**Chemistry Unit 1 - Atomic structure and the periodic table**

|  |  |  |
| --- | --- | --- |
| **C1.1 Simple model of the atom, symbols, relative atomic mass, electronic charge and isotopes** | **** | **** |
| Recall that an atom is the smallest part of an element that can exist |  |  |
| Recall that atoms of each element are represented by a chemical symbol, e.g. O represents an atom of oxygen |  |  |
| State that there are about 100 different elements. Elements are shown in the periodic table |  |  |
| State that compounds are formed from elements in chemical reactions |  |  |
| Describe that compound always involve the formation of new substances, and usually involve a detectable energy change |  |  |
| State that compounds contain two or more elements **combined** in fixed proportions, and are represented by formulae using the symbols of the atoms from which they were formed |  |  |
| Use the names and symbols of the first 20 elements in the periodic table and the elements in group 1 and 7 |  |  |
| Name compounds of these elements from a given formulae or symbol equations |  |  |
| Write word and symbol equations for given reactions |  |  |
| *Write balanced half equations and ionic equations (HT)* |  |  |
| Define a mixture as consisting of two or more elements or compound not chemically joined together |  |  |
| Describe the following separation techniques and suggest what type of substances they separate and when they would be used - filtration, crystallisation, distillation, fractional distillation, and chromatography |  |  |
| State that separating mixtures does NOT involve a chemical reaction |  |  |
| Explain that new experimental evidence may lead to a scientific model being changed or replaced |  |  |
| State that the subatomic particles were found in the following order: electrons, protons, neutrons |  |  |
| Explain that the discovery of the electron led to the plum pudding model of the atom |  |  |
| Describe the plum pudding model as being a ball of positive charge with negative electrons embedded in it |  |  |
| Explain how the alpha particle scattering experiment led to the nuclear model (mass was concentrated at the centre of the atom and that the nucleus was charged) replacing the plum pudding model |  |  |
| State that Niels Bohr adapted the nuclear by suggesting electrons orbit the nucleus at specific distances. |  |  |
| Compare in detail the difference between the plum pudding model and the nuclear model |  |  |
| State the relative mass and charge of protons, neutrons and electrons |  |  |
| Explain that atoms have a neutral charge because they have equal numbers of protons and electrons |  |  |
| State that atoms of different elements have different number of protons |  |  |
| State that atoms have a radius of about 0.1 nm (1 x 10-10 m). |  |  |
| State that radius of a nucleus is less than 1/10 000 of that of the atom (about 1 x 10-14 m). |  |  |
| Recall that the mass number of an atom is the sum of the protons and neutrons  |  |  |
| Define an isotope as an atom of the **same** element with a different number of neutrons |  |  |
| Calculate the number of protons, neutrons and electrons in any given element |  |  |
| Recall that the relative atomic mass of an element is an **average value** of all the isotopes of that element. |  |  |
| Calculate the relative atomic mass of an element given the percentage abundance of its isotopes |  |  |
| Describe how electrons are arranged around the atom: for example, the structure of sodium is 2, 8, 1. Electrons occupy the lowest available energy levels (shells) first |  |  |
| **C1.2 The Periodic Table**  |
| Recall that elements in the periodic table are arranged in order of atomic (proton) number |  |  |
| Recall that elements with **similar properties** are arranged in columns known as groups. The group number corresponds to the number of electrons in the **outer shell** of the atom |  |  |
| Describe that before the discovery of protons, neutrons and electrons, scientists attempted to classify the elements by arranging them in order of their **atomic weights** |  |  |
| Explain that early periodic tables were incomplete and some elements were placed in inappropriate groups because they were arranged by atomic weights |  |  |
| State that Mendeleev left gaps for elements he thought hadn't been discovered |  |  |
| Explain why knowledge of isotopes made it possible to explain why the order based on atomic weights was not always correct |  |  |
| State that metals always react to form positive ions |  |  |
| State that non-metals always react to form negative ions |  |  |
| State where metals and non-metals are found in the periodic table |  |  |
| Recall that elements in Group 0 of the periodic table are called the noble gases |  |  |
| Describe the properties of Group 0 as unreactive and don't easily form molecules because they have a full outer shell |  |  |
| Recall that the boiling points of the noble gases increase with increasing relative atomic mass (going down the group) |  |  |
| Recall that elements in Group 1 are called alkali metals and have the same properties because of the single electron in the outer shell |  |  |
| Describe the reaction of the first three alkali metals with oxygen, chlorine an water |  |  |
| State that the reactivity of group 1 metals increases going down the group |  |  |
| Recall that elements in Group 7 of the periodic table are known as the halogens, and they have 7 electrons in their outer shell |  |  |
| Recall that halogens are non-metals and consist of molecules made up of **pairs of atoms e.g. Cl2** |  |  |
| Describe the nature of the compounds formed when chlorine, bromine and iodine react with metals and non-metals |  |  |
| State that in group 7, the further down the group an element is the higher its relative molecular mass, melting point and boiling point |  |  |
| State the in group 7 the reactivity decreases the further down the group |  |  |
| Describe that a more reactive halogen can displace a less reactive halogen from an aqueous solution of its salt |  |  |

