# Switching AQA GCSE (9-1) Chemistry to OCR GCSE (9-1) Gateway Chemistry A

## Introduction

Are you currently teaching the AQA GCSE sciences? Are you thinking of switching? We are here to help.

We will provide you with all the support you could need to switch from the AQA GCSE Chemistry qualification to our OCR GCSE Chemistry A, including:

* Mapping of AQA’s specification to OCR’s specification
* An overview of the differences in assessment
* Mapping of the AQA textbook to OCR’s specification

## Our offer

* Our GCSE (9-1) Gateway Chemistry A qualification has been created by our subject specialist team working with a number of stakeholders including: OCR Science Consultative Forum, teachers, assessors, Higher Education Institutions and learned societies. It has been created to be a qualification which engages students so they achieve their full potential.
* Our GCSE team are passionate about both science and education. With industry, teaching and assessment experience, they are fully committed to supporting centres’ delivery of our GCSE qualifications.
* We have produced a wide range of support materials, such as handbooks (including maths skills), delivery guides, practical activities and end of topic quizzes. We have a selection of practice papers which can be used as mock papers in preparation for the exams and we have a free and user-friendly tool - ExamBuilder - that you can use to create customised papers for students.
* Within this document as well as mapping the specifications, we also provide textbook mapping – illustrating how you can use your existing AQA textbooks to teach the OCR specification; making it easier for you to use the resources you already have.
* Join our conversations on the OCR Community and @ocr\_science on Twitter to discuss and share good practice.

## Key differences

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| **OCR GCSE (9-1) Gateway Chemistry A** | **AQA GCSE (9-1) Chemistry** |
| **8 flexible practical** activities -select from our suggested activities or use your own preferred practical activities. | 8 required practical activities you have to deliver. |
| In each assessment students have 1 hour and 45 minutes to complete **90** marks worth of questions | In each assessment students have 1 hour and 45 minute to complete **100** marks worth of questions. |
| 15 marks of multiple choice questions at the start of each paper. | Some multiple choice questions scattered throughout papers. |
| 1 x 6 mark level of response question per paper. | Not a set number, but **more than one** 6 mark level of response question on all sample assessment material. |

## Content mapping

The content within the OCR GCSE (9-1) in Chemistry A (Gateway) covers the key concepts of chemistry and will be very familiar. We’ve laid it out in a logical progression to support teaching the GCSE in a linear way.

Below is a table to show where AQA Chemistry content is covered in the OCR Gateway Chemistry specification.

| **AQA Chemistry (8462)** | **OCR Chemistry A (Gateway Science)** | **Additional content in AQA Chemistry** |
| --- | --- | --- |
| 4.1.1 A simple model of the atom, symbols, relative atomic mass, electronic charge and isotopes | C1.1 The Particle Model  C1.2 Atomic Structure  C2.1 Purity and separating mixtures  C2.2 Bonding |  |
| 4.1.2 The periodic table | C2.2 Bonding  C4.1 Predicting chemical reactions |  |
| 4.1.3 Properties of transition metals (chemistry only) | C4.1 Predicting chemical reactions | AQA goes into more detail about transition metals: Students should be able to describe the difference compared with Group 1 in melting points, densities, strength, hardness and reactivity with oxygen, water and halogens. Many transition elements have ions with different charges, form coloured compounds and are useful as catalysts. Students should be able to exemplify these general properties by reference to compounds of Cr, Mn, Fe, Co, Ni, Cu. |
| 4.2.1 Chemical bonds, ionic, covalent and metallic | C2.2 Bonding |  |
| 4.2.2 How bonding and structure are related to the properties of substances | C1.1 The particle model  C2.2 Bonding  C2.3 Properties of materials  C3.1 Introducing chemical reactions  C6.1 Improving processes and products |  |
| 4.2.3 Structure and bonding of carbon | C2.3 Properties of materials |  |
| 4.2.4 Bulk and surface properties of matter including nanoparticles (chemistry only) | C2.3 Properties of materials |  |
| 4.3.1 Chemical measurements, conservation of mass and the quantitative interpretation of chemical equations | C3.1 Introducing chemical reactions  C5.1 Monitoring chemical reactions | AQA makes these more explicit:  •represent the distribution of results and make estimations of uncertainty  •use the range of a set of measurements about the mean as a  measure of uncertainty. |
| 4.3.2 Use of amount of substance in relation to masses of pure substances | C3.1 Introducing chemical reactions  C5.1 Monitoring chemical reactions |  |
| 4.3.3 Yield and atom economy of chemical reactions (chemistry only | C3.1 introducing chemical reactions  C5.1 Monitoring chemical reactions |  |
| 4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only) | C5.1 Monitoring chemical reactions |  |
| 4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only) | C5.1 Monitoring chemical reactions |  |
| 4.4.1 Reactivity of metals | C4.1 Predicting chemical reactions |  |
| 4.4.2 Reactions of acids | C4.1 Predicting chemical reactions |  |
| 4.4.3 Electrolysis | C3.4 Electrolysis  C6.1 Improving processes and products |  |
| 4.5.1 Exothermic and endothermic reactions | C3.2 Energetics |  |
| 4.5.2 Chemical cells and fuel cells (chemistry only) | C6.2 Organic Chemistry |  |
| 4.6.1 Rate of reaction | C5.2 Controlling reactions |  |
| 4.6.2 Reversible reactions and dynamic equilibrium | C5.2 Controlling reactions |  |
| 4.7.1 Carbon compounds as fuels and feedstock | C6.2 Organic Chemistry |  |
| 4.7.2 Reactions of alkenes and alcohols (chemistry only) | C6.2 Organic Chemistry |  |
| 4.7.3 Synthetic and naturally occurring polymers (chemistry only) | C6.2 Organic Chemistry |  |
| 4.8.1 Purity, formulations and chromatography | C2.1 Purity and separating mixtures |  |
| 4.8.2 Identification of common gases | C4.2 Identifying the products of chemical reactions |  |
| 4.8.3 Identification of ions by chemical and spectroscopic means (chemistry only) | C4.2 Identifying the products of chemical reactions |  |
| 4.9.1 The composition and evolution of the Earth's atmosphere | C6.3 Interpreting and interacting with Earth systems |  |
| 4.9.2 Carbon dioxide and methane as greenhouse gases | C6.3 Interpreting and interacting with Earth systems |  |
| 4.9.3 Common atmospheric pollutants and their sources | C6.3 Interpreting and interacting with Earth systems |  |
| 4.10.1 Using the Earth's resources and obtaining potable water | C6.3 Interpreting and interacting with Earth systems |  |
| 4.10.2 Life cycle assessment and recycling | C6.1 Improving processes and products |  |
| 4.10.3 Using materials (chemistry only) | C6.1 Improving processes and products |  |
| 4.10.4 The Haber process and the use of NPK fertilisers  (chemistry only) | C6.1 Improving processes and products |  |

## Assessment

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| **OCR GCSE (9-1) Gateway Chemistry A** | **AQA GCSE (9-1) Chemistry** |
| **Paper 1 (Foundation) or Paper 3 (Higher)**  **Assessed: Topics 1-3 and 7**  Time allowed: 1 hour 45 minutes  Foundation and Higher tier available  Marks 90 marks  Weighting 50% of GCSE  Question types:  Section A: 15 x Multiple choice  Section B: structured, closed short answer and 1 x 6 mark level of response | **Paper 1**  **Assessed: Topics 1-5**  Time allowed: 1 hour 45 minutes  Foundation and Higher tier available  Marks: 100 marks  Weighting: 50% of GCSE  Question types: Multiple choice, structured, closed short answer and open response |
| **Paper 2 (Foundation) or Paper 4 (Higher)**  **Assessed: Topics 4-6 and 7 (may draw knowledge from topics 1-3).**  Foundation and Higher tier available  Marks 90 marks  Weighting 50% of GCSE  Question types:  Section A: 15 x Multiple choice  Section B: structured, closed short answer and 1 x 6 mark level of response | **Paper 2**  **Assessed: Topics 6-10 (may draw on knowledge from topics 1-5)**  Time allowed: 1 hour 45 minutes  Foundation and Higher tier available  Marks: 100 marks  Weighting: 50% of GCSE  Question types: Multiple choice, structured, closed short answer and open response. |

## Using the AQA textbook

Below you will find all the information you need to start teaching OCR GCSE (9-1) Gateway Chemistry A while still using the new AQA textbooks. We have mapped our specification to the AQA OUP, Hodder and Collins textbooks to save you having to buy another set of textbooks. We also have endorsed textbooks for use with our specification and details of these textbooks can be found on the qualification page on the OCR website.

