Subject	Y13 Core Knowledge – Autumn/Spring/Summer term	How to support students' learning
Science - Chemistry	**Autumn Term** **Isomerism and carbonyl compounds -** 1. Draw the structural formulas and displayed formulas of enantiomers. 2. Understand how racemic mixtures (racemates) are formed and why they are optically inactive. 3. Outline the nucleophilic addition mechanism for reduction reactions with NaBH4 (the nucleophile should be shown as H:-). 4. Write overall equations for the formation of hydroxynitriles using HCN. 5. Outline the nucleophilic addition mechanism for the reaction with KCN followed by dilute acid. 6. Explain why nucleophilic addition reactions of KCN, followed by dilute acid, can produce a mixture of enantiomers. 7. Describe the reactions of esters to produce soap and biodiesels. 8. Outline the mechanism of nucleophilic addition-elimination reactions of acyl chlorides and acid anhydrides with water, alcohols, ammonia and primary amines. **Aromatic compounds and amines -** 9. Use thermochemical evidence from enthalpies of hydrogenation to account for benzene stability. 10. Explain why electrophilic substitution reactions occur with benzene in preference to electrophilic addition reactions. 11. Outline the electrophilic substitution mechanisms of nitration, including the generation of the nitrenium ion. 12. Outline the electrophilic substitution mechanisms of Friedel Craft's acylation, including formation of the acylium ion using AlCl3 as a catalyst. 13. Explain the difference in base strength in terms of the availability of the lone pair of electrons on the N atom of an amine. 14. Outline the mechanism of the nucleophilic substitution reactions of amines. **Thermodynamics -** 15. Construct Born–Haber cycles to calculate lattice enthalpies using enthalpy changes.	• CGP AQA A level Chemistry year 1 and 2 revision guide (can be bought through the school). • CGP AQA A level Chemistry year 1 and 2 textbook (can be bought through the school). • Seneca: https://senecalearning.com/en-GB/ Free revision resource. • Chemguide https://www.chemguide.co.uk/ • MaChemguy https://www.youtube.com/channel/UCyl4XN9zNapzmKAn-fJgQ • Freesciencelessons https://www.freesciencelessons.co.uk/a-level-revision-videos/a-level-chemistry/ • Physics and maths tutor https://www.physicsandmathstutor.com/chemistry-revision/a-level-aqa/ • There is a revision schedule that has been emailed out to parents, please encourage your child to follow it.

	16. Understand and explain what Born–Haber cycles are. 17. Compare lattice enthalpies from Born–Haber cycles with those from calculations based on a perfect ionic model to provide evidence for covalent character in ionic compounds. 18. Perform calculations of an enthalpy change using Born Haber cycles. 19. Calculate entropy changes from absolute entropy values. 20. Use the relationship ΔG = ΔH – TΔS to determine how ΔG varies with temperature. 21. Use the relationship ΔG = ΔH – TΔS to determine the temperature at which a reaction becomes feasible. **Rate equations and Kp -** 22. Perform calculations using the rate equation. 23. Explain the qualitative effect of changes in temperature on the rate constant k. 24. Perform calculations using the equation k = Ae–Ea/RT. 25. Understand that the equation k = Ae–Ea/RT can be rearranged into the form ln k = -Ea /RT + ln A and know how to use this rearranged equation with experimental data to plot a straight-line graph with slope -Ea/R. 26. Use concentration-time graphs to deduce the rate of a reaction. 27. Use initial concentration–time data to deduce the initial rate of a reaction. 28. Derive the rate equation for a reaction from the orders with respect to each of the reactants. 29. Use the orders with respect to reactants to provide information about the rate determining/limiting step of a reaction. 30. Derive partial pressure from mole fraction and total pressure. 31. Construct an expression for Kp for a homogeneous system in equilibrium. 32. Predict the qualitative effects of changes in temperature and pressure on the position of equilibrium. 33. Predict the qualitative effects of changes in temperature on the value of Kp. 34. Understand that, whilst a catalyst can affect the rate of attainment of an equilibrium, it does not affect the value of the equilibrium constant.	

