## Switching Edexcel GCSE (9-1) Chemistry to OCR GCSE (9-1) Twenty First Century Chemistry B

## Introduction

Are you currently teaching the Edexcel 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 Edexcel GCSE Chemistry qualification to our OCR GCSE Chemistry B, including:

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

## Our offer

* Our GCSE (9-1) Twenty First Century Chemistry B qualification has been developed in partnership with University of York Science Education Group (UYSEG), and working with a number of stakeholders, including OCR Science Consultative Forum, teachers and assessors. 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 chapter 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 Edexcel 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) Twenty First Century Chemistry B** | **Edexcel GCSE (9-1) Chemistry** |
| **8 flexible practical** activities - select from our suggested activities or use your own preferred practical activities. | 8 core 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. |
| Context – linked specification | Content led specification. |
| **Two** 6 mark level of response in the depth paper and **none** in the breadth. | **Two** 6 mark level of response question on all sample assessment material. |

## Content mapping

The content within the OCR GCSE (9-1) in Chemistry B (Twenty First Century Science) 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 Edexcel Chemistry content is cover in the OCR twenty first century chemistry specification.

| **Pearson Edexcel GCSE (9-1) in Chemistry (1CH0)** | **OCR Chemistry B (Twenty First Century Science)** | **Additional content in Pearson Edexcel Chemistry** |
| --- | --- | --- |
| Topic 1 – Key concepts in Chemistry: Atomic Structure | C2.1 How have our ideas about atoms developed over time? |  |
| Topic 1 – Key concepts in Chemistry: The periodic table | C2.2 What does the Periodic Table tell us about elements?  C2.3 How do metals and non-metals combine to form compounds? |  |
| Topic 1 – Key concepts in Chemistry: Ionic Bonding | C2.3 How do metals and non-metals combine to form compounds?  C2.4 How are equations used to represent chemical reactions? |  |
| Topic 1 – Key concepts in Chemistry: Covalent Bonding | C2.4 How are equations used to represent chemical reactions?  C3.4 Why is crude oil important as a source of new materials? |  |
| Topic 1 – Key concepts in Chemistry: Types of substance | C2.3 How do metals and non-metals combine to form compounds?  C3.4 Why is crude oil important as a source of new materials? |  |
| Topic 1 – Key concepts in Chemistry: Calculations involving masses | C2.3 How do metals and non-metals combine to form compounds?  C3.1 How are atoms held together in a metal?  C3.4 Why is crude oil important as a source of new materials?  C5.3 How are the amounts of substances in reactions calculated?  C5.4 How are the amounts of chemicals in solution measured? | 1.46 Describe an experiment to determine the empirical formula of a simple compound such as magnesium oxide. |
| Topic 2 – States of matter and mixtures: States of matter | C1.1 How has the Earth's atmosphere changed over time, and why? |  |
| Topic 2 – States of matter and mixtures: Methods of separating and purifying substances | C5.1 How are chemicals separated and tested for purity?  C1.4 How can scientists help improve the supply of potable water? |  |
| Topic 3 – Chemical Changes: Acids | C5.4 How are the amounts of chemicals in solution measured?  C6.1 What useful products can be made from acids?  C1.1 How has the Earth's atmosphere changed over time, and why? (Test for gases) | 3.9  Recall that a base is any substance that reacts with an acid to form a salt and water only.  3.10  Recall that alkalis are soluble bases.  3.19  Recall the general rules which describe the solubility of common types of substances in water.  3.20  Predict, using solubility rules, whether or not a precipitate will be formed when named solutions are mixed together, naming the precipitate if any.  3.21  Describe the method used to prepare a pure, dry sample of an insoluble salt. |
| Topic 3 – Chemical Changes: Electrolytic Processes | C3.3 What are electrolytes and what happens during electrolysis? |  |
| Topic 4 – Extracting metals and equilibria: Obtaining and using metals | C3.2 How are metals with different reactivities extracted?  C4.5 What happens to products at the end of their useful life? (Life cycle) |  |
| Topic 4 – Extracting metals and equilibria: reversible reactions and equilibria | C6.3 What factors affect the yield of chemical reactions?  C6.4 How are chemicals made on an industrial scale? (separate science only) – Haber process |  |
| Topic 5 – Separate chemistry 1: Transition metals, alloys and corrosion | C2.5 What are the properties of the transition metals? (separate science only)  C4.5 What happens to products at the end of their useful life?  C4.1 How is data used to choose a material for a particular use? | 5.3C  Explain how rusting of iron can be prevented by:  a exclusion of  oxygen  b exclusion of water  c sacrificial protection  5.4C  Explain how electroplating can be used to improve the appearance and/or the resistance to corrosion of metal objects |
| Topic 5 – Separate chemistry 1: Quantitative analysis | C5.3 How are the amounts of substances in reactions calculated?  C5.4 How are the amounts of chemicals in solution measured?  C6.3 What factors affect the yield of chemical reactions?  C6.4 How are chemicals made on an industrial scale? (separate science only) |  |
| Topic 5 – Separate chemistry 1: Dynamic equilibria | C6.3 What factors affect the yield of chemical reactions?  C6.4 How are chemicals made on an industrial scale? (separate science only) |  |
| Topic 5 – Separate chemistry 1: Chemical cells and fuel cells | C1.2 Why are there temperature changes in chemical reactions? |  |
| Topic 6 – Groups in the periodic table: Group 1 | C2.2 What does the Periodic Table tell us about elements? |  |
| Topic 6 – Groups in the periodic table: Group 7 | C1.4 How can scientists help improve the supply of potable water? (Chlorine test)  C2.2 What does the Periodic Table tell us about elements?  C3.3 What are electrolytes and what happens during electrolysis? (Displacement) |  |
