KS5 Chemistry Curriculum Intent, Implementation, and Impact

Curriculum Intent

To develop skilled knowledgeable independent practical scientists.

The curriculum will allow all students across the academy to become successful scientists. All students will be supported to develop their understanding, motivated to secure their knowledge, and challenged to exceed expectations and maximise their potential in science.

At KS5 students choose to study specialised sciences. In Chemistry they will significantly develop numeracy skills and increase their scientific literacy. Students will be encouraged to work independently both individually and as part of teams in their practical work, problem solving and presenting their understanding. The KS5 curriculum will help develop students for further scientific study beyond their A Level courses, and offer opportunities to explore scientific careers.

Year 12 Implementation

The following skills are delivered across the two-year curriculum

Maths skills

Units, unit prefixes, powers of ten and standard form, converting units. Data handling, significant figures, decimal places.
Algebra, equations, changing the subject, substitution
Graphs, straight line graphs and the equation of a straight line, calculating gradients, x and y-intercepts, calculation in rates, curved graphs, tangents,
Geometry, logarithms, rules of logarithms, base 10, natural logarithms, exponential decrease.

Practical Skills

Planning experiments, variables, choosing equipment, methods, evaluating a plan. Working Safely, risks, hazards and ethical considerations.
Taking measurements including, mass, volume, temperature, pH.
Equipment including, beakers, conical flasks, measuring cylinders, pipettes, burettes, gas syringes, pH meters, electric heaters, water baths, distillation apparatus, filtration.
Analysising data, presenting data, correlation vs cause, conclusions, evaluations, errors, uncertainty, repeatability, accuracy and precision

Please note: the precise timings of when each topic is taught may vary from year to year depending on various factors. The timings below are a guide.

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	Autumn Term	Spring Term	Summer Term
	Teacher One **Physical Chemistry** **Atomic Structure** Fundamental particles, developing the atom, relative change and mass, mass number, atomic number, isotopes, Mass spectrometry, time of flight. **Amount Of Substance** Relative atomic and molecular masses, Avogadro's constant, the mole. Concentration. The ideal gas equation; Boyle's law, Charles Law, Gay-Lussac Law. Molar gas constant. Empirical and molecular formula. Balanced equations and stoichiometry. Atom economy, percentage yield, **Energetics** Endothermic and Exothermic reactions, enthalpy changes, enthalpy level diagrams. Standard enthalpies ("of combustion" and "of formation") heat and temperature, specific heat capacity, flame calorimeter, Measuring enthalpy changes (in neutralisation and displacement reactions), Hess's Law, thermochemical cycles, enthalpy diagrams, enthalpy of elements, bond enthalpies,	**Teacher One** **Physical Chemistry** **Kinetics** Collision theory, activation energy, factors affecting rates of reaction, Maxwell-Boltzmann distribution, catalysts. **Equilibria** Dynamic equilibrium, conditions for equilibrium, physical and chemical equilibria, Le Chatelier's Principle, changing concentration, temperature, or pressure, Industrial reactions, the Haber Process, equilibrium constant, **Redox** Reduction, reducing agents, oxidation, oxidising agents, gain and loss of electrons, oxidation states, adding oxidation states, redox equations, balancing redox reactions, half equations.	**Teacher One** **Inorganic Chemistry** **Periodicity** The Periodic Table, spd and f blocks, groups, reactivity, periods, trend in period 3 including, melting and boiling points, atomic radii, ionisation energy. Ionisation energies patterns, **Group 2** Physical and chemical properties: electron arrangement, melting points, ionisation energies, atom size. Chemical reactions: with water. Solubilities of hydroxides and sulfates. **Group 7** Physical properties: atom size, electronegativity, melting and boiling points. Chemical properties: oxidising power, displacement reactions. Halide ions; reducing agents, reaction of sodium halide with sulfuric acid, reaction of metal halides with silver ions. Uses of Chlorine: reaction with water, with alkali.

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	Teacher Two **Physical Chemistry** **Atomic Structure: Electrons** Arrangement of Electrons, electron shells, electron diagrams, energy levels, atomic orbitals, spin. Ionisation energy, removing electrons, trends in ionisation energy. **Bonding** Ionic, Covalent and Metallic Bonding, electrostatic forces, forming molecules, double covalent bonds, coordinate bonding, properties of metals, electronegativity, bond polarity, intermolecular forces, van der Waals forces, dipole-dipole forces, hydrogen bonding. Shapes of molecules, electron pair repulsion, lone pairs. Properties linked to bonding: states of matter, crystals, giant structures, electrical conductivity, melting and boiling points Organic Chemistry **Introduction** Carbon Compounds, bonding, formulae, (empirical, molecular, display, structural, skeletal, 3D) Reaction mechanisms, free radicals. Nomenclature, roots, prefixes and suffixes, functional groups, chains and position isomers, Homologous series. Isomers: structural isomerism, stereoisomerism,	**Teacher Two** **Organic Chemistry** **Alkanes** General formula, branched and unbranched chains, structure, physical properties: boiling point, polarity, solubility. Fractional Distillation of crude oil, the fractionating column, fracking. Industrial cracking: thermal cracking, catalytic cracking. Combustion: complete and incomplete, pollution, flue gas desulfurisation, Global warming and the greenhouse effect. Formation of Halogenoalkanes; chain reactions **Halogenoalkanes** General Formula, naming halogenoalkanes, Physical Properties: Bond polarity, solubility, boiling point. Reactivity; bond enthalpies. Nucleophilic substitution; nucleophiles, Reactions: with aqueous sodium hydroxide, with cyanide ions, with ammonia. Elimination reactions; OH- ion as a base. Mechanism of elimination, Conditions. CFCs and the environment **Alkenes** General formula. Structure, isomers, CIP notation, physical properties. Reactions: Combustion, with hydrogen halides, of assymetrical alkenes, with halogens, with conc. Sulfuric acid, with water. Addition polymers, plastics, biodegradability, recycling,	**Teacher Two** **Organic Chemistry** **Alcohols** General formula and structure, Nomenclature, classification, physical properties. Production, from crude oil, by fermentation. Reactions: combustion, dehydration, oxidation. Aldehydes and Ketones. Tollens test, Fehling's test. **Organic analysis** Test tube reactions, mass spectrometry, infrared spectroscopy
Impact	Each topic includes the following assessments: • End of Topic Knowledge Checker. • CPAC assessment of required practicals • Past paper practice End of Term Synoptic assessment assesses all content from this term.	Each topic includes the following assessments: • End of Topic Knowledge Checker. • CPAC assessment of required practicals • Past paper practice End of Term Synoptic assessment assesses all content from the Autumn and Spring terms	Each topic includes the following assessments: • End of Topic Knowledge Checker. • CPAC assessment of required practicals • Past paper practice End of Year Synoptic assessment assesses all content from this year.