## AQA OUP textbook mapping

 indicates content is for separate science chemistry only

| **Specification statement** | **Chapter covering specification statement** | **Page number** | **Comments** | |
| --- | --- | --- | --- | --- |
| **Topic C1 Particles** | | | | |
| **C1.1 The particle model** | | | | |
| C1.1a describe the main features of the particle model in terms of states of matter and change of state | C3 Structure and bonding | 36-37 |  | |
| C1.1b explain in terms of the particle model the distinction between physical changes and chemical changes | C3 Structure and bonding | 37 |  | |
| **C1.1c explain the limitations of the particle model in relation to changes of state when particles are represented by inelastic spheres (e.g. like bowling balls)** | C3 Structure and bonding | 37 |  | |
| CM1.1i represent three-dimensional shapes in two dimensions and vice versa when looking at chemical structures, e.g. allotropes of carbon | C3 Structure and bonding | 44/47 |  | |
| **C1.2 Atomic structure** | | | | |
| C1.2a describe how and why the atomic model has changed over time | C1 Atomic Structure | 12 |  | |
| C1.2b describe the atom as a positively charged nucleus surrounded by negatively charged electrons, with the nuclear radius much smaller than that of the atom and with most of the mass in the nucleus | C1 Atomic Structure | 14 |  | |
| C1.2c recall the typical size (order of magnitude) of atoms and small molecules | C1 Atomic structure | 16 | Very briefly covered. | |
| C1.2d recall relative charges and approximate relative masses of protons, neutrons and electrons | C1 Atomic structure | 14 |  | |
| C1.2e calculate numbers of protons, neutrons and electrons in atoms and ions, given atomic number and mass number of isotopes | C1 Atomic structure | 15 |  | |
| CM1.2i relate size and scale of atoms to objects in the physical world | C1 Atomic structure | 16 | Very briefly covered. | |
| CM1.2ii  estimate size and scale of atoms and nanoparticles | C3 Structure and bonding | 56 |  | |
| **Topic C2 Elements, compounds and mixtures** | | | | |
| **C2.1 Purity and separating mixtures** | | | | |
| C2.1a explain what is meant by the purity of a substance, distinguishing between the scientific and everyday use of the term ‘pure’ | C12 Chemical Analysis | 181 |  | |
| C2.1b use melting point data to distinguish pure from impure substances | C12 Chemical Analysis | 180 |  | |
| C2.1c calculate relative formula masses of species separately and in a balanced chemical equation | C4 Chemical Calculations | 62 |  | |
| C2.1d deduce the empirical formula of a compound from the relative numbers of atoms present or from a model or diagram and vice versa | C3 Structure and bonding | 47 |  | |
| C2.1e explain that many useful materials are formulations of mixtures | C15 - Using our resources |  | Throughout chapter. | |
| C2.1f describe, explain and exemplify the processes of filtration, crystallisation, simple distillation, and fractional distillation | C1 Atomic structure | 8 |  | |
| C2.1g describe the techniques of paper and thin layer chromatography | C12 Chemical Analysis | 183 | No mention of aqueous and non-aqueous solvents or locating agents. | |
| C2.1h recall that chromatography involves a stationary and a mobile phase and that separation depends on the distribution between the phases | C12 Chemical Analysis | 182 | TLC not mentioned. | |
| C2.1i interpret chromatograms, including measuring Rf values | C12 Chemical Analysis | 183 |  | |
| C2.1j suggest suitable purification techniques given information about the substances involved | C1 Atomic structure | 8 |  | |
| C2.1k suggest chromatographic methods for distinguishing pure from impure substances | C12 Chemical Analysis | 183 |  | |
| CM2.1i arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry | C4 Chemical Calculations | 66 |  | |
| CM2.1ii provide answers to an appropriate number of significant figures |  |  | Not explicit in book. | |
| CM2.1iii change the subject of a mathematical equation | C4 Chemical Calculations | 66 |  | |
| CM2.1iv arithmetic computation and ratio when determining empirical formulae, balancing equations | C4 Chemical Calculations | 66 |  | |
| **C2.2 Bonding** | | | | |
| C2.2a describe metals and non-metals and explain the differences between them on the basis of their characteristic physical and chemical properties | C2 The Periodic Table | 24 |  | |
| C2.2b explain how the atomic structure of metals and non-metals relates to their position in the periodic table | C2 The Periodic Table | 24 |  | |
| C2.2c explain how the position of an element in the periodic table is related to the arrangement of electrons in its atoms and hence to its atomic number | C2 The Periodic Table | 22/23-24 |  | |
| C2.2d describe and compare the nature and arrangement of chemical bonds in: i. ionic compounds  ii. simple molecules iii. giant covalent structures  iv. polymers  v. metals | C3 Structure and bonding | 46 | Metals C3 pg 53, Polymers C15 pg 225 | |
| C2.2e explain chemical bonding in terms of electrostatic forces and the transfer or sharing of electrons | C3 Structure and bonding | 40 |  | |
| C2.2f construct dot and cross diagrams for simple covalent and binary ionic substances | C3 Structure and bonding | 39 / 44 |  | |
| C2.2g describe the limitations of particular representations and models to include dot and cross diagrams, ball and stick models and two- and three-dimensional representations | C3 Structure and bonding | 46 |  | |
| C2.2h explain how the reactions of elements are related to the arrangement of electrons in their atoms and hence to their atomic number | C2 The Periodic Table | 24 |  | |
| C2.2i explain in terms of atomic number how Mendeleev’s arrangement was refined into the modern periodic table | C2 The Periodic Table | 22 |  | |
| CM2.2i  estimate size and scale of atoms and nanoparticles | C3 Structure and bonding | 56 |  | |
| CM2.2ii represent three-dimensional shapes in two dimensions and vice versa when looking at chemical structures, e.g. allotropes of carbon | C3 Structure and bonding | 44/47 |  | |
| CM2.2iii translate information between diagrammatic and numerical forms | C3 Structure and bonding | 46 |  | |
| **C2.3 Properties of materials** | | | | |
| C2.3a recall that carbon can form four covalent bonds |  |  | Nowhere specific. | |
| C2.3b explain that the vast array of natural and synthetic organic compounds occur due to the ability of carbon to form families of similar compounds, chains and rings |  |  | Nowhere specific. | |
| C2.3c explain the properties of diamond, graphite, fullerenes and graphene in terms of their structures and bonding | C3 Structure and bonding | 49 |  | |
| C2.3d use ideas about energy transfers and the relative strength of chemical bonds and intermolecular forces to explain the different temperatures at which changes of state occur | C9 - Crude oil and fuels | 36 | Also C3 page 47 | |
| C2.3e use data to predict states of substances under given conditions | C3 Structure and bonding | 60 | Appears in Summary Questions. | |
| C2.3f explain how the bulk properties of materials (ionic compounds; simple molecules; giant covalent structures; polymers and metals) are related to the different types of bonds they contain, their bond strengths in relation to intermolecular forces and the ways in which their bonds are arranged | C3 Structure and bonding | 46 |  | |
| C2.3g  compare ‘nano’ dimensions to typical dimensions of atoms and molecules | C3 Structure and bonding | 56 |  | |
| C2.3h  describe the surface area to volume relationship for different-sized particles and describe how this affects properties | C3 Structure and bonding | 57 |  | |
| C2.3i  describe how the properties of nanoparticulate materials are related to their uses | C3 Structure and bonding | 56 |  | |
| C2.3j  explain the possible risks associated with some nanoparticulate materials | C3 Structure and bonding | 59 |  | |
| CM2.3i represent three-dimensional shapes in two dimensions and vice versa when looking at chemical structures, e.g. allotropes of carbon | C3 Structure and bonding | 44/47 |  | |
| CM2.3ii  relate size and scale of atoms to objects in the physical world | C1 Atomic structure | 16 | Very briefly covered. | |
| CM2.3iii  estimate size and scale of atoms and nanoparticles | C3 Structure and bonding | 56 |  | |
| CM2.3iv  interpret, order and calculate with numbers written in standard form when dealing with nanoparticles | C3 Structure and bonding | 57 |  | |
| CM2.3v  use ratios when considering relative sizes and surface area to volume comparisons | C3 Structure and bonding | 57 |  | |
| CM2.3vi  calculate surface areas and volumes of cubes | C3 Structure and bonding | 57 |  | |
| **Topic C3 Chemical reactions** | | | | |
| **C3.1 Introducing chemical reactions** | | | | |
| C3.1a use chemical symbols to write the formulae of elements and simple covalent and ionic compounds | C1 Atomic structure | 6 |  | |
| C3.1b use the names and symbols of common elements and compounds and the principle of conservation of mass to write formulae and balanced chemical equations **and half equations** | C1 Atomic structure | 6 | C6 Electrolysis | |
| C3.1c use the names and symbols of common elements from a supplied periodic table to write formulae and balanced chemical equations where appropriate | C1 Atomic structure | 6 |  | |
| C3.1d use the formula of common ions to deduce the formula of a compound | C3 Structure and bonding | 41 |  | |
| **C3.1e construct balanced ionic equations** | C1 Atomic structure | 6 | Ionic equations also mentioned C5 Chem Changes pg 87 : C4 Chemical Calculations Chapter also covers all this to Higher level | |
| C3.1f describe the physical states of products and reactants using state symbols (s, l, g and aq) | C1 Atomic structure | 6 |  | |
| **C3.1g recall and use the definitions of the Avogadro constant (in standard form) and of the mole** | C4 Chemical Calculations | 62 |  | |
| **C3.1h explain how the mass of a given substance is related to the amount of that substance in moles and vice versa** | C4 Chemical Calculations | 62 |  | |
| C3.1i recall and use the law of conservation of mass | C1 Atomic structure | 6 |  | |
| C3.1j explain any observed changes in mass in non-enclosed systems during a chemical reaction and explain them using the particle model | C1 Atomic structure | 6 |  | |
| **C3.1k deduce the stoichiometry of an equation from the masses of reactants and products and explain the effect of a limiting quantity of a reactant** | C4 Chemical Calculations | 67 |  | |
| **C3.1l use a balanced equation to calculate masses of reactants or products** | C4 Chemical Calculations | 64 |  | |
| CM3.1i arithmetic computation and ratio when determining empirical formulae, balancing equations | C4 Chemical Calculations | 66 |  | |
| **CM3.1ii calculations with numbers written in standard form when using the Avogadro constant** | C4 Chemical Calculations | 63 |  | |
| CM3.1iii provide answers to an appropriate number of significant figures |  |  | Not explicit in book. | |
| CM3.1iv convert units where appropriate **particularly from mass to moles** | C4 Chemical Calculations | 64 |  | |
| **C3.2 Energetics** | | | | |
| C3.2a distinguish between endothermic and exothermic reactions on the basis of the temperature change of the surroundings | C7 Energy Changes | 113 |  | |
| C3.2b draw and label a reaction profile for an exothermic and an endothermic reaction | C7 Energy Changes | 116 |  | |
| C3.2c explain activation energy as the energy needed for a reaction to occur | C7 Energy Changes | 117 |  | |
| **C3.2d calculate energy changes in a chemical reaction by considering bond making and bond breaking energies** | C7 Energy Changes | 118 |  | |
| CM3.2i interpretation of charts and graphs when dealing with reaction profiles | C7 Energy Changes | 117 |  | |
| CM3.2ii arithmetic computation when calculating energy changes | C7 Energy Changes | 119 |  | |
| **C3.3 Types of chemical reactions** | | | | |
| C3.3a explain reduction and oxidation in terms of loss or gain of oxygen, identifying which species are oxidised and which are reduced |  |  | Not explicit in book. | |
| **C3.3b explain reduction and oxidation in terms of gain or loss of electrons, identifying which species are oxidised and which are reduced** | C5 Chemical Changes | 87 |  | |
| C3.3c recall that acids form hydrogen ions when they dissolve in water and solutions of alkalis contain hydroxide ions | C5 Chemical Changes | 99 |  | |
| C3.3d describe neutralisation as acid reacting with alkali or a base to form a salt plus water | C5 Chemical Changes | 92 |  | |
| C3.3e recognise that aqueous neutralisation reactions can be generalised to hydrogen ions reacting with hydroxide ions to form water | C5 Chemical Changes | 96 |  | |
| C3.3f recall that carbonates and some metals react with acids and write balanced equations predicting products from given reactants | C5 Chemical Changes | 95 |  | |
| **C3.3g use and explain the terms dilute and concentrated (amount of substance) and weak and strong (degree of ionisation) in relation to acids** | C5 Chemical Changes | 98 |  | |
| C3.3h recall that relative acidity and alkalinity are measured by pH | C5 Chemical Changes | 96 |  | |
| **C3.3i describe neutrality and relative acidity and alkalinity in terms of the effect of the concentration of hydrogen ions on the numerical value of pH (whole numbers only)** | C5 Chemical Changes | 99 |  | |
| **C3.3j recall that as hydrogen ion concentration increases by a factor of ten the pH value of a solution decreases by a factor of one** | C5 Chemical Changes | 99 |  | |
| C3.3k describe techniques and apparatus used to measure pH | C4 Chemical Changes | 148 |  | |
| CM3.3i arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry | C4 Chemical Calculations | 66 |  | |
| **C3.4 Electrolysis** | | | | |
| C3.4a recall that metals (or hydrogen) are formed at the cathode and non-metals are formed at the anode in electrolysis using inert electrodes | C6 Electrolysis | 103 |  | |
| C3.4b predict the products of electrolysis of binary ionic compounds in the molten state | C6 Electrolysis | 103 |  | |
| C3.4c describe competing reactions in the electrolysis of aqueous solutions of ionic compounds in terms of the different species present | C6 Electrolysis | 105 |  | |
| C3.4d describe electrolysis in terms of the ions present and reactions at the electrodes | C6 Electrolysis | 102 |  | |
| C3.4e describe the technique of electrolysis using inert and non-inert electrodes | C6 Electrolysis | 102 |  | |
| CM3.4i arithmetic computation and ratio when determining empirical formulae, balancing equations | C4 Chemical Calculations | 66 |  | |
| **Topic C4 Predicting and identifying reactions and products** | | | | |
| **C4.1 Predicting chemical reactions** | | | | |
