Chemistry

State School Syllabus

For students sitting the SEC06 (2029) examination onwards

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GOVERNMENT OF MALTA
MINISTRY FOR EDUCATION, SPORT, YOUTH
RESEARCH AND INNOVATION
DIRECTORATE FOR LEARNING AND ASSESSMENT PROGRAMMES

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Introduction

This chemistry state school syllabus:

- is based on the SEC06 Chemistry syllabus,
- delineates what state school chemistry teachers must teach at Years 9, 10, and 11,
- provides broad learning outcomes which group related assessment criteria,
- sets a scheme of assessment,
- provides a series of information tables (refer to Appendices A – G) reproduced from the SEC06 Chemistry syllabus,
- indicates where cross curricular themes and related learning outcomes can be applied by means of icons (refer to Appendix H).

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 and Broad Learning Outcomes

At the end of the programme, I can:

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

- BLO I I can describe the scientific process.
- BLO II I can apply health and safety measures during laboratory practice.
- BLO III I can perform experiments.
- BLO IV I can write experiment reports.
- BLO V I can represent chemical reactions using balanced equations.

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

- BLO I I can describe the components of air, their properties and uses.
- BLO II I can describe matter at the atomic and sub-atomic levels.
- BLO III I can describe how covalent bonds are formed.
- BLO IV I can prepare, collect, and identify CO_2, O_2, and H_2.
- BLO V I can describe atmospheric pollution, its adverse effects and how to reduce them.

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

- BLO I I can describe the importance and properties of water.
- BLO II I can describe how to obtain table salt from various sources.
- BLO III I can describe how ionic bonds are formed.

BLO IV I can write chemical formulae.

BLO V I can describe different types of mixtures.

BLO VI I can describe the chemistry behind hard and soft water.

BLO VII I can describe how fresh water can be obtained by distillation and reverse osmosis.

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

BLO I I can describe acids, bases and alkalis, their relation to pH, and the use of indicators.

BLO II I can describe reactions of acids involving acids and bases including their application to real life situations.

BLO III I can prepare salts using several techniques depending on their properties.

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

BLO I I can classify ionic and covalent materials as conductors, non-conductors, electrolytes, or non-electrolytes.

BLO II I can explain what happens when molten salts and solutions of salts are electrolysed.

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

BLO I I can name some groups of the Periodic Table and distinguish between metals and non-metals.

BLO II I can describe and compare the properties of group 1 and group 7 elements.

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

BLO I I can perform chromatography and interpret chromatograms.

BLO II I can perform tests to identify gases, cations, and anions.

BLO III I can conduct a titration and perform calculations involving molar concentrations.

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

BLO I I can describe the properties of limestone in relation to other building materials used in the construction industry.

BLO II I can describe the properties of metals, their extraction and how extraction processes impact the environment.

BLO III I can use the chemical properties of metals to compare their reactivity.

BLO IV I can describe the differences and similarities between some allotropes of carbon.

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

BLO I I can distinguish between physical and chemical changes.

BLO II I can describe and explain changes of state.

LO 10 Perform quantitative calculations.

BLO I I can perform calculations related to relative mass and percentage by mass.

BLO II I can perform calculations to determine the amount of reacting substances.

LO 11 Investigate why and how chemical reactions proceed at different rates.

BLO I I can perform experiments to study the rate of a reaction.

BLO II I can investigate the factors that affect rates of reaction.

LO 12 Describe dynamic equilibria and the conditions needed to shift a reaction in equilibrium.

BLO I I can classify different kinds of chemical reactions.

BLO II I can explain dynamic equilibria and the factors which affect it in chemical reactions.

BLO III I can identify needs for chemical products and related environmental issues.

LO 13 Describe the chemical nature of fossil fuels and the substances obtained from them.

BLO I I can describe the importance of crude oil including its risks and benefits.

BLO II I can describe the fractions of crude oil and how they can be separated from each other.

BLO III I can describe pollution problems related to fossil fuels.

LO 14 Distinguish different homologous series and their physical and chemical properties.

BLO I I can classify organic molecules into the various homologous series.

BLO II I can describe cracking.

BLO III I can describe the chemistry of alkanes.

