Year 13 Chemistry Curriculum Unit Overview

Year 13 A Level Chemistry Module 1 **Thermodynamics**				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
Definitions of enthalpy changes used in Born–Haber and solution enthalpy cycles. Using Born–Haber cycles for ionic compounds. Considering covalent character of ionic compounds. Using solution enthalpy cycles for ionic compounds. To calculate entropy changes for reactions To calculate Gibbs free-energy changes and determine	• Write equations to represent enthalpy changes (AO2 - Apply knowledge and understanding). • Construct Born-Haber cycles and use them to calculate missing enthalpy change values (AO2 - Apply knowledge and understanding; MS2.2 Change the subject of an equation). • Compare and comment on values of enthalpy changes from Born–Haber cycles with those calculated theoretically using the perfect ionic model (AO3 - Analyse, interpret and evaluate data to make judgements). • Construct and use cycles involving the solution of ionic compounds in water to find missing enthalpy change values (AO2 - Apply knowledge and understanding MS2.2 Change the subject of an equation). • Rich question – predict the relative magnitude of the lattice enthalpy of the following compounds: aluminium oxide, potassium oxide, sodium chloride, sodium oxide. • Rich question – for an ionic compound with covalent character, deduce whether the lattice enthalpy will have a greater or smaller magnitude than that calculated theoretically from the perfect ionic model. • Rank given substances in terms of entropy (AO2 -	• June 2013 Unit 5 Question 1 (QS13.5.01) • June 2013 Unit 5 Question 2 (QS13.5.02) • January 2013 Unit 5 Question 2(QW13.5.02) • June 2011 Unit 5 Question 1 (QS11.5.01) • January 2010 Unit 5 Question 4 (QW10.5.04) • June 2013 Unit 5 Question 3 (QS13.5.03) • January 2012 Unit 5 Question 2 (QW12.5.02) • June 2011 Unit 5 Question 2	**AS Chemistry** - 3.1.4 – Energetics. GCSE Chemistry: energy changes.	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 RSC Classic Chemical Demonstrations - ΔH and ΔS for the vaporization of water using a kettle http://media.rsc.org/Classic%20Chem%20Demos/CCD-57.pdf Many suitable calculations can be found at http://www.docbrown.info/ and http://www.chemsheets.co.uk/

whether reactions are feasible at various temperatures	Apply knowledge and understanding). • Use entropy values to calculate the entropy change for a reaction (AO2 - Apply knowledge and understanding MS2.2 Change the subject of an equation; MS2.3 Substitute numerical values into algebraic equations). • Predict, where possible, whether reactions have an increase or decrease in entropy (AO2 - Apply knowledge and understanding). • Use the equation $\Delta G = \Delta H - T\Delta S$ to determine whether reactions are feasible at given temperatures, and determine the temperature at which reactions become feasible (AO2 - Apply knowledge and understanding; MS2.2 - Change the subject of an equation; MS2.3 - Substitute numerical values into algebraic equations using appropriate units for physical quantities). • Plot graphs of ΔG versus T to determine ΔH and ΔS (MS3.3 - Determine the slope and intercept of a linear graph). • Forecast how temperature affects the feasibility of reactions given the sign of the enthalpy and entropy changes (AO2 - Apply knowledge and understanding). • Apply the equation $\Delta G = \Delta H - T\Delta S$ to state changes to find ΔH, ΔS, melting and/or boiling points (AO2 - Apply knowledge and understanding; MS2.2 - Change the subject of an equation; MS2.3 - Substitute numerical values into algebraic equations using appropriate units for physical quantities). • Determine ΔH and ΔS for the vaporization of water using a kettle (PS 3.2 - Process and analyse data using appropriate mathematical skills as exemplified in the mathematical appendix for each science).	(QS11.5.02) • June 2010 Unit 5 Question 6 (QS10.5.06)		

Year 13 A Level Chemistry Module 2 Kinetics – rate equations				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
Understand rate equations and order of reaction. Deduce order of reaction, rate equations and rate constants from rate data. Describe how the rate constant changes with temperature. Use the Arrhenius equation. Understand that rate equations have to be determined by experiment. Link rate equations to mechanisms. Determine rate	• Describe how changes in concentration will affect reaction rates given the rate equation (AO2 - Apply knowledge and understanding). • Use rate equations to determine reaction rates or rate constants (with units) using initial rate data (AO2 - Apply knowledge and understanding; MS0.0 - Recognise and make use of appropriate units in calculation; MS2.3 – substitute numerical values into algebraic equations; MS2.4 - Solve algebraic equations). • Students use a graph of concentration–time and calculate the rate constant of a zero-order reaction by determination of the gradient. (AO2 - Apply knowledge and understanding; MS3.3 - Determine the slope of a linear graph; MS3.4 - Calculate rate of change from a graph showing a linear relationship). • Students can measure the activation energy for the catalysed and uncatalysed reaction of iodine with peroxodisulphate(VI) ions by experiment and plotting graphs (AO2 - Apply knowledge and understanding; MS3.3 - Determine the slope of a linear graph). Determine rate equations, rate constants (with units) using initial rate data (AO2 - Apply knowledge and understanding; MS0.0 - Recognise and make use of appropriate units in calculation; MS2.3 – substitute numerical values into algebraic equations; MS2.4 - Solve algebraic equations). • Students do the iodine clock reaction and determine the order of reaction for a reactant (AO2 - Apply knowledge and	• June 2006 Unit 4 Question 5a and 5b (QS06.4.05) • June 2003 Unit 4 Question 1 (QS03.4.01) • SAM A-level paper 2 (set 1) Q2 • June 2013 Unit 4 Question 1 (QS13.4.01) • January 2013 Unit 4 Question 1 (QW13.4.01) • January 2011 Unit 4 Question 1 (QW11.4.01) • January 2010 Unit 4 Question 3 (QW10.4.03) • January 2006 Unit 4 Question	**AS Chemistry** - 3.1.5 – Kinetics. GCSE Chemistry: rates of reaction	Calculations in AS / A Level Chemistry (Clark) ISBN 9780582411272 *Chemistry Review* article: Establishing a rate equation (Volume 14, edition 2) ILPAC Unit P5: Chemical Kinetics (free download from www.nationalstemcentre.org.uk) Avogadro web site on rate equations: http://www.avogadro.co.uk/kinetics/rate_equation.htm