**Videos:**

<https://goo.gl/MnvjXf> - broken into 20 short videos here

**Revision guide reference:**

Higher page: 96-112

Foundation page: 96-112

**Chemistry Unit 2 – Bonding, structure and the properties of matter**

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| **C2.1 Chemical Bonds, Ionic, Covalent and Metallic** | **** | **** |
| Ionic bonding occurs in compounds formed from metals combined with non-metals.  |  |  |
| Covalent bonding occurs in most non-metallic elements and in compounds of non-metals. |  |  |
| Metallic bonding occurs in metallic elements and alloys. |  |  |
| Students should be able to explain chemical bonding in terms of electrostatic forces and the transfer or sharing of electrons. |  |  |
| Students should be able to draw dot and cross diagrams for ionic compounds formed by metals in Groups 1 and 2 with non-metals in Groups 6 and 7.  |  |  |
| The charge on the ions produced by metals in Groups 1 and 2 and by non-metals in Groups 6 and 7 relates to the group number of the element in the periodic table.  |  |  |
| Students should be able to work out the charge on the ions of metals and non-metals from the group number of the element, limited to the metals in Groups 1 and 2, and non-metals in Groups 6 and 7. |  |  |
| Students should deduce that a compound is ionic from a diagram of its structure  |  |  |
| Describe the limitations of using dot and cross, ball and stick, two and three-dimensional diagrams to represent a giant ionic structure |  |  |
| Work out the empirical formula of an ionic compound from a given model or diagram that shows the ions in the structure. |  |  |
| Students be able to draw dot and cross diagrams for the molecules of hydrogen, chlorine, oxygen, nitrogen, hydrogen chloride, water, ammonia and methane  |  |  |
| Deduce the molecular formula of a substance from a given model or diagram in these forms showing the atoms and bonds in the molecule. |  |  |
| Represent the covalent bonds in small molecules, in the repeating units of polymers and in part of giant covalent structures, using a line to represent a single bond |  |  |
| Describe the limitations of using dot and cross, ball and stick, two and three-dimensional diagrams to represent molecules or giant structures |  |  |
| Deduce the molecular formula of a substance from a given model or diagram in these forms showing the atoms and bonds in the molecule. |  |  |
| Students need to understand that metals consist of giant structures of atoms arranged in a regular pattern.  |  |  |
| 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. |  |  |
| **C2.2 How bonding and structure are related to the properties of substances** |
| Know that the three states of matter are solid, liquid and gas. Melting and freezing take place at the melting point, boiling and condensing take place at the boiling point. |  |  |
| Students need to be able to predict the states of substances at different temperatures given appropriate data (HT only) explain the limitations of the particle theory in relation to changes of state when particles are represented by solid inelastic spheres which have no forces between them. |  |  |
| Explain the different temperatures at which changes of state occur in terms of energy transfers and types of bonding |  |  |
| Recognise that atoms themselves do not have the bulk properties of materials |  |  |
| (HT only) Explain the limitations of the particle theory in relation to changes of state when particles are represented by solid inelastic spheres which have no forces between them. |  |  |
| Recognise that in chemical equations, the three states of matter are shown as (s), (l) and (g), with (aq) for aqueous solutions. |  |  |
| Ionic compounds have regular structures (giant ionic lattices) in which there are strong electrostatic forces of attraction in all directions between oppositely charged ions.  |  |  |
| These compounds have high melting points and high boiling points because of the large amounts of energy needed to break the many strong bonds. |  |  |
| When melted or dissolved in water, ionic compounds conduct electricity because the ions are free to move and so charge can flow. |  |  |
| Substances that consist of small molecules are usually gases or liquids that have relatively low melting points and boiling points.  |  |  |
| These substances have only weak forces between the molecules (intermolecular forces). It is these intermolecular forces that are overcome, not the covalent bonds, when the substance melts or boils. |  |  |
| The intermolecular forces increase with the size of the molecules, so larger molecules have higher melting and boiling points. |  |  |
| Simple covalent substances do not conduct electricity because the molecules do not have an overall electric charge. |  |  |
| Polymers have very large molecules. The atoms in the polymer molecules are linked to other atoms by strong covalent bonds.  |  |  |
| The intermolecular forces between polymer molecules are relatively strong and so these substances are solids at room temperature. |  |  |
| 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.  |  |  |
| Recognise that Diamond and graphite (forms of carbon) and silicon dioxide (silica) are examples of giant covalent structures. |  |  |
| Metals have giant structures of atoms with strong metallic bonding. This means that most metals have high melting and boiling points.  |  |  |
| In pure metals, atoms are arranged in layers, which allows metals to be bent and shaped. Pure metals are too soft for many uses and so are mixed with other metals to make alloys which are harder. |  |  |
| 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. |  |  |
| **C2.3 Structure and bonding of carbon** |
| 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. |  |  |
| 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.  |  |  |
| Know that in graphite, one electron from each carbon atom is delocalised. |  |  |
| Students should know that graphite is similar to metals in that it has delocalised electrons. |  |  |
| Graphene is a single layer of graphite and has properties that make it useful in electronics and composites  |  |  |
| Fullerenes are molecules of carbon atoms with hollow shapes. The structure of fullerenes is based on hexagonal rings of carbon atoms but they may also contain rings with five or seven carbon atoms. The first fullerene to be discovered was Buckminsterfullerene (C60) which has a spherical shape. |  |  |
| Carbon nanotubes are cylindrical fullerenes with very high length to diameter ratios. Their properties make them useful for nanotechnology, electronics and materials. |  |  |

