Year 13 Chemistry Curriculum Summary

YEAR GROUP: 13 **SUBJECT: Chemistry**

When?	Knowledge	Understanding	Assessment
Thermodynamics	**Thermodynamics** **Be able to:** • **Construct Born-Haber cycles to calculate lattice enthalpies and other enthalpy changes, and compare lattice enthalpies from Born-Haber cycles with those from calculations based on a perfect ionic model to provide evidence for covalent character in ionic compounds.** • **Use enthalpy cycles to calculate enthalpies of solution for ionic compounds from lattice enthalpies and enthalpies of hydration.** • **Understand the concept of increasing disorder (entropy change ΔS) plus calculate entropy changes from absolute entropy values.**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **Thermodynamics** • Students perform calculations of an enthalpy change using Born-Haber cycles • Students could be asked to find ΔS for vaporization of water using a kettle. • Students rearrange the equation $\Delta G = \Delta H - T\Delta S$ to find unknown values. • Students determine ΔS and ΔH from a graph of ΔG versus T.	Thermodynamics Test

	• **Understand and use the relationship $\Delta G = \Delta H - T\Delta S$.**		
Rate equation **Equilibria 2**	**<u>PC9 Rate equation</u>** **Be able to:** • **Measure rate of reaction experimentally using different methods.** • **Determine the rate equation from given orders.** • **Perform calculations using the Arrhenius equation** **<u>Equilibria 2</u>** **Be able to:** • **construct an expression for Kc for a homogeneous system in equilibrium and perform more complex calculations involving Kc.** • **construct an expression for Kp for a homogeneous system in equilibrium and perform**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **<u>Rate equation</u>** • Students use given rate data and deduce a rate equation, then use some of the data to calculate the rate constant including units. Rate equations could be given and students asked to calculate rate constant or rate. • Students use a graph of concentration–time and calculate the rate constant of a zero-order reaction by determination of the gradient. • Students could determine the order of reaction for a reactant in the iodine clock reaction. • Students could be given data to plot and interpret in terms of order with respect to a reactant. Alternatively, students could just be given appropriate graphs and asked to derive order(s). • Students calculate the rate constant of a zero-order reaction by determining the gradient of a concentration–time graph. • Students plot concentration–time graphs from collected or supplied data and draw an appropriate best-fit curve. • Students draw tangents to such curves to deduce rates at different times. **<u>Equilibria 2</u>** • Students report calculations to an appropriate number of significant figures, given raw data quoted to varying numbers of significant figures. • Students calculate the partial pressures of reactants and	Rate equation Test Equilibria 2 Test

	calculations involving Kp. • **calculate an equilibrium constant experimentally** • **predict the qualitative effects of changes in temperature and pressure on the position of equilibrium and Kp.**	products at equilibrium. Students calculate the value of an equilibrium constant K p.	
isomerism, aldehydes e.t.c	**<u>isomerism, aldehydes e.t.c</u>** **Be able to:** • **Name and draw aldehydes and ketones.** • **outline the mechanism for nucleophilic addition reaction for the reduction of carbonyls and formation of hydroxynitriles.** • **Draw pairs of enantiomers and describe their effect on plane polarised light.**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **<u>isomerism, aldehydes e.t.c</u>** • Students could be asked to recognise the presence of a chiral centre in a given structure in 2D or 3D forms. They could also be asked to draw the 3D representation of chiral centres in various species. • Students understand the origin of optical isomerism. • Students could carry out test-tube reactions of Tollens' reagent and Fehling's solution to distinguish aldehydes and ketones.	Isomerism, aldehydes e.t.c Test Electrochemistry Test

Electrochemistry	**Electrochemistry** **Be able to:** • **state and use the rules to assign oxidation states of a variety of elements in a compound or ion** • **write half equations identifying oxidation and reduction and give overall redox equations** • **write and draw the conventional representation of cells and calculate the EMF of a cell also SHE.** • **use the EΘ values to predict the direction of redox reactions** • **Describe reactions in a lithium battery and fuel cells also use electrode data to deduce reaction in rechargeable and non-rechargeable cells.**	**Electrochemistry** • Students could make simple cells and use them to measure unknown electrode potentials. • 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|Zn2+||Cu2+|Cu • Students could use EΘ values to predict the direction of simple redox reactions, then test these predictions by simple test-tube reactions. • Students investigate how knowledge and understanding of electrochemical cells has evolved from the first voltaic battery.	
Carboxylic acids e.t.c	**Carboxylic acids e.t.c** **Be able to:** • **Draw and name**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification.	Carboxylic acids e.t.c Test

