



Course Outline

Chemistry Year 13

*Inspiring excellence, empowering global minds*

## Overview

The Chemistry Syllabus at GEMS Wesgreen International Secondary School aims to develop well rounded chemists who can not only explain complex theoretical concepts but can investigate them practically for themselves. Investigative skills and techniques are at the heart of chemistry at Wesgreen International and we have embedded frequent opportunities for our learners to develop these at all stages of the curriculum. Throughout the year we will build upon prior knowledge and challenge students to work independently and autonomously, be resilient and have the confidence and determination to overcome significant challenges.

## Learning Outcomes

The aims of the Chemistry Syllabus are to:

- acquire knowledge and understanding and develop practical skills, including efficient, accurate and safe scientific practices
- learn to apply the scientific method, while developing an awareness of the limitations of scientific theories and models
- develop skills in data analysis, evaluation and drawing conclusions, cultivating attitudes relevant to science such as objectivity, integrity, enquiry, initiative and inventiveness
- develop effective scientific communication skills, using appropriate terminology and scientific conventions
- understand their responsibility to others/society and to care for the environment
- enjoy science and develop an informed interest in the subject that may lead to further study.

## Topic Overviews

### Term 1

#### Topic 11 - Kinetics

Approximate length: 15 lessons

In this topic, students make a quantitative study of chemical kinetics and extend their study of organic reaction mechanisms.

#### Specific objectives with the Edexcel syllabus covered:

- Understand the terms: rate of reaction, rate equation,  $\text{rate} = k[\text{A}]^m[\text{B}]^n$  where  $m$  and  $n$  are 0, 1 or 2, order with respect to a substance in a rate equation, overall order of a reaction, rate constant, half-life, rate-determining step, activation energy, heterogeneous and homogeneous catalyst
- Be able to calculate the half-life of a reaction, using data from a suitable graph, and identify a reaction with a constant half-life as being first order
- Be able to select and justify a suitable experimental technique to obtain rate data for a given reaction, including: titration, colorimetry, mass change, volume of gas evolved, other suitable techniques for a given reaction
- Understand experiments that can be used to investigate reaction rates by: an initial-rate method, carrying out separate experiments where different initial concentrations of one reagent are used. A 'clock reaction' is an acceptable approximation of this method, a continuous monitoring method to generate data to enable concentration-time or volume-time graphs to be plotted
- Be able to deduce the order (0, 1 or 2) with respect to a substance in a rate equation using data from: a concentration-time graph, a rate-concentration graph, an initial-rate method
- Understand how to: obtain data to calculate the order with respect to the reactants (and the hydrogen ion) in the acid-catalysed iodination of propanone, use these data to make predictions about species involved in the rate-determining step, deduce a possible mechanism for the reaction
- Be able to deduce the rate-determining step from a rate equation and vice versa
- Be able to deduce a reaction mechanism, using knowledge of the rate equation and the stoichiometric equation for a reaction
- Understand that knowledge of the rate equations for the hydrolysis of halogenoalkanes can be used to provide evidence for  $\text{S}_{\text{N}}1$  and  $\text{S}_{\text{N}}2$  mechanisms for tertiary and primary halogenoalkane hydrolysis
- Be able to use calculations and graphical methods to find the activation energy for a reaction from experiment data

- The Arrhenius equation will be given if needed
- Understand the use of a solid (heterogeneous) catalyst for industrial reactions, in the gas phase, in terms of providing a surface for the reaction

## Topic 12 – Entropy and Energetics

**Approximate length: 10 lessons**

In this topic, students entropy and energetics show how chemists are able to predict quantitatively the direction and extent of chemical change.

