CHEMISTRY

INTRODUCTION

Chemistry is the study of matter and its changes. It presumes that the interactions within and between matter in the universe occur in consistent patterns that can be understood through careful and systematic study. The study of chemistry focuses on investigating the physical and chemical properties of substances, chemical reactions and processes, the interaction of energy and matter, as well as the interpretation of natural phenomena and the prediction of changes at the atomic and the molecular level. It is anticipated that the study of chemistry can help to foster:

(a) an appreciation of the beauty of the nature,
(b) an appreciation of the benefits that have been brought about by the advancement of chemistry, and
(c) a recognition that chemistry can provide solutions to problems related to social, economic and environmental issues.

Chemistry is an experimental discipline requiring creativity and imagination. Upon completion of the course, candidates are expected to have acquired a certain amount of chemical knowledge, and more importantly skills in scientific investigation. These skills include: to ask questions; to propose hypotheses, to investigate and experiment; to gather, analyse and assess scientific information; to communicate effectively using the language of chemistry; and to propose solutions based on chemical principles to problems faced in daily life.

Acknowledging the fact that candidates may have a wide range of abilities, the syllabus has been designed to allow flexibility in teaching and in learning. In some sections of the syllabus, the contents are divided into two parts, namely the Core and the Extension parts. The Core represents the basic components of chemistry that all candidates should learn. The Extension includes additional materials and candidates may be required to exercise higher order thinking skills in order to master the chemical knowledge therein. In the syllabus, the Extension parts are underlined.

AIMS

The syllabus aims to develop in the candidates:

1. an ability to observe, to analyse and to interpret objectively;
2. an understanding of the concepts and theories in chemistry;
3. manipulative and experimental skills, and an awareness of safety issues related to the handling of chemicals;
4. an awareness of the provisional nature of explanations about natural phenomena, and the complex relationships between phenomena;
5. attitudes on which scientific investigations depend, such as curiosity, honesty, persistence, critical thinking, willingness to suspend judgement and tolerance of uncertainty;
6. an ability to make rational decisions and to solve problems involving chemistry;
7. communicative skills used in the study of chemistry;
8. an appreciation of the applications of chemistry in daily life; and
9. an awareness of the social, economic, environmental and technological implications of chemistry.

Most of these aims are reflected in the assessment objectives but some are not. Although some aims cannot be translated readily into assessment objectives, they are by no means unimportant in the study of chemistry.

ASSESSMENT OBJECTIVES

The objectives of the examination are to test the following abilities:

1. to recall and understand chemical facts and phenomena;
2. to understand the fundamental principles, concepts, terminology and conventions used in chemistry;
3. to understand the use of apparatus and materials in planning and performing experiments;
4. to understand how chemicals can be used safely in the laboratory and in daily life situations;
5. to analyse and interpret experimental data, and draw relevant conclusions;
6. to interpret and evaluate scientific information presented in written, numerical, tabular and graphical forms;
7. to manipulate chemical data and to perform calculations;
8. to apply chemical knowledge to explain observations and to solve problems which may involve unfamiliar situations;
9. to organize and present ideas effectively in matters relating to chemistry;
10. to make decisions from chemical data and information on the basis of scientific, ethical, economic, political and social considerations.

THE EXAMINATION

The examination will consist of two papers. Each paper will consist of two sections, Section A (60% of the paper mark) and Section B (40% of the paper mark). In each paper, Section A will comprise questions set on the Core part of the syllabus, while Section B will comprise questions set on the whole syllabus.

Paper 1 (1¾ hours) (64%)

This paper will consist of conventional questions. All questions are compulsory.

Paper 2 (1 hour) (36%)

This paper will consist of multiple-choice questions. All questions are compulsory.

NOTES

1. Candidates will be expected to have knowledge of the chemistry components of core part of the S1-3 science curriculum.
2. SI units will be used as far as possible.
3. Systematic names of compounds as recommended by the International Union of Pure and Applied Chemists (IUPAC) will be used. The booklet 'Guidelines for Systematic Chemical Nomenclature (2000)' published by the Hong Kong Examinations Authority is a useful reference.
4. The booklet 'An English-Chinese Glossary of Terms Commonly Used in the Teaching of Chemistry in Secondary Schools (1999)' published by the Education Department is a useful reference for the Chinese terms.

