Subject: Science Chemistry Trilogy

	Half Term 1 Sept-Oct	Half Term 2 Oct-Dec	Half Term 3 Jan-Feb	Half Term 4 Feb-April	Half Term 5 April-May	Half Term 6 May-July
7	**Laboratory safety** - Covering the basics of lab safety and how to operate within the lab setting. Includes health and safety, lab rules and introduction to equipment and simple practicals. **Solids, Liquids and Gasses – *Why does an ice cube disappear on a hot day?*** Introduction to particles and particle diagrams, melting and freezing, making salts, diffusion and gas pressure. **Chemical Reactions – *How can chemical reactions keep you warm?*** Oxidation, Gas tests for Hydrogen, Oxygen and Carbon Dioxide, reactions of metals and nonmetals and exothermic and endothermic reactions	**Reproduction – *How is new life made?*** Reproductive systems, fertilisation and implantation, sexual reproduction, development of the foetus, menstrual cycle, puberty and growth, flowers and pollination **Cells – *What do cells look like under a microscope?*** Microscopes, animal, plant and specialised cells, cell division, unicellular,	**Light - *Why do we see rainbows?*** How light travels, reflection and refraction, colours, transverse waves, EM Spectrum **Energy – *How many energy stores are present during a PE lesson?*** Energy stores and transfers, power, work done, energy resources, temperature and energy, insulation	**Energy Transfer - *Why is it better to be a prey rather than predator?*** Food chains and webs, energy transfer, Predator prey relationships, pyramids of number, pyramids of biomass, bioaccumulation, investigating abundance and distribution of plants and insects and food security **Classification – *Why did giraffes necks get longer?*** Inherited and environmental variation, continuous and discontinuous variation, predicting inheritance, classification of organisms, adaptations, Natural Selection, extinction and conservation	**Space – *Why would your weight change on different planets?*** Mass, weight and gravity, solar system, exploring space, the universe, meteors, days and months, seasons, light years. **Sound – *How can a drummer avoid disturbing their neighbours?*** Sound as waves, transverse vs longitudinal waves, how sound travels, describing sounds, hearing, reflection and absorption of sounds, sound insulation, speed of sound	**Physical Reactions – *How can you separate pen ink to solve a crime?*** Physical properties, physical reactions and atoms, separating mixtures, crystallisation, chromatography, burning candles, **Earth and its atmosphere – *How is our Earth so resourceful?*** Earth structure, type of rock, rock cycle, limestone analysis, atmosphere, carbon cycle
	Skill development: Science skills focus; Hypothesis and Variables. Each unit will have dedicated investigations with these skills as a focus. Mathematics/Science Links: Balancing symbol equations, line graphs, using data in scientific explanations,	Skill Development: Science skills focus; Method and risk assessment. Each unit will have dedicated investigations with these skills as a focus, whilst also continuing the skills developed in previous topics. Mathematics/Science Links: Calculating magnification, converting metric units, line graph	Skill Development: Science skills focus; Tables and Graphs. Each unit will have dedicated investigations with these skills as a focus, whilst also continuing the skills developed in previous topics. Mathematics/Science Links: Tables and graphs, evaluation,	Skill development: Science skills focus; Describe, Explain and Conclude. Each unit will have dedicated investigations with these skills as a focus, whilst also continuing the skills developed in previous topics. Mathematics/Science Links: Graph skills, predicting inheritance (%'s), calculating percentage,	Skill Development: Science skills focus; Evaluation. Each unit will have dedicated investigations with these skills as a focus, whilst also continuing the skills developed in previous topics. Mathematics/Science Links: Calculating speed of sound, calculating gravity, rearranging equations, calculating mean, graph skills, calculating speed of light,	Skill Development: Students wll plan and carry out full investigations in these units, based on skills developed in previous topics throughout the year. Mathematics/Science Links:Interpretation of a pie chart, calculate mean, calculate Rf value of chromatogram,
	Assessment End of topic test (/25). The test consists of both topics covered.	Assessment: End of topic test (/25). The test consists of both topics covered.	Assessment: End of topic test (/25). The test consists of both topics covered.	Assessment: End of topic test (/25). The test consists of both topics covered.	Assessment: End of topic test (/25). The test consists of both topics covered.	Assessment: End of topic test (/25). The test consists of both topics covered.
8	Content: **Respiration – *How does exercise affect the body?*** Aerobic respiration, the heart, heart rate, structure of the lungs, Diffusion of gasses, blood and blood vessels,	Content: **Forces and motion – *Why does a see-saw need two people?*** Measuring forces, Moments, Levers, Speed, distance and time graphs, gravity	Content: **Acids and Alkalis - *Will vinegar treat both a wasp and bee sting?*** Hazards of acids and alkali, indicators, universal indicator, Neutralisation, Neutralisation equations, neutralisation of	Content: **Magnets - *Why is the North pole not actually the North pole?*** Magnetic and non-magnetic, magnetic fields, compasses and magnets, making a magnet, electromagnets, electric bells, motors	Content: **Reactivity series – *How could you make the statue of liberty shiny again?*** Metals in air, metals in water and acid, group 1 metals, displacement, Copper cycle, obtaining metals using carbon, obtaining results, catalysts	Content: **Microbes and disease – *Is immunity important for survival?*** Types of pathogen, clean hands, antibiotics, body defences, immune response, vaccinations, heart disease, smoking, drug development.