BLO IV I can describe the chemistry of alkenes and problems caused by some organic substances.

BLO V I can describe the chemistry of alcohols.

BLO VI I can describe the chemistry of polymers.

LO 15 Describe the energy changes accompanying chemical changes.

BLO I I can describe energy changes of chemical reactions using energy level diagrams.

BLO II I can carry out experiments to determine the heat change of reactions.

Learning Outcomes, Broad Learning Outcomes and Assessment Criteria

Learning Outcome 1: I can demonstrate an understanding of how chemistry works and is communicated.

*** Learning Outcome 1:**	I can demonstrate an understanding of how chemistry works and is communicated.	
Assessment Criteria (Level 1)	**Assessment Criteria (Level 2)**	**Assessment Criteria (Level 3)**
Broad Learning Outcome I: I can describe the scientific process.		
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.	
Broad Learning Outcome II: I can apply health and safety measures during laboratory practice.		
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.
Broad Learning Outcome III: I can perform experiments.		
	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.

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.
	1.2q 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.
Broad Learning Outcome IV: I can write experiment reports.		
	1.2t Structure a laboratory report in sections.	1.3t Write a scientific report for an experiment carried out. 
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. 

Broad Learning Outcome V: I can represent chemical reactions using balanced equations.		
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.

* Learning Outcome 1 is meant to be covered during Year 9 , Year 10, and Year 11. Assessment criteria from this learning outcome may also be assessed in Year 9, Year 10, and Year 11 annual examinations.

** Assessment criteria 1.3c, 1.3m, 1.3n, and 1.3s will not be examined in Year 9. They will be examinable in Year 10 and Year 11.

Year 9

Learning Outcome 2: I can describe and explain the properties of gases that may be found in air and how to prepare them in the lab.

Subject Focus 1:	Substances from the Earth: The Atmosphere	
Learning Outcome 2:	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)**
Broad Learning Outcome I: I can describe the components of air, their properties and uses.		
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.)* LEARNING TO KNOW	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.	

Broad Learning Outcome II: I can describe matter at the atomic and sub-atomic levels.		
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.)* INFORMATION MANAGEMENT	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.
	10.2a (part) Calculate relative molecular mass of a compound from relative atomic masses.	
	2.2e Determine the electron configuration of the first 18 elements in relation to their position in the Periodic Table.	
Broad Learning Outcome III: I can describe how covalent bonds are formed.		
2.1f Distinguish between gases which are monoatomic and others which are diatomic. *(Limited to noble gases, H_2, N_2, and 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.
Broad Learning Outcome IV: I can prepare, collect, and identify CO_2, O_2, and H_2.		
	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.)*
	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.
Broad Learning Outcome V: I can describe atmospheric pollution, its adverse effects and how to reduce them.		
2.1o Relate the emission of the pollutants present in air to human activities. *(Limited to carbon dioxide, carbon monoxide and soot.)*  LEARNING TO KNOW	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.)*  LEARNING TO BE	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.)*
2p and 2q are listed in LO 4, BLO II.		
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.)*  LEARNING TO KNOW	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.)*  LEARNING TO KNOW	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.)*  LEARNING TO DO	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.)*  LEARNING TO LIVE TOGETHER

Learning Outcome 3: I can describe the solvent action of water including the impact of water hardness.

Subject Focus 2:	Substances from the Earth: Aquatic environments	
Learning Outcome 3:	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)**
Broad Learning Outcome I: I can describe the importance and properties of water.		
3.1a Identify sources of potable water and their management in Malta. LEARNING TO LIVE TOGETHER	3.2a Present ideas that water is a very precious resource in the world and a potential source of conflict. COMMUNICATION	3.3a Relate ideas based on research about why water is a very precious resource in the world and a potential source of conflict. INFORMATION MANAGEMENT
3.1b Identify physical properties of pure water.	3.2b State criteria of purity for water. (*Limited to melting point, boiling point, and conductivity.*)	
Broad Learning Outcome II: I can describe how to obtain table salt from various sources.		
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 rock salt. LEARNING TO DO
		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.)*

Broad Learning Outcome III: I can describe how ionic bonds are formed.		
		3.3f Explain the properties of ionic compounds. *(Limited to solubility, melting/boiling points, and electrical conductivity in different states.)*
	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.)*
Broad Learning Outcome IV: I can write chemical formulae.		
	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.)*
	10.2a (part) Calculate relative formula mass of a compound from relative atomic masses.	
Broad Learning Outcome V: I can describe different types of mixtures.		
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.

