Knowledge Organiser

CHEMISTRY

Chemistry

C1- Atomic Structure	
Question:	**Answer:**
Define the term 'atom'?	The smallest part of an element that can exist on its own, that is made up of three subatomic particles (protons, neutrons, electrons)
State the size of the radius of an atom in nm & m	Atoms are very small, having a radius of about 0.1 nm (1 x 10-10 m)
State the size of the radius of the nucleus of an atom in m	The radius of a nucleus is less than 1/10 000 of that of the atom (about 1 x 10-14 m)
Define the term 'atomic (proton)number'?	The sum of protons in an atom (**or** the number of electrons)
Define the term 'atomic mass'?	The sum of the protons and neutrons in an atom
Define the term 'isotopes'?	Atoms of the same element that have different numbers of neutrons e.g C-12 (6 p, 6 n) C-13 (6 p, 7 n) C-14 (6 p, 8 n)
Calculate the number of neutrons in the following isotopes Mg-24 & Mg-25	Mg- 24 (12 p, 12 n) Mg-25 (12 p, 13 n) (Number of neutrons = atomic mass – atomic (proton) number)
Calculate the relative atomic mass of Chlorine given that in a sample of Chlorine, 75% is Cl-35 and 25% is Cl-37	$A_r = \frac{(\text{mass number} \times \text{percentage}) \text{ of isotope 1} + (\text{mass number} \times \text{percentage}) \text{ of isotope 2}}{100}$ A_r = (35 x 75) + (37 x 25) / 100 = 35.5
What is each atom represented by on the periodic table?	Chemical symbol
What is the chemical symbol of Oxygen?	O
What is the chemical symbol of Sodium?	Na
What is the chemical symbol of Neon?	Ne
What is the chemical symbol of Potassium?	K
Explain why an atom has no overall charge?	An atom consists of subatomic particles – **protons** which are **positively charged**, **neutrons** which are **neutral** and **electrons** are **negatively charged**. The number of protons is **equal** to the number of electrons, which means the charges cancel each other out
Define the term 'compound'?	Compounds contain two or more elements chemically combined in fixed proportions
Describe how compounds are represented?	Compounds are represented by formulae using the symbols of the atoms from which they were formed
Describe how compounds are separated?	Compounds can only be separated into elements by chemical reactions.
Define the term 'mixtures'?	These are substances that are physically combined and can be separated using a physical process.
Name the process used to separate salt from sand.	Filtration an Evaporation
Describe how 'rock salt' mixture can be separated?	• Add water to a beaker containing 'rock salt' mixture. • Stir the mixture using a glass/stirring rod until all the salt has dissolved. • Using a filter paper and funnel, filter mixture and collect filtrate • Transfer filtrate into an evaporating dish • Heat evaporating dish on Bunsen burner, until half the volume has disappeared/crystals start appearing on the sides of the dish • Leave evaporating dish in a warm area, to allow for crystallisation
Name the process used to separate pure water from sea water or inky water.	Simple distillation
Describe how to separate pure water from sea water or inky water, using simple distillation?	• Set up simple distillation apparatus and turn the tap on • Add mixture to round bottom flask • Heat mixture to evaporate water • Collect distillate in a beaker/conical flask Distillate = pure water, Residue = salt
Name the process use to separate, dyes, inks or paints.	Chromatography
Name the process that separates crude oil or water from ethanol.	Fractional distillation
Describe how to separate water from ethanol, using fractional distillation?	• Set up fractional distillation apparatus and turn the tap on • Add mixture to round bottom flask • Heat mixture to evaporate the liquid with the lower boiling point distillate 1 (ethanol - 78°C), liquid with a higher boiling point will condense on the beads and fall back into the round bottom flask (water – 100°C) • Collect distillate 1 (ethanol) in a beaker/conical flask • Continue heating until the temperature reaches 100°C and collect distillate 2 Distillate 1 = ethanol , Distillate 2 = water
Write a word equation for the reaction of magnesium and oxygen to form magnesium oxide.	magnesium + oxygen → magnesium oxide
Write a word equation for the reaction of sodium and chlorine to form sodium chloride.	sodium + chlorine → sodium chloride
Write a word equation for the reaction of hydrogen and oxygen to form dihydrogen oxide (water).	hydrogen + oxygen → water
Write a word equation for the reaction of carbon and oxygen to form Carbon dioxide	carbon + oxygen → carbon dioxide
Write a balanced chemical equation for the reaction of magnesium and oxygen to form magnesium oxide.	$2 Mg + O_2 \rightarrow 2 MgO$
Write a balanced chemical equation for the reaction of sodium and chlorine to form sodium chloride.	$2 Na + Cl_2 \rightarrow 2 NaCl$

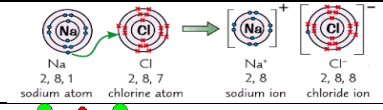
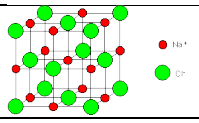
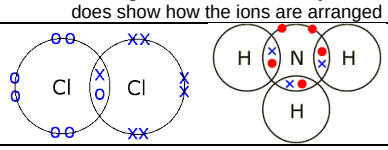
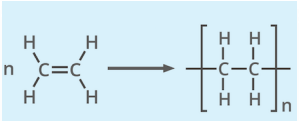
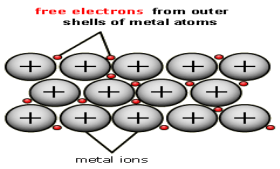
Chemistry

What led to the revision Democritus' model of the atom to the modern atomic model?	New experimental evidence
The discovery of the electron led to which model of the atom?	Plum Pudding Model
Describe the Plum pudding model of the atom.	The plum pudding model suggested that the **atom is a ball of positive charge** with **negative electrons embedded in it** (like plums in a Christmas pudding)
The results from the alpha particle scattering experiment led to three conclusions. **State w**hat they are?	• The discovery of the nucleus which was positively charged • Mass concentrated in the centre of atom • The atom consists of mostly empty space
The Nuclear model of the atom was adapted by whom?	Neils Bohr
What was Bohr's addition the nuclear model?	Electrons orbit the nucleus in shells/ energy levels at specific distances.
The discovery of which sub atomic led to the expansion of the idea of the nucleus.	Proton
In 1932, which scientist found evidence for the existence of particles in the nucleus with mass but no charge?	James Chadwick
Define what an ion is?	An ion is a particle formed when an atom has lost or gained electron(s), from its outer shell, giving it a positive or negative charge. (**Metals** form **positively charged ions** called **cations** & **non-metals** form **negatively charged ions** called **anions**
State the charge of a magnesium cation?	+2
State the charge of a oxide anion?	-2

