A LEVEL CHEMISTRY

Exam Board: OCR

Syllabus Code: H432

Entry Requirement

Boys who wish to study A Level Chemistry should have achieved at least a grade 7 in IGCSE Chemistry or grades 87 in IGCSE Science (Double Award).

Introduction

The specification is divided into chemical topics, each containing different key concepts of Chemistry. Key features of a topic are developed and everyday applications are considered. Chemistry is a very practical subject and these skills are taught in an integrated approach to highlight the theoretical topics. The course has been developed with the Royal Society of Chemistry and is up-to- date with recent developments in this field of science and its impact on the wider society.

Syllabus Content

Module 1 – Development of Practical Skills in Chemistry

Practical skills assessed in a written examination (1.1): Practical skills are embedded throughout all modules in this specification. Learners will be required to develop a range of practical skills throughout the course in preparation for the written examinations.

Module 2 – Foundations in Chemistry

Atoms and reactions (2.1): This section builds directly from GCSE Science, starting with basic atomic structure and isotopes. Important basic chemical skills are developed: writing chemical formulae, constructing equations and calculating chemical quantities using the concept of amount of substance. The role of acids, bases and salts in Chemistry is developed in the context of neutralisation reactions. Finally, redox reactions are studied within the context of oxidation number and electron transfer.

Electrons, bonding and structure (2.2): This section introduces the concept of atomic orbitals and develops a deeper understanding of electron configurations linked to the periodic table. The central role of electrons in ionic and covalent bonding is then studied. The important role of molecules is studied, including an explanation of polarity and intermolecular forces. Finally, this section looks at how bonding and structure contribute to properties of substances.

Module 3 – Periodic Table and Energy

The Periodic Table (3.1): Periodic trends are first studied to extend the understanding of structure and bonding. Group properties are then studied using Group 2 and the halogens as typical metal and non-metal groups respectively, allowing an understanding of redox reactions to be developed further. Finally, this section looks at how unknown ionic compounds can be analysed and identified using simple test-tube tests.

Physical Chemistry (3.2): This section introduces Physical Chemistry within the general theme of energy. Learners first study the importance of enthalpy changes, their uses and determination from experimental results including enthalpy cycles. This section then investigates the ways in which a change in conditions can affect the rate of a chemical reaction, in terms of activation energy, the Boltzmann distribution and catalysis. Reversible reactions are then studied, including the dynamic nature of chemical equilibrium and the influence of conditions upon the position of equilibrium. Finally, the integrated roles of enthalpy changes, rates, catalysts and equilibria are considered as a way of increasing yield and reducing energy

demand, improving the sustainability of industrial processes.

Module 4 – Core Organic Chemistry

Basic Concepts and Hydrocarbons (4.1): This section is fundamental to the study of Organic Chemistry. This section introduces the various types of structures used routinely in Organic Chemistry, nomenclature, and the important concepts of homologous series, functional groups, isomerism and reaction mechanisms using curly arrows. The initial ideas are then developed within the context of the hydrocarbons: alkanes and alkenes.

Alcohols, haloalkanes and analysis (4.2): This section introduces two further functional groups: alcohols and haloalkanes, and considers the importance of polarity and bond enthalpy to organic reactions. Throughout this section, there are many opportunities for developing organic practical skills, including preparation and purification of organic liquids. Finally, the important techniques of infrared spectroscopy and mass spectrometry are used to illustrate instrumental analysis as a valuable tool for identifying organic compounds.

Module 5 – Physical Chemistry and Transition Elements

Rates, equilibrium and pH (5.1): The largely qualitative treatment of reaction rates and equilibria encountered in Module 3 is developed within a quantitative and graphical context. This section also allows learners to develop practical quantitative techniques involved in the determination of reaction rates and pH. There are many opportunities for developing mathematical skills, including use of logarithms and exponents, when studying the content of this section and when carrying out quantitative practical work.