Specific objectives with the Edexcel syllabus covered:

- Understand that, since endothermic reactions can occur spontaneously at room temperature, enthalpy changes alone do not control whether reactions occur
- Understand entropy as a measure of disorder of a system in terms of the random dispersal of molecules and of energy quanta between molecules
- Understand that the entropy of a substance increases with temperature, that entropy increases as solid→liquid→gas and that perfect crystals at zero kelvin have zero entropy
- Be able to interpret the natural direction of change as being in the direction of increasing total entropy (positive entropy change), including gases spread spontaneously through a room
- Understand why entropy changes occur during: changes of state, dissolving of a solid ionic lattice, reactions in which there is a change in the number of moles from reactants to products
- Understand that the total entropy change of any reaction is the sum of the entropy changes of the system and the entropy change of the surroundings, summarised by the expression:

$$\Delta S_{\text{total}} = \Delta S_{\text{system}} + \Delta S_{\text{surroundings}}$$

- Be able to calculate the entropy change of the system for a reaction,  $\Delta S_{\text{system}}$ , given the entropies of the reactants and products.
- Be able to calculate the entropy change in the surroundings, and hence the  $\Delta S_{\text{total}}$ , using the expression:

$$\Delta S_{\text{surroundings}} = -\Delta H \div T$$

- Understand that the feasibility of a reaction depends on: the balance between  $\Delta S_{\text{surroundings}}$ , so that even endothermic reactions can occur spontaneously at room temperature, temperature, as higher temperatures decrease the magnitude of  $\Delta S_{\text{surroundings}}$  so its contribution to  $\Delta S_{\text{total}}$  is less
- Students should be able to calculate the temperature at which a reaction is feasible.

- Students may also use  $\Delta G = \Delta H - T\Delta S_{\text{system}}$  in answers, although this approach is not a requirement of this specification
- Understand that reactions can occur as long as  $\Delta S_{\text{total}}$  is positive even if one of the other entropy changes is negative
- Understand and distinguish between the concepts of thermodynamic stability and kinetic stability

### Topic 13 – Chemical Equilibria

**Approximate length: 5 lessons**

In this topic, students will be able to test the equilibrium law by showing the degree to which it as the environmental conditions alter.

Specific objectives with the Edexcel syllabus covered:

- Be able to deduce an expression for  $K_c$ , for homogeneous and heterogeneous systems, in terms of equilibrium concentrations
- Be able to deduce an expression for  $K_p$  for homogeneous and heterogeneous systems, in terms of equilibrium partial pressures in atm
- Be able to calculate a value, with units where appropriate, for the equilibrium constants ( $K_c$  and  $K_p$ ) for homogeneous and heterogeneous reactions, from experimental data
- Understand how, if at all, a change in temperature, pressure or the presence of a catalyst affects the equilibrium composition in a homogeneous or heterogeneous system
- Understand that the value of the equilibrium constant is not affected by changes in concentration or pressure or by the addition of a catalyst
- Know the effect of changing the temperature on the equilibrium constant ( $K_c$  and  $K_p$ ) for both exothermic and endothermic reactions
- Understand that the effect of temperature on the position of equilibrium is explained using a change in the value of the equilibrium constant
- Understand the effect of a change in temperature on: the value of  $\Delta S_{\text{total}}$ , the magnitude of the equilibrium constant, since  $\Delta S_{\text{total}} = R \ln K$
- Be able to apply knowledge of the value of equilibrium constants to predict the extent to which a reaction takes place

**Topic 14 – Acid-Base Equilibria****Approximate length: 10 lessons**

In this topic, students will be able to test the equilibrium law by showing the degree to which it can accurately predict changes during acid-base reactions, notably the changes to pH during titrations.

