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| **AQA Chemistry (8462) from 2016 Topics C4.6 The rate and extent of chemical change** |
| **Topic** | **Student Checklist** | **R** | **A** | **G** |
| **4.6.1 Rate of reaction** |  Calculate the rate of a chemical reaction over time, using either the quantity of reactant used or the quantity of product formed, measured in g/s, cm3/s or mol/s |   |   |   |
|  Draw and interpret graphs showing the quantity of product formed or reactant used up against time and use the tangent to the graph as a measure of the rate of reaction |   |   |   |
|  **HT ONLY: Calculate the gradient of a tangent to the curve on the graph of the quantity of product formed or reactant used against time and use this as a measure of the rate of reaction**  |   |   |   |
|  Describe how different factors affect the rate of a chemical reaction, including the concentration, pressure, surface area, temperature and presence of catalysts |   |   |   |
|  ***Required practical 5:*** *investigate how changes in concentration affect the rates of reactions by a method involving measuring the volume of a gas produced, change in colour or turbidity* |   |   |   |
|  Use collision theory to explain changes in the rate of reaction, including discussing activation energy |   |   |   |
|  Describe the role of a catalyst in a chemical reaction and state that enzymes are catalysts in biological systems |   |   |   |
|  Draw and interpret reaction profiles for catalysed reactions |   |   |   |
| **4.6.2 Reversible reactions and dynamic equilibrium** |  Explain what a reversible reaction is, including how the direction can be changed and represent it using symbols: A + B ⇌ C + D |   |   |   |
|  Explain that, for reversible reactions, if a reaction is endothermic in one direction, it is exothermic in the other direction |   |   |   |
|  Describe the State of dynamic equilibrium of a reaction as the point when the forward and reverse reactions occur at exactly the same rate |   |   |   |
|  **HT ONLY: Explain that the position of equilibrium depends on the conditions of the reaction and the equilibrium will change to counteract any changes to conditions** |   |   |   |
|  **HT ONLY: Explain and predict the effect of a change in concentration of reactants or products, temperature, or pressure of gases on the equilibrium position of a reaction** |   |   |   |

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| **AQA Chemistry (8462) from 2016 Topics C4.7 Organic chemistry** |
| **Topic** | **Student Checklist** | **R** | **A** | **G** |
| **4.7.1 Carbon compounds as fuels and feedstock** |  Describe what crude oil is and where it comes from, including the basic composition of crude oil and the general chemical formula for the alkanes  |   |   |   |
|  State the names of the first four members of the alkanes and recognise substances as alkanes from their formulae |   |   |   |
|  Describe the process of fractional distillation, state the names and uses of fuels that are produced from crude oil by fractional distillation |   |   |   |
|  Describe trends in the properties of hydrocarbons, including boiling point, viscosity and flammability and explain how their properties influence how they are used as fuels |   |   |   |
|  Describe and write balanced chemical equations for the complete combustion of hydrocarbon fuels  |   |   |   |
|  Describe the process of cracking and state that the products of cracking include alkanes and alkenes and describe the test for alkenes |   |   |   |
|  Balance chemical equations as examples of cracking when given the formulae of the reactants and products |   |   |   |
|  Explain why cracking is useful and why modern life depends on the uses of hydrocarbons |   |   |   |
| **4.7.2 Reactions of alkenes and alcohols** |  *Chem ONLY: State the names and draw structural formulae of the first four members of the alkenes and recognise substances as alkenes from their formulae* |   |   |   |
|  *Chem ONLY: Describe the basic composition of alkenes, including the C=C functional group, the general chemical formula for the alkanes and describe what unsaturated means* |   |   |   |
|  *Chem ONLY: Describe the combustion reactions of alkenes and the reactions of alkenes with hydrogen, water and the halogens* |   |   |   |
|  *Chem ONLY: Draw fully displayed structural formulae of the first four members of the alkenes and the products of their addition reactions with hydrogen, water, chlorine, bromine and iodine* |   |   |   |
|  *Chem ONLY: State the functional group of alcohols and the first four members of the homologous series of alcohols and represent alcohols using formulae* |   |   |   |
|  *Chem ONLY: Describe some properties and reactions of the first four members of alcohols, including dissolving in water, reacting with sodium, burning in air, oxidation and uses* |   |   |   |