| Topic 6 – Groups in the periodic table: Group 0 | C2.2 What does the Periodic Table tell us about elements?  C2.3 How do metals and non-metals combine to form compounds? | 6.15 Explain how the uses of noble gases depend on their inertness, low density and/or non-flammability |
| Topic 7: Rates of reaction and energy changes: Rates of reaction | C6.2 How do chemists control the rate of reaction? |  |
| Topic 7: Rates of reaction and energy changes: Heat energy changes in chemical reactions | C1.2 Why are there temperature changes in chemical reactions? | 7.9 Recall that changes in heat energy accompany the following changes:  a salts dissolving in water  b neutralisation reactions  c displacement reactions  d precipitation reactions and that, when these reactions take place in solution, temperature changes can be measured to reflect the heat changes |
| Topic 8: Fuels and Earth science: Fuels | C1.1 How has the Earth's atmosphere changed over time, and why?  C1.2 Why are there temperature changes in chemical reactions? (Fuel Cell evaluation)  C1.3 What is the evidence for climate change, why is it occurring?  C3.4 Why is crude oil important as a source of new materials? | 8.8  Explain why the incomplete combustion of hydrocarbons can produce carbon and carbon monoxide  8.9  Explain how carbon monoxide behaves as a toxic gas |
| Topic 8: Fuels and Earth science: Earth and atmospheric science | C1.1 How has the Earth's atmosphere changed over time, and why? |  |
| Topic 9 – Separate chemistry 2: Qualitative analysis: tests for ions | C5.2 How do chemists find the composition of unknown samples? (separate science only) | 9.4C Describe the chemical test for ammonia |
| Topic 9 – Separate chemistry 2: Hydrocarbons | C3.4 Why is crude oil important as a source of new materials? | 9.14C Recall the addition reaction of ethene with bromine, showing the structures of reactants and products, and extend this to other alkenes  9.15C Explain how bromine water is used to distinguish between alkanes and alkenes |
| Topic 9 – Separate chemistry 2: Polymers | C4.1 How is data used to choose a material for a particular use?  C4.2 What are the different types of polymer? (separate science only)  C4.5 What happens to products at the end of their useful life? |  |
| Topic 9 – Separate chemistry 2: Alcohols and carboxylic acids | C3.4 Why is crude oil important as a source of new materials? | 9.33C Describe the production of ethanol by fermentation of carbohydrates in aqueous solution, using yeast to provide enzymes  9.34C  Explain how to obtain a concentrated solution of ethanol by fractional distillation of the fermentation mixture |
| Topic 9 – Separate chemistry 2: Bulk and surface properties of matter including nanoparticles | C4.4 Why are nanoparticles so useful? |  |

## Assessment

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| **OCR GCSE (9-1) Twenty First Century Chemistry B** | **Edexcel GCSE (9-1) Chemistry** |
| **Paper 1** **(Breadth)**  Assessed: All Chapters  Time allowed: 1 hour 45 minutes  Foundation and Higher tier available  Marks 90 marks  Weighting 50% of GCSE  Question types:  Short answer (maximum 4 marks per question), some multiple choice and objective style questions | **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** **(Depth)**  Assessed: All chapters  Foundation and Higher tier available  Marks 90 marks  Weighting 50% of GCSE  Question types: Multiple choice, structured, closed short answer and open response, 2 x 6 mark Level of response questions | **Paper 2**  Assessed: Topics 1, 6-9  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 Edexcel textbook

Below you will find all the information you need to start teaching OCR GCSE (9-1) Twenty First Century Chemistry B while still using the new Edexcel textbooks. We have mapped our specification to the Edexcel Pearson’s textbook 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.

## Edexcel Pearson’s textbook mapping

| **Specification statement** | **Chapter covering specification statement** | **Page number** | **Comments** |
| --- | --- | --- | --- |
| **Chapter C1 Air and water** | | | |
| **C1.1 How has the Earth's atmosphere changed over time, and why?** | | | |
| C1.1.1 recall and explain the main features of the particle model in terms of the states of matter and change of state, distinguishing between physical and chemical changes and recognise that the particles themselves do not have the same properties as the bulk substances | SC1 States of matter | 2 |  |
| **C1.1.2 explain the limitations of the particle model in relation to changes of state when particles are represented by inelastic spheres** | SC7 Types of Substance | 48 |  |
| C1.1.3 use ideas about energy transfers and the relative strength of forces between particles to explain the different temperatures at which changes of state occur | SC1 States of matter | 3 |  |
| C1.1.4 use data to predict states of substances under given conditions | SC1 States of matter | 16 | Touched on in "methods of separating substances" practical |
| C1.1.5 interpret evidence for how it is thought the atmosphere was originally formed | SC21 Earth and atmospheric science | 162 |  |
| C1.1.6 describe how it is thought an oxygen-rich atmosphere developed over time | SC21 Earth and atmospheric science | 164 |  |
| C1.1.7 describe the major sources of carbon monoxide and particulates (incomplete combustion), sulfur dioxide (combustion of sulfur impurities in fuels), oxides of nitrogen (oxidation of nitrogen at high temperatures and further oxidation in the air) | SC20 Fuels | 158 |  |
| C1.1.8 explain the problems caused by increased amounts of these substances and describe approaches to decreasing the emissions of these substances into the atmosphere including the use of catalytic converters, low sulfur petrol and gas scrubbers to decrease emissions | SC21 Earth and atmospheric science | 168 |  |
| C1.1.9 use chemical symbols to write the formulae of elements and simple covalent compounds | SC6 Covalent bonding | 40 |  |
| C1.1.10 use the names and symbols of common elements and compounds and the principle of conservation of mass to write formulae and balanced chemical equations | SC9 Calculations involving masses | 74 |  |
| C1.1.11 use arithmetic computations and ratios when balancing equations | SC9 Calculations involving masses | 75 |  |
| C1.1.12 describe tests to identify oxygen, hydrogen and carbon dioxide |  |  | Oxygen pg 165, Carbon Dioxide pg 198, Hydrogen page 66 |