Specific objectives with the Edexcel syllabus covered:

- Understand that a Bronsted-Lowry acid is a proton donor and a Bronsted-Lowry base is a proton acceptor and that acid-base reactions involve proton transfer
- Be able to identify Bronsted-Lowry conjugate acid-base pairs
- Be able to define the term 'pH'
- Be able to calculate pH from hydrogen ion concentration
- Be able to calculate the concentration of hydrogen ions in a solution, in mol dm<sup>-3</sup>, from its pH, using the expression  $[H^+] = 10^{-pH}$
- Understand the difference between a strong acid and a weak acid in terms of the degree of dissociation
- Be able to calculate the pH of a strong acid
- Be able to deduce the expression for the acid dissociation constant,  $K_a$ , for a weak acid
- Be able to calculate the pH of a weak acid from  $K_a$  or  $pK_a$  values, making relevant assumptions
- Students will be expected to solve quadratic equations
- Be able to define the ionic product of water,  $K_w$
- Be able to calculate the pH of a strong base from its concentration, using  $K_w$  or  $pK_w$
- Be able to define the terms 'pKa' and 'pKw'
- Be able to analyse data from the following experiments: measuring the pH of a variety of substances, including equimolar solutions of strong and weak acids, strong and weak bases, and salts, comparing the pH of a strong and weak acid after dilution 10, 100 and 1000 times
- Be able to calculate  $K_a$  for a weak acid from experimental data given the pH of a solution containing a known mass of acid
- Be able to draw and interpret titration curves, using all combinations of strong and weak monoprotic and diprotic acids with bases, and apply these principles to diprotic acids and bases
- Be able to select a suitable indicator for a titration, using a titration curve and appropriate data
- Know what is meant by the term 'buffer solution'
- Understand the action of a buffer solution
- Be able to calculate the pH of a buffer solution given appropriate data
- Be able to calculate the concentrations of solutions required to prepare a buffer solution of a given pH

- Understand how to use a weak acid-strong base or strong acid-weak base titration curve to: demonstrate buffer action, determine  $K_a$  from the pH at the point where half the acid is neutralised/equivalence point
- Understand the importance of buffer solutions in biological environments: buffers in cells and in blood ( $H_2CO_3/HCO_3^-$ ), in foods to prevent deterioration due to pH change (caused by bacterial or fungal activity)

### Topic 15 – Organic Chemistry: Carbonyls, Carboxylic Acids, Chirality

**Approximate length: 14 lessons**

In this topic, students be required to apply their knowledge gained in units 1 and 2. This includes nomenclature, ideas of isomerism, bond polarity, reagents and reaction conditions, reaction types and mechanisms.

Specific objectives with the Edexcel syllabus covered:

- Know that optical isomerism is a result of chirality in molecules with a single chiral centre
- Understand that optical isomerism results from chiral centre(s) in a molecule with asymmetric carbon atom(s) and that optical isomers (enantiomers) are object and non-superimposable mirror images and be able to draw 3D diagrams of these optical isomers
- Know that optical activity is the ability of a single optical isomer to rotate the plane of polarisation of plane-polarised monochromatic light in molecules containing a single chiral centre
- Know what is meant by the term 'racemic mixture'
- Be able to use data on optical activity of reactants and products as evidence for SN1 and SN2 mechanisms and addition to carbonyl compounds
- Understand the nomenclature of aldehydes and ketones and be able to draw their structural, displayed and skeletal formulae
- Understand that aldehydes and ketones: do not form intermolecular hydrogen bonds and this affects their physical properties, can form hydrogen bonds with water and this affects their solubility
- Understand the reactions of carbonyl compounds with: Fehling's or Benedict's solution, Tollens' reagent and acidified dichromate(VI) ions
- In equations, the oxidising agent can be represented as [O] lithium tetrahydridoaluminate(III) (lithium aluminium hydride) in dry ether (ethoxyethane)
- In equations, the reducing agent can be represented by [H] HCN, in the presence of KCN, as a nucleophilic addition reaction, using curly arrows, relevant lone pairs, dipoles and evidence of optical activity to show the mechanism, 2,4-dinitrophenylhydrazine (2,4-

DNPH), as a qualitative test for the presence of a carbonyl group and to identify a carbonyl compound given data of the melting temperatures of derivatives

