



A Level Chemistry (2022/2023)

A Level Chemistry Overview (Year 13)

A Level Chemistry (Year 13) covers the A Level only content of the specification where the focus is on Sections 3.1.8 to 3.1.12 of the Physical Chemistry content, sections 3.2.4 to 3.2.6 of the Inorganic chemistry content and sections 3.3.7 to 3.3.16 of the Organic chemistry content. These are designed to be covered in the second year of A-level. As this is a linear course, the contents of AS subject content are also examined at the end of the two year course. Pupils will support their learning of theory through the completion of a number of required practicals. Pupils will be encouraged to apply their understanding to past exam questions throughout the lessons and their self-study revision.

It is expected that A Level students will complete a minimum of 7 hours extra self-study outside their lesson time. This may be in the form of research, homework or completion of past papers. Teachers will set the pupils adequate homework to help individuals focus their time.

In Chemistry there will be a minimum of one end of unit assessment per half term to identify any gaps in knowledge/understanding that pupils may have and ensure that they are identified and addressed as soon as possible to ensure maximum progression.

Topic of Learning		Half-Termly Overview: Knowledge and Skills	Sample Assessments
HTI	Inorganic Chemistry <ul style="list-style-type: none">• Periodicity• Transition Metals• Reactions of Inorganic Compounds	By the end of the unit, pupils should be able to: <ul style="list-style-type: none">• Explain the trend in the melting point of the oxides of the elements Na–S in terms of their structure and bonding• Explain the trends in the reactions of the oxides with water in terms of the type of bonding present in each oxide• Write equations for the reactions that occur between the oxides of the elements Na–S and given acids and bases.• Discuss the general properties of transition metals and why these occur in terms of structure.• Know the definition of a ligand, complex and co-ordination number.• Understand what conditions enable a substitution reaction to occur.	<p>Required Practical 9: Investigate how pH changes when a weak acid reacts with a strong base and when a strong acid reacts with a weak base</p> <p>Required Practical 11: Carry out simple test-tube reactions to identify transition metal ions in aqueous solution</p> <p>End of HTI – Mid Term Assessment covering all units completed. There will be synoptic questions from AS Inorganic Chemistry units included to allow pupils to continually revisit topics covered previously.</p>



		<ul style="list-style-type: none"> Identify and demonstrate a substitution reaction. Explain the chelate effect, in terms of the balance between the entropy and enthalpy change in these reactions. Understand and draw the shape of complex ions. Understand the origin of cis–trans and optical isomerism. Draw cis–trans and optical isomers Describe the types of stereoisomerism shown by molecules/ complexes. Determine the concentration of a solution of copper(II) ions by colorimetry. Determine the concentration of a solution from a graph of absorption versus concentration. Carry out test-tube reactions of Tollens' reagent to distinguish aldehydes and ketones. Perform calculations for titrations and similar redox reactions Explain the importance of variable oxidation states in catalysis. Explain, with the aid of equations, how V_2O_5 acts as a catalyst in the Contact process Explain, with the aid of equations, how Fe^{2+} ions catalyse the reaction between I^- and $S_2O_8^{2-}$ Explain, with the aid of equations, how Mn^{2+} ions autocatalyse the reaction between $C_2O_4^{2-}$ and MnO_4^- 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 $[M(H_2O)_6]^{2+}$ 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-} 	
<p>HT2</p>	<p>Physical Chemistry</p> <ul style="list-style-type: none"> Thermodynamics Kinematics Equilibrium Constant Electrode Potential 	<p>By the end of the unit, pupils should be able to:</p> <ul style="list-style-type: none"> Define key terms associated with thermodynamics lattice enthalpy Construct Born–Haber cycles to calculate lattice enthalpies using enthalpy changes Construct Born–Haber cycles to calculate one of the other enthalpy changes 	<p>Required Practical 7: Measuring the rate of reaction</p> <ul style="list-style-type: none"> By an initial rate method By a continuous monitoring method. <p>Required Practical 8: Measuring the EMF of an electrochemical cell.</p>



- 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.
- Define the term enthalpy of hydration
- Perform calculations of an enthalpy change using these cycles.
- Calculate entropy changes from absolute entropy values
- Use the relationship $\Delta G = \Delta H - T\Delta S$ to determine how ΔG varies with temperature
- Use the relationship $\Delta G = \Delta H - T\Delta S$ to determine the temperature at which a reaction becomes feasible.
- Define the terms order of reaction and rate constant
- Perform calculations using the rate equation
- Explain the qualitative effect of changes in temperature on the rate constant k
- Perform calculations using the equation $k = Ae^{-E_a/RT}$
- Understand that the equation $k = Ae^{-E_a/RT}$ can be rearranged into the form $\ln k = -E_a/RT + \ln A$ and know how to use this rearranged equation with experimental data to plot a straight line graph with slope $-E_a/R$
- Use concentration–time graphs to deduce the rate of a reaction
- Use initial concentration–time data to deduce the initial rate of a reaction
- Use rate–concentration data or graphs to deduce the order (0, 1 or 2) with respect to a reactant
- Derive the rate equation for a reaction from the orders with respect to each of the reactants
- Use the orders with respect to reactants to provide information about the rate determining/limiting step of a reaction.
- Derive partial pressure from mole fraction and total pressure
- Construct an expression for K_p for a homogeneous system in equilibrium
- Perform calculations involving K_p
- Predict the qualitative effects of changes in temperature and pressure on the position of equilibrium
- Predict the qualitative effects of changes in temperature on the value of K_p

End of HT2 – End of Term Assessment covering all units completed. There will be synoptic questions from AS Physical Chemistry units included to allow pupils to continually revisit topics covered previously.