C1- Periodic Table	
Describe how the modern periodic table is arranged	The elements in the periodic table are arranged in order of atomic (proton) number and so that elements with similar properties are in columns, known as groups.
State why the periodic table is called the 'periodic table'?	The table is called a periodic table because similar properties occur at regular intervals
Describe the similarities of elements in the same group	Elements in the same group in the periodic table have the same number of electrons in their outer shell (outer electrons) and this gives them similar chemical properties.
Describe 'John Newlands' periodic table	• He ordered his table in order of atomic mass • Realised similar properties occurred every eighth element – 'law of octaves'
State why Newlands periodic table had to be revised	'law of octaves' only worked up to calcium, but broke down there after
Describe how the early periodic table was arranged	Before the discovery of protons, neutrons and electrons, scientists attempted to classify the elements by arranging them in order of their atomic weights.
State the short-comings of the early periodic table	• Incomplete as some elements were not yet discovered • Elements were placed in inappropriate groups because the strict order of atomic weights was followed
Explain how 'Dmitri Mendeleev' arranged the periodic table	• He ordered his table in order of atomic mass, but not always strictly – i.e. in some places he changed the order based on atomic weights • Left gaps for elements that he thought had not been discovered yet
State what led to the revision of the order of the periodic table	Knowledge of isotopes made it possible to explain why the order based on atomic weights was not always correct
State what led to the revision of the early periodic table into the modern	When electrons, protons and neutrons were discovered in the early 20th century, elements were ordered in atomic (proton) number. When this was done, all elements were placed in appropriate groups
State why noble gases are found in group 0	All of them (including helium) have full outer shells. They are unreactive (inert) and are monatomic because their atoms have stable arrangements of electrons
State the trend in boiling point and size of relative atomic mass of group 0 elements	The boiling points of the noble gases increase with increasing relative atomic mass (going down the group).
State the collective name of all elements in group 1	Alkali metals
Determine the number of electrons on the outer/valence shell of alkali metals	They have a single (1) electron in their outer shell
State the trend in reactivity of alkali metals	The reactivity of the elements increases going down the group
Explain the trend in reactivity of alkali metals	• The size of the atom increases as you go down the group • The outer (valence) electron is further away from the nucleus • Increased shielding due to inner electrons decreasing positive charge felt by outer electrons • Causes the outer electron to be more easily lost as group descends
State the products of the reaction of alkali metals with the following: A. Oxygen B. Chlorine C. Water	A. Metal Oxide e.g. Sodium Oxide B. Metal Chloride e.g. Sodium Chloride C. Metal Hydroxide + Hydrogen gas e.g. Sodium Hydroxide + Hydrogen
Describe the colour of the flame when alkali metals burn in oxygen. A. Lithium B. Sodium C. Potassium	A. Red B. Orange C. Lilac
Describe how potassium reacts with water	• Metal floats on top of water • Explosive reaction • Lilac flame • Lots of fizzing (hydrogen gas) produced
State the collective name of all elements in group 7	Halogens

Chemistry

Determine the number of electrons on the outer/valence shell of halogens	7
State the trend in reactivity of halogens	The reactivity of the elements decreases going down the group
State the nature of the compounds formed when halogens react with the following: A. Metal B. Non metal	A. Ionic compound B. Covalent compound
State the trend in size, melting and boiling points in group 7 elements	The melting and boiling points of the halogens increase with increasing relative atomic mass (going down the group).
Describe what a displacement reaction with respect to halogens	A reaction in which a more reactive element displaces a less reactive element from its compound. (A more reactive halogen can displace a less reactive halogen from an aqueous solution of its salt)
Describe what is observed when chlorine water is bubbled through the following: A. Potassium Bromide solution B. Potassium Iodide solution	A. Red/Orange solution B. Brown solution
Compare the properties of transition metals and alkali metals	• Are harder and stronger • Have higher melting points (except for mercury) and higher densities • Much less reactive and don't react as vigorously with oxygen or water • Form coloured compounds (except zinc) and have ions that exist with different charges e.g. Cu +1 & Cu +2 • Can be used as catalysts e.g. Fe

C2- Structure, Bonding & Properties of Matter	
State the three types of bonding	There are three types of strong chemical bonds: **ionic, covalent and metallic.**
Describe what happens in ionic bonding	When a metal atom reacts with a non-metal atom electrons in the outer shell of the metal atom are transferred. For ionic bonding the particles are oppositely charged ions.
Describe what happens in covalent bonding	For covalent bonding the particles are atoms which share pairs of electrons. Covalent bonding occurs in most non-metallic elements and in compounds of non-metals
Describe what happens in metallic bonding	For metallic bonding the particles are atoms which share delocalised electrons. Metallic bonding occurs in metallic elements and alloys.
Describe what is a ionic bond	Electrostatic forces of attraction between a cation and an anion, they are usually strong bonds which require lots of energy to break.
Draw dot and cross diagrams to show the formation of Sodium Chloride	
Draw ball and stick diagrams to show the formation of Sodium Chloride	
Compare the models used to represent ionic compounds	• **Dot and cross diagrams**: fine for showing the electronic structure of the ions in a crystal lattice of an ionic compound, but cannot show how the ions are arranged • **Ball and stick**: shows the arrangement of ions in a larger section of the crystal, but using sticks for bonds is misleading because the forces of attraction between ions actually act in all directions • **2D diagram**: gives a limited view of how the ions are arranged in the crystal and doesn't show any detail of how the ions were formed in making the ionic bond • **3D diagram**: doesn't show any detail of how the ions were formed in making the ionic bond but does show how the ions are arranged
Draw dot and cross diagrams to show the formation of chlorine and ammonia	
Draw diagram to show the repeating units of poly(ethene)	
Describe what happens during metallic bonding	The electrons in the outer shell of metal atoms are delocalised and so are free to move through the whole structure. The sharing of delocalised electrons gives rise to strong metallic bonds.
Draw a diagram to show the bonding in metals	
State the name of the process occurring in the following: A. Solid to liquid B. Liquid to Gas C. Gas to Liquid D. Liquid to Solid E. Solid to Gas	A. Melting B. Evaporation/ Boiling C. Condensation D. Freezing E. Deposition F. Sublimation

Chemistry

F. Gas to Solid	
Describe the limitation of the simple models to represent solids, liquids and gases	Limitations of the simple model above include that in the model there are no forces, that all particles are represented as spheres and that the spheres are solid.
State the symbols used to represent the three states of matter	the three states of matter are shown as (s), (l) and (g), with (aq) for aqueous solutions meaning a solid dissolved in water
State and **Explain** the properties of ionic compounds	• Regular structures (giant ionic lattices) in which there are strong electrostatic forces of attraction in all directions between oppositely charged ions • high melting and boiling points because a lot of energy is required to break the many strong bonds • When melted or dissolved in water, ionic compounds conduct electricity because the ions are free to move and carry current • Does not conduct electricity when solid because the ions are fixed in place.
State and **Explain** the properties of simple covalent compounds	• Substances that consist of small molecules are usually gases or liquids that have low boiling and melting points because they have weak intermolecular forces between the molecules. These are broken in boiling or melting, not the covalent bonds • Substances that consist of small molecules don't conduct electricity, because small molecules do not have an overall electric charge.
State and **Explain** the properties of polymers	• Have very large molecules • Atoms in the polymer molecules are linked to other atoms by strong covalent bonds • Intermolecular forces between polymer molecules are relatively strong and so these substances are solids at room temperature
State and **Explain** the properties of giant covalent structures	• Substances that consist of giant covalent structures are solids with very high melting points. • All of the atoms in these structures are linked to other atoms by strong covalent bonds. • These bonds must be overcome to melt or boil these substances. Examples include: diamond and graphite (forms of carbon) and silicon dioxide (silica)
State and **Explain** the properties of metals and alloys	• Metals have giant structures of atoms with strong metallic bonding • Most metals have high melting and boiling points • The layers of atoms in metals are able to slide over each other, so metals can be bent and shaped, which can make them less useful for certain things • Alloys are made from 2 or more different types of metals. • The different sized atoms distort the layers in the structure, making it harder for them to slide over each other. So alloys are harder than pure metals.
Explain why metals are good conductors of electricity	Metals are good conductors of electricity because the delocalised electrons in the metal carry electrical charge through the metal. Metals are good conductors of thermal energy because energy is transferred by the delocalised electrons.
Describe and **Explain** the structure and properties of diamond	In diamond, each carbon atom forms four covalent bonds with other carbon atoms in a giant covalent structure, so diamond is very hard, has a very high melting point and does not conduct electricity.
Describe and **Explain** the structure and properties of graphite	In graphite, each carbon atom forms three covalent bonds with three other carbon atoms, forming layers of hexagonal rings which have no covalent bonds between the layers. These layers are held together by weak intermolecular forces which require a small amount of energy to break, allowing the layers to slide off each other (e.g. pencil or lubricants). In graphite, one electron from each carbon atom is delocalised **which allows it to conduct electricity**
Explain the structure and bonding of graphene	Graphene is a single layer of graphite and has properties that make it useful in electronics and composites.
State the uses of nanoparticles	Nanoparticles have many applications in medicine, in electronics, in cosmetics and sun creams, as deodorants, and as catalysts. New applications for nanoparticulate materials are an important area of research.

