ARNOLD LODGE
4 - 18 yrs Co-educational Independent Day School

Key Stage 5: Curriculum Map

AS Level Chemistry (2022/2023)

A Level Chemistry Overview (Year 12)

AS Level Chemistry (Year 12) covers the AS Level only content of the specification where the focus is on Sections 3.1.1 to 3.1.4 & 3.1.6-7 of the Physical Chemistry content, sections 3.2.1 to 3.2.3 of the Inorganic chemistry content and sections 3.3.1 to 3.3.6 of the Organic chemistry content . This is designed to be covered in the first year of A-level. As this is a linear course, the contents of AS subject content are also examined at the end of the two year course. Pupils will support their learning of theory through the completion of a number of required practicals. Pupils will be encouraged to apply their understanding to past exam questions throughout the lessons and their self-study revision.

It is expected that A Level students will complete a minimum of 7 hours extra self-study outside their lesson time. This may be in the form of research, homework or completion of past papers. Teachers will set the pupils adequate homework to help individuals focus their time.

In Chemistry there will be a minimum of one end of unit assessment per half term to identify any gaps in knowledge/understanding that pupils may have and ensure that they are identified and addressed as soon as possible to ensure maximum progression.

Topic of Learning		Half-Termly Overview: Knowledge and Skills	Sample Assessments
HT1	**Inorganic Chemistry** • Atomic structure • Amount of substance • Bonding	**By the end of the unit, pupils should know or be able to:** • Appreciate that knowledge and understanding of atomic structure has evolved over time. • Determine the number of fundamental particles in atoms and ions using mass number, atomic number and charge • Explain the existence of isotopes. • Understand the principles of a simple time of flight (TOF) mass spectrometer, limited to ionisation, acceleration to give all ions constant kinetic energy, ion drift, ion detection, data analysis. • Interpret simple mass spectra of elements • Calculate relative atomic mass from isotopic abundance, limited to mononuclear ions.	**Required Practical 1:** Make up a volumetric solution and carry out a simple acid–base titration End of HT1 – Mid Term Assessment covering all units completed. There will be synoptic questions from each AS Inorganic Chemistry unit included to allow pupils to continually revisit topics covered previously.

		• Define first ionisation energy • Write equations for first and successive ionisation energies • Explain how first and successive ionisation energies in Period 3 (Na–Ar) and in Group 2 (Be–Ba) give evidence for electron configuration in sub-shells and in shells. • Define relative atomic mass (A_r) • Define relative molecular mass (M_r). • Carry out calculations using the Avogadro constant • Calculate using mass of substance, Mr, and amount in moles • Calculate using concentration, volume and amount of substance in a solution. • Use the Ideal Gas Equation $pV = nRT$ with variables in SI units in calculations • Calculate empirical formula from data giving composition by mass or percentage by mass • Calculate molecular formula from the empirical formula and relative molecular mass. • Calculate the Percentage Atom Economy using the equation • Explain the economic, ethical and environmental advantages for society and industry for developing chemical processes with a higher atom economy. • Balance equations for such reactions and use these to calculate masses, volumes of gases, percentage yields, atom economies and concentrations and volumes of reactions in solutions. • Understand that Ionic bonding involves electrostatic attraction between oppositely charged ions in a lattice. • Recall The formulas of compound ions, e.g. sulfate, hydroxide, nitrate, carbonate and ammonium. • Be able to predict the charge on a simple ion using the position of the element in the Periodic Table • Construct formulas for ionic compounds. • A single covalent bond contains a shared pair of electrons. • Multiple bonds contain multiple pairs of electrons. • A co-ordinate (dative covalent) bond contains a shared pair of electrons with both electrons supplied by one atom. It needs to be drawn using an arrow. • Explain that a metallic bond involves attraction between	

