Scheme of Work 2020 – 2021 (HT2)
Subject: AS Chemistry

Year Group: 12
Specification: AQA 7404

Lesson No	Topic & Objectives	Big Question – What will students learn?	Key Activities & Specialist Terminology (Do Now Task / Starter/Tasks/Plenary	Planned Assessment	Homework or flipped learning resources DODDLE resources	Lit Num SMSC Codes
1 **3.1.4.1 Enthalpy change**	Know that reactions can be exothermic or endothermic. Know what an enthalpy change and is and about standard conditions. Define standard enthalpies of formation and combustion.	**Students should be able to:** • define enthalpy change and standard conditions • define standard enthalpy changes of combustion and formation.	• Students list examples of endothermic and exothermic reactions (AO2 - Apply knowledge and understanding). • Students draw enthalpy profiles for exothermic and endothermic reactions (AO2 - Apply knowledge and understanding). Write balanced chemical equations, to include state symbols, to represent the changes shown by standard enthalpy changes of formation and combustion (AO2 - Apply knowledge and understanding).	• June 2002 Unit 2 Question 1a and 1b (QS02.2.01)	Some everyday examples of exothermic and endothermic reactions: http://antoine.frostburg.edu/chem/senese/101/thermo/faq/exothermic-endothermic-examples.shtml	C3
2	Understand and be able to use the equation $q = mc\Delta T$ to	**Students should be able to:** • recall the equation $q = mc\Delta T$ • Calculate ΔH for reactions using	• Students calculate molar enthalpy changes using provided data from calorimetry experiments (AO2 - Apply knowledge and understanding; MS0.0 - Recognise and make use of appropriate	• January 2011 Unit 2 Question 9b and 9d (QW11.2.09)	Nuffield Science Data Book (free download): http://www.nationalstemcentre.org.uk/elibrary/resource/3402/nuffield	

	calculate molar enthalpy changes. **Required practical 2** Measurement of an enthalpy change.	calorimetry experiment data.	units in calculation ; MS1.1 - Use an appropriate number of significant figures; MS2.3 - Substitute numerical values into algebraic equations using appropriate units for physical quantities). • Practical opportunity: Students find ΔH for a reaction by calorimetry eg • dissolution of potassium chloride • dissolution of sodium carbonate • neutralising NaOH with HCl • displacement reaction between $CuSO_4$ + Zn • Combustion of alcohols (AO2 - Apply knowledge and understanding; MS1.3 - Identify uncertainties in measurements and use simple techniques to determine uncertainty when data are combined; MS3.2 – Plot two variables from experimental data; PS 3.1 - Plot and interpret graphs; PS 3.2 - Process and analyse data using appropriate mathematical skills; PS 3.3 - Consider margins of error, accuracy and precision of data). Students could research how accurate values are found for the energy content in food and fuels.	• June 2009 Unit 2 Question 3 (QS09.2.03) • June 2006 Unit 2 Question 1d (QS06.2.01) • June 2002 Unit 2 Question 2 (QS02.2.02)	-advanced-science-book-of-data-second-edition Chemistry Data Book (Starck, Wallace, McGlashan) ISBN: 9780719539510	
3	Understand Hess's law. Use Hess's law to calculate enthalpy changes using enthalpies of formation and combustion.	**Students should be able to:** • Recall the equation $q = mc\Delta T$ • Calculate ΔH for reactions using calirometry experiment data	• Students calculate Hess's law plus enthalpies of formation and enthalpies of combustion (AO2 - Apply knowledge and understanding). • Practical opportunity: Students could be asked to find ΔH for a reaction using Hess's law and calorimetry, then present data in appropriate ways. Examples of reactions could include: • thermal decomposition of $NaHCO_3$ • hydration of $MgSO_4$ • Enthalpy of formation of $CaCO_3$ (AO2 - Apply knowledge and understanding; AT a - Use appropriate apparatus to record a range of measurements (to include mass, time,	• January 2013 Unit 2 Question 3a (QW13.02.03) • January 2013 Unit 2 Question 4 (QW12.2.04) • June 2012 Unit 2 Question 2a (QS12.2.02) • June 2011 Unit 2 Question 2 (QS11.2.02) • June 2009 Unit 2 Question 2a (QS09.2.02)	Nuffield Science Data Book (free download): http://www.nationalstemcentre.org.uk/elibrary/resource/3402/nuffield-advanced-science-book-of-data-second-edition Chemistry Data Book (Starck, Wallace, McGlashan) ISBN: 9780719539510	

