Curriculum Implementation Mapping

To implement a seamless route of the delivery of the science provision, we approach Science as a 5 year curriculum from Year 7 to 11.

From year 7 to year 11, the curriculum has been mapped according to three Big Ideas for each subject. This shows how topics are interlinked and how they spiral throughout the programme of study. The Big Ideas are captured below:

Biology	Chemistry	Physics
Cells and cellular processes	Materials and their properties	Energy
Biological systems for life	Chemical Changes	Forces and fields
Organisms and their interactions with the environment	Our earth and its atmosphere	Matter and materials

These Big Ideas run through each key stage. The strands running through each Big Idea are

1. Prior knowledge
2. Knowledge
3. Working Scientifically (scientific thinking, using scientific models, analysing and evaluating data, applications and implications of science and the collaborative approach to work of scientists)
4. Literacy & Communication (use of key terminology, effective scientific communication and discussion of misconceptions).
5. Numeracy
6. Assessment

In Year 7 and 8 students learn science using the Exploring Science (Pearson) platform. Year 7 has 7 hours and Year 8 has 6 hours per fortnight, in mixed ability classes.

In year 9 we begin to students continue their science learning using the Edexcel GCSE Pearson provision as a basis, and are taught in mixed ability sets. In year 9, students are taught 9 hours per fortnight; 3 hours per science subject.

In years 10 and 11 students are set based on ability and year half, and are taught 11 hours per fortnight; 4 hours each for Biology and Chemistry, 3 hours for Physics. Students will either study the Combined Science GCSE award or the Single Science GCSE award and we will work with the students to decide which option is best for them as they progress through years 10 and 11.

The three individual science subjects; Biology, Chemistry and Physics are taught, wherever possible, by subject specialists who, we feel, are best able to demonstrate a true depth of subject knowledge and who can enthuse students through a passion for their subject.

Sixth Form

There are A-levels in each of the three individual science subjects: Biology, Chemistry and Physics as well as a BTec National Level 3 Extended Certificate in Applied Science with the following examination boards:

- Biology: AQA
- Chemistry: OCR Salters B
- Physics: OCR A
- BTec Applied Science National Level 3: Pearson

Curriculum Implementation Mapping – Skills and Knowledge – Combined Science – Chemistry

Big ideas	Year 7	Year 8	Year 9	Year 10	Year 11
			Throughout: Formulae, equations and hazards, Spec: 0.1-0.6 (paper 1 & 2)		
Materials and their properties	*The Particle Model* 7Ga, 7Gb, 7Gc, 7Gd, 7Ge *Mixtures and separation techniques* 7Ea, 7Eb, 7Ec, 7Ed, 7Ee *Our Material World* 7Ha, 7Hb, 7Hc	*The Periodic Table* 8Fa, 8Fb, 8Fc, 8Fd, 8Fe *Metals and their uses* 8Ge	**SC1 States of matter ,** SC1a Spec: 2.1-2.4 (paper 1) **SC2 Methods of Separating and Purifying Substances** SC2a, SC2b, SC2c, SC2d, SC2e Spec: 2.5 – 2.12 (paper 1) Core Prac: 2.11 (SC2d) **SC3 Atomic structure** SC3a, SC3b, SC3c Spec: 1.1-1.12, 1.19 (paper 1 & 2) **SC4 The Periodic Table** SC4a, SC4b, SC4c Spec: 1.13-1.20 (paper 1 and 2) **SC5 Bonding** SC5a, SC5b, SC5c Spec: 1.21-1.27 (paper 1 and 2) **SC9 Calculations involving masses**, SC9a Spec: 1.43-1.46 (paper 1 and 2)	**SC6 Covalent Bonding** , SC6a Spec: 1.28-1.31 (paper 1 and 2) **SC7 Types of Substance** SC7a, SC7b, SC7c, SC7d Spec 1.32-1.42 (paper 1 and 2) **SC17 Groups in the Periodic Table** SC17a, SC17b, SC17c, SC17d Spec: 6.1-6.16 (paper 2)	
Chemical changes	*Acids and Alkalis* 7Fa, 7Fb, 7Fc, 7Fd, 7Fe *Our Material World* 7Hd, 7He	*Combustion* 8Ea, 8Eb, 8Ec *Metals and their uses* 8Ga, 8Gb, 8Gc, 8Gd	**SC20 Fuels** SC20a, SC20b, SC20c, SC20d, SC20e, SC20f Spec: 8.1- 8.17 (paper 2)	**SC8 Acids and bases** SC8a, SC8b, SC8c, SC8d, SC8e, SC8f Spec: 3.1-3.21 (Paper 1) Core Prac: 3.6 (SC8c) & 3.17 (SC8d) **SC9 Calculations involving masses,** SC9b, SC9c Spec: 1.47-1.51 (paper 1 & 2)	**SC18 Rates of reaction** SC18a, SC18b, SC18c Spec: 7.1-7.8 (paper 2) Core Prac: 7.1 (SC18b) **SC19 Heat energy changes in chemical reactions,** SC19a, SC19b Spec: 7.9- 7.16 (paper 2) **SC10 Electrolytic processes** SC10a, SC10b Spec: 3.22-3.31 (paper 1) Core Prac: 3.31 (SC10a) **SC12 Reversible reactions and Equilibria,** SC12a, Spec: 4.13-4.17 (paper 1)
Our earth and its atmosphere	*Our Material World* 7Ha, 7Hc	*Combustion* 8Ed, 8Ee *Rocks* 8Ha, 8Hb, 8Hc, 8Hd, 8He	**SC21 Earth and atmospheric science** SC21a, SC21b, SC21c, SC21d Spec: 8.18- 8.26 (paper 2)	**SC11 Obtaining & Using Metals** SC11a, SC11b, SC11c, SC11d Spec: 4.1- 4.12 (paper 1) **SC9 Calculations involving masses,** SC9b Spec: 1.48, 1.52, 1.53 (paper 1 and 2) (paper 1 & 2)	

Curriculum Implementation Mapping – Skills and Knowledge – Single Science - Chemistry

