

Chemistry 2		Higher	
Red		Amber	
			Green
			
8. Rates & Equilibrium	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, cm ³ /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		
	Describe how different factors affect the rate of a chemical reaction, including the concentration, pressure, surface area, temperature and presence of catalysts		
	Required practical: 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		
	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		
	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		
	Explain what a reversible reaction is, including how the direction can be changed and represent it using symbols: $A + B \rightleftharpoons C + D$		
	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			
9. Crude Oil & Fuels	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		

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10. Organic Reactions	State the names and draw structural formulae of the first four members of the alkenes and recognise substances as alkenes from their formulae		
	Describe the basic composition of alkenes, including the C=C functional group, the general chemical formula for the alkanes and describe what unsaturated means		
	Describe the combustion reactions of alkenes and the reactions of alkenes with hydrogen, water and the halogens		
	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		
	State the functional group of alcohols and the first four members of the homologous series of alcohols and represent alcohols using formulae		
	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		
	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		
	Describe some properties and reactions of carboxylic acids, including dissolving in water, reacting with carbonates and reacting with alcohols		
11. Polymers	Describe how alkenes can be used to make polymers by addition polymerisation		
	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		
	Describe the process of condensation polymerisation and explain the basic principles of condensation polymerisation		
	State that amino acids have two different functional groups in a molecule and they react by condensation polymerisation to produce polypeptides		
	Explain that different amino acids can be combined in a chain to produce proteins		
	Describe DNA as a large molecule of two polymer chains made from four different monomers called nucleotides in the form of a double helix		
	State and describe some other naturally occurring polymers such as proteins, starch and cellulose		

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12. Chemical Analysis	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 R _f value of a compound represents, how the R _f value differs in different solvents and interpret and determine R _f values from chromatograms		
	Required practical: investigate how paper chromatography can be used to separate and tell the difference between coloured substances (inc calculation of R _f values)		
	Explain how to test for the presence of hydrogen, oxygen, carbon dioxide and chlorine		
	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		
	Chem only: Required practical: 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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13. Atmosphere of Earth	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		
	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		
	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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14. Earth's Resources	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			
	<i>Required practical: analysis and purification of water samples from different sources, including pH, dissolved solids and distillation.</i>			
	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			
	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)				

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15. Using our Resources	Define corrosion and describe rusting as an example of corrosion			
	Describe ways to prevent corrosion, including providing coatings, sacrificial protection and explain how sacrificial protection works			
	Describe the following alloys bronze, gold, steels and aluminium, their uses and describe the benefits of using alloys instead of pure metals			
	Compare the properties of materials, including glass and clay ceramics, polymers and composites and explain how their properties are related to their uses			
	Discuss the different types of polymers and how their composition affects their properties, including thermosoftening and thermosetting polymers			
	Explain what composites are and provide examples of composites and their benefits over other types of materials			
	Describe the Haber process, including the reactants and products, recycling of remaining hydrogen and nitrogen and the chemical equation			
	For the Haber process interpret graphs of reaction conditions versus rate			
	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			
	Explain how the commercially used conditions for the Haber process are related to the availability and cost of raw materials and energy supplies			
	Recall the names of the salts produced when phosphate rock is treated with nitric acid, sulfuric acid and phosphoric acid			
	Describe NPK fertilisers and the compounds they are composed of and compare the industrial production of fertilisers with the laboratory preparations			

