L-Università ta' Malta

MATSEC
Examinations Board

SEC 06 Syllabus

Chemistry

2026

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Introduction

This syllabus is based on the curriculum principles outlined in *The National Curriculum Framework for All* (NCF) which was translated into law in 2012 and designed using the *Learning Outcomes Framework* that identify what students should know and be able to achieve by the end of their compulsory education.

As a learning outcomes-based syllabus, it addresses the holistic development of all learners and advocates a quality education for all as part of a coherent strategy for lifelong learning. It ensures that all children can obtain the necessary skills and attitudes to be future active citizens and to succeed at work and in society irrespective of socio-economic, cultural, racial, ethnic, religious, gender and sexual status. This syllabus provides equitable opportunities for all learners to achieve educational outcomes at the end of their schooling, which will enable them to participate in lifelong and adult learning, reduce the high incidence of early school leaving and ensure that all learners attain key twenty-first century competences.

This programme also embeds learning outcomes related to cross-curricular themes, namely digital literacy; diversity; entrepreneurship creativity and innovation; sustainable development; learning to learn and cooperative learning and literacy. In this way students will be fully equipped with the skills, knowledge, attitudes and values needed to further; learning, work, life, and citizenship.

What is Chemistry?

Chemistry involves a dynamic and engaging study of the material world. It is a field of human endeavour based on the broad understanding of physical concepts and models, which are united by common procedural and intellectual processes. Chemistry and the work of chemists have a profound impact on the environment, quality of life and on social and cultural practices.

What does a study of Chemistry entail?

Chemistry is an experimental science and practical work is central in a teaching programme of the subject at this level. An investigative approach to teaching Chemistry highlights the study of key concepts of chemistry in real-world contexts. While a practical paper will not be set, it is nevertheless expected that students taking the examination would have direct experience of the laboratory and have carried out a reasonable number of experimental investigations.

Every opportunity should be taken to expose the students to the applications of Chemistry to everyday situations and to help students develop higher order thinking skills. To allow more time for an investigative approach to teaching chemistry and for the development of reasoning skills this syllabus has reduced the emphasis on factual knowledge and decreased the content that students are expected to recall.

The examination paper will test the knowledge and understanding of chemical facts and principles and the ability to apply these to everyday situations as well as to solve theoretical and practical chemical problems both qualitatively and quantitatively.

How is Chemistry related to candidates' lives, to Malta, and to the world?

Since chemistry is fundamental to our world, it plays a role in everyone's lives and touches almost every aspect of our existence in some way. Chemistry is essential for meeting our basic needs of food, clothing, shelter, health, energy, as well as clean air, water, and soil. Chemical technologies enrich our quality of life in numerous ways by providing new solutions to problems in health, materials, and energy usage. Thus, studying chemistry is useful in preparing us for the real world.

This syllabus takes a learning outcomes approach and is based on five themes which put Chemistry at the centre of students' experience. The learning outcomes and assessment criteria have been written in a way that are student centred.

The aspirational programme learning outcomes for this subject are:

At the end of the programme, I can:

1. acquire a knowledge of basic chemical concepts and an understanding of chemical principles and patterns.
2. pursue my studies in chemistry or related subjects further.
3. appreciate that chemistry is a dynamic and evolving subject and that its principles and theories may change.
4. be aware of the importance of adopting the scientific method of investigation.
5. develop relevant practical skills whilst having due regard to correct and safe laboratory practice.
6. develop experimental and investigative competences.
7. develop abilities to:
   a. form hypotheses and design experiments to test these hypotheses;
   b. organize, interpret and evaluate chemical information in order to draw conclusions, make decisions and/or solve problems;
   c. communicate chemical knowledge and findings in appropriate ways.
8. apply the chemical knowledge and understanding to familiar and unfamiliar situations.
9. develop an appreciation of the environmental and technological applications of chemistry and related economic, ethical and social implications.

List of Subject Foci

1. Substances from the Earth: The Atmosphere.
2. Substances from the Earth: Aquatic environments.
3. Substances from the Earth: The Land.
4. Making New Materials: How fast? How far? How much?
5. Carbon compounds. Meeting our energy needs.

List of Learning Outcomes

At the end of the programme, I can:

LO 1. Demonstrate an understanding of how chemistry works and is communicated.

LO 2. Describe and explain the properties of gases that may be found in air and how to prepare them in the lab.

LO 3. Describe the solvent action of water including the impact of water hardness.

LO 4. Describe the chemical properties of acids, bases and salts.

LO 5. Describe the conduction of electricity through solutions and molten salts.

LO 6. Describe the major groups of the Periodic Table including their physical and chemical properties.

LO 7. Describe how substances dissolved in water can be identified and how their concentration can be measured.

LO 8. Describe how different rocks contain important substances, their extraction, chemical nature, responsible use and environmental impact.

LO 9. Describe how and why physical and chemical changes happen.

LO 10. Perform quantitative calculations.

LO 11. Investigate why and how chemical reactions proceed at different rates.
LO 12. Describe dynamic equilibria and the conditions needed to shift a reaction in equilibrium.
LO 13. Describe the chemical nature of crude oil and the substances obtained from it.
LO 14. Distinguish different homologous series and their physical and chemical properties.
LO 15. Describe the energy changes accompanying chemical changes.

Programme Level Descriptors

This syllabus sets out the content and assessment arrangements for the award of Secondary Education Certificate in Chemistry at Level 1, 2 or 3. First teaching of this programme begins in September 2022. First award certificates will be issued in 2025.

The following levels refer to the qualification levels that can be obtained by candidates sitting for SEC examinations. These are generic statements that describe the depth and complexity of each level of study required to achieve an award at Level 1, 2 or 3 in Chemistry. (Level 1 being the lowest and level 3 the highest).

Level 1: At the end of the programme the candidate will have obtained basic knowledge, skills and competences in the subject such as basic repetitive communication skills and the ability to follow basic, simple instructions to complete tasks. Support is embedded within the task.

Level 2: At the end of the programme the candidate will have obtained good knowledge, skills and competence in the subject such as the interpretation of given information and ideas. The candidate will have developed the ability to carry out complex tasks. Limited support may be embedded within the task.

Level 3: At the end of the programme the candidate will autonomously apply knowledge and skills to a variety of complex tasks. Candidates will utilise critical thinking skills to analyse, evaluate and reflect upon their own work and that of others. Problem solving tasks may be part of the assessment process.

