Long Term Plan: Chemistry

Year 1	Knowledge and Skills	Vocabulary, Reading and Numeracy	Checking of understanding	Rationale
Autumn Term	**GCSE Bridging Week:** Recapping key skills from GCSE that are essential to access the exam course **Atomic Structure:** Writing electronic configuration of atoms & ions, explaining trends in ionisation and explaining how a TOF MS works. Key Skills: Numeracy and using key words in explanations **Amount of Substance:** Developing students understanding of the mole from GCSE of the mole and using in a variety of calculations such as empirical formula, ideal gas equation, % yield, making a standard solution, titrations (inc. back titrations) and use of Avogadro's constant. Key skills: Numeracy and precise working in practical experiments, managing uncertainty and using volumetric glassware **Introduction to Organic Chemistry, alkanes & alkenes:** Functional groups, IUPAC naming, different formulas (structural, displayed & skeletal), structural isomers, E&Z stereoisomers, CIP priority, environmental chemistry, cracking,	**Key words**: Ions, moles, sub-atomic particles, isotope, ionisation, sub-shells, quantum number, electron spin, empirical formula, standard solution, concordant, burette, pipette, volumetric flask, uncertainty, aliphatic, aromatic, isomerism, electrophile, nucleophile, carbocation groups, mechanism, electron density, polarity, combustion, desulphurisation, enthalpy, activation energy, **Reading:** Relevant chapters of course textbook and at least 2 articles published on teams to show how chemistry relates to the wider world (chemistry in the news: nanoscale to macroscale)	**In class:** Regular Q&A sessions, white board work, level of independence in tasks, engagement, success in tasks and the ability to ask probing questions to develop understanding. (note: the most able students ask the most questions in class but their questions are challenging) **Homework's:** Regular HW setting including monthly triple R booklets (Repeat, revisit, recall) containing past paper questions over previously learnt content. **Assessments:** Typically, 4 a term containing past paper questions on recently learnt content and one 'look back in anger' question from an older topic. On average there will be 2 CPACs	The Autumns term starts recapping some GCSE content to ensure students have the basic skills to succeed and give an early idea of ability. After this we complete the atomic structure & amount of substance topics. Both of these link well to prior knowledge from GCSE, so that students can gain confidence. They also develop key skills that interleave across all chemistry topics. Both topics also contain some challenging maths that can give an early indication on which students may need more support in numeracy. As the previous topics incorporate a lot of numeracy skills, we next compete a significant organic topic as it requires completely different skills enabling a wider range of students to succeed. The skills introduced in this topic will be reviewed at the start of every organic topic across Yr12 & Yr13. The final topic in Yr13 is the energetics topic. This again links well to GCSE but helps develop logical thought processes. Hess's Law also

	addition polymers & electrophilic addition. Key skills: Drawing skeletal formula, naming compounds, logical thinking, using molymods, organic mechanisms. **Energetics:** Enthalpy changes, Hess's Law, calorimetry practical, mean bond energies. Key skills: Numeracy, logical thinking, accuracy, controlling heat loss in practical, understanding key terms in definitions, deducing chemical equations.	**Numeracy:** Using algebra, converting units, ratios, using standard form and sketching energy level diagrams	(required practical's) a term. Each CPAC will target a different range of skills including: following written instructions, risk assessing, using scientific equipment, selecting appropriate equipment, recording data accurately, using appropriate units, significant figures, drawing graphs, processing data and researching information.	gives opportunity for significant challenge for the most able students

