| Subject | Year 12 Core Knowledge – Autumn/Spring/Summer term | How to support students' learning |
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| **Science – Chemistry** | **Autumn Term**<br>**Atomic structure –**<br>1. Interpret simple mass spectra of elements.<br>2. Calculate relative atomic mass from isotopic abundance, limited to mononuclear ions.<br>3. Define first ionisation energy.<br>4. Write equations for first and successive ionisation energies.<br>5. Explain how first and successive ionisation energies in Period 3 (Na–Ar) and in Group 2 (Be–Ba) give evidence for electron configuration in sub-shells and in shells.<br>6. Define relative atomic mass (Ar).<br>7. Define relative molecular mass (Mr).<br>8. Use equations for moles and concentration accurately.<br>9. Calculate empirical formula from data giving composition by mass or percentage by mass.<br>10. Calculate molecular formula from the empirical formula and relative molecular mass.<br>11. Write balanced equations for reactions studied.<br>12. Balance equations for unfamiliar reactions when reactants and products are specified.<br><br>**Bonding –**<br>13. Predict the charge on a simple ion using the position of the element in the Periodic Table.<br>14. Construct formulas for ionic compounds.<br>15. Represent a covalent bond using a line.<br>16. Represent a co-ordinate bond using an arrow.<br>17. Relate the melting point and conductivity of materials to the type of structure and the bonding present.<br>18. Explain the energy changes associated with changes of state. | • CGP AQA A level Chemistry year 1 revision guide (can be bought through the school).<br>• CGP AQA A level Chemistry year 1 textbook (can be bought through the school).<br>• Seneca: https://senecalearning.com/en-GB/Free revision resource.<br>• Chem guide: https://www.chemguide.co.uk/<br>• MaChemguy: https://www.youtube.com/channel/UCyl4QJXN9zNapzmKAn-fJgQ<br>• Free science lessons: https://www.freesciencelessons.co.uk/a-level-revision-videos/a-level-chemistry/<br>• Physics and maths tutor https://www.physicsandmathstutor.com/chemistry-revision/a-level-aqa/ |

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| | 19. Bonding - Draw diagrams to represent these structures involving specified numbers of particles.<br>20. Explain the shapes of, and bond angles in, simple molecules and ions with up to six electron pairs (including lone pairs of electrons) surrounding the central atom.<br>21. Use knowledge of electronegativity and partial charges to show that a bond is polar.<br>22. Explain why some molecules with polar bonds do not have a permanent dipole.<br>23. Explain the existence of intermolecular forces between familiar and unfamiliar molecules.<br>24. Explain how melting and boiling points are influenced by intermolecular forces.<br>25. Draw structural, displayed and skeletal formulas for given organic compounds.<br><br>**Intro to organic chemistry –**<br>26. Apply IUPAC rules for nomenclature to name organic compounds limited to chains and rings with up to six carbon atoms each.<br>27. Apply IUPAC rules for nomenclature to draw the structure of an organic compound from the IUPAC name limited to chains and rings with up to six carbon atoms each.<br>28. Define the term structural isomer.<br>29. Intro to organic chemistry - Draw the structures of chain, position and functional group isomers.<br>30. Define the term stereoisomer.<br>31. Draw the structural formulas of E and Z isomers.<br>32. Apply the CIP priority rules to E and Z isomers.<br><br>**Alkanes and halogenoalkanes –**<br>33. Explain the economic reasons for cracking alkanes and know the | |

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| | conditions and products of each type.<br>34. Explain why sulphur dioxide can be removed from flue gases using calcium oxide or calcium carbonate.<br>35. Write balanced equations for the steps in a free-radical mechanism.<br>36. Explain the free-radical substitution mechanism involving initiation, propagation and termination steps.<br>37. Outline the steps of a nucleophilic substitution mechanism.<br>38. Explain why the carbon–halogen bond enthalpy influences the rate of reaction.<br>39. Explain the role of the reactive species as both nucleophile and base.<br><br>**Spring Term**<br>**Energetics –**<br>40. Define standard enthalpy of combustion (ΔHcϴ)<br>41. Define standard enthalpy of formation (ΔHfϴ).<br>42. Use the calorimetry equation to calculate the molar enthalpy change for a reaction.<br>43. Use Hess's law to perform calculations, including calculation of enthalpy changes for reactions from enthalpies of combustion or from enthalpies of formation.<br>44. Define the term mean bond enthalpy.<br>45. Use mean bond enthalpies to calculate an approximate value of ΔH for reactions in the gaseous phase.<br>46. Explain why values from mean bond enthalpy calculations differ from those determined using Hess's law.<br><br>**Kinetics –**<br>47. Define the term activation energy.<br>48. Explain why most collisions do not lead to a reaction.<br>49. Draw and interpret distribution curves for different temperatures. | |