Big ideas	Year 7	Year 8	Year 9	Year 10	Year 11
			Throughout: Formulae, equations and hazards, Spec: 0.1-0.6 (paper 1 & 2)		
Materials and their properties	*The Particle Model* 7Ga, 7Gb, 7Gc, 7Gd, 7Ge *Mixtures and separation techniques* 7Ea, 7Eb, 7Ec, 7Ed, 7Ee *Our Material World* 7Ha, 7Hb, 7Hc	*The Periodic Table* 8Fa, 8Fb, 8Fc, 8Fd, 8Fe *Metals and their uses* 8Ge	**SC1 States of matter ,** SC1a Spec: 2.1-2.4 (paper 1) **SC2 Methods of Separating and Purifying Substances** SC2a, SC2b, SC2c, SC2d, SC2e Spec: 2.5 – 2.12 (paper 1) Core Prac: 2.11 (SC2d) **SC3 Atomic structure** SC3a, SC3b, SC3c Spec: 1.1-1.12, 1.19 (paper 1 & 2) **SC4 The Periodic Table** SC4a, SC4b, SC4c Spec: 1.13-1.20 (paper 1 and 2) **SC5 Bonding** SC5a, SC5b, SC5c Spec: 1.21-1.27 (paper 1 and 2) **SC9 Calculations involving masses**, SC9a Spec: 1.43-1.46 (paper 1 and 2)	**SC6 Covalent Bonding** , SC6a Spec: 1.28-1.31 (paper 1 and 2) **SC7 Types of Substance** SC7a, SC7b, SC7c, SC7d Spec 1.32-1.42 (paper 1 and 2) **SC17 Groups in the Periodic Table** SC17a, SC17b, SC17c, SC17d Spec: 6.1-6.16 (paper 2)	**SC22 Hydrocarbons,** SC22a, SC22b Spec:9.10C - 9.16C (paper 2) **SC23 Alcohols & Carboxylic acids** SC23qa, SC23b, SC23c Spec: 20.1C-20.9C (paper 2) Core Practical: 20.3C (SC23b) **SC24 Polymers** SC24a, SC24b, SC24c, SC24d Spec: 19.1C-19.9C (paper 2) **SC25 Qualitative Analysis (tests for ions)** SC25a, SC25b, SC25c Spec: 9.1C-9.9C (paper 2) Core Practical: 9.2C-9.5C (SC25c) **SC26 Bulk and Surface Properties of Matter including Nanoparticles** SC26a, SC26b, SC26c Spec: 21.1C-21.5C (paper 2) **SC13 Transition Metals, Alloys and Corrosion** SC13a, SC13b, SC13c, SC13d, SC13e Spec: 5.1C-5.7C (paper 1)

Chemical changes	*Acids and Alkalis* 7Fa, 7Fb, 7Fc, 7Fd, 7Fe *Our Material World* 7Hd, 7He	*Combustion* 8Ea, 8Eb, 8Ec *Metals and their uses* 8Ga, 8Gb, 8Gc, 8Gd	**SC20 Fuels** SC20a, SC20b, SC20c, SC20d, SC20e, SC20f Spec: 8.1- 8.17 (paper 2)	**SC8 Acids and bases** SC8a, SC8b, SC8c, SC8d, SC8e, SC8f Spec: 3.1-3.21 (Paper 1) Core Prac: 3.6 (SC8c) & 3.17 (SC8d) **SC9 Calculations involving masses,** SC9b, SC9c Spec: 1.47-1.51 (paper 1 & 2)	**SC18 Rates of reaction** SC18a, SC18b, SC18c Spec: 7.1-7.8 (paper 2) Core Prac: 7.1 (SC18b) **SC19 Heat energy changes in chemical reactions,** SC19a, SC19b Spec: 7.9- 7.16 (paper 2) **SC10 Electrolytic processes,** SC10a, SC10b Spec: 3.22-3.31 (paper 1) Core Prac: 3.31 (SC10a) **SC12 Reversible reactions and Equilibria,** SC12a, Spec: 4.13-4.17 (paper 1) **SC14 Quantitative Analysis** SC14a, SC14b, SC14c, SC14d Spec: 5.8C-5.15C (paper 1) Core Practical: 5.9C (SC14d) **SC15 Dynamic Equilibria, Calculations Involving Volumes of Gases** SC14e, SC15a, SC15b Spec: 5.16C-5.24C (paper 1) **SC16 Chemical Cells & Fuel Cells,** SC16a Spec: 5.25-5.27 (paper 1)
● Our earth and its atmosphere	● Our Material World ● 7Ha, 7Hc	● Combustion ● 8Ed, 8Ee ● ● Rocks ● 8Ha, 8Hb, 8Hc, 8Hd, 8He	● SC21 Earth and atmospheric science ● SC21a, SC21b, SC21c, SC21d ● Spec: 8.18- 8.26 (paper 2)	● SC11 Obtaining & Using Metals ● SC11a, SC11b, SC11c, SC11d ● Spec: 4.1- 4.12 (paper 1) ● SC9 Calculations involving masses, SC9b ● Spec: 1.48, 1.52, 1.53 (paper 1 and 2) (paper 1 and 2)	●