THE SYLLABUS

Section 1 Planet Earth

The natural world is made up of chemicals. The earth's crust, the sea and the atmosphere are major sources of chemicals. The study of chemistry includes the investigation of possible methods to isolate useful materials from these sources and the analysis of these materials using various tests. Candidates who have completed this section should have some understanding of scientific investigation and the study of chemistry.

Candidates should know the terms ‘element’, ‘compound’ and ‘mixture’, ‘physical change’ and ‘chemical change’, ‘physical property’ and ‘chemical property’, ‘solvent’, ‘solute’ and ‘saturated solution’, etc. They should be able to use word equations to represent chemical changes, and to suggest appropriate physical methods to separate mixtures and chemical tests to identify some chemical species.

Topic	Explanatory Notes	Relevant Activities
1.1 The atmosphere	• Composition of air.	• Searching for information on issues related to the atmosphere.
	• Separation of oxygen and nitrogen from liquid air by fractional distillation.	
	• Test for oxygen.	• Carrying out test for oxygen.
1.2 The ocean	• Composition of sea water.	
	• Extraction of common salt and isolation of pure water from sea water.	• Performing experiments and evaluating methods on physical separation including evaporation, distillation, crystallisation and filtration.

Topic	Explanatory Notes	Relevant Activities
	• Tests to show the presence of sodium and chloride in a sample of common salt.	• Carrying out the flame test and silver nitrate test.
	• Test for the presence of water in a sample.	
	• Electrolysis of sea water and uses of the products.	• Performing a test to show the presence of water in a given sample.
1.3 Rocks and minerals	• Rocks as a source of minerals.	
	• Isolation of useful materials from minerals as exemplified by extraction of metals from their ores.	
	• Limestone, chalk and marble as different forms of calcium carbonate.	
	• Erosion processes as exemplified by the action of heat, water and acids on calcium carbonate.	• Investigating the effects of heat, water and acids on calcium carbonate.
	• Thermal decomposition of calcium carbonate and test for carbon dioxide.	
	• Tests to show the presence of calcium and carbonate in a sample of limestone/chalk/ marble.	• Designing and performing chemical tests for calcium carbonate.

Section 2 The Microscopic World

The study of chemistry involves the linking up of phenomena in the macroscopic world to the behaviour of atoms, molecules and ions in the microscopic world. A good understanding of the electronic arrangement of atoms, chemical bonding and structure of matter is fundamental to the pursuit of knowledge in chemistry. Candidates should know that the Periodic Table demonstrates remarkable patterns in the physical and chemical properties of the elements. They should also be able to relate the properties of substances to their structures.

Candidates should appreciate that symbols and chemical formulae constitute part of the language used by chemists. They should be able to perform calculations related to chemical formulae.

Topic	Explanatory Notes	Relevant Activities
2.1 Atomic structure	• Elements, atoms and symbols. • Classification of elements into metals, non-metals and metalloids. • Electron, neutron and proton as subatomic particles. • Simple model of atom. • Atomic number (Z) and mass number (A). • Isotopes. • Isotopic masses and relative atomic masses based on $^{12}C = 12.00$. • Calculation of relative atomic masses based on mass numbers and relative abundances of isotopes. • Electronic arrangement of atoms (up to Z=20).	• Searching and presenting information on elements.

Topic	Explanatory Notes	Relevant Activities
	• Stability of noble gases related their electronic arrangements.	
2.2 Periodic Table	• The position of the elements in the Periodic Table related to their electronic arrangements.	• Searching and presenting information on the development of the Periodic Table.
	• Similarities in chemical properties among elements in Groups I, II, VII and 0.	• Investigating chemical similarities in the same groups of the Periodic Table.
	• Predicting the chemical properties of unfamiliar elements in Groups I, II ,VII and 0 of the Periodic Table.	
2.3 Ionic and covalent bonding	• Transfer of electrons in the formation of ionic bond.	
	• Cations and anions.	
	• Electronic diagrams of simple ionic compounds.	
	• Names and formulae of ionic compounds.	
	• Ionic structure as illustrated by sodium chloride.	• Building models of ionic substances.
	• Sharing of electrons in the formation of covalent bond.	
	• Single, double and triple bonds.	

