OCR Chemistry A - Year 12

Module 1: Development of practical skills in chemistry

	1.1 Practical skills assessed in the written examination	R	A	G
1.1 Practical skills assessed in the written examination	Experimental design, including to solve problems set in a practcial context			
	Identification of variables that must be controlled, where appropriate			
	Evaluation that an experimental method is appropriate to meet the expected outcomes			
	How to use a wide range of practcial apparatus and techniques correctly			
	Appropriate units for measurements			
	Presenting observations and data in an appropriate format			
	Processing, analysing and interpreting qualitative and quantitative experimental results			
	Use of appropriate mathematical skills for analysis of quantitative data			
	Appropriate use of significant figures			
	Plotting and interpreting suitable graphs from experimental results including: selection and labelling of axes with appropriate scales, quantities and units			
	Plotting and interpreting suitable graphs from experimental results including: measurement of gradients and intercepts			
	Evaluate results and draw conclusions			
	Identify anomalies in experimental measurements			
	Identify the limitations in experimental procedures			
	Precision and accuracy of measurements and data (Margins of error, percentage error and apparatus uncertainties)			
	Refining experimental design by suggestion of improvements to the procedure and apparatus			

Module 2: Foundations in chemistry

	2.1 Atoms and reactions	R	A	G
2.1 Atoms and reactions	Define isotope			
	Describe atomic structure in terms of protons, electrons, neutrons for atoms and ions given the atomic number, mass number and ionic charge			
	Explain the terms relative isotopic and relative atomic mass, based on the mass of a ^{12}C atom			
	Use of mass spectrometry in: the determination of relative isotopic masss and relative abundances of its isotopes			
	Use of mass spectrometry in: calculation of the relative atomic mass from the relative abundances of its isotopes			
	Use of the terms relative molecular mass (Mr) and relative formula mass and their calculation from relative atomic masses			
	Write the formulae of ionic compounds from ionic charges including: prediciton of ionic charge from the position in the periodic table			
	Write the formulae of ionic compounds from ionic charges including: recall of the names and formulae for the following ions: NO_3^-, CO_3^{2-}, SO_4^{2-}, OH^-, NH_4^+, Zn^{2+} and Ag^+			
	Construction of balanced equations (including ionic), with state symbols, for familiar and unfamiliar reactions			
	Explanation and use of the terms: amount of substance, mole, Avogadro constant, molar mass, molar gas volume			
	Use of the terms empirical formula and molecular formula			
	Calculations of empirical and molecular formulae from composition by mass or percentage compositions by mass and relative formula mass			
	Understand the terms anhydrous, hydrated and water of crystallisation			
	Calculation of the formula of a hydrated salt from percentage composition, mass composition or experimental results			
	Mole calculations involving: mass, gas volume, solution concentration and volume			
	Calculations involving the idela gas equation: $pV = nRT$			
	Use of stoichiometric relationships in calculations			
	Calculations to determine the percentage yield of a reaction or related quantities			
	Calculations to determine the atom economy of a reaction			
	Knowledge of techniques and procedures required during experiments requiring the measurement of mass, volumes of solutions and gas volumes			
	Benefits for sustainability of developing chemical proceses with a high atom economy			
	Know the formulae of the common acids and alkalis			
	Explain acids release H^+ ions in aquenous solutions and alkalis release OH^- ions in aqueous solutions			
	Explain qualitatively strong and weak acids in terms of dissociation			
	Understand neutralisation in terms of ions to form water and salts			
	Techniques and procedures used when preparing a standard solution of required concentration and carrying out an acid-base titration			
	Structured and non-structured titration calculations, based on experimental results for familiar and unfamiliar acids and bases			
	Rules for assigning and calculating oxidation number for atoms in elements, compounds and ions			
	Write formulae using oxidation numbers			
	Use Roman numerals to indicate the magnitude of the oxidation number where applicable			
	Explain oxidation and reducation in terms of electron transfer and changes in oxidation number			
	Full equations (not ionic) for the redox reactions of metals with acids to form salts			
	Interpretation of redox reactions to make predictions in terms of oxidation numbers and eectron loss/ gain			