**Videos:**

<https://goo.gl/BXM5uR> - broken into 13 short videos

**Revision guide reference:**

Higher page: 112 -122

Foundation page: 113 -122

**Chemistry Unit 3 – Quantitative chemistry**

|  |  |  |
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| **C3.1 - Chemical measurements** | **** | **** |
| Recall the law of conservation of mass states that no atoms are lost or made during a chemical reaction so the mass of the products equals the mass of the reactants |  |  |
| Recall that the relative formula mass of a compound is the sum of the relative atomic masses of the atoms |  |  |
| Explain why the relative formula masses of the reactants equals the sum of the relative formula masses of the products |  |  |
| Explain that even though some reactions may appear to involve a change in mass, it is usually explained because a reactant of product is a gas and its mass has not been taken into account |  |  |
| Explain observed changes mass in non-enclosed systems during a chemical reaction given the balanced symbol equation for the reaction and explain the changes in terms of the particle model |  |  |
| Explain how to calculate uncertainty by using the range of a set of measurements about the mean |  |  |
| **C3.2 - Use of amount of substance in relation to masses of pure substances** |
| State that chemical amounts are measured in moles and the symbol for the unit mole is mol. |  |  |
| Recall that the mass of one mole of a substance in grams is numerically equal to its relative formula mass |  |  |
| State that one mole of a substance contains the same number of the stated particles, atoms, molecules or ions as one mole of any other substance |  |  |
| Recall that the number of atoms, molecules or ions in a mole of a given substance is the Avogadro constant.  |  |  |
| State that the value of Avogadro constant is 6.02 x 1023 per mole |  |  |
| Calculate the number of moles in a given mass of that substance using the relative formula mass |  |  |
| Explain how chemical equations can be interpreted in terms of moles |  |  |
| Calculate the masses of substance shown in a balanced symbol equation |  |  |
| Calculate the masses of reactants and products from the balanced symbol equation and the mass of a given reactant of product |  |  |
| State that balancing the numbers in a symbol equation can be calculated from the masses of reactant and products by converting the masses in grams to amounts in moles and converting the numbers of mole to simple whole number ratios |  |  |
| Balance an equation given the masses of reactants and products |  |  |
| Change the subject of a mathematical equation |  |  |
| Recall that in a chemical reaction, it is common to use an **excess** of one of the reactants. The reactant that is fully used up is called the limiting reactant because it limits the amount of products |  |  |
| Explain the effect of a limiting quantity of a reactant on the amount of products it is possible to obtain in terms of amounts in moles or masses in grams |  |  |
| Recall that the concentration of a solution can be measured in mass per given volume of solution e.g. grams per dm3 (g/dm3) |  |  |
| Calculate the mass of solute in a given volume of solution of known concentration in terms of mass per given volume of solution |  |  |
| Explain how the mass of a solute and the volume of a solution is related to the concentration of the solution |  |  |