Topic	Explanatory Notes	Relevant Activities
	• Electronic diagrams of simple covalent molecules.	
	• Names and formulae of covalent substances.	
	• van der Waals' forces as weak intermolecular forces.	
	• Simple molecular structure.	• Building models of covalent substances.
	• Giant covalent structures as illustrated by diamond and quartz.	
	• Formula masses and relative molecular masses.	• Predicting the formation of ionic and covalent substances from given information.
	• Calculations related to formula masses and relative molecular masses.	
2.4 Metallic bonding	• Simple model of metallic bond.	
2.5 Structures and properties	• Relationship between structures and properties of ionic, giant covalent, simple molecular and metallic substances.	• Predicting structures and properties from given information.

Section 3 Metals

Metals have a wide range of uses in our daily life, and as such, the extraction of metals from their ores has been an important activity of human beings since prehistoric times. Candidates should know that the method of extraction of a metal is related to its chemical activity. They should be able to establish a metal reactivity series based on experimental evidence.

The corrosion of metals poses a socioeconomic problem for human beings. It is therefore necessary to develop methods to preserve the limited reserve of metals. An investigation of the factors leading to corrosion and methods to prevent metals from corrosion is a valuable problem-solving exercise and can help candidates to develop a positive attitude towards the resources of our planet earth.

A chemical equation is a concise and universally adopted way to represent a chemical change. Candidates should be able to transcribe word equations into chemical equations and appreciate that a chemical equation shows a quantitative relationship between reactants and products of a reaction. Candidates should be able to do calculations involving mole and chemical equations.

Topic	Explanatory Notes	Relevant Activities
3.1 Occurrence and extraction of metals	• Occurrence of metals in nature in free state and in combined forms.	• Searching and presenting information about the occurrence of metals and their uses in daily life.
	• Obtaining metals by heating metal oxides or by heating metal oxides with carbon.	• Performing experiments to extract metals from metal oxides.
	• Extraction of metals by electrolysis.	
	• Relation of the discovery of metals with the ease of extraction of metals and the availability of raw materials.	• Deciding appropriate methods for extraction of metals from their ores.
	• Limited reserve of metals and their conservation.	

Topic	Explanatory Notes	Relevant Activities
3.2 Reactivity of metals	• Reactions of some metals (sodium, magnesium, calcium, zinc, iron, lead, copper, etc.) with (a) oxygen/air, (b) water, (c) dilute hydrochloric acid and dilute sulphuric acid.	• Performing experiments to investigate reactions of metals with oxygen/air, water and dilute acids.
	• Metal reactivity series and the tendency of metal to form positive ion.	• Constructing a metal reactivity series based on experimental evidence.
	• Displacement reactions and their interpretations based on reactivity series.	• Performing experiments to investigate displacement reactions of metals with aqueous metal ions.
	• Prediction of metal reactions using the reactivity series.	
	• Relation between the extraction method for a metal and its position in the metal reactivity series.	
3.3 Reacting masses	• Quantitative relationship of the reactants and products in a reaction as revealed from a chemical equation.	
	• Mole, Avogadro's constant and molar mass.	
	• Percentage by mass of an element in a compound.	

Topic	Explanatory Notes	Relevant Activities
	• Calculations related to moles and reacting masses.	
	• Empirical formulae derived from experimental data.	• Performing experiments to determine empirical formulae.
	• Reacting masses from chemical equations.	
3.4 Corrosion of metals and their protection	• Factors that influence the rusting of iron.	• Designing and performing experiments to investigate factors that influence rusting.
	• Methods used to prevent iron from rusting (e.g. painting, oiling, galvanising, tin-plating, electroplating, sacrificial protection and alloying).	• Performing experiments to study methods that can be used to prevent rusting.
	• Socioeconomic implications of rusting.	
	• Corrosion resistance of aluminium.	
	• Anodisation as a method to enhance corrosion resistance of aluminium.	• Deciding appropriate methods to prevent metal corrosion based on social, economical and technological considerations.