2.2 Electrons, bonding and structure		R	A	G
2.2 Electrons, bonding and structure	Know the number of electrons that can fill the first four shells			
	Define atom orbitals as: regions around the nucleus that can hold up to two electrons, with opposite spins			
	Know the shapes of s and p orbitals; the number of orbitals making up s, p and d sub-shells and the number of electrons that can fill these shells			
	Know how to fill these orbitals			
	Deduce the electron configuration of atoms given their atomic number (up to Z=36)			
	Deduce the electron configuration of ions given the atomic number and ionic charge; limited to s and p-blocks (up to Z=36)			
	Define ionic bonding and use dot and cross diagrams			
	Explain the solid structures of giant ionic lattices			
	Explain the effect of structure and bonding on the physical properties of ionic compounds (melting and boiling points, electrical conductivity)			
	Define covalent bonding			
	Construct dot and cross diagrams to describe: single, double and dative covalent bonding			
	Define and use the term average bond enthalpy			
	Know the shapes of and bond angles in molecules and ions up to six electron pairs surrounding the central atom			
	Use electron pair reulsion to explain these shapes of molecules and ions: linear, non-linear, trigonal planar, pyramidal, tetrahedral, octahedral			
	Define electronegativity			
	Explain polar bond and permanent dipole within molecules containing covalently- bonded atoms with different electronegativities			
	Explain a polar molecule and overall dipole in terms of permanent dipole(s) and molecular shape			
	Define intermeolecular forces based on dipoles			
	Define hydrogen bonding			
	Explain the anomalous properties of water resulting from hydrogen bonding (density, melting and boiling points)			
	Explanation of the solid structures of simple molecular lattices			
	Explanation of the structure and bonding on the physical properties of covalent compounds with simple molecular structures			

Module 3: Periodic table and energy

	3.1 The periodic table	R	A	G
3.1 The periodic table	Describe the periodic table in terms of: atomic number, periods, periodicity and groups			
	Describe the trend in electron configuration across periods 2 and 3			
	Describe the classification of elements into s, p and d-blocks			
	Define first ionisation energy			
	Explain the trend in first ionisation energies across Periods 2 and 3 and down a group (attraction, nuclear charge and atomic radius)			
	Predict from succesive ionisation energies, the number of electrons in each shell of an atom and the group of an element			
	Explain metallic bonding in terms of electrostatic attraction between cations and delocalised electrons			
	Explain giant lattice structures e.g metals			
	Explain the solid covalent lattices of carbon and silicon			
	Explain the physical properties of giant metalic and giant covalent lattices			
	Explain the variation in melting points across Periods 2 and 3			
	Describe the outer shell s^2 electron configuration and the loss of these electrons in redox reactions to form 2+ ions			
	Describe the relative reactivities of the Group 2 elements shown by their reactions with oxygen, water and dilute acids			
	Trend in reactivity in terms of the first and second ionisation energies of Group 2 elements down the group			
	The action of water on Group 2 oxides and the approximate pH of any resulting solution			
	Uses of Group 2 compounds as bases, including equations, e.g. $Ca(OH)_2$ in agriculture and $Mg(OH)_2$ and $CaCO_3$ as antacids			
	Explain the trend in boiling points of Cl_2, Br_2 and I_2 in terms of induced dipole-dipole interactions			
	The outer shell s^2p^5 electron configuration of halogens and the gaining of one electron in many redox reactions to form 1- ions			
	Trend in reactivity of the halogens, illustrated by the reaction with other halide ions			
	Explaination of this trend in terms of attraction, atomic radius and electron shielding			
	Explanation of the term disproportionation illustrated by: water purification, formation of bleach and reactions analogous to these			
	The benefits and associated risks of chlorine use in water treatment			
	The precipitation reactions, including ionic equations, of the aqueous anions Cl^-, Br^- and I^- with aqueous silver ions followed by aqueous ammonia			
	Qualitative analysis of ions on a test-tube scale, processes and techniques needed to identify the specified ions in an unknown compound			