using concentration-time graphs. Use rate-concentration graphs to deduce order for a reagent. **Required practical 7** Measure the rate of a reaction by an initial rate method, and a continuous monitoring method.	understanding; PS 2.4 - Identify variables including those that must be controlled; PS 3.1 - Plot and interpret graphs; PS 3.2 - Process and analyse data using appropriate mathematical skills; MS3.1 - Translate information between graphical, numerical and algebraic forms; MS3.2 - Plot two variables from experimental or other data; MS3.3 - Determine the slope and intercept of a linear graph AT a, k, l). • Students can react calcium carbonate or magnesium with acid of different concentrations and plot volume of gas formed against time for continuous monitoring. Initial rates could be found from these plots and compared (AO2 - Apply knowledge and understanding; PS 2.4 - Identify variables including those that must be controlled; PS 3.1 - Plot and interpret graphs; PS 3.2 - Process and analyse data using appropriate mathematical skills; MS3.1 - Translate information between graphical, numerical and algebraic forms; MS3.2 - Plot two variables from experimental or other data; MS3.3 - Determine the slope and intercept of a linear graph; MS3.4 - Calculate rate of change from a graph showing a linear relationship; MS3.5 - Draw and use the slope of a tangent to a curve as a measure of rate of change; AT a, k, l). • Students can use colorimetry for continuous monitoring experiments (eg bromine + methanoic acid; propanone + iodine) to determine order (AO2 - Apply knowledge and understanding; PS 3.1 - Plot and interpret graphs; PS 3.2 - Process and analyse data using appropriate mathematical skills; MS3.1 - Translate information between graphical, numerical and algebraic forms; MS3.2 - Plot two variables from experimental or other data; MS3.3 - Determine the slope and intercept of a linear graph; MS3.4 - Calculate rate of change from a graph showing a linear relationship; MS3.5 - Draw and use the slope of a tangent to a curve as a measure of rate of change; AT a, k, l). • Students could be given data to plot and interpret in terms of	1 (QW06.4.01) January 2003 Unit 4 Question 1 (QW03.4.01)		

	order with respect to a reactant. Alternatively, students could just be given appropriate graphs and asked to derive order(s) (AO2 - Apply knowledge and understanding; MS3.1 - Translate information between graphical, numerical and algebraic forms; MS3.2 - Plot two variables from experimental or other data; MS3.3 - Determine the slope and intercept of a linear graph; MS3.4 - Calculate rate of change from a graph showing a linear relationship; MS3.5 - Draw and use the slope of a tangent to a curve as a measure of rate of change). • Students calculate the rate constant of a zero-order reaction by determining the gradient of a concentration–time graph (MS3.3 - Determine the slope and intercept of a linear graph; MS3.4 - Calculate rate of change from a graph showing a linear relationship).			

Year 13 A Level Chemistry Module 3 Carbonyl containing compounds				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
Know about the oxidation of aldehydes. Know about the reduction of aldehydes and ketones with $NaBH_4$, including mechanism. Know about the reaction of aldehydes and ketones with KCN then acid, including mechanism. Draw the structure of and name carboxylic acids and esters. Know that carboxylic acids are weak acids.	• Students draw and name carboxylic acids and esters (AO2 - Apply knowledge and understanding). • Students write equations for, and make esters by reactions of alcohols with carboxylic acids in test tubes; or an ester could be collected and purified using a separating funnel and distillation (AO2 - Apply knowledge and understanding; AT g - Purify a liquid product, including use of separating funnel; AT k - Safely and carefully handle solids and liquids, including corrosive, irritant, flammable and toxic substances; AT d). • Students research uses of esters and the presence of esters in fruit (AO2 - Apply knowledge and understanding). • Students write equations for the hydrolysis of given esters in acidic and alkaline conditions (AO2 - Apply knowledge and understanding). • Students make soap by hydrolysis of castor oil (AO2 - Apply knowledge and understanding; AT k - Safely and carefully handle solids and liquids, including corrosive, irritant, flammable and toxic substances; AT d). • Students make biodiesel (AO2 - Apply knowledge and understanding; AT k - Safely and carefully handle solids and liquids, including corrosive, irritant, flammable and toxic substances; AT d).	• January 2013 Unit 4 Question 3a (QW13.4.03) • June 2010 Unit 4 Question 7a and 7d (QS10.4.07) • January 2010 Unit 4 Question 5 (QW10.4.05) • June 2005 Unit 1 Question 1a and 1d (QS05.4.01) • January 2013 Unit 4	**AS Chemistry** - 3.3.1.1 – Nomenclature - 3.3.1.2 – Reaction mechanisms - 3.3.5.2 – Oxidation of alcohols	RSC resource on aspirin: http://www.rsc.org/learn-chemistry/resource/res00000056/aspirin Aspirin Pre-lab Screen Experiment: http://www.rsc.org/learn-chemistry/resource/res00001644/aspirin-screen-experiment RSC mechanisms resource: http://www.rsc.org/learn-chemistry/resource/res00000638/curly-arrows-and-stereoselectivity-in-organic-reactions Mechanism animations http://science.jbpub.co

Know how esters are made from carboxylic acids. Know some uses of esters. Know how esters are hydrolysed. Know that vegetable oils and animal fats are esters of fatty acids and glycerol Know how soap and biodiesel are made from vegetable oil and animals fats Draw the structure of and name acid anhydrides, acyl chlorides and amides. Understand acylation reactions of water, alcohols, ammonia and amines with acyl chlorides and acid anhydrides, including the mechanism for acyl chlorides. **Required practical 10**	• Students write equations for production of soap and/or biodiesel from specified fats/oils (AO2 - Apply knowledge and understanding). Students could identify an unknown ester by determination of boiling point followed by hydrolysis and then purifying and finding the melting point of the carboxylic acid formed (eg for example methyl benzoate) (AO3 - Analyse, interpret and evaluate scientific information; AT d - Use laboratory apparatus for a variety of experimental techniques including distillation and heating under reflux, including setting up glassware using retort stand and clamps; AT d - Use laboratory apparatus for a variety of experimental techniques including filtration, including use of fluted filter paper, or filtration under reduced pressure; AT k). • Students draw and name acid anhydrides, acyl chlorides and amides (AO2 - Apply knowledge and understanding). • Students write equations and outline mechanisms for acylation reactions of water, alcohols, ammonia and amines with acyl chlorides and acid anhydrides; some of these reactions could be demonstrated. Students prepare, purify and test the purity of aspirin by melting point determination (AO2 - Apply knowledge and understanding; AT d - Use laboratory apparatus for a variety of experimental techniques including distillation and heating under reflux, including setting up glassware using retort stand and clamps; AT d - Use laboratory apparatus for a variety of experimental techniques including filtration, including use of fluted filter paper, or filtration under reduced pressure; AT k. • Students write equations for the oxidation of aldehydes (using reagents acidified potassium dichromate(VI) / Tollen's reagent / Fehling's solution) (AO2 - Apply knowledge and understanding). • Students could carry out test-tube reactions of Tollens' reagent and Fehling's solution to distinguish aldehydes and ketones (AO2 - Apply knowledge and understanding; AT b - Use water bath for heating; AT d - Use laboratory apparatus for a variety of	Question 3a (QW13.4.03) • June 2010 Unit 4 Question 7a and 7d (QS10.4.07) • January 2010 Unit 4 Question 5 (QW10.4.05) • June 2005 Unit 1 Question 1a and 1d (QS05.4.01) • January 2012 Unit 4 Question 10a (QW12.4.10) • June 2006 Unit 4 Question 1 (QS06.4.01) • June 2005 Unit 4 Question 7 (QS05.4.07) • June 2003		m/organic/movies/ *Chemistry Review* article: The structure of benzene (Volume 1, edition 1) *Chemistry Review* article: Who discovered the structure of benzene (Volume 5, edition 1) *Chemistry review* article: Probably the most important reactions in the world (Volume 15, edition 2)