| C1.1.13 explain oxidation in terms of gain of oxygen | SC11 Obtaining and using metals | 90 |  |
| **C1.2 Why are there temperature changes in chemical reactions?** | | | |
| C1.2.1 distinguish between endothermic and exothermic reactions on the basis of the temperature change of the surroundings | SC19 Heat energy changes in chemical reactions | 144 |  |
| C1.2.2 draw and label a reaction profile for an exothermic and an endothermic reaction, identifying activation energy | SC19 Heat energy changes in chemical reactions | 146 |  |
| C1.2.3 explain activation energy as the energy needed for a reaction to occur | SC19 Heat energy changes in chemical reactions | 144 |  |
| C1.2.4 interpret charts and graphs when dealing with reaction profiles | SC19 Heat energy changes in chemical reactions | 146 |  |
| **C1.2.5 calculate energy changes in a chemical reaction by considering bond breaking and bond making energies** | SC19 Heat energy changes in chemical reactions | 147 |  |
| C1.2.6 carry out arithmetic computations when calculating energy changes | SC19 Heat energy changes in chemical reactions | 147 |  |
| C1.2.7 describe how you would investigate a chemical reaction to determine whether it is endothermic or exothermic (separate science only) | SC19 Heat energy changes in chemical reactions | 145 |  |
| C1.2.8 recall that a chemical cell produces a potential difference until the reactants are used up (separate science only) | SC16 Chemical cells and fuel cells | 124 |  |
| C1.2.9 evaluate the advantages and disadvantages of hydrogen/ oxygen and other fuel cells for given uses (separate science only) | SC16 Chemical cells and fuel cells | 125 |  |
| **C1.3 What is the evidence for climate change, why is it occurring?** | | | |
| C1.3.1 describe the greenhouse effect in terms of the interaction of radiation with matter | SC21 Earth and atmospheric science | 166 |  |
| C1.3.2 evaluate the evidence for additional anthropogenic causes of climate change, including the correlation between change in atmospheric carbon dioxide concentration and the consumption of fossil fuels, and describe the uncertainties in the evidence base | SC21 Earth and atmospheric science | 167 |  |
| C1.3.3 describe the potential effects of increased levels of carbon dioxide and methane on the Earth’s climate, including where crops can be grown, extreme weather patterns, melting of polar ice and flooding of low land | SC21 Earth and atmospheric science | 168 |  |
| C1.3.4 describe how the effects of increased levels of carbon dioxide and methane may be mitigated, including consideration of scale, risk and environmental implications | SC21 Earth and atmospheric science | 169 |  |
| C1.3.5 extract and interpret information from charts, graphs and tables |  |  | Skills not explicitly covered in book. |
| C1.3.6 use orders of magnitude to evaluate the significance of data |  |  | Skills not explicitly covered in book. |
| **C1.4 How can scientists help improve the supply of potable water?** | | | |
| C1.4.1 describe the principal methods for increasing the availability of potable water, in terms of the separation techniques used, including the ease of treating waste, ground and salt water including filtration and membrane filtration; aeration, use of bacteria; chlorination and distillation (for salt water) | SC2 Methods of separating and purifying substances | 15 |  |
| C1.4.2 describe a test to identify chlorine (using blue litmus paper) | SC17 Groups in the periodic table | 131 |  |
| **Chapter C2 Chemical patterns** | | | |
| **C2.1 How have our ideas about atoms developed over time?** | | | |
| C2.1.1 describe how and why the atomic model has changed over time to include the main ideas of Dalton, Thomson, Rutherford and Bohr | SC3 Atomic Structure | 18-21 |  |
| C2.1.2 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 | SC3 Atomic Structure | 18 |  |
| C2.1.3 recall relative charges and approximate relative masses of protons, neutrons and electrons | SC3 Atomic Structure | 18 |  |
| C2.1.4 estimate the size and scale of atoms relative to other particles | SC3 Atomic Structure | 18 |  |
| C2.1.5 recall the typical size (order of magnitude) of atoms and small molecules | SC3 Atomic Structure | 18 |  |
| C2.1.6 relate size and scale of atoms to objects in the physical world | SC3 Atomic Structure | 19 |  |
| C2.1.7 calculate numbers of protons, neutrons and electrons in atoms, given atomic number and mass number of isotopes or by extracting data from the Periodic Table | SC3 Atomic Structure | 23 |  |
| **C2.2 What does the Periodic Table tell us about elements?** | | | |
| C2.2.1 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 | SC4 The Periodic table | 26 |  |
| C2.2.2 describe how Mendeleev organised the elements based on their properties and relative atomic masses | SC4 The Periodic table | 26 |  |
| C2.2.3 describe how discovery of new elements and the ordering elements by atomic number supports Mendeleev’s decisions to leave gaps and reorder some elements | SC4 The Periodic table | 27 |  |
| C2.2.4 describe metals and non-metals and explain the differences between them on the basis of their characteristic physical and chemical properties, including melting point, boiling point, state and appearance, density, formulae of compounds, relative reactivity and electrical conductivity | SC7 Types of Substance | 48 |  |
| C2.2.5 recall the simple properties of Group 1 elements including their reaction with moist air, water, and chlorine | SC17 Groups in the periodic table | 128 |  |
| C2.2.6 recall the simple properties of Group 7 elements including their states and colours at room temperature and pressure, their colours as gases, their reactions with Group 1 elements and their displacement reactions with other metal halides | SC17 Groups in the periodic table | 130 |  |
| C2.2.7 predict possible reactions and probable reactivity of elements from their positions in the Periodic Table | SC4 The Periodic table | 30 |  |
| C2.2.8 describe experiments to identify the reactivity pattern of Group 7 elements including displacement reactions | SC17 Groups in the periodic table | 132 |  |
| C2.2.9 describe experiments to identify the reactivity pattern of Group 1 elements | SC17 Groups in the periodic table | 128 |  |
| **C2.3 How do metals and non-metals combine to form compounds?** | | | |