Learning Outcomes and Assessment Criteria

Learning Outcome 1: **Paper I and Paper II**	**At the end of the programme, I can demonstrate an understanding of how chemistry works and is communicated.**

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
1.1a State that scientific knowledge changes with new evidence/observations/experiments.	1.2a Distinguish between a fact, a hypothesis, and a theory.	1.3a Discuss briefly the meaning of science in terms of its healthy scepticism, aimed objectivity, and the value of physical (observable / measurable) evidence.
1.1b State the importance of fair (objective) testing in science.	1.2b Discuss the importance of fair (objective) testing in science.	1.3b Evaluate an experiment in terms of its objectivity.
1.1c Identify variables in an experiment.		1.3c Identify dependent, independent and controlled variables.
	1.1d State the aim/s of an experiment / investigation.	
1.1e Follow health and safety regulations.	1.2e State health and safety considerations.	1.3e Evaluate an experiment in terms of health and safety.
	1.2f Identify precautions for a given experiment/investigation.	1.3f Justify precautions for a given experiment/investigation.
	1.2g Predict what might happen in an experiment / investigation.	1.3g Justify prediction/s made for an experiment / investigation.
1.1h Carry out, with supervision, a written procedure for an experiment.	1.2h Carry out, with limited supervision, a written procedure for an experiment.	1.3h Carry out, with no direct supervision, a written procedure for an experiment.

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
1.1i Complete observations/measurements in a given table for an experiment.	1.2i Record all observations/measurements in a given table for an experiment.	1.3i Record observations/measurements appropriately for an experiment.
	1.2j Record observations/measurements appropriately for an investigation.	1.3j Determine which observations/ measurements are to be measured for an investigation.
1.1k Label given diagrams.	1.2k Draw labelled diagrams from given apparatus.	1.3k Draw labelled diagrams of apparatus used during experiments/ investigations.
1.1l Read values from simple graphical representations.	1.2l Interpret graphical representations containing single series of data.	1.3l Interpret multiple series of data plotted on the same axes.
1.1m Plot a single series of data on given axes.	1.2m Plot a single series of data.	1.3m Plot multiple series of data on the same axes.
	1.2n Interpret situations by sketching a graph.	1.3n Interpret situations by sketching graphs in relation to existing plotted graphs.
	1.2o Draw conclusions from an experiment.	1.3o Draw conclusions from an experiment by relating it to scientific knowledge, laws and theory.
	1.2p Identify sources of error to suggest improvements.	1.3p Evaluate an experimental procedure and results by suggesting improvements.
	1.2q Plan an experiment to solve a given problem with supervision.	1.3q Plan an experiment to solve a given problem without direct supervision.
	1.2r Carry out an experiment to solve a given problem with supervision.	1.3r Carry out an experiment to solve a given problem without direct supervision.

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
1.1s Represent a chemical reaction using a word equation.	1.2s Represent a chemical reaction using a balanced chemical equation.	1.3s Represent a chemical reaction using a net ionic equation.
	1.2t Structure a laboratory report in sections.	1.3t Write a scientific report for an experiment carried out.

Subject Focus:	**Substances from the Earth: The Atmosphere**
Learning Outcome 2: **Paper I and Paper II**	**At the end of the programme, I can describe and explain the properties of gases that may be found in air and how to prepare them in the lab.**

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
2.1a Identify the gases that make up the air naturally and those that may be added by humans. *(E.g. nitrogen, oxygen, carbon dioxide, water vapour, noble gases, carbon monoxide, sulfur dioxide, nitrogen oxides and ozone.)*	2.2a State the approximate percentage of nitrogen, oxygen, carbon dioxide and noble gases in dry, unpolluted air.	2.3a Determine experimentally the percentage oxygen in air.
2.1b Describe the properties of nitrogen, oxygen, carbon dioxide and noble gases.	2.2b Relate the properties of nitrogen, oxygen, carbon dioxide and noble gases to their uses.	
2.1c Distinguish between elements, compounds and mixtures. *(E.g. using gases in air.)*	2.2c Explain the difference between elements, compounds and mixtures.	
2.1d Use a Periodic Table to find information about elements. *(Including an online Periodic Table.)*	2.2d Use a Periodic Table to describe and/or model atoms showing differences between atoms. *(E.g. subatomic particles – protons, neutrons and electrons; atomic number, mass number, isotopes and relative atomic mass.)*	2.3d Calculate relative atomic mass from isotopic data.
	2.2e Determine the electron configuration of the first 18 elements in relation to their position in the Periodic Table.	

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
2.1f Distinguish between gases which are monoatomic and others which are diatomic. *(Limited to noble gases, H_2, N_2, O_2.)*		
		2.3g Explain how covalent bonds are formed.
		2.3h Represent covalent bonds using dot and cross diagrams showing outer electron shells only. *(E.g. hydrogen, oxygen, nitrogen, chlorine, methane, water, carbon dioxide, ammonia and hydrogen chloride)*
		2.3i Explain the properties of covalent substances for simple molecules. *(Limited to melting and boiling points, non-conduction of electricity.)*
	2.2j Explain that gases have different diffusion rates depending on their atomic or molecular mass.	2.3j Explain why gases have different densities when measured under the same conditions of temperature and pressure.
	2.2k Prepare gases safely. *(Limited to carbon dioxide by reacting acid with carbonates, oxygen from hydrogen peroxide, and hydrogen by reacting an acid with an appropriate metal.)*	2.3k Prepare gases safely by selecting and assembling appropriate apparatus. *(Limited to carbon dioxide by reacting acid with carbonates, oxygen from hydrogen peroxide, and hydrogen by reacting an acid with an appropriate metal.)*

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
	2.2l Test the properties of gases following step by step instructions. *(Limited to carbon dioxide, hydrogen and oxygen)*	2.3l Test the properties of gases. *(Limited to carbon dioxide, hydrogen and oxygen)*
	2.2m Collect gases over water or in a gas syringe. *(Limited to carbon dioxide, oxygen and hydrogen.)*	2.3m Collect gases by upward or downward delivery. *(Limited to carbon dioxide, oxygen and hydrogen. Reference to drying of gases is not required.)*
		2.3n Evaluate different collection methods for carbon dioxide, oxygen and hydrogen.
2.1o Relate the emission of the pollutants present in air to human activities. *(Limited to carbon dioxide, carbon monoxide and soot.)*	2.2o Describe how the amount of certain gases and particulates in the environment may increase due to combustion reactions. *(E.g. carbon dioxide due to complete combustion, carbon monoxide and soot due to incomplete combustion.)*	2.3o Explain how the amount of certain gases and particulates in the environment may increase due to combustion reactions and natural causes. *(E.g. carbon dioxide, carbon monoxide, sulfur dioxide, nitrogen oxides and soot.)*
	2.2p Identify carbon dioxide, sulfur dioxide and nitrogen dioxide as examples of acidic oxides.	2.3p Explain how some gases react with water to produce acidic solutions. *(E.g. acidic oxides such as carbon dioxide, nitrogen dioxide and sulfur dioxide.)*
	2.2q Identify water and carbon monoxide as examples of neutral oxides.	