Section 4 Acids and alkalis

Acids and bases/alkalis are involved in numerous chemical processes that occur around us, from industrial processes to biological ones, from reactions in the laboratory to those in our natural environment. Candidates should have encountered acids and bases/alkalis in their junior science courses. In this section, they will further study the properties and reactions of acids and bases/alkalis, and the concept of molarity. They should have an awareness of the potential hazards associated with the handling of acids and alkalis.

Candidates studying the whole syllabus should have knowledge of strong and weak acids/alkalis, the methods of salt preparation, volumetric analysis involving acids and alkalis. They should have some understanding of the rate of reactions, but an interpretation at the molecular level and calculations are not required.

Topic	Explanatory Notes	Relevant Activities
4.1 Acids	• Common acids in daily life and in the laboratory.	
	• Characteristics of acids as illustrated by dilute hydrochloric acid and dilute sulphuric acid.	
	• Reactions of acids: (a) action on metals, (b) action on carbonates and hydrogencarbonates, (c) action on metal oxides and hydroxides.	• Investigating the effects of dilute acids on metals, carbonates, hydrogencarbonates, metal oxides and metal hydroxides.
	• Acidic properties and hydrogen ions ($H^+(aq)$).	
	• Role of water in exhibiting properties of acid.	• Designing and performing experiments to find out the importance of water for acids to exhibit acidic properties.

Topic	Explanatory Notes	Relevant Activities
	• Basicity of acid.	
	• Corrosive nature of concentrated acids.	• Searching for information about the hazardous nature of acids/alkalis.
4.2 Alkalis	• Common alkalis in daily life and in the laboratory.	
	• Characteristics and chemical reactions of alkalis as illustrated by sodium hydroxide and aqueous ammonia.	
	• Reactions of alkalis: (a) action on aqueous metal ions to form metal hydroxide precipitates, (b) action on ammonium compounds to give ammonia gas.	• Investigating the effects of dilute alkalis on metal ions and on ammonium ion.
	• Alkaline properties and hydroxide ions ($OH^-(aq)$).	
	• Corrosive nature of concentrated alkalis.	• Performing experiments to investigate corrosive nature of concentrated acids/alkalis.
4.3 Indicators and pH	• Acid base indicators as exemplified by litmus, methyl orange and phenolphthalein.	
	• pH scale as a measure of acidity and alkalinity.	
	• Use of universal indicator and an appropriate instrument to measure the pH of solutions.	• Performing experiments to find out the pH values of some domestic substances.

	Topic	Explanatory Notes	Relevant Activities
4.4	Strength of acids and alkalis	• Meaning of strong and weak acids as well as strong and weak alkalis in terms of their extent of dissociation.	• Designing and performing experiments to compare the strengths of acids/alkalis.
		• Methods to compare the strength of acids/alkalis.	
4.5	Neutralisation and salts	• Bases as chemical opposites of acids.	
		• Neutralisation as the reaction between acid and base/alkali to form water and salt only.	
		• Exothermic nature of neutralisation.	• Investigating the temperature change in a neutralisation process.
		• Preparation of soluble and insoluble salts based on neutralisation.	• Preparing and isolating salts from acid-alkali or acid-base reactions.
		• Naming of common salts.	
		• Application of neutralisation.	• Searching and presenting information on applications of neutralisation.
4.6	Concentration of solutions	• Concentration of solutions in g dm^{-3} and in mol dm^{-3} (molarity).	
		• Calculations on molarity.	

Topic	Explanatory Notes	Relevant Activities
4.7 Simple volumetric work involving acids and alkalis	• Standard solutions. • Acid-alkali titrations. • Calculations involving titrations. (Back titration is not required.)	• Preparing solutions of known concentrations. • Performing acid-alkali titrations using suitable indicators.
4.8 Rate of Reaction	• Effects of concentration, surface area and temperature on the rate of reaction.	• Designing and performing experiments to study the effects of concentration, surface area and temperature on the rate of reaction.