C3- Quantitative Chemistry	
State the law of conservation of mass?	This states that **no** atoms are lost or made during a chemical reaction so the mass of the products equals the mass of the reactants.
State the common oxidation state of elements in the following groups: A. 1 B. 6 C. 7 D. 3 E. 2	A. +1 B. -2 C. -1 D. +3 E. + 2
State the chemical formula of the following: A. Calcium sulphate B. Magnesium Oxide C. Sodium Chloride D. Aluminium Bromide	A. $CaSO_4$ B. MgO C. NaCl D. $AlBr_3$
Write a balanced equation for magnesium reacting with oxygen.	$2\ Mg_{(s)} + O_{2\ (g)} \rightarrow 2\ MgO_{(s)}$
Write a balanced equation for Calcium reacting with Sulphuric acid.	$Ca_{(s)} + H_2SO_{4\ (aq)} \rightarrow CaSO_{4\ (aq)} + H_{2\ (g)}$
Write a balanced equation for Sodium Carbonate reacting with Hydrochloric acid.	$Na_2CO_{3\ (s)} + 2\ HCl_{(aq)} \rightarrow 2\ NaCl_{(s)} + H_2O_{(l)} + CO_{2\ (g)}$
Write a balanced equation for Potassium Hydroxide reacting with Nitric acid.	$KOH_{(aq)} + HNO_{3\ (aq)} \rightarrow KNO_{3\ (aq)} + H_20_{(l)}$
Balance the following equation: $P_4 + Cl_2 \rightarrow PCl_3$	$P_4 + 6\ Cl_2 \rightarrow 4\ PCl_3$
Balance the following equation: $H_2 + F_2 \rightarrow HF$	$H_2 + F_2 \rightarrow 2\ HF$
Balance the following equation: $N_2 + O_2 \rightarrow NO_2$	$N_2 + 2\ O_2 \rightarrow 2\ NO_2$
Balance the following equation: $Al + O_2 \rightarrow Al_2O_3$	$4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$

Chemistry

Balance the following equation: $PH_5 + O_2 \rightarrow P_2O_5 + 5H_2O$	$2\ PH_5 + 5\ O_2 \rightarrow P_2O_5 + 5\ H_2O$
Balance the following equation: $N_2 + Cl_2 \rightarrow NCl_3$	$N_2 + 3\ Cl_2 \rightarrow 2\ NCl_3$
Balance the following equation: $Na + Br_2 \rightarrow Na\ Br$	$2\ Na + Br_2 \rightarrow 2\ NaBr$
Balance the following equation: $C_2H_4 + O_2 \rightarrow CO_2 + H_2O$	$C_2H_4 + 3\ O_2 \rightarrow 2\ CO_2 + 2\ H_2O$
Define the term relative formula mass (Mr) of a compound.	the sum of the relative atomic masses of the atoms in the numbers shown in the formula.
Calculate the Relative Formula Mass (Mr) of the following: A. Sulfuric Acid (H_2SO_4) B. Sodium Carbonate (Na_2CO_3) C. Phosphorous pentoxide (P_2O_5) Aluminium Oxide (Al_2O_3)	A. (2*1) + (1*32) + (4*16) = 98 g/mol B. (2*23) + (1*12) + (3*16) = 106 g/mol C. (2*31) + (5*16) = 142 g/mol D. (2*27) + (3*16) = 102 g/mol
24g of magnesium reacts with copper oxide to make 40g of magnesium oxide and 64g of copper. Mg + CuO → MgO + Cu 24g 40g 64g Using the conservation of mass rule, work out the mass of copper oxide?	Total mass of reactant(s)= Total mass of product(s) 24g + X = 40g + 64g 24g + X = 104 g X = 104g – 24g X= 80g Mass of CuO is 80g
Explain the following observation: when a metal reacts with oxygen the mass of the oxide produced is greater than the mass of the metal. 2Mg (s) + O2 (g)→ 2MgO (s)	Oxygen has been added to the metal which accounts for the added mass.
Explain the following observation: when metal carbonates thermally decompose the mass of the product decreases in an open system. $CaCO_{3\ (s)} \rightarrow CaO_{\ (s)} + CO_{2\ (g)}$	Carbon dioxide is produced and escapes into the atmosphere leaving the metal oxide as the only solid product, hence the decrease in mass
Explain the following observation: when metal carbonates thermally decompose the mass of the reactant(s) and product(s) in a closed system.	The system is closed which means it does not allow anything to enter of leave, hence the mass is conserved.
Define the term molar mass.	The mass of one mole of a substance in grams is numerically equal to its relative formula mass.
State Avagadro's Law	equal **volumes** of different gases contain an equal number of **molecules.**
State the volume occupied by one mole of any gas at room temperature and pressure (20°C and 1 atmosphere pressure)?	24 dm^3
Calculate the volume of gas is occupied by 0.5 mole of Hydrogen gas?	x 24 dm^3 = 12dm^3
Calculate the number of moles in: A. 20g of MgO B. 250g of $Ca(NO_3)_2$	A. 20g / 40 g/mol = 0.5 B. 250g / 164 g/mol = 1.5
Calculate the amount of grams in the following: A. 2 moles of HCl B. 0.5 moles of K_2SO_4	A. 2 x 36.5 = 73g B. 0.5 x 174 = 87g

C4- Chemical Changes	
State the general reaction of metal with oxygen?	Metal + oxygen → metal oxide
Define the terms oxidation and reduction with respect to oxygen.	Oxidation is the addition of oxygen Reduction is the loss of oxygen
Give examples of oxidation and reduction with oxygen.	Oxidation : magnesium +oxygen →magnesium oxide Magnesium is oxidised Reduction : Zinc oxide + carbon →zinc +carbon dioxide Zinc is reduced
Write a balanced chemical equation for the oxidation of magnesium with oxygen	$2Mg + O_2 \rightarrow 2\ MgO$
Write a balanced chemical equation for the reduction of zinc oxide with carbon	$2\ ZnO + C \rightarrow 2\ Zn + CO_2$
State the general reaction of metal with water?	Metal + water → metal hydroxide (base/alkali) + hydrogen gas
Explain how you know that a base/alkali is created from the reaction of a metal + water?	It turns from colourless to purple when universal indicator is added to it
State the name for the test for hydrogen?	Squeaky pop test
State the name of the salt formed from the following acids: A. hydrochloric acid B. sulphuric acid C. nitric acid	A. Metal **chloride** B. Metal **sulphate** C. Metal **nitrate**