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
2.1r Identify gases that contribute towards the greenhouse effect, ozone depletion and acid rain. *(Greenhouse gases: e.g. CO_2, CH_4 and water vapour.* *Ozone depletion: CFCs.* *Acid rain: e.g. SO_2 and NO_2.)*	2.2r Explain environmental effects of pollutants. *(Such as greenhouse gases, CFCs, SO_2, NO_2 and particulates which include smog, soot, dust and volcanic ash.)*	2.3r Interpret data regarding environmental effects of some pollutants. *(Such as global warming, acid rain, effect of CFCs on ozone and particulates which include smog, soot, dust and volcanic ash.)*
2.1s Identify methods for reducing emission of pollutants into the atmosphere. *(E.g. use of renewable sources of energy.)*	2.2s Describe methods for reducing emission of pollutants into the atmosphere. *(E.g. use of renewable sources of energy, banning or reduction of pollutants, better choice of non-renewable fuels.)*	2.3s Discuss methods for reducing emission of pollutants into the atmosphere. *(E.g. use of renewable sources of energy, catalytic converters and better choice of non-renewable fuels.)*

Subject Focus:	**Substances from the Earth: Aquatic environments**
Learning Outcome 3: **Paper I and Paper II**	**At the end of the programme, I can describe the solvent action of water including the impact of water hardness.**

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
3.1a Identify sources of potable water and their management in Malta.	3.2a Present ideas that water is a very precious resource in the world and a potential source of conflict.	3.3a Relate ideas based on research about why water is a very precious resource in the world and a potential source of conflict.
3.1b Identify physical properties of pure water.	3.2b State criteria of purity for water. (*Limited to melting point, boiling point, density, and conductivity.*)	
3.1c Describe how salt is produced from sea water. *(By evaporation and crystallisation.)*	3.2c Explain how salt is produced from rock salt. *(By solution, filtration, evaporation and crystallisation.)*	3.3c Produce crystals of salt from sea water and rock salt.
		3.3d Compare size of crystals obtained from slow and fast crystallisation methods.
3.1e Explain that sea water contains dissolved charged ions that form crystals on evaporation.	3.2e Identify which elements form positive ions and which form negative ions in relation to their position in the Periodic Table.	3.3e Explain how ionic bonds lead to giant ionic structures. *(Structure limited to sodium chloride. Drawing of structure is not expected.)*
		3.3f Explain the properties of ionic compounds. *(Limited to solubility, melting/boiling points and electrical conductivity in different states.)*

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
	3.2g Determine the electron configuration of ions of the first 18 elements (where applicable) in relation to their position in the Periodic Table.	3.3g Draw dot and cross diagrams to represent ionic binary compounds showing all electron shells. *(Limited to the first 18 elements.)*
	3.2h Work out the formulae of ionic compounds from the charge on the ions. *(Metal ions limited to groups 1 and 2, aluminium, zinc, lead(II), silver, copper(II) and iron(II and III).* *Non-metal ions limited to groups 6 and 7. Polyatomic ions limited to carbonate, hydrogencarbonate, nitrate, sulfate, hydroxide and ammonium.)*	3.3h Work out the formulae of ionic compounds from the charge on the ions. *(Limited to copper(I), nitrite, sulfite, and phosphate.)*
3.1i Distinguish between solute, solvent, and solution.	3.2i Distinguish between dilute, concentrated, and saturated solutions.	
3.1j Distinguish between soluble and insoluble substances.	3.2j Predict solubility of salts in water using the solubility rules.	3.3j Interpret solubility curves of salts/gases in water.
3.1k Distinguish between hard and soft water using simple chemical tests. *(Limited to lathering of soap.)*	3.2k Explain the difference between hard and soft water.	3.3k Investigate the differences between hard and soft water. *(E.g. using soap solution and boiling.)*

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
3.1l Describe the risks and benefits of hard water including issues of health and economics. *(E.g. the need of calcium by the body, clogging of hot water pipes and limescale on electric heating elements.)*	3.2l Describe where hardness, both temporary and permanent, and limescale come from. *(With reference to groundwater.)*	3.3l Explain, using chemical reactions, where temporary hardness and limescale come from. *(With reference to groundwater.)*
3.1m State why water softening is important in hard water areas. *(E.g. to prevent: clogging of hot water pipes, limescale on electric heating elements, etc.)*	3.2m Describe different methods for removing water hardness. *(Using ion exchange resin, boiling water, distillation and addition of washing soda.)*	3.3m Explain, using chemical equations where appropriate, the effectiveness of different methods for removing water hardness. *(Using ion exchange resin, boiling water, distillation and addition of washing soda.)*
3.1n Name desalination techniques that can be used to create demineralised water from seawater. *(Limited to distillation and reverse osmosis.)*	3.2n Describe how simple distillation and reverse osmosis are used to produce demineralised water from impure water.	3.3n Evaluate desalination techniques that can be used to produce demineralised water from seawater. *(Limited to distillation and reverse osmosis.)*

Subject Focus:	**Substances from the Earth: Aquatic environments**
Learning Outcome 4: **Paper I and Paper II**	**At the end of the programme, I can describe the chemical properties of acids, bases and salts.**

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
4.1a Use indicators and the pH scale to distinguish between acidic, alkaline and neutral solutions. *(E.g. Using litmus, universal indicator, phenolphthalein and methyl orange indicators.)*	4.2a Classify a substance as acid, base or alkali. *(E.g. Using litmus, universal indicator, phenolphthalein and methyl orange indicators, and pH scale.)*	4.3a Explain the difference between strong and weak acids/alkalis.
	4.2b Identify basic oxides by their reaction with acids and the metal's position in the Periodic Table.	4.3b Identify amphoteric oxides by their reaction with acids and alkalis as well as the metal's position in the Periodic Table. *(Chemical equations for their reactions with alkalis are not required.)*
	4.2c Represent reactions of non-oxidising acids with bases/alkalis, carbonates/ hydrogencarbonates, and fairly reactive metals, using chemical equations.	4.3c Represent reactions of non-oxidising acids with bases/alkalis, carbonates/ hydrogencarbonates, fairly reactive metals and sulfites, using net ionic equations.
	4.2d Represent the reaction of an alkali with an ammonium salt using chemical equations.	4.3d Represent the reaction of an alkali with an ammonium salt using net ionic equations.
	4.2e Represent the precipitation of an insoluble salt using chemical equations.	4.3e Represent the precipitation of an insoluble salt using net ionic equations.
	4.2f Apply acid-base concepts to the real world. *(E.g. In terms of solutions to environmental issues such as acid rain, neutralisation of acid soils and excess stomach acidity.)*	4.3f Investigate acid-base concepts in real life applications.

