OCR A Level Chemistry Y13

5.1 Rates, equilibrium and pH

5.1.1 How Fast?		R	A	G
5.1.1 How Fast?	Explain and use the terms: rate of reaction, order, overall order, rate constant, half-life, rate-determining step			
	Deduction of orders from experimental data			
	Deduction of a rate equation from orders of the form: rate = $k[A]^m[B]^n$			
	Calculate rate constant k, and related quantities, from a rate equation including determining units			
	Deduce the order with respect to a reactant from the shape of a concentration-time graph			
	Calculate the reaction rate from the gradient of a concentration-time graph			
	Find the constant half-life from a concentration-time graph of a first order reaction			
	Determine the rate constant, k, for a first order reaction from the constant half life			
	Deduce the order with respect to a reactant from a rate-concentration graph			
	Determine the rate constant for a first order reaction from the gradient of a rate-concentration graph			
	Describe techniques and procedures used to investigate reaction rates by the initial rates method, including calorimetry			
	Predict a rate equation consistent with the rate-determining step of a multi-step reaction			
	Predict possible steps in a reaction mechanism for the rate equation and the balanced equation for a multistep			
	Qualitative explaination of the affect of temperature change on the rate of a reaction and the rate constant			
	Use the Arrhenius equation to find the exponential relationship between the rate constant and temperature			
	Use the Arrhenius equation to determine E_a and A graphically			

5.1.2 How Far?		R	A	G
5.1.2 How Far?	Use the terms mole fraction and partial pressue			
	Calculate quantities at equilibrium			
	Describe techniques and procedures used to determine quantities present at equilibrium			
	Use expressions for Kc and Kp for homogeneous and heterogeneous equilibria			
	Calculate Kc and Kp including the determination of units			
	Describe the qualitative effect on equilibrium constants of changing temperature for exothermic and endothermic reactions			
	Describe the constancy of equilibrium constants with changes in concentration, pressure or the presence of a catalyst			
	Explanation of how an equilibrium constant controls the position of equilibium on changing concentration, pressure and temperature			
	Application of above principles for Kc, Kp to other equilibrium constants			

5.1.3 Acids, bases and buffers		R	A	G
5.1.3 Acids, bases and buffers	Define an BrØnsted- lowry acid and base in terms of protons			
	Use the term conjugate acid-base pairs			
	Use the terms monobasic, dibasic and tribasic			
	Describe the role of H^+ in the reaction of acids with metals and bases using ionic equations			
	Use the acid dissociation constant Ka for the extent of acid dissociation			
	Describe the relationship between Ka and pKa			
	Use the expressions for pH as: pH = -log[H+] ; [H+] = 10^{-pH}			
	Use of the expression for the ionic product of water Kw			
	Calculations of pH for: strong monobasic acids and stong bases (using Kw)			
	Calculations of pH, Ka or related quantities for a weak monobasic acis using approximations			
	Describe the limitations of using approximations to Ka related calculations for 'stronger' weak acids			
	Define the term buffer			
	Describe the formation of a buffer from a weak acid and salt of the weak acid			
	Describe the formation of a buffer from excess of weak acid and a strong alkali			
	Explanation of the role of a conjugate acid-base pair in an acid buffer solution			
	Calculation of the pH of a buffer solution from the Ka value of a weak acid and the equilibrium concentrations			
	Explanation of the control of blood pH by the carbonic acid- hydrogencarbonate buffer system			
	Use of pH titration curves for combinations of stong and weak acid			
	Describe the techniques and procedures used when measuring pH with a pH meter			

5.2 Energy

5.2.1 Lattice energy		R	A	G
5.2.1 Lattice energy	Explanation of the term lattice energy and its use as a measure of the strength of ionic bonding in a giant ionic lattice			
	Use of lattice enthalpy of a simple ionic solid and relevant energy terms for the construction of Born-Haber cycles			
	Use of lattice enthalpy of a simple ionic solid and relevant energy terms for related calculations			
	Explanation and use of the term enthalpy change of solution			
	Explanation and use of the term enthalpy change of hydration			
	Use of the enthalpy change of solution and energy terms for the construction of enthalpy cycles			
	Use of the enthalpy change of solution and energy terms for related calculations			
	Qualitative explanation of the effect of ionic charge and ionic radius on lattice enthalpy and enthalpy change of hydration			

5.2.2 Enthalpy and entropy		R	A	G
5.2.2 Enthalpy and entropy	Explanation of term entropy			
	Explantion of the difference in magnitude of the entropy system of solids, liquids and gases			
	Explantion of the difference in magnitude of the entropy system for a reaction with a change in number of gaseous molecules			
	Calculation of the entropy change of a system ΔS and related quantities			
	Explanation on the feasibility of a process based on $T\Delta S$ and ΔH			
	Explanation, and related calculations for free energy ΔG			
	Explantion of process feasibility in terms of ΔG			
	Limitations of predictions made by ΔG about feasibility in terms of kinetics			