Preparation of - a pure organic solid and test of its purity - a pure organic liquid.	experimental techniques including qualitative tests organic functional groups; AT k). Students write equations and mechanisms for the reduction of aldehydes and ketones using $NaBH_4$	Unit 5 Question 8b (QS03.5.08)		

Year 13 A Level Chemistry Module 4: **Equilibrium constant K_p for homogeneous systems**				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
Understand the concept of and calculate partial pressures using mole fractions. Write expressions for and calculate K_p including units. Perform calculations involving K_p. Predict how changes in conditions affect the position of an equilibrium and the value of K_p. The effect of a catalyst affects an equilibrium and K_p.	• Given initial amounts of substances and one substance at equilibrium, find the quantity of each reagent at equilibrium (AO2 - Apply knowledge and understanding). • Calculate mole fractions and then partial pressures in order to determine K_p, with units (AO2 - Apply knowledge and understanding; MS2.3 - Substitute numerical values into algebraic equations using appropriate units for physical quantities). • For given equilibria with enthalpy change data, predict the effect on the position of an equilibrium and the value of K_p (AO2 - Apply knowledge and understanding).	• January 2007 Unit 4 Question 2 (QW04.4.02) • June 2007 Unit 4 Question 1 (QS07.4.01) • January 2008 Unit 4 Question 3 (QW08.4.03) • June 2008 Unit 4 Question 3 (QS08.4.03) • January 2009 Unit 4 Question 3 (QW09.4.03) June 2009 Unit 4 Question 2 (QS09.4.02)	**AS Chemistry** - 3.1.6 – Chemical equilibria, Le Châtelier's principle and K_c	Calculations for A level Chemistry (Ramsden) ISBN 9780748758395 Many suitable calculations can be found at http://www.docbrown.info/ and http://www.chemsheets.co.uk/ (subscription required)

Year 13 A Level Chemistry Module 5: **Aromatic Chemistry**				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
Understand the structure of benzene and evidence for delocalisation. Know nitration and Friedel-Crafts acylation reactions of aromatic compounds, including the mechanism and usefulness.	• Name a range of aromatic compounds with common functional groups (AO2 - Apply knowledge and understanding). • Draw enthalpy diagrams to show the relative stability of cyclohexane, cyclohexene, cyclohexa-1,4-diene, benzene and the theoretical cyclohexa-1,3,5-triene (AO2 - Apply knowledge and understanding). • Write equations (including for the formation of electrophiles) and mechanisms for nitration and Friedel-Crafts acylation reactions given the starting material and products (AO2 - Apply knowledge and understanding). • Students could carry out the preparation of methyl 3-nitrobenzoate by nitration of methyl benzoate, purification by recrystallisation and determination of melting point (AT d - Use laboratory apparatus for a variety of experimental techniques including filtration, including use of fluted filter paper, or filtration under reduced pressure; AT k - Safely and carefully handle solids and liquids, including corrosive, irritant, flammable and toxic substances).	• June 2011 Unit 4 Question 8a (QS11.4.08) • January 2004 Unit 4 Question 7a (QW04.4.07) • January 2012 Unit 4 Question 9a (QW12.4.09) • January 2011 Unit 4 Question 6 (QW11.4.06) • June 2010 Unit 4 Question 8 b) (QS10.4.08) • January 2006 Unit 4 Question 7 (QW06.4.07) • June 2011 Unit	**AS Chemistry** - 3.3.1.1 – Nomenclature. - 3.3.1.2 – Reaction mechanisms.	*Chemistry Review* article: The structure of benzene (Volume 1, edition 1) *Chemistry Review* article: Who discovered the structure of benzene (Volume 5, edition 1) *Chemistry review* article: Probably the most important reactions in the world (Volume 15, edition 2)

		4 Question 8b		

Year 13 A Level Chemistry Module 6: **Electrode potential and electrochemical cells**				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
The idea of a cell that has a potential difference being made by combining two half cells (electrodes). How potentials are measured relative to the Standard Hydrogen Electrode and under standard conditions. Use the electrochemical series to calculate the EMF of cells and predict the direction of simple redox reactions. **Required practical 8** Measuring the EMF of an	• Students make simple cells and use them to measure EMF and unknown electrode potentials (AO2 - Apply knowledge and understanding; PS 1.1 - Solve problems set in practical contexts; AT j - Set up electrochemical cells and measuring voltages). • Students write the standard cell notation for cells (AO2 - Apply knowledge and understanding). • Students predict how changes in conditions will affect EMF (AO2 - Apply knowledge and understanding). • Students could be asked to plan and carry out an experiment to investigate the effect of changing conditions, such as concentration or temperature, in a voltaic cell such as $Zn\|Zn^{2+}\|\|Cu^{2+}\|\ Cu$ (AO2 - Apply knowledge and understanding; PS 1.1 - Solve problems set in practical contexts; PS 2.4 - Identify variables including those that must be controlled; AT j). • Students could use *E* values to predict the direction of simple redox reactions, then test these predictions by simple test-tube reactions (AO2 - Apply knowledge and understanding). • Students make simple cells and use them to measure EMF and unknown electrode potentials (AO2 - Apply knowledge and understanding; PS 1.1 - Solve problems set in practical contexts). • Students write the standard cell notation for cells (AO2 - Apply knowledge and understanding).	• January 2013 Unit 5 Question 7 (QW13.5.07) • January 2012 Unit 5 Question 4 (QW12.5.04) • June 2006 Unit 5 Question 5 (QS06.5.05) • January 2004 Unit 5 Question 4 (QW04.5.04) • June 2013 Unit 5 Question 5 (QS13.5.05) • June 2012 Unit 5 Question 5 (QS12.5.05) • January 2011 Unit 5 Question 5 (QW11.5.05)	**AS Chemistry** - 3.1.7 – Oxidation, reduction and redox equations.	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 *Chemistry Review* articles: Understanding electrode potentials (Volume 12, edition 1) Electrode potentials (Volume 15, edition 3) Some suitable problems can be found at http://www.docbrown.info/ and http://www.chemsheets.co.uk/ (subscription required) 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:

electrochemical cell. That cells can be used as a source of energy. That cells can be non-rechargeable or rechargeable. That fuel cells can be used to generate an electric current. That there are benefits and risks associated with using these cells.	• Students predict how changes in conditions will affect EMF (AO2 - Apply knowledge and understanding). • Students could be asked to plan and carry out an experiment to investigate the effect of changing conditions, such as concentration or temperature, in a voltaic cell such as $Zn\|Zn^{2+}\|\|Cu^{2+}\|\ Cu$ (AO2 - Apply knowledge and understanding; PS 1.1 - Solve problems set in practical contexts; PS 2.4 - Identify variables including those that must be controlled). • Students could use *E* values to predict the direction of simple redox reactions, then test these predictions by simple test-tube reactions (AO2 - Apply knowledge and understanding).			9780719539510 *Chemistry Review* articles: Understanding electrode potentials (Volume 12, edition 1) Electrode potentials (Volume 15, edition 3) Some suitable problems can be found at http://www.docbrown.info/ and http://www.chemsheets.co.uk/ (subscription required)