		<ul style="list-style-type: none">• Understand that, whilst a catalyst can affect the rate of attainment of an equilibrium, it does not affect the value of the equilibrium constant.• Use E^\ominus values to predict the direction of simple redox reactions• Calculate the EMF of a cell• Write and apply the conventional representation of a cell.• Use given electrode data to deduce the reactions occurring in non-rechargeable and rechargeable cells• Deduce the EMF of a cell• Explain how the electrode reactions can be used to generate an electric current.	
HT3	<p>Physical/Organic Chemistry</p> <ul style="list-style-type: none">• Acids and Bases (Physical)• Carbonyl Groups• Aromatics• Amines	<p>By the end of the unit, pupils should be able to:</p> <ul style="list-style-type: none">• Convert concentration of hydrogen ions into pH and vice versa• Calculate the pH of a solution of a strong acid from its concentration.• Use K_w to calculate the pH of a strong base from its concentration.• Construct an expression for K_a• Perform calculations relating the pH of a weak acid to the concentration of the acid and the dissociation constant, K_a• Convert K_a into pK_a and vice versa.• Perform calculations for titrations based on experimental results.• Sketch and explain the shapes of typical pH curves• Use pH curves to select an appropriate indicator.• Explain qualitatively the action of acidic and basic buffers• Calculate the pH of acidic buffer solutions.• Draw the structural formulas and displayed formulas of enantiomers• Understand how racemic mixtures (racemates) are formed and why they are optically inactive• Write overall equations for reduction reactions using $[H]$ as the reductant• Outline the nucleophilic addition mechanism for reduction	<p>Required Practical 10: Preparation of</p> <ul style="list-style-type: none">- a pure organic solid and test of its purity- a pure organic liquid <p>Required Practical 12: Separation of species by thin-layer chromatography.</p> <p>End of HT3 – Mid Term Assessment covering all units completed. There will be synoptic questions from AS Organic Chemistry units included to allow pupils to continually revisit topics covered previously.</p>



		<p>reactions with NaBH_4 (the nucleophile should be shown as H^-)</p> <ul style="list-style-type: none">• Write overall equations for the formation of hydroxynitriles using HCN• Outline the nucleophilic addition mechanism for the reaction with KCN followed by dilute acid• Explain why nucleophilic addition reactions of KCN, followed by dilute acid, can produce a mixture of enantiomers.• Outline the mechanism of nucleophilic addition–elimination reactions of acyl chlorides with water, alcohols, ammonia and primary amines.• Use thermochemical evidence from enthalpies of hydrogenation to account for this extra stability• Explain why substitution reactions occur in preference to addition reactions.• Outline the electrophilic substitution mechanisms of: nitration, including the generation of the nitronium ion and acylation using AlCl_3 as a catalyst.• Explain the difference in base strength in terms of the availability of the lone pair of electrons on the N atom.• Outline the mechanisms of: nucleophilic substitution reactions and the nucleophilic addition–elimination reactions of ammonia and primary amines with acyl chlorides.	
HT4	<p>Organic Chemistry</p> <ul style="list-style-type: none">• Polymers (Natural and Synthetic)• Organic Synthesis• Structural Determination	<ul style="list-style-type: none">• Draw the repeating unit from monomer structure(s)• Draw the repeating unit from a section of the polymer chain• Draw the structure(s) of the monomer(s) from a section of the polymer• Explain the nature of the intermolecular forces between molecules of condensation polymers.• Explain why polyesters and polyamides can be hydrolysed but polyalkenes cannot.• Draw the structures of amino acids as zwitterions and the ions formed from amino acids in acid solution and in alkaline solution.• Draw the structure of a peptide formed from up to three amino acids• Draw the structure of the amino acids formed by hydrolysis of a peptide	<p>End of HT4 – Mock A Level Chemistry exam</p>



		<ul style="list-style-type: none"> Identify primary, secondary and tertiary structures in diagrams Explain how these structures are maintained by hydrogen bonding and S–S bonds Calculate R_f values from a chromatogram. Explain why a stereospecific active site can only bond to one enantiomeric form of a substrate or drug. Explain how hydrogen bonding between base pairs leads to the two complementary strands of DNA. Explain why cisplatin prevents DNA replication Explain why such drugs can have adverse effects Explain why chemists aim to design processes that do not require a solvent and that use non-hazardous starting materials Explain why chemists aim to design production methods with fewer steps that have a high percentage atom economy Use reactions in this specification to devise a synthesis, with up to four steps, for an organic compound. Explain why TMS is a suitable substance to use as a standard Use ^1H NMR and ^{13}C NMR spectra and chemical shift data from the Chemistry Data Booklet to suggest possible structures or part structures for molecules Use integration data from ^1H NMR spectra to determine the relative numbers of equivalent protons in the molecule 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 Calculate R_f values from a chromatogram • compare retention times and R_f values with standards to identify different substances. 	
HT5	Exam Prep/Revision	Revision will be targeted to the needs of the pupil.	
HT6	Examinations	Examinations	External A Level Chemistry Examination