

GCSE (9-1)

***GATEWAY SCIENCE CHEMISTRY A***

**J248**

For first teach in 2016

**Student revision checklist**

Version 1

**[www.ocr.org.uk/chemistry](http://www.ocr.org.uk/chemistry)**

# Student revision checklist

## Revision checklists

The tables below can be used as a revision checklist.

For more information please see the [OCR GCSE Gateway Chemistry A specification.](https://www.ocr.org.uk/Images/234598-specification-accredited-gcse-gateway-science-suite-chemistry-a-j248.pdf)

The table headings are explained below:

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| **Assessable learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| Here is a list of the learning outcomes for this qualification and the content you need to cover and work on.  **Please note the learning outcomes in bold are for Higher tier only.** | You can use the tick boxes to show when you have revised an item and how confident you feel about it.  R = **RED** means you are really unsure and lack confidence; you might want to focus your revision here and possibly talk to your teacher for help.  A = **AMBER** means you are reasonably confident but need some extra practice.  G = **GREEN** means you are very confident.  As your revision progresses, you can concentrate on the **RED** and **AMBER** items in order to turn them into **GREEN** items.  You might find it helpful to highlight each topic in red, orange or green to help you prioritise. | | | You can use the comments column to:   * add more information about the details for each point * add formulae or notes * include a reference to a useful resource * highlight areas of difficulty or things that you need to talk to your teacher about or look up in a textbook. |

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| **C1 Particles** | | | | |
| **C1.1 The particle model** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C1.1a describe the main features of the particle model in terms of states of matter and change of state |  |  |  |  |
| C1.1b explain in terms of the particle model the distinction between physical changes and chemical changes |  |  |  |  |
| 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)**  ***To include* – that it does not take into account the forces of attraction between particles, the size of particles and the space between them** |  |  |  |  |
| **C1.2 Atomic structure** | | | | |
| C1.2a describe how and why the atomic model has changed over time |  |  |  |  |

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| **C1.2 Atomic structure** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 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 |  |  |  |  |
| C1.2c recall the typical size (order of magnitude) of atoms and small molecules  *To include* – the concept that typical atomic radii and bond length are in the order of 10-10m |  |  |  |  |
| C1.2d recall relative charges and approximate relative masses of protons, neutrons and electrons |  |  |  |  |
| C1.2e calculate numbers of protons, neutrons and electrons in atoms and ions, given atomic number and mass number of isotopes  *To include* – definitions of an ion, atomic number, mass number and an isotope, also the standard notation to represent these |  |  |  |  |

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| **C2 Elements, compounds and mixtures** | | | | |
| **C2.1 Purity and separating mixtures** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C2.1a explain what is meant by the purity of a substance, distinguishing between the scientific and everyday use of the term ‘pure’ |  |  |  |  |
| C2.1b use melting point data to distinguish pure from impure substances |  |  |  |  |
| C2.1c calculate relative formula masses of species separately and in a balanced chemical equation  *To include* – the definition of relative atomic mass, relative molecular mass and relative formula mass |  |  |  |  |
| 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 |  |  |  |  |
| C2.1e explain that many useful materials are formulations of mixtures  *To include* – alloys |  |  |  |  |
| **C2.1 Purity and separating mixtures** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C2.1f describe, explain and exemplify the processes of filtration, crystallisation, simple distillation, and fractional distillation  *To include* - knowledge of the techniques of filtration, crystallisation, simple distillation and fractional distillation |  |  |  |  |
| C2.1g describe the techniques of paper and thin layer chromatography  *To include -* using aqueous and non-aqueous solvents and locating agents |  |  |  |  |
| C2.1h recall that chromatography involves a stationary and a mobile phase and that separation depends on the distribution between the phases  *To include* – identification of the mobile and stationary phases |  |  |  |  |
| C2.1i interpret chromatograms, including measuring Rf values  *To include* – the recall and the use of the formula |  |  |  |  |
| **C2.1 Purity and separating mixtures** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C2.1j suggest suitable purification techniques given information about the substances involved |  |  |  |  |
| C2.1k suggest chromatographic methods for distinguishing pure from impure substances  *To include* – paper, thin layer (TLC) and gas chromatography |  |  |  |  |
| **C2.2 Bonding** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C2.2a describe metals and non-metals and explain the differences between them on the basis of their characteristic physical and chemical properties  *To include* - physical properties, formation of ions and common reactions, e.g. with oxygen to form oxides |  |  |  |  |
| C2.2b explain how the atomic structure of metals and non-metals relates to their position in the periodic table |  |  |  |  |