	Required practical 2 Measurement of an enthalpy change.		volume of solutions, temperature); MS1.3 - Identify uncertainties in measurements and use simple techniques to determine uncertainty when data are combined; MS3.2 – Plot two variables from experimental data; PS 3.1 - Plot and interpret graphs; PS 3.2 - Process and analyse data using appropriate mathematical skills; PS 3.3 - Consider margins of error, accuracy and precision of data).	• June 2002 Unit 2 Question 1 (QS02.2.02)		
3	Understand the term mean bond enthalpy. Use mean bond enthalpies to calculate approximate values for ΔH for reactions Understand why most bond enthalpies are mean values.	**Students should be able to:** • calculate enthalpy changes using mean bond enthalpies • understand why most bond enthalpies are mean values.	• Students calculate ΔH for reactions using mean bond enthalpies (AO2 - Apply knowledge and understanding).	• January 2013 Unit 2 Question 6 (QW13.2.06) • January 2006 Unit 2 Question 1 (QW06.2.01) • June 2005 Unit 2 Question 1 (QS05.2.01) • January 2003 Unit 2 Question 2 (QW03.2.02) • January 2011 Unit 2 Question 9d	Nuffield Science Data Book (free download): http://www.nationalstemcentre.org.uk/elibrary/resource/3402/nuffield-advanced-science-book-of-data-second-edition Chemistry Data Book (Starck, Wallace, McGlashan) ISBN: 9780719539510	
4	**3.1.5.1 Collision theory**	**Students should be able to:** explain that reactions can only take place when particles collide with energy greater than or	• Students should be able to explain why reacts do or do not take place using collision theory (AO1 - Demonstrate knowledge and understanding).		Collision theory simulator: http://www.kscience.co.uk/animations/collision.htm	C3

		equal to the activation energy.				
5	**3.1.5.2 Maxwell–Boltzmann distribution**	**Students should be able to:** • draw and interpret Maxwell–Boltzmann distribution curves.	• Students draw and Maxwell–Boltzmann curves at different temperatures, pressures and number of particles, identifying the most probable energy and particles with $E \geq E_a$ (AO2 - Demonstrate knowledge and understanding; MS3.1 - Translate information between graphical, numerical and algebraic forms).	• June 2013 Unit 2 Question 3 (QS13.2.03) • January 2012 Unit 2 Question 3 (QW12.2.03) • June 2006 Unit 2 Question 2 (QS06.2.02) • January 2002 Unit 2 Question 7 (QW02.2.07)	Maxwell–Boltzmann curve simulator: http://www.docbrown.info/BBCbasic/kpts.htm	C3
6	Understand how and why temperature affects the rate of chemical reactions. **Required practical 3** Investigation of how the rate of a reaction changes with temperature.	**Students should be able to:** • define the term rate of reaction • explain how and why temperature affects the rate of reactions using Maxwell–Boltzmann distributions.	• Use Maxwell–Boltzmann curves to explain why a small increase in temperature leads to a large increase in reaction rate (AO2 - Demonstrate knowledge and understanding). • Students could investigate how knowledge and understanding of the factors that affect the rate of chemical reaction have changed methods of storage and cooking of food (AO2 - Demonstrate knowledge and understanding). Practical opportunity: Students could investigate the effect of temperature on the rate of reaction of sodium thiosulfate and hydrochloric acid by an initial rate method (AO2 - Demonstrate knowledge and understanding; PS 2.4 - Identify variables including those that must be controlled; PS 3.1 - Plot and interpret graphs; MS3.2 – Plot two variables from experimental data; AT l - Measure rates of reaction by at least two	• June 2006 Unit 2 Question 2 (QS06.2.02) • January 2004 Unit 2 Question 2 (QW04.2.02) • January 2012 Unit 2 Question 3 (QW12.2.03)	Sodium thiosulfate practical: http://www.rsc.org/learn-chemistry/resource/res00000448/the-effect-of-temperature-on-reaction-rate Collision theory simulator: http://www.kscience.co.uk/animations/collision.htm	C3 C3