| C2.3.1 recall the simple properties of Group 0 including their low melting and boiling points, their state at room temperature and pressure and their lack of chemical reactivity | SC17 Groups in the periodic table | 134 |  |
| C2.3.2 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 | SC17 Groups in the periodic table |  | Group 1 pg 129, Group 7 pg 133, group 0 page 135 |
| C2.3.3 explain how the reactions of elements are related to the arrangement of electrons in their atoms and hence to their atomic number | SC17 Groups in the periodic table |  | Group 1 pg 129, Group 7 pg 133, group 0 page 135 |
| C2.3.4 explain how the atomic structure of metals and non-metals relates to their position in the Periodic Table | SC4 The Periodic table | 31 |  |
| C2.3.5 describe the nature and arrangement of chemical bonds in ionic compounds | SC5 Ionic bonding | 34 |  |
| C2.3.6 explain ionic bonding in terms of electrostatic forces and transfer of electrons | SC5 Ionic bonding | 35 |  |
| C2.3.7 calculate numbers of protons, neutrons and electrons in atoms and ions, given atomic number and mass number or by using the Periodic Table | SC3 Atomic Structure | 21 |  |
| C2.3.8 construct dot and cross diagrams for simple ionic substances | SC5 Ionic bonding | 34 |  |
| C2.3.9 explain how the bulk properties of ionic materials are related to the type of bonds they contain | SC5 Ionic bonding | 38 |  |
| C2.3.10 use ideas about energy transfers and the relative strength of attraction between ions to explain the melting points of ionic compounds compared to substances with other types of bonding | SC5 Ionic bonding | 34 |  |
| C2.3.11 describe the limitations of particular representations and models of ions and ionically bonded compounds, including dot and cross diagrams, and 3-D representations | SC7 Types of Substance | 48 |  |
| C2.3.12 translate information between diagrammatic and numerical forms and represent three dimensional shapes in two dimensions and vice versa when looking at chemical structures for ionic compounds |  |  | Numerical, 3D and 2D all covered but no translation between them in book except drawing dot-and-cross diagrams from formulae. |
| **C2.4 How are equations used to represent chemical reactions?** | | | |
| C2.4.1 use chemical symbols to write the formulae of elements and simple covalent and ionic compounds | C6 Covalent bonding |  |  |
| C2.4.2 use the formulae of common ions to deduce the formula of Group 1 and Group 7 compounds |  |  | Not explicit. |
| C2.4.3 use the names and symbols of the first 20 elements, Groups 1, 7 and 0 and other common elements from a supplied Periodic Table to write formulae and balanced chemical equations where appropriate | SC8 Acids and Alkalis | 60 |  |
| C2.4.4 describe the physical states of products and reactants using state symbols (s, l, g and aq) | SC8 Acids and Alkalis | 56 |  |
| **C2.5 What are the properties of the transition metals? (separate science only)** | | | |
| C2.5.1 recall the general properties of transition metals (melting point, density, reactivity, formation of coloured ions with different charges and uses as catalysts) and exemplify these by reference to copper, iron, chromium, silver and gold | SC13 Transition metals, alloys and corrosion | 96 |  |
| **Chapter C3 Chemicals of the natural environment** | | | |
| **C3.1 How are atoms held together in a metal?** | | | |
| C3.1.1 describe the nature and arrangement of chemical bonds in metals | SC7 Types of Substance | 46 |  |
| C3.1.2 explain how the bulk properties of metals are related to the type of bonds they contain | SC7 Types of Substance | 47 |  |
| **C3.2 How are metals with different reactivities extracted?** | | | |
| C3.2.1 deduce an order of reactivity of metals based on experimental results including reactions with water, dilute acid and displacement reactions with other metals | SC11 Obtaining and using metals | 86 |  |
| C3.2.2 explain how the reactivity of metals with water or dilute acids is related to the tendency of the metal to form its positive ion to include potassium, sodium, calcium, aluminium, magnesium, zinc, iron, lead, [hydrogen], copper, silver | SC17 Groups in the periodic table | 129 |  |
| C3.2.3 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 ionic equations** | SC9 Calculations involving masses | 74 | Ionic equations page 66. |
| C3.2.4 explain, using the position of carbon in the reactivity series, the principles of industrial processes used to extract metals, including the extraction of zinc | SC11 Obtaining and using metals | 88 |  |
| C3.2.5 explain why electrolysis is used to extract some metals from their ores | SC11 Obtaining and using metals | 88 |  |
| **C3.2.6 evaluate alternative biological methods of metal extraction (bacterial and phytoextraction)** | SC11 Obtaining and using metals | 89 |  |
| **C3.3 What are electrolytes and what happens during electrolysis?** | | | |
| C3.3.1 describe electrolysis in terms of the ions present and reactions at the electrodes | SC10 Electrolytic processes | 80 |  |
| C3.3.2 predict the products of electrolysis of binary ionic compounds in the molten state | SC10 Electrolytic processes | 84 |  |
| C3.3.3 recall that metals (or hydrogen) are formed at the cathode and non-metals are formed at the anode in electrolysis using inert electrodes | SC10 Electrolytic processes | 85 |  |
| **C3.3.4 use the names and symbols of common elements and compounds and the principle of conservation of mass to write half equations** | SC10 Electrolytic processes | 84 |  |
| **C3.3.5 explain reduction and oxidation in terms of gain or loss of electrons, identifying which species are oxidised and which are reduced** | SC11 Obtaining and using metals | 90 |  |
| C3.3.6 explain how electrolysis is used to extract some metals from their ores including the extraction of aluminium | SC11 Obtaining and using metals | 90 |  |
| C3.3.7 describe competing reactions in the electrolysis of aqueous solutions of ionic compounds in terms of the different species present, including the formation of oxygen, chlorine and the discharge of metals or hydrogen linked to their relative reactivity | SC10 Electrolytic processes | 85 |  |
| C3.3.8 describe the technique of electrolysis of an aqueous solution of a salt | SC10 Electrolytic processes | 82 |  |
| **C3.4 Why is crude oil important as a source of new materials?** | | | |