**Videos:**

<https://goo.gl/FjiqTH> - broken into 22 short videos here

**Revision guide reference:**

Higher page: 123-128

Foundation page: 123-127

**Chemistry Unit 4 – Chemical changes**

|  |  |  |
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| **C4.4 Reactivity of metals** | **** | **** |
| Metals react with oxygen to produce metal oxides. The reactions are oxidation reactions because the metals gain oxygen.  |  |  |
| Students should be able to explain reduction and oxidation in terms of loss or gain of oxygen. |  |  |
| Metals can be arranged in order of their reactivity in a reactivity series. The non-metals hydrogen and carbon are often included in the reactivity series. |  |  |
| Know that a more reactive metal can displace a less reactive metal from a compound. |  |  |
| You should recall and describe the reactions, if any, of potassium, sodium, lithium, calcium, magnesium, zinc, iron and copper with water or dilute acids and where appropriate, to place these metals in order of reactivity |  |  |
| You should explain how the reactivity of metals with water or dilute acids is related to the tendency of the metal to form its positive ion |  |  |
| You should be able to deduce an order of reactivity of metals based on experimental results. |  |  |
| Unreactive metals such as gold are found in the Earth as the metal itself but most metals are found as compounds that require chemical reactions to extract the metal.  |  |  |
| Metals less reactive than carbon can be extracted from their oxides by reduction with carbon. Reduction involves the loss of oxygen. |  |  |
| You should be able to identify the substances which are oxidised or reduced in terms of gain or loss of oxygen. |  |  |
| **Oxidation is the loss of electrons and reduction is the gain of electrons.**  |  |  |
| **You need to be able to write ionic equations for displacement reactions and identify in a given reaction, symbol equation or half equation which species are oxidised and which are reduced.** |  |  |
| **You should be able to explain in terms of gain or loss of electrons, that these are redox reactions and identify which species are oxidised and which are reduced in given chemical equations.** |  |  |
| Acids are neutralised by alkalis (eg soluble metal hydroxides) and bases (eg insoluble metal hydroxides and metal oxides) to produce salts and water, and by metal carbonates to produce salts, water and carbon dioxide.  |  |  |
| Know that the particular salt produced in any reaction between an acid and a base or alkali depends on: the acid used (hydrochloric acid produces chlorides, nitric acid produces nitrates, sulfuric acid produces sulfates) the positive ions in the base, alkali or carbonate.  |  |  |
| Students should be able to: predict products from given reactants use the formulae of common ions to deduce the formulae of salts |  |  |
| You should know that soluble salts can be made from acids by reacting them with solid insoluble substances, such as metals, metal oxides, hydroxides or carbonates. The solid is added to the acid until no more reacts and the excess solid is filtered off to produce a solution of the salt. Salt solutions can be crystallised to produce solid salts. |  |  |
| Students should be able to describe how to make pure, dry samples of named soluble salts from information provided. Eg making copper sulfate from copper oxide and sulphuric acid |  |  |
| Know that Acids produce hydrogen ions (H+) in aqueous solutions. Aqueous solutions of alkalis contain hydroxide ions (OH– ).  |  |  |
| The pH scale, from 0 to 14, is a measure of the acidity or alkalinity of a solution, and can be measured using universal indicator or a pH probe. A solution with pH 7 is neutral. Aqueous solutions of acids have pH values of less than 7 and aqueous solutions of alkalis have pH values greater than 7. |  |  |
| In neutralisation reactions between an acid and an alkali, hydrogen ions react with hydroxide ions to produce water. |  |  |
| You need to be able to describe the use of universal indicator or a wide range indicator to measure the approximate pH of a solution and use the pH scale to identify acidic or alkaline solutions. |  |  |
| **C4.5 Electrolysis** |
| Know that when an ionic compound is melted or dissolved in water, the ions are free to move about within the liquid or solution. These liquids and solutions are able to conduct electricity and are called electrolytes.  |  |  |
| Passing an electric current through electrolytes causes the ions to move to the electrodes. Positively charged ions move to the negative electrode (the cathode), and negatively charged ions move to the positive electrode (the anode). |  |  |
| Ions are discharged at the electrodes producing elements. This process is called electrolysis. |  |  |
| **HT only**; **Students should be able to write half equations for the reactions occurring at the electrodes during electrolysis, and may be required to complete and balance supplied half equations.** |  |  |
| Students should be able to predict the products of the electrolysis of ionic compounds in the molten state. Eg Lead Bromide = Lead and Bromine gas |  |  |
| Metals can be extracted from molten compounds using electrolysis. Electrolysis is used if the metal is too reactive to be extracted by reduction with carbon or if the metal reacts with carbon. |  |  |
| Large amounts of energy are used in the extraction process to melt the compounds and to produce the electrical current.  |  |  |
| Aluminium is manufactured by the electrolysis of a molten mixture of aluminium oxide and cryolite using carbon as the positive electrode (anode). |  |  |
| Students should be able to explain why a mixture is used as the electrolyte and why the positive electrode must be continually replaced. |  |  |
| The ions discharged when an aqueous solution is electrolysed using inert electrodes depend on the relative reactivity of the elements involved. Required practical activity 9: investigate what happens when aqueous solutions are electrolysed using inert electrodes. This should be an investigation involving developing a hypothesis. |  |  |
| At the negative electrode (cathode), hydrogen is produced if the metal is more reactive than hydrogen. At the positive electrode (anode), oxygen is produced unless the solution contains halide ions when the halogen is produced. |  |  |
| Students should be able to predict the products of the electrolysis of aqueous solutions containing a single ionic compound. |  |  |
| Required practical activity 9: investigate what happens when aqueous solutions are electrolysed using inert electrodes.  |  |  |
| During electrolysis, at the cathode (negative electrode), positively charged ions gain electrons and so the reactions are reductions.  |  |  |
| At the anode (positive electrode), negatively charged ions lose electrons and so the reactions are oxidations. |  |  |
| Reactions at electrodes can be represented by half equations |  |  |