			different methods, for example an initial rate method).			
7	Understand how and why concentration and pressure affect the rate of chemical reactions.	**Students should be able to:** • explain how and why concentration of solutions affects the rate of reactions. • explain how and why pressure of gases affects the rate of reactions.	• diagrams, to explain why an increase in solution concentration leads to an increase in reaction rate (AO2 - Demonstrate knowledge and understanding). • Use collision theory, including diagrams, to explain why an increase in gas pressure leads to an increase in reaction rate (AO2 - Demonstrate knowledge and understanding). Students could investigate the effect of changing the concentration of acid on the rate of a reaction of calcium carbonate and hydrochloric acid by a continuous monitoring method (AO2 - Demonstrate knowledge and understanding; AT l - Measure rates of reaction by at least two different methods, for example a continuous monitoring method; PS 2.4 - Identify variables including those that must be controlled; PS 3.1 - Plot and interpret graphs; MS3.2 – Plot two variables from experimental data; MS3.5 - Draw and use the slope of a tangent to a curve as a measure of rate of change	• June 2012 Unit 2 Question 1a, 1b, 1c and 1d (QS12.2.01)	Collision theory simulator: http://www.kscience.co.uk/animations/collision.htm	C3
8	Understand how and why a catalyst affects the rate of chemical reactions.	**Students should be able to:** • state what a catalyst is • explain how and why a catalyst affects the rate of reactions.	• Use a Maxwell–Boltzmann curve to explain how a catalyst increases the rate of a reaction (AO2 - Demonstrate knowledge and understanding). • Students could research the use of catalysts in catalytic converters in cars (AO3 - Analyse, interpret and evaluate scientific information).	• June 2012 Unit 2 Question 1 (QS12.2.01) • June 2011 Unit 2 Question 1 (QS11.2.01)	Catalysts http://www.rsc.org/learn-chemistry/resource/res00000378/faces-of-chemistry-catalysts	C3

			• Practical opportunity: Students could use Co^{2+} as a catalyst in the oxidation of potassium sodium tartrate by hydrogen peroxide (AO2 - Demonstrate knowledge and understanding; AT k - Safely and carefully handle solids and liquids, including corrosive, irritant, flammable and toxic substances).	• January 2003 Unit 2 Question 3 (QW03.203) • January 2011 Unit 2 Question 2b	RSC AfL activity on catalysis http://www.rsc.org/learn-chemistry/resource/res00000123/afl-how-do-catalysts-affect-reaction-rates Practical showing the catalyst is involved in the reaction (using Co^{2+} as a catalyst in the oxidation of potassium sodium tatrate by hydrogen peroxide) http://www.nuffieldfoundation.org/practical-chemistry/involvement-catalysts-reactions	C3 C3
9 **3.1.6.1 Chemical equilibria and Le Chatelier's principle**	Understand how reversible reactions can reach a state of dynamic equilibrium. Understand Le Chatelier's principle. Understand why a compromise temperature and pressure may be used	**Students should be able to:** • describe what is meant the term dynamic equilibrium • explain how changes in temperature, pressure and concentration affect the position of a system at equilibrium • explain why compromise conditions of temperature and pressure may be used for a reversible reaction in an industrial process.	• Predict and explain the effect of changes in temperature, pressure and concentration on the position of an equilibrium (AO2 - Demonstrate knowledge and understanding). • Practical opportunity: Students carry out test-tube equilibrium shifts to show the effect of concentration and temperature (eg $Cu(H_2O)_6^{2+}$ with concentrated HCl). (AO2 - Demonstrate knowledge and understanding; AT k - Safely and carefully handle solids and liquids, including corrosive, irritant, flammable and toxic substances). • Students explain how conditions in temperature and pressure are a compromise in examples of industrial processes (AO3 - Analyse, interpret and evaluate scientific information).	• June 2013 Unit 2 Question 10a (QS13.2.10) • June 2013 Unit 2 Question 1a (QS13.2.01) • January 2013 Unit 2 Question 2 (QW13.2.02) • January 2012 Unit 2 Question 2 (QW12.2.02)	RSC Resource pack on equilibria http://www.rsc.org/learn-chemistry/resource/res00000843/equilibria RSC AfL exercise http://www.rsc.org/learn-chemistry/resource/res00000117/afl-equilibrium-reactions Many suitable resources can be found at http://www.docbrown.info/ and	C3 C3 C3