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| **C2.2 Bonding** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 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  *To include* – group number and period number |  |  |  |  |
| C2.2d describe and compare the nature and arrangement of chemical bonds in:   1. ionic compounds 2. simple molecules 3. giant covalent structures 4. polymers 5. metals |  |  |  |  |
| C2.2e explain chemical bonding in terms of electrostatic forces and the transfer or sharing of electrons |  |  |  |  |
| C2.2f construct dot and cross diagrams for simple covalent and binary ionic substances |  |  |  |  |

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| **C2.2 Bonding** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 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 |  |  |  |  |
| C2.2h explain how the reactions of elements are related to the arrangement of electrons in their atoms and hence to their atomic number |  |  |  |  |
| C2.2i explain in terms of atomic number how Mendeleev’s arrangement was refined into the modern Periodic Table |  |  |  |  |
| **C2.3 Properties of materials** | | | | |
| C2.3a recall that carbon can form four covalent bonds |  |  |  |  |
| 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 |  |  |  |  |

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| **C2.3 Properties of materials** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C2.3c explain the properties of diamond, graphite, fullerenes and graphene in terms of their structures and bonding |  |  |  |  |
| 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 |  |  |  |  |
| C2.3e use data to predict states of substances under given conditions  *To include* – data such as temperature and how this may be linked to changes of state |  |  |  |  |
| 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    *To include -* recognition that the atoms themselves do not have the bulk properties of these materials |  |  |  |  |
| **C2.3 Properties of materials** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C2.3g compare ‘nano’ dimensions to typical dimensions of atoms and molecules  *(separate science only)* |  |  |  |  |
| C2.3h describe the surface area to volume relationship for different-sized particles and describe how this affects properties  *(separate science only)* |  |  |  |  |
| C2.3i describe how the properties of nanoparticulate materials are related to their uses  *(separate science only)* |  |  |  |  |
| C2.3j explain the possible risks associated with some nanoparticulate materials  *(separate science only)* |  |  |  |  |

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| **C3 Chemical reactions** | | | | |
| **C3.1 Introducing chemical reactions** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C3.1a use chemical symbols to write the formulae of elements and simple covalent and ionic compounds |  |  |  |  |
| 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** |  |  |  |  |
| C3.1c use the names and symbols of common elements from a supplied periodic table to write formulae and balanced chemical equations where appropriate  *To include* – the first 20 elements, Groups 1, 7 and 0 and other common elements included within the specification |  |  |  |  |
| C3.1d use the formula of common ions to deduce the formula of a compound |  |  |  |  |