Year 13 A Level Chemistry Module 7 **Optical isomerism**				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
The cause and nature of optical isomerism. The similarities and differences in the properties of enantiomers. The formation of racemic mixtures.	• Students make models of mirror image molecules of some chiral and non-chiral molecules to see if they are non-superimposable or not (AO2 - Apply knowledge and understanding; MS4.2 - Visualise and represent 2D and 3D forms including two-dimensional representations of 3D objects; MS4.3 - Understand the symmetry of 2D and 3D shapes). • Students identify whether molecules exhibit optical isomerism, and where they do draw the two enantiomers in 3D (AO2 - Apply knowledge and understanding; MS4.2 - Visualise and represent 2D and 3D forms including two-dimensional representations of 3D objects; MS4.3 - Understand the symmetry of 2D and 3D shapes). • Students could see how passing polarised light through a solution of sucrose affects the plane of the	• January 2005 Unit 4 Question 3d (QW05.4.03) • June 2002 Unit 4 Question 5 (QW02.4.05)	**AS Chemistry** - 3.3.1.3 – Isomerism. **A-level Chemistry** - 3.3.8 – Aldehydes and ketones	Molymod models *Chemistry Review* article: Looking in the mirror (Volume 10, edition 3)

	light (PS 1.2 - Apply scientific knowledge to practical contexts). Students could use Molymod models to show how a racemic mixture is formed when ethanal reacts with HCN (AO2 - Apply knowledge and understanding; MS4.2 - Visualise and represent 2D and 3D forms including two-dimensional representations of 3D objects; MS4.3 - Understand the symmetry of 2D and 3D shapes).			

Year 13 A Level Chemistry Module 8: **Amines**				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
Know how primary aliphatic amines are made from halogenoalkanes and from nitriles. Know how aromatic amines are produced and their use in making dyes. Compare the base strength of amines. Understand how amines react with halogenoalkanes, acyl chlorides and acid anhydrides, including mechanisms.	• Identify reagents and conditions and write equations to make specified primary aliphatic amines from halogenoalkanes and nitriles (AO2 - Apply knowledge and understanding). • Identify reagents and conditions and write equations to make specified aromatic amines (AO2 - Apply knowledge and understanding). • Research the use of aromatic amines in making dyes (AO3 - Analyse, interpret and evaluate scientific information). • Given pairs of amines, students should identify the stronger base giving reasons for their choice (AO2 - Apply knowledge and understanding). • Identify the amines and quaternary ammonium salts that can be formed when ammonia and amines react with halogenoalkanes and how changing conditions can affect the main product; outline the mechanism to form these products (AO2 - Apply knowledge and understanding). • Students could research the use of quaternary ammonium salts (AO3 - Analyse, interpret and evaluate scientific information). • Students write equations and mechanisms for acylation reactions of water, alcohols, ammonia and amines with acyl chlorides and acid anhydrides; some	• June 2013 Unit 4 Question 8 (QS13.4.08) • June 2005 Unit 4 Question 5b (QS05.4.05) • January 2005 Unit 4 Question 1 (QW05.4.01) • June 2004 Unit 4 Question 4a and 4b (QS04.4.04) January 2004 Unit 4 Question 8 (QW04.4.08) • January 2005 Unit 4 Question 1d (QW05.4.01) • June 2004 Unit 4 Question 4c (QS04.4.04) • January 2003 Unit 4 Question	**AS Chemistry** - 3.3.1.1 – Nomenclature. - 3.3.1.2 – Reaction mechanisms. - 3.3.3.1 – Nucleophilic substitution.	*Chemistry Review* article: Get real: chemistry in fashion (Volume 11, edition 3) Data books with base strength values: 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 *Chemistry Review* article: Two in one: the chemistry of shampoo and conditioner (Volume 22, edition 3)

	of these reactions could be demonstrated (AO2 - Apply knowledge and understanding). Practical opportunity: The preparation of N-phenylethanamide	6 (QW03.4.06) • June 2013 Unit 4 Question 9a • January 2006 Unit 4 Question 5 (QW06.4.05) • January 2004 Unit 4 Question 8 (QW04.4.08) • January 2003 Unit 4 Question 6 (QW06.4.05)		

Year 13 A Level Chemistry Module 9: **Polymers**				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
Understand how condensation polymers are formed including linkages in polyesters and polyamides. Identify the repeating unit given monomer(s) and vice versa. Understand why polyalkenes are not biodegradable. Understand why polyesters and polyamides are biodegradable. Evaluate different methods of disposing of polymers.	• Draw the structure of repeating units in polyesters and polyamides given the monomer(s) and vice versa (AO2 - Apply knowledge and understanding). • Students could make nylon 6,6 (AO2 - Apply knowledge and understanding); AT k - Safely and carefully handle solids and liquids, including corrosive, irritant, flammable and toxic substances; AT d). • Students could each make a model of a monomer using Molymods and then students collectively join them together to make a long polymer chain (AO2 - Apply knowledge and understanding). • Students can create a summary table to compare and explain the biodegradability of different types of polymers (AO1 - Demonstrate knowledge and understanding of scientific ideas). • Students can research and summarise different methods of disposing of polymers, including recycling, considering advantages, disadvantages and sustainability (AO3 - Analyse, interpret and evaluate scientific information).	• January 2012 Unit 4 Question 8b (QW12.4.08) • June 2011 Unit 4 Question 4a (QS11.4.04) • June 2006 Unit 4 Question 4a (QS06.4.04) • June 2004 Unit 4 Question 5 (QS04.4.05) • June 2003 Unit 4 Question 5b) (QS03.4.05) • January 2013 Unit 4 Question 4b, 4c and 4d (QW13.4.04) • CHM4 Specimen Paper Question 5d (QSP.4.05) • June 2002 Unit 4 Question 7	**AS Chemistry** - 3.3.1.1 – Nomenclature. - 3.3.4.3 – Addition polymers.	Molymods RSC resource on nylon: http://www.rsc.org/learn-chemistry/resource/res00000026/nylon The discovery of Nylon http://www.rsc.org/learn-chemistry/resource/res00000034/anecdotes-nylon Making nylon: http://www.rsc.org/learn-chemistry/resource/res00000755/making-nylon-the-nylon-rope-trick Sandcastles and mudhuts section 27 – Spare Parts (Hancock) ISBN 9780340543696 *Chemistry Review* article: Tougher than a speeding bullet (Volume 13, edition 4) *Chemistry Review* article: Polyesters: plastics of the future (Volume 17, edition 1) *Chemistry Review* article: Kevlar and composites (Volume 20, edition 2)

		(QS02.4.07) • June 2004 Unit 4 Question 5a and 5c (QS04.4.05) • SAM A-level Paper 2 (set 1) Question 7		*Chemistry Review* article: Kevlar – miracle material (Volume 22, edition 4) *Chemistry Review* article: Reclaiming plastic waste (Volume 23, edition 2) Video on recycling plastics: http://www.rsc.org/learn-chemistry/resource/res00001347/recycling-plastics

