaction = Quantity of Reactant Used / Time Taken

Rate of Reaction = Quantity of Product Formed / Time Taken

Quantity	Unit
Mass	g
Volume	cm^3
Rate of Reaction	g/s or cm^3/s

How you can determine the rate of a chemical reaction.

To determine the rate of reaction you need to either measure the quantity of product used, or the quantity of product formed over time.

10 Minutes on….

Factors Which Affect Rates of Reaction

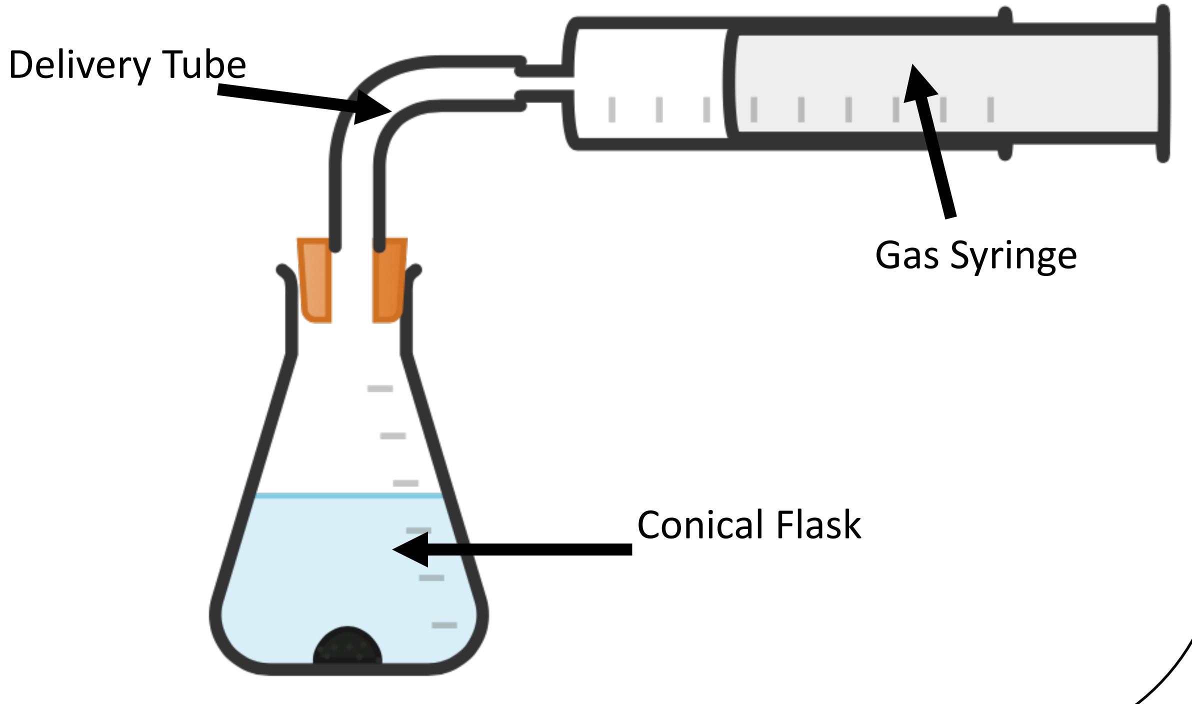
Factor	Explanation of How It Affects Rate of Reaction
Concentration of Reactants	If the concentration of the reactants is increased, then there would be more particles. This means that the frequency of successful collisions would increase and so the rate of reaction would increase.
Pressure of Reacting Gases	If the pressure of reacting gases were increased, then the reactant particles would be closer together. This would mean that the frequency of successful collisions would increase and so the rate of reaction would increase.
Surface Area of Solid Reactants	If the surface area of the reacting solid is increased, then more reactant particles are exposed at the surface. This will mean that the frequency of successful collisions would increase and so the rate of reaction would increase.
Temperature	If temperature were to increase, then the rate of reaction would increase also. This is because the particles will have more kinetic energy and so will be more likely to collide with each other. Not only are collisions more likely, but when the particles do collide, they are more likely to be colliding with enough activation energy for the reaction to occur.
Presence of Catalysts	A catalyst provides an alternative reaction pathway that has a lower activation energy than the uncatalysed reaction. The frequency of collisions does not change, but the number of collisions with sufficient energy increases which means that the rate of reaction increases.

10 Minutes on….

Rates of Reaction 1 RP

A method to investigate how changes in concentration affect the rates of reactions by measuring the volume of gas produced.

When Method Used	When a gas is made.
Outline Method	1. Set up experiment as shown in diagram. 2. Add 10 g of ____________ into the flask. 3. Add 50 cm^3 of ______________, connect the gas syringe and start a timer.
What is Measured (Dependent Variable)	Total volume of gas made in 1 minute. **OR** Volume of gas every 10 seconds for 1 minute.
Possible Variables	Surface Area of Reactant Mass of Reactant Concentration of Acid Temperature of Reactants

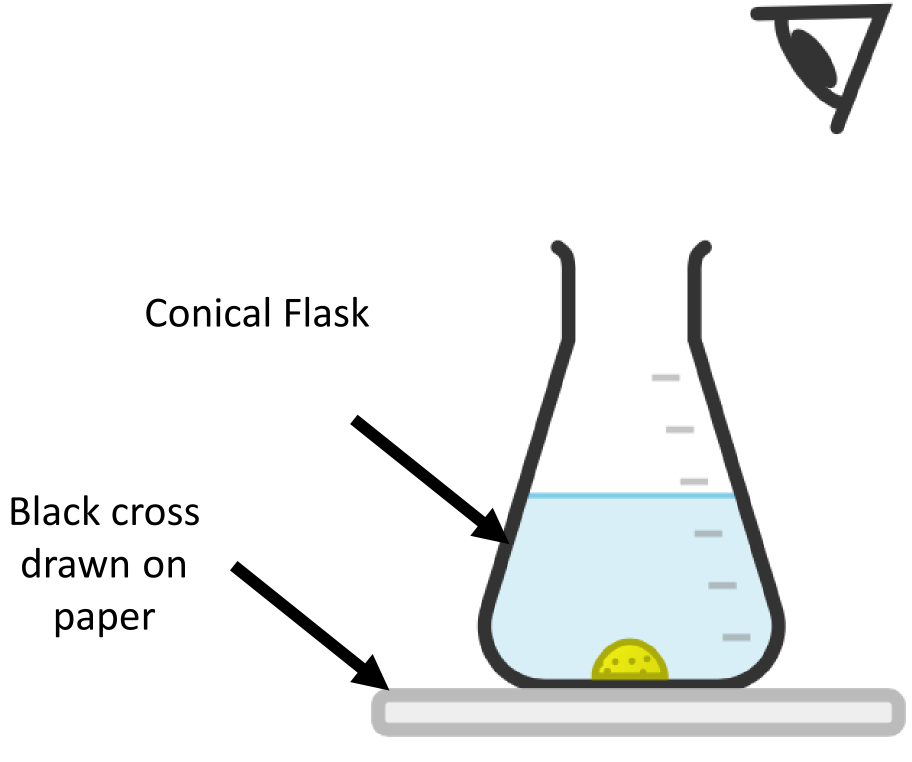


10 Minutes on....

Rates of Reaction 2 RP

A method to investigate how changes in concentration affect the rates of reactions when a precipitate is formed.