| C4.1a recall the simple properties of Groups 1, 7 and 0 | C2 The Periodic Table | 30 |  | |
| C4.1b explain how observed simple properties of Groups 1, 7 and 0 depend on the outer shell of electrons of the atoms and predict properties from given trends down the groups | C2 The Periodic Table | 30 |  | |
| C4.1c  recall the general properties of transition metals and their compounds and exemplify these by reference to a small number of transition metals | C2 The Periodic Table | 32 |  | |
| C4.1d predict possible reactions and probable reactivity of elements from their positions in the periodic table | C2 The Periodic Table | 30 |  | |
| C4.1e explain how the reactivity of metals with water or dilute acids is related to the tendency of the metal to form its positive ion | C5 Chemical Changes | 87 |  | |
| C4.1f deduce an order of reactivity of metals based on experimental results | C5 Chemical Changes | 84-87 |  | |
| CM4.1i arithmetic computation and ratio when determining empirical formulae, balancing equations | C4 Chemical Calculations | 66 |  | |
| **C4.2 Identifying the products of chemical reactions** | | | | |
| C4.2a describe tests to identify selected gases | C12 Chemical Analysis | 185 |  | |
| C4.2b  describe tests to identify aqueous cations and aqueous anions | C12 Chemical Analysis | 185 |  | |
| C4.2c  describe how to perform a flame test | C12 Chemical Analysis | 186 |  | |
| C4.2d  identify species from test results | C12 Chemical Analysis | 186 |  | |
| C4.2e  interpret flame tests to identify metal ions | C12 Chemical Analysis | 186 |  | |
| C4.2f  describe the advantages of instrumental methods of analysis | C12 Chemical Analysis | 190 |  | |
| C4.2g  interpret an instrumental result given appropriate data in chart or tabular form, when accompanied by a reference set of data in the same form | C12 Chemical Analysis | 190 |  | |
| CM4.2i  interpret charts, particularly in spectroscopy | C12 Chemical Analysis | 193 | Flame emission spectrum comparison question. | |
| **Topic C5 Monitoring and controlling chemical reactions** | | | | |
| **C5.1 Monitoring chemical reactions** | | | | |
| **C5.1a  explain how the concentration of a solution in mol/dm3 is related to the mass of the solute and the volume of the solution** | C4 Chemical Calculations | 72 |  | |
| C5.1b  describe the technique of titration | C4 Chemical Calculations | 74 |  | |
| **C5.1c  explain the relationship between the volume of a solution of known concentration of a substance and the volume or concentration of another substance that react completely together** | C4 Chemical Calculations | 76 |  | |
| **C5.1d  describe the relationship between molar amounts of gases and their volumes and vice versa** | C4 Chemical Calculations | 78 |  | |
| **C5.1e  calculate the volumes of gases involved in reactions using the molar gas volume at room temperature and pressure (assumed to be 24dm3)** | C4 Chemical Calculations | 79 |  | |
| **C5.1f explain how the mass of a solute and the volume of the solution is related to the concentration of the solution** | C4 Chemical Calculations | 72 |  | |
| C5.1g  calculate the theoretical amount of a product from a given amount of reactant | C4 Chemical Calculations | 68 |  | |
| C5.1h  calculate the percentage yield of a reaction product from the actual yield of a reaction | C4 Chemical Calculations | 69 |  | |
| C5.1i  define the atom economy of a reaction | C4 Chemical Calculations | 70 |  | |
| C5.1j  calculate the atom economy of a reaction to form a desired product from the balanced equation | C4 Chemical Calculations | 70 |  | |
| **C5.1k  explain why a particular reaction pathway is chosen to produce a specified product given appropriate data** | C4 Chemical Calculations | 70 |  | |
| **CM5.1i calculations with numbers written in standard form when using the Avogadro constant** | C4 Chemical Calculations | 63 |  | |
| CM5.1ii  provide answers to an appropriate number of significant figures |  |  | Not explicit in book. | |
| CM5.1iii  convert units where appropriate **particularly from mass to moles** | C4 Chemical Calculations | 64 |  | |
| CM5.1iv  arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry | C4 Chemical Calculations | 66 |  | |
| CM5.1v  arithmetic computation when calculating yields and atom economy | C4 Chemical Calculations | 69 |  | |
| CM5.1vi  change the subject of a mathematical equation | C4 Chemical Calculations | 66 |  | |
| **C5.2 Controlling reactions** | | | | |
| C5.2a suggest practical methods for determining the rate of a given reaction | C8 Rates and equilibrium | 128 |  | |
| C5.2b interpret rate of reaction graphs | C8 Rates and equilibrium | 128 |  | |
| C5.2c describe the effect of changes in temperature, concentration, pressure, and surface area on rate of reaction | C8 Rates and equilibrium | 130 |  | |
| C5.2d explain the effects on rates of reaction of changes in temperature, concentration and pressure in terms of frequency and energy of collision between particles | C8 Rates and equilibrium | 132-135 |  | |
| C5.2e explain the effects on rates of reaction of changes in the size of the pieces of a reacting solid in terms of surface area to volume ratio | C8 Rates and equilibrium | 130 |  | |
| C5.2f describe the characteristics of catalysts and their effect on rates of reaction | C8 Rates and equilibrium | 136 |  | |
| C5.2g identify catalysts in reactions | C8 Rates and equilibrium | 136 |  | |
| C5.2h explain catalytic action in terms of activation energy | C8 Rates and equilibrium | 136 |  | |
| C5.2i recall that enzymes act as catalysts in biological systems |  |  | Not explicit in book. | |
| CM5.2i arithmetic computation, ratio when measuring rates of reaction | C8 Rates and equilibrium | 131 |  | |
| CM5.2ii drawing and interpreting appropriate graphs from data to determine rate of reaction | C8 Rates and equilibrium | 128 |  | |
| CM5.2iii determining gradients of graphs as a measure of rate of change to determine rate | C8 Rates and equilibrium | 128 |  | |
| CM5.2iv proportionality when comparing factors affecting rate of reaction | C8 Rates and equilibrium | 131 |  | |
| **C5.3 Equilibria** | | | | |
| C5.3a recall that some reactions may be reversed by altering the reaction conditions | C8 Rates and equilibrium | 138 |  | |
| C5.3b recall that dynamic equilibrium occurs in a closed system when the rates of forward and reverse reactions are equal | C8 Rates and equilibrium | 142 |  | |
| **C5.3c predict the effect of changing reaction conditions on equilibrium position and suggest appropriate conditions to produce as much of a particular product as possible** | C8 Rates and equilibrium | 144 |  | |
| CM5.3i arithmetic computation, ratio when measuring rates of reaction | C8 Rates and equilibrium | 131 |  | |
| CM5.3ii drawing and interpreting appropriate graphs from data to determine rate of reaction | C8 Rates and equilibrium | 128 |  | |
| CM5.3iii determining gradients of graphs as a measure of rate of change to determine rate | C8 Rates and equilibrium | 128 |  | |
| CM5.3iv proportionality when comparing factors affecting rate of reaction | C8 Rates and equilibrium | 131 |  | |
| **Topic C6 Global challenges** | | | | |
| **C6.1 Improving processes and products** | | | | |
| C6.1a explain, using the position of carbon in the reactivity series, the principles of industrial processes used to extract metals, including extraction of a non-ferrous metal | C5 Chemical Changes | 88 |  | |
| C6.1b explain why and how electrolysis is used to extract some metals from their ores | C6 Electrolysis | 106 |  | |
| **C6.1c evaluate alternative biological methods of metal extraction** | C14 The Earth's resources | 212 |  | |
| **C6.1d  explain the trade-off between rate of production of a desired product and position of equilibrium in some industrially important processes** | C15 - Using our resources | 230 |  | |
| **C6.1e  interpret graphs of reaction conditions versus rate** | C8 Rates and equilibrium | 128 |  | |
| **C6.1f  explain how the commercially used conditions for an industrial process are related to the availability and cost of raw materials and energy supplies, control of equilibrium position and rate** | C15 - Using our resources | 230 |  | |
| C6.1g  explain the importance of the Haber process in agricultural production | C15 - Using our resources | 228 |  | |
| C6.1h  compare the industrial production of fertilisers with laboratory syntheses of the same products | C15 - Using our resources | 232-235 |  | |
| C6.1i  recall the importance of nitrogen, phosphorus and potassium compounds in agricultural production | C15 - Using our resources |  | Throughout chapter. | |
| C6.1j  describe the industrial production of fertilisers as several integrated processes using a variety of raw materials | C15 - Using our resources | 234 |  | |
| C6.1k describe the basic principles in carrying out a life-cycle assessment of a material or product | C14 The Earth's resources | 214 |  | |
| C6.1l interpret data from a life-cycle assessment of a material or product |  |  | Not explicit in book. | |
| C6.1m describe a process where a material or product is recycled for a different use, and explain why this is viable |  |  | No recycling specific to PET. | |
| C6.1n evaluate factors that affect decisions on recycling | C14 The Earth's resources | 216 |  | |
| C6.1o  describe the composition of some important alloys in relation to their properties and uses | C15 - Using our resources | 222 |  | |
| C6.1p  describe the process of corrosion and the conditions which cause corrosion | C15 - Using our resources | 220 |  | |
| C6.1q  explain how mitigation of corrosion is achieved by creating a physical barrier to oxygen and water and by sacrificial protection | C15 - Using our resources | 220 |  | |
| C6.1r  compare quantitatively the physical properties of glass and clay ceramics, polymers, composites and metals | C15 - Using our resources | 222-227 |  | |
| C6.1s  explain how the properties of materials are related to their uses and select appropriate materials given details of the usage required | C15 - Using our resources | 222-227 |  | |
| CM6.1i arithmetic computation, ratio when measuring rates of reaction | C8 Rates and equilibrium | 131 |  | |
| CM6.1ii drawing and interpreting appropriate graphs from data to determine rate of reaction | C8 Rates and equilibrium | 128 |  | |
| CM6.1iii  determining gradients of graphs as a measure of rate of change to determine rate | C8 Rates and equilibrium | 128 |  | |
| CM6.1iv  proportionality when comparing factors affecting rate of reaction | C8 Rates and equilibrium | 131 |  | |
| **C6.2 Organic chemistry** | | | | |
| C6.2a  recognise functional groups and identify members of the same homologous series | C10 Organic reactions | 158-165 |  | |
| C6.2b  name and draw the structural formulae, using fully displayed formulae, of the first four members of the straight chain alkanes, alkenes, alcohols and carboxylic acids | C10 Organic reactions | 158-165 |  | |
| C6.2c  predict the formulae and structures of products of reactions of the first four and other given members of the homologous series of alkanes, alkenes and alcohols | C10 Organic reactions | 158-165 |  | |
| C6.2d  recall the basic principles of addition polymerisation by reference to the functional group in the monomer and the repeating units in the polymer | C10 Organic reactions | 158-165 |  | |
| **C6.2e  explain the basic principles of condensation polymerisation** | C11 Polymers | 170 |  | |
| **C6.2f  describe practical techniques to make a polymer by condensation** |  |  |  | |
| C6.2g  deduce the structure of an addition polymer from a simple alkene monomer and vice versa | C11 Polymers | 169 |  | |
| C6.2h  recall that DNA is a polymer made from four different monomers called nucleotides and that other important naturally-occurring polymers are based on sugars and amino-acids | C11 Polymers | 174 |  | |
| C6.2i  recall that it is the generality of reactions of functional groups that determine the reactions of organic compounds | C10 Organic reactions | 158-165 |  | |
| C6.2j describe the separation of crude oil by fractional distillation | C9 - Crude oil and fuels | 150 |  | |
| C6.2k explain the separation of crude oil by fractional distillation | C9 - Crude oil and fuels | 150 |  | |
| C6.2l describe the fractions as largely a mixture of compounds of formula CnH2n+2 which are members of the alkane homologous series | C9 - Crude oil and fuels | 149 |  | |
| C6.2m recall that crude oil is a main source of hydrocarbons and is a feedstock for the petrochemical industry | C9 - Crude oil and fuels | 148 |  | |
| C6.2n explain how modern life is crucially dependent upon hydrocarbons and recognise that crude oil is a finite resource | C9 - Crude oil and fuels | 148 |  | |
| C6.2o describe the production of materials that are more useful by cracking | C9 - Crude oil and fuels | 154 |  | |
| C6.2p  recall that a chemical cell produces a potential difference until the reactants are used up | C7 Energy Changes | 120 |  | |
| C6.2q  evaluate the advantages and disadvantages of hydrogen/oxygen and other fuel cells for given uses | C7 Energy Changes | 122 |  | |
| CM6.2i  represent three-dimensional shapes in two dimensions and vice versa when looking at chemical structures, e.g. allotropes of carbon | C3 Structure and bonding | 44/47 |  | |
| **C6.3 Interpreting and interacting with Earth systems** | | | | |
| C6.3a interpret evidence for how it is thought the atmosphere was originally formed | C13 The Earth's atmosphere | 194-195 | |  |
| C6.3b describe how it is thought an oxygen-rich atmosphere developed over time | C13 The Earth's atmosphere | 194 | |  |
| C6.3c describe the greenhouse effect in terms of the interaction of radiation with matter within the atmosphere | C13 The Earth's atmosphere | 198 | |  |
| C6.3d evaluate the evidence for additional anthropogenic (human activity) causes of climate change and describe the uncertainties in the evidence base | C13 The Earth's atmosphere | 199 | |  |
| C6.3e describe the potential effects of increased levels of carbon dioxide and methane on the Earth’s climate and how these effects may be mitigated | C13 The Earth's atmosphere | 200 | |  |
| C6.3f describe the major sources of carbon monoxide, sulfur dioxide, oxides of nitrogen and particulates in the atmosphere and explain the problems caused by increased amounts of these substances | C13 The Earth's atmosphere | 200-202 | |  |
| C6.3g describe the principal methods for increasing the availability of potable water in terms of the separation techniques used | C14 The Earth's resources | 208 | |  |
| CM6.3i extract and interpret information from charts, graphs and tables | C13 The Earth's atmosphere | 199 | |  |
| CM6.3ii use orders of magnitude to evaluate the significance of data | C13 The Earth's atmosphere | 199 | |  |