**Videos:**

<https://goo.gl/olvAuW> - Reactivity series

<https://goo.gl/v8xS1W> - Electrolysis

<https://goo.gl/hRJVFN> - Metal extraction

**Revision guide reference:**

Higher page: 129 - 137

Foundation page: 128 - 133

PAPER 2

**Chemistry Unit 5 – Energy changes**

|  |  |  |
| --- | --- | --- |
| **C5.1 - Exothermic and endothermic reactions** | **** | **** |
| State that energy is conserved in chemical reactions |  |  |
| Explain that if a reaction transfers energy to the surroundings the product molecules mist have less energy that the reactants, by the amount transferred |  |  |
| State that exothermic reaction transfer energy to the surroundings, increasing temperature |  |  |
| Give examples and uses of exothermic reactions |  |  |
| State that endothermic reactions take in energy from the surroundings, decreasing the temperature |  |  |
| Give examples and uses of endothermic reactions |  |  |
| Evaluate the uses and applications of exo and endothermic reactions with appropriate information |  |  |
| Explain that chemical reactions require a collision of particles. The amount of energy needed for them to react is called the 'activation energy' |  |  |
| Draw simple reaction profiles for exo and endothermic reactions showing the relative energies of reactants and products, the activation energy and the overall change, with a curved line to show the energy as the reaction proceeds |  |  |
| Use reaction profiles to identify reactions as exothermic or endothermic |  |  |
| State that energy must be supplied to break bonds in the reactants |  |  |
| State that energy is released when bonds in the products are formed |  |  |
| Calculate the energy transferred in chemical reactions using bond energies supplied |  |  |
| Recall in an exothermic reaction, the energy released from forming new bonds is greater than the energy needed to break existing bonds |  |  |
| Recall in an endothermic reaction, the energy needed to break existing bonds is greater than the energy released from forming new bonds |  |  |

**Videos:**

<https://goo.gl/7oEvy1> - broken into 5 short videos here

**Revision guide reference:**

Higher page: 123-128

Foundation page: 123-127

**Chemistry Unit 6 – The rate and extent of chemical change**

|  |  |  |
| --- | --- | --- |
| **C6.1 - Rate of reaction** | **** | **** |
| Explain the two ways of calculating rate of reaction is taking either the quantity of the reactant used, or the quantity of the product formed and dividing how long it takes in seconds |  |  |
| State the units of rate of reaction g/s or cm3/s. |  |  |
| Calculate the mean rate of a reaction from given information about the quantity of a reactant used or the quantity of a product formed and the time taken |  |  |
| Draw, and interpret, graphs showing the quantity of product formed or quantity of reactant used up against time |  |  |
| Draw tangents to the curves on these graphs and use the slope of the tangent as a measure of the rate of reaction |  |  |
| *Calculate the gradient of a tangent to the curve on these graphs as a measure of rate of reaction at a specific time.* |  |  |
| Explain, using the words frequency and energy of collisions the factors that increase rate of reaction as concentration, pressure, surface area, temperature & a catalyst |  |  |
| Describe an investigation as to how changes in concentration affect the rates of reactions by a method involving measuring the volume of a gas produced and a method involving a change in colour turbidity |  |  |
| Describe collision theory |  |  |
| Explain what is meant by 'activation energy' |  |  |
| Predict and explain using collision theory the effects of changing conditions of concentration, pressure and temperature on the rate of a reaction |  |  |
| Predict and explain the effects of changes in the size of pieces of a reacting solid in terms of surface area to volume ratio |  |  |
| Use simple ideas about proportionality when using collision theory to explain the effect of a factor on the rate of a reaction. |  |  |
| Explain that a catalyst changes the rate of a reaction but is not used up |  |  |
| State that different reactions need different catalyst |  |  |
| Explain how a catalyst works by providing a different pathway for the reaction that has a lower activation energy |  |  |
| Identify catalysts in reactions from their effect on the rate of reaction and because they are not included in the chemical equation for the reaction |  |  |
| Explain catalytic action in terms of activation energy |  |  |
| **C6.2 - Reversible reactions and dynamic equilibrium** |
| Explain that a reversible reaction is on in which the products of the reaction react to produce the original reactants |  |  |
| Identify the symbol for a reversible reaction |  |  |
| State that if a reaction is exothermic in one direction, it is endothermic in the opposite direction |  |  |
| Explain that when a reversible reaction occurs in apparatus which prevents the escape of reactants and products, equilibrium is reached when the forward and reverse reactions occur at exactly the same rate |  |  |
| **Explain the effect of changing conditions on a system at equilibrium using Le Chatelier's Principle** |  |  |
| **Make qualitative predictions about the effect of changes on systems at equilibrium**  |  |  |
| **State that if the concentration of a reactant is increased, more products will be formed until equilbrium is reached again** |  |  |
| **State that if the concentration of a product is decreased, more reactants will react until equilibrium is reached again** |  |  |
| **Explain if the temperature of a system at equilibrium is increased, either the relative amount of products at equilibrium increases for an endothermic reaction** |  |  |
| **Explain if the temperature of a system at equilibrium is increased, either the relative amount of products at equilibrium decreases for an exothermic reaction** |  |  |
| **Explain if the temperature of a system at equilibrium is decreased the relative amount of products at equilibrium decreases for an endothermic reaction** |  |  |
| **Explain if the temperature of a system at equilibrium is decreased the relative amount of products at equilibrium increases for an exothermic reaction** |  |  |
| **Explain that for gaseous reactions at equilibrium an increase in pressure causes the equilibrium position to shift towards the side with the smaller number of molecules as shown by the symbol equation for that reaction** |  |  |
| **Explain that for gaseous reactions at equilibrium an decrease in pressure causes the equilibrium position to shift towards the side with the larger number of molecules as shown by the symbol equation for that reaction** |  |  |