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| **C3.1 Introducing chemical reactions** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C3.1e **construct balanced ionic equations** |  |  |  |  |
| C3.1f describe the physical states of products and reactants using state symbols (s, l, g and aq) |  |  |  |  |
| C3.1g **recall and use the definitions of the Avogadro constant (in standard form) and of the mole**  *To include* – **the calculation of the mass of one atom/molecule.** In recognition of IUPAC’s review, we will accept both the classical (carbon-12 based) and revised (Avogadro constant based) definitions of the mole in examinations from June 2018 onwards  (see <https://iupac.org/new-definition-mole-arrived/>) |  |  |  |  |
| C3.1h **explain how the mass of a given substance is related to the amount of that substance in moles and vice versa** |  |  |  |  |
| C3.1i recall and use the law of conservation of mass |  |  |  |  |
| **C3.1 Introducing chemical reactions** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C3.1j explain any observed changes in mass in non-enclosed systems during a chemical reaction and explain them using the particle model |  |  |  |  |
| 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** |  |  |  |  |
| C3.1l **use a balanced equation to calculate masses of reactants or products** |  |  |  |  |
| **C3.2 Energetics** | | | | |
| C3.2a distinguish between endothermic and exothermic reactions on the basis of the temperature change of the surroundings |  |  |  |  |
| C3.2b draw and label a reaction profile for an exothermic and an endothermic reaction.  *To include* – activation energy, energy change, reactants and products |  |  |  |  |

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| **C3.2 Energetics** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C3.2c explain activation energy as the energy needed for a reaction to occur |  |  |  |  |
| C3.2d **calculate energy changes in a chemical reaction by considering bond making and bond breaking energies** |  |  |  |  |
| **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  *To include* – the concept of oxidising agent and reducing agent |  |  |  |  |
| C3.3b **explain reduction and oxidation in terms of gain or loss of electrons, identifying which species are oxidised and which are reduced** |  |  |  |  |
| C3.3c recall that acids form hydrogen ions when they dissolve in water and solutions of alkalis contain hydroxide ions |  |  |  |  |

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| **C3.3 Types of chemical reactions** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C3.3d describe neutralisation as acid reacting with alkali or a base to form a salt plus water |  |  |  |  |
| C3.3e recognise that aqueous neutralisation reactions can be generalised to hydrogen ions reacting with hydroxide ions to form water |  |  |  |  |
| C3.3f recall that carbonates and some metals react with acids and write balanced equations predicting products from given reactants |  |  |  |  |
| C3.3g **use and explain the terms dilute and concentrated (amount of substance) and weak and strong (degree of ionisation) in relation to acids**  ***To include* – ratio of amount of acid to volume of solution** |  |  |  |  |
| C3.3h recall that relative acidity and alkalinity are measured by pH |  |  |  |  |

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| **C3.3 Types of chemical reactions** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 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)**  ***To include* – pH of titration curves** |  |  |  |  |
| 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** |  |  |  |  |
| C3.3k describe techniques and apparatus used to measure pH  *To include -* the use of universal indicator and pH meters |  |  |  |  |
| **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  *To include* – the terms cations and anions |  |  |  |  |

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| **C3.4 Electrolysis** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C3.4b predict the products of electrolysis of binary ionic compounds in the molten state  *To include* – compounds such as NaC𝑙 |  |  |  |  |
| C3.4c describe competing reactions in the electrolysis of aqueous solutions of ionic compounds in terms of the different species present  *To include* – the electrolysis of aqueous NaC𝑙 and CuSO4 using inert electrodes |  |  |  |  |
| C3.4d describe electrolysis in terms of the ions present and reactions at the electrodes  *To include -* the equations and **half equations** of the reactions at the electrodes |  |  |  |  |
| C3.4e describe the technique of electrolysis using inert and non-inert electrodes |  |  |  |  |