Subject: Chemistry **Year group: 7**

Topic	7E: Mixtures & Separation	7F: Acids & Alkalis	7G: The Particle Model	7H Atoms, Elements and Molecules
Prior KS2 knowledge	Most students will: ● observe that materials change state when heated or cooled, and measure temperature ● identify evaporation and condensation and associate the rate with temperature ● understand that materials can dissolve to form a solution ● decide how to separate mixtures, including by filtering, sieving and evaporating ● demonstrate that some changes are reversible	Most students will be able to: recall some examples of reversible and irreversible changes recall what happens when acids are mixed with bicarbonate of soda	Most students will be able to: ● group materials together based on their state ● understand that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution ● use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating	Most students will be able to: ● group materials together, based on their state or on properties; hardness, solubility, transparency, conductivity ● observe that materials change state when heated or cooled, and measure temperature in (°C) ● demonstrate that dissolving, mixing and changes of state are reversible changes ● explain that some changes result in new materials, and that this change is not usually reversible
Knowledge	● Understanding of states of matter, and extending the understanding of mixtures and solubility including use of related terminology ● Understanding separation techniques and when appropriate to use each: filtration, evaporation, evaporation, distillation and chromatography.	● chemical reactions as the rearrangement of atoms ● representing chemical reactions using formulae and using equations, including reactions of acids and alkalis to produce salt and water ● defining acids and alkalis/bases in terms of neutralisation reactions and determining pH to measure acidity/alkalinity	● the properties of the different states of matter (solid, liquid and gas) in terms of the particle model, including gas pressure ● similarities and differences, including density differences, between solids, liquids and gases ● Brownian motion in gases ● Differences in arrangements, in motion and in closeness of particles explaining changes of state, shape and density, the anomaly of ice–water transition.	● the concept of a pure substance versus a mixture ● differences between atoms, elements, compounds and molecules including chemical symbols and formulae ● combustion, thermal decomposition, oxidation and displacement reactions ● the varying physical and chemical properties of different elements and the difference between chemical and physical changes
Working Scientifically (WS) Literacy & Communication (L&C) Maths (M)	● WS: understanding of hazards & using appropriate techniques, apparatus, and materials in laboratory work ● L&C: Use of flow charts, use of conventions and symbols when communicating science	● WS: focusses on evaluating risks ● L&C: identifying key points in text, pictures, charts and graphs ● M: reading and plotting graphs	● WS: understand that scientific methods and theories develop to take account of new evidence and ideas, make predictions, present observations ● M: converting between metres and nanometres & calculating volumes using simple formulae.	● WS: present data using appropriate methods, use SI units and chemical nomenclature ● L&C: the use of facts and opinions to inform and persuade. ● M: qualitative and quantitative data & the use of: tables and graphs
Assessment Pattern	7E and 7F are assessed together in one 35 mark assessment.		7G and 7H are assessed together in one 35 mark assessment.	

Subject: Chemistry **Year group: 8**

Topic	8E: Combustion	8F: The Periodic Table	8G: Metals and Their Uses	8H: Rocks
Prior knowledge	Most students will: ● be able to define the term fuel (7I) ● name the three states of matter and describe their properties (7G) ● describe features of chemical reactions (7F, 7H) ● be able to carry out the test for carbon dioxide (7H).	Most students will ● group materials based on properties ● explain that chemical reactions make new materials, generally irreversible, & describe the possible changes when compounds are formed (7H) ● describe the difference between chemical and physical changes (7H) ● describe and identify metals and non-metals by their properties (7H) ● use the particle model to explain observations about matter (7G) ● describe elements, mixtures and compounds using particle theory(7H) ● use chemical symbols , name simple compounds and use word equations to describe chemical reactions (7H).		Most students will: ● group together different kinds of rocks on the basis of their appearance and simple physical properties ● describe in how fossils are formed ● describe elements, compounds and mixtures, chemical and physical changes (7H).
Knowledge	● the properties of the different states of matter in terms of the particle model, including gas pressure ● differences between atoms, elements and compounds ● chemical symbols for elements ● the conservation of mass and changes of state in reactions ● chemical reactions as the rearrangement of atoms and representing this using equations ● combustion, oxidation and exothermic reactions ● what catalysts do ● the carbon cycle & the composition of the atmosphere; the impact of human activity on the climate (CO_2).	● a simple (Dalton) atomic model ● differences between atoms, elements and compounds ● chemical symbols and formulae for elements and compounds ● chemical reactions as the rearrangement of atoms, using equations ● the varying physical and chemical properties of different elements; the properties of metals and non-metals ● the principles underpinning the Mendeleev periodic table (periods and groups; metals and non-metals) ● how patterns can be predicted with reference to the periodic table ● the chemical properties of metal and non-metal oxides relating to acidity.	● chemical symbols and formulae for elements and compounds ● the concept of a pure substance versus a mixture ● the identification of pure substances ● representing chemical reactions using formulae and using equations ● combustion, thermal decomposition, oxidation and displacement reactions ● reactions of acids with metals to produce a salt plus hydrogen ● the varying physical and chemical properties of different elements; the properties of metals and non-metals ● the order of metals and carbon in the reactivity series.	● the composition of the Earth ● the structure of the Earth ● the rock cycle and the formation of igneous, sedimentary and metamorphic rocks ● Earth as a source of limited resources and the efficacy of recycling.
Working Scientifically (WS) Literacy & Communication (L&C) Maths (M)	● WS; select, plan and carry out investigations to test predictions, including identifying variables ● M: interpreting line graphs	● WS: interpret observations and data and draw conclusions; evaluate data, showing awareness of sources error. ● L&C: the use of sentences to explain ideas clearly. ● M: identify anomalous results & ranges, use graphs to present data.	● WS: record observations and measurements; evaluate methods and suggest improvements. ● L&C: the use of adjectives to describe substances in science. ● M: drawing and interpreting graphs; calculate means and percentages,	● WS: how the scientific method is adapted ● L&C: analysing emotive language and evaluating media reports. ● Maths skills: interpreting graphs and substituting into formulae
Assessment Pattern	8E is assessed together with 8F in one 35 mark assessment.	8G and 8H are assessed together in one 35 mark assessment.		

