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Course Outline

Chemistry Year 11

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:

- Arouse learner's curiosity in chemistry and by extension the natural world enabling them to use scientific ideas to explain physical phenomena, fostering a deeper understanding and appreciation of chemistry in their everyday lives.
- Develop student scientific knowledge by building progression atop core ideas from KS2 throughout KS3 & KS4 via logical sequencing of the curriculum.
- Provide students the opportunities to work scientifically through experimentation, data analysis, making inferences and drawing conclusions in line with results.
- Develop students critical thinking skills enabling them to make logical and informed decisions based on information presented to them.
- Develop student understanding of the relationship between mathematical concepts and scientific ideas.
- Develop independent, resilient, and reflective learners through self-study, adequate challenge and personalized feedback.
- To equip learners with the skills and understanding they need to be scientifically literate citizens and to pursue the study of chemical sciences at higher levels should they so wish.

Topic Overviews

Term 1

Topic 1 – Physical Chemistry (Parts a and c) **Approximate length: 9 lessons**

In this topic, students will focus on exothermic and endothermic reactions, using the reactions to be able to calculate temperature chance and molar enthalpy change. Additionally, students will carry out a series of experiments to investigate temperature changes.

Specific objectives with the Edexcel syllabus covered:

- Know that chemical reactions in which heat energy is given out are described as exothermic, and those in which heat energy is taken in are described as endothermic
- Draw and explain energy level diagrams to represent exothermic and endothermic reactions
- Calculate the heat energy change from a measured temperature change using the expression $Q = mc\Delta T$
- Calculate the molar enthalpy change (ΔH) from the heat energy change, Q
- Know that bond-breaking is an endothermic process and that bond-making is an exothermic process
- Use bond energies to calculate the enthalpy change during a chemical reaction
- Describe simple calorimetry experiments for reactions such as combustion, displacement, dissolving and neutralization
- Investigate temperature changes accompanying some of the following types of change: salts dissolving in water, neutralisation reactions, displacement reactions and combustion reactions.
- Know that some reactions are reversible and this is indicated by the symbol ⇌ in equations
- Describe reversible reactions such as the dehydration of hydrated copper(II) sulfate and the effect of heat on ammonium chloride
- Know that a reversible reaction can reach dynamic equilibrium in a sealed container
- Know that the characteristics of a reaction at dynamic equilibrium are: the forward and reverse reactions occur at the same rate, the concentrations of reactants and products remain constant.
- Understand why a catalyst does not affect the position of equilibrium in a reversible reaction
- Know the effect of changing temperature on the position of equilibrium in a reversible reaction: an increase (or decrease) in temperature shifts the position of equilibrium in the direction of the endothermic (or exothermic) reaction
- Know the effect of changing pressure on the position of equilibrium in a reversible reaction: an increase (or decrease) in pressure shifts the position of equilibrium in the direction that produces fewer (or more) moles of gas

Topic 2 – Inorganic Chemistry (Parts f, g and h) **Approximate length: 11 lessons**

In this topic, In this topic, students will continue to look at the inorganic chemistry side of the course. This will involve investigating acids and alkalis, along with the various methods of determining pH. Students will learn about neutralization reactions between a series of acids and metals in various forms. Furthermore, students will be able to carry out a series of practicals to investigation neutralization and flame tests.

Specific objectives with the Edexcel syllabus covered:

- Understand acids and bases in terms of proton transfer
- Understand that an acid is a proton donor and a base is a proton acceptor
- Know that metal oxides, metal hydroxides and ammonia can act as bases, and that alkalis are bases that are soluble in water
- Know that acids in aqueous solution are a source of hydrogen ions and alkalis in an aqueous solution are a source of hydroxide ions
- Describe the use of litmus, phenolphthalein and methyl orange to distinguish between acidic and alkaline solutions
- Understand how to use the pH scale, from 0–14, can be used to classify solutions as strongly acidic (0–3), weakly acidic (4–6), neutral (7), weakly alkaline (8–10) and strongly alkaline (11–14)
- Describe the use of universal indicator to measure the approximate pH value of an aqueous solution
- Describe the reactions of hydrochloric acid, sulfuric acid and nitric acid with metals, bases and metal carbonates (excluding the reactions between nitric acid and metals) to form salts
- Know that alkalis can neutralise acids
- Describe how to carry out an acid-alkali titration
- Describe an experiment to prepare a pure, dry sample of a soluble salt, starting from an acid and alkali
- Prepare a sample of pure, dry hydrated copper(II) sulfate crystals starting from copper(II) oxide
- Describe an experiment to prepare a pure, dry sample of a soluble salt, starting from an insoluble reactant
- Prepare a sample of pure, dry lead(II) sulfate
- Describe an experiment to prepare a pure, dry sample of an insoluble salt, starting from two soluble reactants
- Know the general rules for predicting the solubility of ionic compounds in water: common sodium, potassium and ammonium compounds are soluble, all nitrates are soluble, common chlorides are soluble, except those of silver and lead(II), common sulfates are soluble, except for those of barium, calcium and lead(II), common carbonates are insoluble, except for those of sodium, potassium and ammonium, common hydroxides are insoluble except for those of sodium, potassium and calcium (calcium hydroxide is slightly soluble).
- Describe tests for these cations: NH_4^+ using sodium hydroxide solution and identifying the gas evolved, Cu^{2+}, Fe^{2+} and Fe^{2+} using sodium hydroxide solution.
- Describe tests for these anions: Cl^-, Br^- and I^- using acidified silver nitrate solution, SO_4^{2-} using acidified barium chloride solution, CO_3^{2-} using hydrochloric acid and identifying the gas evolved.
- Describe how to carry out a flame test

- Know the colours formed in flame tests for these cations: Li^+ is red, Na^+ is yellow, K^+ is lilac, Ca^{2+} is orange-red, Cu^{2+} is blue-green
- Describe a test for the presence of water using anhydrous copper(II) sulfate
- Describe a physical test to show whether a sample of water is pure

Topic 3 - Organic Chemistry **Approximate length: 8 lessons**

In this topic, students will look at alkanes and alkenes and the role they play in real world application of crude oil, fractional distillation and cracking. Students will continue to understand the negative impacts pollutants released from burning fuels has on the planet.

Specific objectives with the Edexcel syllabus covered:

- Know that a hydrocarbon is a compound of hydrogen and carbon only
- Know the general formula for alkanes
- Explain why alkanes are classified as saturated hydrocarbons
- Know what is meant by the terms homologous series, functional group and isomerism
- Understand how to draw the structural and displayed formulae for alkanes with up to five carbon atoms in the molecule, and to name the unbranched-chain isomers
- Know that alkenes contain the functional group >C=C<
- Know the general formula for alkenes
- Explain why alkenes are classified as unsaturated hydrocarbons
- Understand how to draw the structural and displayed formulae for alkenes with up to four carbon atoms in the molecule, and name the unbranched-chain isomers
- Know the general formula for alkanes
- Describe the reactions of alkanes with halogens in the presence of ultraviolet radiation, limited to mono-substitution
- Describe the reactions of alkenes with bromine to produce dibromoalkanes
- Describe how bromine water can be used to distinguish between an alkane and an alkene
- Know that crude oil is a mixture of hydrocarbons
- Describe how the industrial process of fractional distillation separates crude oil into fractions
- Know the names and uses of the main fractions obtained from crude oil: refinery gases, gasoline, kerosene, diesel, fuel oil and bitumen
- Know the trend in colour, boiling point and viscosity of the main fractions
- Describe how long-chain alkanes are converted to alkenes and shorter-chain alkanes by catalytic cracking (using silica or alumina as the catalyst and a temperature in the range of 600–700 ºC)
- Explain why cracking is necessary
- Know that a fuel is a substance that, when burned, releases heat energy
- Know the possible products of complete and incomplete combustion of hydrocarbons with oxygen in the air
- Understand why carbon monoxide is poisonous, in terms of its effect on the capacity of blood to transport oxygen references to haemoglobin are not required

- Know that, in car engines, the temperature reached is high enough to allow nitrogen and oxygen from air to react, forming oxides of nitrogen
- Explain how the combustion of some impurities in hydrocarbon fuels results in the formation of sulfur dioxide
- Understand how sulfur dioxide and oxides of nitrogen contribute to acid rain