## AQA Collins textbook mapping

| **Specification statement** | **Chapter covering specification statement** | **Page number** | **Comments** |
| --- | --- | --- | --- |
| **Topic C1 Particles** | | | |
| **C1.1 The particle model** | | | |
| C1.1a describe the main features of the particle model in terms of states of matter and change of state | C2 Structure, bonding and the properties of matter | 68 |  |
| C1.1b explain in terms of the particle model the distinction between physical changes and chemical changes | C2 Structure, bonding and the properties of matter | 68 |  |
| **C1.1c explain the limitations of the particle model in relation to changes of state when particles are represented by inelastic spheres (e.g. like bowling balls)** | C2 Structure, bonding and the properties of matter | 69 |  |
| CM1.1i represent three-dimensional shapes in two dimensions and vice versa when looking at chemical structures, e.g. allotropes of carbon | C2 Structure, bonding and the properties of matter | 90 |  |
| **C1.2 Atomic structure** | | | |
| C1.2a describe how and why the atomic model has changed over time | C1 Atomic structure and the periodic table | 20 |  |
| C1.2b describe the atom as a positively charged nucleus surrounded by negatively charged electrons, with the nuclear radius much smaller than that of the atom and with most of the mass in the nucleus | C1 Atomic structure and the periodic table | 22 |  |
| C1.2c recall the typical size (order of magnitude) of atoms and small molecules | C2 Structure, bonding and the properties of matter | 88 |  |
| C1.2d recall relative charges and approximate relative masses of protons, neutrons and electrons | C1 Atomic structure and the periodic table | 24 |  |
| C1.2e calculate numbers of protons, neutrons and electrons in atoms and ions, given atomic number and mass number of isotopes | C1 Atomic structure and the periodic table | 26 |  |
| CM1.2i relate size and scale of atoms to objects in the physical world | C2 Structure, bonding and the properties of matter | 88 |  |
| CM1.2ii  estimate size and scale of atoms and nanoparticles | C2 Structure, bonding and the properties of matter | 86 |  |
| **Topic C2 Elements, compounds and mixtures** | | | |
| **C2.1 Purity and separating mixtures** | | | |
| C2.1a explain what is meant by the purity of a substance, distinguishing between the scientific and everyday use of the term ‘pure’ | C8 Chemical Analysis | 264 |  |
| C2.1b use melting point data to distinguish pure from impure substances | C8 Chemical Analysis | 264 |  |
| C2.1c calculate relative formula masses of species separately and in a balanced chemical equation | C3 Chemical quantities and calculations | 100 |  |
| C2.1d deduce the empirical formula of a compound from the relative numbers of atoms present or from a model or diagram and vice versa | C3 Chemical quantities and calculations | 91 |  |
| C2.1e explain that many useful materials are formulations of mixtures | C8 Chemical Analysis | 266 |  |
| C2.1f describe, explain and exemplify the processes of filtration, crystallisation, simple distillation, and fractional distillation | C1 Atomic structure and the periodic table | 18 |  |
| C2.1g describe the techniques of paper and thin layer chromatography | C8 Chemical Analysis | 263 |  |
| C2.1h recall that chromatography involves a stationary and a mobile phase and that separation depends on the distribution between the phases | C8 Chemical Analysis | 268 |  |
| C2.1i interpret chromatograms, including measuring Rf values | C8 Chemical Analysis | 268 |  |
| C2.1j suggest suitable purification techniques given information about the substances involved | C4 Chemical Changes | 146 |  |
| C2.1k suggest chromatographic methods for distinguishing pure from impure substances | C8 Chemical Analysis | 268 |  |
| CM2.1i arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry | C3 Chemical quantities and calculations | 110 |  |
| CM2.1ii provide answers to an appropriate number of significant figures |  |  | Not explicit. |
| CM2.1iii change the subject of a mathematical equation | C3 Chemical quantities and calculations | 124 |  |
| CM2.1iv arithmetic computation and ratio when determining empirical formulae, balancing equations | C3 Chemical quantities and calculations | 110 | Use of ratios but not for empirical formulae. |
| **C2.2 Bonding** | | | |
| C2.2a describe metals and non-metals and explain the differences between them on the basis of their characteristic physical and chemical properties | C1 Atomic structure and the periodic table | 34 |  |
| C2.2b explain how the atomic structure of metals and non-metals relates to their position in the periodic table | C1 Atomic structure and the periodic table | 36 |  |
| C2.2c explain how the position of an element in the periodic table is related to the arrangement of electrons in its atoms and hence to its atomic number | C1 Atomic structure and the periodic table | 30 |  |
| C2.2d describe and compare the nature and arrangement of chemical bonds in: i. ionic compounds ii. simple molecules iii. giant covalent structures iv. polymers v. metals | C2 Structure, bonding and the properties of matter | 56-64 |  |
| C2.2e explain chemical bonding in terms of electrostatic forces and the transfer or sharing of electrons | C2 Structure, bonding and the properties of matter | 60 |  |
| C2.2f construct dot and cross diagrams for simple covalent and binary ionic substances | C2 Structure, bonding and the properties of matter | 64 | C1 Atomic structure and the periodic table. |
| C2.2g describe the limitations of particular representations and models to include dot and cross diagrams, ball and stick models and two- and three-dimensional representations | C2 Structure, bonding and the properties of matter | 69 |  |
| C2.2h explain how the reactions of elements are related to the arrangement of electrons in their atoms and hence to their atomic number | C1 Atomic structure and the periodic table | 28 |  |
| C2.2i explain in terms of atomic number how Mendeleev’s arrangement was refined into the modern periodic table | C1 Atomic structure and the periodic table | 32 |  |
| CM2.2i  estimate size and scale of atoms and nanoparticles | C2 Structure, bonding and the properties of matter | 86 |  |
| CM2.2ii represent three-dimensional shapes in two dimensions and vice versa when looking at chemical structures, e.g. allotropes of carbon | C2 Structure, bonding and the properties of matter | 90 |  |
| CM2.2iii translate information between diagrammatic and numerical forms | C2 Structure, bonding and the properties of matter | 90 |  |
| **C2.3 Properties of materials** | | | |
| C2.3a recall that carbon can form four covalent bonds | C2 Structure, bonding and the properties of matter | 76-84 |  |
| C2.3b explain that the vast array of natural and synthetic organic compounds occur due to the ability of carbon to form families of similar compounds, chains and rings | C2 Structure, bonding and the properties of matter | 76-84 |  |
| C2.3c explain the properties of diamond, graphite, fullerenes and graphene in terms of their structures and bonding | C2 Structure, bonding and the properties of matter | 77 | Diamond pg 80, Graphite pg 82, Graphene/Fullerenes pg 84 |
| C2.3d use ideas about energy transfers and the relative strength of chemical bonds and intermolecular forces to explain the different temperatures at which changes of state occur | C7 Hydrocarbons | 231-233 |  |
| C2.3e use data to predict states of substances under given conditions | C2 Structure, bonding and the properties of matter | 68 |  |
| C2.3f explain how the bulk properties of materials (ionic compounds; simple molecules; giant covalent structures; polymers and metals) are related to the different types of bonds they contain, their bond strengths in relation to intermolecular forces and the ways in which their bonds are arranged | C2 Structure, bonding and the properties of matter | 64 |  |
| C2.3g  compare ‘nano’ dimensions to typical dimensions of atoms and molecules | C2 Structure, bonding and the properties of matter | 86 |  |
| C2.3h  describe the surface area to volume relationship for different-sized particles and describe how this affects properties | C2 Structure, bonding and the properties of matter | 87 |  |
| C2.3i  describe how the properties of nano-particulate materials are related to their uses | C2 Structure, bonding and the properties of matter | 87 |  |
| C2.3j  explain the possible risks associated with some nano-particulate materials | C2 Structure, bonding and the properties of matter | 87 |  |
| CM2.3i represent three-dimensional shapes in two dimensions and vice versa when looking at chemical structures, e.g. allotropes of carbon | C2 Structure, bonding and the properties of matter | 90 |  |
| CM2.3ii  relate size and scale of atoms to objects in the physical world | C2 Structure, bonding and the properties of matter | 88 |  |
| CM2.3iii  estimate size and scale of atoms and nanoparticles | C2 Structure, bonding and the properties of matter | 86 |  |
| CM2.3iv  interpret, order and calculate with numbers written in standard form when dealing with nanoparticles | C2 Structure, bonding and the properties of matter | 88 |  |
| CM2.3v  use ratios when considering relative sizes and surface area to volume comparisons | C2 Structure, bonding and the properties of matter | 88 |  |
| CM2.3vi  calculate surface areas and volumes of cubes | C2 Structure, bonding and the properties of matter | 86 |  |
| **Topic C3 Chemical reactions** | | | |
| **C3.1 Introducing chemical reactions** | | | |
| C3.1a use chemical symbols to write the formulae of elements and simple covalent and ionic compounds | C2 Structure, bonding and the properties of matter | 68 |  |
| C3.1b use the names and symbols of common elements and compounds and the principle of conservation of mass to write formulae and balanced chemical equations **and half equations** | C2 Structure, bonding and the properties of matter | 62 | C4 Chemical Changes |
| C3.1c use the names and symbols of common elements from a supplied periodic table to write formulae and balanced chemical equations where appropriate | C3 Chemical quantities and calculations | 98 |  |
| C3.1d use the formula of common ions to deduce the formula of a compound | C2 Structure, bonding and the properties of matter | 62 |  |
| **C3.1e construct balanced ionic equations** | C4 Chemical Changes | 139 |  |
| C3.1f describe the physical states of products and reactants using state symbols (s, l, g and aq) | C2 Structure, bonding and the properties of matter | 68 |  |
| **C3.1g recall and use the definitions of the Avogadro constant (in standard form) and of the mole** | C3 Chemical quantities and calculations | 106 |  |
| **C3.1h explain how the mass of a given substance is related to the amount of that substance in moles and vice versa** | C3 Chemical quantities and calculations | 106 |  |
| C3.1i recall and use the law of conservation of mass | C3 Chemical quantities and calculations | 100 |  |
| C3.1j explain any observed changes in mass in non-enclosed systems during a chemical reaction and explain them using the particle model | C3 Chemical quantities and calculations | 102 |  |
| **C3.1k deduce the stoichiometry of an equation from the masses of reactants and products and explain the effect of a limiting quantity of a reactant** | C6 The rate and extent of chemical change | 196 |  |
| **C3.1l use a balanced equation to calculate masses of reactants or products** | C3 Chemical quantities and calculations | 110 |  |
| CM3.1i arithmetic computation and ratio when determining empirical formulae, balancing equations | C3 Chemical quantities and calculations | 110 | Use of ratios but not for empirical formulae. |
| **CM3.1ii calculations with numbers written in standard form when using the Avogadro constant** | C3 Chemical quantities and calculations | 107 |  |
| CM3.1iii provide answers to an appropriate number of significant figures |  |  | Not explicit. |
| CM3.1iv convert units where appropriate **particularly from mass to moles** | C3 Chemical quantities and calculations | 106 |  |
| **C3.2 Energetics** | | | |
| C3.2a distinguish between endothermic and exothermic reactions on the basis of the temperature change of the surroundings | C5 Energy Changes | 178 |  |
| C3.2b draw and label a reaction profile for an exothermic and an endothermic reaction | C5 Energy Changes | 178 |  |
| C3.2c explain activation energy as the energy needed for a reaction to occur | C5 Energy Changes | 178 |  |
| **C3.2d calculate energy changes in a chemical reaction by considering bond making and bond breaking energies** | C5 Energy Changes | 180 |  |
| CM3.2i interpretation of charts and graphs when dealing with reaction profiles | C5 Energy Changes | 179 |  |
| CM3.2ii arithmetic computation when calculating energy changes | C5 Energy Changes | 180 |  |
| **C3.3 Types of chemical reactions** | | | |
| C3.3a explain reduction and oxidation in terms of loss or gain of oxygen, identifying which species are oxidised and which are reduced | C4 Chemical Changes | 132 and 136 |  |
| **C3.3b explain reduction and oxidation in terms of gain or loss of electrons, identifying which species are oxidised and which are reduced** | C4 Chemical Changes | 138 |  |
| C3.3c recall that acids form hydrogen ions when they dissolve in water and solutions of alkalis contain hydroxide ions | C4 Chemical Changes | 149 |  |
| C3.3d describe neutralisation as acid reacting with alkali or a base to form a salt plus water | C4 Chemical Changes | 140 |  |
| C3.3e recognise that aqueous neutralisation reactions can be generalised to hydrogen ions reacting with hydroxide ions to form water | C4 Chemical Changes | 149 |  |
| C3.3f recall that carbonates and some metals react with acids and write balanced equations predicting products from given reactants | C4 Chemical Changes | 144 |  |
| **C3.3g use and explain the terms dilute and concentrated (amount of substance) and weak and strong (degree of ionisation) in relation to acids** | C4 Chemical Changes | 152 |  |
| C3.3h recall that relative acidity and alkalinity are measured by pH | C4 Chemical Changes | 148 |  |
| **C3.3i describe neutrality and relative acidity and alkalinity in terms of the effect of the concentration of hydrogen ions on the numerical value of pH (whole numbers only)** | C4 Chemical Changes | 148 |  |
| **C3.3j recall that as hydrogen ion concentration increases by a factor of ten the pH value of a solution decreases by a factor of one** | C4 Chemical Changes | 148 |  |
| C3.3k describe techniques and apparatus used to measure pH | C4 Chemical Changes | 148 |  |
| CM3.3i arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry | C3 Chemical quantities and calculations | 110 |  |
| **C3.4 Electrolysis** | | | |
| C3.4a recall that metals (or hydrogen) are formed at the cathode and non-metals are formed at the anode in electrolysis using inert electrodes | C4 Chemical Changes | 156 |  |
| C3.4b predict the products of electrolysis of binary ionic compounds in the molten state | C4 Chemical Changes | 156 |  |
| C3.4c describe competing reactions in the electrolysis of aqueous solutions of ionic compounds in terms of the different species present | C4 Chemical Changes | 161 |  |
| C3.4d describe electrolysis in terms of the ions present and reactions at the electrodes | C4 Chemical Changes | 154 |  |
| C3.4e describe the technique of electrolysis using inert and non-inert electrodes | C4 Chemical Changes | 160 |  |
| CM3.4i arithmetic computation and ratio when determining empirical formulae, balancing equations | C3 Chemical quantities and calculations | 110 | Use of ratios but not for empirical formulae. |