Chemistry

State what the reactivity series of metals is?	It is a list of metals in order of most reactive to least reactive.
Define a displacement reaction	This is where a more reactive element displaces or removes a less reactive element from its compound
Define the term ore.	An ore is a rock that contains enough of a metal or a metal compound to make extracting the metal worthwhile
State how is the method of extraction of metal is chosen?	The method of extraction chosen depends on how reactive a metal is
State how metals above carbon in the reactivity series are extracted?	By electrolysis
State how metals below carbon in the reactivity series are extracted?	Reduction using carbon
Describe the process of reduction with carbon when extracting copper form one of it's ores.	The copper ore is heated strongly with carbon which will reduce the copper ore to copper and produce carbon dioxide in the process.
Describe how to test for the presence of carbon dioxide?	Bubble the gas produced/ evolved through limewater
Describe what is observed when carbon dioxide is present?	The limewater should turn cloudy or milky white.
Describe the substance that is a. oxidised and b. reduced during the extraction of copper?	a. Carbon is oxidised b. Copper oxide is reduced
Define the terms: A. Oxidation (with respect to electrons) B. Reduction (with respect to electrons)	A. Oxidation is the loss of electron(s), which gives an increase in oxidation number. B. Reduction is gain of electron(s), which results in a decrease of oxidation number
Define a redox reaction?	A reaction in which oxidation and reduction takes place simultaneously
Define the definition of an acid?	A substance that produce H+ ions in an aqueous solution
State the pH range of acidic solutions?	Between 0-6.9
Give the definition of the term 'alkali'?.	This is a soluble substance that produces OH- ions in aqueous solution
Give the definition of the term 'base'?	Insoluble metal hydroxide and metal oxide
State the general equation for a neutralisation reaction?	$H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$
Name the product of the reaction between sodium hydroxide and sulphuric acid?	Sodium sulphate and water
Write a chemical equation for the reaction of sodium hydroxide and sulphuric acid.	$2\ NaOH_{(aq)} + H_2SO_{4\ (aq)} \rightarrow Na_2SO_{4\ (aq)} + H_2O_{(l)}$
State the product of an acid + metal carbonate?	Salt , carbon dioxide and water
Name the products of the reaction between magnesium carbonate and hydrochloric acid.	Magnesium chloride, carbon dioxide and water **(any order)**
Write a chemical equation for the reaction of magnesium carbonate and hydrochloric acid.	$MgCO_{3\ (aq)} + 2\ HCl_{(l)} \rightarrow MgCl_{2\ (aq)} + H_2O_{(l)} + CO_{2\ (g)}$
A soluble salt can be made by reacting an acid with solids like?	Metal oxide, metal carbonate
State the general reaction of metal with acid?	Metal + acid → metal salt + hydrogen
How do you know that a base/alkali is created from the reaction of a metal + water?	It turns from colourless to purple when universal indicator is added to it
Describe how a dry sample of copper sulphate is formed from sulphuric acid and copper oxide.	• Measure a fixed volume (10-25 ml) of sulphuric acid. • Add excess solid copper oxide to the acid. • Stir the mixture until no further reaction takes place. • Filter the solution formed and collect the filtrate. • Discard the residue (excess copper oxide). • Transfer filtrate into and evaporating dish. • Remove excess water by heating over a water bath until crystals tart to form. • Air dry blue copper sulphate crystals.
State the equipment that is needed for the filtration process?	Filter funnel, filter paper and conical flask/beaker
State why is the copper oxide added in excess of the acid?	To ensure that all the acid is used up in making copper sulphate
Define what is meant by the term "soluble salt?"	A salt that dissolves in water to form an aqueous solution.
Which other method can be used to produce a salt?	Neutralisation
Define neutralisation	This occurs when and acid reacts with an alkali/base to produce a salt and water
What is the pH of the solution that results from a neutralisation reaction?	7
State the range of the values of a pH scale?	0-14
State the range of alkali/basic pH?	8 -14
Write an Ionic equation to represent a neutralisation reaction	$H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$
State what a strong acid is?	A strong acid is completely ionised in aqueous solution
State what a weak acid is ?	A strong acid is only partially ionised in aqueous solution
Give named examples of strong acids?	hydrochloric, nitric and sulfuric acids
Give named examples of weak acids?	ethanoic, citric and carbonic acids
What is concentration?	This is the amount of a substance contained is a given volume
State the link between pH and strength of acid?	The stronger the acid the lower the pH

Chemistry

State how we measure the pH of a substance	Use red or blue litmus, pH probes/meters, universal indicators or indicators
Which is more accurate in measuring the pH of a substance?	pH probes
Which is a least accurate in measuring the pH of a solution?	Red or blue litmus
Explain why are red and blue litmus the least effective way to measure pH?	Red and blue litmus can only tell if a solution is acid or basic so it's the least accurate.
Explain why are pH probes the most effective way to measure pH?	pH probes give the an accurate measure of how acidic or basic a solution is in some case to 2
State the colour of universal indicator in the following: A. strongly acidic solution - pH 1? B. neutral solution pH 7 C. strongly alkaline solution- pH 14	A. Red B. Green C. Purple

C4- Chemical Changes - Electrolysis	
State what happens to the ions in an ionic compound when they are in solution or liquid?	Ions become mobile
Any liquids and solutions are able to conduct electricity and are called	Electrolytes
Explain why ionic solids are unable to conduct electricity	The ions are not free to move about which means they cannot carry electricity.
State what positively charge ions are called?	Cations
State what negatively charged ions are called?	Anions
State what are the positively charge electrodes called?	Anode
State what are negatively charged electrodes called?	Cathode
State which electrode are cations attracted to?	Cathode
State which electrode are anions attracted to?	Anode
State what process takes place at the cathode?	Reduction
State what process takes place at the anode	Oxidation
In the electrolysis of molten lead bromide **state** which ion goes to the cathode?	Lead ions
In the electrolysis of molten lead bromide **state** which ion goes to the anode?	Bromide ions
In the electrolysis of dilute sodium chloride **state** which ions go towards the cathode?	Hydrogen ions Sodium Ions
In the electrolysis of dilute sodium chloride **state** which ions go towards the anode?	Hydroxide ions Chloride ions
In the electrolysis of dilute sodium chloride **state** what product comes off at the cathode?	Hydrogen gas
In the electrolysis of dilute sodium chloride **state** what product comes off at the anode?	Chlorine gas
In the electrolysis of dilute sodium chloride **write** an equation for the reaction taking place at the cathode.	$2\ H^+_{(aq)} + 2e^- \rightarrow H_{2\ (g)}$
In the electrolysis of dilute sodium chloride **write** an equation for the reaction taking place at the anode.	$4\ OH^-_{(aq)} \rightarrow O_{2\ (g)} + 2\ H_2O_{(l)} + 4e^-$ **OR** $4\ OH^-_{(aq)} - 4e^- \rightarrow O_{2\ (g)} + 2\ H_2O_{(l)}$
State why aluminium oxide does not react with carbon?	Aluminium is above carbon in the reactivity series
Explain why do the aluminium ions collect at the negative electrode?	Aluminium ions are positively charged, which means they are attracted to the negatively charged electrode (cathode)
Explain how carbon dioxide forms at the positive electrodes during electrolysis	Oxygen is produced at the anode which then reacts with the carbon electrodes, producing carbon dioxide

C5- Energy Changes	
State the law of conservation of energy?	The amount of energy in the universe at the end of a chemical reaction is the same as before the reaction takes place.
Define the term 'exothermic' reaction?	An exothermic reaction is one that transfers energy to the surroundings, so the temperature of the surroundings increases.
Give examples of different types of reactions that are exothermic in nature	Exothermic reactions include combustion, many oxidation and neutralisation.
Give examples of everyday uses of exothermic reactions.	Self-heating cans and handwarmers.
Define the term 'endothermic' reaction?	An endothermic reaction is one that takes in energy from the surroundings.
State what happens to the temperature of the surroundings during endothermic reactions?	Goes down, decreases