	3.2 Physical chemistry	R	A	G
3.2 Physical chemistry	Explain some chemical reactions are accompanied by enthalpy changes that are exothermic or endothermic			
	Construct energy profile diagrams to show the difference in the enthalpy of reactants compare with products			
	Explain qualitatively the term activation energy including the use of enthapy profile diagrams			
	Explanation and use of the terms: standard conditions, standard states; enthalpy change of reaction, formation, combustion and neutralisation			
	Determination of enthalpy changes including the relationship: $q = mc\Delta T$			
	Explanation of the term average bond enthalpy			
	Explanation of exothermic and enothermic reactions in terms of enthalpy changes associated with making and breaking bonds			
	Use of average bond enthalpies to calculate enthalpy changes and related quantities			
	Use Hess' law to determine indirectly: an enthalpy change of reaction from entahlpy changes of combustion			
	Use Hess' law to determine indirectly: an enthalpy change of reaction from entahlpy changes of formation			
	Use Hess' law to determine indirectly: from unfamiliar enthalpy cycles			
	Techniques and procedures used to determine enthalpy changes directly and indirectly			
	The effect of concentration, including pressure of gases, on the rate of reaction			
	Calculation of reaction rate from the gradients of graphs measuring how a physical quantity changes with time			
	Explain the role of a catalyst (raection rate, not used up in overall reaction, activation energy)			
	Explain the terms homogeneous and heterogeneous catalysts			
	Explain the economic importance and benefits of catalysts			
	Techniques and procedures used to investigate reaction rates			
	Qualitative explanation of the Boltzmann distribution and its relationship with activation energy			
	Explanation of the impact of temperature changes on the Boltzmann distribution			
	Explanation of the impact of catalytic behaviour on the Boltzmann distribution			
	Explanation of dynamic equilibrium			
	Le Chatelier's principle to deduce qualitatively the effect of a change in temperature, pressure or concentration on the position of equilibrium			
	Explanation of how catalysts affect equilibrium			
	Techniques and procedures used to investigate changes to the position of equilibrium (temperature and pressure)			
	Explain the importance of compromise between chemical equilibrium and reaction rate			
	Calculations of the equilibrium constant Kc, from provided equilibrium concentrations and the creation of expressions for Kc			
	Estimation of the position of equilibrium from the magnitude of Kc			

Module 4: Core organic chemistry

	4.1 Basic concepts and hydrocarbons	R	A	G
4.1 Basic concepts and hydrocarbons	Apply IUPAC rules of nomenclature for systematically naming organic compounds			
	Interpret and use the terms: general formula, structural formula, displayed formula, skeletal formula			
	Interpret and use the terms: homologous series, functional group, alkyl group, aliphatic, alicyclic, aromatic, saturated			
	Use the general formula of a homologous series to predict the formula of any member of the series			
	Explain the term structural isomer and determine the possible structural formulae of an organic molecule, given the molecular formula			
	Understand the different types of covalent bond fission: homolytic, heterolytic			
	Understand the term radical and the use of dots			
	Understand the use of curly arrows			
	Use diagrams to show the movement of an electron pair in a reaction mechanism			
	Alkanes as saturated hydrocarbons conatining single C-C and C-H bonds with free rotation around s-bonds			
	Explain the tetrahedral shape around each carbon in alkanes in terms of electron pair repulsion (including 3-D diagrams)			
	Explain the variations in boiling points of alkanes (carbon chain length and branching) in terms of induced dipole-dipole interactions (London)			
	Low reactivity of alkanes in terms of high bond enthalpy and very low polarity of the s-bonds			
	Complete and incomplete combustion of alkane fuels			
	Reaction of alkanes with chlorine and bromine by radical substitution using UV radiation, including the mechanism (initiation, propogation and termination)			
	Limitations of radical substitution in synthesis			
	Alkenes as unsaturated hydrocarbons containing C=C bond with p-bond and s-bond and restricted rotation of the p-bond			
	Explain the trigonal planar shape and bond angle around each carbon in the C=C of alkenes in terms of electron pair repulsion			
	Explain the terms: sterioisomers, E/Z isomerism, cis-trans isomerism			
	Use of Cahn-Ingold-Prelog (CIP) priority rules to identify the E and Z stereoisomers			
	Determine the possible E/Z or cis-trans stereoisomer of an organic molecule, given its structural formula			
	Reactivity of alkenes in terms of the relatively low bond enthalpy of the p-bond			
	Addition reactions of alkenes with: hydrogen, halogens, hydrogen halides and steam			
	Use of bromine to detect the presence of a C+C bond as a test for unsaturation			
	Define and use the term electrophile			
	Mechanism of electrophilic addition in alkenes by heterolytic fission			
	Use of Markownikoff's rule to predict formation of a major organic product in addition reactions of H-X to unsymmetrical alkenes			
	Addition polymerisation of alkanes and substituted alkenes: deduce repeat unit of an addition polymer given the monomer			
	Identify the monomer that would produce a section of an addition polymer			
	Benefits for sustainability of processing waste by: combustion, organic feedstock, removal of toxic wste products			
	Benefits to the environment of development of biodegradable and photodegradable polymers			