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	AUTUMN TERM	SPRING TERM	SUMMER TERM
Year 13	**Teacher One** **Physical** **Thermodynamics** Enthalpy change, Hess's Law, Born-Haber Cycles, trends in lattice enthalpies, enthalpy of solution, entropy, Gibbs Free energy. **Kinetics** Reaction rate, rate expression, order of reaction, rate-concentration graphs, iodine clock reaction. Arrhenius equation, rate limiting step. **Equilibrium Constant** Kp for a homogeneous system, partial pressure, gaseous equilibrium. **Electrode Potentials** Electrode potentials and electrochemical series, half cells, hydrogen electrode, representing cells, direction of redox reactions. Electrochemical cells; non-rechargeable cells, rechargeable cells, portable batteries, hydrogen economy	**Teacher One** **Physical** **Acids, Bases and Buffers** Defining an acid; proton transfer, water as an acid and base, ionisation of water. The pH Scale, pH and temperature, finding concentration hydrogen ions and hydroxide ions, pH of strong solutions. Weak acids and bases; dissociation of weak acids, calculating pH of weak acids. Acid-Base titrations; pH changes, titration curves, calculating concentrations. Choosing indicators, half neutralisation point. Buffer solutions. **Inorganic** **Periodicity** Reactions of Period 3 elements; redox reactions, reactions with water, reactions with oxygen. Oxides of Period 3; metal oxides, non-metal oxides, reactions with water. Acid/base nature of Period 3 oxides.	**Revision of all A Level content.** **Completion of outstanding required practicals.** **Paper 3 – practical skills practice.** **All other exam practice.**

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	Teacher Two **Organic** **Nomenclature and Isomerism** Naming organic compounds, functional groups, IUPAC. Optical Isomerism; stereoisomerism, chirality, optical activity. Synthesis of optically active compounds; optical isomers in the drug industry, structure of ibuprofen, thalidomide. **Structure Determinism** NMR spectroscopy; Carbon-13 NMR, chemical shift. Proton NMR, The integration trace, chemical shift values, tetramethyl silane. Interpreting proton H-1 NMR spectra; spin-spin coupling, n+1 rule, predicting NMR spectra. **Compounds Containing the Carbonyl Group** Aldehydes and Ketones; names, physical properties, solubility, reactivity. Reactions of carbonyl group; nucleophilic addition, redox reactions, Fehling's test, silver mirror test, reduction. Carboxylic Acids and esters; names, physical properties, esters, naming esters. Reactions of carboxylic and esters. Acylation. **Aromatic Chemistry** Arenes, structure and bonding on benzene, physical properties and naming, reactivity of aromatic compounds. Reactions of Arenes; electrophilic substitution, Nitration and nitrated arenes, Friedel-crafts acylation reactions. **Amines** Naming Amines, properties of primary amines, reactivity of amines. Amines as bases and their reactions. Amines and nucleophiles and their synthesis; reactions of ammonia with halogenoalkanes, preparation of amines, phenylamine. **Polymerisation** Condensation polymerisation; polyester, polyamides, polypeptides and proteins, identifying monomers and repeat units, disposal.	**Teacher Two** **Organic** **Amino Acids, Proteins & DNA** Amino Acids; properties, acid-vase properties. Peptides, polypeptides and proteins; Amino Acids and the peptide link, Hydrolysis, structure of proteins, stretchiness of wool, bonding between amino acids, Levels of protein structure. Thin layer chromatography. Enzymes; stereospecificity, enzyme inhibition, computer modelling. DNA; the monomers (nucleotides) Polymerisation, the Double Helix. Anti-cancer Drugs. **Organic Synthesis and Analysis** Synthetic routes, connections between functional groups, reagents, oxidising agents and reducing agents, dehydrating agents. Example reaction schemes. Organic Analysis; reactions, functional group tests. **Chromatography** Chromatography; mobile phase, stationary phase, thin layer chromatography, column chromatography, gas-liquid chromatography, GCMS **Inorganic** **Transition Metals** General properties, definition, electronic configurations, Chemical properties. Complex formation and the shape of complex ions; multidentate ligands – chelation, the chelate effect, isomerism. Coloured Ions; colorimetry. Variable oxidation states of transition elements; half equations, redox titrations. Catalysis; heterogeneous catalysts, homogeneous catalysts, autocatalysis. **Reactions of Inorganic Compounds** Acid-base chemistry of aqueous transition metal ions; Lewis acids and bases, Theories of acidity, distinguishing iron ions, amphoteric hydroxides. Ligand substitution reactions. Acid-base and substitution reactions of some metal ions.	

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