- Understand the nomenclature of carboxylic acids and be able to draw their structural, displayed and skeletal formulae
- Understand that hydrogen bonding affects the physical properties of carboxylic acids, in relation to their boiling temperatures and solubility
- Understand that carboxylic acids can be prepared by the oxidation of alcohols or aldehydes and the hydrolysis of nitriles
- Understand the reactions of carboxylic acids with: lithium tetrahydridoaluminate(III) (lithium aluminium hydride) in dry ether (ethoxyethane), bases to produce salts, phosphorous(V) chloride (phosphorus pentachloride), alcohols in the presence of an acid catalyst
- Understand the nomenclature of acyl chlorides and esters and be able to draw their structural, displayed and skeletal formulae
- Understand the reactions of acyl chlorides with: water, alcohols, concentrated ammonia, amines
- Understand the hydrolysis reactions of esters, in acidic and alkaline solution
- Understand how polyesters, such as terylene, are formed by condensation polymerisation reactions
- Be able to use data from mass spectra to: suggest possible structures of a simple organic compound given accurate relative molecular masses, calculate the accurate relative molecular mass of a compound, given accurate relative atomic masses to four decimal places
- Understand that carbon-13 ( $^{13}\text{C}$ ) NMR spectroscopy provides information about the positions of  $^{13}\text{C}$  atoms in a molecule
- Be able to use data from the  $^{13}\text{C}$  NMR spectroscopy to: predict the different environments for carbon atoms present in a molecule, given values of chemical shift,  $\delta$ , justify the number of peaks present in a  $^{13}\text{C}$  NMR spectrum in terms of the number of carbon atoms in different environments
- Be able to use both low- and high-resolution proton NMR spectroscopy to: predict the different types of protons present in a molecule, given values of chemical shift,  $\delta$ , relate relative peak area, or ratio number of protons, to the relative numbers of  $^1\text{H}$  atoms in different environments, deduce the splitting patterns of adjacent, non-equivalent protons using the  $(n+1)$  rule and hence suggest the possible structures for a molecules, predict the chemical shifts and splitting patterns of the  $^1\text{H}$  atoms in a given molecule
- Know that chromatography separates components of a mixture using a mobile phase and a stationary phase
- Be able to calculate  $R_f$  values from one-way chromatograms in paper and thin-layer chromatography (TLC) and understand reasons for differences in  $R_f$  values

- Know that high-performance liquid chromatography, HPLC, and gas chromatography, GC, are types of column chromatography that separate substances because of different retention times in the column and may be used in conjunction with mass spectrometry, in applications such as forensics or drug testing in sport

## Term 2

### Topic 16 – Redox Equilibria

Approximate length: 15 lessons

In this topic, students will build upon the study of redox in unit 2 with standard electrode potentials, including the oxidation number and the use of redox half equations.

Specific objectives with the Edexcel syllabus covered:

- Understand the terms 'oxidation' and 'reduction' in terms of electron transfer and changes in oxidation number, applied to s-, p-, and d- block elements
- Know what is meant by the term 'standard electrode potential',  $E^\ominus$
- Know that the standard electrode potential,  $E^\ominus$ , is measured in conditions of: 298K temperature, 100 kPa pressure of gases, 1.00 mol dm<sup>-3</sup> concentration of ions
- Know the features of the standard hydrogen electrode and understand why a reference electrode is necessary
- Understand that different methods are used to measure standard electrode potentials of: metals or non-metals in contact with their ions in aqueous solution, ions of the same element with different oxidation numbers
- Be able to calculate a standard emf,  $E^\ominus_{\text{cell}}$ , by combining two standard electrode potentials
- Be able to write cell diagrams using the conventional representation of half-cells
- Understand the importance of the conditions when measuring an electrode potential,  $E$
- Be able to use standard electrode potentials to predict the thermodynamic feasibility of a reaction
- Understand that  $E^\ominus_{\text{cell}}$  is directly proportional to the total entropy change and to  $\ln K$  for a reaction
- Understand the limitations of predictions made using standard electrode potentials, in terms of kinetic stability of systems and departure from standard conditions
- Know that standard electrode potentials are sometimes referred to as standard reduction potentials and can be listed as an electrochemical series
- Understand how standard electrode potentials can be used to predict the thermodynamic feasibility of disproportionation reactions