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
	4.2g Prepare a pure dry sample of an insoluble salt from named starting substances.	4.3g Prepare a pure dry sample of a soluble/insoluble salt from different starting substances. *(Limited to metal with acid, carbonate with acid, base with acid, alkali with acid, and precipitation reactions.)*

Subject Focus:	**Substances from the Earth: Aquatic environments**
Learning Outcome 5: **Paper I and Paper II**	**At the end of the programme, I can describe the conduction of electricity through solutions and molten salts.**

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
5.1a Give examples of conductors and non-conductors (insulators), electrolytes and non-electrolytes.	5.2a Define conductors and non-conductors (insulators), electrolytes and non-electrolytes of electricity.	
5.1b State whether solid/molten ionic and covalent substances conduct electricity when connected to a DC circuit.	5.2b Perform an experiment to show what happens when an electric current passes through solids, molten ionic salts, graphite, and covalent substances.	5.3b Explain why conductive solids, molten ionic salts and graphite conduct electricity but solid ionic and covalent substances do not.
	5.2c Describe what happens when electricity is applied to molten ionic salts.	5.3c Explain what happens when electricity is applied to molten ionic salts. *(E.g. lead(II) bromide).*
		5.3d Explain what happens when electricity is applied to solutions of salts. *(E.g. Electrolysis of dilute sulfuric acid, electrolysis of copper(II) sulfate solution using inert and active electrodes and electrolysis of concentrated sodium chloride solution.)*
		5.3e Describe electrolysis using half equations.
		5.3f Interpret electrolytic half equations in terms of oxidation and reduction.

Subject Focus:	**Substances from the Earth: Aquatic environments**
Learning Outcome 6: **Paper I and Paper II**	**At the end of the programme, I can describe the major groups of the Periodic Table including their physical and chemical properties.**

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
6.1a Name the groups of the Periodic Table. *(Limited to alkali metals, alkaline earth metals, transition metals, halogens and noble gases.)*	6.2a Distinguish between metals and non-metals in terms of their physical properties.	
6.1b List common uses of halogens. *(E.g. Bleaching and antibacterial action of chlorine in water and antiseptic properties of iodine.)*	6.2b Describe the trends in physical and chemical properties of group 7 elements. *(Limited to state and colours of halogens at room temperature and reactions of halogens with hydrogen.)*	6.3b Investigate displacement reactions of halogen/halide mixtures to construct a reactivity series of non-metals. *(Limited to chlorine, bromine and iodine. Represent reactions using balanced chemical equations and net ionic equations.)*
		6.3c Interpret displacement reactions of halogen/halide mixtures in terms of oxidation and reduction.
6.1d List common uses of group 1 metal compounds. *(Limited to sodium chloride, potassium nitrate, and sodium hydrogencarbonate.)*	6.2d Describe trends in physical and chemical properties of group 1 metals. *(Limited to;* *Physical properties: melting/boiling points and hardness.* *Chemical properties: reactions of metals with water to form alkalis and with oxygen to form simple oxides.)*	6.3d Compare trends in reactivity found in groups 1 and 7 using atomic structures to explain the variation of reactivity within a group.

Subject Focus:	**Substances from the Earth: Aquatic environments**
Learning Outcome 7: **Paper I and Paper II**	**At the end of the programme, I can describe how substances dissolved in water can be identified and how their concentration can be measured.**

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
7.1a Use paper chromatography to identify the components of a coloured mixture. *(Solvent limited to water.)*	7.2a Perform paper chromatography. *(Solvents limited to water and ethanol.)*	7.3a Interpret chromatograms.
7.1b Perform chemical tests to identify gases. *(Limited to water vapour, oxygen, hydrogen, carbon dioxide, chlorine and ammonia.)*	7.2b Describe the test of gases and the expected observations. *(Limited to water vapour, oxygen, hydrogen, carbon dioxide, chlorine and ammonia.)*	7.3b Identify gases from descriptions of chemical tests. *(Limited to water vapour, oxygen, hydrogen, carbon dioxide, chlorine and ammonia.)*
7.1c Perform flame tests. *(Limited to identification of Li^+, Na^+, K^+, and Ca^{2+} ions)*	7.2c Identify cations present in salts/solutions using flame tests. *(Limited to identification of Li^+, Na^+, K^+, and Ca^{2+} ions)*	
	7.2d Identify cations present in solutions. *(Limited to identification of Mg^{2+}, Ca^{2+}, NH_4^+, Cu^{2+}, Fe^{2+}, and Fe^{3+} with sodium hydroxide solution.)*	7.3d Identify cations present in solutions. *(Limited to identification of* • *Al^{3+}, Pb^{2+} with sodium hydroxide solution;* • *Pb^{2+} with KI solution.)*
	7.2e Identify anions present in solutions. *(Limited to identification of:* • *Cl^-, Br^-, I^- with acidified $AgNO_3$ solution;* • *CO_3^{2-} with dilute acid and identifying CO_2)*	7.3e Identify anions present in solutions. *(Limited to identification of:* • *SO_3^{2-} and SO_4^{2-} with acidified $BaCl_2$ solution;* • *NO_3^- by reduction with aluminium and alkali.)*

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
	7.2f Represent reactions for cations and anions using chemical equations.	7.3f Represent reactions for cations and anions using net ionic equations. *(Except the test for nitrate ions.)*
		7.3g Perform calculations involving moles and molar concentrations. *(Do not use the formula:* $\frac{MaVa}{mole\ ratio\ (a)}=\frac{MbVb}{mole\ ratio\ (b)}$ *)*
	7.2h Prepare a standard solution using step by step instructions. *(Limited to sodium carbonate.)*	7.3h Prepare a standard solution. *(Limited to sodium carbonate.)*
	7.2i Conduct an acid/base titration using step by step instructions. *(Limited to hydrochloric acid, sulfuric acid, with sodium hydroxide, potassium hydroxide and sodium carbonate.)*	7.3i Conduct an acid/base titration to determine the concentration of a given solution. *(E.g. hydrochloric acid, sulfuric acid, nitric acid, ethanoic acid with sodium hydroxide, potassium hydroxide and sodium carbonate.)*
		7.3j Calculate the concentration/volume of a solution taking part in a reaction.