Spring Term	**Bonding:** Recap of GCSE explanations of the 3 main types of bonding, crystal lattices, electronegativity and shapes of molecules. Key skills: Using key words in explanations, thinking in 3D, drawing in 3D and logic skills **Kinetics & Equilibrium:** Recap collision theory from GCSE, the Boltzmann Distribution, measuring rate experimentally, Le Chatelier's Principle, the equilibrium constant Kc. Key skills: Using graphs, practical skills, managing uncertainty, numeracy, logical thinking. **Halogenoalkanes, Alcohols & Organic Analysis:** Physical & chemical properties of halogenoalkanes & alcohols, free radical substitution, nucleophilic substitution, base & acid catalysed elimination, oxidation of alcohols, reflux/distillation practical, IR spectroscopy. Key skills: Drawing skeletal formula, naming compounds, logical thinking, using molymods, organic mechanisms, thinking in 3D, practical	**Key words**: Cations, anions, electrostatic attraction, crystal lattice, dative covalent, delocalised, trigonal planar, tetrahedral, trigonal pyramidal, trigonal bipyramidal, octahedral, lone pair, bonding pair, repulsion, electronegativity, polar, induced, Van der Waals', H bonding, activation energy, catalyst, dynamic equilibrium, compromise, homogeneous, reduction, oxidation, agents, solubility, precipitation, disproportionation, free radicals, electronegativity, photochemical dissociation, chain-reaction, nucleophile, acid catalyst, base, cyanide, concurrent, reflux, distillation, carbonyl, aldehyde, ketone, carboxylic	**In class:** Regular Q&A sessions, white board work, level of independence in tasks, engagement, success in tasks and the ability to ask probing questions to develop understanding. (note: the most able students ask the most questions in class but their questions are challenging) **Homework's:** Regular HW setting including monthly triple R booklets (Repeat, revisit, recall) containing past paper questions over previously learnt content. **Assessments:** Typically, 4 a term containing past paper questions on recently learnt content and one 'look back in anger' question from an older topic. On average there will be 2 CPACs (required practical's) a term. Each CPAC will	Before continuing with the more complex organic functional groups, it is important that students understand intermolecular forces from the bonding topic in order to discuss physical properties. It is important to review students terminology from GCSE as often non-specialist teachers give the students non mark scheme based key words. This needs to be clear before starting any inorganic chemistry Next comes equilibrium which is a vitally important topic for the success of Year 13. It is important that this topic is done thoroughly so there are no misconceptions hence this topic may be extended depending on the needs of the students. Ensure the strands of chemistry are blended, the final topic of the term is a large organic topic. This gives a chance to revisit some core organic skills after a suitable gap. This is 3 topics merged together as there is a lot of linked content and it is recommended that students study a lot of the organic content together due to the synoptic nature of the organic chemistry.

	skills, drawing scientific diagrams, using quick fit apparatus.	acid, fermentation, carbon-neutral, spectroscopy. **Reading:** Relevant chapters of course textbook and at least 2 articles published on teams to show how chemistry relates to the wider world (chemistry in the news: nanoscale to macroscale) **Numeracy:** Using algebra, deducing units, ratios, using standard form and interpreting graphs	target a different range of skills including: following written instructions, risk assessing, using scientific equipment, selecting appropriate equipment, recording data accurately, using appropriate units, significant figures, drawing graphs, processing data and researching information.	
Summer Term	**Redox:** Oxidation states, half equations and redox reactions. Key skills: Practical skills, using charts, logic, using charge,. **Inorganic Chemistry 1:** Trends in: atomic radii, ionisation energy and melting point across a period and group 2. The reactions of group 2 and 7 elements, destruction of the ozone layer, tests for cations & anions.	**Key words**: Reduction, oxidation, agents, solubility, precipitation, disproportionation, free radical, catalyst, ozone. **Reading:** Relevant chapters of course textbook and at least 2 articles published on teams to show how chemistry relates to the wider world	**In class:** Regular Q&A sessions, white board work, level of independence in tasks, engagement, success in tasks and the ability to ask probing questions to develop understanding. (note: the most able students ask the most questions in class but their questions are challenging)	Before covering Inorganic it is vital to complete the redox topic. Although the content is minimal in this topic, the redox skills are important and often students need to go through redox several times and don't feel secure in their knowledge until Yr13. As the next topic is inorganic, these skills can be practice regularly over a period of weeks. The final topic in Year 12 is an inorganic topic. The reason for this is that inorganic is predominantly

	Key skills: Practical skills, recalling information, deducing chemical equations, logic, using charge and using fume cupboards. **Revision for end of summer Year 12 assessment:** Depending on time and the needs of the student some targeted revision lessons will consolidate understanding and develop exam skills.	(chemistry in the news: nanoscale to macroscale) **Numeracy:** Interpreting and explaining graphs	**Homework's:** Regular HW setting including monthly triple R booklets (Repeat, revisit, recall) containing past paper questions over previously learnt content. **Assessments:** This term will include at least one end of Yr12 summer assessment. This will be a full AS exam paper (normally physical and organic) with the accurate grade boundary applied. Depending on the needs of the students a 2nd paper (physical and inorganic) may be completed before or after summer. On average there will be 2 CPACs (required practical's) a term. Each CPAC will target a different range of skills including: following written instructions, risk assessing, using scientific equipment, selecting appropriate	recall and although retrieval practice is vital to success there are less new skills. New skills require practice with teacher support, whereas retrieval of recall can be done more independently and quizlet flash cards are available and regular whiteboard/internet quizzes are included to check progress and reemphasise the importance of using retrieval practices. Note: It is the intention to complete a topic from year 13. However this needs to be flexibale as timings change depending on the needs of the students. If there are a few weeks spare the thermodynamics topic will be covered, if time is limited the optical isomers topic will be covered as this is a topic that can review valuable organic skills.

			equipment, recording data accurately, using appropriate units, significant figures, drawing graphs, processing data and researching information.	