	Food and Digestion – *Why do we need to digest food?* Food groups, food tests, enzymes, digestive system, Case study: Obesity, deficiency diseases,	**Matter and Pressure – *Why doesn't a beach ball sink in the sea?*** States of matter, density of regular objects, density of irregular objects, ship building, gas pressure, atmospheric pressure, pressure in liquids, stress in solids	carbonates, metals in acid, Acid strength **Elements, compounds and mixtures –*What is everything made from?*** Elements, periodic table, compounds, Naming compounds, making compounds, mixtures, salt and boiling water, chemical formulae	**Circuits – *Why do we get static shocks?*** What is electricity?, series circuits, parallel circuits, potential difference, how does potential difference affect current, resistance, equations, static	**Combustion - *How are OUR chemical reactions affecting the planet?*** Fire triangle, fire extinguishers burning candles, complete and incomplete combustion, climate change, reducing climate change, thermal decomposition, conservation of mass.	**Plant Growth – *What factors affect plant growth?*** Photosynthesis, leaves, growing cress, testing a leaf for starch, factors affecting photosynthesis, moving water, plant hormones, plant diseases.
	Skill development Science skills focus; Hypothesis and Variables. Each unit will have dedicated investigations with these skills as a focus. Maths/Science Links: Extracting data from external articles, calculating mean, line graph skills, using data, drawing pie charts, use data to explain recovery from exercise, evaluation,	Skill development Science skills focus; Method and risk assessment. Each unit will have dedicated investigations with these skills as a focus, whilst also continuing the skills developed in previous topics. Maths/Science Links: Drawing results table, graph skills, calculating moments, calculating speed, drawing distance time graphs, calculating speed from graph, calculating rate, calculating gravity. calculating and rearranging density equations, converting units, calculating pressure	Skill development Science skills focus; Method and risk assessment. Each unit will have dedicated investigations with these skills as a focus, whilst also continuing the skills developed in previous topics. Maths/Science Links: Results table, drawing graph, rearranging balanced symbol equation,	Skill development Science skills focus; Describe, Explain and Conclude. Each unit will have dedicated investigations with these skills as a focus, whilst also continuing the skills developed in previous topics. Maths/Science Links: Results table for current and potential difference, calculating resistance, rearranging equations, describing a relationship between variables,	Skill development Science skills focus; Evaluation. Each unit will have dedicated investigations with these skills as a focus, whilst also continuing the skills developed in previous topics. Maths/Science Links: Balanced symbol equation, calculate conservation of mass, use data to identify errors in an investigation,	Skill development Students wll plan and carry out full investigations in these units, based on skills developed in previous topics throughout the year. Maths/Science Links: calculate area of a circle (zone of inhibition), evaluate evidence, plan a drug trial, results table, drawing graphs.
	Assessment End of topic test (/25). The test consists of both topics covered.	Assessment End of topic test (/25). The test consists of both topics covered.	Assessment End of topic test (/25). The test consists of both topics covered.	Assessment End of topic test (/25). The test consists of both topics covered.	Assessment End of topic test (/25). The test consists of both topics covered.	Assessment End of topic test (/25). The test consists of both topics covered.

9	Content ***We can change states of matter by heating and cooling but can they be separated?*** States of matter, Cooling Curve (Stearic Acid), Atoms, elements and compounds, Separating mixtures, Filtration and crystalisation, Distillation, Fractional distillation ***Is the periodic table designed correctly?*** Atoms, History of the atom	Content: ***Is the periodic table designed correctly?*** Structure of the atom, Isotopes, Electronic structures, Development of the periodic table, Electronic structures and the periodic table, Group 1 - the alkali metals, Group 7 - the halogens, Displacement reaction practical, Explaining trends, **The transition Elements**	Content: ***Why can we ingest salt but not chlorine?*** Forming ions, atoms into ions, Ionic bonding, Giant ionic lattices / testing conductivity, Covalent bonding, Structure of simple molecules	Content: ***Diamond, pencil, medicines - same or different?*** Giant covalent structures, Fullerenes and graphene, Bonding in metals, Giant metallic structures,	Content: ***How do skittles produce a rainbow?*** Pure substances and mixtures, Paper chromatography, Analysing chromatograms, ***How clean is the Humber Estuary?*** Testing for gases - Hydrogen, Testing for gases - Carbon dioxide,	Content ***How clean is the Humber Estuary?*** Testing for gases oxygen and chlorine,
	Skill development WS 1.1, 1.2, 1.6, 2.2, 2.3, Maths/Science Links: Shapes and structure, Area, Surface area and volume,	Skill development: WS 1.1, 1.2, 1.6, 4.3, 4.4 Maths/Science Links: Estimating the result of calculation, standard form,	Skill development: WS 1.2 Maths/Science Links: Shapes and Structures, Ratios, Fractions and percentages	Skill Development: WS 1.2, 1.4 Maths/Science Links: Shapes and structure, **Standard form, Estimating the result of calculation, Estimates and order of magnitude, Area, Surface area and volumes**	Skill Development: WS 1.2, **1.3, 1.4, 1.5,** 1.6, 2.2, 3.1, 3.2, 3.3, 3.5, **3.6,** 4.1 Maths/Science Links: **Standard Form,** Ratios, fractions and percentages, Mathematical symbols, Quantities and units, Decimal form, Estimating the result of calculation, Significant figures	Skill development: WS 1.2, **1.3, 1.4, 1.5,** 1.6, 2.2, 3.1, 3.2, 3.3, 3.5, **3.6,** 4.1 Maths/Science Links: **Standard Form,** Ratios, fractions and percentages, Mathematical symbols, Quantities and units, Decimal form, Estimating the result of calculation, Significant figures
	Assessment 10 mark assessment covering structure and bonding	Assessment 25 mark assessment covering separation and atoms	Assessment 10 mark assessment covering the periodic table	Assessment 10 mark assessment covering covalent bonding	Assessment 25 mark assessment covering metallic bonding and nanoparticles	Assessment End of year examination