Chemistry

Give examples of different types of reactions that are endothermic in nature.	Thermal decompositions and the reaction of citric acid and sodium hydrogen carbonate.
Give examples of everyday uses of endothermic reactions.	Sports injury packs
Describe the relationship between temperature change and the amount of energy absorbed or released.	The greater the change in energy the greater the amount of energy absorbed or released.
State the biggest source of error when measuring the heat change during a reaction?	Unwanted heat transfers
Describe how we minimise unwanted heat transfers during a reaction?	Make sure we do the reaction in a closed system.
What does and energy profile diagram show?	It shows the energy in the **reactants** and **products**, and the difference in energy between them.
Define the term 'activation energy'?	The minimum energy needed by particles when they collide for a reaction to occur.
Describe how you can tell from a reaction profile that a reaction is exothermic.	In the profile for an exothermic reaction, the overall change is negative. You can tell this because the products have less energy than the reactants, and the arrow showing the overall change in energy points downwards.
Describe how you can tell from a reaction profile that a reaction is endothermic.	In the profile for an endothermic reaction, the overall change is positive. You can tell this because the products have more energy than the reactants, and the arrow showing the overall change in energy points upwards.
During a chemical reaction, **state** what happens to the bonds?	bonds in the **reactants** are broken new bonds are made in the **products**
The difference between the energy needed to break bonds and the energy released when new bonds are made determines what about the type of reaction?	Whether the reaction endo or exothermic.
If more heat energy is released in making bonds in the products than is taken in when breaking bonds in the reactant. What type of reaction is occurring?	Exothermic
State the type of reaction that is occurring if less heat energy is released in making bonds in the products than is taken in when breaking bonds in the reactants?	Endothermic
Define the term 'bond energy'?	Bond energy is the amount of **energy** needed to break one **mole** of a particular **covalent bond**.
Describe how to calculate an energy change for a reaction	1. Add together the bond energies for all the bonds in the **reactants** - this is the 'energy in' 2. Add together the bond energies for all the bonds in the **products** - this is the 'energy out' 3. Energy change = energy in - energy out
Calculate the bond energy for the formation of hydrogen chloride from it's elements and determine the type of reaction. Given that: 2 × (H−Br) → H−H + Br−Br **Bond** **Bond Energy (kJ/mol)** H−H 436 Br−Br 193 H−Br 366	1. Energy in = 2 × 366 = 732 kJ mol-1 2. Energy out = 436 + 193 = 629 kJ mol-1 3. Energy change = in – out = 732 - 629 = **+103 kJ mol^{-1}** **Endothermic Reaction** (positive energy change means energy is taken in from the surroundings)
Calculate the bond energy for the formation of water from it's elements and determine the type of reaction. Given that: 2 H-H + O=O → 2 H-O-H **Bond** **Bond Energy (kJ/mol)** H−H 436 O=O 498 O−H 464	1. Energy in = (2 x 436) + 498 = 1370 kJ/mol 2. Energy out = 4 × 464 = 1856 kJ/mol 3. Energy change = in – out = 1370 – 1856 = **-486 kJ/mol** **Exothermic Reaction** (negative energy change means energy is given out to the surroundings)
Define a chemical cell	Chemical cells use chemical reactions to transfer energy by electricity
State two factors that affect the voltage of a cell	The type of electrode and the electrolyte
Describe how a simple cell is made	A simple cell can be made by connecting two different metals in contact with an electrolyte.
Define a battery	Batteries consist of two or more cells connected together in series to provide a greater voltage
State the two types of batteries	Non-rechargeable cells (Alkaline batteries) and rechargeable cells
Explain the difference between the two types of batteries	In non-rechargeable cells and batteries, the chemical reactions stop when one of the reactants has been used up. Rechargeable cells and batteries can be recharged because the chemical reactions are reversed when an external electrical current is supplied.
Evaluate the advantages and disadvantages of using chemical cells	Advantages: Easy to obtain, can be recharged Disadvantages: Reactants will eventually run out, an external device is needed to charge the re-chargeable cells
Describe how a fuel cell produces potential difference	The fuel is oxidised electrochemically within the fuel cell to produce a potential difference.
State the two possible sources of a fuel cell	Hydrogen and Oxygen (from air)
Evaluate the advantages and disadvantages of using a hydrogen fuel cell	Advantages: Quiet in use, only waste product is water, no pollutants are produced Disadvantages: Hydrogen is more difficult to store, flammable
Write the half equation of a fuel cell	At the **Anode**: $H_{2\,(g)} \rightarrow 2\,H^{+}_{(aq)} + 2e^{-}$ At the **Cathode**: $O_{2\,(g)} \rightarrow 2\,O^{2-}_{(aq)} + 4e^{-}$ **Overall**: $2\,H_{2\,(g)} + O_{2\,(g)} \rightarrow 2\,H_2O_{(l)}$

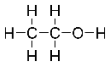
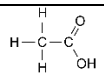
Chemistry

C6- The Rate and Extent of Chemical Change	
Describe how to measure the rate of a reaction	The rate of a chemical reaction can be found by measuring the quantity of a reactant used or the quantity of product formed over time:
Write the equation of working out the mean/average rate of a reaction	mean rate of reaction = quantity of reactant used or quantity of product formed / time taken
State the units for the above equation	Mass = g/s or Volume = cm3/s or Moles = mol/s
State the factors that affect the rate of a chemical reaction	• concentration • pressure (in the case of gases) • surface area • temperature • catalysts
State what collision theory is	Collision theory: chemical reactions can occur only when reacting particles collide with each other and with sufficient energy
Define 'activation energy'	Activation energy: the minimum amount of energy that particles must have to react
Describe and **explain** how increasing **concentration** affects the rate of a chemical reaction	In high concentrations there are: • More particles in the same space means more frequent collisions. • More frequent collisions means greater chance of successful collisions • If you double the concentration, you double the number of collisions
Describe and **explain** how increasing the **pressure** affects the rate of a chemical reaction	• If you increase the pressure of a gas, you squeeze it into a smaller volume • So the particles have a shorter distance to travel, • Which increases the number of collisions • More collisions means more effective collisions means faster rate.
Describe and **explain** how increasing **surface area** affects the rate of a chemical reaction	• Using smaller particles leads to a larger surface area • Increase in surface area allows more collisions at surface • More collisions means more effective collisions means faster rate.
Describe and **explain** how increasing **temperature** affects the rate of a chemical reaction	• The hotter the reactants the faster they move. • When they move faster they collide more frequently. • Particles also have more energy, so a **higher proportion of particles exceed the activation energy, meaning there are more successful collisions → rate will increase.**
Describe and **explain** how increasing **catalysts** affects the rate of a chemical reaction	• Catalysts reduce the activation energy needed for a reaction • They do this by offering an **alternate route** for the reaction to take • Lower activation energy means more particles will exceed the activation energy, therefore greater chance of successful collisions. • More effective collisions means faster rate
State what a reversible reaction is	A reversible reaction is where reactants form products and products react to reform the original reactants
Use A, B, C, D to represent a reversible reaction	$A + B \rightleftharpoons C + D$
Give an example of a reversible reaction	$NH_4Cl_{(s)} \rightleftharpoons NH_{3\,(g)} + HCl_{(g)}$
Describe what happens during equilibrium	Equilibrium is reached when the forward and reverse reactions occur at exactly the same rate.
Describe the effect on equilibrium that increasing the concentration of a reactant or product has	If the concentration of one of the reactants or products is changed, the system is no longer at equilibrium and the concentrations of all the substances will change until equilibrium is reached again.
Describe the effect on equilibrium that increasing the concentration of a reactant has	If the concentration of a reactant is increased, more products will be formed until equilibrium is reached again.

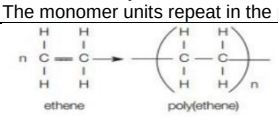
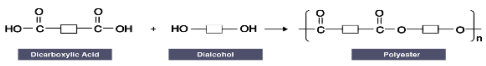
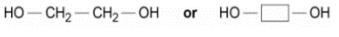
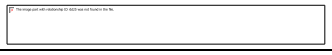
C7- Organic Chemistry	
Define 'hydrocarbon'	Molecules made up of hydrogen and carbon atoms only. Most of the hydrocarbons in crude oil are hydrocarbons called alkanes
Describe how crude oil is formed	Crude oil is a finite resource found in rocks. Crude oil is the remains of an ancient biomass consisting mainly of plankton that was buried in mud.
State what crude oil is	Crude oil is a mixture of a very large number of compounds.
What is the general formula for the homologous series of alkanes	C_nH_{2n+2}
Name the first four members of the alkanes series	Methane, Ethane, Propane and Butane
Write and **Draw** the displayed formula of Ethane	C_2H_6 
Name the process used to separate the fractions of crude oil	Fractional Distillation
Describe the use of the fractions produced from crude oil	Fuels and feedstock for the petrochemical industry
Explain how the size of the chain of the hydrocarbon affects where it is produced on the fractionating column	Longer (heavier) hydrocarbon molecules = bottom Shorter (lighter) hydrocarbon molecules = top
Explain how increasing the molecular size of a hydrocarbon affects the following: A. Boiling point B. Viscosity C. Flammability	A. Increases B. Thicker to pour C. Harder to light
Write the balanced equation for combustion of ethane	$2\,C_2H_6 + 7\,O_2 \rightarrow 4\,H_2O + 6\,CO_2$
Define 'cracking'	Breakdown of a large **alkanes** into smaller, more useful **alkenes**