**Videos:**

<https://goo.gl/SMaFCB> - broken into short videos here

**Revision guide reference:**

Higher page: 142 - 149

Foundation page: 138 - 145

**Chemistry Unit 7 – Organic chemistry**

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| --- | --- | --- |
| **C7.1 - Carbon compounds as fuels and feedstock** | **** | **** |
| Describe oil as a finite resource found in rocks from the remains of ancient biomass consisting mainly of plankton that's been buried in the mud |  |  |
| State that crude oil is a mixture of hydrocarbons, which are molecules made up of hydrogen and carbon only |  |  |
| Explain that most hydrocarbons in crude oil are called alkanes |  |  |
| State the general formula of an alkane is CnH2n+2 |  |  |
| Recall the first four alkanes: methane, ethane, propane, butane |  |  |
| Recognise substances as alkanes in molecular of displayed formula form |  |  |
| Explain the process of fractional distillation in terms of evaporation and condensation |  |  |
| Recall some of the fuels produced from crude oil we are reliant on for modern lifestyle |  |  |
| State some useful materials that are produced by the petrochemical industry |  |  |
| Recall how boiling point, viscosity and flammability change with increasing molecular size |  |  |
| State that the combustion of hydrocarbon fuels releases energy |  |  |
| Recall that the oxidation of carbon and hydrogen in the fuel releases water and carbon dioxide |  |  |
| Write balanced symbol equations for the complete combustion of hydrocarbons |  |  |
| Describe cracking as the process of breaking large hydrocarbons down into smaller molecules |  |  |
| State two types of cracking as catalytic cracking and steam cracking |  |  |
| State that a product of cracking include alkanes and alkenes |  |  |
| Recall that alkenes and more reaction than alkanes |  |  |
| Recall that bromine water changes from yellow to colourless in the presence of an alkene, but not in the presence of an alkane |  |  |
| State alkenes are used to produce polymers and as starting materials for the production of many other chemicals |  |  |
| Give examples to illustrate the usefulness of cracking |  |  |

**Videos:**

<https://goo.gl/KeH8Pr> - Videos 1 - 5

**Revision guide reference:**

Higher page: 150 - 152

Foundation page: 146 - 149

**Chemistry Unit 8 – Chemical analysis**

|  |  |  |
| --- | --- | --- |
| **C8.1 - Purity, formulations & chromatography** | **** | **** |
| Describe a pure substance: a single element or compound not mixed with any other substance |  |  |
| State that pure elements and compounds melt and boil at specific temperatures |  |  |
| Use melting and boiling point data to distinguish pure from impure substances |  |  |
| Describe a formulation as a mixture that has been designed as a useful product |  |  |
| Describe how a formulation is made and give examples of formulations |  |  |
| Explain how paper chromatography separates mixtures |  |  |
| Describe what a stationary phase and a mobile phase is in chromatography |  |  |
| Suggest how chromatographic methods can be used for distinguishing pure substances from impure substances |  |  |
| Interpret chromatograms and determine Rf values from chromatograms |  |  |
| **Required practical:** investigate how paper chromatography can be used to separate and tell the difference between coloured substances. Students should calculate Rf values. |  |  |
| **C8.2 - Identification of common gases** |
| Describe 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 the test for oxygen uses a glowing splint inserted into a test tube of the gas. The splint relights in oxygen. |  |  |
| Describe 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). |  |  |
| Describe the test for chlorine uses litmus paper. When damp litmus paper is put into chlorine gas the litmus paper is bleached and turns white |  |  |