- Be able to carry out both structured and unstructured titration calculations involving redox reaction, including iron (II) ions and potassium manganate (VII) and sodium thiosulfate and iodine
- Be able to discuss the uncertainty of measurements and their implications for the validity of the final results
- Understand that fuel cells use the energy released on the reaction of a fuel with oxygen to generate a voltage
- Knowledge that methanol and other hydrogen-rich fuels are used in fuel cells is expected
- Know the electrode reactions that occur in a hydrogen-oxygen fuel cell
- Knowledge of hydrogen-oxygen fuel cells with both acidic and alkaline electrolyte is expected

### Topic 17 – Transition Metals and their Chemistry

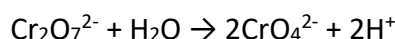
Approximate length: 22 lessons

In this topic, students will investigate transition metals and understand how they form ions, as well as the properties of these metals.

#### Specific objectives with the Edexcel syllabus covered:

- Know that transition metals are d-block elements that form one or more stable ions with incompletely-filled d-orbitals
- Be able to deduce the electronic configuration of atoms and ions of the d-block elements of Period 4 (Sc-Zn) given their atomic number and charge (if any)
- Understand why transition metals show variable oxidation number
- Know what is meant by the term 'ligand'
- Understand that dative (coordinate) covalent bonding is involved in the formation of complex ions
- Know that a complex ion is a central metal ion surrounded by ligands
- Know that aqueous solutions of transition metal ions are usually coloured
- Understand that the colour of aqueous ions, and other complex ions, is a consequence of the splitting of the energy levels of the d-orbitals by ligands
- Understand why there is a lack of colour in some aqueous ions and other complex ions
- Understand the meaning of the term 'coordination number'
- Understand that colour changes in transition metal ions may arise as a result of changes in: oxidation number of the ion, ligand, coordination number of the complex
- Understand that  $\text{H}_2\text{O}$ ,  $\text{OH}^-$ , and  $\text{NH}_3$  act as monodentate ligands
- Understand why complexes with six-fold coordination have an octahedral shape, such as those formed by metal ions with  $\text{H}_2\text{O}$ ,  $\text{OH}^-$ , and  $\text{NH}_3$  as ligands

- Know that transition metal ions may form tetrahedral complexes with relatively large ions such as  $\text{Cl}^-$
- Know that square planar complexes are also formed by transition metal ions and that cis-platin is an example of such a complex which is used in cancer treatment where it is supplied as a single isomer and not in a mixture with the trans form
- Understand the terms 'bidentate' and 'hexadentate' in relation to ligands, and be able to identify examples such as  $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$  and  $\text{EDTA}^{4-}$
- Know that haemoglobin is an iron (II) complex containing a polydentate ligand and that ligand exchange occurs when an oxygen molecule bound to haemoglobin is replaced by a carbon monoxide molecule
- The structure of the haem group will not be assessed
- Know the colours of the oxidation states of vanadium (+5, +4, +3 and +2) in its compounds
- Understand redox reactions for the interconversion of the oxidation states of vanadium (+5, +4, +3 and +2), in terms of the relevant  $E^\ominus$  values
- Understand, in terms of the relevant  $E$  values, that the dichromate (VI) ion,  $\text{Cr}_2\text{O}_7^{2-}$  can be reduced to  $\text{Cr}^{3+}$  and  $\text{Cr}^{2+}$  ions using zinc in acidic conditions and can be produced by the oxidation of  $\text{Cr}^{3+}$  ions using hydrogen peroxide in alkaline conditions (followed by acidification)
- Know that the dichromate (VI) ion,  $\text{Cr}_2\text{O}_7^{2-}$  can be converted into chromate (VI) ions as a result of the equilibrium