Long Term Plan: Chemistry

Year 2	Knowledge and Skills	Vocabulary, Reading and Numeracy	Checking of understanding	Rationale
Autumn Term	**Thermodynamics:** Recap of Hess's law from Yr12, thermodynamic definitions, Born-Haber cycles, perfect ionic models, enthalpy of solution, entropy & Gibbs free energy. Key Skills: Numeracy, using definitions, deducing chemical equations **Carbonyl Compounds:** Recap of oxidation of an alcohol, optical isomers, aldehydes, ketones, carboxylic acids derivatives and making and purifying organic liquids and solids. Key skills: Drawing skeletal formula, naming compounds, logical thinking, using molymods, organic mechanisms, thinking in 3D, practical skills, using quick fit apparatus, drawing scientific diagrams and using Buchner funnels (filtration under reduced pressure) **Aromatic Chemistry:** Evidence for the delocalised benzene ring, nucleophilic substitution Key skills: Drawing skeletal formula, naming compounds, logical thinking, using molymods, organic mechanisms.	**Key words**: Enthalpy, lattice dissociation, atomisation, ionisation, electron affinity, degree of covalency, hydration, entropy, feasibility, disorder, spontaneity, optical isomers, chiral carbons, enantiomers, plane polarised light, racemic mixture, nucleophilic attack, substitution reactions, addition-eliminations, carboxyl, acid anhydride, acyl chloride, esterification, triglycerides, fatty acids, trans-esterification, saponification, aromatic, aliphatic, hydrogenation, sigma bonds, pi bonds, delocalisation, electrophile, acylation, nitronium ion, diprotic acids, dissociation, equivalence point, buffer, quenching,	**In class:** Regular Q&A sessions, white board work, level of independence in tasks, engagement, success in tasks and the ability to ask probing questions to develop understanding. (note: the most able students ask the most questions in class but their questions are challenging) **Homework's:** Regular HW setting including monthly triple R booklets (Repeat, revisit, recall) containing past paper questions over previously learnt content. **Assessments:** Typically, 4 a term containing past paper questions on recently learnt content and one 'look back in anger' question from an older topic. On	**Note:** This is an incredibly topic heavy term, which should overlap with the previous and future terms depending on the needs of the students. The topics chosen this term link well to the Yr12 topics and contain more skills than content that require practice to master, hence it is important to complete in the first Yr13 term. Thermodynamics continues from the Yr12 energetics course hence it is an opportunity to consolidate prior learning. Relating the Gibbs free energy to linear graphs to calculate entropy from the gradient is always an area of difficulty. Later in the term in the rates topic the skill is repeated with the more complicated Arrhenius equation. Repeating this skills after a suitable gap on a more complex example should increase fluency. The Carbonyl compounds topic is in essence 3 topics in one that relate closely. It is better to teach these together as this is how they will be assessed in exams and it improves efficiency. There are a lot of organic skills first introduced in Yr12 in this topic hence it is a good