| C3.4.1 recall that crude oil is a main source of hydrocarbons and is a feedstock for the petrochemical industry | SC20 Fuels | 150 |  |
| C3.4.2 explain how modern life is crucially dependent upon hydrocarbons and recognise that crude oil is a finite resource | SC20 Fuels | 151 |  |
| C3.4.3 describe and explain the separation of crude oil by fractional distillation | SC20 Fuels | 152 |  |
| C3.4.4 describe the fractions of crude oil as largely a mixture of compounds of formula CnH2n+2 which are members of the alkane homologous series | SC20 Fuels | 154 |  |
| C3.4.5 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 | SC7 Types of Substance | 42 |  |
| C3.4.6 deduce the empirical formula of a compound from the relative numbers of atoms present or from a model or diagram and vice versa | SC9 Calculations involving masses | 73 |  |
| C3.4.7 use arithmetic computation and ratio when determining empirical formulae | SC9 Calculations involving masses | 73 |  |
| C3.4.8 describe the arrangement of chemical bonds in simple molecules | SC5 Ionic bonding and SC6 Covalent bonding | 38, 40 |  |
| C3.4.9 explain covalent bonding in terms of the sharing of electrons | SC6 Covalent bonding | 40 |  |
| C3.4.10 construct dot and cross diagrams for simple covalent substances | SC6 Covalent bonding | 40 |  |
| C3.4.11 represent three dimensional shapes in two dimensions and vice versa when looking at chemical structures for simple molecules | SC6 Covalent bonding | 41 |  |
| C3.4.12 describe the limitations of dot and cross diagrams, ball and stick models and two and three dimensional representations when used to represent simple molecules |  |  | Not discussed. |
| C3.4.13 translate information between diagrammatic and numerical forms |  |  | Numerical, 3D and 2D all covered but no translation between them in book except drawing dot-and-cross diagrams from formulae. |
| C3.4.14 explain how the bulk properties of simple molecules are related to the covalent bonds they contain and their bond strengths in relation to intermolecular forces | SC7 Types of Substance | 42 |  |
| C3.4.15 describe the production of materials that are more useful by cracking | SC20 Fuels | 160 |  |
| C3.4.16 recognise functional groups and identify members of the same homologous series (separate science only) | SC22 Hydrocarbons, SC23 Alcohols and Carboxylic Acids |  | Alkanes 172, Alkenes 173, Alcohols 178, Carboxylic Acids 182 |
| C3.4.17 name and draw the structural formulae, using fully displayed formulae, of the first four members of the straight chain alkanes and alkenes, alcohols and carboxylic acids (separate science only) | SC22 Hydrocarbons, SC23 Alcohols and Carboxylic Acids |  | Alkanes 172, Alkenes 173, Alcohols 178, Carboxylic Acids 182 |
| C3.4.18 predict the formulae and structures of products of reactions (combustion, addition across a double bond and oxidation of alcohols to carboxylic acids) of the first four and other given members of these homologous series (separate science only) | SC22 Hydrocarbons, SC23 Alcohols and Carboxylic Acids |  | Alkanes 172, Alkenes 173, Alcohols 178, Carboxylic Acids 182 |
| C3.4.19 recall that it is the generality of reactions of functional groups that determine the reactions of organic compounds (separate science only) | SC22 Hydrocarbons, SC23 Alcohols and Carboxylic Acids |  | Alkanes 172, Alkenes 173, Alcohols 178, Carboxylic Acids 182 |
| **Chapter C4 Materials choices** | | | |
| **C4.1 How is data used to choose a material for a particular use?** | | | |
| C4.1.1 compare quantitatively the physical properties of glass and clay ceramics, polymers, composites and metals, including melting point, softening temperature (for polymers), electrical conductivity, strength (in tension or compression), stiffness, flexibility, brittleness, hardness, density, ease of reshaping | C26 Bulk and surface properties of matter including nanoparticles | 202 |  |
| C4.1.2 explain how the properties of materials are related to their uses and select appropriate materials given details of the usage required | C26 Bulk and surface properties of matter including nanoparticles | 202-205 |  |
| C4.1.3 describe the composition of some important alloys in relation to their properties and uses, including steel (separate science only) | SC13 Transition metals, alloys and corrosion | 102 |  |
| **C4.2 What are the different types of polymer? (separate science only)** | | | |
| C4.2.1 recall the basic principles of addition polymerisation by reference to the functional group in the monomer and the repeating units in the polymer | SC24 Polymers | 184 |  |
| C4.2.2 deduce the structure of an addition polymer from a simple monomer with a double bond and vice versa | SC24 Polymers | 184 |  |
| C4.2.3 explain the basic principles of condensation polymerisation by reference to the functional groups of the monomers, the minimum number of functional groups within a monomer, the number of repeating units in the polymer, and simultaneous formation of a small molecule i Learners are not expected to recall the formulae of dicarboxylic acid, diamine and diol monomers | SC24 Polymers | 188 |  |
| C4.2.4 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 | SC24 Polymers | 185 |  |
| **C4.3 How do bonding and structure affect the properties of materials?** | | | |
| C4.3.1 explain how the bulk properties of materials (including strength, melting point, electrical and thermal conductivity, brittleness, flexibility, hardness and ease of reshaping) 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, recognising that the atoms themselves do not have these properties | C26 Bulk and surface properties of matter including nanoparticles | 202 |  |
| C4.3.2 recall that carbon can form four covalent bonds |  |  | Not explicitly stated. |
| C4.3.3 explain that the vast array of natural and synthetic organic compounds occurs due to the ability of carbon to form families of similar compounds, chains and rings | SC7 Types of Substance | 44 |  |
| C4.3.4 describe the nature and arrangement of chemical bonds in polymers with reference to their properties including strength, flexibility or stiffness, hardness and melting point of the solid | SC24 Polymers | 186 |  |
| C4.3.5 describe the nature and arrangement of chemical bonds in giant covalent structures | SC7 Types of Substance | 45 |  |