Chemistry

State the two main types of cracking	Catalytic cracking and steam (thermal) cracking
Describe the conditions for the following types of cracking: A. Catalytic cracking B. Steam (thermal) cracking	A. Passing them over a hot catalyst B. Mixing them with steam and heated to a very high temperature (500°C)

C7- Organic Reactions (CHEMISTRY ONLY)	
Describe the test used to distinguish between alkanes and alkenes	Bromine water – orange/brown/red → colourless (Decolourises in the presence of alkenes)
State what alkenes are	Alkenes are hydrocarbons with a double carbon-carbon bond
State the general formula for the homologous series of alkenes	C_nH_{2n}
Explain why alkenes are considered unsaturated	They contain two fewer hydrogen atoms than the alkane with the same number of carbon atoms.
Name the first four members of the alkenes series	Ethene, Propene, Butene and Pentene
Write and **Draw** the displayed formula of Ethene	C_2H_4 
Describe the reaction of alkenes during incomplete combustion	They tend to burn in air with smoky/sooty flame
State the product formed from alkenes react with the following: A. Hydrogen B. Water C. Halogen	A. Alkane (Hydrogenation) B. Alcohol (Hydration) C. Halo-alkane (Halogenation)
State the product formed from ethene reacts with the following: A. Hydrogen B. Water C. Chlorine	A. Ethane (Hydrogenation) B. Ethanol (Hydration) C. 1,2 di-Chloroethane (Halogenation)
What is the name and the formula for the functional group 'alcohols'	Functional group –OH (Hydroxyl)
State the name of the first four members of the alcohol homologous series	Methanol, ethanol, propanol and butanol
State and **draw** how alcohols are represented using ethanol as the example	CH_3CH_2OH 
Describe the reaction of alcohols with the following: A. Sodium B. Oxygen (in air) C. Water D. Oxidising agent	A. Salt (Sodium (alkan)oate) + hydrogen B. Carbon dioxide + Water (Complete combustion) C. Neutral solution (pH 7) D. Carboxylic acids (organic acids)
Recall the main uses of these alcohols	• Methanol: chemical feedstock, in anti-freeze, to make biodiesel • Ethanol: the main alcohol in alcoholic drinks, used as a solvent and fuel • All 4: can be used as fuels
State the product of the fermentation of sugar solutions using yeast	Ethanol
Describe the conditions used for fermentation of sugar using yeast	Conditions: about 35°C, anaerobic respiration (without oxygen) and yeast enzyme catalyst
Write a word equation for the fermentation of sugar using yeast	Sugar → ethanol + carbon dioxide
Write a balanced equation for the complete combustion (reaction with oxygen) of ethanol	$C_2H_5OH + 3\ O_2 \rightarrow 2\ CO_2 + 3\ H_2O$.
What is the name and the formula for the functional group 'carboxylic acids'	Functional group –COOH
State the name of the first four members of the 'carboxylic acids' homologous series	methanoic acid, ethanoic acid, propanoic acid and butanoic acid
State and **draw** how carboxylic acids are represented using ethanoic acid as the example	CH_3COOH 
Describe the reaction of carboxylic acids with the following: A. Carbonates B. Water C. Alcohol	A. Salt (Metal (alkan)oate) + Carbon dioxide + Water B. Weak Acidic solution C. Ester
State the product of the reaction of ethanoic acid with the following: A. Sodium Carbonate B. Water C. Ethanol	A. Sodium ethanoate + Carbon dioxide + Water B. Aqueous solution (pH 4-6) C. Ethyl ethanoate
Explain why carboxylic acids are considered weak acids	Because they only ionise or dissociate partially
State the type of polymerisation exhibited by alkenes	Addition polymerisation
Name the polymer formed by the following alkenes A. Propene B. Ethene	A. Poly(propene) B. Poly(ethene)

Chemistry

C7- Polymers (CHEMISTRY ONLY)	
Define the term 'monomer'	These are many small molecules joined together to create very large molecules called polymers. The monomer units repeat in the polymer formed
Draw structures to show the polymerisation of ethene	 the 'n' means that the monomer units are repeated a large number of times
Define the term 'condensation polymerisation'	These are polymers formed when different types of monomers react they join together, usually losing small molecules such as water during the process,
Recall the functional groups present in the monomers of a polyester	Alcohol (OH - Hydroxyl) and Carboxylic acid (COOH) groups
Draw diagrams to represent the formation of a polyester	
Describe how a condensation polymer can be formed.	The simplest polymers are formed from two different monomers, each monomer must have two of the same functional group on it. Example di-alcohol:  has 2 alcohol groups at either end di-carboxylic acid:  has 2 carboxylic acid functional group
State the product of the condensation polymerisation of amino acids	Polypeptides
State the product formed when different amino acids combine in the same chain.	Proteins
Recall the functional groups present in amino acids	Amine (NH_2) and Carboxylic acid (COOH) groups
Recall the function of DNA	DNA (deoxyribonucleic acid) is a large molecule essential for life. It encodes genetic instructions for the development and functioning of living organisms and viruses
Describe the structure of most DNA molecules	Most DNA molecules are two polymer chains, made from four different monomers called nucleotides, in the form of a double helix
Identify the monomer units from which the following naturally occurring polymers are made A. Proteins B. Starch C. Cellulose	Proteins - amino acid Starch - glucose Cellulose – glucose

C8- Chemical Analysis	
Define a pure substance	A pure substance is a single element or compound, not mixed with any other substance.
Describe how pure substances are distinguished from mixtures	Pure elements and compounds melt and boil at specific temperatures to distinguish between pure substances and mixtures you can determine the melting/boiling point
Define a formulation	A formulation is a mixture that has been designed as a useful product. Many products are complex mixtures in which each chemical has a particular purpose
Describe how a formulation is made	Formulations are made by mixing the components in carefully measured quantities to ensure that the product has the required properties.
Give examples of formulations	Fuels, cleaning agents, paints, medicines, alloys, fertilisers and foods
Identify the phases used in chromatography	Stationary and mobile phase
Describe how substances can be separated using paper chromatography	1. Draw a baseline **using a pencil** 1cm from the bottom of the chromatography paper (stationary phase) 2. Place a small amount of the mixture (using a capillary tube) on the baseline 3. Pour a small amount of solvent (mobile phase) into the beaker (just enough to cover the bottom of the beaker) 4. Add chromatography sheet into the beaker containing your solvent (making sure the baseline sits just above the solvent) 5. Allow the solvent to travel up the paper 6. When the solvent has travelled ¾ of the length of the chromatography paper, remove paper from the beaker and allow to dry 7. Measure the distance from the baseline to where the solvent has stopped (solvent front) 8. Measure the distance from the baseline to half way through each sample 9. Calculate the R_f value
Define R_f value	The ratio of the distance moved by a compound (centre of spot from origin) to the distance moved by the solvent
Write the formula of R_f value	Rf = distance moved by substance / distance moved by solvent
Describe how to deduce whether a substance is pure using paper chromatography	The compounds in a mixture may separate into different spots depending on the solvent but a pure compound will produce a single spot in all solvents
Explain how chromatography works	The components of a mixture will interact differently with the stationary and mobile phase. The more soluble component(s) will have a greater interaction with the mobile phase and thus travel further up the paper
Describe and **explain** the positive test for hydrogen	The test for hydrogen uses a burning splint held at the open end of a test tube of the gas. Hydrogen burns rapidly with a pop sound.
Describe and **explain** the positive test for oxygen	The test for oxygen uses a glowing splint inserted into a test tube of the gas. The splint relights in oxygen
Describe and **explain** the positive test for carbon dioxide	The test for carbon dioxide uses an aqueous solution of calcium hydroxide (lime water). When carbon dioxide is shaken with or bubbled through limewater the limewater turns milky (cloudy).