Subject Focus:	**Substances from the Earth: The Land**
Learning Outcome 8: **Paper I and Paper II**	**At the end of the programme, I can describe how different rocks contain important substances, their extraction, chemical nature, responsible use and environmental impact.**

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
8.1a State uses of limestone.	8.2a Describe the use of limestone in industry. *(Including the manufacture of quicklime and slaked lime. As an aggregate in construction.)*	
	8.2b Investigate simple physical properties of substances used in buildings and relate them to their use. *(E.g. density, heat and electrical conductivity of limestone, concrete, wood, steel and aluminium.)*	8.3b Investigate the chemical properties of substances used in buildings and relate them to their use. *(Limited to action of acids and water on limestone, concrete, wood, steel and aluminium)*
	8.2c Describe the economic and environmental impact of open quarrying of stone.	8.3c Debate the economic and environmental impact of open quarrying of stone.
8.1d Identify metals that are found free in nature or that are extracted from certain minerals found in rocks. *(Limited to iron from haematite and aluminium from bauxite as well as the very few metals found as elements in the ground e.g. gold and platinum.)*		8.3d Describe the essential chemical reactions and conditions in the industrial extraction of metals. *(Limited to aluminium from bauxite and iron in the blast furnace. Drawing of diagrams and technical details are not required.)*
8.1e List uses of iron and aluminium in everyday life.	8.2e State advantages and disadvantages of using iron and/or aluminium.	

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
	8.2f Describe typical properties of transition elements/compounds.	
		8.3g Interpret the extraction of metals as examples of redox reactions. *(In terms of loss or gain of oxygen/hydrogen, loss or gain of electrons and change in oxidation numbers. Oxidation numbers limited to binary compounds. Oxidizing and reducing agents.)*
8.1h Describe methods that prevent rusting.	8.2h Investigate the conditions needed for iron to rust.	8.3h Investigate the effectiveness of various rust prevention techniques in different situations.
	8.2i Relate metals' position in the reactivity series to their ease of corrosion and extraction. *(Metals limited to potassium, sodium, calcium, magnesium, aluminium, zinc, iron, lead, copper, silver, gold and platinum.)*	
	8.2j Determine metals' position in the reactivity series from their reactions with water/steam and hydrochloric acid. *(Metals limited to calcium, magnesium, aluminium, zinc, iron, lead, and copper. Represent reactions using balanced chemical equations.)*	8.3j Determine the position of an unknown metal (e.g. tin) with respect to other metals in the reactivity series from their reactions with water/steam and hydrochloric acid. *(Other metals limited to, magnesium, aluminium, zinc, iron, lead, and copper. Represent reactions using balanced chemical equations.)*

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
		8.3k Determine metals' position in the reactivity series from displacement reactions. *(Metals limited to calcium, magnesium, aluminium, zinc, iron, lead, and copper.* *Represent reactions using balanced chemical equations and net ionic equations.)*
		8.3l Interpret displacement reactions of metal/metal ion mixtures in terms of oxidation and reduction.
		8.3m Use the reactivity series of metals to predict the best method of metal extraction by reduction with carbon or electrolysis.
8.1n Identify diamond, graphite, graphene and carbon nanotubes from given molecular diagrams.	8.2n Explain that diamond, graphite, and carbon nanotubes are allotropes.	8.3n Relate the structure of diamond, graphite, graphene (giant molecular structures) and carbon nanotubes to their properties and uses.
	8.2o Discuss the environmental issues surrounding the mining of metals.	8.3o Evaluate the economic and environmental impact of the extraction of metals. *(Limited to aluminium and iron.)*
	8.2p Describe the best course of action when considering the finite nature of many metals. *(Reduce, reuse, recycle)*	8.3p Evaluate the best course of action when considering the finite nature of many metals. *(Reduce, reuse, recycle)*

Subject Focus:	**Making New Substances: How fast? How far? How much?**
Learning Outcome 9: **Paper I and Paper II**	**At the end of the programme, I can describe how and why physical and chemical changes happen.**

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
	9.2a Explain that some substances are useful in their native state and that other substances need to be changed by chemical reactions to be more useful.	
9.1b Compare chemical reactions with physical changes.	9.2b Name the changes that take place when chemical reactions occur.	
9.1c State the physical properties of the three states of matter. *Limited to: compressibility, ease of flow, and shape.*	9.2c Describe using diagrams, the arrangement, movement of particles, and forces of attraction between particles in the three states of matter. *(Forces of attraction limited to strong and weak forces.)*	9.3c Interpret the physical properties (*E.g. compressibility, ease of flow, shape*) of the three states of matter in terms of the kinetic theory.
9.1d Name the six changes of state. *(Melting, freezing, evaporation/boiling, condensation, sublimation and deposition.)*	9.2d Interpret the shape of heating/cooling curves. *(Without reference to the kinetic theory.)*	9.3d Explain energy changes accompanying changes of state using the kinetic theory of matter.
	9.2e Explain that when chemical reactions happen mass is conserved.	

Subject Focus:	Making New Substances: How fast? How far? How much?
Learning Outcome 10: Paper I and Paper II	At the end of the programme, I can perform quantitative calculations.

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
	10.2a Calculate relative formula mass or relative molecular mass of a compound from relative atomic masses.	
	10.2b Work out percentage by mass calculations. *(E.g. Percentage by mass of an element in a compound and the value of xH_2O in a hydrated compound.)*	
		10.3c Perform an experiment to determine the empirical formula of a substance. *Limited to binary compounds and finding the value of xH_2O in a hydrated compound.*
		10.3d Calculate the formula of reacting masses from experiment and relate empirical and molecular formulae of simple substances.
		10.3e Calculate the amount of products formed from given amount of one reactant in a reaction and vice versa. *(In moles, number of particles, masses, and volumes of gases at STP. Concept of limiting reagent will not be assessed. Use of Avogadro's constant and Avogadro's law.)*

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
		10.3f Calculate the theoretical and percentage yield of product for a given reaction.

Subject Focus:	Making New Substances: How fast? How far? How much?
Learning Outcome 11: Paper I and Paper II	At the end of the programme, I can investigate why and how chemical reactions proceed at different rates.

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
	11.2a State that rate of reaction is the increase in amount of product or decrease in amount of reactant with time.	
	11.2b Perform experiments to measure the rate of a reaction. *(E.g. Between an acid and different metals; between limestone and acid; precipitation reactions such as the reaction of thiosulfate with an acid. No chemical equation required for the latter.)*	11.3b Investigate methods to follow the rate of a reaction. *(E.g. Between an acid and different metals; between limestone and acid; precipitation reactions such as the reaction of thiosulfate with an acid.)*
11.1c Identify conditions that may affect the rate of a given reaction. *(Limited to state of subdivision of reactants, and temperature.)*	11.2c Identify conditions that may affect the rate of a given reaction. *(Limited to concentration, catalyst, light, and pressure in gases.)*	
	11.2d Investigate how the rate of reaction may be affected by surface area of reactants/catalysts.	11.3d Investigate how the rate of reaction may be affected by various factors. *(E.g. Surface area of reactants, concentration of reactants, temperature, light and the use of a catalyst.)*
	11.2e Plot a single series of data using experimental results.	11.3e Plot multiple series of data using experimental results.