		delocalised electrons and positive ions arranged in a lattice. • Identify the 4 different types of crystal structures: ionic, metallic, macromolecular (giant covalent) and simple molecular with named examples for each. • Relate the melting point and conductivity of materials to the type of structure and the bonding present • Explain the energy changes associated with changes of state • Draw diagrams to represent these structures involving specified numbers of particles. • Explain the shapes of, and bond angles in, simple molecules and ions with up to six electron pairs (including lone pairs of electrons) surrounding the central atom. • Understand electronegativity and explain how electron distribution in a covalent bond is unsymmetrical producing a polar covalent bond and use partial charges to show that a bond is polar • Explain why some molecules with polar bonds do not have a permanent dipole. • Identify the different forces between molecules as permanent dipole–dipole forces, induced dipole–dipole (van der Waals, dispersion, London) forces and hydrogen bonding. • The melting and boiling points of molecular substances are influenced by the strength of these intermolecular forces. • The importance of hydrogen bonding in the low density of ice and the anomalous boiling points of compounds.	
HT2	**<u>Physical Chemistry</u>** • Periodicity • Group 2, the alkaline earth metals • Group 7(17), the halogens	**By the end of the unit, pupils should be able to:** • Identify that an element is classified as s, p, d or f block according to its position in the Periodic Table, which is determined by its proton number. • Explain the trends in atomic radius and first ionisation energy of Period 3 elements Na - Ar • Explain the melting point of the Period 3 elements in terms of their structure and bonding.	**<u>Required Practical 4:</u>** Carry out simple test-tube reactions to identify: cations – Group 2, NH_4^+ anions – Group 7 (halide ions), OH^-, CO_3^{2-}, SO_4^{2-} **<u>Required Practical 5:</u>** Distillation of a product from a reaction.

		• Explain the trends in atomic radius and first ionisation energy of Group 2 elements Mg-Ba • Explain the melting point of the elements in terms of their structure and bonding. • Explain their reactions with water, uses in extraction, relative solubilities of the hydroxides and how to test for sulphate ions. • Explain the trend in electronegativity and boiling point of the elements in Group 7 (Halogens) in terms of their structure and bonding. • Explain the trend in oxidising ability of the halogens down the group, including displacement reactions of halide ions in aqueous solution. • Explain the trend in reducing ability of the halide ions, including the reactions of solid sodium halides with concentrated sulfuric acid. • Explain how acidified silver nitrate solution is used to identify and distinguish between halide ions. • Explain the trend in solubility of the silver halides in ammonia. • Explain the reaction of chlorine with water to form chloride ions and chlorate(I) ions. • Appreciate that society assesses the advantages and disadvantages when deciding if chemicals should be added to water supplies. • Give the use of chlorine in water treatment. • Carry out simple test-tube reactions to identify cations – Group 2, NH_4^+ and anions – Group 7 (halide ions), OH^-, CO_3^{2-}, SO_4^{2-}	*End of HT2 – End of Term Assessment covering all units completed. There will be synoptic questions from AS Inorganic Chemistry units included to allow pupils to continually revisit topics covered previously.*
HT3	**Physical** • Energetics • Kinetics • Chemical equilibria, Le Chatelier's principle and K_c	**By the end of the unit, pupils should be able to:** • Define standard enthalpy of combustion ($\Delta_c H^\ominus$) • Define standard enthalpy of formation ($\Delta_f H^\ominus$). • Use the equation $q = mc\Delta T$ to calculate the molar enthalpy change for a reaction and in related calculations	**Required Practical 2:** Measurement of an enthalpy change. **Required Practical 3:** Investigation of how the rate of a reaction changes with temperature.

		• Carry out a required practical to measure an enthalpy change • Use Hess's law to perform calculations, including calculation of enthalpy changes for reactions from enthalpies of combustion or from enthalpies of formation. • Define the term mean bond enthalpy • Use mean bond enthalpies to calculate an approximate value of ΔH for reactions in the gaseous phase • Explain why values from mean bond enthalpy calculations differ from those determined using Hess's law. • Define the term activation energy • Explain why most collisions do not lead to a reaction. • Interpret the Maxwell–Boltzmann distribution of molecular energies in gases. • Draw and interpret distribution curves for different temperatures and use the Maxwell–Boltzmann distribution to explain why a small temperature increase can lead to a large increase in rate. • Explain how a change in concentration or a change in pressure influences the rate of a reaction. • Use a Maxwell–Boltzmann distribution to help explain how a catalyst increases the rate of a reaction involving a gas. • Use Le Chatelier's principle to predict qualitatively the effect of changes in temperature, pressure and concentration on the position of equilibrium • Explain why, for a reversible reaction used in an industrial process, a compromise temperature and pressure may be used. • Construct an expression for K_c for a homogeneous system in equilibrium • Calculate a value for K_c from the equilibrium concentrations for a homogeneous system at constant temperature • Perform calculations involving K_c • Predict the qualitative effects of changes of temperature on the value of K_c	End of HT3 – Mid Term Assessment covering all units completed. There will be synoptic questions from AS Physical Chemistry units included to allow pupils to continually revisit topics covered previously.