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| | 50. Use the Maxwell–Boltzmann distribution to explain why a small temperature increase can lead to a large increase in rate.<br>51. Explain how a change in concentration or a change in pressure influences the rate of a reaction.<br>52. Use a Maxwell–Boltzmann distribution to help explain how a catalyst increases the rate of a reaction involving a gas.<br><br>**Alkenes and alcohols –**<br>53. Outline the mechanisms for alkene addition reactions.<br>54. Explain the formation of major and minor products by reference to the relative stabilities of primary, secondary and tertiary carbocation intermediates.<br>55. Draw the repeating unit of an addition polymer from a monomer structure.<br>56. Draw the repeating unit from a section of the polymer chain.<br>57. Draw the structure of the alkene monomer from a section of the addition polymer.<br>58. Explain why addition polymers are unreactive.<br>59. Explain the nature of intermolecular forces between molecules of polyalkenes.<br>60. Explain the meaning of the term biofuel.<br>61. Justify the conditions used in the production of ethanol by fermentation of glucose.<br>62. Write equations to support the statement that ethanol produced by fermentation is a carbon neutral fuel and give reasons why this statement is not valid.<br>63. Outline the mechanism for the formation of an alcohol by the reaction of an alkene with steam in the presence of an acid catalyst.<br>64. Discuss the environmental (including ethical) issues linked to decision making about biofuel use. | |

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| | 65. Write equations for oxidation reactions of alcohols and aldehydes (use equations showing [O] as the oxidant).<br>66. Explain how the method used to oxidise a primary alcohol determines whether an aldehyde or carboxylic acid is obtained.<br>67. Use chemical tests to distinguish between aldehydes and ketones including Fehling's solution and Tollens' reagent.<br>68. Outline the mechanism for the elimination of water from alcohols.<br><br>**Organic analysis –**<br>69. Identify the functional groups in a molecule using observations and information from reactions in the specification.<br>70. Use precise atomic masses and the precise molecular mass to determine the molecular formula of a compound.<br>71. Use infrared spectra and the Chemistry Data Booklet to identify particular bonds, and therefore functional groups, and also to identify impurities.<br><br>**Summer Term**<br>**Equilibria and redox reactions –**<br>72. Use Le Chatelier's principle to predict qualitatively the effect of changes in temperature, pressure and concentration on the position of equilibrium.<br>73. Explain why, for a reversible reaction used in an industrial process, a compromise temperature and pressure may be used.<br>74. Construct an expression for Kc for a homogeneous system in equilibrium.<br>75. Calculate a value for Kc from the equilibrium concentrations for a homogeneous system at constant temperature.<br>76. Perform calculations involving Kc. | |

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| | 77. Predict the qualitative effects of changes of temperature on the value of Kc.<br>78. Work out the oxidation state of an element in a compound or ion from the formula.<br>79. Write half-equations identifying the oxidation and reduction processes in redox reactions.<br>80. Combine half-equations to give an overall redox equation.<br><br>**Group 2 and group 7 –**<br>81. Explain why acidified silver nitrate solution is used to identify halide ions.<br>82. Explain the trends in atomic radius and first ionisation energy in group 2.<br>83. Explain the melting point of the group 2 elements in terms of their structure and bonding.<br>84. Explain why $BaCl_2$ solution is used to test for sulfate ions and why it is acidified.<br>85. Explain the trend in electronegativity in group 7.<br>86. Explain the trend in the boiling point of the group 7 elements in terms of their structure and bonding.<br>87. Explain how acidified silver nitrate solution followed by dilute and concentrated ammonia solutions are used to identify halide ions, including simplest ionic equations.<br>88. Explain how different reagents are used to identify positive and negative ions in an unknown solution.<br>89. Explain with equations the reducing power of the halide ions.<br>90. Explain with equations the oxidising power of the halogens. | |