Section 5 Chemical Cells and Electrolysis

Chemical reactions are associated with the release or absorption of energy. In a chemical cell, the chemical energy released is converted to electrical energy. The flow of electrons in the external circuit indicates the occurrence of oxidation and reduction at the electrodes. Candidates should know that redox reactions involve the transfer of electrons. They should also have experience in carrying out experiments with commonly used oxidising and reducing agents, and be able to write chemical equations for redox reactions.

Candidates studying the whole syllabus should know the reactions occurring in more complicated chemical cells as well as electrolysis.

Topic	Explanatory Notes	Relevant Activities
5.1 Chemical cells in daily life	• Uses of chemical cells in relation to factors such as size, price and life expectancy.	• Decision-making exercise on the choice of chemical cells in daily life based on available information.
5.2 Simple chemical cells	• Simple chemical cells: (a) chemical cells consisting of two metal electrodes and an electrolyte, (b) chemical cells consisting of metal-metal ion half cells and salt bridge/porous device. • Changes occurring at the electrodes and electron flow in the external circuit. • Ionic half equations and overall cell equations.	• Making simple chemical cells and measuring their voltages.

Topic	Explanatory Notes	Relevant Activities
5.3 Redox reactions	• Oxidation and reduction.	• Performing experiments on redox reactions.
	• Oxidising agents (e.g. $MnO_4^-(aq)/H^+(aq)$, $Cr_2O_7^{2-}(aq)/H^+(aq)$, $Fe^{3+}(aq)$, $Cl_2(aq)$).	
	• Reducing agents (e.g. $SO_3^{2-}(aq)$, $I^-(aq)$, $Fe^{2+}(aq)$, $Zn(s)$).	
	• Oxidation numbers.	
	• Balancing redox equations by using ionic half equations or by oxidation numbers.	
	• Nitric acid of different concentrations as oxidising agent to give NO and NO_2.	• Investigating redox reactions of nitric acid of different concentrations with metals.
5.4 Reactions in chemical cells	• Reactions in chemical cells consisting of half cell(s) other than metal-metal ions systems.	• Predicting changes in chemical cells based on given information.
	• Reactions in zinc-carbon cell.	
5.5 Electrolysis	• Electrolysis as the decomposition of substances by electricity as exemplified by electrolysis of (a) dilute sulphuric acid, (b) sodium chloride solution of different concentrations, (c) copper(II) sulphate solution.	• Performing experiments to investigate changes in electrolysis.
	• Anodic and cathodic reactions.	

Topic	Explanatory Notes	Relevant Activities
	• Preferential discharge of ions in relation to the electrochemical series, concentration of ions and nature of electrodes.	
	• Industrial application of electrolysis: (a) electroplating, (b) electrolysis of brine.	• Designing and performing electroplating experiments.

Section 6 Products from Important Processes

Chlorine and sulphuric acid are important chemicals as they are produced and consumed annually in a million tonne scale. Chlorine is commonly used as bleach and as a disinfectant. Sulphuric acid has a wide range of uses both in industry and in our daily life. Candidates should understand the concept of redox and have a good awareness of the necessity of handling chemicals safely in the laboratory. Through a study of the Contact Process, candidates will be exposed to a wider horizon by looking into the industrial aspects of chemistry. Candidates should know the meaning of reversible reaction although the concept of equilibrium and technical details of the industrial process are not required.

Candidates studying the whole syllabus are expected to have knowledge of the manufacture of chlorine, the molar volume of gases and factors that need to be considered when setting up a chemical plant.

Topic	Explanatory Notes	Relevant Activities
6.1 Chlorine and hypochlorite	• Uses of chlorine and hypochlorite.	• Searching for information on uses of chlorine.
	• Manufacture of chlorine by electrolysis of brine.	• Designing and performing experiments to make chlorine bleach.
	• Properties and reactions of chlorine: (a) bleaching action of aqueous chlorine, (b) reactions with aqueous halides, (c) reaction with dilute sodium hydroxide solution.	• Performing experiments to investigate properties and reactions of chlorine and hypochlorite.
	• Sodium hypochlorite as the active ingredient in chlorine bleach.	
	• Properties and reactions of sodium hypochlorite: (a) bleaching action, (b) reaction with dilute acids.	