Broad Learning Outcome VI: I can describe the chemistry behind hard and soft 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 water.)*
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 hardness, both temporary and permanent, and limescale come from. *(With reference to groundwater.)*
3.1m Explain why water softening is important in hard water areas by referring to the local scenario.	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.)*
Broad Learning Outcome VII: I can describe how fresh water can be obtained by distillation and reverse osmosis.		
3.1n Name desalination techniques that can be used to create demineralised water from sea water. *(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 sea water. *(Limited to distillation and reverse osmosis.)*

Learning Outcome 4: I can describe the chemical properties of acids, bases, and salts.

Subject Focus 2:	Substances from the Earth: Aquatic environments	
Learning Outcome 4:	I can describe the chemical properties of acids, bases, and salts.	
Assessment Criteria (Level 1)	**Assessment Criteria (Level 2)**	**Assessment Criteria (Level 3)**
Broad Learning Outcome I: I can describe acids, bases and alkalis, their relation to pH, and the use of indicators.		
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.
Broad Learning Outcome II: I can describe reactions of acids involving acids and bases including their application to real life situations.		
	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.	
	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 is listed in LO 8, BLO III.

	4.2d Represent the reaction of an alkali with an ammonium salt using chemical equations.	4.3d is listed in LO 8, BLO III.
	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.)*  LEARNING TO DO  SOCIAL CHANGE	4.3f Investigate acid-base concepts in real life applications.
Broad Learning Outcome III: I can prepare salts using several techniques depending on their properties.		
	4.2e Represent the precipitation of an insoluble salt using chemical equations.	4.3e is listed in LO 7, BLO II.
	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.)*

Learning Outcome 9: I can describe how and why physical and chemical changes happen.

Subject Focus 4:	Making New Substances: How fast? How far? How much?	
Learning Outcome 9:	I can describe how and why physical and chemical changes happen.	
Assessment Criteria (Level 1)	**Assessment Criteria (Level 2)**	**Assessment Criteria (Level 3)**
Broad Learning Outcome I: I can distinguish between physical and chemical changes.		
	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.	
Broad Learning Outcome II: I can describe and explain changes of state.		
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.	

Year 10

Learning Outcome 5: I can describe the conduction of electricity through solutions and molten salts.

Subject Focus 2:	Substances from the Earth: Aquatic environments	
Learning Outcome 5:	I can describe the conduction of electricity through solutions and molten salts.	
Assessment Criteria (Level 1)	**Assessment Criteria (Level 2)**	**Assessment Criteria (Level 3)**
Broad Learning Outcome I: I can classify ionic and covalent materials as conductors, non-conductors, electrolytes, or non-electrolytes.		
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.
Broad Learning Outcome II: I can explain what happens when molten salts and solutions of salts are electrolysed.		
	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.

Learning Outcome 6: I can describe the major groups of the Periodic Table including their physical and chemical properties.

Subject Focus 2:	Substances from the Earth: Aquatic environments	
Learning Outcome 6:	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)**
Broad Learning Outcome I: I can name some groups of the Periodic Table and distinguish between metals and non-metals.		
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.	
Broad Learning Outcome II: I can describe and compare the properties of group 1 and group 7 elements.		
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.

Learning Outcome 7: I can describe how substances dissolved in water can be identified and how their concentration can be measured.

Subject Focus 2:	**Substances from the Earth: Aquatic environments**	
Learning Outcome 7:	**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)**
Broad Learning Outcome I: I can perform chromatography and interpret chromatograms.		
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.
Broad Learning Outcome II: I can perform tests to identify gases, cations, and anions.		
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.)*

	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.)*
		4.3e Represent the precipitation of an insoluble salt using net ionic equations.
Broad Learning Outcome III: I can conduct a titration and perform calculations involving molar concentrations.		
		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. *(Example 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.