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HT4	**Organic Chemistry** • Introduction to organic chemistry (to be started in HT3) • Alkanes • Halogenoalkanes • Alkenes • Alcohols • Organic analysis	**By the end of the unit, pupils should be able to:** • Draw structural, displayed and skeletal formulas for given organic compounds • Apply IUPAC rules for nomenclature to name organic compounds limited to chains and rings with up to six carbon atoms each • Apply IUPAC rules for nomenclature to draw the structure of an organic compound from the IUPAC name limited to chains and rings with up to six carbon atoms each. • Explain reactions of organic compounds using mechanisms • Write balanced equations for the steps in a free-radical mechanism. • Outline mechanisms by drawing the structures of the species involved and curly arrows to represent the movement of electron pairs. • Define the term structural isomer • Draw the structures of chain, position and functional group isomers • Define the term stereoisomer • Draw the structural formulas of *E* and *Z* isomers • Apply the CIP priority rules to *E* and *Z* isomers. • Explain how Petroleum is a mixture consisting mainly of alkane hydrocarbons that can be separated by fractional distillation. • Explain the process of cracking and explain the economic reasons for cracking alkanes. • Understand that alkanes are used as fuels and that combustion of alkanes and other organic compounds can be complete or incomplete. • Explain how the internal combustion engine produces a number of pollutants including NO_x, CO, carbon and unburned hydrocarbons and how it can be removed using catalytic converters. • Explain that combustion of hydrocarbons containing sulfur leads to sulfur dioxide that causes air pollution.	**Required practical 6:** Tests for alcohols, aldehyde, alkene and carboxylic acids. End of HT4: End of Term Assessment covering all units completed.

		• Explain the reaction of methane and chlorine as a free-radical substitution mechanism involving initiation, propagation and termination steps. • Outline the nucleophilic substitution mechanisms of these reactions • Explain why the carbon–halogen bond enthalpy influences the rate of reaction. • Explain the role of the reagent as both nucleophile and base • Outline the mechanisms the concurrent substitution and elimination reactions of a halogenoalkane (eg 2-bromopropane with potassium hydroxide). • Use equations, such as the following, to explain how chlorine atoms catalyse decomposition of ozone: $Cl\bullet + O_3 \rightarrow ClO\bullet + O_2$ and $ClO\bullet + O_3 \rightarrow 2O_2 + Cl\bullet$ • Outline the mechanisms for Electrophilic addition reactions of alkenes with HBr, H_2SO_4 and Br_2 • Explain the formation of major and minor products by reference to the relative stabilities of primary, secondary and tertiary carbocation intermediates. • Understand that addition polymers are formed from alkenes and substituted alkenes. • Draw the repeating unit from a monomer structure and draw the repeating unit from a section of the polymer chain. Also be able to draw the structure of the monomer from a section of the polymer • Explain why addition polymers are unreactive • Explain the nature of intermolecular forces between molecules of polyalkenes. • Explain the meaning of the term biofuel • Justify the conditions used in the production of ethanol by fermentation of glucose • Write equations to support the statement that ethanol produced by fermentation is a carbon neutral fuel and give reasons why this statement is not valid • Outline the mechanism for the formation of an alcohol by the reaction of an alkene with steam in the presence of an acid catalyst	

		• Discuss the environmental (including ethical) issues linked to decision making about biofuel use. • Write equations for the oxidation reactions of primary, secondary and tertiary alcohols (equations showing [O] as oxidant are acceptable) • Explain how the method used to oxidise a primary alcohol determines whether an aldehyde or carboxylic acid is obtained • Use chemical tests to distinguish between aldehydes and ketones including Fehling's solution and Tollens' reagent. • Outline the mechanism for the elimination of water from alcohols. • Identify the functional groups using reactions in the specification. • Use precise atomic masses and the precise molecular mass to determine the molecular formula of a compound. • Use infrared spectra and the Chemistry Data Sheet or Booklet to identify particular bonds, and therefore functional groups, and also to identify impurities.	
HT5	**Exam Prep/Revision**	Revision will be targeted to the needs of the pupil.	End of HT5 – Mock AS Level Chemistry exam
HT6	**Examinations**	**Examinations**	External AS Chemistry Exam.