| C4.3.6 explain the properties of diamond and graphite in terms of their structures and bonding, include melting point, hardness and (for graphite) conductivity and lubricating action | SC7 Types of Substance | 44 |  |
| C4.3.7 represent three dimensional shapes in two dimensions and vice versa when looking at chemical structures e.g. allotropes of carbon | SC7 Types of Substance | 48 |  |
| C4.3.8 describe and compare the nature and arrangement of chemical bonds in ionic compounds, simple molecules, giant covalent structures, polymers and metals | SC7 Types of Substance | 47 | Metallic bonding pg 47, |
| **C4.4 Why are nanoparticles so useful?** | | | |
| C4.4.1 compare ‘nano’ dimensions to typical dimensions of atoms and molecules | SC26 Bulk and surface properties of matter including nanoparticles | 206 |  |
| C4.4.2 describe the surface area to volume relationship for different-sized particles and describe how this affects properties | SC26 Bulk and surface properties of matter including nanoparticles | 207 |  |
| C4.4.3 describe how the properties of nanoparticulate materials are related to their uses including properties which arise from their size, surface area and arrangement of atoms in tubes or rings | SC26 Bulk and surface properties of matter including nanoparticles | 206 |  |
| C4.4.4 explain the properties fullerenes and graphene in terms of their structures | SC7 Types of Substance | 44 |  |
| C4.4.5 explain the possible risks associated with some nanoparticulate materials including: a) possible effects on health due to their size and surface area b) reasons that there is more data about uses of nanoparticles than about possible health effects c) the relative risks and benefits of using nanoparticles for different purposes | SC26 Bulk and surface properties of matter including nanoparticles | 206 |  |
| C4.4.6 estimate size and scale of atoms and nanoparticles including the ideas that: a) nanotechnology is the use and control of structures that are very small (1 to 100 nanometres in size) b) data expressed in nanometres is used to compare the sizes of nanoparticles, atoms and molecules | SC26 Bulk and surface properties of matter including nanoparticles | 206 |  |
| C4.4.7 interpret, order and calculate with numbers written in standard form when dealing with nanoparticles | SC26 Bulk and surface properties of matter including nanoparticles | 206 |  |
| C4.4.8 use ratios when considering relative sizes and surface area to volume comparisons | SC26 Bulk and surface properties of matter including nanoparticles | 207 |  |
| C4.4.9 calculate surface areas and volumes of cubes |  |  | Not covered. |
| **C4.5 What happens to products at the end of their useful life?** | | | |
| C4.5.1 describe the conditions which cause corrosion and the process of corrosion, and explain how mitigation is achieved by creating a physical barrier to oxygen and water and by sacrificial protection (separate science only) | SC13 Transition metals, alloys and corrosion | 99 |  |
| C4.5.2 explain reduction and oxidation in terms of loss or gain of oxygen, identifying which species are oxidised and which are reduced | SC11 Obtaining and using metals | 90 |  |
| **C4.5.3 explain reduction and oxidation in terms of gain or loss of electrons, identifying which species are oxidised and which are reduced** | SC11 Obtaining and using metals | 90 |  |
| C4.5.4 describe the basic principles in carrying out a life-cycle assessment of a material or product including a) the use of water, energy and the environmental impact of each stage in a life cycle, including its manufacture, transport and disposal b) incineration, landfill and electricity generation schemes c) biodegradable and non-biodegradable materials | SC11 Obtaining and using metals | 93 |  |
| C4.5.5 interpret data from a life-cycle assessment of a material or product | SC11 Obtaining and using metals |  | No data interpretation. |
| C4.5.6 describe the process where PET drinks bottles are reused and recycled for different uses, and explain why this is viable | SC24 Polymers | 191 |  |
| C4.5.7 evaluate factors that affect decisions on recycling with reference to products made from crude oil and metal ores | SC11 Obtaining and using metals |  | Some data given but no evaluation |
| **Chapter C5 Chemical analysis** | | | |
| **C5.1 How are chemicals separated and tested for purity?** | | | |
| C5.1.1 explain that many useful materials are formulations of mixtures | SC2 Methods of separating and purifying substances | 4 |  |
| C5.1.2 explain what is meant by the purity of a substance, distinguishing between the scientific and everyday use of the term ‘pure’ | SC2 Methods of separating and purifying substances | 4 |  |
| C5.1.3 use melting point data to distinguish pure from impure substances | SC2 Methods of separating and purifying substances | 5 |  |
| C5.1.4 recall that chromatography involves a stationary and a mobile phase and that separation depends on the distribution between the phases | SC2 Methods of separating and purifying substances | 8 |  |
| C5.1.5 interpret chromatograms, including calculating Rf values | SC2 Methods of separating and purifying substances | 9 |  |
| C5.1.6 suggest chromatographic methods for distinguishing pure from impure substances Including the use of: a) paper chromatography b) aqueous and non-aqueous solvents c) locating agents | SC2 Methods of separating and purifying substances | 12 |  |
| C5.1.7 describe, explain and exemplify the processes of filtration, crystallisation, simple distillation, and fractional distillation | SC2 Methods of separating and purifying substances | 6 | Distillation page 10, Fractional distillation page 11 |
| C5.1.8 suggest suitable purification techniques given information about the substances involved | SC2 Methods of separating and purifying substances | 12 |  |
| **C5.2 How do chemists find the composition of unknown samples? (separate science only)** | | | |
| C5.2.1 describe the purpose of representative sampling in qualitative analysis |  |  | Not explicitly stated. |
| C5.2.2 interpret flame tests to identify metal ions, including the ions of lithium, sodium, potassium, calcium and copper | SC25 Qualitative analysis: Tests for ions | 194 |  |
| C5.2.3 describe the technique of using flame tests to identify metal ions | SC25 Qualitative analysis: Tests for ions | 194 |  |
