Chemistry Curriculum Overview – Year 12 (Teacher B)

Sequencing of topics	What knowledge will students develop? (Including key terminology)	What skills will students develop? (Including literacy & numeracy)	Assessment opportunities	Homework opportunities	Personal development (Ursuline Values, Catholic Social Teaching, Cultural Capital, Cross-curricular, Careers)	Curriculum links
Autumn Term 1						
Atomic structure Amount of substance (I)	• Fundamental particles: appreciate that knowledge and understanding of atomic structure has evolved over time • Explain the existence of mass number and isotopes. • How a TOF mass spectrometer works and some of its simple uses. • Explain how ionisation energy data provides evidence for electron structure. • Relative atomic mass and relative molecular mass	• Interpret and analyse simple mass spectra of elements • Calculate relative atomic mass from isotopic abundance, limited to mononuclear ions • Write equations for first and successive ionisation energies • Explain how first and successive ionisation energies in Period 3 and in Group 2 give evidence for electron configuration in sub-shells and in shells. • Carry out calculations using numbers in standard and ordinary form eg. using the Avogadro constant • Perform calculations to an appropriate number of	Starter quizzes to retrieve knowledge and understanding Exam style questions for students to complete Self and peer assessment End of topic test **Required practical 1** Make up a volumetric solution and carry out a	Students find the concentration of NaCl in intravenous saline (9 g per dm^3), glucose in isotonic sports drinks (17 g in 500 cm^3) and other similar calculations for everyday solutions. Research why ^{12}C was chosen as the standard; using the following skills- analyse, interpret and evaluate scientific information	Reflect on the way Catholic social teaching connects the arms race, weapons of mass destruction, poverty, and the causes of war. **Dignity of the human person** How is nuclear proliferation related to human life and dignity? **Moral:** Justice, law and order **Nuclear Physics** Analytical Chemist use Mass Spectrometer for drug testing and discovery and also	GCSE Chemistry The structure of atoms (although this is revisited here). GCSE Physics - The structure of atoms (although this is revisited here). - The effect of a force on moving objects. - The effect of a magnetic field on a moving, electrically charged particle (Separate Science)

	• The mole, Avogadro constant and concentration of a substance in solution.	significant figures, given raw data quoted to varying numbers of significant figures • Practice doing calculations involving Avogadro constant, involving mass, M_r and moles, and involving concentration, volume and amount of substance and quoting the final results to the appropriate number of significant figures for data provided	simple acid–base titration.		the food industry (food scientist) Accurate chemical measurements are vital for a range of applications including accurately administering medicines, monitoring environmental pollution, assuring food and water quality and optimising chemical engineering processes.	
Autumn Term 2						
Amount of substance (II)	• The ideal gas equation pV = nRT with the variables in SI units • Perform calculations using the ideal gas equation. • Explain the difference between empirical and molecular formulae • Identify the relationship between empirical formula and molecular formula • Balanced equations and associated calculations	• Be able to rearrange the ideal gas equation, work in appropriate units and quote answers to an appropriate number of significant figures Recognise and make use of appropriate units in ideal gas calculations • Practical opportunity to find the M_r of a volatile liquid • Investigate the link between the gas laws and the ideal gas equation • Balance equations, including ones where	Carry out calculations: to find empirical formula from data giving composition by mass or percentage by mass; to find molecular formula from the empirical formula and relative molecular mass Practical skills: To find the empirical	Find the Mr of a volatile liquid Calculation opportunities using the ideal gas equation, so that the correct units need to be in pV = nRT. Carry out calculations with the ideal gas equation, including rearranging the ideal gas equation to find unknown quantities.	Used by engineers when dealing with different situations, such as the capacity of storage containers, vehicle airbags and air pressure levels airplane cabins **Engineering** **Personal:** such as careers, finance and work experience	**GCSE Chemistry** - Relative atomic mass, relative molecular mass, relative formula mass (although this is revisited here). - Writing formulae (elements, common compounds and ionic compounds). - Balancing equations (although this is revisited here).