5.2.3 Redox and electrode potentials		R	A	G
5.2.3 Redox and electrode potentials	Explanation and use of the terms oxidising agent and reducing agent			
	Construction of redox equations using half-equations and oxidation numbers			
	Interpretation and prediction of reactions involving electron transfer			
	Describe techniques and procedures used when carrying out redox titrations			
	Use of structured and non-structured titration calculations, based on experimental results of redox titrations			
	Use of the term standard electrode (redox) potential including its measurement			
	Describe techniques and procedures used for the measurement of cell potentials			
	Calculation of standard cell potential by combining two standard electrode potentials			
	Prediction of feasibility of a reaction and limitations using standard electrode potentials			
	Application of principles of electrode potentials to modern storage cells			
	Explanation of a fuel cell in terms of oxygen			

5.3 Transition elements

	5.3.1 Transition elements	R	A	G
5.3.1 Transition elements	Electron configuration of atoms and ions of the d-block elements of period 4, given atomic number and charge			
	Know the elements Ti- Cu as transition elements			
	Illustration using at least two transition elements of: the existence of more than 1 oxidation state			
	Illustration using at least two transition elements of: the formation of coloured ions			
	Illustration using at least two transition elements of: the catalystic behaviour of elements and compounds			
	Explanation of the term ligand in terms of coordinate bonding, including bidentate ligands			
	Use of terms complex ion and coordination number			
	Examples of complexes with six-fold coordination with an octohedral shape			
	Examples of complexes with four-fold coordination with either a planar or tetrahedral shape			
	Types of stereoisomerism shown by complexes including those associated with bidentate and multidentate ligands			
	Use of cis-platin as an anticancer drug and its action			
	Ligand substitution reactions and the accompanying colour changes			
	Explanation of the biochemical importance of iron in haemoglobin, including ligand substitutuion			
	Precipitaion reactions, including ionic equations and colour changes for transition element ions with sodium hydroxide and ammonia			
	Complex formation with sodium hydroxide(aq) and ammonia(aq)			
	Redox reactions and colour changes for interconversions between Fe^{2+} and Fe^{3+}			
	Redox reactions and colour changes for interconversions between Cr^{3+} and $Cr_2O_7^{2-}$			
	Redox reactions and colour changes for reduction of Cu^{2+} to Cu^{+} and disproportionation			
	Interpretation and prediction of unfamiliar reactions including ligand substitution, precipitation and redox			

	5.3.2 Qualitative analysis	R	A	G
5.3.2 Qualitative analysis	Qualitative analysis of ions on a test tube scale			

6.1 Aromatic compounds, carbonyls and acids

6.1.1 Aromatic compounds		R	A	G
6.1.1 Aromatic compounds	Comparison of the Kekulé model of benzene and the subsequent delocalised models			
	Experimental evidence for delocalised, rather than Kekulé model			
	Use of IUPAC rules of nomenclature for systematically naming substituted aromatic compounds			
	Understanding of electrophilic substitution of aromatic compounds with concentrated nitric acid			
	Understanding of electrophilic substitution of aromatic compounds with a halogen			
	Understanding of electrophilic substitution of aromatic compounds with a haloalkane or acyl chloride			
	Understanding of mechanism of electrophilic substitution in arenes for nitration and halogenation			
	Explanation of the relative resistance to bromination of benzene compared with alkenes			
	Interpretation of unfamiliar electrophilic substitution reactions of aromatic compounds			
	Understanding of the weak acidity of phenols			
	Understanding of the electrophilic substitution reactions of phenol with bromine and dilute nitic acid			
	Explanation of the relative ease of electrophilic substitution of phenol compared to benzene			
	Explantion of the 2- and 4-directing effect of electron donating groups in electrophilic substituion of aromatic compounds			
	Understanding of 3-directing effect of electron withdrawing groups in electrophilic substituion of aromatic compounds			
	Prediction of substitution products of aromatic compouinds			

6.1.2 Carbonyl compounds		R	A	G
6.1.2 Carbonyl compounds	Understand oxidation of aldehydes using $Cr_2O_7^{2-}/H^+$ to form carboxylic acids			
	Understand nucleophilic addition reactions of carbonyl compounds with $NaBH_4$ and HCN			
	Describe the mechanism of nucleophilic addition reactions of aldehydes and ketones with $NaBH_4$ and HCN			
	Describe the use of 2,4-dinitrophenolhydrazine to detect the presence of a carbonyl group			
	Describe the use of 2,4-dinitrophenolhydrazine to identify a carbonyl compound from the melting point of the derivative			
	Describe the use of Tollens' reagent to detect the presence of an aldehyde group			
	Describe the use of Tollens' reagent to distinguish between aldehydes and ketones, with explanation			