Topic	Explanatory Notes	Relevant Activities
	• Potential hazards associated with the use of chlorine bleach.	
6.2 Sulphuric acid and sulphur dioxide	• Uses of sulphuric acid and sulphur dioxide. • Manufacture of sulphuric acid by the Contact Process. • Molar volume of gases at room temperature and pressure. • Calculations involving molar volume of gases. • Properties and reactions of concentrated sulphuric acid: (a) dehydrating property, (b) oxidising property. • Properties and reactions of sulphur dioxide/sulphite: (a) bleaching property, (b) action of acids on sulphite.	• Searching for information on uses of sulphuric acid. • Performing experiments to investigate the dehydrating and oxidising properties of concentrated sulphuric acid. • Diluting concentrated sulphuric acid. • Designing and performing experiments to prepare sulphur dioxide, and to study properties and reactions of sulphur dioxide.
6.3 Chemical plants	• Location of chemical plants in relation to the availability of resources, transport and environmental impact.	• Presenting arguments on the desirability of setting up chemical plants for the production of chlorine/sulphuric acid.

Section 7 Fossil Fuels and of Carbon Compounds

Carbon compounds play an important role in industry and in our daily life. Coal and petroleum are two major sources of carbon compounds. In this section, the main focus is placed on the use of petroleum fractions as fuel and as a source of hydrocarbons. Candidates should appreciate that the use of fossil fuels has brought us benefits and convenience, as well as environmental problems like air pollution, acid rain, the global greenhouse effect, etc. They should realise that human activities can have impacts on our environment.

This section also introduces some basic concepts of organic chemistry like homologous series, functional group, general formula and structural formula. Candidates should be able to give systematic names of alkanes, alkenes, alkanols and alkanoic acids with no more than four carbon atoms. They should also know the terms 'exothermic reaction' and 'endothermic reaction'.

Topic	Explanatory Notes	Relevant Activities
7.1 Fossil fuels	• Coal, petroleum and natural gas as fossil fuels.	
	• Petroleum as a mixture of hydrocarbons and its separation into useful fractions by fractional distillation.	
	• Relation of the gradation in properties (e.g. colour, viscosity, volatility and burning characteristics) to the number of carbon atoms in the molecules of the various fractions.	• Investigating colour, viscosity, volatility and burning characteristics of petroleum fractions.
	• Major uses of distilled fractions of petroleum.	• Searching and presenting information about oil fractions regarding their major uses and properties.

Topic	Explanatory Notes	Relevant Activities
7.2 Homologous series, structural formulae and naming of carbon compounds	• Homologous series as illustrated by alkanes, alkenes, alkanols and alkanoic acids.	
	• Structural formulae and systematic naming of alkanes, alkenes, alkanols and alkanoic acids.	• Building models of simple alkanes, alkenes, alkanols and alkanoic acids.
7.3 Alkanes and alkenes	• Petroleum as a source of alkanes.	
	• Reactions of alkanes: (a) combustion, (b) substitution reactions with chlorine and bromine.	• Performing experiments to investigate reactions of alkanes.
	• Cracking and its industrial importance	• Performing experiment on cracking of petroleum fraction and testing products.
	• Reactions of alkenes with: (a) bromine, (b) acidified potassium permanganate solution.	• Performing experiments to investigate reactions of alkenes.
7.4 Consequences of using fossil fuels	• Fossil fuels as an important source of energy.	• Searching for information and presenting arguments on the pros and cons of using fossil fuels.
	• Complete and incomplete combustion of hydrocarbons.	
	• Hazards associated with the use of household fuels: (a) toxicity, (b) flammability.	• Making informed decision on the safe practice of using household fuels.
	• Safety precautions in using household fuels.	

Topic	Explanatory Notes	Relevant Activities
	• Major air pollutants from cars, factories, incinerators and power stations: unconsumed hydrocarbons, particulates, carbon monoxide, sulphur dioxide and oxides of nitrogen.	
	• Environmental problems associated with the burning of fossil fuels.	
	• Measures to reduce air pollutants from the burning of fossil fuels.	
	• Alternative sources of energy.	• Searching for information on alternative sources of energy.
7.5 Alcohols	• Uses of alcohols in drinks, as solvents and fuels.	• Searching and presenting on information of problems associated with drinking alcohol.
	• Reactions of alkanols with (a) acidified potassium dichromate to produce alkanoic acids, (b) alkanoic acids to produce esters.	• Performing experiments to investigate reactions of alkanols with acidified potassium dichromate and alkanoic acids.
	• Uses of esters as fragrances, flavourings and solvents.	