Learning Outcome 8: I can describe how different rocks contain important substances, their extraction, chemical nature, responsible use, and environmental impact.

Subject Focus 3:	Substances from the Earth: The Land	
Learning Outcome 8:	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)**
Broad Learning Outcome I: I can describe the properties of limestone in relation to other building materials used in the construction industry.		
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. LEARNING TO KNOW	8.3c Debate the economic and environmental impact of open quarrying of stone.
Broad Learning Outcome II: I can describe the properties of metals, their extraction and how extraction processes impact the environment.		
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.	

	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. Oxidising 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.
	8.2o Discuss the environmental issues surrounding the mining of metals.  LEARNING TO KNOW	8.3o Evaluate the economic and environmental impact of the extraction of metals. *(Limited to aluminium and iron.)*  LEARNING TO LIVE TOGETHER
	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)*  PRACTICAL
Broad Learning Outcome III: I can use the chemical properties of metals to compare their reactivity.		
	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 calcium, magnesium, aluminium, zinc, iron, lead, and copper. Represent reactions using balanced chemical equations.)*
		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.)*
		4.3c Represent reactions of non-oxidising acids with bases/alkalis, carbonates/ hydrogencarbonates, fairly reactive metals, and sulfites, using net ionic equations.
		4.3d Represent the reaction of an alkali with an ammonium salt using 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.
Broad Learning Outcome IV: I can describe the differences and similarities between some allotropes of carbon.		
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.

Learning Outcome 10: I can perform quantitative calculations.

Subject Focus 4:	Making New Substances: How fast? How far? How much?	
Learning Outcome 10:	I can perform quantitative calculations.	
Assessment Criteria (Level 1)	**Assessment Criteria (Level 2)**	**Assessment Criteria (Level 3)**
Broad Learning Outcome I: I can perform calculations related to relative mass and percentage by mass.		
	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.)*	
Broad Learning Outcome II: I can perform calculations to determine the amount of reacting substances.		
		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.)*
		10.3f Calculate the theoretical and percentage yield of product for a given reaction.

Year 11

Learning Outcome 11: I can investigate why and how chemical reactions proceed at different rates.

Subject Focus 4:	Making New Substances: How fast? How far? How much?	
Learning Outcome 11:	I can investigate why and how chemical reactions proceed at different rates.	
Assessment Criteria (Level 1)	**Assessment Criteria (Level 2)**	**Assessment Criteria (Level 3)**
Broad Learning Outcome I: I can perform experiments to study the rate of a reaction.		
	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.)* & PERSONAL LEARNING
Broad Learning Outcome II: I can investigate the factors that affect rates of reaction.		
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.
	11.2f Interpret results/graph containing single series of data related to rates of reactions.	11.3f Interpret results/graphs containing multiple 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.

Learning Outcome 12: I can describe dynamic equilibria and the conditions needed to shift a reaction in equilibrium.

Subject Focus 4:	Making New Substances: How fast? How far? How much?	
Learning Outcome 12:	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)**
Broad Learning Outcome I: I can classify different kinds of chemical reactions.		
	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.	
Broad Learning Outcome II: I can explain dynamic equilibria and the factors which affect it in chemical reactions.		
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.*)
Broad Learning Outcome III: I can identify needs for chemical products and related environmental issues.		
	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.)*

Learning Outcome 13: I can describe the chemical nature of crude oil and the substances obtained from it.

Subject Focus 5:	Carbon compounds. Meeting our energy needs.	
Learning Outcome 13:	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)**
Broad Learning Outcome I: I can describe the importance of crude oil including its risks and benefits.		
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.  COMMUNICATION
		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.  USE OF DIGITAL MEDIA
	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.  LEARNING TO KNOW
Broad Learning Outcome II: I can describe the fractions of crude oil and how they can be separated from each other.		
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.)*  LEARNING TO KNOW	13.3e Describe how crude oil is separated by fractional distillation.
13.1f Distinguish between miscible and immiscible liquids.	13.2f Separate immiscible liquids using a separating funnel.	
Broad Learning Outcome III: I can describe pollution problems related to fossil fuels.		
13.1g Describe the problems of high sulfur content in fossil fuels.	13.2g Discuss the importance of desulfurisation of fuels.  LEARNING TO BE	
	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.)*  LEARNING TO KNOW	13.3h Explain how the use of fossil fuels contributes to pollution. *(By liberating particulates, carbon monoxide, carbon dioxide, nitrogen oxides, and sulfur during combustion , and oil spills, etc.)*
		13.3i Interpret data on the use of fossil fuels and the gases generated.  USE OF DIGITAL MEDIA

Learning Outcome 14: I can distinguish different homologous series and their physical and chemical properties.