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| **C4 Predicting and identifying reactions and products** | | | | |
| **C4.1 Predicting chemical reactions** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C4.1a recall the simple properties of Groups 1, 7 and 0  *To include* – physical and chemical properties |  |  |  |  |
| 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  *To include* – ease of electron gain or loss, physical and chemical properties |  |  |  |  |
| C4.1c recall the general properties of transition metals and their compounds and exemplify these by reference to a small number of transition metals  *To include* – melting point, density, reactivity, formation of coloured ions with different charges and uses as catalysts  *(separate science only)* |  |  |  |  |
| C4.1d predict possible reactions and probable reactivity of elements from their positions in the periodic table |  |  |  |  |
| **C4.1 Predicting chemical reactions** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 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 |  |  |  |  |
| C4.1f deduce an order of reactivity of metals based on experimental results |  |  |  |  |
| **C4.2 Identifying the products of chemical reactions** | | | | |
| C4.2a describe tests to identify selected gases  *To include* – oxygen, hydrogen, carbon dioxide and chlorine |  |  |  |  |
| C4.2b describe tests to identify aqueous cations and aqueous anions  *To include* – calcium, copper, iron (II), iron (III) and zinc using sodium hydroxide; carbonates and sulfates using aqueous barium chloride followed by hydrochloric acid; chloride, bromide and iodide using silver nitrate  *(separate science only)* |  |  |  |  |
| C4.2c describe how to perform a flame test  *(separate science only)* |  |  |  |  |
| **C4.2 Identifying the products of chemical reactions** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C4.2d identify species from test results  *(separate science only)* |  |  |  |  |
| C4.2e interpret flame tests to identify metal ions  *To include* – the ions of lithium, sodium, potassium, calcium and copper  *(separate science only)* |  |  |  |  |
| C4.2f describe the advantages of instrumental methods of analysis  *To include* – sensitivity, accuracy and speed  *(separate science only)* |  |  |  |  |
| 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  *To include -* the features of a mass spectroscopy chart  *(separate science only)* |  |  |  |  |

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| **C5 Monitoring and controlling chemical reactions** | | | | |
| **C5.1 Monitoring chemical reactions** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 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**  ***(separate science only)*** |  |  |  |  |
| C5.1b describe the technique of titration  *(separate science only)* |  |  |  |  |
| 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**  ***To include* – titration calculations**  ***(separate science only)*** |  |  |  |  |
| C5.1d **describe the relationship between molar amounts of gases and their volumes and vice versa**  ***(separate science only)*** |  |  |  |  |

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| **C5.1 Monitoring chemical reactions** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C5.1e **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)*** |  |  |  |  |
| C5.1f **explain how the mass of a solute and the volume of the solution is related to the concentration of a solution** |  |  |  |  |
| C5.1g calculate the theoretical amount of a product from a given amount of reactant  *(separate science only)* |  |  |  |  |
| C5.1h calculate the percentage yield of a reaction product from the actual yield of a reaction  *(separate science only)* |  |  |  |  |
| C5.1i define the atom economy of a reaction  *(separate science only)* |  |  |  |  |
| C5.1j calculate the atom economy of a reaction to form a desired product from the balanced equation  *(separate science only)* |  |  |  |  |

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| **C5.1 Monitoring chemical reactions** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C5.1k **explain why a particular reaction pathway is chosen to produce a specified product given appropriate data**  ***To include* – data such as atom economy (if not calculated), yield, rate, equilibrium position and usefulness of by-products**  ***(separate science only)*** |  |  |  |  |
| **C5.2 Controlling reactions** | | | | |
| C5.2a suggest practical methods for determining the rate of a given reaction |  |  |  |  |
| C5.2b interpret rate of reaction graphs  *To include* – 1/t is proportional to rate and gradients of graphs  (not order of reaction) |  |  |  |  |
| C5.2c describe the effect of changes in temperature, concentration, pressure, and surface area on rate of reaction |  |  |  |  |

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| **C5.2 Controlling reactions** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 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 |  |  |  |  |
| 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 |  |  |  |  |
| C5.2f describe the characteristics of catalysts and their effect on rates of reaction |  |  |  |  |
| C5.2g identify catalysts in reactions |  |  |  |  |
| C5.2h explain catalytic action in terms of activation energy  *To include* – reaction profiles |  |  |  |  |
| C5.2i recall that enzymes act as catalysts in biological systems |  |  |  |  |

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| **C5.3 Equilibria** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C5.3a recall that some reactions may be reversed by altering the reaction conditions |  |  |  |  |
| C5.3b recall that dynamic equilibrium occurs in a closed system when the rates of forward and reverse reactions are equal |  |  |  |  |
| 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**  ***To include* - Le Chatelier’s principle concerning concentration, temperature and pressure** |  |  |  |  |