Year 13 A Level Chemistry Module 10 **Acids and bases**

What are we learning?	What knowledge, understanding and skills will we gain?	Evaluation and assessment methods	Implementation	What additional resources are available?
The idea of acids as proton donors and bases as proton acceptors. Calculate the pH of strong acids from concentration and vice versa. Use K_w to calculate the pH of strong bases. Understand the term *weak* in relation to acids and bases. Use K_a to find the pH of weak acids from the concentration and vice versa. Relate K_a to pK_a Calculate the pH of the solution formed when	• Identify which species acts as the acid and which as the base in Brønsted-Lowry acid-base reactions (AO2 - Apply knowledge and understanding). • Identify acids as being strong or weak and monoprotic or diprotic (AO2 - Apply knowledge and understanding). • Calculate the pH of strong acids from the acid concentration, including examples where the acids are diluted (AO2 - Apply knowledge and understanding; MS0.4 - Use calculators to find and use power, exponential and logarithmic functions; MS2.5 - Use logarithms in relation to quantities that range over several orders of magnitude). • Calculate the concentration of strong acids from the pH (AO2 - Apply knowledge and understanding; MS0.4 - Use calculators to find and use power, exponential and logarithmic functions; MS2.5 - Use logarithms in relation to quantities that range over several orders of magnitude). • Derive the expression $K_w = [H^+][OH^-]$ (AO1 - Demonstrate knowledge and understanding). • Calculate the pH of strong bases from the base concentration and vice versa, including dilutions (AO2 - Apply knowledge and understanding; MS0.4 - Use calculators to find and use power, exponential and logarithmic functions; MS2.5 - Use logarithms in relation to quantities that range over several orders of magnitude). • Calculate the pH of water at different temperatures (AO2 - Apply knowledge and understanding; MS0.4 - Use calculators to find and use power, exponential and logarithmic functions; MS2.5 - Use	• June 2012 Unit 4 Question 3a and 3b (QS12.4.03) • January 2013 Unit 4 Question 2a (QW13.4.02) • June 2011 Unit 4 Question 2a (QS11.4.02) • June 2010 Unit 4 Question 5a and 5b (QS10.4.05) • June 2013 Unit 4 Question 3 (QS13.4.03) • June 2011 Unit 4 Question 1 (QS11.4.01)	**AS Chemistry** - 3.1.6 – Chemical equilibria, Le Châtelier's principle and K_c	Theory of acids history websites: http://www.bbc.co.uk/dna/ptop/plain/A708257 http://pubs.acs.org/subscribe/archive/tcaw/12/i03/pdf/303chronicles.pdf RSC acid-base simulator: http://www.rsc.org/learn-chemistry/resource/res00001457/acid-base-solutions-rsc-funded RSC pH simulator: http://www.rsc.org/learn-chemistry/resource/res00001458/ph-scale-simulation-rsc-funded Some suitable problems can be

strong or weak acids react with strong bases. Sketch pH curves and choose suitable indicators for titrations. **Required practical 9** Investigate how pH changes when a weak acid reacts with a strong base and when a strong acid reacts with a weak base. Know what buffer solutions are, how they are made and what they are used for. Explain how acidic and basic buffer solutions work. Calculate the pH of acidic buffer solutions.	logarithms in relation to quantities that range over several orders of magnitude). • Explain how the pH and neutrality of water is or is not affected by changes in temperature (AO2 - Apply knowledge and understanding). • Explain the difference between strong and weak acids and bases (AO1 - Demonstrate knowledge and understanding). • Derive expressions for K_a for stated acids (AO1 - Demonstrate knowledge and understanding). • Perform calculations linking K_a to concentration and pH (AO2 - Apply knowledge and understanding; MS0.4 - Use calculators to find and use power, exponential and logarithmic functions; MS2.5 - Use logarithms in relation to quantities that range over several orders of magnitude). • Convert K_a values to pK_a and vice versa, and use these values to rank acids in order of strength (AO2 - Apply knowledge and understanding; MS0.4 - Use calculators to find and use power, exponential and logarithmic functions; MS2.5 - Use logarithms in relation to quantities that range over several orders of magnitude). • Measure K_a of a weak acid by measuring pH at half neutralisation (AO2 - Apply knowledge and understanding; AT c - Measure pH using pH charts, or pH meter, or pH probe on a data logger; PS 4.1 - Know and understand how to use a wide range of experimental and practical instruments, equipment and techniques; AT d).	• CHEM4 Specimen Paper Question 3 (QSP 4.03) • June 2005 Unit 4 Question 2 (QS05.4.02) • June 2005 Unit 5 Question 2 (QS05.5.02) • June 2003 Unit 4 Question 3 (QW03.4.03) • January 2013 Unit 4 Question 2 (QW13.4.02) • January 2011 Unit 4 Question 2 (QW11.4.02) • CHEM4 Specimen Paper Question 4 (QSP 4.04) • January 2005		found at http://www.docbrown.info/ and http://www.chemsheets.co.uk/ (subscription required) Creative problem solving in Chemistry – weak acids: http://www.rsc.org/learn-chemistry/resource/res00000677/a-weak-acid pH curve simulators: http://chem-ilp.net/labTechniques/AcidBaseIdicatorSimulation.htm http://terpconnect.umd.edu/~toh/models/TitrationDemo.html

	• Perform calculations to find the pH of mixtures of strong/weak acids with strong bases, with either excess acid or base (AO2 - Apply knowledge and understanding; MS0.4 - Use calculators to find and use power, exponential and logarithmic functions; MS2.5 - Use logarithms in relation to quantities that range over several orders of magnitude). • Produce pH curves by experiment (AO2 - Apply knowledge and understanding; AT c - Measure pH using pH charts, or pH meter, or pH probe on a data logger; AT d, k, a). • Sketch pH curves for given acid and base combinations, and choose a suitable indicator (AO2 - Apply knowledge and understanding). • Describe how buffer solutions are made, how they work and what they are used for (AO2 - Apply knowledge and understanding). • Calculate the pH of a buffer solution given details about quantities of the reagents it is made from, and changes in pH when small amounts of acid/alkali are added to buffer solutions (AO2 - Apply knowledge and understanding; MS0.4 - Use calculators to find and use power, exponential and logarithmic functions; MS2.5 - Use logarithms in relation to quantities that range over several orders of magnitude). • Students could prepare a solution of a specific pH and then test the solution to check its pH and buffer action (AO2 - Apply knowledge and understanding; MS0.4 - Use calculators to find and use power, exponential and logarithmic functions; MS2.5 - Use logarithms in relation to quantities that range over several orders of magnitude; AT c - Measure pH using pH charts, or pH meter, or pH probe on a data logger; AT e - Use volumetric flask, including accurate technique for making up a standard solution; PS 1.1 - Solve problems set in practical contexts; PS 4.1 - Know and understand how to use a wide range of experimental and practical instruments, equipment and techniques).	Unit 4 Question 8 (QW05.4.08) • January 2002 Unit 4 Question 3 (QW02.4.03)			