Chemistry

Describe and **explain** the positive test for chlorine	The test for chlorine uses litmus paper. When damp litmus paper is put into chlorine gas the litmus paper is bleached and turns white.
Identify the colour of the flame test for each of the following cations: A. Lithium B. sodium C. potassium D. calcium E. copper	A. Crimson/red flame B. Yellow flame C. Lilac flame D. Orange/red flame E. Green flame
Describe the observations when sodium hydroxide solution is added in excess to a sample containing the following ions: A. Aluminium B. Calcium C. Magnesium D. Copper(II) E. Iron(II) D. Iron(III)	A. White precipitate (soluble in excess) B. White precipitate (insoluble in excess) C. White precipitate (insoluble in excess) D. Copper precipitate E. Green precipitate D. Brown precipitate
Write a balanced equation for sodium hydroxide reacted with the following ions: A. Aluminium B. Iron (II) C. Calcium	A. $Al^{+3}_{(aq)} + 3\ OH^{-}_{(aq)} \rightarrow Al(OH)_{3\ (aq)}$ B. $Fe^{+2}_{(aq)} + 2\ OH^{-}_{(aq)} \rightarrow Fe(OH)_{2\ (s)}$ C. $Ca^{+2}_{(aq)} + 2\ OH^{-}_{(aq)} \rightarrow Ca(OH)_{2\ (s)}$
Describe how to test for carbonates (CO_3^{-2})	Carbonates react with dilute acids to form carbon dioxide gas. Carbon dioxide can be identified with limewater.
Describe the observations for positive identification of the following halide ions using silver nitrate in the presence of dilute nitric acid: A. Chloride (Cl^-) B. Bromide (Br^-) C. Iodide (I^-)	Halide ions in solution produce precipitates with silver nitrate solution in the presence of dilute nitric acid. A. Silver chloride is white B. Silver bromide is cream C. Silver iodide is yellow.
Describe the observation for positive identification of sulphate ions with barium chloride solution in the presence of dilute hydrochloric acid.	White precipitate
State the advantages of identifying elements and compounds using instrumental methods over chemical tests	Instrumental methods are more accurate, sensitive and faster
Describe how flame emission tests can be used to analyse metal ions in solutions	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.

C9- Chemistry of the Atmosphere	
Describe the composition if the gases in the atmosphere	• About four-fifths (approximately 80%) nitrogen • About one-fifth (approximately 20%) oxygen •Small proportions of various other gases, including carbon dioxide, water vapour and noble gases.
Describe the formation of earth's earlier atmosphere	Intense volcanic activity that released gases that formed the early atmosphere and water vapour that condensed to form the oceans The Earth's atmosphere consisted of mainly carbon dioxide with little or no oxygen gas. Volcanoes also produced nitrogen which gradually built up in the atmosphere and there may have been small proportions of methane and ammonia. When the oceans formed carbon dioxide dissolved in the water and carbonates were precipitated producing sediments, reducing the amount of carbon dioxide in the atmosphere.
Describe how the concentration of oxygen increased over time	Algae and plants produced the oxygen that is now in the atmosphere by photosynthesis 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 to a level that enabled animals to evolve.
Write a word and balanced equation to represent how the concentration of oxygen increased	$6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$ (light) carbon dioxide + water → glucose + oxygen
Describe how the concentration of carbon dioxide deceased over time	Algae and plants decreased the percentage of carbon dioxide in the atmosphere by photosynthesis. CO_2 was also decreased by the formation of sedimentary rocks that contain carbon (e.g. limestone and coal) and by the production of fossil fuels from the remains of dead plants and animals when they decayed
State the function of greenhouse gases	Maintain temperatures on earth high enough to support life
Identify the greenhouse gases	Water vapour (H_2O), Carbon dioxide (CO_2) & methane (CH_4)
Describe what 'greenhouse effect' is	**The greenhouse gas effect:** Electromagnetic radiation at most wavelengths (both long and short) from the sun passes through the Earth's atmosphere The Earth absorbs some radiation and thus warms up (essential for life on Earth). But some heat is radiated from the Earth as infrared radiation. Some of this IR radiation is absorbed by greenhouse gases in the atmosphere Atmosphere warms up leading to the greenhouse effect and global warming
Identify ways in which human activity contributes to the greenhouse effect	Driving (CO_2) Consuming electricity (CO_2) Raising livestock (cows – CH_4) Decay of organic waste in landfill sites (CH_4)
Describe the effect of increasing the average global temperature on climate change	• Extinction of species • Raising sea levels due to the melting of polar ice caps • Migration- people will move from areas suffering drought/flooding

Chemistry

	• Decrease in crop yield for all major world crops • Flooding
Define 'carbon footprint'	The carbon footprint is the total amount of carbon dioxide and other greenhouse gases emitted over the full life cycle of a product, service or event.
State how carbon footprint can be reduced	The carbon footprint can be reduced by reducing emissions of carbon dioxide and methane e.g. by using less electricity (so using less fossil fuels or using an alternative source of electricity), by reducing the amount of travel or transportation (of either goods or people) by planting more trees.

C9- The Earth's resources	
State the main components of most fuels	Carbon and/or hydrogen
List the possible gases released into the atmosphere when a fuel is burned	Carbon dioxide, water vapour, carbon monoxide, sulphur dioxide and oxides of nitrogen
Describe how solid particulates and soot are released from burning fuels	If there's not enough oxygen, some of the fuel doesn't burn – this is partial/incomplete combustion. Here, solid particles of soot (carbon), carbon monoxide and unburnt fuel are released
Predict the products made from complete combustion	Carbon + hydrogen (in the fuels) are oxidised → carbon dioxide + water
Predict the products made from incomplete combustion	Carbon + hydrogen (in the fuels) are oxidised (not enough oxygen) → carbon monoxide + carbon (soot) +water
State why carbon monoxide is not easily detectable	Carbon monoxide: toxic gas which is colourless and odourless so not easy to detect
State the effects on humans and in the atmosphere of the following: A. Sulphur dioxide B. Oxides of nitrogen C. Particulates	A. Cause acid rain and respiratory problems in humans B. Cause acid rain and respiratory problems in humans C. Cause global dimming and human health problems