	for a reversible reaction in an industrial process. Understand the effect of a catalyst on an equilibrium.				http://www.chemsheets.co.uk/ (subscription required) Co^{2+} equilibrium experiment: http://www.rsc.org/learn-chemistry/resource/res00000001/cobalt-equilibrium	C3
10	Write an expression for and calculate K_c including units. Predict the effect, if any, of changes in conditions on the value of K_c.	**Students should be able to:** • write an expression for K_c for a homogeneous equilibrium, including its units • calculate the moles and concentration of reagents at equilibrium • calculate the value of K_c predict qualitatively how the value of K_c will change, if at all, as the position of an equilibrium moves as conditions are changed	• units for a variety of equilibria (AO2 - Demonstrate knowledge and understanding). • Calculate the moles and concentration of reagents at equilibrium given initial quantities and the quantity of one reagent at equilibrium (AO2 - Demonstrate knowledge and understanding). • Calculate K_c from data (AO2 - Demonstrate knowledge and understanding; MS2.3 - Substitute numerical values into algebraic equations using appropriate units for physical quantities. • Practical opportunity: Students set up a reaction between ethanol and ethanoic acid with acid catalyst and leave to reach equilibrium before titrating and using the results to determine K_c (AO2 - Demonstrate knowledge and understanding; AT d - Use laboratory apparatus for a variety of experimental techniques including titration, using burette and pipette ; AT k - Safely and carefully handle solids and liquids, including corrosive, irritant, flammable and toxic substances; PS 3.2 - Process and	• June 2013 Unit 4 Question 2 (QS13.4.02) • January 2010 Unit 4 Question 1 (QW10.04.01) • June 2006 Unit 4 Question 2 (QS06.4.02) • January 2003 Unit 4 Question 2 (QW03.04.02)	RSC Resource pack on equilibria http://www.rsc.org/learn-chemistry/resource/res00000843/equilibria Many suitable resources can be found at http://www.docbrown.info/ and http://www.chemsheets.co.uk/ (subscription required)	C3 C3

			analyse data using appropriate mathematical skills). Students predict qualitatively how the value of K_c will change, if at all, as the position of an equilibrium moves as conditions are changed.			
11 **3.1.7 Oxidation, reduction and redox equations**	Oxidation and reduction in terms of electron transfer. Oxidation states. Writing redox half equations and full equations.	**Students should be able to:** • determine oxidation states • write redox half equations • combine redox half equations to produce full equations • identify reduction and oxidation processes.	• Determine the oxidation state of each element in substances and ions (AO2 - Demonstrate knowledge and understanding). • Determine and then combine redox half equations (AO2 - Demonstrate knowledge and understanding). Determine and then combine redox half equations for the reaction of a brass 2p coin with concentrated nitric acid (AO2 - Demonstrate knowledge and understanding).	• June 2013 Unit 2 Question 4a (QS13.2.04) • January 2012 Unit 2 Question 5a and 5b (QW12.2.05) • June 2011 Unit 2 Question 5a (QS11.2.05) • January 2005 Unit 2 Question 2 (QW05.2.02) • January 2002 Unit 2 Question 4 (QW02.2.04)	Many suitable resources can be found at http://www.docbrown.info/ and http://www.chemsheets.co.uk/ (subscription required)	