When Method Used	When a solid (precipitate) is made.
Outline Method	1. Put 50 cm^3 of sodium thiosulfate solution into a container. 2. Put the container on a cross drawn on a piece of paper. 3. Add 5 cm^3 of dilute hydrochloric acid and start timing.
What is Measured (Dependent Variable)	Time it takes for the cross to disappear.
Possible Variables	Concentration/Volume of Sodium Thiosulfate Concentration/Volume of Acid Temperature of Reactants



10 Minutes on.... Collision Theory

Key Term	Definition
Collision Theory	A theory that states that chemical reactions occur when reacting particles collide with enough energy.
Activation Energy	The minimum energy required for a reaction to occur.

Factor	Explanation of How It Affects Rate of Reaction Linked to Collision Theory/Activation Energy
Concentration of Reactants	If the concentration of the reactants is increased, then there would be more particles. This means that the frequency of successful collisions would increase and so the rate of reaction would increase.
Pressure of Reacting Gases	If the pressure of reacting gases were increased, then the reactant particles would be closer together. This would mean that the frequency of successful collisions would increase and so the rate of reaction would increase.
Surface Area of Solid Reactants	If the surface area of the reacting solid is increased, then more reactant particles are exposed at the surface. This will mean that the frequency of successful collisions would increase and so the rate of reaction would increase.
Temperature	If temperature were to increase, then the rate of reaction would increase also. This is because the particles will have more kinetic energy and so will be more likely to collide with each other. Not only are collisions more likely, but when the particles do collide, they are more likely to be colliding with enough activation energy for the reaction to occur.
Presence of Catalysts	A catalyst provides an alternative reaction pathway that has a lower activation energy than the uncatalysed reaction. The frequency of collisions does not change, but the number of collisions with sufficient energy increases which means that the rate of reaction increases.

10 Minutes on….

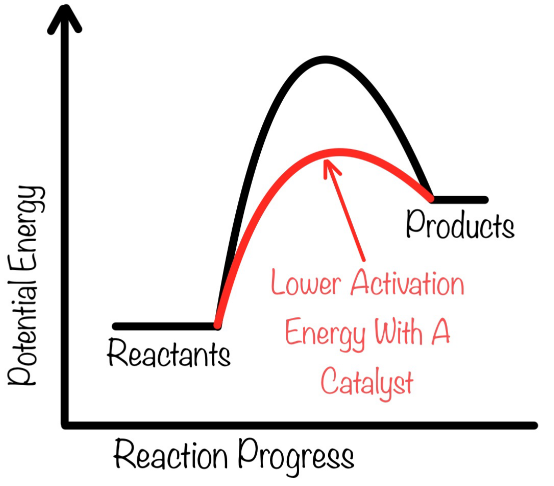
Catalysts

Key Term	Definition
Catalyst	A substance that lowers the activation energy of a chemical reaction but are not used up themselves.
Activation Energy	The minimum energy required for a reaction to occur.

How a catalyst works.

Catalysts change the rate of chemical reactions but are not used up during the reaction. Different reactions need different catalysts. Enzymes act as catalysts in biological systems. Catalysts increase the rate of reaction by providing a different pathway for the reaction that has a lower activation energy.

A reaction profile to model how catalysts work.



10 Minutes on….

Reversible Reactions

Key Term	Definition
Reversible Reaction	A chemical reaction in which the products of the reaction can react to make the original reactants.
Exothermic Reaction	Reaction in which energy is given out to the surroundings.
Endothermic Reaction	Reaction in which energy is taken in.

Simple equation to show how reversible reactions are modelled.

$$A + B \rightleftharpoons C + D$$

The energy changes involved in a reversible reaction.

In a reversible reaction one of the reactions is exothermic while the reaction in the opposite direction is endothermic. The same amount of energy is transferred in each reaction.

10 Minutes on….

Equilibrium

Key Term	Definition
Equilibrium	A point reached when the forward and reverse reactions in a reversible reaction occur at exactly the same rate.
Le Chatelier's Principle	A principle that states if a change is made to a system the equilibrium will shift to counteract the equilibrium.

Change	Effect on Reversible Reaction
Concentration of Reactants is Increased	An increase in concentration of reactants would cause the equilibrium to shift so that more products were made.
Concentration of Products is Decreased	An increase in concentration of products would cause the equilibrium to shift so that more reactants were made.
Increase in Temperature	An increase in temperature favours the endothermic reaction. The equilibrium would shift, and the endothermic reaction would occur at a greater rate.
Decrease in Temperature	A decrease in temperature favours the exothermic reaction. The equilibrium would shift, and the exothermic reaction would occur at a greater rate.
Pressure Increased	An increase in pressure favours the side with the lower gas volume. The equilibrium would shift so the side of the reaction with more moles would happen at a greater rate.
Pressure Decreased	A decrease in pressure favours the side with the higher gas volume. The equilibrium would shift so the side of the reaction with fewer moles would happen at a greater rate.

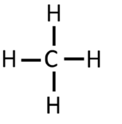
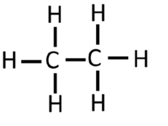
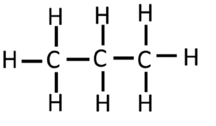
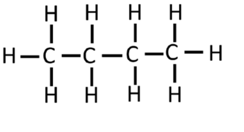
10 Minutes on....

Crude Oil

Key Term	Definition
Crude Oil	A finite resource that is a mixture of hydrocarbons.
Hydrocarbon	A compound made up of hydrogen and carbon atoms only.

General formula of alkanes.

$$C_nH_{2n+2}$$

No. of C Atoms	Alkane	Formula	Diagram
1	Methane	CH_4	
2	Ethane	C_2H_6	
3	Propane	C_3H_8	
4	Butane	C_4H_{10}	

10 Minutes on….

Fractional Distillation

Key Term	Definition
Fractional Distillation	A separation technique that separates a mixture into fractions with similar boiling points.
Fraction	A group of molecules with a similar number of carbon atoms.
Condensation	A change in state in which a gas become a liquid.
Evaporation	A change in state in which a liquid becomes a gas.

Fuels obtained from crude oil.

Crude oil can be used to make lots of fuels that we depend on. Examples include petrol, diesel oil, kerosene, heavy fuel oil and liquefied petroleum gases.

Process of fractional distillation.

The crude oil is heated so that the compounds vaporise. The vapours enter fractioning column which is hotter at the bottom and cooler at the top. The vapours rise up the column and as they do they cool and condense at their boiling points. Different substances have different boiling points and so the fractions collect at different levels. The smallest molecules have the lowest boiling points and so collect as gases at top of the column while larger hydrocarbons have higher boiling points and so collect nearer the bottom

10 Minutes on….

Properties of Hydrocarbons

Property	What Happens With Increasing Molecular Size of Hydrocarbon
Boiling Point	The larger the molecule the higher the boiling point.
Viscosity	The larger molecules are more viscous than smaller ones.
Flammability	Flammability decreases with increasing molecule size.