10	Content ***How do ice packs and hand warmers work?*** Exothermic and Endothermic reactions, Explaining endothermic and exothermic reactions Using energy transfers from reactions, Reaction profiles **HT: Bond energy Calculations,** ***How much squash is really in your drink?*** Maths skills, Conservation of mass,	Content: ***How much squash is really in your drink?*** Relative masses and **moles (HT)**, % Mass, Breaking the law of conservation of mass, **HT: Equations and calculations Reacting masses L1, HT Equations and calculations Reacting Masses L2**, **HT: From masses to balanced equations, HT, Limiting Reactants**, Expressing concentrations, ***Where did the copper for the Statue of Liberty come from?*** The reactivity series, Displacement reactions Extracting metals intro, Extracting copper, Extracting metals: Iron **HT: Extracting metals from ores**	Content: ***Where did the copper for the Statue of Liberty come from?*** Expressing concentrations, The reactivity series, Displacement reactions Extracting metals intro, Extracting copper, Extracting metals: Iron ***How do we make coke cans from rocks? Foundation only at this point*** Introduction to electrolysis, Changes at the electrodes molten, The extraction of aluminium, Electrolysis of aqueous solutions	Content: ***How do we make coke cans from rocks? Higher only at this point*** Introduction to electrolysis, Changes at the electrodes, The extraction of aluminium, Electrolysis of aqueous solutions ***Where did the copper for the Statue of Liberty come from? Higher only at this point*** **HT: Other methods of extracting metals**, Salts from metals, ***How can you make table salt in a lab? Higher only at this point*** Salts from metals,	Content: ***How can you make table salt in a lab? Higher only at this point*** Salts from insoluble bases Making more salts, Neutralisation and the pH scale, Neutralisation equations HT**: Strong and weak acids** ***Why won't your bike explode in the rain? Higher only at this point*** Rate of reaction, Collision theory and surface area,	Content: ***Why won't your bike explode in the rain? both higher and foundation*** Rate of reaction, Collision theory and surface area, The effect of temperature, The effect of concentration and pressure, Effect of catalysts ***How does walking the wrong way up an escalator link to chemistry ?Both higher and foundation*** Reversible reactions, Energy and reversible reactions, Dynamic equilibrium, **HT: Altering Conditions**
	Skill development: WS 1.2, 2.3, 4.3, 4.4, 4.5 Maths/Science Links: Decimal form, Collecting data by changing a variable, Standard Form, Significant figures, Changing the subject of an equation,Ratios, fractions and percentages, Mathematical symbols, Quantities and SI Units	Skill development: WS 1.4, 4.3 Maths/Science Links: Decimal Form, Ratios, fractions and percentages, Quantities and SI Units, Changing the subject of an equation	Skill development: WS 3.6, 4.1 Maths/Science Links: Estimate and order of magnitude	Skill development: WS 1.2, 1.4, 1.5, 2.4, 3.5 Maths/Science Links: Ratios, fractions and percentages	Skill development: WS 1.2, 2.1, 2.4, 2.6, 3.1, 3.2, 3.5 Maths/Science Links: Decimal form, Ratios, Fractions and percentages, Estimating the result of calculation, Collecting data by changing a variable, Graphs and equations, Plotting data, Determining the gradient of a graph, Using transects, Standard form, significant figures, mathematical symbols, Quantities and SI units, shapes and structures, Arithmetic means, changing the subject of an equation,	Skill development: WS 2.3, 2.4, 2.6, 3.7 Maths/Science Links: Decimal form, Standard Form, Significant figures, Arithmetic means, Collecting data by changing a variable, Graphs and equations, Plotting data, Maths/Science Links:
	Assessment 10 mark assessment covering masses, moles and calculations	Assessment 25 mark assessment covering chemical calculations	Assessment 25 mark assessment covering salts	Assessment 10 mark assessment covering reaction profiles and fuel cells	Assessment 10 mark assessment	Assessment End of year examination
11	Theoretical Content: ***Crude oil - hero or villain?*** Hydrocarbons, Fractional distillation of oil, Properties of hydrocarbons, Burning hydrocarbon fuels,	Theoretical Content: ***How do astronauts drink in space?*** Finite and renewable resources, Water safe to drink, Treating	Theoretical Content:	Theoretical Content:	Theoretical Content:	Theoretical Content:

	Cracking hydrocarbon, ***Life on Earth - how did we get here and how long have we got?*** History of our atmosphere, Our evolving atmosphere, Greenhouse gasses, Climate change, Global climate change, Atmospheric pollutants	wastewater, Life cycle assessments, Reduce, reuse, and recycle				
	Skill development WS 1.1, 1.2, 1.3, 1. 4, 1.6, 2.2, 2.4, 2.6, 3.1, 3.2, 3.5, 3.6, 4.1 Maths/Science Links: Ratios, Fractions and percentages, Frequency tables, bar charts and histograms, ratios, fractions and percentages, frequency tables, bar charts and histograms, Collecting data by changing a variable, Plotting data	Skill development WS 1.3, 1.4, 1.5, 2.2, 2.3, 3.2 Maths/Science Links: Standard Form, Frequency tables, bar charts and histograms, Estimates and order of magnitude, Collecting data by changing a variable, Arithmetic means,	Skill development WS 1.3, 1.4, 1.5, 2.2, 2.3, 3.2 Maths/Science Links: Decimal form, Ratios, Fractions and percentages, Estimating the result of calculation, Significant figures,	Skill development Maths/Science Links:	Skill development Maths/Science Links:	Skill development Maths/Science Links:
	Assessment: 10 mark assessment	Assessment: November PPE	Assessment: 10 mark assessment Feb PPE	Assessment:	Assessment:	Assessment:
12	Theoretical Content: Teacher A: Topic 5: Moles, Avogadro constant, Molar mass, 'empirical formula' and 'molecular formula' and calculating from data, write balanced full and ionic equations, calculate amounts of substances (in mol) in reactions involving mass, volume of gas, volume of solution and concentration, calculate reacting masses from chemical equations, calculate reacting volumes of gases from chemical equations, calculate reacting volumes of gases from chemical equations, calculate solution concentrations, percentage error and percentage uncertainty in experiments, Teacher B: Topic 1: students can consider how models for the atom have developed over time, as new evidence has become available.	Theoretical content: Teacher A: Topic 5: Atom economy, relate ionic and full equations, with state symbols, to observations from simple test tube reactions, Topic 2: Ionic bonding and properties, isoelectronic ions, covalent bonding and properties, shapes of, and bond angles in, simple molecules and ions, electronegativity, polar bonds, intermolecular forces, properties of water Teacher B: Topic 6: students can consider how the polymer industry provides useful solutions for many modern applications, but	Theoretical Content: Teacher A: Topic 2: Solubility, metallic bonding, giant lattices, Carbon allotropes Topic 4: Physics and chemical trends of Group 2, solubility of the hydroxides and sulfates of Group 2 elements, trends in thermal stability of the nitrates and the carbonates of the elements in Groups 1& 2, Flame tests for Gr1 & 2. Physics and chemical trends of Group 7, understand given reactions in terms of changes in oxidation number, Understand given reactions for group 7. Teacher B: Topic 6: students can consider how the polymer industry provides useful solutions for many modern applications, but	Theoretical content: Teacher A: Topic 2: Analysis of inorganic compounds Topic 10: Reversible reactions and dynamic equilibrium, qualitative effect of a change in temperature, concentration or pressure on a homogeneous system in equilibrium, Application to industrial processes and compromises, deduce an expression for Kc Teacher B: Topic 7: students can consider how different instrumental methods can provide evidence for analysis. They can see how	Theoretical content: Teacher A: Topic 10: Application of reversible reactions to industrial processes and compromises. Topic 9: collision theory, the effect of a change in concentration, temperature, pressure and surface area on the rate of a chemical reaction, activation energy, calculate the rate of a reaction from data and gradient of a suitable graph, Maxwell-Boltzmann distribution Teacher B: Topic 8: Within this topic, students can consider how the use of Hess's Law can facilitate the study of energy changes in reactions which are not directly measurable. They can also	Theoretical content: Teacher A: Topic 9: Role of catalysts, reaction profiles Revision Begin Topic 16: Understand key terms for the topic, suitable experimental technique to obtain rate data for a given reaction, determine and use rate equations, calculate the rate of reaction and the half-life of a first-order reaction, deduce the order (0, 1 or 2) with respect to a substance in a rate equation using data from a graph Teacher B: Topic 13:

	They can also consider how data is used to investigate relationships, such as between the magnitude of ionisation energy and the structure of an atom. Topic 3: students can consider how the concept of oxidation number provides a more considered route for the process of balancing chemical equations.	poses questions about sustainability of resources and the feasibility of recycling. They will also encounter practical organic chemistry, showing them how chemists work safely with potentially hazardous chemicals by managing risks.Possible experiments include cracking of artificial crude oil, extracting limonene from orange peel, dehydrating an alcohol to an alkene, preparing a simple halogenoalkane such as 1-bromobutane, simple test tube reactions for different functional groups.	poses questions about sustainability of resources and the feasibility of recycling. They will also encounter practical organic chemistry, showing them how chemists work safely with potentially hazardous chemicals by managing risks.Possible experiments include cracking of artificial crude oil, extracting limonene from orange peel, dehydrating an alcohol to an alkene, preparing a simple halogenoalkane such as 1-bromobutane, simple test tube reactions for different functional groups.	accurate and sensitive methods of analysis can be applied to the study of chemical changes, but also to detect drugs such as in blood or urine testing in sport. skills that could be developed in this topic include analysing fragmentation patterns and peak heights in mass spectra.	consider the value of a general chemical concept, such as mean bond enthalpy, and why the use of a simplification such as this has some benefits, as well as some short-comings.	Within this topic, students can consider how chemists evaluate theoretical models by comparing the real and ideal properties of chemicals, for example in the study of theoretical and experimental lattice energies. The study of entropy shows students how chemists use formal, abstract thinking to answer fundamental questions about the stability of chemicals and the direction of chemical change.
	Skill development: 5a.1, 5a.2, 5a.3, 5a.4 5b.1, 5b.2, 5b.4 5c.1, 5c.4, 5c.5, 5c.6, 5c.11 Maths/Science Links: Teacher A: B 0.0, B 0.1,B 0.2, B 0.3, B 0.4 B 1.1, B 1.2, B 1.3, B 2.1, B 2.2, B 2.3, B 2.4	Skill development 5a.1, 5a.2 5b.1, 5b.2, 5b.3 5c.4, 5c.11 Maths/Science Links: Teacher A: B 0.2 B 1.1 B 2.2, B 2.3 B 4.1, B 4.2	Skill development 5a.1, 5a.4 5b.1, 5b.2, 5b.3 5c.4, 5c.11 Maths/Science Links: Teacher A: B 3.1 - trends in data	Skill development 5a.1, 5a.2, 5a.4 5b.1, 5b.2, 5b.3, 5b.4 5c.4, 5c.11 Maths/Science Links: Teacher A: B 0.2, B 0.3 B 1.1, B 1.2, B 1.3	Skill development 5a.1, 5a.2, 5a.3, 5a.4 5b.1, 5b.2, 5b.4 5c.1, 5c.2, 5c.4, 5c.11,5c.12 Maths/Science Links: Teacher A: B 0.0, B 0.1, B0.3, B 0.4 B 1.1, B 2.1, B 2.2, B 2.3 B 3.1, B 3.2, B 3.3, B 3.4	Skill development 5a.1, 5a.2, 5a.3, 5a.4 5b.1, 5b.2, 5b.4 5c.1, 5c.4, 5c.1, 5c.12 Maths/Science Links: Teacher A: B 0.0, B 0.1 B 1.1 B 2.2, B 2.3, B 2.4 B 3.1, B 3.2, B 3.3, B 3.4, B 3.5
	Assessment: Teacher A: CORE PRACTICAL 1: Measure the molar volume of a gas CORE PRACTICAL 2: Prepare a standard solution from a solid acid and use it to find the concentration of a solution of sodium hydroxide CORE PRACTICAL 3: Find the concentration of a solution of hydrochloric acid Suitability test Teacher B Entry exam R1 Topic 1 test	Assessment Teacher A: EOUT Topic 5 End of chapter questions Teacher B CPAC 4 & 5	Assessment: Teacher A: EOUT Topic 2 End of chapter questions Jan PPE Teacher B R2 Topic 3 and 6a test CPAC 6	Assessment: Teacher A: CORE PRACTICAL 7: Analysis of some inorganic and organic unknowns EOUT Topic 4 End of chapter questions Teacher B: R3 Topic 6b and 7 test CPAC 7	Assessment: Teacher A: EOUT Topic 10 End of chapter questions Teacher B: R4 Topic 8 Test CPAC 8	Teacher A: EOUT Topic 10 End of chapter questions End of year 12 PPE Teacher B End of year PPE
13	Theoretical Content Teacher A; Topic 16: Recap end of year 12.	Theoretical Content: Teacher A; Topic 11: Deduce an expression for Kc and Kp, calculate values, with units	Theoretical Content: Teacher A; Topic 12: Draw and interpret titration curves, select a suitable indicator, using a	Theoretical Content: Teacher A; Topic 14:	Theoretical Content: Teacher A; Topic 15: Electronic configurations of atoms and ions of the d-block	Theoretical Content:

	Determine and use rate equations, understand experiments that can be used to investigate reaction rates by: initial-rate method (‘clock reaction’), a continuous monitoring method. To deduce the order w.r.t. a substance from an initial-rate method, Obtain rate data from the acid-catalysed iodination of propanone.Rate-determining step and possible mechanism for the reaction. Rate equations for the hydrolysis of halogenoalkanes can be used to provide evidence for S 1 or S 2 mechanisms for halogenoalkane hydrolysis, graphical methods to find the activation energy for a reaction from data Teacher B: Topic 13 students can consider how chemists evaluate theoretical models by comparing the real and ideal properties of chemicals, for example in the study of theoretical and experimental lattice energies. The study of entropy shows students how chemists use formal, abstract thinking to answer fundamental questions about the stability of chemicals and the direction of chemical change	where appropriate, for the equilibrium constant from experimental data, effect of changing temperature on the equilibrium constant and position of equilibrium, effect on equilibrium constant and position of equilibrium by changes in concentration or pressure or by the addition of a catalyst. Topic 12: Brønsted–Lowry acid and base, acid-base reactions, Brønsted–Lowry conjugate acid-base pairs, define and calculate ‘pH’, calculate the concentration of hydrogen ions in a solution from its pH, using the expression, strong and weak acids. Write and use the expression for Ka 10. Write and use the ionic product of water, Kw, terms ‘pKa ’ and ‘pKw ’. Analyse data from the following experiments: i measuring the pH of a variety of substances, ii comparing the pH of a strong acid and a weak acid after dilution 10, 100 and 1000 times Teacher B: Topic 17 students can consider how organic synthesis can produce a variety of important materials, such as esters for solvents, flavourings and perfumes. They will also continue their study of reaction mechanisms, and see the ways in which different mechanisms act as a pattern to describe a range of organic reactions.	titration curve and appropriate data, ‘buffer solutions’, calculate the concentrations of solutions required to prepare a buffer solution of a given pH, use a weak acid–strong base titration curve to: i demonstrate buffer action ii determine K from the pH at the point where half the acid is neutralised, enthalpy changes of neutralisation values for strong and weak acids, roles of carbonic acid molecules and hydrogencarbonate ions in controlling the pH of blood Teacher B: Topic 18 students can consider how the model for benzene structure has developed in response to new evidence. By this stage, their continuing practical experience should enable them to use techniques to carry out reactions and purify products efficiently and safely.	Use terms ‘oxidation’ and ‘reduction’ in terms of electron transfer and changes in oxidation number, ‘standard electrode potential’, standard hydrogen electrode, different methods are used to measure standard electrode potentials, calculate a standard emf, E cell, write cell diagrams , predict the thermodynamic feasibility of a reaction using standard electrode potentials. Link between E, K and entropy change, limitations of predictions made using standard electrode potentials, in terms of kinetics. Electrochemical series, disproportionation reactions, application of electrode potentials to storage cells, fuel cells, redox titration calculations and experiments. Start Topic 15 - see next HT. Teacher B: Topic 19 students can consider a wider range of instrumental methods used for analysis, such as NMR; and see how this technique is used in medicine through MRI scans. They can also see a wide range of applications that rely on a combination of different analytical techniques.	elements of period 4, Definition of transition metals, why transition metals show variable oxidation number, ‘ligands’, formation of complex ions, Colours of transition metals in solution and what causes this, ‘coordination number’, monodentate ligands, bidentate ligands, Shape of metal complexes, Metal complexes in cancer treatment, haemoglobin as an iron(II) complex containing a multidentate ligand, ligand exchange reactions, vanadium compound and redox reactions, chromium complexes, Copper complexes. Complex reactions with sodium hydroxide and aqueous ammonia, ligand exchange reactions and entropy Teacher B Revise course	
	Skill development 5a.1, 5a.2, 5a.3, 5a.4 5b.1, 5b.2, 5b.4 5c.1, 5c.2, 5c.4, 5c.11, 5c.12 Maths/Science Links: Teacher A:	Skill development 5a.1, 5a.2, 5a.3, 5a.4 5b.1, 5b.2, 5b.3, 5b.4 5c.1, 5c.2, 5c.3, 5c.4, 5c.6, 5c.11 Maths/Science Links:	Skill development 5a.1, 5a.2, 5a.3, 5a.4 5b.1, 5b.2, 5b.4 5c.1, 5c.3, 5c.4, 5c.5, 5c.6, 5c.11	Skill development 5a.1, 5a.2, 5a.4 5b.1, 5b.2, 5 b.3, 5b.4 5c.1, 5c.3, 5c.4, 5c.5, 5c.6, 5c.10, 5c.11	Skill development 5a.1, 5a.2, 5a.4 5b.1, 5b.2, 5b.4 5c.1, 5c.4, 5c.11 Maths/Science Links: Teacher A: B 4.1, B 4.2	Skill development Maths/Science Links:

	B 0.0, B 0.1,B 0.2, B 0.3, B 0.4 B 1.1 B 2.2, B 2.3, B 2.4 B 3.1, B 3.2, B 3.3, B 3.4, B 3.5	Teacher A: B 0.0, B 0.1,B 0.2, B 0.3, B 0.4 B 1.1 B 2.1, B 2.2, B 2.3, B 2.4, B 2.5 B 3.1	Maths/Science Links: Teacher A: B 0.0, B 0.1,B 0.2, B 0.3, B 0.4 B 1.1 B 2.1, B 2.2, B 2.3, B 2.4, B 2.5 B 3.1, B 3.2	Maths/Science Links: Teacher A: B 0.0, B 0.1,B 0.2, B 0.4 B 1.1, B 1.3 B 2.1, B 2.2, B 2.3, B 2.4, B 2.5		
	Assessment Teacher A: CORE PRACTICAL 13a and 13b: Rates of reaction Following the rate of the iodine-propanone reaction by a titrimetric method and investigating a 'clock reaction' CORE PRACTICAL 14: Finding the activation energy of a reaction EOUT Topic 16 End of chapter questions Teacher B: Yr12 Revision exam / re-entry exam R1 Topic 13 and 17a test	Assessment: Teacher A: EOUT Topic 11 End of chapter questions Teacher B: R2 Topic 17 Test	Assessment: Teacher A: CORE PRACTICAL 9: Finding the Ka value for a weak acid EOUT Topic 12 End of chapter questions Teacher B CPAC 15 and 16 Both: Jan PPE	Assessment: Teacher A: CORE PRACTICAL 10: Investigating some electrochemical cells CORE PRACTICAL 11: Redox titration EOUT Topic 14 End of chapter questions Teacher B R3 Topic 18 and 19 test	Assessment: Teacher A: CORE PRACTICAL 12: The preparation of a transition metal complex EOUT Topic 15 End of chapter questions Teacher B Past papers Both: In class PPE	

Scientific Skills - Working Scientifically

1 Development of scientific thinking		2 Experimental skills and strategies		3 Analysis and evaluation		4 Scientific vocabulary, quantities, units, symbols and nomenclature	
WS 1.1	Understand how scientific methods and theories develop over time.	WS 2.1	Use scientific theories and explanations to develop hypotheses.	WS 3.1	Presenting observations and other data using appropriate methods.	WS 4.1	Use scientific vocabulary, terminology and definitions.
WS1.2	Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts.	WS 2.2	Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena.	WS 3.2	Translating data from one form to another.	WS 4.2	Recognise the importance of scientific quantities and understand how they are determined.
WS 1.3	Appreciate the power and limitations of science and consider any ethical issues which may arise.	WS 2.3	Apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment.	WS 3.3	Carrying out and represent mathematical and statistical analysis.	WS 4.3	Use SI units (eg kg, g, mg; km, m, mm; kJ, J) and IUPAC chemical nomenclature unless inappropriate.
WS 1.4	Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments.	WS 2.4	Carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations.	WS 3.4	Representing distributions of results and making estimations of uncertainty.	WS 4.4	Use prefixes and powers of ten for orders of magnitude (eg tera, giga, mega, kilo, centi, milli, micro and nano).
WS 1.5	Evaluate risks both in practical science and the wider societal context, including perception of risk in relation to data and consequences.	WS 2.5	Recognise when to apply a knowledge of sampling techniques to ensure any samples collected are representative.	WS 3.5	Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions.		

WS 1.6	Recognise the importance of peer review of results and of communicating results to a range of audiences.	WS 2.6	Make and record observations and measurements using a range of apparatus and methods.	WS 3.6	Presenting reasoned explanations including relating data to hypotheses.	
		WS 2.7	Evaluate methods and suggest possible improvements and further investigations.	WS 3.7	Being objective, evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error.	
				WS 3.8	Communicating the scientific rationale for investigations, methods used, findings and reasoned conclusions through paper-based and electronic reports and presentations using verbal, diagrammatic, graphical, numerical and symbolic forms.	

KS5 - Scientific Skills

Code	Skills ares	Specific skill
5a.1	Independent thinking	• solve problems set in practical contexts • apply scientific knowledge to practical contexts
5a.2	Use and application of scientific methods and practices	• comment on experimental design and evaluate scientific methods • present data in appropriate ways • evaluate results and draw conclusions with reference to measurement uncertainties and errors • identify variables including those that must be controlled
5a.3	Numeracy and the application of mathematical concepts in a practical context	• plot and interpret graphs • process and analyse data using appropriate mathematical skills as exemplified in the mathematical appendix for each science • consider margins of error, accuracy and precision of data
5a.4	Instruments and equipment	• know and understand how to use a wide range of experimental and practical instruments, equipment and techniques appropriate to the knowledge and understanding included in the specification

Code	Skills ares	Specific skill
5b.1	Independent thinking	• apply investigative approaches and methods to practical work
5b.2	Use and application of scientific methods and practices	• safely and correctly use a range of practical equipment and materials • follow written instructions • make and record observations • keep appropriate records of experimental activities • present information and data in a scientific way • use appropriate software and tools to process data, carry out research and report findings
5b.3	Research and referencing	• use online and offline research skills including websites, textbooks and other printed scientific sources of information • correctly cite sources of information
5b.4	Instruments and equipment	• use a wide range of experimental and practical instruments, equipment and techniques appropriate to the knowledge and understanding included in the specification