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| **C6 Global challenges** | | | | |
| **C6.1 Improving processes and products** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 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  *To include:* the principles of using carbon to extract iron and other metals from their ores |  |  |  |  |
| C6.1b explain why and how electrolysis is used to extract some metals from their ores |  |  |  |  |
| C6.1c **evaluate alternative biological methods of metal extraction**  ***To include* – bacterial and phytoextraction** |  |  |  |  |
| C6.1d **explain the trade-off between rate of production of a desired product and position of equilibrium in some industrially important processes**  ***To include* – the Haber process and Contact process**  ***(separate science only)*** |  |  |  |  |
| **C6.1 Improving processes and products** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C6.1e **interpret graphs of reaction conditions versus rate *(separate science only)*** |  |  |  |  |
| 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**  ***(separate science only)*** |  |  |  |  |
| C6.1g explain the importance of the Haber process in agricultural production  *(separate science only)* |  |  |  |  |
| C6.1h compare the industrial production of fertilisers with laboratory syntheses of the same products *(separate science only)* |  |  |  |  |
| C6.1i recall the importance of nitrogen, phosphorus and potassium compounds in agricultural production *(separate science only)* |  |  |  |  |

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| **C6.1 Improving processes and products** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C6.1j describe the industrial production of fertilisers as several integrated processes using a variety of raw materials  *To include* – ammonium nitrate and ammonium sulfate  *(separate science only)* |  |  |  |  |
| C6.1k describe the basic principles in carrying out a life-cycle assessment of a material or product  *To include:* the use of resources and impact on the environment of all stages of a life-cycle assessment:  • making materials for a product from raw  materials through to the process used to  make the product  • the use of the product  • transport of the product  • the method used for its disposal at the  end of its life |  |  |  |  |
| C6.1l interpret data from a life-cycle assessment of a material or product |  |  |  |  |

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| **C6.1 Improving processes and products** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C6.1m describe a process where a material or product is recycled for a different use and explain why this is viable |  |  |  |  |
| C6.1n evaluate factors that affect decisions on recycling |  |  |  |  |
| C6.1o describe the composition of some important alloys in relation to their properties and uses.  *To include* – steel, brass, bronze, solder, duralumin  *(separate science only)* |  |  |  |  |
| C6.1p describe the process of corrosion and the conditions which cause corrosion  *To include* – iron and other metals  *(separate science only)* |  |  |  |  |
| C6.1q explain how mitigation of corrosion is achieved by creating a physical barrier to oxygen and water and by sacrificial protection *(separate science only)* |  |  |  |  |

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| **C6.1 Improving processes and products** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C6.1r compare quantitatively the physical properties of glass and clay ceramics, polymers, composites and metals  *(separate science only)* |  |  |  |  |
| C6.1s explain how the properties of materials are related to their uses and select appropriate materials given details of the usage required  *(separate science only)* |  |  |  |  |

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| **C6.2 Organic chemistry** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C6.2a recognise functional groups and identify members of the same homologous series  *To include* - homologous series, of alkanes, alkenes, alcohols and carboxylic acids  *(separate science only)* |  |  |  |  |
| 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  *(separate science only)* |  |  |  |  |
| 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  *To include* - combustion; addition of bromine and hydrogen across a double bond; oxidation of alcohols to carboxylic acids using potassium manganate(VII)  *(separate science only)* |  |  |  |  |

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| **C6.2 Organic chemistry** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 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 *(separate science only)* |  |  |  |  |
| C6.2e **explain the basic principles of condensation polymerisation**  ***To include* - 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, e.g. a polyester or polyamide, using block diagrams to represent polymers**  ***(separate science only)*** |  |  |  |  |
| C6.2f **describe practical techniques to make a polymer by condensation**  ***(separate science only)*** |  |  |  |  |