Term 2

Topic 4 – Organic Chemistry continued **Approximate length: 9 lessons**

Specific objectives with the Edexcel syllabus covered:

- Know that alcohols contain the functional group –OH
- Understand how to draw structural and displayed formulae for methanol, ethanol, propanol (propan-1-ol only) and butanol (butan-1-ol only), and name each compound the names propanol and butanol are acceptable
- Know that ethanol can be manufactured by: reacting ethene with steam in the presence of a phosphoric acid catalyst at a temperature of about 300 ºC and a pressure of about 60–70 atm, the fermentation of glucose, in the absence of air, at an optimum temperature of about 30 ºC and using the enzymes in yeast
- Understand the reasons for fermentation, in the absence of air, and at an optimum temperature
- Know that ethanol can be oxidised by: burning in air or oxygen (complete combustion), reaction with oxygen in the air to form ethanoic acid (microbial oxidation), heating with pot
- Know that carboxylic acids contain the functional group
- Understand how to draw structural and displayed formulae for unbranched-chain carboxylic acids with
- Know that vinegar is an aqueous solution containing ethanoic acid
- Describe the reactions of aqueous solutions of carboxylic acids with metals and metal carbonates
- Know that esters contain the functional group
- Know that ethyl ethanoate is the ester produced when ethanol and ethanoic acid react in the presence of an acid catalyst
- Understand how to write the structural and displayed formulae of ethyl ethanoate
- Understand how to write the structural and displayed formulae of an ester, given the name or formula of the alcohol and carboxylic acid from which it is formed and vice versa
- Know that esters are volatile compounds with distinctive smells and are used as food flavourings and in perfumes
- Prepare a sample of an ester such as ethyl ethanoate
- Know that an addition polymer is formed by joining up many small molecules called monomers
- Understand how to draw the repeat unit of an addition polymer, including poly(ethene), poly(propene), poly(chloroethene) and (poly)tetrafluoroethene

- Understand how to deduce the structure of a monomer from the repeat unit of an addition polymer and vice versa
- Explain problems in the disposal of addition polymers, including: their inertness and inability to biodegrade, the production of toxic gases when they are burned.
- Know that condensation polymerisation, in which a dicarboxylic acid reacts with a diol, produces a polyester and water
- Understand how to write the structural and displayed formula of a polyester, showing the repeat unit, given the formulae of the monomers from which it is formed including the reaction of ethanedioic acid and ethanediol
- Know that some polyesters, known as biopolyesters, are biodegradable.

Topic 5 – Principals of Chemistry (Part e) **Approximate length: 12 lessons**

In this topic, students will be able to use their maths skills to calculate moles. Furthermore, they will be able to use their knowledge of moles to calculate relative formula mass and percentage yield as well as empirical and molecular formula.

Specific objectives with the Edexcel syllabus covered:

- Write word equations and balanced chemical equations (including state symbols): for reactions studied in this specification, for unfamiliar reactions where suitable information is provided.
- Calculate relative formula masses (including relative molecular masses) (M_r) from relative atomic masses (A_r)
- Know that the mole (mol) is the unit for the amount of a substance.
- Understand how to carry out calculations involving amount of substance, relative atomic mass (A_r) and relative formula mass (M_r)
- Calculate reacting masses using experimental data and chemical equations
- Calculate percentage yield
- Understand how the formulae of simple compounds can be obtained experimentally, including metal oxides, water and salts containing water of crystallization
- Know what is meant by the terms empirical formula and molecular formula
- Calculate empirical and molecular formulae from experimental data
- Know how to determine the formula of a metal oxide by combustion (e.g. magnesium oxide) or by reduction (e.g. copper(II) oxide)
- Understand how to carry out calculations involving gas volumes and the molar volume of a gas (24 dm^3 and 24 000 cm^3 at room temperature and pressure (rtp))
- Understand how to carry out calculations involving amount of substance, volume and concentration (in mol/dm^3) of solution

Following the conclusion of topic 5, for the remainder of the academic year prior to the IGCSE 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 GCSE 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. Students will also complete standardized tests such as the GL. This allows us to measure the students' attainment throughout the term and year.