	Spring and Summer Term **Polymers -** 35. Draw the repeating unit from monomer structure(s) and draw the repeating unit from a section of the polymer chain for addition and condensation polymers. 36. Explain the nature of the intermolecular forces between molecules of condensation polymers. 37. Explain why polyesters and polyamides can be hydrolysed but polyalkenes cannot. 38. Amino acids, proteins and DNA - 39. Draw the structures of amino acids as zwitterions and the ions formed from amino acids in acid solution and alkaline solution. 40. Draw the structure of a peptide formed from up to three amino acids. 41. Identify primary, secondary and tertiary structures of proteins in diagrams. 42. Explain how these structures are maintained by hydrogen bonding and disulfide bridges (S-S bonds). 43. Explain why a stereospecific active site of an enzyme can only bond to one enantiomeric form of a substrate or drug. 44. Explain how hydrogen bonding between base pairs leads to the two complementary strands of DNA. 45. Explain why cisplatin prevents DNA replication and explain why such drugs can have adverse effects. **Electrode potentials and cells -** 46. Use Eϴ values to predict the direction of simple redox reactions. 47. Calculate the EMF of a cell. 48. Write and apply the conventional representation of a cell. 49. Use given electrode data to deduce the reactions occurring in non-rechargeable and rechargeable cells. 50. Deduce the EMF of a cell. 51. Explain how the electrode reactions can be used to generate an electric current. **Acids, bases and Ph -** 52. Calculate the pH of a solution of a strong acid from its concentration. 53. Use Kw to calculate the pH of a strong base from its concentration. 54. Construct an expression for Ka.	

	55. Perform calculations relating the pH of a weak acid to the concentration of the acid and the dissociation constant, Ka. 56. Sketch and explain the shapes of typical pH curves. 57. Use pH curves to select an appropriate indicator. 58. Explain qualitatively the action of acidic and basic buffers. 59. Calculate the pH of acidic buffer solutions. **Organic synthesis -** 60. Explain why chemists aim to design processes that do not require a solvent and that use non-hazardous starting materials. 61. Use reactions in the specification to devise a synthesis, with up to four steps, for an organic compound. 62. Explain why TMS is a suitable substance to use as a standard in NMR. 63. Use 1H NMR and 13C NMR spectra and chemical shift data from the Chemistry Data Booklet to suggest possible structures or part structures for molecules. 64. Use integration data from 1H NMR spectra to determine the relative numbers of equivalent protons in the molecule. 65. Use the n+1 rule to deduce the spin–spin splitting patterns of adjacent, non-equivalent protons, limited to doublet, triplet and quartet formation in aliphatic compounds. 66. Calculate Rf values from a chromatogram. 67. Compare retention times and Rf values with standards to identify different substances. **Transition metals -** 68. Explain the chelate effect, in terms of the balance between the entropy and enthalpy change in these reactions. 69. Understand and draw the shape of complex ions. 70. Determine the concentration of a coloured complex ion by colorimetry. 71. Perform titration calculations involving redox reactions of transition metals. 72. Explain the importance of variable oxidation states in catalysis. 73. Write equations to show how V2O5, Fe2+ ions and Mn2+ ions act as catalysts.	

	74. Explain, in terms of the charge/size ratio of the metal ion, why the acidity of $[M(H_2O)_6]^{3+}$ is greater than that of $[M(H_2O)_6]^{2+}$. 75. Describe and explain the simple test-tube reactions of: $M^{2+}(aq)$ ions, limited to M = Fe and Cu, and of $M^{3+}(aq)$ ions, limited to M = Al and Fe, with the bases $OH^–$, NH_3 and $CO_3^{2–}$. **Period 3 elements -** 76. Explain the trend in the melting point of the oxides of the elements Na to S in terms of their structure and bonding. 77. Explain the trends in the reactions of the oxides with water in terms of the type of bonding present in each oxide. 78. Write equations for the reactions that occur between the oxides of the elements Na to S and given acids and bases.	