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
	11.2f Interpret results/graph containing single series of data related to rates of reactions.	11.3f Interpret results/graphs containing multiples series of data related to rates of reaction.
		11.3g Use the kinetic and collision theories to explain how factors such as state of subdivision, concentration, temperature and pressure affect the rate of a reaction.

Subject Focus:	**Making New Substances: How fast? How far? How much?**
Learning Outcome 12: **Paper I and Paper II**	**At the end of the programme, I can describe dynamic equilibria and the conditions needed to shift a reaction in equilibrium.**

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
	12.2a Classify reactions as acid-base, combustion, thermal decomposition and precipitation.	12.3a Classify reactions as displacement and/or redox.
12.1b Describe changes of state as an example of a reversible change.	12.2b Describe reversible changes such as hydration of copper(II) sulfate and thermal dissociation of ammonium chloride.	
12.1c Use the appropriate symbol to represent a reversible change.		12.3c Explain how some chemical reactions in closed conditions do not go to completion but reach dynamic equilibrium.
		12.3d Explain how changing temperature or pressure affects the position of equilibrium in a reversible reaction.
		12.3e Explain how in the Haber process the best yield of ammonia is obtained by applying compromised conditions with respect to temperature and pressure and the use of a catalyst. (*Values for pressure (200 atm.) and temperature (450 °C) will be given.*)
	12.2f Identify needs for chemical products such as ammonia and substances produced from it. *(Limited to fertilizers.)*	12.3f Discuss the environmental issues related to the use and misuse of chemical products such as ammonia and substances produced from it. *(Limited to fertilizers and explosives.)*

Subject Focus:	**Carbon compounds. Meeting our energy needs.**
Learning Outcome 13: **Paper I and Paper II**	**At the end of the programme, I can describe the chemical nature of fossil fuels and the substances obtained from them.**

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
13.1a Identify coal, crude oil, and natural gas as fossil fuels.	13.2a Describe the importance of fossil fuels as a source of energy for transport and production of electricity as well as the use of crude oil as feedstock for chemical production.	13.3a Evaluate the importance of fossil fuels as a source of energy for transport and production of electricity as well as the use of crude oil as feedstock for chemical production.
		13.3b Present an argument demonstrating that fossil fuels are crucial raw materials and that their control in the world is a possible source of conflict.
	13.2c Describe the risks and benefits of the transport of fossil fuels to and storage on an island and the use of crude oil as a finite fuel.	13.3c Evaluate the risks and benefits of the transport of fossil fuels to and storage on an island and the use of crude oil as a finite fuel.
13.1d Define hydrocarbons.		
13.1e State that crude oil consists of a mixture of hydrocarbons.	13.2e Describe the uses of fractions obtained from crude oil. *(Students should be able to list the following fractions in this order: refinery gases, gasoline/petrol, naphtha, kerosene, diesel oil, fuel oil and residue. Details of carbon chain length and fraction temperatures are not required.)*	13.3e Describe how crude oil is separated by fractional distillation.

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
13.1f Distinguish between miscible and immiscible liquids.	13.2f Separate immiscible liquids using a separating funnel.	
13.1g Describe the problems of high sulfur content in fossil fuels.	13.2g Discuss the importance of desulfurisation of fossil fuels.	
	13.2h Describe how the use of fossil fuels contributes to pollution. *(By liberating particulates, carbon monoxide and carbon dioxide during combustion, and oil spills, etc.)*	13.3h Explain how the use of fossil fuels contributes to pollution. *(By liberating particulates, carbon monoxide, carbon dioxide, nitrogen oxides and sulfur dioxide during combustion, and oil spills, etc.)*
		13.3i Interpret data on the use of fossil fuels and the gases generated.

Subject Focus:	Carbon compounds. Meeting our energy needs.
Learning Outcome 14: Paper I and Paper II	At the end of the programme, I can distinguish different homologous series and their physical and chemical properties.

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
	14.2a Explain why carbon is a special element that can form many different compounds that are natural and/or synthetic.	
	14.2b Define homologous series, alkanes, alkenes, alkynes, alcohols, carboxylic acids.	14.3b Use the terms homologous series, empirical formula, molecular formula, structural formula, displayed formula, general formula and functional group. *(For homologous series: alkanes, alkenes, alkynes, alcohols, carboxylic acids.)*
	14.2c Identify the homologous series of given simple organic molecules from their names and/or displayed formulae. *(Limited to the first 5 straight chain members of alkanes, alkenes, alkynes, alcohols, and carboxylic acids.)*	14.3c Draw structures of simple organic molecules from their names and vice-versa. *(Limited to the first 5 straight chain members of alkanes, alkenes, alkynes, alcohols, and carboxylic acids where the functional group (if applicable) is on the first carbon atom.)*
	14.2d Define isomerism.	
	14.2e Identify isomers from displayed formulae of alkanes. (*Limited to alkanes with 4 and 5 carbon atoms. No naming of branched hydrocarbons is required.*)	14.3e Draw isomers of alkanes from their molecular formulae. (*Limited to alkanes with 4 and 5 carbon atoms. No naming of branched hydrocarbons is required.*)

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
	14.2f Describe how long chain alkanes can be converted to smaller, more useful ones. *(Limited to thermal cracking only. Specific cracking temperatures are not required.)*	14.3f Identify possible alkanes and alkenes that can be obtained from thermal cracking of long chain alkanes.
	14.2g Name common alkanes that are used as fuels. *(E.g. methane, propane, butane, etc.)*	
		14.3h Compare the strength of intramolecular bonding (covalent) and intermolecular forces (weak forces of attraction) in alkanes and use these to explain the trends in properties of alkanes such as boiling points and melting points.
	14.2i Relate the production of carbon dioxide / carbon monoxide with complete / incomplete combustion of hydrocarbons.	14.3i Describe the main chemical reactions of alkanes. *(Limited to cracking, combustion and halogenation (monosubstitution)).*
	14.2j Define saturated and unsaturated hydrocarbons.	14.3j Link the saturated nature of alkanes to their lack of reactivity.
	14.2k Describe a test to distinguish between saturated and unsaturated hydrocarbons.	14.3k Describe addition reactions of ethene. *(E.g. bromination, hydration and hydrogenation. Details of reaction conditions are not required.)*
		14.3l Link the reactivity of alkenes and alkynes to unsaturation.

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
	14.2m Describe how certain organic substances, other than fuels, can contribute to environmental problems. *(Limited to non-biodegradable plastics; the ongoing effect of CFCs on ozone depletion and their replacement.)*	
14.1n Describe some important uses of ethanol. *(E.g. Solvent, fuel and alcoholic drinks.)*	14.2n Describe how ethanol can be produced through fermentation and hydration of ethene.	14.3n Evaluate the advantages and disadvantages of fermentation and hydration of ethene.
		14.3o Describe how ethanol can be oxidised to ethanoic acid using acidified potassium dichromate and by aerial oxidation. *(Chemical equations are not required.)*
14.1p List uses of polyethene, PTFE and PVC.	14.2p Discuss how applying a strategy of "reduce, reuse, recycle" can alleviate environmental problems caused by organic substances.	14.3p Model the production of polymers from alkenes and other unsaturated monomers by addition polymerisation. *(Limited to polyethene, PTFE and PVC.)*
		14.3q Construct the reaction between a carboxylic acid and an alcohol to form an ester. *(Limited to ethyl ethanoate.)*
		14.3r Identify the ester functional group in a displayed formula.