	• To write balanced full and ionic equations. • To understand the importance of processes having a high atom economy for society and industry.	formulae are given and some where they are not • Write ionic equations from given equations • Use an appropriate number of significant figures; Substitute numerical values into algebraic equations using appropriate units for physical quantities • Practical skills: perform titration to analyse many substances, including many everyday substances : the concentration of ethanoic acid in vinegar	formula of a metal oxide– process & analyse data using appropriate mathematical skills Calculations to find masses, percentage yields, atom economies, volumes of gases, concentrations & volumes of solutions Practical skills: the yield for the conversion of magnesium to magnesium oxide Practical skills: Students find the M_r of a hydrated salt (eg copper sulfate or magnesium sulfate) by heating to constant mass	Research how the behaviour of real gases deviates from ideal gas behaviour although this is beyond the specification Determine the empirical formula of a metal oxide. Opportunity to look at some further information about elemental microanalysis using the RSC resource (analyse, interpret and evaluate scientific information)		- Moles (although this is revisited here). - Calculations involving Masses (although this is revisited here). - Concentration of solutions (Separate Science - although this is revisited here). - Empirical and molecular formulae (although this is revisited here).
Bonding	• Understand ionic bonding. • Understand covalent bonding, including co-ordinate bonds. • Understand metallic bonding. • Understand the structure of ionic, molecular, giant covalent and metallic substances. • Explain why molecules and ions have the shapes that they have. • Bond polarity; definition of electronegativity. • The three types of intermolecular force: van der Waals' forces, permanent dipole-dipole forces; and hydrogen bonds.	• Write the formula of ionic compounds, including those with common compound ions • Draw molecules with lines/arrows showing covalent/co-ordinate bonds. • Create a summary table to describe and explain the structure and properties of ionic, molecular, giant covalent and metallic substances • Sketch the structures of diamond, graphite, ice, iodine, magnesium and sodium chloride as solids and label the diagrams to explain their		Research: Which of the following ionic compounds have the highest and lowest melting points: sodium chloride, potassium chloride; magnesium chloride – explain your reasoning? Research: Why is there no hydrogen bonding between molecules of HCl gas	**Care for Creation**: Almost everything a person sees or touches in daily life—the air we breathe, the food we eat, the clothes we wear, and so on—is the result of a chemical bond, or, more accurately, many chemical bonds **Physical:** food preparation and nutrition; health eating	**GCSE Chemistry** - Structure and bonding

		melting/boiling points and conductivity • Make models of molecular shapes • Explain how melting and boiling points of molecular substances depend on the relative strength of intermolecular forces. • Identify the impact of hydrogen bonding on the density of ice and melting/boiling points.	Practical skills: try to deflect jets of various liquids from burettes to investigate the presence of different types and relative size of intermolecular forces	even though Cl is more electronegative than N yet NH_3 has hydrogen bonding? Explain why ice floats on water by reference to hydrogen bonding		
Spring Term 1						
Energetics	• Know that reactions can be exothermic or endothermic. • Know what an enthalpy change is and about standard conditions. • Define standard enthalpies of formation and combustion. • Calorimetry • Understand and be able to use the equation $q = mc\Delta T$ to calculate molar enthalpy changes.	• Draw enthalpy profiles for exothermic and endothermic reactions • Write balanced chemical equations, to include state symbols, to represent the changes shown by standard enthalpy changes of formation and combustion • Calculate molar enthalpy changes using provided data from calorimetry experiments • Practical opportunity: Students find *ΔH* for a reaction by calorimetry eg. dissolution of potassium chloride, sodium carbonate, neutralising NaOH with HCl, displacement reaction between $CuSO_4$ + Zn; Combustion of alcohols	**Required practical 2:** Measurement of an enthalpy change. Exam questions Starter quizzes End of topic test	Research how accurate values are found for the energy content in food and fuels.	Food and fuel industries Bomb calorimetry is used to determine the calorie content of food products. Bomb calorimeter is also used for animal feed research, coal analysis and explosive analysis **Dignity of God's people**: ingredients and foods for all **Serviam:** foodbanks	**GCSE Chemistry** - Exothermic and endothermic reactions

	• Understand Hess's law. • Use Hess's law to calculate enthalpy changes using enthalpies of formation and combustion. • Understand the term mean bond enthalpy.	• Plot two variables from experimental data • Plot and interpret graphs; Consider margins of error, accuracy and precision of data • Practical opportunity: to find ΔH for a reaction using Hess's law and calorimetry, then present data in appropriate ways. Examples of reactions could include: • thermal decomposition of $NaHCO_3$ • hydration of $MgSO_4$ • Enthalpy of formation of $CaCO_3$ • Calculate ΔH for reactions using mean bond enthalpies		Calculate Hess's law plus enthalpies of formation and enthalpies of combustion Use mean bond enthalpies to calculate approximate values for ΔH for reactions	**Social:** charity work for foodbank	
Spring Term 2						
Kinetics	Collision theory. Maxwell–Boltzmann distribution curves. Understand how and why temperature affects the rate of chemical reactions.	• Using collision theory to explain why reacts do or do not take place • Draw and Maxwell–Boltzmann curves at different temperatures, pressures and number of particles, identifying the most probable energy and particles with $E \geq E_a$ • Practical opportunity: investigate the effect of temperature on the rate of	**Required practical 3** Investigation of how the rate of a reaction changes with temperature. Starter quizzes	Use Maxwell–Boltzmann curves to explain why a small increase in temperature leads to a large increase in reaction rate Investigate how knowledge and understanding of the factors that affect the rate of chemical reaction	Industry application of kinetics such as the Haber process which has a massive of applications from cleaning reagents to weapons. Reaction rates play a crucial role from production of chemicals and materials to the manufacture of	**GCSE Chemistry** - Reaction rates. **GCSE Chemistry** - Reaction rates. - Exothermic and endothermic reactions. - Equilibria (Separate Science but re-visited here).