Subject: Chemistry **Year group: 9**

Topic	Formulae and Symbol Equations	SC1 States of Matter/SC2 Methods of Separating and Purifying Substances	SC3 Atomic Structure/SC4 The Periodic Table	SC5 Ionic Bonding/SC9 Calculations Involving Masses	SC20 Fuels	SC21 Earth and Atmospheric Science
Prior Knowledge	● WS: use chemical nomenclature ● chemical symbols and formulae for elements and compounds ● representing chemical reactions using formulae and using equations	● Understanding of states and properties (particle model), pure substances & mixtures ● Understanding separation techniques filtration, evaporation, distillation and chromatography. ● Chemical and physical changes	● Differences between atoms, elements and compounds ● Dalton's atomic model ● Physical and chemical properties of elements ● Principles of Mendeleev's periodic table ● Predicting periodic patterns	● Chemical reactions as the rearrangement of atoms ● SC3/SC4	● combustion, oxidation and exothermic reactions ● what catalysts do	● The composition of the atmosphere; the impact of human activity on the climate (CO_2). ● Earth as a source of limited resources and the efficacy of recycling.
Knowledge	● Write word and balanced equations using chemical formulae and state symbols ● To be able to risk assess and manage hazards during laboratory work	● Describe and explain the arrangement, movement, the relative energy of particles and interconversions of the three states of matter ● Predict the physical state of a substance	● Describe the historic development of the structure of the atom ● Describe and explain atomic structure (protons, neutrons and electrons) and know their properties ● Recall the meaning of mass number, atomic number and relative atomic mass ● Describe the periodic table's structure and use data to describe atoms and isotopes ● Calculate R.A.M (H) ● Describe Mendeleev's periodic table (lay-out, gaps, predictions and pair reversals)	● Explain ions and ionic bonding using dot-cross diagrams and suitable language ● Calculate the number of protons, neutrons and electrons in ions ● Name ionic compounds and deduce the formula ● Explain the structure of an ionic compound and explain key ionic properties ● Calculate RFM, empirical and molecular formula ● Describe how to determine the empirical formula experimentally	● Describe what crude oil and hydrocarbons are and explain how crude oil is made useful using fractional distillation and cracking ● Describe the use of different fractions and explain their properties ● Explain what an homologous series is ● Describe the products of complete and incomplete combustion and the issues caused by each ● Describe the cause of acid rain and the issues caused by it ● Evaluate the use of hydrogen as a fuel	● Describe the changes to the Earth's atmosphere since the Earth was formed ● Describe the greenhouse effect and the possible issues it will cause, and evaluate how human activities may be causing climate change ● Describe the chemical tests for key gases
Disciplinary		Risk Assessments Method Writing Analysis Evaluation	Tabulating	Analysis Hypothesis Evaluation	Variables Method Writing Tabulating	Graph plotting
Literacy		Tier 3 keywords	Tier 2 (AWL)	Tier 2 (AWL)	Tier 2 (AWL)	Tier 3 keywords

		Extended Writing Reading Comprehension	Tier 3 keywords Extended Writing Reading Comprehension Dual Coding	Tier 3 keywords Extended Writing Reading Comprehension Dual Coding	Tier 3 keywords Extended Writing Reading Comprehension	Extended Writing Reading Comprehension Group Discussion
Numeracy	1a, 1c		1a, 1c, 1d, 3a - 3c, 4a, 5b	1a, 1c, 2a, 3b, 5b	1c, 1d, 2c, 4a, 4c	2c, 2h, 3a, 4a
Personal Development		Career Links	Career Links Development of scientific theories	Career Links Material science awareness	Career Links The petrochemical industry Health implications of combustion Environmental impacts of acid rain Alternative fuels	Career Links Combatting climate change
Assessment Pattern	Assessed within each topic when appropriate	40 mark end of topic test	40 mark end of topic test	25 mark interim test (raw mark only)	40 mark end of topic test	
	50 mark end of year test					

Subject: Chemistry **Year group: 10**

Topic	Formulae and Symbol Equations	SC6 Covalent bonding/ SC7 Types of Bonding	SC8 Acids and Alkalis/ SC9 Calculations involving Masses	SC11 Obtaining and Using Metals/ SC9 Calculations involving Masses	SC10 Electrolytic processes	SC12 Reversible reactions and Equilibria
Prior Knowledge	● Write word and balanced equations using chemical formulae and state symbols ● To be able to risk assess and manage hazards	● SC3 Atomic Structure ● SC4 The Periodic Table ● SC5 Ionic Bonding	● defining acids and alkalis/bases in terms of neutralisation reactions and determining pH ● reactions of acids with metals	● properties of metals & non-metals ● the reactivity series ● SC3/ SC4 ● SC9a RFM/Empirical Formula	● SC5 Ionic Bonding ● SC7 Types of Bonding	● Chemical reactions as the rearrangement of atoms ● Write word and balanced equations using chemical formulae and state symbols
Knowledge	● Write word and balanced equations using chemical formulae and state symbols ● (H) Write ionic equations ● To be able to risk assess and manage hazards during laboratory work	● Explain what a covalent bond is both with dot-cross diagrams and suitable language, when it is formed and the properties of simple molecules and giant covalent structures ● Explain why substances can be classified as ionic, simple molecular & giant covalent (including polymers and allotropes of carbon) and metallic and the properties of each structure type ● Describe the limitations of structural models	● Recall what acids, bases and alkali are and link to the pH scale ● Investigate the change in pH ● Explain the neutralisation reactions of acids with bases and alkalis ● Explain that the link between hydrogen ion concentration and pH (a tenfold dilution, raises pH by 1). Explain the terms dilute, concentrated, weak and strong acids (H) ● Describe the test for hydrogen and carbon dioxide ● Explain how to prepare a soluble salt an insoluble reactant and using a titration ● Recall the solubility rules & describe the preparation of an insoluble salt	● Deduce and explain the reactivity of metals using experimental observations ● Recall how metals are extracted from the Earth and how the extraction links to the reactivity series ● Explain displacement reactions as redox reactions (as both loss and gain of electrons (H) and oxygen) ● Evaluate biological methods of metal extraction (H) ● Explain how resistance to oxidation is related position in the reactivity series ● Evaluate the advantages of recycling metals ● Describe what life cycle assessments are ● Calculate masses of reactants and products	● Recall what electrolytes and explain the movement of ions during electrolysis ● Describe what electrolysis is ● Explain the formation of the products in the electrolysis, using inert electrodes, of both molten ionic substances and solutions of ionic substances ● Write half equations for reactions occurring and explain redox reactions (H) ● Explain how electrolysis can be used to purify copper	● Recall that some chemical reactions are reversible and that the direction of some reversible reactions can be altered by changing the reaction conditions using the Haber Process as an example ● Recall the conditions for the Haber process ● Explain what is meant by dynamic equilibrium and predict how the position of a dynamic equilibrium is affected by changes in conditions (H)

			● Explain the law of conservation of mass ● Calculate the concentration of solutions in g dm–3 ● Recall what Avogadro's constant and use the mole triangle for calculations (H)	from balanced equations; and deduce the stoichiometry of a reaction (H) ● Explain what a limiting reactant is (H)		
Disciplinary		Results Tabulating Conclusion	Method Writing Risk Assessment	Method Writing Conclusions	Recording Observations Graph Plotting Analysis	
Literacy		Tier 2 (AWL) Tier 3 keywords Extended Writing Reading Comprehension Dual Coding	Tier 3 keywords Method Writing Extended Writing Reading Comprehension	Tier 2 (AWL) Tier 3 keywords Extended Writing Reading Comprehension Dual Coding	Tier 2 (AWL) Tier 3 keywords Extended Writing Reading Comprehension Dual Coding	Tier 2 (AWL) Tier 3 keywords
Numeracy	1a, 1c	1d, 4a, 5b	1a, 1b, 1c, 2a, 3a, 3b, 3c, 4a, 4c	1a, 1c, 4a, 4b, 4c, 4d		
Personal Development		Career Links Limitations of models Material science awareness	Career Links Hazard Symbols Working safely	Career Links Finite resources Recycling	Career Links	Career Links
Assessment Pattern	Assessed within each topic when appropriate	40 mark end of topic test (covering SC5 to SC7)	25 mark interim test (Part 1) 40 mark end of topic test	25 mark interim test (raw marks only)	40 mark end of topic test (covers SC9 to SC12)	
	60 mark end of year test					