- Be able to record observations and write suitable equations for the reactions of  $\text{Cr}^{3+}(\text{aq})$ ,  $\text{Mn}^{2+}(\text{aq})$ ,  $\text{Fe}^{2+}(\text{aq})$ ,  $\text{Fe}^{3+}(\text{aq})$ ,  $\text{Co}^{2+}(\text{aq})$ ,  $\text{Ni}^{2+}(\text{aq})$ ,  $\text{Cu}^{2+}(\text{aq})$  and  $\text{Zn}^{2+}(\text{aq})$  with aqueous sodium hydroxide and aqueous ammonia, including excess
- Be able to write ionic equations to show the meaning of amphoteric behaviour, deprotonation and ligand exchange in the reactions
- Understand that ligand exchange, and an accompanying colour change, occurs in the formation of:  $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$  from  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$  via  $\text{Cu}(\text{OH})_2(\text{H}_2\text{O})_4$ ,  $[\text{CuCl}_4]^{2-}$  from  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ ,  $[\text{CoCl}_4]^{2-}$  from  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$
- Understand, in terms of the positive increase in  $\Delta S_{\text{system}}$ , that the substitution of a monodentate ligand by a bidentate or hexadentate ligand leads to a more stable complex ion
- Know that transition metals and their compounds can act as heterogeneous and homogeneous catalysts
- Know that a heterogeneous catalyst is in a different phase from the reactants and that the reaction occurs at the surface of the catalyst
- Know that a homogeneous catalyst is in the same phase as the reactants and appreciate that the catalysed reaction will proceed via an intermediate species

- Understand the role of  $\text{Fe}^{2+}$  ions in catalysing the reaction between  $\text{I}^-$  and  $\text{S}_2\text{O}_8^{2-}$  ions
- Know the role of  $\text{Mn}^{2+}$  ions in autocatalysing the reaction between  $\text{MnO}_4^-$  and  $\text{C}_2\text{O}_4^{2-}$  ions
- Understand, in terms of oxidation number, how  $\text{V}_2\text{O}_5$  acts as a catalyst in the contact process
- Understand how a catalytic converter decreases carbon monoxide and nitrogen monoxide emissions from internal combustion engines by: adsorption of CO and NO molecules onto the surface of the catalyst, resulting in the weakening of bonds and chemical reaction, desorption of  $\text{CO}_2$  and  $\text{N}_2$  product molecules from the surface of the catalyst

### Topic 18 – Organic Chemistry - Arenes

Approximate length: 3 lessons

In this topic, students will be able to investigate the structure of benzene and how it reacts with a wide variety of reactants.

#### Specific objectives with the Edexcel syllabus covered:

- Be able to use thermochemical, X-ray diffraction and infrared data as evidence for the structure and stability of the benzene ring
- Understand that the delocalised model for the structure of benzene involves overlap of p-orbitals to form  $\pi$ -bonds
- Understand why benzene is resistant to bromination, compared to alkenes, in terms of delocalisation of  $\pi$ -bonds in benzene compared to the localised electron density of the  $\pi$ -bond in alkenes
- Know the following reactions of benzene limited to: oxygen in air (combustion to form a smoky flame), bromine, in the presence of a catalyst, a mixture of concentrated nitric and sulfuric acids, fuming sulfuric acid, halogenoalkanes and acyl chlorides with aluminium chloride as catalyst (Friedel-Crafts reaction)
- Understand the mechanism of the electrophilic substitution reactions of benzene in halogenation, nitration and Friedel-Crafts reactions, including the generation of the electrophile
- Understand the reaction of phenol with bromine water and the reasons for the relative ease of this reaction compared to benzene

**Topic 19 – Organic Nitrogen Compounds: Amines, Amides, Amino Acids and Proteins****Approximate length: 12 lessons**

In this topic, students will be able to continue their understanding on benzenes and their involvement in amines, amides, amino acids and proteins, as well as their involvement in polymerization.