Subject Focus:	**Carbon compounds from the Earth. Meeting our energy needs.**
Learning Outcome 15: **Paper I and Paper II**	**At the end of the programme, I can describe the energy changes accompanying chemical changes.**

Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
15.1a Identify chemical reactions that are exothermic or endothermic.	15.2a Associate an exothermic reaction with a negative value of ΔH and an endothermic reaction with a positive value of ΔH.	
15.1b Identify exothermic and endothermic reactions from given energy level diagrams.	15.2b Draw energy level diagrams to represent exothermic and endothermic reactions including activation energy.	15.3b Explain energy level diagrams in terms of bond energies. (*Calculations are not required.*)
	15.2c Carry out experiments to compare energy released by different food samples.	15.3c Determine the heat of combustion of different food samples (in kJ g^{-1}).
	15.2d Define heat of combustion.	15.3d Calculate the heat of combustion of a fuel (in kJ mol^{-1}).
	15.2e Define heat of neutralisation.	15.3e Calculate the heat of neutralisation (in kJ mol^{-1}).
		15.3f Carry out experiments to determine the change in heat of a reaction (in kJ mol^{-1}). *(Limited to combustion of safe liquid fuels and neutralisation of an acid with an alkali.)*

Scheme of Assessment

General Notes

- All learning outcomes form part of a subject focus, except for Learning Outcome 1 which is suggested to be implemented when carrying out school-based assessment activities.
- Some assessment criteria include further information in brackets and italics. Note that "limited to" implies that only those examples listed will be examined while "e.g." means that apart from the examples listed, other related instances may be examined.
- Throughout this programme, chemical reactions should be represented by balanced chemical equations. States of substances including solids, liquids, gases, and aqueous solutions, should be represented by (s), (l), (g), and (aq) respectively.
- Net ionic equations are only expected for assessment criteria where they are specified.
- Questions will be set in English and must be answered in English.
- Electronic calculators may be used in any part of the examination.
- The Periodic Table (Appendix A) complete with atomic numbers, relative atomic masses and full names, will be provided in all controlled papers.
- The Reactivity Series (Appendix B) will also be provided in all controlled papers.
- The order of discharge at electrodes (Appendix C), a list of polyatomic ions and their charges (Appendix D) as well as solubility rules (Appendix E) will be given in separate tables in controlled papers for School Candidates Level 1-2 and Private Candidates Level 1-2-3.
- The following 'Useful Data' will be provided in all controlled papers:
    - Avogadro constant = 6.02×10^{23}
    - Specific heat capacity of water = 4.2 J g^{-1} $^{o}C^{-1}$
    - The molar volume for gases = 22.4 dm^3 at STP
    - STP conditions = 0 ^{o}C and 10^5 Pa/1 atm.
- The minimum mathematical requirements are:
    - The ability to perform simple arithmetic processes such as addition, subtraction, multiplication and division of quantities expressed in decimal form, as fractions, or in index notation;
    - The ability to calculate volumes; simple percentage calculations; calculations involving ratios and proportion;
    - The ability to use and interpret simple graphs, carry out extrapolations and interpolations and measure gradients.

School Candidates

The assessment consists of Paper I and Paper II. Paper I consists of unmoderated school-based assessment (SBA) that is to be set and assessed by the school. Paper II consists of a controlled assessment that will take place at the end of the three-year programme.

School-based assessment (SBA): is any type of assessment of a candidate made by the school relevant to the respective SEC syllabus contributing to the final level awarded in the subject.

Controlled assessment: is comprised of a two-hour written exam set at the end of the programme and differentiated between two tiers:

a. Levels 1 and 2;
b. Levels 2 and 3.

Candidates are to satisfy the examiner in Paper I and Paper II to obtain a level higher than 1.

Paper I - School Based Assessment (30% of the total mark)

The school-based assessment shall be marked out of 100 each year (9, 10 and 11). The assessment for each year will contribute to 10% of the overall mark and will be reported to MATSEC by the school in Year 11. Therefore, each year will equally contribute to the final mark of the school-based assessment. The school-based assessment shall reflect the MATSEC syllabus covered in Year 9, Year 10 and Year 11.

School-based assessment can be pegged at either of two categories:

- SBA at categories 1-2 must identify assessment criteria from these two levels. It is suggested that ACs are weighted at a ratio of 40% at Level 1 and 60% at Level 2.
- SBA at categories 1-2-3 must identify assessment criteria from each of Levels 1, 2, and 3. It is suggested that ACs are weighted at a ratio of 30% at each of Levels 1 and 2, and 40% at Level 3.

The mark for SBA at level categories 1-2 presented for a qualification at level categories 2-3 will be calculated to 60% of the original mark. The mark stands in all other cases.

Paper II - Controlled Assessment (70% of the total mark)

Written Examination (100 marks; 2 hours)

Learning outcomes with assessment criteria related to the psychomotor domain may be assessed by asking questions in pen-and-paper format.

Controlled Assessment will:

- cover most learning outcomes including all learning outcomes which are not indicated to be covered through SBA;
- have no sections and consist of 10 – 15 items of graded difficulty which are compulsory.

Private Candidates

Private candidates will not be expected to carry out any school-based assessment as school candidates. Instead, private candidates need to sit for another Controlled paper as an alternative to the school-based assessment. Private candidates will be assessed through the means of **TWO** Controlled Papers, one of which is common with school candidates.

Paper I – Controlled Assessment - Private Candidates Only (30% of the total mark)

Written Examination (100 marks; 2 hours)

Paper I for private candidates shall be a controlled assessment assessing levels 1, 2 and 3 as described in the respective syllabus and set and marked by MATSEC. It shall mainly focus on the learning outcomes marked in the respective syllabi as suggested for school-based assessment.

Learning outcomes with assessment criteria related to the psychomotor domain may be assessed by asking questions in pen-and-paper format.

Controlled Assessment will:

- have no sections and consist of 10 – 15 items of graded difficulty which are compulsory.