Chemistry Combined **Year group: 11**

Topic	**Formulae and Symbol Equations**	**SC18 Rates of reaction**	**SC19 Heat energy changes in chemical reactions**	**SC17 Groups in the Periodic Table**
Prior Knowledge	● Write word and balanced equations using chemical formulae and state symbols ● To be able to risk assess and manage hazards during laboratory work	● chemical reactions as the rearrangement of atoms ● Understanding of states and properties (particle model) ● Neutralisation, displacement, combustion, redox and thermal decomposition reactions	● combustion, thermal decomposition, oxidation and displacement reactions ● chemical reactions as the rearrangement of atoms ● Understanding of states and properties (particle model)	● SC4 The Periodic Table

Knowledge	● Write word and balanced equations using chemical formulae and state symbols ● (H) Write ionic equations ● To be able to risk assess and manage hazards during laboratory work	● How to investigate the effect of changing conditions on the rate of reaction ● Explain collision theory and how rate of reaction can be altered ● Interpret graphs of mass, volume or concentration of reactant or product against time ● Describe what a catalyst is and explain how it changes rate of reaction ● Recall that enzymes are biological catalysts	● Describe exo and endo thermic reactions and provide examples ● Use energy level diagrams to describe exo and endothermic reactions and explain the term activation energy ● Recall that bond breaking is endothermic and bond making is exothermic and the balance between the to processes determines whether the overall heat energy change is exothermic or endothermic ● Calculate the energy change in a reaction (in kJ mol-1) (H)	● Link classification of elements to the periodic table ● Recall the physical properties of the alkali metals and describe their reactions with water; describe and explain the pattern in reactivity ● Recall the appearance of the halogens and describe the pattern in physical properties ● Describe the test for chlorine ● Describe the reactions of halogens to form metal halides and hydrogen halides, which dissolve in water to form acidic solutions ● Describe and explain the relative reactivity of the halogens as shown by their displacement reactions and explain why these displacement reactions are redox ● Explain why the noble gases are chemically inert, explain their uses and the pattern in their physical properties
Disciplinary		Method writing		
Literacy		Tier 2 (AWL) Tier 3 keywords Extended Writing Reading Comprehension Dual Coding	Tier 2 (AWL) Tier 3 keywords Extended Writing Reading Comprehension Dual Coding	Tier 2 (AWL) Tier 3 keywords Extended Writing Reading Comprehension Dual Coding
Numeracy				1d, 2c,
Personal Development		Career Links	Career Links	Career Links
Assessment Pattern	Assessed within each topic when appropriate	25 mark end of topic test (Interim)		
	Paper 1 & Paper 2 mocks in November/December (60 marks)	Paper 2 mock March (60 marks)		

Subject: Chemistry Single (additional material) **Year group: 11**

Topic	SC13 Transition Metals, Alloys and Corrosion	SC14 Quantitative Analysis SC15 Dynamic Equilibria, Calculations Involving Volumes of Gases SC16 Chemical Cells & Fuel Cells	SC22 Hydrocarbons SC23 Alcohols & Carboxylic acids SC24 Polymers	SC25 Qualitative Analysis (tests for ions) SC26 Bulk and Surface Properties of Matter including Nanoparticles
Prior Knowledge	● Recall the physical properties of the alkali metals ● Explain redox reactions (as loss and gain of electrons (H) and oxygen) ● Explain how resistance to oxidation is related to the reactivity series	● Neutralisation reactions of acids and metal hydroxides ● Explain how to prepare a soluble salt using a titration ● Calculate masses of reactants and products from balanced equations ● Calculate concentration (g /dm^3)	● Describe what hydrocarbons are ● Explain what an homologous series is (including alkanes and alkenes) ● Describe the products of complete and incomplete combustion ● Explain covalent bonds using dot-cross diagrams and suitable language ● Explain why substances can be classified simple molecular (including polymers)	● SC5 Ionic Bonding
Knowledge	● Recall that most metals are transition metals and describe their properties ● Recall that oxidation of metals is corrosion and explain how it can be prevented ● Explain why converting pure metals into alloys increases their strength using steel as an example ● Explain how uses of metals relate to their properties	● Calculate the concentration of solutions in mol dm–3 (H) ● Carry out titrations and titration calculations (H) ● Calculate the percentage yield and describe why it is never 100% ● Calculate atom economy ● Explain why a particular reaction pathway is chosen (H) ● Describe molar volume and calculate reaction masses/volumes (H) ● Describe the Haber process and how to change the position of equilibrium & rate using reaction conditions ● Recall the importance of ammonia ● Compare laboratory and industrial preparation of ammonium sulfate ● Recall how a chemical cell works and the products of a H_2-O_2 fuel cell ● Evaluate the strengths and weaknesses of fuel cells	● Provide the formulae & structures of alkanes, alkenes, alcohols and carboxylic acids. Identify their functional groups. ● Explain the terms saturated and unsaturated hydrocarbons, and their identification using bromine water ● Describe complete combustion ● Investigate the energy of fuels ● Recall how carboxylic acids are produced from alcohols ● Define an homologous series ● Describe the production of ethanol by fermentation & distillation ● Explain what polymers & monomers are (including addition and condensation polymers) ● Link use of polymer to properties ● Describe polymers environmental issues and evaluate their recycling ● Recall DNA and starch are polymers	● Describe tests to identify metal ions, non-metal ions and ammonia ● Describe the benefits of instrumental methods of analysis ● Evaluate data from a flame photometer ● Compare the size of nanoparticles atoms and molecules ● Describe how the properties of nanoparticulate materials are related to their uses & explain the possible risks associated with them ● Compare the physical properties of materials and link to their uses
Disciplinary				
Literacy	Tier 3 keywords Extended Writing Reading Comprehension Dual Coding	Tier 3 keywords Extended Writing Reading Comprehension Dual Coding	Tier 3 keywords Extended Writing Reading Comprehension Dual Coding	Tier 3 keywords Extended Writing Reading Comprehension Dual Coding