| **Topic C4 Predicting and identifying reactions and products** | | | |
| **C4.1 Predicting chemical reactions** | | | |
| C4.1a recall the simple properties of Groups 1, 7 and 0 | C1 Atomic structure and the periodic table | 47 |  |
| C4.1b explain how observed simple properties of Groups 1, 7 and 0 depend on the outer shell of electrons of the atoms and predict properties from given trends down the groups | C1 Atomic structure and the periodic table | 47 |  |
| C4.1c  recall the general properties of transition metals and their compounds and exemplify these by reference to a small number of transition metals | C1 Atomic structure and the periodic table | 48 |  |
| C4.1d predict possible reactions and probable reactivity of elements from their positions in the periodic table | C1 Atomic structure and the periodic table | 46 |  |
| C4.1e explain how the reactivity of metals with water or dilute acids is related to the tendency of the metal to form its positive ion | C4 Chemical Changes | 135 |  |
| C4.1f deduce an order of reactivity of metals based on experimental results | C4 Chemical Changes | 134 |  |
| CM4.1i arithmetic computation and ratio when determining empirical formulae, balancing equations | C3 Chemical quantities and calculations | 110 | Use of ratios but not for empirical formulae. |
| **C4.2 Identifying the products of chemical reactions** | | | |
| C4.2a describe tests to identify selected gases | C8 Chemical Analysis | 272 |  |
| C4.2b  describe tests to identify aqueous cations and aqueous anions | C8 Chemical Analysis | 276-279 |  |
| C4.2c  describe how to perform a flame test | C8 Chemical Analysis | 274 |  |
| C4.2d  identify species from test results | C8 Chemical Analysis | 274 |  |
| C4.2e  interpret flame tests to identify metal ions | C8 Chemical Analysis | 274 |  |
| C4.2f  describe the advantages of instrumental methods of analysis | C8 Chemical Analysis | 284 |  |
| C4.2g  interpret an instrumental result given appropriate data in chart or tabular form, when accompanied by a reference set of data in the same form | C8 Chemical Analysis | 282 |  |
| CM4.2i  interpret charts, particularly in spectroscopy | C8 Chemical Analysis | 282 |  |
| **Topic C5 Monitoring and controlling chemical reactions** | | | |
| **C5.1 Monitoring chemical reactions** | | | |
| **C5.1a  explain how the concentration of a solution in mol/dm3 is related to the mass of the solute and the volume of the solution** | C3 Chemical quantities and calculations | 113 |  |
| C5.1b  describe the technique of titration | C3 Chemical quantities and calculations | 118 |  |
| **C5.1c  explain the relationship between the volume of a solution of known concentration of a substance and the volume or concentration of another substance that react completely together** | C3 Chemical quantities and calculations | 119 |  |
| **C5.1d  describe the relationship between molar amounts of gases and their volumes and vice versa** | C3 Chemical quantities and calculations | 120 |  |
| **C5.1e  calculate the volumes of gases involved in reactions using the molar gas volume at room temperature and pressure (assumed to be 24dm3)** | C3 Chemical quantities and calculations | 120 |  |
| **C5.1f explain how the mass of a solute and the volume of the solution is related to the concentration of the solution** | C3 Chemical quantities and calculations | 112 |  |
| C5.1g  calculate the theoretical amount of a product from a given amount of reactant | C3 Chemical quantities and calculations | 109 |  |
| C5.1h  calculate the percentage yield of a reaction product from the actual yield of a reaction | C3 Chemical quantities and calculations | 114 |  |
| C5.1i  define the atom economy of a reaction | C3 Chemical quantities and calculations | 116 |  |
| C5.1j  calculate the atom economy of a reaction to form a desired product from the balanced equation | C3 Chemical quantities and calculations | 116 |  |
| **C5.1k  explain why a particular reaction pathway is chosen to produce a specified product given appropriate data** | C3 Chemical quantities and calculations | 116 |  |
| **CM5.1i  calculations with numbers written in standard form when using the Avogadro constant** | C3 Chemical quantities and calculations | 107 |  |
| CM5.1ii  provide answers to an appropriate number of significant figures |  |  | Not explicit. |
| CM5.1iii  convert units where appropriate **particularly from mass to moles** | C3 Chemical quantities and calculations | 106 |  |
| CM5.1iv  arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry | C3 Chemical quantities and calculations | 110 | Throughout chapter 3. |
| CM5.1v  arithmetic computation when calculating yields and atom economy | C3 Chemical quantities and calculations | 114 |  |
| CM5.1vi  change the subject of a mathematical equation | C3 Chemical quantities and calculations | 124 |  |
| **C5.2 Controlling reactions** | | | |
| C5.2a suggest practical methods for determining the rate of a given reaction | C6 The rate and extent of chemical change | 194 |  |
| C5.2b interpret rate of reaction graphs | C6 The rate and extent of chemical change | 198 |  |
| C5.2c describe the effect of changes in temperature, concentration, pressure, and surface area on rate of reaction | C6 The rate and extent of chemical change | 200 |  |
| C5.2d explain the effects on rates of reaction of changes in temperature, concentration and pressure in terms of frequency and energy of collision between particles | C6 The rate and extent of chemical change | 206 |  |
| C5.2e explain the effects on rates of reaction of changes in the size of the pieces of a reacting solid in terms of surface area to volume ratio | C6 The rate and extent of chemical change | 200 |  |
| C5.2f describe the characteristics of catalysts and their effect on rates of reaction | C6 The rate and extent of chemical change | 200 |  |
| C5.2g identify catalysts in reactions | C6 The rate and extent of chemical change | 208 |  |
| C5.2h explain catalytic action in terms of activation energy | C5 Energy Changes | 178 |  |
| C5.2i recall that enzymes act as catalysts in biological systems | C7 Hydrocarbons | 248 | Quick mention in relation to yeast/alcohol otherwise not explicit. |
| CM5.2i arithmetic computation, ratio when measuring rates of reaction | C6 The rate and extent of chemical change | 198 |  |
| CM5.2ii drawing and interpreting appropriate graphs from data to determine rate of reaction | C6 The rate and extent of chemical change | 198 |  |
| CM5.2iii determining gradients of graphs as a measure of rate of change to determine rate | C6 The rate and extent of chemical change | 198 |  |
| CM5.2iv proportionality when comparing factors affecting rate of reaction |  |  | Not explicit. |
| **C5.3 Equilibria** | | | |
| C5.3a recall that some reactions may be reversed by altering the reaction conditions | C6 The rate and extent of chemical change | 210 |  |
| C5.3b recall that dynamic equilibrium occurs in a closed system when the rates of forward and reverse reactions are equal | C6 The rate and extent of chemical change | 212 |  |
| **C5.3c predict the effect of changing reaction conditions on equilibrium position and suggest appropriate conditions to produce as much of a particular product as possible** | C6 The rate and extent of chemical change | 214-219 |  |
| CM5.3i arithmetic computation, ratio when measuring rates of reaction | C6 The rate and extent of chemical change | 198 |  |
| CM5.3ii drawing and interpreting appropriate graphs from data to determine rate of reaction | C6 The rate and extent of chemical change | 198 |  |
| CM5.3iii determining gradients of graphs as a measure of rate of change to determine rate | C6 The rate and extent of chemical change | 198 |  |
| CM5.3iv proportionality when comparing factors affecting rate of reaction |  |  | Not explicit. |
| **Topic C6 Global challenges** | | | |
| **C6.1 Improving processes and products** | | | |
| C6.1a explain, using the position of carbon in the reactivity series, the principles of industrial processes used to extract metals, including extraction of a non-ferrous metal | C4 Chemical Changes | 136 |  |
| C6.1b explain why and how electrolysis is used to extract some metals from their ores | C4 Chemical Changes | 158 |  |
| **C6.1c evaluate alternative biological methods of metal extraction** | C10 Sustainable development | 332 |  |
| **C6.1d  explain the trade-off between rate of production of a desired product and position of equilibrium in some industrially important processes** | C10 Sustainable development | 344 |  |
| **C6.1e  interpret graphs of reaction conditions versus rate** | C6 The rate and extent of chemical change | 198 |  |
| **C6.1f  explain how the commercially used conditions for an industrial process are related to the availability and cost of raw materials and energy supplies, control of equilibrium position and rate** | C10 Sustainable development | 344 |  |
| C6.1g  explain the importance of the Haber process in agricultural production | C10 Sustainable development | 344 |  |
| C6.1h  compare the industrial production of fertilisers with laboratory syntheses of the same products | C10 Sustainable development | 346 |  |
| C6.1i  recall the importance of nitrogen, phosphorus and potassium compounds in agricultural production | C10 Sustainable development | 347 |  |
| C6.1j  describe the industrial production of fertilisers as several integrated processes using a variety of raw materials | C10 Sustainable development | 346 |  |
| C6.1k describe the basic principles in carrying out a life-cycle assessment of a material or product | C10 Sustainable development | 334 |  |
| C6.1l interpret data from a life-cycle assessment of a material or product | C10 Sustainable development | 334 |  |
| C6.1m describe a process where a material or product is recycled for a different use, and explain why this is viable | C10 Sustainable development | 336 | Brief mention of plastic recycling. |
| C6.1n evaluate factors that affect decisions on recycling | C10 Sustainable development | 336 |  |
| C6.1o  describe the composition of some important alloys in relation to their properties and uses | C2 Structure, bonding and the properties of matter | 78 |  |
| C6.1p  describe the process of corrosion and the conditions which cause corrosion | C10 Sustainable development | 338 |  |
| C6.1q  explain how mitigation of corrosion is achieved by creating a physical barrier to oxygen and water and by sacrificial protection | C10 Sustainable development | 338 |  |
| C6.1r  compare quantitatively the physical properties of glass and clay ceramics, polymers, composites and metals | C10 Sustainable development | 342 |  |
| C6.1s  explain how the properties of materials are related to their uses and select appropriate materials given details of the usage required | C10 Sustainable development | 343 |  |
| CM6.1i arithmetic computation, ratio when measuring rates of reaction | C6 The rate and extent of chemical change | 198 |  |
| CM6.1ii drawing and interpreting appropriate graphs from data to determine rate of reaction | C6 The rate and extent of chemical change | 198 |  |
| CM6.1iii  determining gradients of graphs as a measure of rate of change to determine rate | C6 The rate and extent of chemical change | 198 |  |
| CM6.1iv  proportionality when comparing factors affecting rate of reaction |  |  | Not explicit. |
| **C6.2 Organic chemistry** | | | |
| C6.2a  recognise functional groups and identify members of the same homologous series | C7 Hydrocarbons | 238-245 | Alkenes 240, Alcohols 242, Carboxylic Acids 244 |
| C6.2b  name and draw the structural formulae, using fully displayed formulae, of the first four members of the straight chain alkanes, alkenes, alcohols and carboxylic acids | C7 Hydrocarbons | 238-245 | Alkenes 240, Alcohols 242, Carboxylic Acids 244 |
| C6.2c  predict the formulae and structures of products of reactions of the first four and other given members of the homologous series of alkanes, alkenes and alcohols | C7 Hydrocarbons | 238-245 | Alkenes 240, Alcohols 242, Carboxylic Acids 244 |
| C6.2d  recall the basic principles of addition polymerisation by reference to the functional group in the monomer and the repeating units in the polymer | C7 Hydrocarbons | 238-245 | Alkenes 240, Alcohols 242, Carboxylic Acids 244 |
| **C6.2e  explain the basic principles of condensation polymerisation** | C7 Hydrocarbons | 248 |  |
| **C6.2f  describe practical techniques to make a polymer by condensation** |  |  |  |
| C6.2g  deduce the structure of an addition polymer from a simple alkene monomer and vice versa | C7 Hydrocarbons | 246 |  |
| C6.2h  recall that DNA is a polymer made from four different monomers called nucleotides and that other important naturally-occurring polymers are based on sugars and amino-acids | C7 Hydrocarbons | 252 |  |
| C6.2i  recall that it is the generality of reactions of functional groups that determine the reactions of organic compounds | C7 Hydrocarbons | 238-245 | Alkenes 240, Alcohols 242, Carboxylic Acids 244 |
| C6.2j describe the separation of crude oil by fractional distillation | C7 Hydrocarbons | 230 |  |
| C6.2k explain the separation of crude oil by fractional distillation | C7 Hydrocarbons | 230 |  |
| C6.2l describe the fractions as largely a mixture of compounds of formula CnH2n+2 which are members of the alkane homologous series | C7 Hydrocarbons | 228 |  |
| C6.2m recall that crude oil is a main source of hydrocarbons and is a feedstock for the petrochemical industry | C7 Hydrocarbons | 228 |  |
| C6.2n explain how modern life is crucially dependent upon hydrocarbons and recognise that crude oil is a finite resource | C10 Sustainable development | 337 |  |
| C6.2o describe the production of materials that are more useful by cracking | C7 Hydrocarbons | 236 |  |
| C6.2p  recall that a chemical cell produces a potential difference until the reactants are used up | C5 Energy Changes | 182 |  |
| C6.2q  evaluate the advantages and disadvantages of hydrogen/oxygen and other fuel cells for given uses | C5 Energy Changes | 184 |  |
| CM6.2i  represent three-dimensional shapes in two dimensions and vice versa when looking at chemical structures, e.g. allotropes of carbon | C2 Structure, bonding and the properties of matter | 90 |  |
| **C6.3 Interpreting and interacting with Earth systems** | | | |
| C6.3a interpret evidence for how it is thought the atmosphere was originally formed | C9 The atmosphere | 296 |  |
| C6.3b describe how it is thought an oxygen-rich atmosphere developed over time | C9 The atmosphere | 298 |  |
| C6.3c describe the greenhouse effect in terms of the interaction of radiation with matter within the atmosphere | C9 The atmosphere | 302 |  |
| C6.3d evaluate the evidence for additional anthropogenic (human activity) causes of climate change and describe the uncertainties in the evidence base | C9 The atmosphere | 304 |  |
| C6.3e describe the potential effects of increased levels of carbon dioxide and methane on the Earth’s climate and how these effects may be mitigated | C9 The atmosphere | 306-308 |  |
| C6.3f describe the major sources of carbon monoxide, sulfur dioxide, oxides of nitrogen and particulates in the atmosphere and explain the problems caused by increased amounts of these substances | C9 The atmosphere | 312-314 |  |
| C6.3g describe the principal methods for increasing the availability of potable water in terms of the separation techniques used | C10 Sustainable development | 326 |  |
| CM6.3i extract and interpret information from charts, graphs and tables | C10 Sustainable development | 348 |  |
| CM6.3ii use orders of magnitude to evaluate the significance of data | C4 Chemical Changes | 166 |  |