**Videos:**

<https://goo.gl/ayX1Uw> - Videos 1 - 3

**Revision guide reference:**

Higher page: 153 - 156

Foundation page: 150 - 154

 **Chemistry Unit 9 – Chemistry of the atmosphere**

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| **C9.1 The composition and evolution of the Earth's atmosphere** | **** | **** |
| Recall the proportions of different gases in the Earth's atmosphere |  |  |
| Explain that evidence for the early atmosphere is limited because of the time scale of 4.6 billion years |  |  |
| Recall that one theory suggests during the first billion years of the Earth, volcanic activity released gases that formed the early atmosphere and water condensed to form oceans |  |  |
| Recall that the early atmosphere was mainly carbon dioxide, similar to Mars and Venus today |  |  |
| Recall that the early atmosphere had nitrogen (from volcanoes) and small amounts of methane and ammonia |  |  |
| Describe how carbon dioxide has become sequestered in oceans and carbonates |  |  |
| Describe how oxygen levels increased through photosynthesis and how long it took |  |  |
| Describe how photosynthesis decreased levels of carbon dioxide in the atmosphere |  |  |
| Describe that carbon dioxide decreased by the formation of sedimentary rocks and fossil fuel formation |  |  |
| Describe the main changes in the atmosphere over time and some of the likely causes of these changes |  |  |
| Describe and explain the formation of deposits of limestone, coal, crude oil and natural gas |  |  |
| **C9.2 Carbon dioxide and methane as greenhouse gases** |
| Explain the importance of greenhouse gases in the atmosphere to maintain temperature on Earth high enough to support life |  |  |
| State the 3 main greenhouse gases: Water vapour, carbon dioxide and methane |  |  |
| Describe the greenhouse effect in terms of the interaction of short and long wavelength radiation with matter |  |  |
| Recall at least two human activities that increase the amounts of each of the greenhouse gases carbon dioxide and methane |  |  |
| Evaluate quality of evidence in a report about global climate change given appropriate information |  |  |
| Describe uncertainties in the evidence base |  |  |
| Recognise the importance of peer review of results and of communicating results to a wide range of audiences |  |  |
| Describe briefly four potential effects of global climate change |  |  |
| Discuss the scale, risk and environmental implications of global climate change |  |  |
| Know 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. |  |  |
| Describe actions to reduce emissions of carbon dioxide and methane |  |  |
| Give reasons why actions to reduce carbon footprint may be limited |  |  |
| **C9.3 Carbon dioxide and methane as greenhouse gases** |
| Know that most fuels, including coal, contain carbon and/or hydrogen and may also contain some sulfur |  |  |
| State the atmospheric pollution released through combustion of fuels: including carbon dioxide, water vapour, carbon monoxide, sulfur dioxide and oxides of nitrogen |  |  |
| Recall that particulates are solid particles that come from unburned hydrocarbons |  |  |
| Describe how carbon monoxide, soot (carbon particles), sulfur dioxide and oxides of nitrogen are produced by burning fuels |  |  |
| Predict the products of combustion of a fuel given appropriate information about the composition of the fuel and the conditions in which it is used |  |  |
| Recall that carbon monoxide is a toxic gas. It is colourless and odourless and so is not easily detected |  |  |
| Recall that sulfur dioxide and oxides of nitrogen cause respiratory problems in humans and cause acid rain |  |  |
| Recall that particulates cause global dimming and health problems for humans |  |  |
| Describe and explain the problems caused by increased amounts of these pollutants in the air |  |  |
| State the 3 main greenhouse gases: Water vapour, carbon dioxide and methane |  |  |
| Describe the greenhouse effect in terms of the interaction of short and long wavelength radiation with matter |  |  |
| Recall at least two human activities that increase the amounts of each of the greenhouse gases carbon dioxide and methane |  |  |