Alkane	Word Equation for Combustion	Symbol Equation for Combustion
Methane	Methane + Oxygen → Carbon Dioxide + Water	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
Ethane	Ethane + Oxygen → Carbon Dioxide + Water	$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$
Propane	Propane + Oxygen → Carbon Dioxide + Water	$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$
Butane	Butane + Oxygen → Carbon Dioxide + Water	$2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$

10 Minutes on….

Cracking and Alkenes

Key Term	Definition
Cracking	The process of breaking down large hydrocarbons into smaller more useful ones.
Alkene	A hydrocarbon with a double bond between 2 carbon atoms.
Alkane	A hydrocarbon in which all the carbon atoms have single bonds between them.

Alkene Uses	Alkane Uses
Polymers Starting Material For Making Other Chemicals	Fuels

Process of cracking.

Hydrocarbons can be broken down to make smaller, more useful molecules in a process called cracking. There are two ways of cracking. These are:

- Catalytic cracking which uses a high temperature of around 550°C and a catalyst
- Steam cracking which uses higher temperature of around 800°C and no catalyst

In cracking larger molecules are broken down into smaller ones using heat. This means that cracking is an example of thermal decomposition.

How to test for alkanes and alkenes.

Bromine can be used as a test for alkenes. When bromine water reacts with an alkene it turns from orange to colourless.

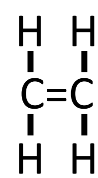
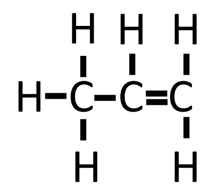
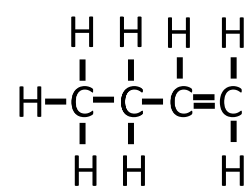
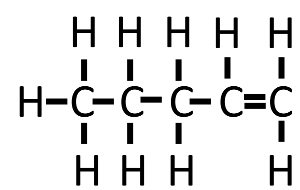
10 Minutes on.... Alkenes

Key Term	Definition
Alkene	Hydrocarbons with a double carbon-carbon bond.

General formula of alkenes.

C_nH_{2n}

Why alkenes are unsaturated.
Alkenes contain two fewer hydrogen atoms that the alkene with the same number of carbon atoms.

No. of C Atoms	Alkene	Formula	Diagram
2	Ethene	C_2H_4	
3	Propene	C_3H_6	
4	Butene	C_4H_8	
5	Pentene	C_5H_{10}	

10 Minutes on….

Reactions of Alkenes

What happens when an alkene reacts with oxygen.

When an alkene reacts with oxygen combustion occurs. Alkenes can undergo complete combustion, but they tend to burn in air with smoky flames due to incomplete combustion.

What happens when an alkene reacts with hydrogen, water and the halogens.

When alkenes react with hydrogen, water and the halogens there is an addition of atoms across the carbon-carbon double bond. The double bond becomes a single carbon-carbon bond.

Reactants	Products	Type of Reaction
Alkene + Hydrogen	Alkane	Addition
Alkene + Water	Alcohol	Addition
Alkene + Halogen	Halogenoalkanes	Addition

How alkenes can be identified

Alkenes decolourise bromine water.

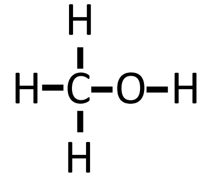
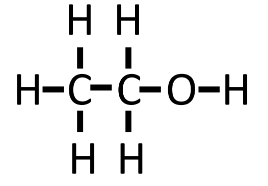
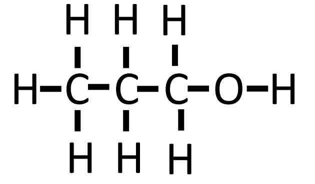
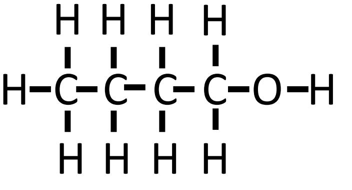
How the reactivity of alkenes compare to alkanes

Alkenes are more reactive than alkanes.

10 Minutes on....

Alcohols 1

Substance	Functional Group
Alcohol	-OH

No. of C Atoms	Alcohol	Formula	Diagram
1	Methanol	CH_3OH	
2	Ethanol	CH_3CH_2OH or C_2H_5OH	
3	Propanol	$CH_3CH_2CH_2OH$ or C_3H_7OH	
4	Butanol	$CH_3CH_2CH_2CH_2OH$ or C_4H_9OH	

Main uses of the alcohol's above.

Ethanol is the main ingredient in alcoholic drinks and alcohols can be used as solvents as they dissolve many other organic compounds. This means they are used in products such as perfumes, aftershaves and mouthwashes.

10 Minutes on....

Alcohols 2

Reactants	Products
Alcohol + Sodium	Salt + Hydrogen
Alcohol + Oxygen	Carbon Dioxide + Water
Alcohol + Oxidising Agent	Carboxylic Acid + Water

What happens when alcohol is added to water

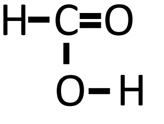
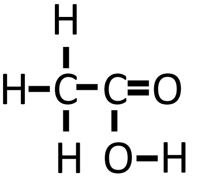
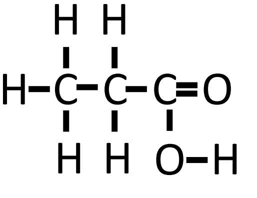
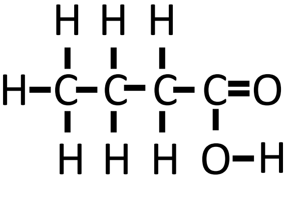
Small molecules of alcohol mix well with water and make neutral solutions. As the molecules become larger the solubility decreases. This means that methanol is the most soluble, while propanol is the least soluble.

Conditions for the fermentation of sugar using yeast.

- The sugar is dissolved in water
- This solution is mixed with yeast
- The container the reaction takes place in has an air lock to allow carbon dioxide out while preventing any air from getting in.
- The temperature is between 25°C and 35°C

10 Minutes on.... Carboxylic Acids

Substance	Functional Group
Carboxylic Acids	-COOH

No. of C Atoms	Alcohol	Formula	Diagram
1	Methanoic Acid	HCOOH	
2	Ethanoic Acid	CH_3COOH	
3	Propanoic Acid	C_2H_5COOH	
4	Butanoic Acid	C_3H_7COOH	

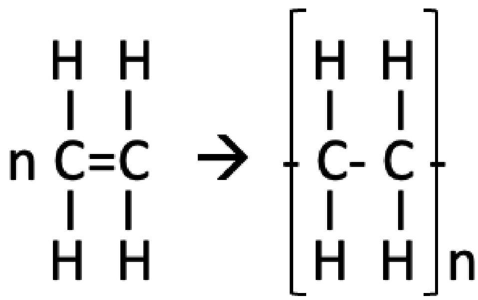
Reactants	Products
Carboxylic Acid + Carbonate	Salt + Water + Carbon Dioxide
Carboxylic Acid + Alcohol	Ester + Water

10 Minutes on….

Addition Polymerisation

Key Term	Definition
Addition Polymerisation	A reaction in which many small molecules known as monomers join together to form very large molecules known as polymers.

Diagram to model addition polymerisation of ethene into polyethene.



What happens during addition polymerisation.