| C5.2.4 describe tests to identify aqueous cations and aqueous anions and identify species from test results including:  a) tests and expected results for metal ions in solution by precipitation reactions using dilute sodium hydroxide (calcium, copper, iron(II), iron(III), zinc) b) tests and expected results for carbonate ions (using dilute acid), chloride, bromide and iodide ions (using acidified dilute silver nitrate) and sulfate ions (using acidified dilute barium chloride or acidified barium nitrate) | SC25 Qualitative analysis: Tests for ions | 196 | Also pg 198 for carbonates, sulfides and halides |
| C5.2.5 interpret an instrumental result for emission spectroscopy given appropriate data in chart or tabular form, when accompanied by a reference set in the same form | SC25 Qualitative analysis: Tests for ions | 195 |  |
| C5.2.6 describe the advantages of instrumental methods of analysis (sensitivity, accuracy and speed) | SC25 Qualitative analysis: Tests for ions | 195 |  |
| C5.2.7 interpret charts, particularly in spectroscopy | SC25 Qualitative analysis: Tests for ions | 195 |  |
| **C5.3 How are the amounts of substances in reactions calculated?** | | | |
| C5.3.1 recall and use the law of conservation of mass | SC9 Calculations involving masses | 74 |  |
| C5.3.2 explain any observed changes in mass in non-enclosed systems during a chemical reaction and explain them using the particle model | SC9 Calculations involving masses | 74 |  |
| C5.3.3 calculate relative formula masses of species separately and in a balanced chemical equation | SC9 Calculations involving masses | 74 |  |
| **C5.3.4 recall and use the definitions of the Avogadro constant (in standard form) and of the mole** | SC9 Calculations involving masses | 76 |  |
| **C5.3.5 explain how the mass of a given substance is related to the amount of that substance in moles and vice versa and use the relationship: number of moles = mass of substance (g) relative formula mass (g)** | SC9 Calculations involving masses | 76 |  |
| **C5.3.6 deduce the stoichiometry of an equation from the masses of reactants and products and explain the effect of a limiting quantity of a reactant** | SC9 Calculations involving masses | 76 |  |
| **C5.3.7 use a balanced equation to calculate masses of reactants or products** | SC9 Calculations involving masses | 75 |  |
| C5.3.8 use arithmetic computation, ratio, percentage and multistep calculations throughout quantitative chemistry | SC9 Calculations involving masses |  | Throughout chapter. |
| **C5.3.9 carry out calculations with numbers written in standard form when using the Avogadro constant** | SC9 Calculations involving masses | 76 |  |
| C5.3.10 change the subject of a mathematical equation |  |  | Not explicitly covered. |
| C5.3.11 calculate the theoretical amount of a product from a given amount of reactant (separate science only) | SC14 Quantitative analysis | 109 |  |
| C5.3.12 calculate the percentage yield of a reaction product from the actual yield of a reaction (separate science only) | SC14 Quantitative analysis | 108 |  |
| C5.3.13 suggest reasons for low yields for a given procedure (separate science only) | SC14 Quantitative analysis | 109 |  |
| **C5.3.14 describe the relationship between molar amounts of gases and their volumes and vice versa, and calculate the volumes of gases involved in reactions, using the molar gas volume at room temperature and pressure (assumed to be 24dm3) (separate science only)** | SC14 Quantitative analysis | 118 |  |
| **C5.4 How are the amounts of chemicals in solution measured?** | | | |
| C5.4.1 identify the difference between qualitative and quantitative analysis (separate science only) |  |  | Not explicitly covered. |
| **C5.4.2 explain how the mass of a solute and the volume of the solution is related to the concentration of the solution and calculate concentration using the formula: concentration (g/dm3) = mass of solute (g) / volume (dm3)** | SC9 Calculations involving masses | 74 | Also SC14 pg 112 |
| **C5.4.3 explain how the concentration of a solution in mol/dm3 is related to the mass of the solute and the volume of the solution and calculate the molar concentration using the formula concentration (mol/dm3) = number of moles of solute / volume (dm3)** | SC14 Quantitative analysis | 113 |  |
| C5.4.4 describe neutralisation as acid reacting with alkali to form a salt plus water including the common laboratory acids hydrochloric acid, nitric acid and sulfuric acid and the common alkalis, the hydroxides of sodium, potassium and calcium | SC8 Acids and Alkalis | 56 |  |
| C5.4.5 recall that acids form hydrogen ions when they dissolve in water and solutions of alkalis contain hydroxide ions | SC8 Acids and Alkalis | 64 |  |
| C5.4.6 recognise that aqueous neutralisation reactions can be generalised to hydrogen ions reacting with hydroxide ions to form water | SC8 Acids and Alkalis | 64 |  |
| C5.4.7 describe and explain the procedure for a titration to give precise, accurate, valid and repeatable results | SC14 Quantitative analysis | 116 |  |
| C5.4.8 evaluate the quality of data from titrations | SC14 Quantitative analysis | 114 |  |
| C5.4.9 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 (separate science only) | SC14 Quantitative analysis | 116 |  |
| **Chapter C6 Making useful chemicals** | | | |
| **C6.1 What useful products can be made from acids?** | | | |
| C6.1.1 recall that acids react with some metals and with carbonates and write equations predicting products from given reactants | SC8 Acids and Alkalis | 66 |  |
| C6.1.2 describe practical procedures to make salts to include appropriate use of filtration, evaporation, crystallisation and drying | SC8 Acids and Alkalis | 58 |  |
| C6.1.3 use the formulae of common ions to deduce the formula of a compound |  |  | Not explicit. |
| C6.1.4 recall that relative acidity and alkalinity are measured by pH including the use of universal indicator and pH meters | SC8 Acids and Alkalis | 52 |  |
| **C6.1.5 use and explain the terms dilute and concentrated (amount of substance) and weak and strong (degree of ionisation) in relation to acids including differences in reactivity with metals and carbonates** | SC8 Acids and Alkalis | 53 |  |
| **C6.1.6 use the idea that as hydrogen ion concentration increases by a factor of ten the pH value of a solution decreases by one** | SC8 Acids and Alkalis | 54 |  |
| **C6.1.7 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)** | SC8 Acids and Alkalis | 54 |  |