|  *Chem ONLY: State the functional group of carboxylic acids and the first four members of the homologous series of carboxylic acids and represent them using diagrams and formulae* |   |   |   |
|  *Chem ONLY: Describe some properties and reactions of carboxylic acids, including dissolving in water, reacting with carbonates and reacting with alcohols* |   |   |   |
| **4.7.3 Synthetic and naturally occurring polymers** |  *Chem ONLY: Describe how alkenes can be used to make polymers by addition polymerisation* |   |   |   |
|  *Chem ONLY: Identify addition polymers and monomers from diagrams and from the presence of the functional group and draw diagrams to represent the formation of an addition polymers* |   |   |   |
|  ***Chem & HT ONLY: Describe the process of condensation polymerisation and explain the basic principles of condensation polymerisation*** |   |   |   |
|  ***Chem & HT ONLY: State that amino acids have two different functional groups in a molecule and they react by condensation polymerisation to produce polypeptides*** |   |   |   |
|  ***Chem & HT ONLY: Explain that different amino acids can be combined in a chain to produce proteins*** |   |   |   |
|  *Chem ONLY: Describe DNA as a large molecule of two polymer chains made from four different monomers called nucleotides in the form of a double helix* |   |   |   |
|  *Chem ONLY: State and describe some other naturally occurring polymers such as proteins, starch and cellulose* |   |   |   |

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| **AQA Chemistry (8462) from 2016 Topics C4.8 Chemical analysis** |
| **Topic** | **Student Checklist** | **R** | **A** | **G** |
| **4.8.1 Purity, formulations and chromatograph & 4.8.2 ID of gases** |  Define a pure substance and identify pure substances and mixtures from data about melting and boiling points |  |  |  |
|  Describe a formulation and identify formulations given appropriate information |  |  |  |
|  Describe chromatography, including the terms stationary phase and mobile phase and identify pure substances using paper chromatography |  |  |  |
|  Explain what the Rf value of a compound represents, how the Rf value differs in different solvents and interpret and determine Rf values from chromatograms |  |  |  |
|  ***Required practical 6:*** *investigate how paper chromatography can be used to separate and tell the difference between coloured substances (inc calculation of Rf values)* |  |  |  |
|  Explain how to test for the presence of hydrogen, oxygen, carbon dioxide and chlorine |  |  |  |
| **4.8.3 Identification of ions by chemical and spectroscopic means** |  *Chem ONLY: Identify some metal ions from the results of flame tests and describe how to conduct a flame test* |  |  |  |
|  *Chem ONLY: Describe how sodium hydroxide solution can be used to identify some metal ions and identify metal ions from the results of their reactions with sodium hydroxide solution* |  |  |  |
|  *Chem ONLY: Write balanced equations for the reactions between sodium hydroxide solution and some metal ions to produce insoluble hydroxides* |  |  |  |
|  *Chem ONLY: Describe how to identify carbonates using limewater* |  |  |  |
|  *Chem ONLY: Describe how to identify negative ions, including halide ions using silver nitrate and sulfate ions using barium chloride* |  |  |  |
|  ***Required practical 7:*** *use of chemical tests to identify the ions in unknown single ionic compounds*  |  |  |  |
|  *Chem ONLY: State the advantages of using instrumental methods to identify elements and compounds compared to chemical tests* |  |  |  |
|  *Chem ONLY: Describe the process of and how to use flame emission spectroscopy to identify metal ions; interpret the results of a flame emission spectroscopy tests* |  |  |  |

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| **AQA Chemistry (8462) from 2016 Topics C4.9 Chemistry of the atmosphere** |
| **Topic** | **Student Checklist** | **R** | **A** | **G** |
| **4.9.1 The composition and evolution of the Earth's atmosphere** |  Describe the composition of gases in the Earth's atmosphere using percentages, fractions or ratios |  |  |  |
|  Describe how early intense volcanic activity may have helped form the early atmosphere and how the oceans formed |  |  |  |
|  Explain why the levels of carbon dioxide in the atmosphere changes as the oceans were formed |  |  |  |
|  State the approximate time in Earth's history when algae started producing oxygen and describe the effects of a gradually increasing oxygen level |  |  |  |
|  Explain the ways that atmospheric carbon dioxide levels decreased |  |  |  |
| **4.9.2 Carbon dioxide and methane as greenhouse gases** |  Name some greenhouse gases and describe how they cause an increase in Earth's temperature |  |  |  |
|  List some human activities that produce greenhouse gases |  |  |  |
|  Evaluate arguments for and against the idea that human activities cause a rise in temperature that results in global climate change |  |  |  |