During addition polymerisation there are alkenes present, known as monomers, with carbon double bonds. These carbon double bonds open and form single bonds. This means that the alkene monomers form a long chain.

10 Minutes on....

Condensation Polymerisation

Key Term	Definition
Condensation Polymerisation	A reaction in which monomers with two functional groups react and join together, usually losing small molecules such as water in the process.
Diol	A chemical that contains two –OH alcohol functional groups.
Dicarboxylic Acid	A chemical that contains two –COOH functional groups.

How polyester is made.

A polyester is made through condensation polymerisation. A diol such as ethanediol reacts with a dicarboxylic acid such as hexanedioic acid. Polymerisation occurs and a polyester is made. The –OH functional group from the diol and –COOH functional group from the dicarboxylic acid form an ester link –COO and the remaining oxygen and hydrogen make water.

10 Minutes on….

Amino Acids

Substance	Functional Groups
Amino Acids	$-NH_2$ -COOH

How polypeptides are made.

Amino acids react by condensation polymerisation to make polypeptides and water.

A model to show what happens when glycine polymerises to make a polypeptide.

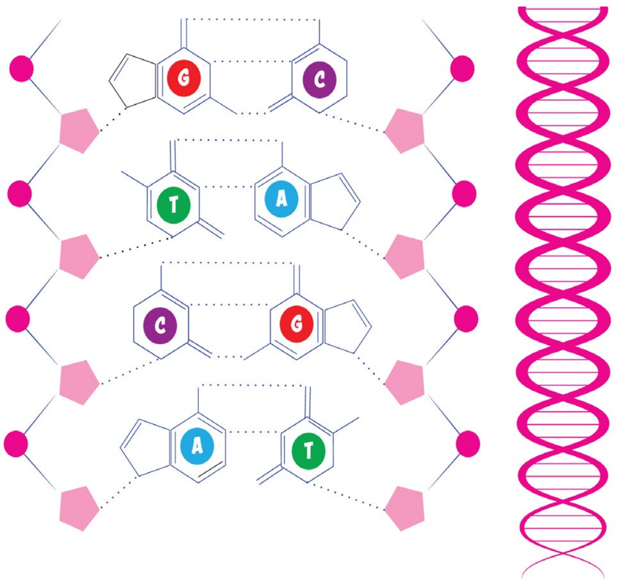
$$\left(HNCH_2COO \right)_n \text{ and n } H_2O.$$

10 Minutes on.... DNA

Key Term	Definition
DNA	A large molecule essential for life. It encodes genetic instructions for the development and functioning of living organisms and viruses.

Structure of DNA.

DNA molecules are two polymer chains made from four different monomers called nucleotides, in the form of a double helix.



Naturally Occurring Polymer	Monomer
Protein	Amino Acids
Starch	Glucose
Cellulose	Glucose
DNA	Nucleotides

10 Minutes on....

Pure Substances

Key Term	Definition	Example
Pure Substance (In Chemistry)	A single element or compound not mixed with any other substance.	Carbon Dioxide, Gold
Pure Substance (In Everyday Language)	A substance that has had nothing added to it.	Pure milk

How to use melting and boiling points to determine if a substance is pure or impure.

Pure elements and compounds melt and boil at specific temperatures. Melting point and boiling point data can be used to distinguish pure substances from mixtures. A pure substance will have one distinct melting and boiling point, while a mixture may have a couple of different points in which there is a state change. To determine this you would heat your liquid until it evaporated and at regular intervals use a thermometer to measure the temperature. You would then plot a graph of temperature against time. If you found just one plateau in temperature then the substance was pure, if you find two or more plateaus of temperature than the substance was a mixture.

10 Minutes on....

Formulations

Key Term	Definition	Examples
Formulation	A mixture that has been designed as a useful product.	Fuels, Cleaning Agents, Paints, Medicines, Alloys, Fertilisers and Foods

How formulations are made.

Formulations are made by mixing the components in carefully measured quantities to ensure that the product has the required properties.

10 Minutes on....

Chromatography

Key Term	Definition
Chromatography	A separation technique that can be used to separate different substances dissolved in a liquid
Rf Value	The ratio of the distance moved by a compound to the distance moved by the solvent.

How to calculate the Rf value.

You would measure the distance moved by the substance and measure the distance moved by the solvent. You would then divide the distance moved by the substance by the distance moved by the solvent to find the Rf value. This value should be less than 1.

How chromatography separates mixtures.

As the solvent soaks up the paper, it carries the mixtures with it. Different components of the mixture will move at different rates. This separates the mixture out.

How chromatography can be used to determine if a substance is pure or not.

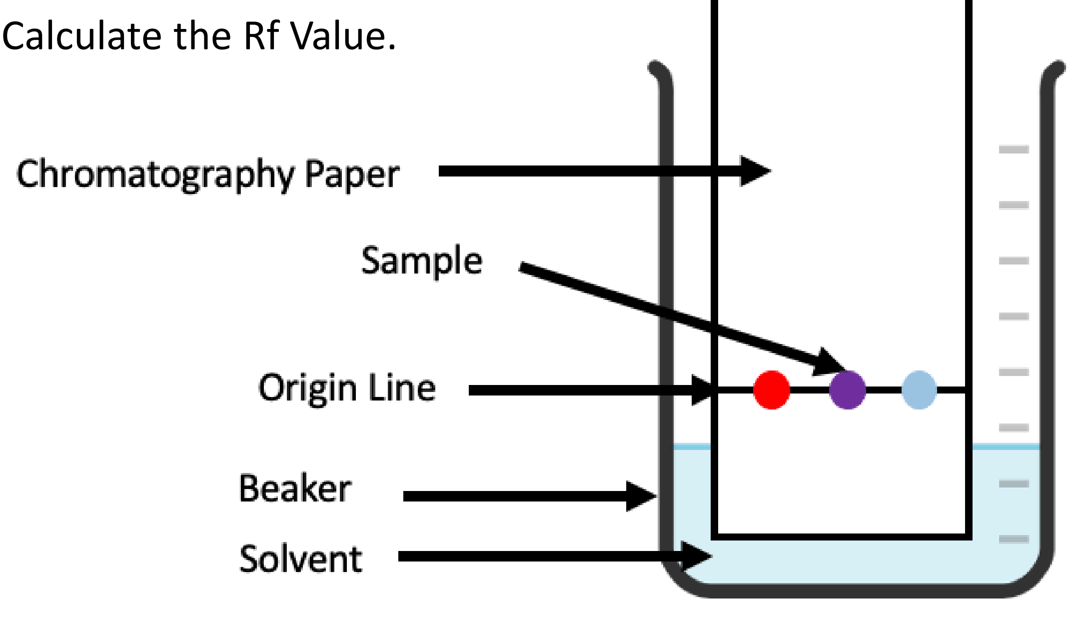
If a substance is pure, you would obtain only one spot on your chromatography paper, while an impure substance will separate out and you will have 2 or more spots.

10 Minutes on….

Chromatography RP

A method to investigate how chromatography can be used to separate and tell the difference between coloured substances.