## AQA Hodder textbook mapping

| **Specification statement** | **Chapter covering specification statement** | **Page number** | **Comments** |
| --- | --- | --- | --- |
| **Topic C1 Particles** | | | |
| **C1.1 The particle model** | | | |
| C1.1a describe the main features of the particle model in terms of states of matter and change of state | C2 Bonding, Structure and the properties of matter | 49 |  |
| C1.1b explain in terms of the particle model the distinction between physical changes and chemical changes | C2 Bonding, Structure and the properties of matter | 49 |  |
| **C1.1c explain the limitations of the particle model in relation to changes of state when particles are represented by inelastic spheres (e.g. like bowling balls)** |  |  | Not explicit. |
| CM1.1i represent three-dimensional shapes in two dimensions and vice versa when looking at chemical structures, e.g. allotropes of carbon | C2 Bonding, Structure and the properties of matter | 34 |  |
| **C1.2 Atomic structure** | | | |
| C1.2a describe how and why the atomic model has changed over time | C1 Atomic structure and the periodic table | 7 |  |
| C1.2b describe the atom as a positively charged nucleus surrounded by negatively charged electrons, with the nuclear radius much smaller than that of the atom and with most of the mass in the nucleus | C1 Atomic structure and the periodic table | 2 |  |
| C1.2c recall the typical size (order of magnitude) of atoms and small molecules | C1 Atomic structure and the periodic table | 2 |  |
| C1.2d recall relative charges and approximate relative masses of protons, neutrons and electrons | C1 Atomic structure and the periodic table | 2 |  |
| C1.2e calculate numbers of protons, neutrons and electrons in atoms and ions, given atomic number and mass number of isotopes | C1 Atomic structure and the periodic table | 4 |  |
| CM1.2i relate size and scale of atoms to objects in the physical world | C1 Atomic structure and the periodic table | 3 |  |
| CM1.2ii  estimate size and scale of atoms and nanoparticles | C2 Bonding, Structure and the properties of matter | 51 |  |
| **Topic C2 Elements, compounds and mixtures** | | | |
| **C2.1 Purity and separating mixtures** | | | |
| C2.1a explain what is meant by the purity of a substance, distinguishing between the scientific and everyday use of the term ‘pure’ | C8 Chemical Analysis | 204 |  |
| C2.1b use melting point data to distinguish pure from impure substances | C8 Chemical Analysis | 203 |  |
| C2.1c calculate relative formula masses of species separately and in a balanced chemical equation | C3 Quantitative Chemistry | 68 |  |
| C2.1d deduce the empirical formula of a compound from the relative numbers of atoms present or from a model or diagram and vice versa | C7 Organic Chemistry |  | Alkanes 172, Alkenes 177, Alcohols 181, Carboxylic Acids 183 |
| C2.1e explain that many useful materials are formulations of mixtures | C8 Chemical Analysis | 204 |  |
| C2.1f describe, explain and exemplify the processes of filtration, crystallisation, simple distillation, and fractional distillation | C1 Atomic structure and the periodic table | 22 |  |
| C2.1g describe the techniques of paper and thin layer chromatography | C8 Chemical Analysis | 205 | TLC not explicitly mentioned. |
| C2.1h recall that chromatography involves a stationary and a mobile phase and that separation depends on the distribution between the phases | C8 Chemical Analysis | 205 |  |
| C2.1i interpret chromatograms, including measuring Rf values | C8 Chemical Analysis | 206 |  |
| C2.1j suggest suitable purification techniques given information about the substances involved | C1 Atomic structure and the periodic table | 22 |  |
| C2.1k suggest chromatographic methods for distinguishing pure from impure substances | C8 Chemical Analysis | 268 |  |
| CM2.1i arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry | C3 Quantitative Chemistry | 70 |  |
| CM2.1ii provide answers to an appropriate number of significant figures |  |  | Not explicit. |
| CM2.1iii change the subject of a mathematical equation | C3 Quantitative Chemistry |  | Throughout chapter. |
| CM2.1iv arithmetic computation and ratio when determining empirical formulae, balancing equations |  |  |  |
| **C2.2 Bonding** | | | |
| C2.2a describe metals and non-metals and explain the differences between them on the basis of their characteristic physical and chemical properties | C1 Atomic structure and the periodic table | 10 |  |
| C2.2b explain how the atomic structure of metals and non-metals relates to their position in the periodic table | C1 Atomic structure and the periodic table | 13-19 | Group 0 - pg 13, Group 1- pg 14, Group 7 - pg 18 |
| C2.2c explain how the position of an element in the periodic table is related to the arrangement of electrons in its atoms and hence to its atomic number | C1 Atomic structure and the periodic table | 4 |  |
| C2.2d describe and compare the nature and arrangement of chemical bonds in: i. ionic compounds ii. simple molecules iii. giant covalent structures iv. polymers v. metals | C2 Bonding, Structure and the properties of matter | 33-46 | Not direct comparison but all the information is given to allow comparison. |
| C2.2e explain chemical bonding in terms of electrostatic forces and the transfer or sharing of electrons | C2 Bonding, Structure and the properties of matter | 37 |  |
| C2.2f construct dot and cross diagrams for simple covalent and binary ionic substances | C2 Bonding, Structure and the properties of matter | 42 and 38 |  |
| C2.2g describe the limitations of particular representations and models to include dot and cross diagrams, ball and stick models and two- and three-dimensional representations | C2 Bonding, Structure and the properties of matter | 34 |  |
| C2.2h explain how the reactions of elements are related to the arrangement of electrons in their atoms and hence to their atomic number | C1 Atomic structure and the periodic table | 13-18 | Group 0 - pg 13, Group 1- pg 14, Group 7 - pg 17 |
| C2.2i explain in terms of atomic number how Mendeleev’s arrangement was refined into the modern periodic table | C1 Atomic structure and the periodic table | 20 |  |
| CM2.2i  estimate size and scale of atoms and nanoparticles | C2 Bonding, Structure and the properties of matter | 51 |  |
| CM2.2ii represent three-dimensional shapes in two dimensions and vice versa when looking at chemical structures, e.g. allotropes of carbon | C2 Bonding, Structure and the properties of matter | 34 |  |
| CM2.2iii translate information between diagrammatic and numerical forms | C2 Bonding, Structure and the properties of matter | 34 |  |
| **C2.3 Properties of materials** | | | |
| C2.3a recall that carbon can form four covalent bonds |  |  | Not explicit. |
| C2.3b explain that the vast array of natural and synthetic organic compounds occur due to the ability of carbon to form families of similar compounds, chains and rings | C2 Bonding, Structure and the properties of matter | 54 |  |
| C2.3c explain the properties of diamond, graphite, fullerenes and graphene in terms of their structures and bonding | C2 Bonding, Structure and the properties of matter | 54-55 |  |
| C2.3d use ideas about energy transfers and the relative strength of chemical bonds and intermolecular forces to explain the different temperatures at which changes of state occur | C2 Bonding, Structure and the properties of matter | 39 |  |
| C2.3e use data to predict states of substances under given conditions | C2 Bonding, Structure and the properties of matter | 50 | Questions. |
| C2.3f explain how the bulk properties of materials (ionic compounds; simple molecules; giant covalent structures; polymers and metals) are related to the different types of bonds they contain, their bond strengths in relation to intermolecular forces and the ways in which their bonds are arranged | C2 Bonding, Structure and the properties of matter | 39 |  |
| C2.3g  compare ‘nano’ dimensions to typical dimensions of atoms and molecules | C2 Bonding, Structure and the properties of matter | 51 |  |
| C2.3h  describe the surface area to volume relationship for different-sized particles and describe how this affects properties | C2 Bonding, Structure and the properties of matter | 52 |  |
| C2.3i  describe how the properties of nanoparticulate materials are related to their uses | C2 Bonding, Structure and the properties of matter | 52 |  |
| C2.3j  explain the possible risks associated with some nanoparticulate materials | C2 Bonding, Structure and the properties of matter | 53 |  |
| CM2.3i represent three-dimensional shapes in two dimensions and vice versa when looking at chemical structures, e.g. allotropes of carbon | C2 Bonding, Structure and the properties of matter | 34 |  |
| CM2.3ii  relate size and scale of atoms to objects in the physical world | C1 Atomic structure and the periodic table | 3 |  |
| CM2.3iii  estimate size and scale of atoms and nanoparticles | C2 Bonding, Structure and the properties of matter | 51 |  |
| CM2.3iv  interpret, order and calculate with numbers written in standard form when dealing with nanoparticles | C2 Bonding, Structure and the properties of matter | 51 |  |
| CM2.3v  use ratios when considering relative sizes and surface area to volume comparisons | C2 Bonding, Structure and the properties of matter | 52 |  |
| CM2.3vi  calculate surface areas and volumes of cubes | C2 Bonding, Structure and the properties of matter | 52 |  |
| **Topic C3 Chemical reactions** | | | |
| **C3.1 Introducing chemical reactions** | | | |
| C3.1a use chemical symbols to write the formulae of elements and simple covalent and ionic compounds | C11 Formulae and equations | 277 |  |
| C3.1b use the names and symbols of common elements and compounds and the principle of conservation of mass to write formulae and balanced chemical equations **and half equations** | C11 Formulae and equations | 283 | C4 Chemical Changes |
| C3.1c use the names and symbols of common elements from a supplied periodic table to write formulae and balanced chemical equations where appropriate | C11 Formulae and equations | 283 |  |
| C3.1d use the formula of common ions to deduce the formula of a compound | C2 Bonding, Structure and the properties of matter | 36 |  |
| **C3.1e construct balanced ionic equations** | C3 Quantitative Chemistry | 68 | Also C11 page 283 |
| C3.1f describe the physical states of products and reactants using state symbols (s, l, g and aq) | C11 Formulae and equations | 284 |  |
| **C3.1g recall and use the definitions of the Avogadro constant (in standard form) and of the mole** | C3 Quantitative Chemistry | 65 |  |
| **C3.1h explain how the mass of a given substance is related to the amount of that substance in moles and vice versa** | C3 Quantitative Chemistry | 66 |  |
| C3.1i recall and use the law of conservation of mass | C3 Quantitative Chemistry | 68 |  |
| C3.1j explain any observed changes in mass in non-enclosed systems during a chemical reaction and explain them using the particle model | C3 Quantitative Chemistry | 69 |  |
| **C3.1k deduce the stoichiometry of an equation from the masses of reactants and products and explain the effect of a limiting quantity of a reactant** | C3 Quantitative Chemistry | 73 |  |
| **C3.1l use a balanced equation to calculate masses of reactants or products** | C3 Quantitative Chemistry | 77 |  |
| CM3.1i arithmetic computation and ratio when determining empirical formulae, balancing equations | C3 Quantitative Chemistry | 70 |  |
| **CM3.1ii calculations with numbers written in standard form when using the Avogadro constant** | C3 Quantitative Chemistry | 65 |  |
| CM3.1iii provide answers to an appropriate number of significant figures |  |  | Not explicit. |
| CM3.1iv convert units where appropriate **particularly from mass to moles** | C3 Quantitative Chemistry | 64 |  |
| **C3.2 Energetics** | | | |
| C3.2a distinguish between endothermic and exothermic reactions on the basis of the temperature change of the surroundings | C5 Energy Changes | 129 |  |
| C3.2b draw and label a reaction profile for an exothermic and an endothermic reaction | C5 Energy Changes | 131 |  |
| C3.2c explain activation energy as the energy needed for a reaction to occur | C5 Energy Changes | 131 |  |
| **C3.2d calculate energy changes in a chemical reaction by considering bond making and bond breaking energies** | C5 Energy Changes | 133 |  |
| CM3.2i interpretation of charts and graphs when dealing with reaction profiles | C5 Energy Changes | 131 |  |
| CM3.2ii arithmetic computation when calculating energy changes | C5 Energy Changes | 134 |  |
| **C3.3 Types of chemical reactions** | | | |
| C3.3a explain reduction and oxidation in terms of loss or gain of oxygen, identifying which species are oxidised and which are reduced | C4 Chemical Changes | 99 |  |
| **C3.3b explain reduction and oxidation in terms of gain or loss of electrons, identifying which species are oxidised and which are reduced** | C4 Chemical Changes | 103 |  |
| C3.3c recall that acids form hydrogen ions when they dissolve in water and solutions of alkalis contain hydroxide ions | C4 Chemical Changes | 111 |  |
| C3.3d describe neutralisation as acid reacting with alkali or a base to form a salt plus water | C4 Chemical Changes | 111 |  |
| C3.3e recognise that aqueous neutralisation reactions can be generalised to hydrogen ions reacting with hydroxide ions to form water | C4 Chemical Changes | 111 |  |
| C3.3f recall that carbonates and some metals react with acids and write balanced equations predicting products from given reactants | C4 Chemical Changes | 113 |  |
| **C3.3g use and explain the terms dilute and concentrated (amount of substance) and weak and strong (degree of ionisation) in relation to acids** | C4 Chemical Changes | 109 |  |
| C3.3h recall that relative acidity and alkalinity are measured by pH | C4 Chemical Changes | 107 |  |
| **C3.3i describe neutrality and relative acidity and alkalinity in terms of the effect of the concentration of hydrogen ions on the numerical value of pH (whole numbers only)** | C4 Chemical Changes | 109 |  |
| **C3.3j recall that as hydrogen ion concentration increases by a factor of ten the pH value of a solution decreases by a factor of one** | C4 Chemical Changes | 107 |  |
| C3.3k describe techniques and apparatus used to measure pH | C4 Chemical Changes | 107 |  |
| CM3.3i arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry | C3 Quantitative Chemistry | 70 |  |
| **C3.4 Electrolysis** | | | |
| C3.4a recall that metals (or hydrogen) are formed at the cathode and non-metals are formed at the anode in electrolysis using inert electrodes | C4 Chemical Changes | 117 |  |
| C3.4b predict the products of electrolysis of binary ionic compounds in the molten state | C4 Chemical Changes | 117 |  |
| C3.4c describe competing reactions in the electrolysis of aqueous solutions of ionic compounds in terms of the different species present | C4 Chemical Changes | 120 |  |
| C3.4d describe electrolysis in terms of the ions present and reactions at the electrodes | C4 Chemical Changes | 117 |  |
| C3.4e describe the technique of electrolysis using inert and non-inert electrodes | C4 Chemical Changes | 121 |  |
| CM3.4i arithmetic computation and ratio when determining empirical formulae, balancing equations |  |  |  |
| **Topic C4 Predicting and identifying reactions and products** | | | |
| **C4.1 Predicting chemical reactions** | | | |