	4.2 Alcohols, haloalkanes and analysis	R	A	G
4.2 Alcohols, haloalkanes and analysis	Explain the water solubility and relatively low volatility of alcohols compared to alkanes (polarity, hydrogen bonding)			
	Classification of alcohols into primary, secondary and tertiary alcohols			
	Combustion of alcohols			
	Oxidation of alcohols by an oxidising agent: primary (aldehydes and carboxylic acids); secondary (ketones); tertiary (resistance to oxidation)			
	Elimination of water from alcohols in the presence of an acid catalyst and heta to form alkenes			
	Substitution with halide ions in the presence of acid to form haloalkanes			
	Hydrolysis of haloalkanes in substitution reactions (alkali, water)			
	Define and use the term nucleophile			
	Mechanism of nucleophilic substitution in the hydrolysis of primary haloalkanes with aqueous alkali			
	Explain the trend in the rates of hydrolysis of primary haloalkanes in terms of the bond enthapies of carbon-halogen bonds			
	Production of halogen radicals by UV radiation action on CFCs in the upper atmosphere and the impact on the ozone layer			
	Equations to represent: production of halogen radicals; the catalysed breakdown of ozone by $Cl^{\cdot}$ and other radicals			
	Techniques and procedures for the use of quickfit apparatus for: distillation and heating under reflux			
	Techniques and procedures for the use of quickfit apparatus for: Preparation and purification of an organic liquid			
	Identify individual functional groups and predict the properties and reactions for an organic molecule containing several functional groups			
	Two-stage synthetic routes for preparing organic compounds			
	Infrared radiation causes covalent bons to vibrate more and absorb energy			
	Absorption of infrared radiation by atomspheric gases containing C=O, O-H and C-H bonds and the suspected link to global warming			
	Use of infrared spectrum to identify: alcohol (O-H); aldehyde or ketone (C=O); carboxylic acid (C=O and O-H)			
	Interpret and predict infra red spectrum of familiar or unfamiliar substances using data			
	Use of infrared spectroscopy to monitor gases causing air pollution and in modern breathalysers			
	Use of mass spectrum to identify the molecular ion peak and hence determine the molecular mass			
	Analyse fragmentation peaks in a mass spectrum to identify parts of structures			