1. Draw a horizontal origin pencil line 2cm from a short edge of the chromatography paper.
2. Use a glass capillary tube to put a small spot of each of the samples onto the paper.
3. Add the solvent to a beaker and place the chromatography in making sure that the origin line is above the water level.
4. Wait for the solvent to travel up to the top of the chromatography paper.
5. Remove the paper.
6. Let the paper dry.
7. Measure the distance the solvent moved. This is the solvent front.
8. Measure the distance the substances in the samples travelled this is the solvent front.
9. Calculate the Rf Value.



10 Minutes on....

Identifying Common Gases

Gas	Test	Positive Result
Hydrogen	Place a burning splint at the open end of the test tube containing the gas.	Squeaky pop sound.
Oxygen	Place a glowing splint into a test tube of the gas.	The splint will relight.
Carbon Dioxide	Bubble the carbon dioxide through an aqueous solution of calcium hydroxide (known as limewater).	The limewater turns milky.
Chlorine	Place damp litmus into the test tube containing the gas.	The litmus paper will be bleached and will turn white.

10 Minutes on....

Flame Tests

Key Term	Definition
Flame Test	A test that involves the use of a Bunsen Burner to identify some metal ions.

Metal Ion	Positive Result
Lithium	Crimson Red Flame
Sodium	Yellow Flame
Potassium	Lilac Flame
Calcium	Orange-Red Flame
Copper	Green Flame

The problem that can occur if a sample contains a mixture of ions.

If a sample contains a mixture of ions that some of the flame colours can be masked and it can be very difficult to identify them.

10 Minutes on....

Metal Hydroxides

How to carry out a test for ions using metal hydroxides.

To test for metal ions, you can add sodium hydroxide and observe the colour of the precipitate formed.

Metal Ion	Positive Result
Aluminium	White Precipitate Formed That Dissolved In Excess
Calcium	White Precipitate Formed.
Magnesium	White Precipitate Formed.
Copper (II)	Blue Precipitate Formed.
Iron (II)	Green Precipitate Formed.
Iron (III)	Brown Precipitate Formed.

How to distinguish between aluminium and calcium ions.

To determine if a substance contains aluminium or calcium ions you would continue to add sodium hydroxide. If the white precipitate disappeared then the solution contain aluminium, if the precipitate does not dissolve and disappear then the solution contains calcium ions.

10 Minutes on….

Carbonates

How to carry out a test for carbonates using dilute acids.

To test for a carbonate, you would react the substance with a dilute acid. If the gas produced is carbon dioxide, then the substance was a carbonate. To identify you would use limewater which turns cloudy in the presence of carbon dioxide.

Word and balanced symbol equations to model the reaction between:

Magnesium Carbonate and Sulfuric Acid

Magnesium Carbonate + Sulfuric Acid → Magnesium Sulfate + Water + Carbon Dioxide

$MgCO_3 + H_2SO_4 \rightarrow MgSO_4 + H_2O + CO_2$

Lithium Carbonate and Hydrochloric Acid.

Lithium Carbonate + Sulfuric Acid →Lithium Sulfate + Water + Carbon Dioxide

$Li_2CO_3 + H_2SO_4 \rightarrow Li_2SO_4 + H_2O + CO_2$

Word and balanced symbol equations to model how a precipitate is formed when carbon dioxide is bubbled through calcium hydroxide $Ca(OH)_2$ (limewater).

Calcium Hydroxide + Carbon Dioxide → Calcium Carbonate + Water

$Ca(OH)_2 (aq) + CO_2 (g) \rightarrow CaCO_3 (s) + H_2O (l)$

10 Minutes on….

Halides and Sulfates

How to carry out a test for halides.

To test for halides, add silver nitrate and dilute nitric acid and observe the colour of the precipitate formed.

Halide	Positive Result
Silver Chloride	White Precipitate
Silver Bromide	Cream Precipitate
Silver Iodide	Yellow Precipitate

How to carry out a test for sulfates.

To test for sulfates, you would add barium chloride solution with dilute hydrochloric acid. If a white precipitate formed, then sulfate ions were present.

What a precipitate is.

A precipitate is a solid that is formed during a chemical reaction. The state symbol you would use for these is (s).

10 Minutes on….

Identifying Ions RP

A method to identify the ions in unknown single ionic compounds.

To test for metal ions, you could use flame tests. During this procedure you would put a piece of the sample in solution in a Bunsen flame and observe the colour that you saw.

Alternatively, to test for metal ions you could you can add sodium hydroxide and observe the colour of the precipitate formed.

To test for a carbonate, you would react the substance with a dilute acid. If the gas produced is carbon dioxide, then the substance was a carbonate. To identify you would use limewater which turns cloudy in the presence of carbon dioxide.

To test for halides, add silver nitrate and dilute nitric acid and observe the colour of the precipitate formed.

To test for sulfates you would add barium chloride solution with dilute hydrochloric acid. If a white precipitate formed, then sulfate ions were present.

10 Minutes on....

Instrumental Methods

Key Term	Definition	Advantages
Instrumental Methods	The use of equipment to carry out an analysis of chemicals.	Fast, Sensitive, Accurate
Flame Emission Spectroscopy	An instrumental method that is based on flame testing.	Fast, Sensitive, Accurate

Flame emission spectroscopy.

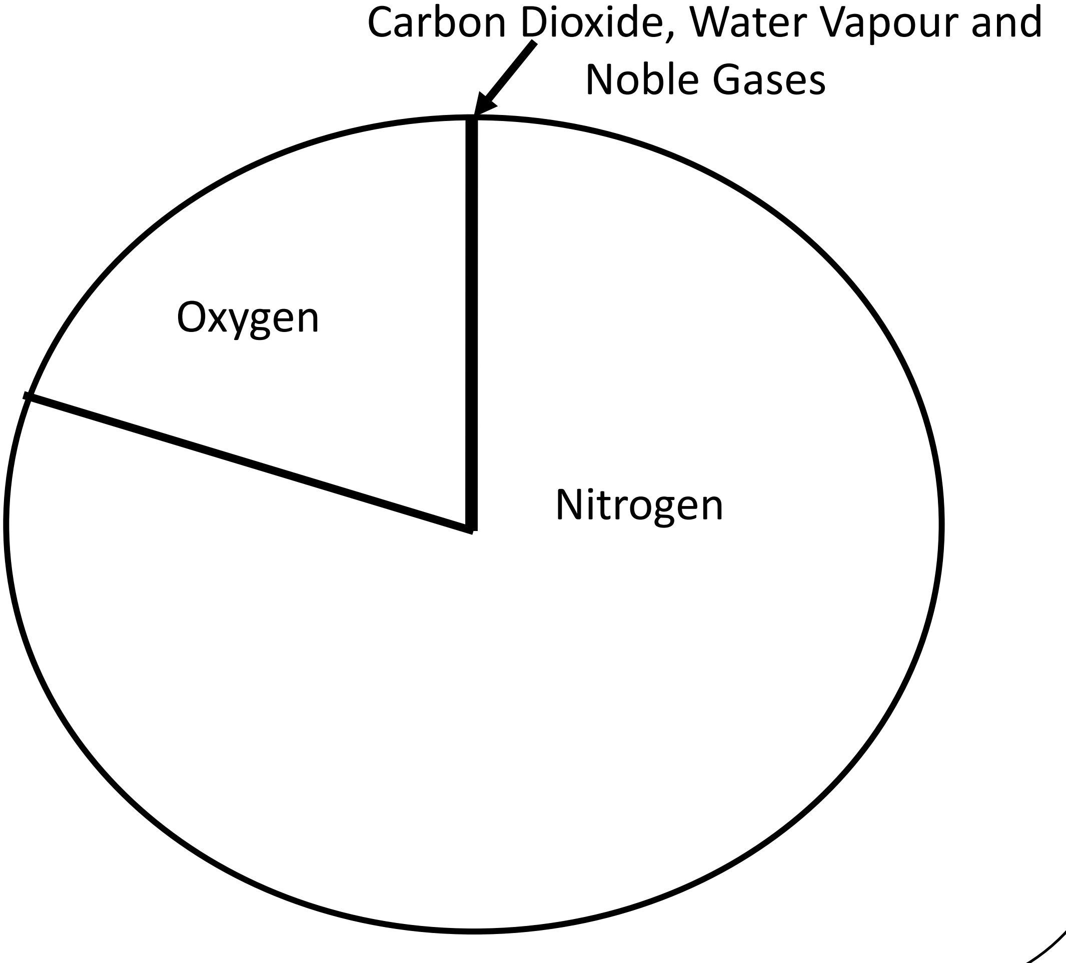
During flame emission spectroscopy the sample is put into a flame and the light given out is passed through a spectroscope. The output is a line spectrum that can be analysed to identify the metal ions in the solution and measure their concentrations.