| C4.1a recall the simple properties of Groups 1, 7 and 0 | C1 Atomic structure and the periodic table | 13-17 |  |
| C4.1b explain how observed simple properties of Groups 1, 7 and 0 depend on the outer shell of electrons of the atoms and predict properties from given trends down the groups | C1 Atomic structure and the periodic table | 13-17 |  |
| C4.1c  recall the general properties of transition metals and their compounds and exemplify these by reference to a small number of transition metals | C1 Atomic structure and the periodic table | 18 |  |
| C4.1d predict possible reactions and probable reactivity of elements from their positions in the periodic table | C1 Atomic structure and the periodic table | 11 |  |
| C4.1e explain how the reactivity of metals with water or dilute acids is related to the tendency of the metal to form its positive ion | C4 Chemical Changes | 101 |  |
| C4.1f deduce an order of reactivity of metals based on experimental results | C4 Chemical Changes | 99 |  |
| CM4.1i arithmetic computation and ratio when determining empirical formulae, balancing equations |  |  |  |
| **C4.2 Identifying the products of chemical reactions** | | | |
| C4.2a describe tests to identify selected gases | C8 Chemical Analysis | 207 |  |
| C4.2b  describe tests to identify aqueous cations and aqueous anions | C8 Chemical Analysis | 209 |  |
| C4.2c  describe how to perform a flame test | C8 Chemical Analysis | 209 |  |
| C4.2d  identify species from test results | C8 Chemical Analysis | 209 |  |
| C4.2e  interpret flame tests to identify metal ions | C8 Chemical Analysis | 209 |  |
| C4.2f  describe the advantages of instrumental methods of analysis | C8 Chemical Analysis | 214 | No expectation of interpretation. |
| C4.2g  interpret an instrumental result given appropriate data in chart or tabular form, when accompanied by a reference set of data in the same form | C8 Chemical Analysis | 214 |  |
| CM4.2i  interpret charts, particularly in spectroscopy | C8 Chemical Analysis | 214 | No expectation of interpretation. |
| **Topic C5 Monitoring and controlling chemical reactions** | | | |
| **C5.1 Monitoring chemical reactions** | | | |
| **C5.1a  explain how the concentration of a solution in mol/dm3 is related to the mass of the solute and the volume of the solution** | C3 Quantitative Chemistry | 86 |  |
| C5.1b  describe the technique of titration | C3 Quantitative Chemistry | 88 |  |
| **C5.1c  explain the relationship between the volume of a solution of known concentration of a substance and the volume or concentration of another substance that react completely together** | C3 Quantitative Chemistry | 89 |  |
| **C5.1d  describe the relationship between molar amounts of gases and their volumes and vice versa** | C3 Quantitative Chemistry | 82 |  |
| **C5.1e  calculate the volumes of gases involved in reactions using the molar gas volume at room temperature and pressure (assumed to be 24dm3)** | C3 Quantitative Chemistry | 82 |  |
| **C5.1f explain how the mass of a solute and the volume of the solution is related to the concentration of the solution** | C3 Quantitative Chemistry | 86 |  |
| C5.1g  calculate the theoretical amount of a product from a given amount of reactant | C3 Quantitative Chemistry | 78 |  |
| C5.1h  calculate the percentage yield of a reaction product from the actual yield of a reaction | C3 Quantitative Chemistry | 78 |  |
| C5.1i  define the atom economy of a reaction | C3 Quantitative Chemistry | 79 |  |
| C5.1j  calculate the atom economy of a reaction to form a desired product from the balanced equation | C3 Quantitative Chemistry | 79 |  |
| **C5.1k  explain why a particular reaction pathway is chosen to produce a specified product given appropriate data** | C10 Using the Earth's resources | 267 |  |
| **CM5.1i  calculations with numbers written in standard form when using the Avogadro constant** | C3 Quantitative Chemistry | 65 |  |
| CM5.1ii  provide answers to an appropriate number of significant figures |  |  | Not explicit. |
| CM5.1iii  convert units where appropriate **particularly from mass to moles** | C3 Quantitative Chemistry | 64 |  |
| CM5.1iv  arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry | C3 Quantitative Chemistry | 70 |  |
| CM5.1v  arithmetic computation when calculating yields and atom economy | C3 Quantitative Chemistry | 78 |  |
| CM5.1vi  change the subject of a mathematical equation | C3 Quantitative Chemistry |  | Throughout chapter. |
| **C5.2 Controlling reactions** | | | |
| C5.2a suggest practical methods for determining the rate of a given reaction | C6 The rate and extent of chemical change | 156 |  |
| C5.2b interpret rate of reaction graphs | C6 The rate and extent of chemical change | 150 |  |
| C5.2c describe the effect of changes in temperature, concentration, pressure, and surface area on rate of reaction | C6 The rate and extent of chemical change | 152 |  |
| C5.2d explain the effects on rates of reaction of changes in temperature, concentration and pressure in terms of frequency and energy of collision between particles | C6 The rate and extent of chemical change | 151 |  |
| C5.2e explain the effects on rates of reaction of changes in the size of the pieces of a reacting solid in terms of surface area to volume ratio | C6 The rate and extent of chemical change | 153 |  |
| C5.2f describe the characteristics of catalysts and their effect on rates of reaction | C6 The rate and extent of chemical change | 153 |  |
| C5.2g identify catalysts in reactions | C6 The rate and extent of chemical change | 153 |  |
| C5.2h explain catalytic action in terms of activation energy | C6 The rate and extent of chemical change | 153 |  |
| C5.2i recall that enzymes act as catalysts in biological systems | C6 The rate and extent of chemical change | 154 |  |
| CM5.2i arithmetic computation, ratio when measuring rates of reaction | C6 The rate and extent of chemical change | 150 | Questions. |
| CM5.2ii drawing and interpreting appropriate graphs from data to determine rate of reaction | C6 The rate and extent of chemical change | 150 | Questions. |
| CM5.2iii determining gradients of graphs as a measure of rate of change to determine rate | C6 The rate and extent of chemical change | 150 |  |
| CM5.2iv proportionality when comparing factors affecting rate of reaction |  |  | Not obvious. |
| **C5.3 Equilibria** | | | |
| C5.3a recall that some reactions may be reversed by altering the reaction conditions | C6 The rate and extent of chemical change | 158 |  |
| C5.3b recall that dynamic equilibrium occurs in a closed system when the rates of forward and reverse reactions are equal | C6 The rate and extent of chemical change | 159 |  |
| **C5.3c predict the effect of changing reaction conditions on equilibrium position and suggest appropriate conditions to produce as much of a particular product as possible** | C6 The rate and extent of chemical change | 160-164 |  |
| CM5.3i arithmetic computation, ratio when measuring rates of reaction | C6 The rate and extent of chemical change | 150 | Questions. |
| CM5.3ii drawing and interpreting appropriate graphs from data to determine rate of reaction | C6 The rate and extent of chemical change | 150 | Questions. |
| CM5.3iii determining gradients of graphs as a measure of rate of change to determine rate | C6 The rate and extent of chemical change | 150 |  |
| CM5.3iv proportionality when comparing factors affecting rate of reaction |  |  | Not obvious. |
| **Topic C6 Global challenges** | | | |
| **C6.1 Improving processes and products** | | | |
| C6.1a explain, using the position of carbon in the reactivity series, the principles of industrial processes used to extract metals, including extraction of a non-ferrous metal | C4 Chemical Changes | 106 |  |
| C6.1b explain why and how electrolysis is used to extract some metals from their ores | C4 Chemical Changes | 119 |  |
| **C6.1c evaluate alternative biological methods of metal extraction** | C10 Using the Earth's resources | 261 |  |
| **C6.1d  explain the trade-off between rate of production of a desired product and position of equilibrium in some industrially important processes** | C10 Using the Earth's resources | 267 |  |
| **C6.1e  interpret graphs of reaction conditions versus rate** | C6 The rate and extent of chemical change | 150 |  |
| **C6.1f  explain how the commercially used conditions for an industrial process are related to the availability and cost of raw materials and energy supplies, control of equilibrium position and rate** | C10 Using the Earth's resources | 266 |  |
| C6.1g  explain the importance of the Haber process in agricultural production | C10 Using the Earth's resources | 266 |  |
| C6.1h  compare the industrial production of fertilisers with laboratory syntheses of the same products |  |  | No comparison. |
| C6.1i  recall the importance of nitrogen, phosphorus and potassium compounds in agricultural production | C10 Using the Earth's resources | 268 |  |
| C6.1j  describe the industrial production of fertilisers as several integrated processes using a variety of raw materials | C10 Using the Earth's resources | 268 |  |
| C6.1k describe the basic principles in carrying out a life-cycle assessment of a material or product | C10 Using the Earth's resources | 250 |  |
| C6.1l interpret data from a life-cycle assessment of a material or product | C10 Using the Earth's resources | 250 |  |
| C6.1m describe a process where a material or product is recycled for a different use, and explain why this is viable | C10 Using the Earth's resources | 250 |  |
| C6.1n evaluate factors that affect decisions on recycling | C10 Using the Earth's resources | 251 |  |
| C6.1o  describe the composition of some important alloys in relation to their properties and uses | C2 Bonding, Structure and the properties of matter | 46 |  |
| C6.1p  describe the process of corrosion and the conditions which cause corrosion | C10 Using the Earth's resources | 258 |  |
| C6.1q  explain how mitigation of corrosion is achieved by creating a physical barrier to oxygen and water and by sacrificial protection | C10 Using the Earth's resources | 258 |  |
| C6.1r  compare quantitatively the physical properties of glass and clay ceramics, polymers, composites and metals | C10 Using the Earth's resources | 264 | Metals - C2 page 45 |
| C6.1s  explain how the properties of materials are related to their uses and select appropriate materials given details of the usage required | C10 Using the Earth's resources | 264 |  |
| CM6.1i arithmetic computation, ratio when measuring rates of reaction | C6 The rate and extent of chemical change | 150 | Questions. |
| CM6.1ii drawing and interpreting appropriate graphs from data to determine rate of reaction | C6 The rate and extent of chemical change | 150 | Questions. |
| CM6.1iii  determining gradients of graphs as a measure of rate of change to determine rate | C6 The rate and extent of chemical change | 150 |  |
| CM6.1iv  proportionality when comparing factors affecting rate of reaction |  |  | Not obvious. |
| **C6.2 Organic chemistry** | | | |
| C6.2a  recognise functional groups and identify members of the same homologous series | C7 Organic Chemistry |  | Alkanes 172, Alkenes 177, Alcohols 181, Carboxylic Acids 183 |
| C6.2b  name and draw the structural formulae, using fully displayed formulae, of the first four members of the straight chain alkanes, alkenes, alcohols and carboxylic acids | C7 Organic Chemistry |  | Alkanes 172, Alkenes 177, Alcohols 181, Carboxylic Acids 183 |
| C6.2c  predict the formulae and structures of products of reactions of the first four and other given members of the homologous series of alkanes, alkenes and alcohols | C7 Organic Chemistry |  | Alkanes 172, Alkenes 177, Alcohols 181, Carboxylic Acids 183 |
| C6.2d  recall the basic principles of addition polymerisation by reference to the functional group in the monomer and the repeating units in the polymer | C7 Organic Chemistry |  | Alkanes 172, Alkenes 177, Alcohols 181, Carboxylic Acids 183 |
| **C6.2e  explain the basic principles of condensation polymerisation** | C7 Organic Chemistry | 189 |  |
| **C6.2f  describe practical techniques to make a polymer by condensation** |  |  |  |
| C6.2g  deduce the structure of an addition polymer from a simple alkene monomer and vice versa | C7 Organic Chemistry | 187 |  |
| C6.2h  recall that DNA is a polymer made from four different monomers called nucleotides and that other important naturally-occurring polymers are based on sugars and amino-acids | C7 Organic Chemistry | 193 |  |
| C6.2i  recall that it is the generality of reactions of functional groups that determine the reactions of organic compounds | C7 Organic Chemistry |  | Alkanes 172, Alkenes 177, Alcohols 181, Carboxylic Acids 183 |
| C6.2j describe the separation of crude oil by fractional distillation | C7 Organic Chemistry | 173 |  |
| C6.2k explain the separation of crude oil by fractional distillation | C7 Organic Chemistry | 173 |  |
| C6.2l describe the fractions as largely a mixture of compounds of formula CnH2n+2 which are members of the alkane homologous series | C7 Organic Chemistry | 172 |  |
| C6.2m recall that crude oil is a main source of hydrocarbons and is a feedstock for the petrochemical industry | C7 Organic Chemistry | 171 |  |
| C6.2n explain how modern life is crucially dependent upon hydrocarbons and recognise that crude oil is a finite resource | C7 Organic Chemistry | 172 |  |
| C6.2o describe the production of materials that are more useful by cracking | C7 Organic Chemistry | 176 |  |
| C6.2p  recall that a chemical cell produces a potential difference until the reactants are used up | C5 Energy Changes | 136 |  |
| C6.2q  evaluate the advantages and disadvantages of hydrogen/oxygen and other fuel cells for given uses | C5 Energy Changes | 138 |  |
| CM6.2i  represent three-dimensional shapes in two dimensions and vice versa when looking at chemical structures, e.g. allotropes of carbon | C2 Bonding, Structure and the properties of matter | 34 |  |
| **C6.3 Interpreting and interacting with Earth systems** | | | |
| C6.3a interpret evidence for how it is thought the atmosphere was originally formed | C9 Chemistry of the atmosphere | 224 |  |
| C6.3b describe how it is thought an oxygen-rich atmosphere developed over time | C9 Chemistry of the atmosphere | 226 |  |
| C6.3c describe the greenhouse effect in terms of the interaction of radiation with matter within the atmosphere | C9 Chemistry of the atmosphere | 227 |  |
| C6.3d evaluate the evidence for additional anthropogenic (human activity) causes of climate change and describe the uncertainties in the evidence base | C9 Chemistry of the atmosphere | 228 |  |
| C6.3e describe the potential effects of increased levels of carbon dioxide and methane on the Earth’s climate and how these effects may be mitigated | C9 Chemistry of the atmosphere | 232/238 |  |
| C6.3f describe the major sources of carbon monoxide, sulfur dioxide, oxides of nitrogen and particulates in the atmosphere and explain the problems caused by increased amounts of these substances | C9 Chemistry of the atmosphere | 236 |  |
| C6.3g describe the principal methods for increasing the availability of potable water in terms of the separation techniques used | C10 Using the Earth's resources | 252 |  |
| CM6.3i extract and interpret information from charts, graphs and tables |  |  | Not explicit. |
| CM6.3ii use orders of magnitude to evaluate the significance of data |  |  | Not explicit. |