Year 13 A Level Chemistry Module 11: **Amino acids, proteins and DNA**				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
Understand the structure of amino acids. Draw the structure of given amino acids in acidic solution, alkaline solution and as zwitterions. Understand how DNA replicates and how anti-cancer drug cisplatin prevents this. Understand the principle of drug action and the	• Given the structure of the amino acid, students show draw the structure of the species formed in acidic solution, alkaline solution and as a zwitterion (AO2 - Apply knowledge and understanding). • Draw the structure of peptides formed from joining amino acids together (AO2 - Apply knowledge and understanding). • Identify amino acids formed when peptides are hydrolysed (AO2 - Apply knowledge and understanding). • Identify the primary, secondary and tertiary parts of the structure of some proteins (AO2 - Apply knowledge and understanding). • Students can carry out some thin-layer chromatography of some amino acids to identify an unknown amino acid (AO2 - Apply knowledge and understanding; AT i - Use thin-layer or paper chromatography).	• June 2013 Unit 4 Question 6 (QS13.4.06) • January 2012 Unit 4 Question 7 (QS12.4.07) • January 2005 Unit 4 Question 2 (QW05.4.02) • January 2010 Unit 4 Question 6 (QW10.4.06) • SAM A level Paper 2	**AS Chemistry** - 3.1.3.7 – Forces between molecules. - 3.3.1.1 – Nomenclature. **A-level Chemistry** - 3.3.9 – Carboxylic acids. - 3.3.11 – Amines. - 3.3.16 – Chromatography	Structure of amino acids (rotatable) https://undergrad-ed.chemistry.ohio-state.edu/jmol-viewer/# RSC resource on basic biochemistry http://www.rsc.org/Education/Teachers/Resources/cfb/proteins.htm AQA Biochemistry Teachers' Notes (covers 3.3.13): http://www.aqa.org.uk/resources/science/as-and-a-level/chemistry-7404-7405/teach/teaching-notes RSC resource on basic biochemistry of enzymes http://www.rsc.org/Education/Teachers/Resources/cfb/enzymes.htm

use of computer aided design. Understand the structure of the components of DNA (given on data sheet). Understand the nature of nucleotides. Understand the structure of single DNA strands and the arrangement of these together in the double helix structure. Understand the structure of proteins. Understand how peptide links can be hydrolysed to release amino acids. Know how to use thin-layer chromatography to separate and identify amino acids.	• Use a right handed glove with their right/left hands to model enzyme action (AO2 - Apply knowledge and understanding). • Make a 2D or 3D model of DNA using cut out components (AO2 - Apply knowledge and understanding). • Label a diagram of DNA to show the components and the hydrogen bonding between base pairs (AO1 - Demonstrate knowledge and understanding of scientific ideas). • Write notes to accompany a sequence of diagrams showing DNA replication (AO1 - Demonstrate knowledge and understanding of scientific ideas). • Write notes to accompany a diagram showing the action of cisplatin (AO1 - Demonstrate knowledge and understanding of scientific ideas). Evaluate the benefits and adverse effects of using drugs such as cisplatin (AO3 - Analyse, interpret and evaluate scientific information).	Questions 5 • June 2011 Unit 4 Question 4c (QS11.4.04) • January 2011 Unit 4 Question 4f (QW11.4.04) • SAM A-level Paper 2 (set 1) Question 8		Useful animations on action of enzymes (eg hydrolysis of sucrose) http://doctorprodigious.wordpress.com/hd-animations/ How Stuff Works on the structure of DNA http://science.howstuffworks.com/life/cellular-microscopic/dna1.htm Simple animation showing the structure of DNA: http://www.youtube.com/watch?v=qy8dk5iS1f0 Useful animations on biochemistry http://doctorprodigious.wordpress.com/hd-animations/ *Chemistry review* article: Why is DNA helical? (Volume 1, edition 1) Useful animations on biochemistry (DNA replication) http://doctorprodigious.wordpress.com/hd-animations/ Youtube video on action of cisplatin http://www.youtube.com/watch?v=Wq_up2uQRDo Cisplatin – molecule of the month http://www.chm.bris.ac.uk/motm/cisplatin/htmlonly/

Understand the structure of enzymes. Understand the action of enzymes in terms of active sites.				*Chemistry review* article: Metals in medicine (Volume 8, edition 2) *Chemistry review* article: Curing cancer with chemistry (Volume 18, edition 3

Year 13 A Level Chemistry Module 12: **Organic synthesis and analysis**				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
Devise synthetic routes to make specified compounds. Using ^{1}H and ^{13}C NMR to deduce	• Devise synthetic routes, including reaction conditions, to make organic compounds using reactions in the specification (AO2 - Apply knowledge and understanding). • Describe features of processes that improve	• Specimen Paper CHM4 Question 8 (QSP.4.08) • Specimen	**AS Chemistry** - All organic chemistry topics. **A-level Chemistry** - 3.3.8–3.3.13	RSC synthesis resource http://www.rsc.org/learn-chemistry/resource/res00000003/synthesis-explorer *Chemistry review* article: New tricks for stacking bricks: modern

information about the structure of organic molecules. Understand similarities and differences between ^{1}H and ^{13}C NMR. Understand the use of TMS and suitable solvents.	sustainability (A03 - Analyse, interpret and evaluate scientific information). • Predict the number, position, relative intensity and splitting of signals in the ^{1}H NMR spectrum of compounds (AO2 - Apply knowledge and understanding). • Predict the number and position of signals in the ^{13}C NMR spectrum of compounds (AO2 - Apply knowledge and understanding). • Use data from NMR, and other analytical methods on the specification, to deduce the structure of compounds (AO2 - Apply knowledge and understanding; MS3.1 Translate information between graphical, numerical and algebraic forms).	Paper CHM4 Question 9 (QSP.4.09) • June 2006 Unit 4 Question 6 (QS06.4.06) • January 2003 Unit 4 Question 7 (QW03.4.07) • June 2002 Unit 4 Question 7 (QS02.4.07) • June 2013 Unit 4 Question 7 (QS13.4.07) • January 2013 Unit 4 Question 5 (QS13.4.05) • June 2012 Unit 4 Question 8 (QS12.4.08) • January 2011 Unit 4 Question 5 (QW11.4.05) • January 2003 Unit 4 Question 5 (QW03.4.05) January 2002 Unit 4 Question 4 (QW02.4.04)		approaches to organic synthesis (Volume 12, edition 3) *Chemistry review* article: Salbutamol: saving your breath (Volume 18, edition 4) RSC Spectral School: http://www.rsc.org/learn-chemistry/collections/spectroscopy?uol_r=3ae0be55 RSC Spectroscopy resource: http://www.rsc.org/learn-chemistry/resource/res00000847/spectroscopy Database of spectra for organic compounds http://sdbs.db.aist.go.jp/sdbs/cgi-bin/cre_index.cgi CLEAPSS Spectra (Secondary Science Guide L202) http://www.cleapss.org.uk/secondary/secondary-science/secondary-science-guides?start=20 (Subscription required)