**Videos:**

<https://goo.gl/wFvtKi> - broken into short videos here

**Revision guide reference:**

Higher page: 157 - 160

Foundation page: 155 - 158

 **Chemistry Unit 10 – Using resources**

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| **C10.1 Using the Earth's resources and obtaining potable water** | **** | **** |
| Know that humans use the Earth’s resources to provide warmth, shelter, food and transport |  |  |
| Know that natural resources, supplemented by agriculture, provide food, timber, clothing and fuels |  |  |
| Explain that finite resources from the Earth, oceans and atmosphere are processed to provide energy and materials |  |  |
| State examples of natural products that are supplemented or replaced by agricultural and synthetic products |  |  |
| Distinguish between finite and renewable resources given appropriate information |  |  |
| Extract and interpret information about resources from charts, graphs and tables |  |  |
| Use orders of magnitude to evaluate the significance of data |  |  |
| Recall that water that is safe to drink is called potable water, and should have sufficiently low levels of dissolved salts and microbes |  |  |
| Know that potable water is not pure as it contains dissolved substances |  |  |
| Describe the 3 ways most potable water is produced by |  |  |
| Describe how water is sterilised using sterilising agents include: chlorine, ozone or ultraviolet light |  |  |
| Know what desalination is, and how it is done using distillation or reverse osmosis |  |  |
| Distinguish between potable water and pure water |  |  |
| Describe the differences in treatment of ground water and salty water |  |  |
| Give reasons for the steps used to produce potable water |  |  |
| Recall that sewage and agricultural waste water require removal of organic matter and harmful microbes |  |  |
| Recall that industrial waste water may require removal of organic matter and harmful chemicals |  |  |
| Describe the four stages of sewage treatment works |  |  |
| Comment on the relative ease of obtaining potable water from waste, ground and salt water |  |  |
| Know that copper ores are becoming rare so new ways of extracting are being developed |  |  |
| Describe how phytomining works using plants to absorb metal compounds, then the plants are harvested and burned to produce ash that contains metal compounds  |  |  |
| Describe how bioleaching uses bacteria to produce leachate solutions that contain metal compounds |  |  |
| Describe how copper is obtained from solutions of copper compounds by displacement using scrap iron by electrolysis |  |  |
| **C10.2 Life cycle assessment and recycling** |
| Describe how life cycle assessments (LCAs) are carried out at the five 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. |  |  |
| Know that use of water, resources, energy sources and production of some wastes can be fairly easily quantified |  |  |
| Know that allocating numerical values to pollutant effects is less straightforward and requires value judgements, so LCA is not a purely objective process. |  |  |
| Carry out simple comparative LCAs for shopping bags made from plastic and paper |  |  |
| Explain the importance of reduction, reuse, and recycling by end users to reduce use of limited resources, use of energy sources, waste and environmental impacts |  |  |
| Know that metals, glass, building materials, clay ceramics and most plastics are produced from limited raw materials |  |  |
| Explain how quarrying and mining for raw materials causes environmental impact |  |  |
| Know that some products, such as glass bottles, can be reused. Glass bottles can be crushed and melted to make different glass products |  |  |
| Explain how metals can be recycled by melting and recasting or reforming into different products |  |  |
| Explain that the amount of separation required for recycling depends on the material and the properties required of the final product |  |  |
| Evaluate ways of reducing the use of limited resources, given appropriate information |  |  |

**Videos:**

<https://goo.gl/YBkLWz> - Videos 1 - 5

**Revision guide reference:**

Higher page: 161 - 166

Foundation page: 159 - 166

**Chemistry Required Practicals**

**Paper 1**

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| **Required practical activity 1:** Preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate, using a Bunsen burner to heat dilute acid and a water bath or electric heater to evaporate the solution.  |

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| **Required practical activity 2 (Triple science only):** Determination of the reacting volumes of solutions of a strong acid and a strong alkali by titration.(HT only) determination of the concentration of one of the solutions in mol/dm3 and g/dm3 from the reacting volumes and the known concentration of the other solution.  |

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| **Required practical activity 3:** Investigate what happens when aqueous solutions are electrolysed using inert electrodes. This should be an investigation involving developing a hypothesis.  |

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| **Required practical activity 4:** Investigate the variables that affect temperature changes in reacting solutions such as, eg acid plus metals, acid plus carbonates, neutralisations, displacement of metals. |

**Paper 2**

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| **Required practical activity 5:** Investigate how changes in concentration affect the rates of reactions by a method involving measuring the volume of a gas produced and a method involving a change in colour or turbidity. This should be an investigation involving developing a hypothesis. |

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| **Required practical activity 6:** Investigate how paper chromatography can be used to separate and tell the difference between coloured substances. Students should calculate Rf values. |

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| **Required practical activity 7 (Triple science only):** Use of chemical tests to identify the ions in unknown single ionic compounds covering the ions from sections Flame tests through to Sulfates  |

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| **Required practical activity 8:** Analysis and purification of water samples from different sources, including pH, dissolved solids and distillation. |

**Videos:**

**Paper 1**

Required practical 1: <https://goo.gl/w9YQde>

Required practical 2: <https://goo.gl/BVfeGV>

Required practical 3: <https://goo.gl/jp6hYs>

Required practical 4: <https://goo.gl/szVK6U>

**Paper 2**

Required practical 5: <https://goo.gl/mT3zCo>

Required practical 6: <https://goo.gl/iAWCMb>

Required practical 7: <https://goo.gl/73efuc>

Required practical 8: <https://goo.gl/9xWE6Y>