Module 5: Physical chemistry and transition elements

5.1 Rates, equilibria and pH		R	A	G
5.1 Rates, equilibria and pH	Explain and use of the terms: rate of reaction, order, overall order, rate constant, halflife, rate-determining step			
	Deduction of: orders from experimental data; a rate equation from orders of the form: rate = k[A]m[B]n, where m and n are 0, 1 or 2			
	Calculate the rate constant, k, and related quantities, from a rate equation including determination of units			
	From a concentration–time graph: deduct the order (0 or 1) with respect to a reactant from the shape of the graph			
	Using a concentration–time graph: calculate reaction rates from the measurement of gradients			
	Using a concentration–time graph of a first order reaction, measurement of constant half-life, t1/2			
	Determine, for a first order reaction, the rate constant, k, from the constant half-life, $t_{1/2}$,using the relationship: $k = \ln 2/t_{1/2}$			
	Using a rate–concentration graph: deduct the order (0, 1 or 2) with respect to a reactant from the shape of the graph			
	Using a rate–concentration graph: determine the rate constant for a first			
	order reaction from the gradient			
	techniques and procedures used to investigate reaction rates by the initial rates method and by continuous monitoring, including use of colorimetry			
	Predict, for a multi-step reaction, a rate equation that is consistent with the rate-determining step			
	Predict, for a multi-step reaction, possible steps in a reaction mechanism from the rate equation and the balanced equation for the overall reaction			
	Explain qualitatively, the effect of temperature change on the rate of a reaction and hence the rate constant			
	Exponential relationship between the rate constant, k and temperature, T given by the Arrhenius equation, $k = Ae^{-Ea/RT}$			
	Determine Ea and A graphically using: ln k = –Ea/RT + ln A derived from the Arrhenius equation.			
	Use of the terms mole fraction and partial pressure			
	Calculate quantities present at equilibrium, given appropriate data			
	Techniques and procedures used to determine quantities present at equilibrium			
	Expressions for Kc and Kp for homogeneous and heterogeneous equilibria			
	Calculate Kc and Kp, or related quantities, including determination of units			
	Qualitative effect on equilibrium constants of changing temperature for exothermic and endothermic reactions			
	Constancy of equilibrium constants with changes in concentration, pressure or in the presence of a catalyst			
	explain how an equilibrium constant controls the position of equilibrium on changing concentration, pressure and temperature			
	Application of these principles for Kc, Kp to other equilibrium constants			
	Define a Brønsted–Lowry acid			
	Use of the terms: conjugate acid-base pairs, monobasic, dibasic and tribasic acids			
	Role of H+ in the reactions of acids with metals and bases (including carbonates, metal oxides and alkalis), using ionic equations			
	Acid dissociation constant, Ka, for the extent of acid dissociation and the relationship between Ka and pKa			
	Use the expression for pH as: pH = –log[H+] $[H+] = 10^{-pH}$; and the expression for the ionic product of water, Kw			
	Calculateof pH, or related quantities, for: strong monobasic acids; strong bases, using Kw			
	Calculate pH, Ka or related quantities, for a weak monobasic acid using approximations			
	Limitations of using approximations to Ka related calculations for 'stronger' weak acids			
	Define the term buffer solution			
	Formation of a buffer solution from: a weak acid and a salt of the weak acid; excess of a weak acid and a strong alkali			
	Explain the role of the conjugate acid–base pair in an acid buffer solution			
	Calculate the pH of a buffer solution, from the Ka value of a weak acid and the equilibrium concentrations of the conjugate acid–base pair			
	Explain the control of blood pH by the carbonic acid–hydrogencarbonate buffer system			
	Sketch and interpret the shapes of pH titration curves for combinations of strong and weak acids with strong and weak bases			
	Explain the choice of suitable indicators, given the pH range of the indicator			
	Explain indicator colour changes in terms of equilibrium shift between the HA and A^- forms of the indicator			
	Techniques and procedures used when measuring pH with a pH meter.			

	5.2 Energy	R	A	G
5.2 Energy	Explain the term lattice enthalpy			
	Use the lattice enthalpy of a simple ionic solid and relevant energy terms for: the construction of Born–Haber cycles and related calculations			
	Explain and use the terms enthalpy change of solution and enthalpy change of hydration			
	Use the enthalpy change of solution of a simple ionic solid and relevant energy terms for: the construction of enthalpy cycles and related calculations			
	Explain qualitatively the effect of ionic charge and ionic radius on the exothermic value of a lattice enthalpy and enthalpy change of hydration.			
	Explain entropy is a measure of the dispersal of energy in a system which is greater, the more disordered a system			
	Explain the difference in magnitude of the entropy of a system: of solids, liquids and gases			
	Explain the difference in magnitude of the entropy of a system for a reaction in which there is a change in the number of gaseous molecules			
	Calculate the entropy change of a system, ΔS, and related quantities for a reaction given the entropies of the reactants and products			
	Explain the feasibility of a process depends upon $T\Delta S$, and ΔH			
	Explain, and calculate, the free energy change, ΔG, as: $\Delta G = \Delta H - T\Delta S$; and that a process is feasible when ΔG has a negative value			
	Limitations of predictions made by ΔG about feasibility, in terms of kinetics.			
	Explain and use the terms oxidising agent and reducing agent			
	Construct redox equations using half equations and oxidation numbers			
	Interpret and predict reactions involving electron transfer			
	Techniques and procedures used when carrying out redox titrations			
	Structured and non-structured titration calculations, based on experimental results of redox titrations			
	Use the term standard electrode (redox) potential, E^θ including its measurement using a hydrogen electrode			
	Techniques and procedures used for the measurement of cell potentials			
	Calculate a standard cell potential by combining two standard electrode potentials			
	Predict the feasibility of a reaction using standard cell potentials and the limitations of such predictions			
	Apply principles of electrode potentials to modern storage cells			
	Explain how fuel cells create voltage and the changes that take place at each electrode			