Section 8 Plastics and detergents

Plastics are remarkably useful materials. Many objects used in our daily life are made of plastics. Candidates should know that 'plastics' is a collective term which embraces a large number of polymers, and that uses of different plastics are related to their thermal properties which are in turn related to their structures. Candidates should appreciate that one great advantage of using plastics over other materials, their durability, is also a drawback, as most plastics do not readily degrade in a natural environment. It is therefore necessary to explore ways to dispose of plastic waste.

In this section, the term ‘detergent’ denotes two classes of substances which assist cleansing: soaps and soapless detergents. Candidates should appreciate that the structure of detergents consists of both hydrophilic and hydrophobic parts. These structural characteristics of detergents render the emulsifying properties of detergents.

Candidates studying the whole syllabus should know what condensation polymers are, the difference in the cleaning abilities of soaps and soapless detergents and the environmental problems associated with the use of detergents.

Topic	Explanatory Notes	Relevant Activities
8.1 Plastics	• Plastics as important material in the modern world.	
	• Thermoplastics and thermosetting plastics (a) uses and moulding methods in relation to their thermal properties, (b) differences in thermal properties explained in terms of their structures.	• Investigating properties such as the strength and ease of softening upon heating of different plastics.
	• Monomers, polymers and repeating units.	
	• Addition polymerisation.	

Topic	Explanatory Notes	Relevant Activities
	• Condensation polymerisation as exemplified by the formation of nylon and polyester.	
	• Environmental issues related to the use of plastics.	• Searching and presenting information on environmental issues related to the use of plastics.
8.2 Detergents	• Detergent as a substance which helps to remove dirt by (a) its ability to act as a wetting agent, (b) its emulsifying action.	• Searching and presenting information on the historical development of detergents. • Performing experiments to investigate the wetting ability and emulsifying action of detergents.
	• Structures of soaps and soapless detergents.	
	• Emulsifying properties of detergents in relation to their structures.	
	• Production of soaps by reacting fats or oils with an alkali.	• Preparing soap from a fat or oil, and testing its properties.
	• Cleaning abilities of soaps and soapless detergents in hard water.	• Designing and carrying out experiments to compare the cleaning abilities of soaps and soapless detergents.
	• Environmental problems associated with the use of detergents.	• Searching and presenting information on environmental issues related to the use of detergents.

Section 9 Detection and analysis

Candidates should be able to apply knowledge and skills acquired in other sections to suggest tests for some common chemicals. They should know that in addition to the separation methods mentioned previously, chromatography is commonly used to separate a mixture of substances. They should also appreciate that these methods and tests play an important role in everyday life.

Candidates should be aware of the limitation inherent in the use of conventional chemical tests in the detection of chemical species and the application of modern chemical instruments in chemical analysis.

Topic	Explanatory Notes	Relevant Activities
9.1 Separation of mixtures	• Paper chromatography.	• Performing experiment to separate colour mixtures by chromatography.
	• Crystallisation, filtration and evaporation.	
	• Distillation and fractional distillation.	• Devising a scheme to separate a mixture of known substances.
9.2 Tests for substances	• Detecting the presence of calcium, copper, potassium and sodium in substances by the flame test.	• Performing experiments to detect the presence of certain chemical species in a sample.
	• Application of appropriate tests to detect the presence of (a) hydrogen, oxygen, chlorine, carbon dioxide, water, ammonia and sulphur dioxide,	• Designing and performing an investigation to deduce the chemical nature of a given sample.

Topic	Explanatory Notes	Relevant Activities
	(b) ions: aluminium, calcium, copper(II), iron(II), iron(III), zinc, chloride, bromide, iodide, carbonate, hypochlorite, ammonium and sulphite.	
	• Awareness of the uses of modern chemical instruments.	• Searching for information on the uses of modern chemical techniques.