Year 13 A Level Chemistry Module 13: **Properties of Period 3 elements and their oxides**				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
Reactions of Na and Mg with water. Reactions of Na, Mg, Al, Si, P and S with oxygen. Melting points of period 3 oxides. Reactions of period 3 oxides with water.	• Practical opportunity: react specified period 3 elements with water and oxygen; react specified oxides with water. • Plot a graph of melting points of period 3 oxides and annotate it with explanation of the relative melting points. • Complete tables including equations to show how period 3 elements react with water and/or oxygen, and how period 3 oxides react with water.	• June 2013 Unit 5 Question 4a, 4b and 4c (QS13.5.04) • January 2013 Unit 5 Question 4a, 4b, 4c and 4d (QW13.5.04) • January 2012 Unit 5 Question 3 (QW12.5.03) • January 2011	**AS Chemistry** - 3.1.3 – Bonding. - 3.2.1 – Periodicity.	Youtube video on Period 3 oxides: https://www.youtube.com/watch?v=D0pNAFjyE6o Youtube video of reaction of phosphorus with oxygen: https://www.youtube.com/watch?v=U6_-EUcswSc&src_vid=mjkuSm__G7s&feature=iv&annotation_id=annotation_323593

		Unit 5 Question 3 (QW11.5.03)		

Year 13 A Level Chemistry Module 14: **Transition metals**				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
Give the electron structure of transition metals and their ions. Know the characteristic properties of transition metals. Understand the terms complex, ligand co-ordinate bond, and co-ordination	• State the electron structure of first row transition metals and their ions (AO1 - Demonstrate knowledge and understanding). • Explain why the elements Ti–Cu have properties characteristic of transition metals, and what those characteristics are (AO1 - Demonstrate knowledge and understanding). • Identify the oxidation state of the metal, the ligands and co-ordination number in a series of complexes (AO2 - Apply knowledge and understanding). • Identify an element from the series Ti–Cu and find examples for that element to confirm its characteristic properties (AO3 - Analyse, interpret and evaluate	• January 2005 Unit 5 Question 6a (QW05.5.06) • June 2010 Unit 5 Question 4a and 4b (QS10.5.06) • January 2011 Unit 5 Question 4a and 4b (QW11.5.04) • June 2010 Unit	**AS Chemistry** - 3.1.1 – Atomic structure (electron structure). - 3.1.7 – Oxidation, reduction and redox reactions (oxidation states, oxidation, reduction, redox equations).	*Chemistry Review* article: Vanadium (Volume 19, edition 4) Molecule of month article on EDTA http://www.chm.bris.ac.uk/motm/edta/edtah.htm - Practical Uses of EDTA RSC article on uses of EDTA http://www.rsc.org/chemistryworld/podcast/CIIEcompounds/transcripts/EDTA.asp Molymod molecular models Shapes viewer (including

number. Understand the different types of ligands. Understand ligand exchange. Know about oxygen transfer by haemoglobin. Understand the chelate effect. Know the shapes of complexes with 2/4/6 ligands. Understand how complexes can show *cis–trans (E–Z)* or optical isomerism. Understand why transition metal ions are coloured and what affects the colour. Use colorimetry to measure concentration of solutions.	scientific information, ideas and evidence). • Give examples of monodentate, bidentate and multidentate ligands (AO1 - Demonstrate knowledge and understanding). • Students should carry out substitution reactions of metal aqua complexes with monodentate ligands (from ammonia and concentrated hydrochloric acid) to consider whether there is a change in co-ordination number and whether all the water ligands are substituted (AO2 - Apply knowledge and understanding; AT k - Safely and carefully handle solids and liquids, including corrosive, irritant, flammable and toxic substances; AT d). • Students could carry out test-tube reactions of complexes with monodentate, bidentate and multidentate ligands to compare ease of substitution (AO2 - Apply knowledge and understanding; PS 1.1 - Solve problems set in practical contexts; AT d, k). • Give examples of and sketch the shape of octahedral, tetrahedral, square planar and linear complexes (AO1 - Demonstrate knowledge and understanding; MS4.1 - Use angles and shapes in regular 2D and 3D structures; MS4.2 - Visualise and represent 2D and 3D forms including two-dimensional representations of 3D objects; MS4.3 - Understand the symmetry of 2D and 3D shapes). • Explain how *cis–trans (E–Z)* isomerism arises in some octahedral and square planar complexes, including cisplatin, and draw the isomers (AO2 - Apply knowledge and understanding). • Explain how optical isomerism arises in some octahedral complexes with bidentate ligands, and draw the isomers (AO2 - Apply knowledge and	5 Question 4a, 4b, 4d and 4e (QS10.5.06) • January 2005 Unit 5 Question 6b (QW05.5.06) • June 2004 Unit 5 Question 4b (QS04.5.04) • June 2002 Unit 5 Question 6 (QS02.5.06) • January 2011 Unit 5 Question 4a, 4b and 4c (QW11.5.04) • January 2004 Unit 5 Question 10b (QW04.5.10) • June 2003 Unit 5 Question 3 (QS03.5.03) • June 2013 Unit 5 Question 6 (QS13.5.06) • January 2012 Unit 5 Question 7a and 7b (QW12.5.07) • Specimen		inorganic complexes) https://undergrad-ed.chemistry.ohio-state.edu/jmol-viewer/# Colorimetric determination of a copper ore: http://www.nuffieldfoundation.org/practical-chemistry/colorimetric-determination-copper-ore *Chemistry Review* article: Colorimetry (Volume 12, edition 3) RSC booklet on colorimetry from Gifted & Talented Chemistry: http://www.rsc.org/learn-chemistry/resource/res00000847/spectroscopy RSC Spectral School with range of resources: http://www.rsc.org/learn-chemistry/collections/spectroscopy 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 ILPAC Advanced Practical

Know what happens when vanadate(V) is reduced by zinc in acidic solution. How the redox potential for a transition metal is affected by the pH and ligand. The reduction of silver (I) in Tollen's reagent to test for aldehydes. Redox titrations, including calculations, of MnO_4^- with Fe^{2+} and $C_2O_4^{2-}$ in acidic solution. Understand what heterogeneous catalysts are and how they work, including examples and how they can become poisoned. Understand what homogeneous catalysts are, with specific	understanding). • Students can use Molymod kits to make models of isomers (AO2 - Apply knowledge and understanding; MS4.1 - Use angles and shapes in regular 2D and 3D structures; MS4.2 - Visualise and represent 2D and 3D forms including two-dimensional representations • Students should react an acidified solution of ammonium vanadate(V) with zinc to observe colour changes , identify vanadium species and write redox reactions for each reduction reaction (AO1 - Demonstrate knowledge and understanding; AT k - Safely and carefully handle solids and liquids, including corrosive, irritant, flammable and toxic substances; AT d). • Compare redox potentials for Cr^{3+} at different pH values and different ligands (AO2 - Apply knowledge and understanding). • Test aldehydes and ketones with Tollens reagent (AO1 - Demonstrate knowledge and understanding; AT k - Safely and carefully handle solids and liquids, including corrosive, irritant, flammable and toxic substances; AT d). • Carry out redox titrations, including associated titrations, of Fe^{2+} with MnO_4^- in acidic solution (eg analysis of iron in iron tablets, analysis of iron in lawn sand, analysis of iron in steel, finding the M_r of hydrated ammonium (II) sulfate) (AO2 - Apply	Paper Unit 5 Question 6 (QSP.5.6) • June 2002 Unit 5 Question 3 (QW02.5.03) • June 2006 Unit 5 Question 1 (QW06.5.01) • June 2005 Unit 5 Question 5 (QS05.5.05) • June 2003 Unit 5 Question 2 (QS03.5.02) • January 2003 Unit 5 Question 7b (QW03.5.07) • January 2013 Unit 5 Question 6 (QW13.5.06) • January 2012 Unit 5 Question 6 (QW12.5.06) • January 2011 Unit 5 Question 4d (QW11.5.04) • January 2010 Unit 5 Question		Chemistry ISBN 9780719575075 *Chemistry Review* article: Catalysts: getting chemistry going (Volume 20, edition 3) *Chemistry Review* article: Catalysts: heterogeneous catalysis (Volume 23, edition 1) *Chemistry Review* article: Catalysts: homogeneous catalysis (Volume 23, edition 3)