	5.3 Transition elements	R	A	G
5.3 Transition elements	Electron configuration of atoms and ions of the d-block elements of Period 4 (Sc–Zn), given the atomic number and charge			
	Elements Ti–Cu d-block elements that have an ion with an incomplete d-sub-shell (Transition elements)			
	Use at least two transition to demonstrate: the existence of more than one oxidation state for each element in its compounds			
	Use at least two transition to demonstrate: the formation of coloured ions			
	Use at least two transition to demonstrate: the catalytic behaviour of the elements and their compounds and their industrial importance			
	Explain and use the term ligand			
	Use the terms complex ion and coordination number and examples of complexes with: octahedral shape and either a planar or tetrahedral shape			
	Types of stereoisomerism shown by complexes: cis–trans isomerism; optical isomerism			
	Use of cis-platin as an anti-cancer drug and its action by binding to DNA preventing cell division			
	Ligand substitution reactions and the accompanying colour changes			
	Explain the biochemical importance of iron in haemoglobin, including ligand substitution involving O_2 and CO			
	Reactions, including ionic equations, of transition ions with aqueous sodium hydroxide and aqueous ammonia			
	Redox reactions and accompanying colour changes for: interconversions between Fe^{2+} and Fe^{3+}			
	Redox reactions and accompanying colour changes for: interconversions between Cr^{3+} and $Cr_2O_7^{2-}$			
	Redox reactions and accompanying colour changes for: reduction of Cu^{2+} to Cu^+ and disproportionation of Cu^+ to Cu^{2+} and Cu			
	Interpret and predict unfamiliar reactions including ligand substitution, precipitation, redox.			
	Qualitative analysis of ions on a test-tube scale: processes and techniques needed to identify the following ions in an unknown compound			

Module 6: Organic chemistry and analysis

	6.1 Aromatic compounds, carbonyls and acids	R	A	G
6.1 Aromatic compounds, carbonyls and acids	Compare the Kekulé model of benzene with the subsequent delocalised models for benzene; including an examination of the experimental evidence			
	Use IUPAC rules of nomenclature for systematically naming substituted aromatic compounds			
	Electrophilic substitution of aromatic compounds with: concentrated nitric acid in the presence of concentrated sulfuric acid			
	Electrophilic substitution of aromatic compounds with: a halogen in the presence of a halogen carrier			
	Electrophilic substitution of aromatic compounds with: a haloalkane or acyl chloride in the presence of a halogen carrier			
	Mechanism of electrophilic substitution in arenes for nitration and halogenation			
	Explain the relative resistance to bromination of benzene, compared with alkenes			
	Interpret unfamiliar electrophilic substitution reactions of aromatic compounds, including prediction of mechanisms			
	Weak acidity of phenols shown by the neutralisation reaction with NaOH but absence of reaction with carbonates			
	Electrophilic substitution reactions of phenol: with bromine to form 2,4,6-tribromophenol; with dilute nitric acid to form 2-nitrophenol			
	Compare the relative ease of electrophilic substitution of phenol with benzene			
	The effect of electrondonating groups and of electron-withdrawing groups in electrophilic substitution of aromatic compounds			
	Predict substitution products of aromatic compounds by directing effects and the importance to organic synthesis			
	Oxidation of aldehydes to form carboxylic acids			
	Nucleophilic addition reactions of carbonyl compounds to form alcohols and hydroxynitriles			
	Mechanism for nucleophilic addition reactions of aldehydes and ketones $NaBH_4$ and HCN			
	Uses of 2,4-dinitrophenylhydrazine when identifying carbonyl groups or compounds			
	Use of Tollens' reagent to: detect the presence of an aldehyde group; distinguish between aldehydes and ketones			
	Explain how Tollens' reagent distinguishes between aldehydes and ketones			
	Explain the water solubility of carboxylic acids in terms of hydrogen bonding			
	Reactions in aqueous conditions of carboxylic acids with metals and bases			
	Esterification of: carboxylic acids with alcohols in the presence of an acid catalyst; acid anhydrides with alcohols			
	Hydrolysis of esters: to form carboxylic acids and alcohols; to form carboxylate salts and alcohols			
	Formation of acyl chlorides from carboxylic acids			
	Use of acyl chlorides in synthesis in formation of esters, carboxylic acids and primary and secondary amides			