Acids and Bases	**carboxylic acids and give equations for the reactions of carboxylic acids.** • **Write equations for the formation and hydrolysis of esters.** • **Outline mechanisms for nucleophilic addition-elimination reactions.** • **Describe different organic techniques for synthesis, separation and analysis.** **Acids and bases** **Be able to:** • **define an acid and a base and identify conjugate acids and bases** • **explain the pH of pure water and calculate pH for strong and weak acids and strong bases.** • **construct an expression for Ka for a weak acid and calculate from an experiment** • **sketch and explain the shapes of typical pH curves and use to determine**	**Carboxylic acids e.t.c** • Students make esters by reacting alcohols with carboxylic acids, purifying the product using a separating funnel and by distillation • Students carry out the preparation of aspirin, purification by recrystallisation and determination of its melting point. • Students carry out the purification of impure benzoic acid and determination of its melting point. **Acids and bases** • Students carry out pH calculations. • Students could be given concentration values and asked to calculate pH or vice versa. • Students use an appropriate number of decimal places in pH calculations. • Students understand standard form when applied to areas such as (but not limited to) • Students use KW = [H+][OH–] to find the pH of strong bases. • Students carry out pKa calculations and give appropriate units. • Students understand standard form when applied to areas such as (but not limited to) Ka • Students could calculate Ka of a weak acid by measuring the pH at half neutralisation • Students could plot pH curves to show how pH changes during reactions. • Students make appropriate mathematical approximations in buffer calculations.	Acids and bases Test

	indicators • explain the actions of an acidic and basic buffer and calculate the pH of acidic buffers.		
Aromatics	**Aromatics** **Be able to:** • **Describe the structure and bonding in benzene, including the stability of the benzene ring.** • **Explain the substitution reactions of Benzene including mechanisms**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **Aromatics** • Students use thermochemical evidence from enthalpies of hydrogenation to account for this extra stability • Students explain why substitution reactions occur in preference to addition reactions. • Students outline mechanisms	Aromatics Test
Nitrogen Chemistry	**Nitrogen Chemistry** **Be able to:** • **Describe and outline the mechanism of the nucleophilic-addition elimination reactions and substitution.** • **Draw and name primary – quaternary salts.** • **Describe the repeating units of poylesters and polyamides and the intermolecular**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **Nitrogen Chemistry** • Students explain the difference in base strength in terms of the availability of the lone pair of electrons on the N atom. • Students describe and draw condensation polymers • Students outline mechanisms. • Students explain why polyesters and polyamides can be hydrolysed but polyalkenes cannot. • Students draw the structures of amino acids as zwitterions and the ions formed from amino acids • Students describe the different components that make up	Nitrogen Chemistry Test IC4 Period 3 Test

Period 3	**forces between them.** • **Name and draw amino acids as well as repeating units.** • **Describe DNA and draw repeating units and hydrogen bonds between DNA bases.** **<u>Period 3</u>** **Be able to:** • **describe the reactions of sodium and Magnesium with water** • **describe and explain the trends in reactions of the elements of sodium, magnesium aluminium, silicon, phosphorus and sulfur with oxygen** • **describe the trends in melting points of the oxides of the elements Na-S** • **describe the reactions of the oxides of the elements Na-S with water and the pH of the solutions formed**	proteins • Students explain why a stereospecific active site can only bond to one enantiomeric form of a substrate or drug. • Students explain how hydrogen bonding between base pairs leads to the two complementary strands of DNA **<u>Period 3</u>** • Students carry out reactions of elements with oxygen and test the pH of the resulting oxides. • Students explain the trend in the melting point of the oxides of the elements Na–S in terms of their structure and bonding • Students explain the trends in the reactions of the oxides with water in terms of the type of bonding present in each oxide • Students write equations for the reactions that occur between the oxides of the elements Na–S and given acids and bases.	

	and write equations for the reactions between oxides of the elements Na-S and acids and bases		
Organic Synthesis **Transition Metals**	**Organic Synthesis** **Be able to:** • **Be able to construct summary charts of organic reactions** • **Be able to determine more complex organic synthesis pathways** **Transition metals** **Be able to:** • **write the electronic configurations of d block atoms and ions** • **define complex ion and ligand plus** • **determine the coordination number, types of ligands and shapes of complex ions** • **identify the types of isomerism in octahedral and square complexes** • **explain colour and spectroscopy in complex ions** • **explain stability of complex ions** • **Investigate**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **Organic Synthesis** • Students explain why chemists aim to design processes that do not require a solvent and that use non-hazardous starting materials • Students explain why chemists aim to design production methods with fewer steps that have a high percentage atom economy • Students use reactions learnt throughout the course to devise a synthesis, with up to four steps, for an organic compound. **Transition metals** • Students carry out test-tube reactions of complexes with monodentate, bidentate and multidentate ligands to compare ease of substitution. • Students carry out test-tube reactions of solutions of metal aqua ions with ammonia or concentrated hydrochloric acid. • Students understand and draw the shape of complex ions. • Students draw cis–trans and optical isomers. • Students describe the types of stereoisomerism shown by molecules/ complexes. • Students determine the concentration of a solution from a graph of absorption versus concentration. • Students could carry out redox titrations. • Students could identify unknown substances using reagents.	Organic Synthesis Test Transition Metals Test

	complexes of copper and oxidation states of vanadium. • **perform calculations for titrations of redox reactions** • **explain catalysts in terms of transitions metals and compounds** • **describe and explain test tube reactions on M^{2+} and M^{3+} ions of hydroxide ions, ammonia and carbonate ions.**		
NMR and Chromatography	**<u>NMR and Chromatography</u>** **Be able to:** • **Analyse NMR chromatograms for C NMR and H NMR using integration, chemical shift values and splitting patterns where applicable.** • **Describe gas, column, and TLC chromatography.**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **<u>NMR and Chromatography</u>** • Students should be able to use data in the Chemistry Data Booklet to suggest possible structures for molecules. • Students calculate Rf values from a chromatogram • Students compare retention times and Rf values with standards to identify different substances.	NMR and Chromatography Test