Numeracy	5b	1a, 1b, 1c, 1d, 2a, 2b, 3a, 3b, 3c	1a, 1c, 2c, 5b	1b, 1c, 1d, 2c, 2h, 4a, 5c
Personal Development	Career Links	Career Links	Career Links	Career Links
Assessment Pattern	40 mark end of topic test (covers SC9-13)	40 mark end of topic test	40 mark end of topic test	40 mark end of topic test
	Paper 1 & Paper 2 mocks in November/December (75 marks) Paper 2 mock March (100 marks)			

Mathematical skills

Details of the mathematical skills in other science subjects are given for reference.

1	**Arithmetic and Numerical Computation**
a	Recognise and use expressions in decimal form
b	Recognise and use expressions in standard form
c	Use ratios, fractions and percentages
d	Make estimates of the results of simple calculations
2	**Handling Data**
a	Use an appropriate number of significant figures
b	Find arithmetic means
c	Construct and interpret frequency tables and diagrams, bar charts and histograms
d	Understand the principles of sampling as applied to scientific data
e	Understand simple probability
f	Understand the terms mean, mode and median
g	Use a scatter diagram to identify a correlation between two variables
h	Make order of magnitude calculations
3	**Algebra**
a	Understand and use the symbols: =, <, <<, >>,>, ∝, ~
b	Change the subject of an equation
c	Substitute numerical values into algebraic equations using appropriate units for physical quantities
d	Solve simple algebraic equations
4	**Graphs**
a	Translate information between graphical and numeric form
b	Understand that $y = mx + c$ represents a linear relationship

c	Plot two variables from experimental or other data
d	Determine the slope and intercept of a linear graph
e	Draw and use the slope of a tangent to a curve as a measure of rate of change
f	Understand the physical significance of area between a curve and the *x*-axis and measure it by counting squares as appropriate
5	**Geometry and Trigonometry**
a	Use angular measures in degrees
b	Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects
c	Calculate areas of triangles and rectangles, surface areas and volumes of cubes

Working Scientifically

The GCSE in Chemistry requires students to develop the skills, knowledge and understanding of working scientifically. Working scientifically will be assessed through examination and the completion of the core practical tasks.

1 Development of scientific thinking a Understand how scientific methods and theories develop over time. b Use a variety of models, such as representational, spatial, descriptive, computational and mathematical, to solve problems, make predictions and to develop scientific explanations and an understanding of familiar and unfamiliar facts. c Appreciate the power and limitations of science, and consider any ethical issues that may arise. d 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. e Evaluate risks both in practical science and the wider societal context, including perception of risk in relation to data and consequences. f Recognise the importance of peer review of results and of communicating results to a range of audiences. **2 Experimental skills and strategies** a Use scientific theories and explanations to develop hypotheses. b Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena. c Apply a knowledge of a range of techniques, instruments, apparatus and materials to select those appropriate to the experiment. d Carry out experiments appropriately, having due regard to the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. e Recognise when to apply a knowledge of sampling techniques to ensure any samples collected are representative. f Make and record observations and measurements using a range of apparatus and methods. g Evaluate methods and suggest possible improvements and further investigations.	**3 Analysis and evaluation** Apply the cycle of collecting, presenting and analysing data, including: a presenting observations and other data using appropriate methods. b translating data from one form to another. c carrying out and representing mathematical and statistical analysis. d representing distributions of results and making estimations of uncertainty. e interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions. f presenting reasoned explanations, including relating data to hypotheses. g being objective, evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error. h 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. **4 Scientific vocabulary, quantities, units, symbols and nomenclature** a Use scientific vocabulary, terminology and definitions. b Recognise the importance of scientific quantities and understand how they are determined. c Use SI units (e.g. kg, g, mg; km, m, mm; kJ, J) and IUPAC chemical nomenclature unless inappropriate. d Use prefixes and powers of ten for orders of magnitude (e.g. tera, giga, mega, kilo, centi, milli, micro and nano). e Interconvert units. f Use an appropriate number of significant figures in calculation.

Working scientifically skill areas 1 and 4 will be developed throughout the course and integrated with content. Skill areas 2 and 3 will be developed through teaching of core practical tasks. The details of provision for skill areas 2 and 3 are evidenced within the core practical task schemes of learning.
Scientific literacy is subsumed within working scientifically. Schemes of Learning are detailed with key terminology and support the development of effective scientific communication.