Specific objectives with the Edexcel syllabus covered:

- Be able to use thermochemical, X-ray diffraction and infrared data as evidence for the structure and stability of the benzene ring
- Understand that the delocalised model for the structure of benzene involves overlap of p-orbitals to form  $\pi$ -bonds
- Understand why benzene is resistant to bromination, compared to alkenes, in terms of delocalisation of  $\pi$ -bonds in benzene compared to the localised electron density of the  $\pi$ -bond in alkenes
- Know the following reactions of benzene limited to: oxygen in air (combustion to form a smoky flame), bromine, in the presence of a catalyst, a mixture of concentrated nitric and sulfuric acids, fuming sulfuric acid, halogenoalkanes and acyl chlorides with aluminium chloride as catalyst (Friedel-Crafts reaction)
- Understand the mechanism of the electrophilic substitution reactions of benzene in halogenation, nitration and Friedel-Crafts reactions, including the generation of the electrophile
- Understand the reaction of phenol with bromine water and the reasons for the relative ease of this reaction compared to benzene
- Understand that amides can be prepared from acyl chloride
- Be able to describe: condensation polymerisation for the formation of polyamides such as nylon and proteins, addition polymerisation, including poly(propenamide) and poly(ethenol)
- Be able to draw the structural formulae of the repeat units of the polymers in 19.8
- Be able to comment on the physical properties of polyamides and the solubility in water of the addition polymer poly(ethenol) in terms of hydrogen bonding, including soluble laundry bags or liquid-detergent capsules (liquid tabs)
- Be able to describe experiments to investigate the characteristic behaviour of amino acids limited to: acidity and basicity and the formation of zwitterions, effect of aqueous solutions on plane-polarise monochromatic light, formation of peptide bonds by condensation polymerization

**Topic 20 – Organic Synthesis****Approximate length: 4 lessons**

In this topic, students will be able to use their knowledge of organic chemistry to solve unfamiliar problems.

**Specific objectives with the Edexcel syllabus covered:**

- Understand methods of increasing the length of the carbon chain in a molecule by the use of magnesium to form Grignard reagents and the reactions of the latter with carbon dioxide and with carbonyl compounds in dry ether
- Be able to deduce the empirical formulae, molecular formulae and structural formulae from data drawn from combustion analysis, element percentage composition, characteristic reactions of functional groups, infrared spectra, mass spectra and NMR spectra (both  $^{13}\text{C}$  and proton)
- Be able to use knowledge of organic chemistry contained given in this specification to solve problems such as: predicting the properties of unfamiliar compounds containing one or more of the functional groups included in the specification and explain these predictions, planning reaction schemes of up to 4 steps, recalling familiar reactions and using unfamiliar reactions given sufficient information, selecting suitable practical procedures for carrying out reactions involving compounds with functional groups included in this specification, identifying appropriate control measures to reduce risk based on data of hazards
- Understand the following techniques used in the preparation and purification of organic compounds: refluxing, purification by washing, including with water and sodium carbonate solution, solvent extraction, recrystallization, drying, distillation, steam distillation, melting/boiling temperature determination

**Following the conclusion of topic 20, for the remainder of the academic year prior to the IAL examinations, students will be revising content from throughout the chemistry syllabus, the sequence will be determined by highlighting any gaps in knowledge and misconceptions identified during lessons and the mock examination series.**

**Textbook – Pearson Edexcel International A Level Chemistry**

## Assessment

**Formative:** Throughout the chapters, the students will complete end of chapter assessments, quizzes and problem-solving activities which will allow the teacher to assess the students' progress and inform their planning.

**Summative:** Students will be assessed on their understanding of each chapter with end of topic assessments. At the end of each term, we will complete internal assessments which will be based on certain chapters.