10 Minutes on….

Gases In the Atmosphere

Gas	Proportion in the Atmosphere Today
Nitrogen	80%
Oxygen	20%
Carbon Dioxide, Water Vapour and Noble Gases	Small Amounts

A pie chart to model the proportion of gases in the atmosphere.



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10 Minutes on….

Early Atmosphere

Why evidence for the early atmosphere is limited.

Evidence for the early atmosphere is limited because of the time scale of 4.6 billion years.

How we think the Earth's early atmosphere formed.

During the first billion years of the Earth's existence there was a lot of volcanic activity that released gases. It was these gases that formed the early atmosphere. It is thought that the volcanoes released carbon dioxide gas, water vapour, nitrogen, and small amounts of methane and ammonia.

Volcanic activity released water into the Earth's atmosphere. As the Earth cooled below 100°C this water vapour condensed that formed the early atmosphere and water vapour that condensed to form the oceans. When the oceans formed carbon dioxide dissolved into the water to make carbonates. These carbonates precipitated and produced sediments. This means that when the oceans formed the amount of carbon dioxide in the atmosphere began to reduce.

10 Minutes on....

Increasing Oxygen

Key Term	Definition
Photosynthesis.	A chemical process used by plants to make glucose and oxygen from carbon dioxide and water, using light energy.

Word and balanced symbol equations for photosynthesis.

Carbon Dioxide + Water → Glucose + Oxygen

$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$

Why the proportion of oxygen in the atmosphere has increased.

Oxygen began to increase in the atmosphere when plants evolved. Algae and plants produced the oxygen that is now in the atmosphere by photosynthesis , which can be represented by the equation:

Carbon Dioxide + Water → Glucose + Oxygen

$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$

Algae first produced oxygen about 2.7 billion years ago and soon after this oxygen appeared in the atmosphere. Over the next billion years plants evolved and the percentage of oxygen gradually increased. This increase in oxygen meant that it was possible for animals to evolve.

10 Minutes on....

Decreasing Carbon Dioxide

Ways the carbon dioxide have decreased in the atmosphere.

Dissolved in oceans, became locked in rocks, through photosynthesis became locked in fossil fuels.

Formation of deposits of limestone, coal, crude oil and natural gas.

To form sedimentary rocks carbon dioxide dissolved into oceans to form carbonates. These carbonates were used by sea animals to make shells and bones. When these organisms died they settled on the ocean floor, became compressed and locked into sedimentary rocks such as limestone. The carbon also entered into plants and animals due to photosynthesis. When some of these animals died they turned into fossil fuels and the carbon was locked into the fossil fuel. Locked carbon is carbon dioxide which has formed sedimentary rocks or fossil fuels.

10 Minutes on....

Greenhouse Gases

Key Term	Definition
Greenhouse Gases	Gases in the atmosphere that maintain temperatures on Earth high enough to support life.

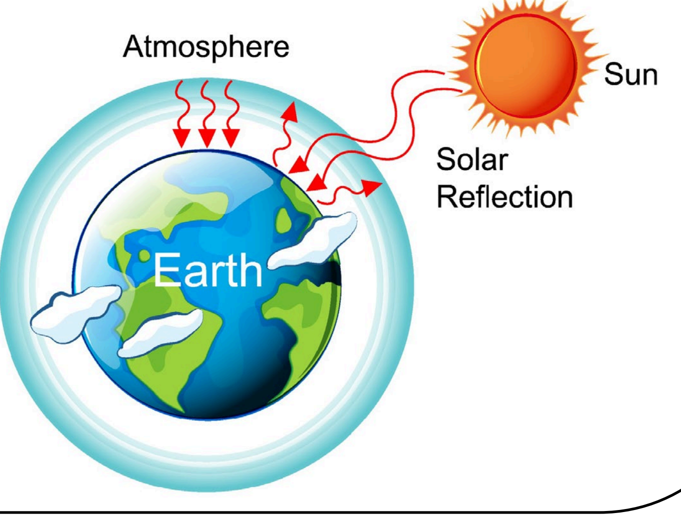
Examples of greenhouse gases.

Examples of greenhouse gases include:

- Water vapour
- Carbon dioxide
- Methane

The greenhouse effect in terms of the interaction of short and long wavelength radiation with matter.

The greenhouse effect traps some of the energy from the Sun and keeps our planet at a suitable temperature for life. Shorter wavelength radiation from the Sun passes through the atmosphere. It is re-emitted from the Earth's surface as longer wavelength radiation. This is absorbed by the greenhouse gases.



10 Minutes on.... Human Activities

Greenhouse Gas	Human Activity that Increases its Amount in the Atmosphere
Carbon Dioxide	Combustion Deforestation
Methane	Production of Waste Agriculture

Key Term	Definition
Peer Review	When the scientific community evaluate the evidence of others. This is done to prevent bias and ensures scientists are confident with the accuracy of data.

Why the theory of global warming is widely accepted

Evidence supporting the theory of global warming has been peer reviewed by many scientists and as a result many scientists believe that human activities will cause the temperature of the Earth's atmosphere to increase which will result in global climate change.

Why there are still uncertainties in the evidence for global warming.

Global warming and climate change are complex and difficult to model. This has caused models to have been oversimplified. This has meant some uncertainty in the evidence and so not all people support the theory.

10 Minutes on....

Global Climate Change

Key Term	Definition
Global Warming	This is the increase in the mean temperature of the Earth.
Climate Change	A change in global or regional climate conditions.

Effects of Global Climate Change	Explanation
Glaciers and Polar Ice Melting	Organisms that live in these areas are losing their habitat causing their numbers to decrease. Sea levels will rise causing flood and destruction of habitats elsewhere also.
Expansion of Seawater	The rising temperatures will cause the seawater to expand. This can cause flooding of of low-lying land around the world.
Extreme Weather	The extreme weather destroys habitats and so reduces biodiversity.
Changes in Animal Migration Patterns	This disrupts food chains and puts other species who are in the same food web/chain at risk also..
Changes in Rainfall	Some areas will have heavier rainfall and become much wetter, while other areas will have much less rainfall and become drier. This can cause deserts to form in a process called desertification
Loss and Extinction of Animals and Plants	Other organisms may depend on these plants and animals and so they will be at risk also.
Habitats Changing	Organisms may struggle to survive in their changed habitat and so biodiversity decreases.