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| **C6.2 Organic chemistry** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C6.2g deduce the structure of an addition polymer from a simple alkene monomer and vice versa  *To include* - the following representation of a polymer [repeat unit]n  *(separate science only)* |  |  |  |  |
| 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  *To include* – the name of the nucleotides  *(separate science only)* |  |  |  |  |
| C6.2i recall that it is the generality of reactions of functional groups that determine the reactions of organic compounds  *(separate science only)* |  |  |  |  |
| C6.2j describe the separation of crude oil by fractional distillation  *To include* – the names of the fractions |  |  |  |  |

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| **C6.2 Organic chemistry** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C6.2k explain the separation of crude oil by fractional distillation  *To include* – molecular size and intermolecular forces |  |  |  |  |
| C6.2l describe the fractions as largely a mixture of compounds of formula CnH2n+2 which are members of the alkane homologous series |  |  |  |  |
| C6.2m recall that crude oil is a main source of hydrocarbons and is a feedstock for the petrochemical industry |  |  |  |  |
| C6.2n explain how modern life is crucially dependent upon hydrocarbons and recognise that crude oil is a finite resource |  |  |  |  |
| C6.2o describe the production of materials that are more useful by cracking  *To include* – conditions and reasons for cracking and some of the useful materials produced |  |  |  |  |

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| **C6.2 Organic chemistry** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C6.2p recall that a chemical cell produces a potential difference until the reactants are used up  *(separate science only)* |  |  |  |  |
| C6.2q evaluate the advantages and disadvantages of hydrogen/oxygen and other fuel cells for given uses  *To include* – the chemistry of the hydrogen/oxygen fuel cell  *(separate science only)* |  |  |  |  |

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| **C6.3 Interpreting and interacting with earth systems** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| C6.3a interpret evidence for how it is thought the atmosphere was originally formed  *To include* - knowledge of how the composition of the atmosphere has changed over time |  |  |  |  |
| C6.3b describe how it is thought an oxygen-rich atmosphere developed over time |  |  |  |  |
| C6.3c describe the greenhouse effect in terms of the interaction of radiation with matter within the atmosphere |  |  |  |  |
| C6.3d evaluate the evidence for additional anthropogenic (human activity) causes of climate change and describe the uncertainties in the evidence base  *To include* - the correlation between change in atmospheric carbon dioxide concentration and the consumption of fossil fuels |  |  |  |  |

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| **C6.3 Interpreting and interacting with earth systems** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 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  *To include* – consideration of scale, risk and environmental implications |  |  |  |  |
| 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 |  |  |  |  |
| C6.3g describe the principal methods for increasing the availability of potable water in terms of the separation techniques used  *To include* – ease of treatment of waste, ground and salt water |  |  |  |  |

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| **WS1 Working scientifically assessed in written examinations** | | | | |
| **WS1.1 Development of scientific thinking** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 1.1a understand how scientific methods and theories develop over time  *To include* – new technology allowing new evidence to be collected and changing explanations as new evidence is found |  |  |  |  |
| 1.1b use models to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts  *To include* – representational, spatial, descriptive, computational and mathematical models |  |  |  |  |
| 1.1c understand the power and limitations of science  *To include* – how developments in science have led to increased understanding and improved quality of life and questions and problems that science cannot currently answer |  |  |  |  |
| **WS1 Working scientifically assessed in written examinations** | | | | |
| **WS1.1 Development of scientific thinking** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 1.1d discuss ethical issues arising from developments in science |  |  |  |  |
| 1.1e explain everyday and technological applications of science |  |  |  |  |
| 1.1f evaluate associated personal, social, economic and environmental implications |  |  |  |  |
| 1.1g make decisions based on the evaluation of evidence and arguments |  |  |  |  |
| 1.1h evaluate risks both in practical science and the wider societal context  *To include* – perception of risk in relation to data and consequences |  |  |  |  |
| 1.1i recognise the importance of peer review of results and of communicating results to a range of audiences |  |  |  |  |