6.1.3 Carboxylic acids and esters		R	A	G
6.1.3 Carboxylic acids and esters	Explantion of the water solubility of carboxylic acids in terms of hydrogen bonding			
	Description of the reactions of carboxylic acids with metals and bases			
	Understanding of esterification of carboxylic acids with alcohols in the presence of an acid catalyst			
	Understanding of esterification of acid anhydrides with alcohols			
	Understanding of hydrolysis of esters in hot aqueous acid to form carboxylic acids and alcohols			
	Understanding of hydrolysis of esters in hot aqueous alkali to form carboxylate salts and alcohols			
	Understanding of the formation of acyl chlorides from carboxylic acids using $SOCl_2$			
	Use of acyl chlorides in synthesis in formation of esters, carboxylic acids and primary and secondary amides			

6.2 Nitrogen compounds, polymers and synthesis

	6.2.1 Amines	R	A	G
6.2.1 Amines	Explain basicity of amines in terms of protons and reactions with dilute acids			
	Understand the preparation of aliphatic amines by substitution of haloalkanes with excess ethanolic ammonia and amines			
	Understand the preparation of aromatic amines by reduction of nitroarenes using tin and concetrated hydrochloric acid			

	6.2.2 Amino acids, amides and chirality			
6.2.2 Amino acids, amides and chirality	State the general formula for an α-amino acids as $RCH(NH_2)COOH$			
	Understand the reactions of the carboxylic acid group with alkalis and in the formation of esters			
	Understand the reaction of the amine group with acids			
	Describe the structures of primary and secondary amides			
	Understanding of optical isomerism			
	Identification of chiral centres in a molecule of any organic compound			

	6.2.3 Polyesters and polyamides	R	A	G
6.2.3 Polyesters and polyamides	Understanding of condensation polymerisation to form polyesters and polyamides			
	Understanding of the acid and base hydrolysis of ester groups in polyesters and amide groups in polyamides			
	Prediction form addition and condensation reactions of: the repeat unit, monomer required, type of polymerisation			

	6.2.4 Carbon-carbon bond formation	R	A	G
6.2.4 Carbon-carbon bond formation	Describe the use of C-C bond formation in synthesis to increase the length of a carbon chain			
	Understand the formation of C-C=N by reaction of haloalkanes with CN^- and ethanol, including mechanism			
	Understand the formation of C-C=N by reaction of carbonyl compounds with HCN, including mechanism			
	Understand the reaction of nitriles by reduction and acid hydrolysis			
	Understand the formation of substituted aromatic C-C by alkylation and acylation (Friedel-Crafts reaction)			

	6.2.5 Organic synthesis	R	A	G
6.2.5 Organic synthesis	Describe techniques and procedures used for the preparation and purification of organic solids			
	Describe the synthetic routes for an organic molecule containing several functional groups			
	Describe the multistage synthetic routes for the preparation of organic compounds			

6.3 Analysis

6.3.1 Chromatography and qualitative analysis		R	A	G
6.3.1 Chromatography and qualitative analysis	Interpretation of one-way TLC chromatograms in terms of Rf values			
	Interpretation of gas chromatograms in terms of retention rates and the amounts and proportions of the components			
	Qualitative analysis of organic functional groups on a test tube scale: alkenes by bromine			
	Qualitative analysis of organic functional groups on a test tube scale: Halogenoalkanes by aqueous silver nitrate in ethanol			
	Qualitative analysis of organic functional groups on a test tube scale: Phenols by weak acidity but no reaction with CO_3^{2-}			
	Qualitative analysis of organic functional groups on a test tube scale: Carbonyl compounds by reaction with 2,4-DNP			
	Qualitative analysis of organic functional groups on a test tube scale: Aldehydes by reaction with Tollens' reagent			
	Qualitative analysis of organic functional groups on a test tube scale: Primary and secondary alcohols and aldehydes by reaction with acidified dichromate			
	Qualitative analysis of organic functional groups on a test tube scale: Carboxylic acids by reaction with CO_3^{2-}			

6.3.2 Spectroscopy		R	A	G
6.3.2 Spectroscopy	Analyse carbon-13 NMR spectrum of an organic molecule to make predictions			
	Analyse high resolution proton NMR spectrum of an organic molecule to make predictions			
	Predict the carbon-13 or proton NMR spectrum for a given molecule			
	Explain the use of tetramethylsilane, TMS, as the standard for chemical shift measurements			
	Explain the need for deuterated solvents when running an NMR spectrum			
	Identify O-H and N-H protons by proton exchange using D_2O			
	Deduce the structures of organic compounds from different analytical data			