Subject: Chemistry **Year group: 12**

Topic	Elements of Life	Developing Fuels	Elements from the Sea	Ozone	What's in a Medicine
Prior Knowledge	KS4 prior learning ● The periodic table ● Atomic structure ● Chemical bonding ● Chemical equations ● EMS ● Relative atomic mass, relative formula mass ● Chemical formulae ● Acids ● Precipitation	KS4 prior learning ● Simple organic chemistry and homologous series ● Useful products from crude oil ● Combustion of alkanes ● Exo and endothermic reactions ● Bond enthalpies ● Sources of atmospheric pollutants ● Catalysis	KS4 prior learning & year 12 ● halogens ● oxidation and reduction ● electrolysis ● dynamic equilibria ● moles (EL) ● structure of the atom (EL) ● covalent bonding (EL, DF) ● Periodic table (EL)	KS4 prior learning & year 12 ● Rates of reaction ● How catalysts work ● Covalent bonding ● Moles and quantitative chemistry (DF) ● EMS (EL) ● Electronic structure (EL) ● Simple organic molecules (DF) ● Enthalpy changes and bond enthalpies (DF) ● Oxidation states (ES) ● Catalysis (DF)	From previous year 12: ● Hydrogen bonding (OZ) ● Alcohols (DF) ● Oxidation (ES) ● Alkenes (DF) Equilibria (ES) ● Acids (EL) ● The interaction of radiation with matter (EL/OZ) ● Bond polarity (OZ) ● Mass spectrometry (EL) ● Atom economy (ES)
Knowledge	● EL1: atomic structure, mass spectrometry, nuclear fusion (EL a, h, g, x) ● EL2: wave & particle models of lights (EL v, w) ● EL3: shells, subshells and orbitals (EL e, f) ● EL4: periodicity (EL f, m, n) ● EL5: covalent bonding and shapes of molecules (EL I, j, k) ● EL6: RAM, RFM, percentage yield, balanced equations (EL a, b, d) ● EL7: bonding, structure, properties and precipitates (EL d, s, t, j, l) ● EL8: group 1 and group 2 chemistry (EL m, q, p, u, r) ● EL9: reacting masses, acids and bases, neutralisation and concentrations (EL b, t, c)	● DF1: thermochemistry (DF d, f, a) ● DF2: enthalpy cycles and Hess's Law (DF g, f) ● DF3: alkanes and shapes of molecules (DF l, m, r) ● DF4: bond enthalpies (DF e, g) ● DF5: catalysis & cracking (DFj, h, i) ● DF6: electrophilic addition, sigma & pi bonds (DFb,m, o, q) ● DF7: addition polymerisation (DF p) ● DF8: Combustion of fuels, gas calculations, ideal gas equation (DF a) ● DF9: shapes of molecules, organic structures, E/Z isomerism (DF c, s, t, m) ● DF10: polluting gases (DF k, n) ● DF11:alternative fuels (DFu, k)	● ES1: Chemistry of the halogens (ES h, I, j, k) ● ES2: Oxidation states and redox (ES b, d, e, f, g) ● ES3: Electrolysis (ES b, c) ● ES4: Dynamic equilibrium and the equilibrium constant (ES o, p, q) ● ES5: Redox, titrations, risk and benefits of chlorine (ES n, f) ● ES6: Atom economy and hydrogen halides (ES, a, l, m) ● ES7: Le Chatelier's principle (ES q)	● OZ1: Gas calculations (OZ I, s, r) ● OZ2: Interactions of radiation with matter (OZ t, u, s, r) ● OZ3: Radical reactions (OZ o, p) ● OZ4: Measuring rates of reaction and the effect of temperature on reaction rates (OZ e, f) ● OZ5: Homogeneous catalysis (OZ f, g, h, q) ● OZ6: Haloalkanes and intermolecular bonding (OZ j, a, b, d, k) ● OZ7: Hydrogen Bonding (OZ c) ● OZ8: Nucleophilic substitution (OZ j, k, l, m, n, q)	WM1: Reactions of alcohols (WM a,b,d, f, h) WM2: The OH group in different environments and derivatives of carboxylic acids (WM a, c) WM3: Infrared spectroscopy (WM j) WM4: Mass spectrometry for organic compounds (WM i) WM5: Synthesis of salicylic acid and aspirin with the principles of green chemistry (WM d, e, f)

Math Skills	M0.0, 0.1, 0.2, 1.1, 1.2, 1.3, 2.2, 2.3, 2.4,	M0.0, 0.1, 0.4, 1.1, 2.2, 2.3, 2.4, 3.1, 3.2, 4.2, 4.3	M0.1, 0.2, 0.3, 2.1	M0.0, 0.1, 3.2	M0.2, 3.1
Assessment Pattern	1 x interim test (50 marks) 1 x End of topic test (5o marks)	1 x interim test (50 marks) 1 x End of topic test (5o marks)	1 x End of topic test (5o marks)	1 x End of topic test (5o marks)	1 x End of topic test (5o marks)
	End of year Exam (70 marks)				

Subject: Chemistry Year group: 13

Topic	**The Chemical Industry**	**Polymers and Life**	**Developing Metals**	**Colour by Design**	**Oceans**
Prior Knowledge	● Bond enthalpies (DF) ● Redox reactions and oxidation states (ES) ● Equilibria and equibrium contants)ES) ● Rates of reaction (OZ) ● Calcualtions involving amount of substance (EL) ● Catalysis (OZ)	● Addition polymers (DF) ● Carboxylic acids, aldehydes, ketones and phenols (WM) ● Formation of esters (WM) ● Stereoisomerism (DF) ● Chromatography (WM) ● Intermolecular bonds (OZ) ● Catalysis (DF, OZ, CI) ● Mass spectrometry (EL, WM)	● Electron energy levels (EL, ES) ● Atomic absorption and emission spectra (EL) ● Redox reactions and oxidation states (ES) ● Chemical equilibria (OZ, CI) ● Catalysis (DF, OZ, PL)	● Origin of colour in coloured complexes (DM) ● Sigma and pi bonds (DF) ● VSPR and shapes of molecules (EL) ● Enthalpy changes (DF) ● Organic functional groups and nomenclature (DF, OZ, WM, PL) ● Esters and ester formation (WM, PL) ● Electrophiles (DF) ● Nucleophiles (OZ) ● Organic mechanisms using curly arrows (DF, OZ) ● Intermolecular bonding (OZ, PL) ● Chromatography (WM) ● Organic synthesis (WM) ● Carbonyl compounds (WM) ● Addition, elimination, substitution reactions (DF, WM, OZ)	Ionic bonding (EL) Acids and bases (EL) Enthalpy changes (DF) Intermolecular bonds (OZ) Chemical equilibria (ES) Equilibrium constants (CI, ES)