examples.	• Explain using diagrams and the equation $\Delta E = hv\ (= hc/\lambda)$ why transition metal complexes are coloured and what factors affect the colour (AO1 - Demonstrate knowledge and understanding). • Use a graph of absorption versus concentration to determine the concentration of the solution. • Use a colorimeter to produce a calibration curve and then find the concentration of a coloured solution, eg containing copper(II) ions (AO2 - Apply knowledge and understanding; AT a - Use appropriate apparatus to record a range of measurements; AT d - Use laboratory apparatus for a variety of experimental techniques; PS 3.1 - Plot and interpret graphs; MS3.2 - Plot two variables from experimental or other data). • knowledge and understanding; AT d - Use laboratory apparatus for a variety of experimental techniques including titration, using burette and pipette; AT e - Use volumetric flask, including accurate technique for making up a standard solution; AT k; PS 2.3 - Evaluate results and draw conclusions with reference to measurement uncertainties and errors; MS2.3 – substitute numerical values into algebraic equations). • Carry out redox titrations, including associated titrations, of $C_2O_4^{2-}$ with MnO_4^- in acidic solution (eg finding the M_r of ethanedioic acid) (AO2 - Apply knowledge and understanding; AT d - Use laboratory apparatus for a variety of experimental techniques including titration, using burette and pipette; AT e - Use volumetric flask, including accurate technique for making up a standard solution; AT k; PS 2.3 - Evaluate results and draw conclusions with reference to measurement uncertainties and errors; MS2.3 – substitute numerical values into algebraic equations).	1 (QW10.5.01) • June 2006 Unit 5 Question 9 (QS06.5.09)		

	• Create a set of notes on how heterogeneous and homogeneous catalysts work, including the specific examples required: • V_2O_5 in the contact process. • Fe^{2+} ions in the reaction of I^- with $S_2O_8^{2-}$. • Mn^{2+} ions in the reaction of $C_2O_4^{2-}$ and MnO_4^- (AO1 - Demonstrate knowledge and understanding). • Students could investigate Mn^{2+} as the autocatalyst in the reaction between ethanedioic acid and acidified potassium manganate(VII) (AO2 - Apply knowledge and understanding).			

Year 13 A Level Chemistry Module 15: **Chromatography**				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
Describe the similarities and differences between thin-layer, column and gas chromatography. Explain how chromatography works. Use chromatography	• Produce a summary to compare similarities and differences between thin-layer, column and gas chromatography (AO1 - Demonstrate knowledge and understanding of scientific ideas). • Separate mixtures and identify substances (eg amino acids) by thin-layer chromatography (AO2 - Apply knowledge and understanding; AT i - Use thin-layer or paper chromatography). • Use retention time and R_f data to identify substances separated by chromatography.	• January 2011 Unit 4 Question 4f (QW11.4.04)	**AS level Chemistry** - 3.3.13 Amino acids, proteins and DNA	AQA Chromatography Teachers' Notes: http://filestore.aqa.org.uk/resources/chemistry/AQA-7405-TN-CHROMATOGRAPHY.PDF RCS video on TLC http://www.rsc.org/learn-chemistry/resource/res00001074/thin-layer-chromatography Modern Chemical Techniques RSC resource: http://www.rsc.org/learn-chemistry/resource/res00001301/chromatography

to separate and identify substances. **Required practical 12** Separation of species by thin-layer chromatography				*Chemistry Review* articles: How pure is your aspirin? (Volume 6, edition 3) What is chromatography? (Volume 8, edition 2) Antarctic atmospheric chemistry (Volume 13, edition 2) Drugs on money (Volume 13, edition 4) Thin-layer chromatography (Volume 14, edition 3) Body oddities: the chemical reactions of eating (Volume 21, edition 1) Body oddities: the chemical reactions of eating (Volume21, edition 4)

Year 13 A Level Chemistry Module 16: **Reactions of ions in aqueous solution**				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
The nature of meta-aqua ions. The relative acidity of metal-aqua ions. The reaction of metal-aqua ions (Fe^{2+}, Cu^{2+}, Al^{3+}, Fe^{3+}) with bases OH^-, NH_3, CO_3^{2-}. The character of metal hydroxides as basic or amphoteric. **Required practical 11** Carry out simple test-tube reactions to identify transition metal ions in aqueous solution.	• Students could measure the pH of solution of metal aqua ions (of equal concentration) and explain the difference in pH (AO2 - Apply knowledge and understanding; AT c,d,k). • Students could complete a series of test-tube reactions of iron(II) and iron(III) ions with reagents such as Mg, Na_2CO_3 to exemplify the difference in pH; AT d,k). • Students could carry out test-tube reactions of metal-aqua ions with NaOH, NH_3 and Na_2CO_3 (AO2 - Apply knowledge and understanding; AT d,k). • Students could identify unknown substances (containing cations and anions on the specification) using reagents (AO2 - Apply knowledge and understanding; AT d,k). • Students could produce precipitates of metal hydroxides and then test how they react with acid and alkali to determine whether they are basic or amphoteric (AO2 - Apply knowledge and understanding; AT d,k).	• January 2013 Unit 5 Question 8 (QW13.5.08) • Specimen Paper CHM5 Question 8 (QSP.5.08) • June 2004 Unit 5 Question 4 (QW04.5.04)	**AS Chemistry** - 3.1.7 – Oxidation, reduction and redox reactions (oxidation states, oxidation, reduction, redox equations). **A-level Chemistry** - 3.2.5 – Transition metals.	Complexes and First Row Transition Metals (Nicholls) ISBN 9780333170885 AQA Reactions of metal ions in aqueous solution resource: http://filestore.aqa.org.uk/resources/chemistry/AQA-7405-REACTIONS-OF-METAL-IONS.PDF

Year 13 A Level Chemistry Module				
What are we learning?	**What knowledge, understanding and skills will we gain?**	**Evaluation and assessment methods**	**Implementation**	**What additional resources are available?**