Code	Apparatus and Techniques

5c.1	use appropriate apparatus to record a range of measurements (to include mass, time, volume of liquids and gases, temperature)
5c.2	use water bath or electric heater or sand bath for heating
5c.3	measure pH using pH charts, or pH meter, or pH probe on a data logger
5c.4	use laboratory apparatus for a variety of experimental techniques, including: ● titration, using burette and pipette ● distillation and heating under reflux, including setting up glassware using retort stand and clamps ● qualitative tests for ions and organic functional groups ● filtration, including use of fluted filter paper, or filtration under reduced pressure
5c.5	use volumetric flask, including accurate technique for making up a standard solution
5c.6	use acid-base indicators in titrations of weak/strong acids with weak/strong alkalis
5c.7	purify: ● a solid product by recrystallization ● a liquid product, including use of separating funnel
5c.8	use melting point apparatu
5c.9	use thin-layer or paper chromatography
5c.10	set up electrochemical cells and measuring voltages
5c.11	safely and carefully handle solids and liquids, including corrosive, irritant, flammable and toxic substances
5c.12	measure rates of reaction by at least two different methods, for example: ● an initial rate method such as a clock reaction ● a continuous monitoring method

KS5 maths skills

	Mathematical skills	Exemplification of mathematical skill in the context of A Level chemistry (assessment is not limited to the examples given below)
B.0 - arithmetic and numerical computation		
B 0.0	Recognise and make use of appropriate units in calculation	• convert between units, e.g. cm3 to dm3 as part of volumetric calculations • give units for an equilibrium constant or a rate constant • understand that different units are used in similar topic areas, so that conversions may be necessary, e.g. entropy in J mol-1 K-1 and enthalpy changes in kJ mol-1
B 0.1	Recognise and use expressions in decimal and ordinary form	• use an appropriate number of decimal places in calculations, e.g. for pH • carry out calculations using numbers in standard and ordinary form, e.g. use of Avogadro’s number • understand standard form when applied to areas such as (but not limited to) Kw • convert between numbers in standard and ordinary form • understand that significant figures need retaining when making conversions between standard and ordinary form, e.g. 0.0050 mol dm-3 is equivalent to 5.0 x 10-3 mol dm-3
B 0.2	Use ratios, fractions and percentages	• calculate percentage yields • calculate the atom economy of a reaction

		• construct and/or balance equations using ratios
B 0.3	Make estimates of the results of calculations (without using a calculator)	• evaluate the effect of changing experimental parameters on measurable values, e.g. how the value of Kc would change with temperature given different specified conditions
B 0.4	Use calculators to find and use power, exponential and logarithmic functions	• carry out calculations using the Avogadro constant • carry out pH and pKa calculations • make appropriate mathematical approximations in buffer calculations
B.1 – handling data		
B 1.1	Use an appropriate number of significant figures	• report calculations to an appropriate number of significant figures given raw data quoted to varying numbers of significant figures • understand that calculated results can only be reported to the limits of the least accurate measurement
B 1.2	Find arithmetic means	• calculate weighted means, e.g. calculation of an atomic mass based on supplied isotopic abundances • select appropriate titration data (i.e. identification of outliers) in order to calculate mean titres
B 1.3	Identify uncertainties in measurements and use simple techniques to determine uncertainty when data are combined	● determine uncertainty when two burette readings are used to calculate a titre value
B.2 – algebra		
B 2.1	Understand and use the symbols: =, <, <<, >>, >, ∝, ~, equilibrium sign	
B 2.2	Change the subject of an equation	• carry out structured and unstructured mole calculations, e.g. calculate a rate constant k from a rate equation
B 2.3	Substitute numerical values into algebraic equations using appropriate units for physical quantities	• carry out structured and unstructured mole calculations • carry out rate calculations • calculate the value of an equilibrium constant KC
B 2.4	Solve algebraic equations	• carry out Hess's law calculations • calculate a rate constant k from a rate equation
B 2.5	Use logarithms in relation to quantities that range over several orders of magnitude	• carry out pH and pKa calculations
B.3 - graphs		
B 3.1	Translate information between graphical, numerical and algebraic forms	• interpret and analyse spectra • determine the order of a reaction from a graph • derive rate expression from a graph
B 3.2	Plot two variables from experimental or other data	• plot concentration–time graphs from collected or supplied data and draw an appropriate best-fit curve
B 3.3	Determine the slope and intercept of a linear graph	• calculate the rate constant of a zero order reaction by determination of the gradient of a concentration–time graph
B 3.4	Calculate rate of change from a graph showing a linear relationship	• calculate the rate constant of a zero order reaction by determination of the gradient of a concentration–time graph
B 3.5	Draw and use the slope of a tangent to a curve as a measure of rate of change	• determine the order of a reaction using the initial rates method

B.4 – geometry and trigonometry		
B 4.1	Appreciate angles and shapes in regular 2D and 3D structures.	• predict/identify shapes of and bond angles in molecules with and without a lone pair(s), for example NH3, CH4, H2O etc
B 4.2	Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects	• draw different forms of isomers • identify chiral cen
B 4.3	Understand the symmetry of 2D and 3D shapes	• describe the types of stereoisomerism shown by molecules/complexes • identify chiral centres from a 2D or 3D representation