Chemical equilibria (I)	Understand how and why concentration and pressure affect the rate of chemical reactions. Understand how and why a catalyst affects the rate of chemical reactions. Equilibrium constant Kc for homogeneous systems	reaction of sodium thiosulfate and hydrochloric acid by an initial rate method • Plot and interpret graphs • Measure rates of reaction by at least two different methods, for example an initial rate method • Investigate the effect of changing the concentration of acid on the rate of a reaction of calcium carbonate and hydrochloric acid by a continuous monitoring method • Use a Maxwell–Boltzmann curve to explain how a catalyst increases the rate of a reaction • Construct an expression for Kc for a homogeneous system in equilibrium • Perform calculations involving Kc	Summary worksheet to complete. Exam style questions to practise examination techniques Peer and self-assessments	have changed methods of storage and cooking of food Use collision theory, including diagrams, to explain why an increase in solution concentration leads to an increase in reaction rate Use collision theory, including diagrams, to explain why an increase in gas pressure leads to an increase in reaction rate Research the use of catalysts in catalytic converters in cars Calculate the concentration of a reagent at equilibrium. Calculate the value of an equilibrium constant Kc	pharmaceuticals and food products (research chemist, chemical engineer) Contact and Haber industrial processes in the chemical manufacture industry	**AS Chemistry** - Energetics (useful to do this first, but not essential as GCSE knowledge would suffice). - Kinetics (useful to do this first, but not essential as GCSE knowledge would suffice).
Summer Term 1						
Chemical equilibria (II)	Understand how reversible reactions can reach a state of dynamic equilibrium. Understand Le Chatelier's principle.	• Practical opportunity: carry out test-tube equilibrium shifts to show the effect of concentration and temperature (eg $Cu(H_2O)_6^{2+}$ with concentrated HCl).	• Practical: Set up a reaction between ethanol and ethanoic acid with acid	Practise writing expressions for K_c and derive units for a variety of equilibria	Industrial production to produce compounds such as methanol, ethanol, sulfuric acid and ammonia	GCSE Chemistry: chemical equilibrium such as Haber process

	Understand why a compromise temperature and pressure may be used for a reversible reaction in an industrial process. Understand the effect of a catalyst on an equilibrium. Predict the effect, if any, of changes in conditions on the value of K_c.	• Analyse, interpret and evaluate scientific information to explain how conditions in temperature and pressure are a compromise in examples of industrial processes • Calculate K_c from data	catalyst and leave to reach equilibrium before titrating and using the results to determine K_c	Calculate the moles and concentration of reagents at equilibrium given initial quantities and the quantity of one reagent at equilibrium		
Summer Term 2						
Oxidation, reduction and redox equations	• Oxidation is the process of electron loss and oxidising agents are electron acceptors. • Reduction is the process of electron gain and reducing agents are electron donors. • Understand the rules for assigning oxidation states	• Work out the oxidation state of an element in a compound or ion from the formula • Write half-equations identifying the oxidation and reduction processes in redox reactions • Combine half-equations to give an overall redox equation.	Preparation for DfE. Exam style questions Presentation from students of previous topics Mini review assessments of topics covered in Y12		Application of redox titrations in pharmaceutical analysis, electrochemistry and medicine. Redox reactions are also important in the production of metals.	GCSE Chemistry: oxidation, reduction and redox reactions
Equilibrium Constant Kp	• Understand that the equilibrium constant Kp is deduced from the equation for a reversible reaction occurring in the gas phase. • Kp is the equilibrium constant calculated from partial pressures for a system at constant temperature. • Understand that, whilst a catalyst can affect the rate of attainment of an equilibrium, it does not affect the value of the equilibrium constant	• Derive partial pressure from mole fraction and total pressure • Construct an expression for Kp for a homogeneous system in equilibrium • Perform calculations involving Kp • Predict the qualitative effects of changes in temperature and pressure on the position of equilibrium and the value of Kp		Calculate the partial pressures of reactants and products at equilibrium. Calculate the value of an equilibrium constant Kp		