10 Minutes on….

Carbon Footprint

Key Term	Definition
Carbon Footprint	The total amount of carbon dioxide and other greenhouse gases emitted over the full life cycle of a product, service or event.

Way Carbon Footprint can be Reduced	Explanation	Limitations
Solar Panels	Most of our electricity is generating using fossil fuels that release carbon dioxide when burned. To generate electricity using solar panels will reduce the greenhouse gases emitted.	Installing solar panels are very expensive which prevents people installing them.
Cycling to School/Work	When we use cars for travel, they burn fossil fuels which release greenhouse gases when burned. To cycle instead will reduce the amount of fuel that is burned and so will reduce the greenhouse gases emitted.	It will be difficult to cycle if where you are wanting to cycle is far away.
Improving Home Insulation	When homes are better insulated more energy is kept within the home. This means that the temperature of the house does not fall as much and so the heating does not need to be on for as long. When we use our heating, we usually burn gas which releases greenhouse gases. By reducing how much our heating is on we reduce how much gas is burned and so how much greenhouse gases is released.	There is usually a cost of improving insulation in the home and so not everyone can afford to do it.

10 Minutes on….

Atmospheric Pollutants

Pollutant	How It Is Formed	Problems Caused By Pollutant
Carbon Monoxide	Incomplete combustion of fuels due to a lack of oxygen in the air.	Toxic gas. It reduces oxygen content in the blood. It is not easily detected as it is colourless and odorless.
Soot	Incomplete combustion of fuels due to a lack of oxygen in the air.	Global Dimming and health problems for humans.
Carbon Dioxide	Complete combustion of fuels.	Causes global warming.
Sulfur Dioxide	Some fuels such as coal can contain sulfur. When the fuel burns the sulfur reacts with oxygen also producing sulfur dioxide.	Dissolves in water to form acid rain. This damages buildings and can damage plants as well as organisms in bodies of water such as ponds. It can also cause respiratory problems.
Oxides of Nitrogen	The conditions in a car's engine is very hot and high pressure. This causes the nitrogen in the air to react with oxygen forming oxides of nitrogen.	Dissolves in water to form acid rain. It can also cause respiratory problems.

10 Minutes on….

Using Earth's Resources

Key Term	Definition
Finite Resource	Resource that can only be used once and is in limited supply.
Renewable Resource	A resource that is being constantly replaced and will not run out.

The role of chemistry in sustainable development.

Chemistry plays an important role in improving agricultural and industrial processes to provide new products and in sustainable development. Sustainable development is the development that meets the needs of current generations without compromising the ability of future generations to meet their own needs.

What humans use the Earth's resources for.

Humans use the Earth's resources to provide warmth, shelter, food and transport.

Examples of natural products that are supplemented or replaced by agricultural and synthetic products.

Manure supplemented with fertilisers

10 Minutes on....

Potable Water

Key Term	Definition
Potable Water	Water that is safe to drink.

What the method used to make potable water depends on.

The methods used to produce potable water depend on available supplies of water and local conditions.

Process of making fresh-water potable.

The fresh water would first be filtered. Filtering would remove solids such as small insoluble particles. The water would then have a chemical such as chlorine added to it. This would be to sterilise the water and reduce the number of microbes that was in it.

How salty water can be used to make potable water.

Seawater is used as a source of water for making potable water when there is not a sufficient supply of ground water available. This is because to make seawater safe to drink you would need to desalinate the water, either by reverse osmosis or distillation which are both more expensive to do as they require large amounts of energy.

10 Minutes on....

Water Samples RP

A method to identify if a water sample is pure or contains dissolved substances.

1. Add a evaporating dish to a balance and record the mass.

↓

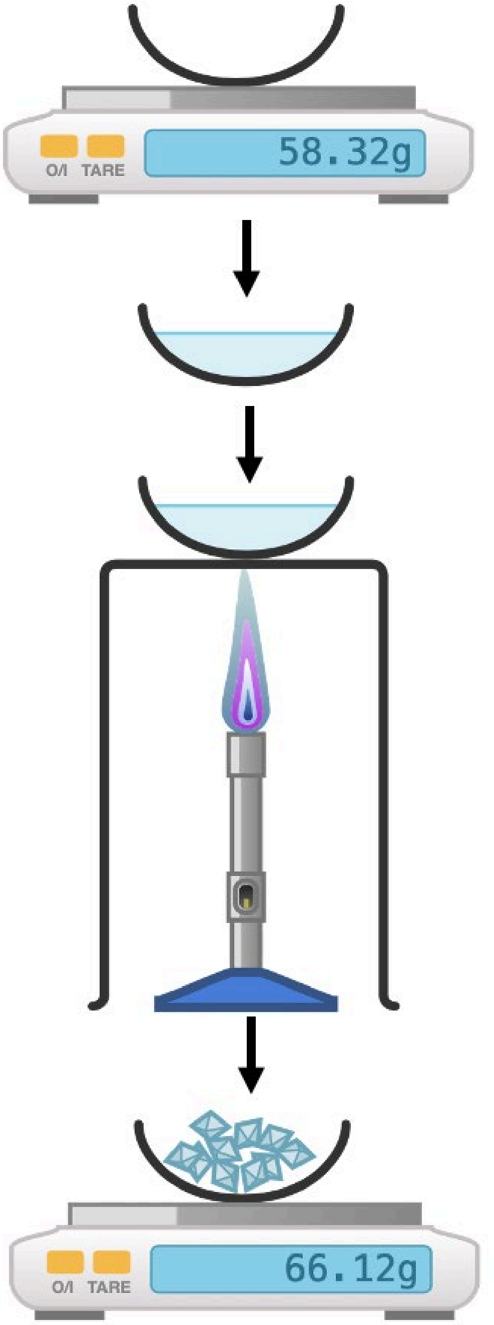
2. Measure the volume required of the test solution and add this to the evaporating dish.

↓

3. Use a Bunsen burner to evaporate away all of the water.

↓

4. Record the mass of the evaporating dish. The different in mass is the mass of the salt in the solution. If there is a difference in mass then the water sample was not pure.



10 Minutes on….

Waste Water

Key Term	Definition
Waste Water	Water made by urban lifestyles and industrial processes that requires treatment before being released into the environment.

Sources of waste water.

Urban lifestyles, industrial processes and agriculture.

Process of treating sewerage.

First the sewerage passes through a metal grid which removes the large debris and substances such as grit. This processes is known as screening. The screened sewerage is then left for sedimentation to occur. The heavier substances will sink to the bottom and form a layer of sludge while the liquid layer above is the effluent. The sludge is piped away any broken down by microbes anaerobically while the effluent is broken down aerobically in another tank by microbes. The water is then sterilised to kill off any pathogens.

Why sewerage needs to be treated.

Sewerage needs to be treated to remove organic matter and harmful microbes. Water produced by industrial processes may also contain harmful chemicals that need to be removed also.