	6.2 Amines	R	A	G
6.2 Amines	Basicity of amines in terms of proton acceptance by the nitrogen lone pair and the reactions of amines with dilute acids to form salts			
	Preparation of: aliphatic amines by substitution of haloalkanes			
	Preparation of: aromatic amines by reduction of nitroarenes			
	General formula for an α-amino acid as RCH(NH2)COOH			
	Reactions of amino acids: carboxylic acid group with alkalis and in the formation of esters; amine group with acids			
	Structures of primary and secondary amides			
	Define optical isomerism and use it to draw 3-D diagrams			
	Identify chiral centres in a molecule of any organic compound			
	Condensation polymerisation to form polyesters and polyamides			
	Acid and base hydrolysis of: the ester groups in polyesters; the amide groups in polyamides			
	Predict from addition and condensation polymerisation: the repeat unit from a given monomer(s)			
	Predict from addition and condensation polymerisation: the monomer(s) required for a given section of a polymer molecule			
	Predict from addition and condensation polymerisation: the type of polymerisation.			
	Use of C–C bond formation in synthesis to increase the length of a carbon chain			
	Formation of C–C≡N by reaction of: haloalkanes with CN– and ethanol, including nucleophilic substitution mechanism			
	Formation of C–C≡N by reaction of: carbonyl compounds with HCN, including nucleophilic addition mechanism			
	Reaction of nitriles: by reduction to form amines; by acid hydrolysis to form carboxylic acids			
	Formation of a substituted aromatic C–C by alkylation and acylation			
	Techniques and procedures used for the preparation and purification of organic solids involving use of a range of techniques			
	Identify the functional groups and predict the properties and reactions for an organic molecule containing several functional groups			
	Multi-stage synthetic routes for preparing organic compounds.			

6.3 Analysis		R	A	G
6.3 Analysis	Interpret one-way TLC chromatograms in terms of Rf values			
	Interpret gas chromatograms in terms of: retention times; the amounts and proportions of the components in a mixture.			
	Qualitative analysis of organic functional groups on a test-tube scale to identify the functional groups in an unknown compound			
	Analyse a carbon-13 NMR spectrum of an organic molecule to make predictions about: the number of carbon environments in the molecule			
	Analyse a carbon-13 NMR spectrum of an organic molecule to make predictions about: the different types of carbon environment present			
	Analyse a carbon-13 NMR spectrum of an organic molecule to make predictions about: possible structures for the molecule			
	Analyse a high resolution proton NMR spectrum to make predictions about: the number and type of proton environments in the molecule			
	Analyse a high resolution proton NMR spectrum to make predictions about: relative numbers of each type of proton present			
	Analyse a high resolution proton NMR spectrum to make predictions about: the number of non-equivalent protons adjacent to a given proton			
	Analyse a high resolution proton NMR spectrum to make predictions about: possible structures for the molecule			
	Predict a carbon-13 or proton NMR spectrum for a given molecule			
	Use of tetramethylsilane, TMS, as the standard for chemical shift measurements			
	The need for deuterated solvents when running an NMR spectrum			
	The identification of O–H and N–H protons by proton exchange			
	Deduce the structures of organic compounds from different analytical data			