| **C6.2 How do chemists control the rate of reaction?** | | | |
| C6.2.1 describe the effect on rate of reaction of changes in temperature, concentration, pressure, and surface area | SC18 Rates of reaction | 138 |  |
| C6.2.2 explain the effects on rates of reaction of changes in temperature, concentration and pressure in terms of frequency and energy of collision between particles | SC18 Rates of reaction | 138 |  |
| C6.2.3 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 | SC18 Rates of reaction | 139 |  |
| C6.2.4 describe the characteristics of catalysts and their effect on rates of reaction | SC18 Rates of reaction | 142 |  |
| C6.2.5 identify catalysts in reactions | SC18 Rates of reaction | 142 |  |
| C6.2.6 explain catalytic action in terms of activation energy | SC18 Rates of reaction | 143 |  |
| C6.2.7 suggest practical methods for determining the rate of a given reaction including:  for reactions that produce gases: i. gas syringes or collection over water can be used to measure the volume of gas produced  ii. mass change can be followed using a balance  **measurement of physical factors: iii. colour change iv. formation of a precipitate** | SC18 Rates of reaction | 140 |  |
| C6.2.8 interpret rate of reaction graphs | SC18 Rates of reaction | 137 | Quick "sketch a graph" task. |
| **C6.2.9 interpret graphs of reaction conditions versus rate (separate science only)** *i* an understanding of orders of reaction is not required | SC18 Rates of reaction | 136 | Very few graphs interpretation. |
| C6.2.10 use arithmetic computation and ratios when measuring rates of reaction |  |  | Not seemingly covered explicitly. |
| C6.2.11 draw and interpret appropriate graphs from data to determine rate of reaction |  |  | Not seemingly covered explicitly. |
| C6.2.12 determine gradients of graphs as a measure of rate of change to determine rate |  |  | Not seemingly covered explicitly. |
| C6.2.13 use proportionality when comparing factors affecting rate of reaction |  |  | Not seemingly covered explicitly. |
| C6.2.14 describe the use of enzymes as catalysts in biological systems and some industrial processes | SC18 Rates of reaction |  |  |
| **C6.3 What factors affect the yield of chemical reactions?** | | | |
| C6.3.1 recall that some reactions may be reversed by altering the reaction conditions including: a) reversible reactions are shown by the symbol ↔ b) reversible reactions (in closed systems) do not reach 100% yield | SC12 Reversible reactions and equilibria | 94 |  |
| C6.3.2 recall that dynamic equilibrium occurs when the rates of forward and reverse reactions are equal | SC12 Reversible reactions and equilibria | 94 |  |
| **C6.3.3 predict the effect of changing reaction conditions (concentration, temperature and pressure) on equilibrium position and suggest appropriate conditions to produce a particular product, including: a) catalysts increase rate but do not affect yield b) the disadvantages of using very high temperatures or pressures** | SC12 Reversible reactions and equilibria | 95 |  |
| **C6.4 How are chemicals made on an industrial scale? (separate science only)** | | | |
| C6.4.1 recall the importance of nitrogen, phosphorus and potassium compounds in agricultural production | SC15 Dynamic Equilibria, Calculations involving volumes of gases | 120 | Not a lot of detail. |
| C6.4.2 explain the importance of the Haber process in agricultural production and the benefits and costs of making and using fertilisers, including: a) the balance between demand and supply of food worldwide b) the sustainability and practical issues of producing and using synthetic and natural fertilisers on a large scale c) the environmental impact of over-use of synthetic fertilisers (eutrophication) | SC15 Dynamic Equilibria, Calculations involving volumes of gases | 120 | Not a lot of detail. |
| **C6.4.3 explain how the commercially used conditions for the Haber process are related to the availability and cost of raw materials and energy supplies, control of equilibrium position and rate including: a) the sourcing of raw materials and production of the feedstocks; nitrogen (from air), and hydrogen (from natural gas and steam) b) the effect of a catalyst, temperature and pressure on the yield and rate of reaction c) the separation of the ammonia and recycling of unreacted nitrogen and hydrogen** | SC15 Dynamic Equilibria, Calculations involving volumes of gases | 120 | Not a lot of detail. |
| **C6.4.4 explain the trade-off between rate of production of a desired product and position of equilibrium in some industrially important processes** | SC15 Dynamic Equilibria, Calculations involving volumes of gases | 121 | Not a lot of detail. |
| C6.4.5 define the atom economy of a reaction | SC14 Quantitative analysis | 110 |  |
| C6.4.6 calculate the atom economy of a reaction to form a desired product from the balanced equation using the formula: atom economy = mass of atoms in desired product / total mass of atoms in reactants | SC14 Quantitative analysis | 110 |  |
| C6.4.7 use arithmetic computation when calculating atom economy | SC14 Quantitative analysis | 110 |  |
| **C6.4.8 explain why a particular reaction pathway is chosen to produce a specified product given appropriate data such as atom economy (if not calculated), yield, rate, equilibrium position, usefulness of by-products and evaluate the sustainability of the process** | SC14 Quantitative analysis | 111 |  |
| C6.4.9 describe the industrial production of fertilisers as several integrated processes using a variety of raw materials and compare with laboratory syntheses. including: a) demand for fertilisers (including ammonium sulfate) is often met from more than one process b) some fertilisers are made as a bi-product or waste product of another process c) process flow charts are used to summarise industrial processes and give information about raw materials, stages in the process, products, by-products and waste d) lab processes prepare chemicals in batches, industrial processes are usually continuous. | SC15 Dynamic Equilibria, Calculations involving volumes of gases | 121 | Brief |
| C6.4.10 compare the industrial production of fertilisers with laboratory syntheses of the same products | SC15 Dynamic Equilibria, Calculations involving volumes of gases | 121 | Brief |

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