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| **WS1 Working scientifically assessed in written examinations** | | | | |
| **WS1.2 Experimental skills and strategies** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 1.2a use scientific theories and explanations to develop hypotheses |  |  |  |  |
| 1.2b plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena |  |  |  |  |
| 1.2c apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment |  |  |  |  |
| 1.2d recognise when to apply a knowledge of sampling techniques to ensure any samples collected are representative |  |  |  |  |
| 1.2e evaluate methods and suggest possible improvements and further investigations |  |  |  |  |

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| **WS1 Working scientifically assessed in written examinations** | | | | |
| **WS1.3 Analysis and evaluation** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| Apply the cycle of collecting, presenting and analysing data, including: |  |  |  |  |
| 1.3a presenting observations and other data using appropriate methods  *To include –* methods to include descriptive, tabular diagrammatic and graphically |  |  |  |  |
| 1.3b translating data from one form to another |  |  |  |  |
| 1.3c carrying out and representing mathematical and statistical analysis  *To include* – statistical analysis to include arithmetic means, mode, median |  |  |  |  |
| 1.3d representing distributions of results and make estimations of uncertainty |  |  |  |  |

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| **WS1 Working scientifically assessed in written examinations** | | | | |
| **WS1.3 Analysis and evaluation** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 1.3e interpreting observations and other data  *To include* – data presentations to include verbal, diagrammatic, graphical, symbolic or numerical form interpretations to include identifying patterns and trends, making inferences and drawing conclusions |  |  |  |  |
| 1.3f presenting reasoned explanations  *To include* – relating data to hypotheses |  |  |  |  |
| 1.3g evaluating data in terms of accuracy, precision, repeatability and reproducibility |  |  |  |  |
| 1.3h identifying potential sources of random and systematic error |  |  |  |  |

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| **WS1 Working scientifically assessed in written examinations** | | | | |
| **WS1.3 Analysis and evaluation** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 1.3i communicating the scientific rationale for investigations, methods used, findings and reasoned conclusions  *To include* – presentations through paper- based presentations using diagrammatic, graphical, numerical and symbolic forms |  |  |  |  |
| **WS1.4 Scientific vocabulary, quantities, units, symbols and nomenclature** | | | | |
| 1.4a use scientific vocabulary, terminology and definitions |  |  |  |  |
| 1.4b recognise the importance of scientific quantities and understand how they are determined |  |  |  |  |
| 1.4c use SI units and IUPAC chemical nomenclature unless inappropriate  *To include* – base units & derived units |  |  |  |  |

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| **WS1 Working scientifically assessed in written examinations** | | | | |
| **WS1.4 Scientific vocabulary, quantities, units, symbols and nomenclature** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 1.4d use prefixes and powers of ten for orders of magnitude  *To include* – tera, giga, mega, kilo, deci, centi, milli, micro and nano |  |  |  |  |
| 1.4e interconvert units |  |  |  |  |
| 1.4f use an appropriate number of significant figures in calculation |  |  |  |  |

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| **WS2 Working scientifically skills demonstrated** | | | | |
| **Practical skills to be developed** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 2a carry out experiments  *To include* – due regard to the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations, and following written instructions. |  |  |  |  |
| 2b make and record observations and measurements using a range of apparatus and methods  *To include* – keeping appropriate records |  |  |  |  |
| 2c presenting observations using appropriate methods  *To include* – methods to include descriptive, tabular diagrammatic and graphically |  |  |  |  |

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| **WS2 Working scientifically skills demonstrated** | | | | |
| **Practical skills to be developed** | | | | |
| **Learning outcomes**  You will be required to: | **R** | **A** | **G** | **Comments** |
| 2d communicating the scientific rationale for investigations, methods used, findings and reasoned conclusions    *To include* – presentations through paper- based and electronic reports and presentations using verbal, diagrammatic, graphical, numerical and symbolic forms |  |  |  |  |

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