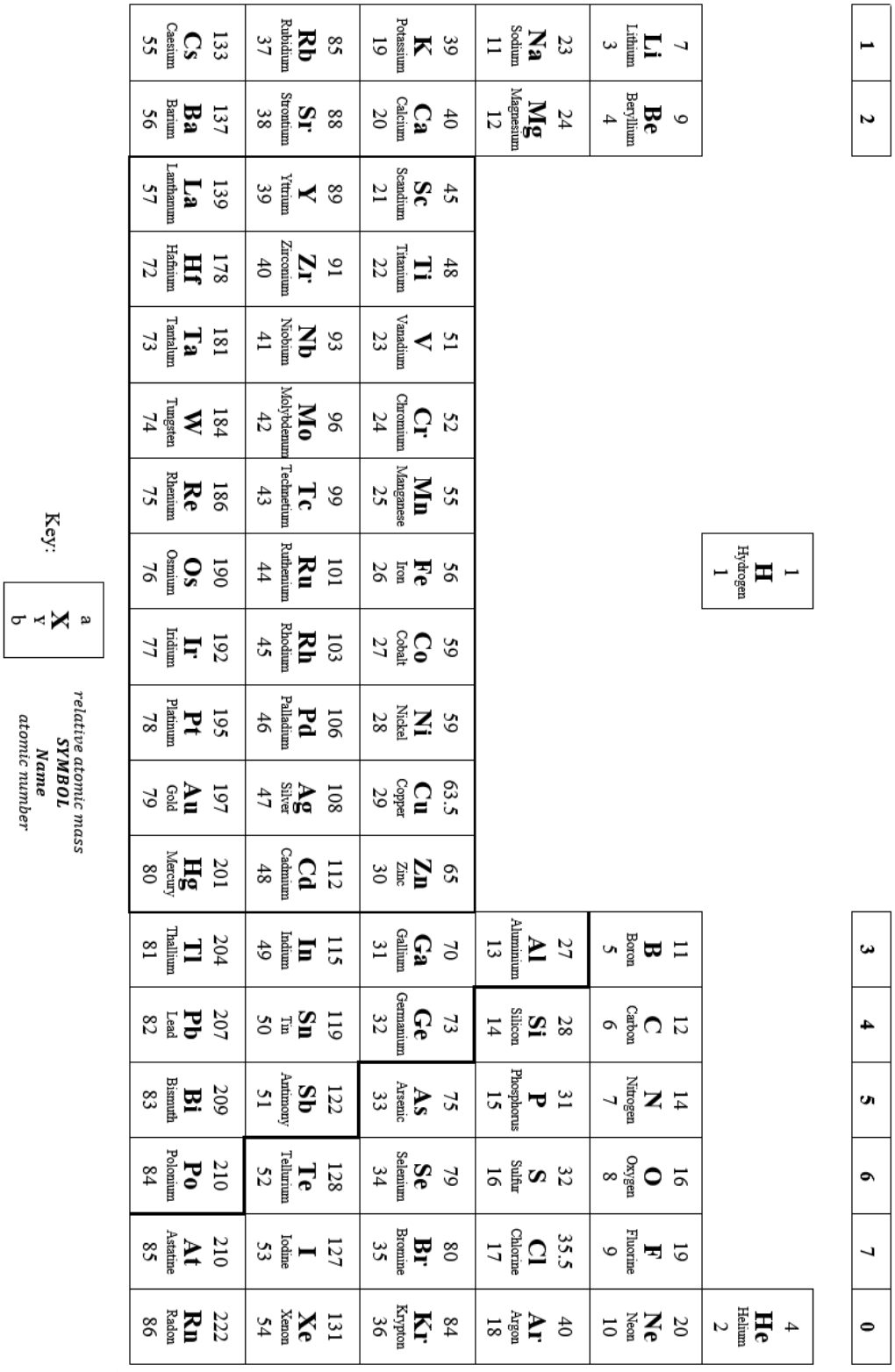
Paper II - Controlled Assessment (70% of the total mark)

Paper II is common with school candidates.

Appendices

Appendix A Periodic Table

(All Controlled papers)



Appendix B Reactivity series

(All Controlled papers)

Reactivity series
Potassium
Sodium
Calcium
Magnesium
Aluminium
Carbon
Zinc
Iron
Lead
Hydrogen
Copper
Silver
Gold
Platinum

Decreasing Reactivity

Appendix C Order of discharge at electrodes

(Controlled papers for School Candidates Level 1-2 and Private Candidates Level 1-2-3)

Order of discharge at cathode
Na^+
Mg^{2+}
Al^{3+}
Zn^{2+}
Fe^{2+}
Pb^{2+}
H^+
Cu^{2+}
Ag^+

Increasing Ease of Discharge

Order of discharge at anode
1. For aqueous very dilute solutions OH^- is discharged.
2. For aqueous concentrated solutions containing halide ions (Cl^-, Br^- and I^-), these are discharged in preference to OH^-.
3. SO_4^{2-}, NO_3^- and CO_3^{2-} are never discharged from aqueous solutions.

Appendix D List of polyatomic ions and their charges

(Controlled papers for School Candidates Level 1-2 and Private Candidates Level 1-2-3)

List of polyatomic ions and their charges.	
Name	**Formula**
Ammonium	NH_4^+
Nitrate	NO_3^-
Sulfate	SO_4^{2-}
Carbonate	CO_3^{2-}
Hydrogencarbonate	HCO_3^-
Hydroxide	OH^-

Appendix E Solubility rules

(Controlled papers for School Candidates Level 1-2 and Private Candidates Level 1-2-3)

Solubility rules	
Soluble	**Insoluble**
• All nitrates. • All hydrogencarbonates. • All group 1 metal salts. • All ammonium salts. • Halides except silver and lead halides. • Sulfates except barium, calcium, and lead sulfates.	• Carbonates except group 1 metal and ammonium carbonate. • Metal oxides except group 1 and 2 metal oxides that react with water. • Hydroxides except group 1 metal and ammonium hydroxides.

Appendix F Qualitative test colours

Metal ion	Flame test colour
lithium	red
sodium	golden yellow
potassium	lilac
calcium	orange-red

Qualitative test	Precipitate colour
Test for halide ions with acidified silver nitrate solution.	Chloride → White Bromide → Cream Iodide → Pale yellow
Test for metal cations with dilute sodium hydroxide solution.	Mg^{2+} → White Ca^{2+} → White Cu^{2+} → Blue Fe^{2+} → Green Fe^{3+} → Brown Al^{3+} → White (soluble in excess) Pb^{2+} → White (soluble in excess)
Confirmatory test for lead(II) ions with potassium iodide solution.	Canary yellow

Appendix G Fractions of crude oil and their uses

Fraction	Use
Refinery Gases	Bottled gas
Gasoline (Petrol)	Fuel for cars
Naphtha	Making chemicals
Kerosene	Aircraft fuel
Diesel Oil	Fuel for cars, lorries and buses
Fuel Oil	Fuel for ships and power stations
Residue	Bitumen for roads and roofs