C10- Using Resources	
Define 'potable water'	Water that is safe to drink
Distinguish between potable water and pure water	Potable water is not 'pure' because it contains dissolved substances, although to be safe it must have sufficiently low levels of dissolved salts and microbes
Describe how water in the UK is made potable (safe to drink)	• An appropriate source of fresh water is selected (rain provides water with low levels of dissolved substances and this collects in the ground/rivers/lakes) • The water is passed through filter beds to remove different sized insoluble solids • The water is then sterilised, to kill microbes (sterilising agents include: ozone, UV light or chlorine)
Describe how sea water/salty water is made potable (safe to drink)	If only salty/sea water is available, **desalination** is required. Desalination can be done by: • Distillation • Can be done using processes with membranes (e.g. reverse osmosis) **(BOTH are very expensive)**
Describe how correct quality water is produced	1. Water is passed through a mesh screen to remove large bits e.g twigs or grit 2. Chemicals are added to make solids and microbes stick together to form sediment and sink 3. There is then anaerobic digestion of sewage sludge 4. The water is then sterilised with chlorine to kill any microbes left
State the advantages of wastewater treatment compared to the desalination methods	Relatively cheaper and easier to obtain potable water from groundwater and wastewater than salt water, although seawater is a plentiful raw material, so is good for countries with little fresh water
State the two methods of extracting copper from low-grade ores	Phytomining, and bioleaching
Explain how phytomining is used to extract copper	Phytomining uses plants to absorb metal compounds. o Plants are harvested and then burned to produce ash that contains metal compounds
Explain how bioleaching is used to extract copper	• Bioleaching uses bacteria to produce leachate solutions that contain metal compounds • The metal compounds can be processed to obtain the metal • For example, copper can be obtained from solutions of copper compounds by displacement using scrap iron or by electrolysis
State the purpose of 'life-cycle assessment,	Analyse of the impact of a manufactured product on the environment.
Recall the main stages of LCAs	• Extracting and processing the raw materials needed • Manufacturing the product and its packaging • Using the product during its lifetime • Disposing of the product at the end of its useful life
Describe the main environmental impact at each of the following stages: A. Raw material B. Manufacture C. Use of material **D.** Disposal	**Raw materials** • using up limited resources such as ores and crude oil • damaging habitats through quarrying, mining, or felling trees **Manufacture** • using up land for factories • the use of machines and people **Use** The impact of a product on the environment during its use depends on the type product. For example, a wooden chair has very little impact, unless it needs cleaning or repair. On the other hand, using a car will have a significant impact. **Disposal** • using up land for landfill sites • whether any or all product can be recycled or reused
State the impact of resources made from reusable material on the environment using glass bottles as example	Some items made from these materials can be reused, and this saves the most energy and reduces the impact on the environment. Example - glass bottles only need to be washed and sterilised before they can be filled again.

Chemistry

<table>
<tr><td>Evaluate which of the types of carrier bags will have a lower negative impact on the atmosphere using comparative LCAs.</td><td>
<table>
<tr><th>Life cycle stage</th><th>Plastic carrier bags</th><th>Paper carrier bags</th></tr>
<tr><td>Raw materials</td><td>Getting raw material Is expensive and requires large amounts of energy.

Crude oil is a finite resource; fractional distillation, cracking and polymerisation all require a lot of energy.</td><td>Can be made from recycled paper, or from trees.
Making paper from trees requires more energy than recycling paper, but much less than making plastics.</td></tr>
<tr><td>Manufacture</td><td>Cheaper to make large quantities of bags from plastic.</td><td>More expensive to make bags from paper because the handles must be glued on.</td></tr>
<tr><td>Use</td><td>Lower impact on the environment because plastic bags are usually stronger so they can be reused many times.</td><td>Relatively short lifetime; can only be reused a limited number of times.</td></tr>
<tr><td>Disposal</td><td>Can sometimes be collected and recycled; if disposed of as litter, they do not biodegrade; in landfill, may take decades or centuries to degrade.</td><td>Can be recycled easily; if disposed of in landfill, they biodegrade quickly.</td></tr>
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</td></tr>
<tr><td>Recall the advantages of recycling compared to producing material from natural resources</td><td>• Fewer quarries and mines are needed to extract finite reserves of metal ores
• Less crude oil needs to be extracted from the crust as a raw material for making plastics
• Less energy is needed for recycling compared with making a new product from natural Resources, so the emission of greenhouse gases is reduced
• The amount of waste that is disposed of in landfill is reduced</td></tr>
<tr><td>Recall the disadvantages of recycling compared to producing material from natural resources</td><td>• The collection and transport of used items needs organisation, workers, vehicles and fuel
• It can be difficult to sort different metals from one another
• The sorted metal may need to be transported to where it can be turned into ingots</td></tr>
<tr><td>State the names of the biological process of extracting metals from low grade ores</td><td>Phytoextraction
Bioleaching</td></tr>
<tr><td>Describe how phytoextraction is used in metal extraction</td><td>Plants absorb mineral ions through their roots. Phytoextraction makes use of this:
• Plants are grown on a low-grade ore
• The plants absorb metal ions through their roots and concentrate these ions in their cells
• The plants are harvested and burnt
• The ash left behind contains metal compounds</td></tr>
<tr><td>State the advantages of phytoextraction</td><td>• Reduces the need to obtain new ore by mining
• Conserves limited supplies of high-grade ores
• Reduces the amount of rock waste that must be disposed of after traditional mining</td></tr>
<tr><td>State a disadvantage of phytoextraction</td><td>The process is slow</td></tr>
<tr><td>Describe how bioleaching extracts copper from low grade ores</td><td>Certain bacteria can break down low-grade ores to produce an acidic solution containing copper ions. The solution is called a leachate

Processing the metal compounds
Iron is more reactive than copper. It can displace copper from the leachate. For example:
iron + copper sulfate → iron(II) sulfate + copper
Fe (s) + $CuSO_4$ (aq) → $FeSO_4$ (aq) + Cu (s)
Since iron is cheaper than copper, the use of scrap iron is a cost-effective way to produce copper from the leachate.
Alternatively, the copper compounds can be dissolved, and the solution electrolysed to produce copper metal.</td></tr>
<tr><td>State an advantage of bioleaching</td><td>Does not require high temperatures</td></tr>
<tr><td>State a disadvantage of bioleaching</td><td>It produces toxic substances, including sulfuric acid, which damage the environment.</td></tr>
<tr><td>Define ‘corrosion’</td><td>Destruction of materials by chemical reactions with substances in the environment o E.g. rusting</td></tr>
<tr><td>State the conditions necessary for corrosion of iron</td><td>Both air and water are necessary for iron to rust</td></tr>
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Chemistry

State some ways in which corrosion can be prevented	Corrosion can be prevented by applying a coating that acts as a barrier, such as greasing, painting or electroplating
Describe how Aluminium is protected from corrosions	Aluminium has an oxide coating that protects the metal from further corrosion
Explain sacrificial protection and give a suitable example	Sacrificial protection works by the more reactive metal donating electrons to any ions of the other metal that may have formed so they don't corrode **Example zinc is used to galvanise iron**
State the disadvantage of using pure metals like gold over alloys	Pure copper, gold, iron and aluminium are all too soft for everyday uses and so are mixed with small amounts of similar metals to make them harder for everyday use.
State the uses the following alloys: A. Bronze B. Low-carbon steels C. High-carbon steels D. Stainless steels E. Aluminium alloys	• Bronze is an alloy of copper and tin - used in electrical connectors o Brass is an alloy of copper and zinc - used for tools • Low carbon steel are easily shaped - used for sheeting (malleable) • High carbon steels are hard - used for cutting tools • Stainless steels (containing chromium and nickel) are resistant to corrosion - used for cutlery • Aluminium alloys are low density - used for aircraft
Describe how the following materials are made Soda-lime glass Borosilicate glass Clay ceramics	● **Soda-lime glass:** made by heating a mixture of sand, sodium carbonate and limestone (most commonly used glass) ● **Borosilicate glass**: made from sand and boron trioxide, melts at higher temperatures than soda-lime glass ● **Clay ceramics**: including pottery and bricks, are made by shaping wet clay and then heating in a furnace
Explain the differences between LDPE and HDPE	• **Low density polyethene** has weaker forces of attraction as the chains are further apart, meaning it has a low melting point and is soft • **HD polyethene** has higher forces of attraction, as the chains are closer together, giving it a higher melting point
Describe how thermosoftening polymers are made and how they are separated	Thermosoftening polymers are made of individual, tangled polymer chains which are easily separated and are melted by heat • There are weak intermolecular forces between the chains • The chains are easy to separate • At lower temperatures • Less heat energy is needed to break the chains
State an advantage of thermosetting polymers	Thermosetting polymers consist of polymer chains, which cross links, so that they do not melt when heated.
Describe how composites are made and give examples.	Most composites are made of two materials, a matrix or binder surrounding and binding together fibres or fragments of the other material, which is called the reinforcement o examples of composites: bricks and pottery (both are very hard but very brittle)