	Acids & Bases: Recap GCSE content, Bronsted-Lowry acids, pH, weak acids, Ka, Kw buffers, titration curves practical, indicators Key skills: Numeracy, using logic, practical skills, graph plotting **Rate Equations:** Recap Yr12 kinetics, the rate constant, order of reaction, rate determining step, the initial rates method, the continuous method, the Arrhenius equation Key skills: Numeracy, using logic, interpreting tables of data, practical skills, graph plotting **Equilibrium Constant of Homogeneous Gaseous Systems (Kp):** Recap of Kc from Yr12, partial pressures and Kp Key skills: Numeracy and using logic	mole fraction, partial pressure **Reading:** Relevant chapters of course textbook and at least 2 articles published on teams to show how chemistry relates to the wider world (chemistry in the news: nanoscale to macroscale) **Numeracy:** Algebra, graphs, linking linear equations to formula, using logarithms (natural & to the base 10), deducing units	average there will be 2 CPACs (required practical's) a term. Each CPAC will target a different range of skills including: following written instructions, risk assessing, using scientific equipment, selecting appropriate equipment, recording data accurately, using appropriate units, significant figures, drawing graphs, processing data and researching information.	opportunity to revisit these and boost fluency. The carbonyls topic also links well to amino acids & polymers taught in the Spring Term hence there is an opportunity later in the year to revisit. Aromatic chemistry is discrete topic hence can be taught at anytime providing it is before polymers. Hence this topic may be moved depending on timing. Rate equations & Kp also link well to Yr12 topics. All exams contain a large equilibrium topic hence it is a good idea to teach before the Yr13 mock exam so it can be included in the paper. The Arrhenius equation is probably the most difficult in terms of numeracy ,hence it is left till later in the term in order that numeracy skills have time to be developed
Spring Term	**Electrode Potentials and Cells:** Redox equilibria, electrochemical cells, feasibility of redox reactions and commercial cells. Key Skills: Numeracy, practical skills, drawing scientific apparatus and using key words in explanations.	**Key words**: resistance, electromotive force, cell conventions/notations, feasibility, anode, cathode, fuel cells, lone pair, quaternary ammonium salt, nucleophile, polyesters,	**In class:** Regular Q&A sessions, white board work, level of independence in tasks, engagement, success in tasks and the ability to ask probing questions to develop understanding.	In order to have quality revision time it is the intention to complete the course in this term. The electrode potential and cells topic will revisit redox chemistry from Yr12 and develop a much deeper understanding. Although this topic links to the electrolysis and metal reactivity topics in

	Amines, Proteins, Polymers & DNA: Base strength of amines, nucleophilic substitution, nucleophilic addition-elimination, condensation polymers, amino acids, protein structure, DNA, anti-cancer drugs Key skills: Drawing skeletal formula, naming compounds, logical thinking, using molymods, organic mechanisms **Inorganic Chemistry 2:** Period 3 oxides, transition metals, vanadium chemistry, coloured ions, redox titrations and catalysts. Key skills: Drawing in 3D, practical skills, using key words in explanations, recalling colours and chemical equations. **Organic Synthesis and NMR:** Organic synthesis, ^{1}H NMR, ^{13}C NMR and chromatography. Key skills: Interpreting data, thinking logically and using key words in explanations.	polyamides, hydrolysis, biodegradability, zwitterion, a-helix, β-pleated sheet, stereospecific active site, nucleotide, cisplatin, amphoteric oxide, mono-, bi- and polydentate ligands, chelate effect, entropy, enthalpy, cis/trans isomerisation, wavelength, frequency, complimentary colour, absorbance, emission, excited, oxidation state, homogenous, heterogeneous, autocatalysis, adsorb, resonance, spectroscopy, multiplets, mobile phase, stationary phrase, retention factor. **Reading:** Relevant chapters of course textbook and at least 2 articles published on teams to show how chemistry relates to the wider world (chemistry in the news:	(note: the most able students ask the most questions in class but their questions are challenging) **Homework's:** Regular HW setting including monthly triple R booklets (Repeat, revisit, recall) containing past paper questions over previously learnt content. **Assessments:** This term is dominated by a large mock exam with potentially extra end of topic assessments. On average there will be 2 CPACs (required practical's) a term. Each CPAC will target a different range of skills including: following written instructions, risk assessing, using scientific equipment, selecting appropriate equipment, recording data accurately, using appropriate units, significant figures,	GCSE, the focus is more on redox. Therefor the challenge is ensuring students change their terminology which would have been acceptable in GCSE. For this reason GCSE recap is avoided. The amines, proteins & DNA links well to the carbonyl topic. It could all be taught together however that would entail a lengthy teaching sequence and revisiting addition-elimination reactions after a suitable time gap will help cement understanding. The final inorganic topic requires a good understanding of redox. Teaching this in 3 different learning episodes across the course should help develop this. This topic also includes a lot of recall information and as students will be starting to focus on revision, it is a good opportunity to remind them of revision tools used throughout the course. The final organic topic is organic synthesis and NMR. These topics are quite synoptic by nature and require a developed understanding of functional groups. For this reason this topic is left till last and it also gives a good

		nanoscale to macroscale) **Numeracy:** Algebra, graphs,	drawing graphs, processing data and researching information.	opportunity to go over all organic mechanisms which is vital revision for their final exam.
Summer Term	**Revision:** Revision will focus on areas of weakness highlighted by previous assessments and experience of areas the students struggle in. This will also include a 'walking talking mock' exam and how to build multiple choice questions.			At this point the most effective revision sessions are driven by the students. Recall quizzes will also be used to highlight areas of weakness. The multiple-choice section is often the area that students struggle with as they are very time restrictive and the answers on mark schemes do not help students understand questions.