Energy (5.2): Born–Haber cycles are used as a theoretical model to illustrate the energy changes associated with ionic bonding. Entropy and free energy are then introduced as concepts used to predict quantitatively the feasibility of chemical change. Redox chemistry permeates chemistry and the introductory work in Module 2 is developed further within this section, including use of volumetric analysis for redox titrations and an introduction of electrochemistry in the context of electrode potentials.

Transition elements (5.3): This section provides learners with a deeper knowledge and understanding of the periodic table within the context of the transition elements. This section includes the role of ligands in complex ions, stereochemistry, precipitation, ligand substitution and redox reactions. The colour changes and observations in these reactions increase the toolkit of qualitative inorganic tests for identifying unknown ionic compounds.

Module 6 – Organic Chemistry and Analysis

Aromatic compounds, carbonyls and acids (6.1): This section extends the range of functional groups encountered in Module 4. Aromatic compounds are first introduced, including the central role of delocalisation within the chemistry of arenes and phenols. Directing groups are also introduced, including their importance to organic synthesis. The important carbonyl compounds, aldehydes and ketones, are then studied. Finally, carboxylic acids and their related functional groups, acyl chlorides and esters, are studied. The importance of acyl chlorides in organic synthesis is emphasised.

Nitrogen compounds, polymers and synthesis (6.2): This section focuses on organic nitrogen compounds, including amines, amides and amino acids. Chirality and optical isomerism is also introduced. Condensation polymerisation is also introduced and compared with addition polymerisation. The importance of carbon–carbon bond formation in organic synthesis is stressed. Learners are also able to consider multi-stage synthetic routes towards an organic product. This module allows learners many opportunities to further develop their organic practical skills, especially in preparing and purifying organic solids, including

recrystallisation and determination of melting points.

Analysis (6.3): This section develops and complements the spectroscopic areas of organic chemistry previously encountered (see Module 4: Core organic chemistry; 4.2.4 Analytical techniques). This section demonstrates how analytical techniques introduced in Module 4 (infrared spectroscopy, mass spectrometry and elemental analysis) may be used in combination with NMR spectroscopy to provide evidence of structural features in molecules. The instrumentation methods of analysis studied during the A Level course provide learners with an important base of knowledge, understanding and awareness for further study in Higher Education and in many areas of employment in the broad scientific field. This section also looks at how unknown organic functional groups can be analysed and identified using simple test-tube tests.

Assessment

The A Level assessment is as follows:

Periodic table, elements and Physical Chemistry (Component 01)

This component is worth 100 marks and is split into two sections and assesses content from teaching modules **1, 2, 3 and 5**. Learners answer all questions.

Section A contains multiple choice questions. This section of the paper is worth 15 marks.

Section B includes short answer question styles (structured questions, problem solving, calculations, practical) and extended response questions. This section of the paper is worth 85 marks.

Synthesis and Analytical Techniques (Component 02)

This component is worth 100 marks and is split into two sections and assesses content from teaching modules **1, 2, 4 and 6**. Learners answer all questions.

Section A contains multiple choice questions. This section of the paper is worth 15 marks.

Section B includes short answer question styles (structured questions, problem solving, calculations, practical) and extended response questions. This section of the paper is worth 85 marks.

Unified Chemistry (Component 03)

This component assesses content from across all teaching modules 1 to 6. Learners answer all questions. This component is worth 70 marks.

Question styles include short answer (structured questions, problem solving, calculations, practical) and extended response questions.

Practical endorsement in Chemistry (Component 04)

Performance in this component is reported separately to the performance in the A Level as measured through externally assessed components 01 to 03. This non exam assessment component rewards the development of practical competency for chemistry and is teacher assessed. Learners complete a minimum of 12 assessed practical activities covering the technical skills (together with the use of apparatus and practical techniques). Teachers who award a pass to their learners need to be confident that the learner consistently and routinely exhibits the competencies before completion of the A Level course.