10 Minutes on….

Alternative Methods of Extracting Metals

Key Term	Definition
Phytomining	A process that uses plants to absorb metal compounds.
Bioleaching	A process that uses bacteria to make leachate solutions that contain metal compounds.
Electrolysis	The process by which ionic substances are broken down into simpler substances through the use of an electric current.

Process of phytomining.

Plants are grown on land containing low grade copper ores. Once the plants are grown the plants are then harvested and burned to make an ash. The ash is collected and added to an acid for it to dissolve and form a copper solution. This solution then undergoes electrolysis to extract the copper.

Process of bioleaching.

Bioleaching uses bacteria to produce leachate solutions that contain metal compounds. During this process certain bacteria break down the ores to make an acidic solution which contains copper ions. The leachate is then processed to extract the copper.

10 Minutes on....

Life Cycle Assessment

Key Term	Definition
Life Cycle Assessment	A method of assessing environmental impacts associated with the life cycle of a commercial product.

Stages considered during a life cycle assessment.

Life cycle assessments (LCAs) are carried out to assess the environmental impact of products in each of these stages:

- Extracting and processing raw materials
- Manufacturing and packaging
- Use and operation during its lifetime
- Disposal at the end of its useful life, including transport and
- Distribution at each stage.

Why lifecycle assessments are not a purely objective process.

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 LCA is not a purely objective process. Selective or abbreviated LCAs can be devised to evaluate a product but these can be misused to reach pre-determined conclusions, for example they could be made in support of claims for advertising purposes.

10 Minutes on....

Reducing Use of Resources

Why we need to reduce our use of resources.

The reduction in use, reuse and recycling of materials by end users reduces the use of limited resources, use of energy sources, waste and environmental impacts.

Method of Reducing Use of Resources	Description	Examples
Re-Use	To use again, this could be in a different way or after reprocessing the material.	Glass bottled can be washed and sterilised to then use again.
Recycling	The process of turning waste into reusable material. It involves turning an item into raw materials which can be used again.	Metals can be recycled by melting and recasting or reforming into different products. Glass bottles can be crushed and melted to make different glass products.

10 Minutes on….

Preventing Corrosion

Key Term	Definition
Corrosion	Destruction of materials by chemical reactions with substances in the environment.
Rusting	An example of corrosion.

What is required for iron to rust

For iron to rust there needs to be:
- Air
- Water

How rusting can be prevented

One way that we can prevent rusting is to apply a coat to the material that acts as a barrier between the material and water/air. We can do this by:
- Greasing
- Painting
- Electroplating

We would also place a more reactive metal as a coating on the material to provide sacrificial protection. An example of this is when zinc is used to galvanise iron.

Why aluminum doesn't tend to corrode.

Aluminium has an oxide coating (aluminium oxide) that forms a barrier and protects the metal from any further corrosion.

10 Minutes on…. Alloys

Key Term	Definition
Alloy	A mixture made by combining a metal with one or more metals or non-metals. This can be done to give greater strength or resistance to corrosion

Alloy	Composition
Bronze	Alloy of copper and tin
Brass	Alloy of copper and zinc
Gold	An alloy that contains gold as well as silver, copper and zinc.
Steel	An alloy that contains iron, carbon and other metals.
Stainless Steel	An alloy that contains iron, nickel and chromium

What 24ct, 18ct and 12ct gold is

24 carat gold is 100% pure gold while 18 carat gold is an alloy made up of 75% gold and 25% other metals 12 carat gold is an alloy made up of 50% gold and 50% other metals.

Steel Alloy	Properties
High Carbon Steel	Strong, but brittle
Low Carbon Steel	Softer and more easily shaped
Stainless Steel	Hard and resistant to corrosion.

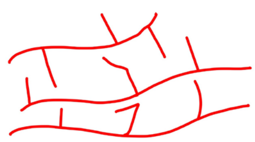
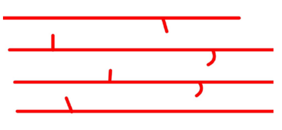
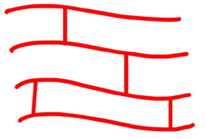
10 Minutes on....

Ceramics, Polymers and Composites

Type of Glass	Description
Soda-Lime Glass	This is made by heating a mixture of sand, sodium carbon and limestone.
Borosilicate Glass	This is made from sand and boron trioxide. It melts at a higher temperature than soda-lime glass.

Examples of clay ceramics and describe how they are made.

Examples of clay ceramics include pottery and bricks. They are made by shaping wet clay and then heating in a furnace.

Type of Polymer	Diagram	Description
Low Density Polyethene		A polymer with low strength and melting point because the intermolecular bonds between each polymer chain are weak.
High Density Polyethene		A polymer with high strength and melting point because the intermolecular bonds between each polymer chain are strong.
Thermosoftening Polymer		A type of polymer that melts when heated. This is because there are no strong bonds between each chain.
Thermosetting Polymer		A type of polymer that does not melt when heated. This is because there are strong covalent bonds between each chain.

Key Term	Definition	Example
Composite	A substance made up of two materials, a matrix surrounding, and fragments known as reinforcement.	Reinforced Concrete, Chipboard

10 Minutes on….

Haber Process

Key Term	Definition
Haber Process	A process that is used to manufacture ammonia.

Raw Material	Source
Nitrogen	Extracted from the air.
Hydrogen	Obtained from natural gas.

A word equation to model the Haber Process

Nitrogen + Hydrogen ⇌ Ammonia

Condition of the Haber Process	Explanation
450°C	The Haber Process takes place at **450 °C.** The breakdown of ammonia is an **endothermic reaction** and so when temperatures are higher the breakdown of ammonia would increase. However, at lower temperatures the particles would move slower leading to **fewer collisions** between hydrogen and nitrogen and so less ammonia would form. A temperature of **450 °C** is therefore used as an **optimum**.
200 Atmospheres	The Haber Process takes place at **200 atmospheres**. The greater the pressure the **higher the yield** of ammonia as **equilibrium** is moved to the right. However, the higher the pressure the **higher the cost** and the greater the **safety risk**. A pressure of 200 atmospheres is therefore used as an **optimum**.
Iron Catalyst	The catalyst used in the Haber processes is **iron**. It is used because it lowers the **activation energy** of the reaction. It is relatively **cheap** and helps to achieve an acceptable **yield** of ammonia in an acceptable **time**.

10 Minutes on….

NPK Fertilisers

Key Term	Definition
NPK Fertilisers	Compounds of nitrogen, phosphorus and potassium that are used as fertilisers.

What ammonia can be used for

Ammonia can be used to make ammonium salts and nitric acid.

How potassium chloride, potassium sulfate and phosphate rock can be obtained.

These different rocks are obtained by mining.

How soluble salts can be made from phosphate rock.

To make a soluble salt from phosphate rock you would add an acid such as nitric or sulfuric acid.

Acid Added To Phosphate Rock	Salt Made
Nitric Acid	Calcium Nitrate and Phosphoric Acid
Sulfuric Acid	Single Superphosphate (A mixture of Calcium Sulfate and Calcium Phosphate)
Phosphoric Acid	Triple Superphosphate (Calcium Phosphate)