|  State some potential side effects of global climate change, including discussing scale, risk and environmental implications |  |  |  |
|  Define the term carbon footprint and list some actions that could reduce the carbon footprint |  |  |  |
| **4.9.3 Common atmospheric pollutants and their sources** |  Describe the combustion of fuels as a major source of atmospheric pollutants and name the different gases that are released when a fuel is burned |  |  |  |
|  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 |  |  |  |
|  Describe the properties and effects of carbon monoxide, sulfur dioxide and particulates in the atmosphere |  |  |  |
|  Describe and explain the problems caused by increased amounts of these pollutants in the air |  |  |  |

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| **AQA Chemistry (8462) from 2016 Topics C4.10 Using resources** |
| **Topic** | **Student Checklist** | **R** | **A** | **G** |
| **4.10.1 Using the Earth's resources and obtaining potable water** |  State what humans use Earth's resources for, give some examples of natural resources that they use  |  |  |  |
|  Define the term finite and distinguish between finite and renewable resources  |  |  |  |
|  Explain what sustainable development is and discuss the role chemistry plays in sustainable development, including improving agricultural and industrial processes |  |  |  |
|  State examples of natural products that are supplemented or replaced by agricultural and synthetic products  |  |  |  |
|  Discuss the importance of water quality for human life, including defining potable water |  |  |  |
|  Describe methods to produce potable water, including desalination of salty water or sea water and the potential problems of desalination |  |  |  |
|  ***Required practical 8:*** *analysis and purification of water samples from different sources, including pH, dissolved solids and distillation.*  |  |  |  |
|  Describe waste water as a product of urban lifestyles and industrial processes that includes organic matter, harmful microbes and harmful chemicals |  |  |  |
|  Describe the process of sewage treatment and compare the ease of obtaining potable water from waste water as opposed to ground or salt water |  |  |  |
|  **HT ONLY: Name and describe alternative biological methods for extracting metals, including phytomining and bioleaching** |  |  |  |
|  **HT ONLY: Evaluate alternative methods for extracting metals** |  |  |  |
| **4.10.2 Life cycle assessment and recycling** |  Describe, carry out and interpret a simple comparative life cycle assessment (LCA) of materials or products |  |  |  |
|  Discuss the advantages and disadvantages of LCAs |  |  |  |
|  Carry out simple comparative LCAs for shopping bags made from plastic and paper |  |  |  |
|  Discuss how to reduce the consumption of raw resources and explain how reusing and recycling reduces energy use (inc environmental impacts) |  |  |  |
| **4.10.3 Using materials** |  *Chem ONLY: Define corrosion and describe rusting as an example of corrosion* |  |  |  |
|  *Chem ONLY: Describe ways to prevent corrosion, including providing coatings, sacrificial protection and explain how sacrificial protection works* |  |  |  |
|  *Chem ONLY: Describe the following alloys bronze, gold, steels and aluminium, their uses and describe the benefits of using alloys instead of pure metals* |  |  |  |
|  *Chem ONLY: Compare the properties of materials, including glass and clay ceramics, polymers and composites and explain how their properties are related to their uses* |  |  |  |
|  *Chem ONLY: Discuss the different types of polymers and how their composition affects their properties, including thermosoftening and thermosetting polymers* |  |  |  |
|  *Chem ONLY: Explain what composites are and provide examples of composites and their benefits over other types of materials* |  |  |  |
| **4.10.4 The Haber process and the use of NPK fertilisers** |  *Chem ONLY: Describe the Haber process, including the reactants and products, recycling of remaining hydrogen and nitrogen and the chemical equation* |  |  |  |
|  *Chem & HT ONLY: For the Haber process interpret graphs of reaction conditions versus rate* |  |  |  |
|  *Chem ONLY: Apply the principles of dynamic equilibrium to the Haber process and discuss the trade-off between the rate of production and the position of equilibrium*  |  |  |  |
|  *Chem ONLY: Explain how the commercially used conditions for the Haber process are related to the availability and cost of raw materials and energy supplies* |  |  |  |
|  *Chem ONL: Recall the names of the salts produced when phosphate rock is treated with nitric acid, sulfuric acid and phosphoric acid*  |  |  |  |
|  *Chem ONLY: Describe NPK fertilisers and the compounds they are composed of and compare the industrial production of fertilisers with the laboratory preparations* |  |  |  |