## Want to switch?

If you’re an OCR-approved centre, all you need to do is download the specification and start teaching. Your exams officer can complete an intention to teach form which enables us to provide appropriate support. When you’re ready to enter your students, you just need to speak to your exams officer to:

1. Make estimated entries by 10 October so we can prepare the question papers and ensure we’ve got enough examiners.
2. Make final entries by 21 February. If you are not already an OCR-approved centre please refer your exams officer to the centre approval section of our admin guide.

## Next steps

1. Familiarise yourself with the specification, sample assessment materials and teaching resources on the OCR Chemistry A qualification page of the OCR website.

<http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-chemistry-a-j248-from-2016/>

1. Get a login for our secure extranet, Interchange – this allows you to access the latest past/practice papers and use our results analysis service, Active Results.

<https://interchange.ocr.org.uk>

1. Sign up to receive subject updates by email.

<http://www.ocr.org.uk/i-want-to/email-updates>

1. Sign up to attend a training event or take part in webinars on specific topics running throughout the year and our Q&A webinar sessions every half term. <https://www.cpdhub.ocr.org.uk>
2. Attend one of our free teacher network events that are run in each region every term. These are hosted at the end of the school day in a school or college near you, with teachers sharing best practice and subject specialists on hand to lead discussion and answer questions. <http://ocr.org.uk/qualifications/professional-development/teacher-networks/>