Knowledge	● CI1: Nitrogen chemistry and redox reactions (Spec: CI j) ● CI2: Equilibrium constants and the effects os changes in conditions (Spec: CI h, f) ● CI3: Measuring rates of reaction (Spec: CI a, c) ● CI4: Orders of reactions and the use of the Arrhenius Equation (Spec: CI a, d) ● CI5: Finding orders using a half-life method and the link between rate equations and mechanisms (Spec: CI b, c, e) ● CI6: A case study of industrial process (Spec: CI I, g, k)	● PL1: Carboxylic acids, phenols, esters and condensation reactions (Spec: PL k, o, p, h) ● PL2: Amines, acyl chlorides and the formation of amides (Spec: PL k, j, l, m) ● PL3: Hydorlysis of esters and amides (Spec: PL k, m) ● PL4: Aminoacids, optical isomerism and the formation of peptide bonds (Spec: PL a, I, q, b) ● PL5: Protein structure and the bonds that determine the different levels of structure (Spec: PL b) ● PL6: The catalytic behaviour of enzymes (Spec: PL g, f) ● PL7: Interactions between drugs and receptor sites (Spec: PL e) ● PL8: The structure and function of DNA and RNA (Spec: PL c, d) ● PL9: Mass spectrometry, NMR, bringing together all spectroscopic techniques (Spec: PL, r, s, t)	DM1: Introduction to transition metals and their oxidation states (Spec: DM, a, g, h) DM2: Transition metals as catalysts (Spec DM l) DM3: Colour in transition metal compounds and complexes (Spec: DM g, k, m, i, j, n) DM4: Electrochemical cells (Spec: DM c, d, e, f) DM5: Rusting and methods of protection (Spec: DM f) DM6: Structure and properties of complexes (Spec: DM b, I , j)	● CD1: the origin of colour in organic molecules (Spec: CD m) ● CD2: evidence for the delocalised model of benzene (Spec: CD e) ● CD3: Naming molecules containing benzene rings (Spec: CD d) ● CD4: Electophilic substitution reactions (Spec: CD g, d) ● CD5: Making and modifying dye molecules (Spec: CD g, h, b) ● CD6: Dye fiber interactions (Spec: CD a) ● CD7: The strture of triglyceride molecules (Spec: CD c) ● CD8: GC/LC (Spec: CD n) ● CD9: Reactions of aldehydes and ketones and their mechanisms (Spec: CD i. k) ● CD10: recognising functional groups and using functional group interconversion in synthesis (Spec: CD f, j) ● CD11: Classifying organic reactions and devising synthetic routes (Spec: CD l)	O1: Dissolving processes (Spec O c, b, a) O2: the greenhouse effect and and acid-base chemistry (Spec O n, I, j, k, l) O3: buffer solutions (Spec O m) O4: solubility products (Spec O h) O5: Entropy changes (Spec O d, e, f, g)
Math Skills	M0.0, 0.3, 2.2,2.3, 2.4, 2.5, 3.1, 3.2, 3.3, 3.4, 3.5	M3.1, 4.2, 4.3	M0.1, 0.2, 1.1, 2.2, 2.3, 3.1, 3.2		M0.0, 0.1, 0.4, 2.2, 2.3, 2.4, 2.5
Assessment Pattern	1 x End of topic test (5o marks)	1 x End of topic test (5o marks)	1 x End of topic test (5o marks)	1 x End of topic test (5o marks)	1 x End of topic test (5o marks)
	End of year Exam (70 marks)				

Mathematical Skills

M0 - Arithmetic and numerical computation		
M0.0	Recognise and make use of appropriate units in calculation	Learners may be tested on their ability to: convert between units e.g. cm3 to dm3 as partb of volumetric calculations give units for an equilibrium constants 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.
M0.1	Recognise and use expressions in decimal and ordinary form	Learners may be tested on their ability to: use an appropriate number of decimal places in calculations; carry out calculations using numbers in standard and ordinary form, e.g. use of Avogadro's constant; understand standard form when applied to areas such as (but not limited to) Kw; 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 × 10–3 mol dm–3.
M0.2	Use ratios, fractions and percentages	Learners may be tested on their ability to: calculate percentage yields; calculate the atom economy of a reaction; construct and/or balance equations using ratios.
M0.3	Estimate results	Learners may be tested on their ability to: 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.
M0.4	Use calculators to find and use power, exponential and logarithmic functions	Learners may be tested on their ability to: carry out calculations using the Avogadro constant; carry out pH and pKa calculations; make appropriate mathematical approximations in buffer calculations.
M1 - Handling Data		
M1.1	Use an appropriate number of significant figures	Learners may be tested on their ability to: 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.
M1.2	Find arithmetic means	Learners may be tested on their ability to: 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.
M1.3	Identify uncertainties in measurements and use simple techniques to determine uncertainty when data are combined	Learners may be tested on their ability to: determine uncertainty when two burette readings are used to calculate a titre value.
M2 - Algebra		
M2.1	Understand and use the symbols: =, <, <<, >>, >, proportionality, approximately equal to, ⇌	No exemplification required.
M2.2	Change the subject of an equation	Learners may be tested on their ability to: carry out structured and unstructured mole calculations; calculate a rate constant k from a rate equation.

M2.3	Substitute numerical values into algebraic equations using appropriate units for physical quantities	Learners may be tested on their ability to: carry out enthalpy change calculations; carry out rate calculations; calculate the value of an equilibrium constant Kc.
M2.4	Solve algebraic equations	Learners may be tested on their ability to: carry out Hess' law calculations; calculate a rate constant k from a rate equation.
M2.5	Use logarithms in relation to quantities that range over several orders of magnitude	Learners may be tested on their ability to: carry out pH and pKa calculations.
M3 - Graphs		
M3.1	Translate information between graphical, numerical and algebraic forms	Learners may be tested on their ability to: interpret and analyse spectra; determine the order of a reaction from a graph and derive rate expression.
M3.2	Plot two variables from experimental or other data	Learners may be tested on their ability to: plot graphs from collected or supplied data to follow the course of a reaction; draw lines of best fit; extrapolate and interpolate; construct calibration curves.
M3.3	Determine the slope and intercept of a linear graph	Learners may be tested on their ability to: calculate values for Ea and A from the gradient and intercept of a graph using the Arrhenius equation.
M3.4	Calculate rate of change from a graph showing a linear relationship	Learners may be tested on their ability to: calculate the rate constant of a first-order reaction by determination of the gradient of a rate–concentration graph.
M3.5	Draw and use the slope of a tangent to a curve as a measure of rate of change	Learners may be tested on their ability to: calculate the rate of a reaction from the gradient of a concentration–time graph for a first or second order reaction.
M4 - Geometry and trigonometry		
M4.1	Use angles and shapes in regular 2-D and 3-D structures	Learners may be tested on their ability to: predict/identify shapes of and bond angles in molecules with and without a lone pair(s), for example NH3, CH4, H2O etc.
M4.2	Visualise and represent 2-D and 3-D forms including 2-D representations of 3-D objects	Learners may be tested on their ability to: draw different forms of isomers; identify chiral centres from a 2-D or 3-D representation.
M4.3	Understand the symmetry of 2-D and 3-D shapes	Learners may be tested on their ability to: describe the types of stereoisomerism shown by molecules/complexes; identify chiral centres from a 2-D or 3-D representation.