Subject Focus 5:	Carbon compounds. Meeting our energy needs.	
Learning Outcome 14:	I can distinguish different homologous series and their physical and chemical properties.	
Assessment Criteria (Level 1)	**Assessment Criteria (Level 2)**	**Assessment Criteria (Level 3)**
Broad Learning Outcome I: I can classify organic molecules into the various homologous series.		
	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.*)

Broad Learning Outcome II: I can describe cracking.		
	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.
Broad Learning Outcome III: I can describe the chemistry of 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.
Broad Learning Outcome IV: I can describe the chemistry of alkenes and problems caused by some organic substances.		
	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.

	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.)*  LEARNING TO KNOW	
Broad Learning Outcome V: I can describe the chemistry of alcohols.		
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.  COMMUNICATION
		14.3o Describe how ethanol can be oxidised to ethanoic acid using acidified potassium dichromate and by aerial oxidation. *(Chemical equations are not required.)*
Broad Learning Outcome VI: I can describe the chemistry of polymers.		
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.

Learning Outcome 15: I can describe the energy changes accompanying chemical changes.

Subject Focus 5:	Carbon compounds from the Earth. Meeting our energy needs.	
Learning Outcome 15:	I can describe the energy changes accompanying chemical changes.	
Assessment Criteria (Level 1)	**Assessment Criteria (Level 2)**	**Assessment Criteria (Level 3)**
Broad Learning Outcome I: I can describe energy changes of chemical reactions using energy level diagrams.		
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.*)
	15.2d Define heat of combustion.	
	15.2e Define heat of neutralisation.	
Broad Learning Outcome II: I can carry out experiments to determine the heat change of reactions.		
	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}).
		15.3d Calculate the heat of combustion of a fuel (in kJ mol^{-1}).
		15.3e Calculate the heat of neutralisation (in kJ mol^{-1}).
		15.3f Carry out experiments to determine the change in heat (in kJ mol^{-1}). *(Limited to combustion of safe liquid fuels and neutralisation of an acid with an alkali.)*

Scheme of assessment

General notes

- Questions will be set in English and must be answered in English.
- Electronic calculators may be used in any part of the examination.
- The following 'Useful Data' will be provided with annual examination papers as follows:
    - Year 9 – nil.
    - Year 10
        - Avogadro constant: 6.02×10^{23},
        - STP conditions: 0 °C and 10^5 Pa / 1 atm.,
        - The molar volume for gases: 22.4 dm^3 at STP.
    - Year 11
        - Avogadro constant: 6.02×10^{23},
        - STP conditions: 0 °C and 10^5 Pa / 1 atm.,
        - The molar volume for gases: 22.4 dm^3 at STP,
        - Specific heat capacity of water: 4200 J kg^{-1} $°C^{-1}$.
- Year 9 and Year 10 examination papers will be pegged at Levels 1-2-3 while for Year 11 there will be two papers, one paper at Levels 1-2, and another paper at Levels 2-3. At some point during the scholastic year, Year 11 students will need to choose which paper to sit for.
- All learning outcomes form part of a subject focus, except for Learning Outcome 1 which should be implemented with other learning outcomes assigned to Year 9, Year 10, and Year 11.
- 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." implies that the examples listed may not be the only ones examined.
- Some assessment criteria have icons related to cross-curricular themes (refer to appendix H). The annual examination will not feature questions related to learning outcomes and assessment criteria related to these cross-curricular themes. However, teachers are encouraged to link these areas of chemistry to the relevant cross-curricular theme/s.
- 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.
- The Periodic Table (refer to appendix A) will be provided with all annual examination papers.
- The reactivity series (refer to appendix B) will be provided with all annual examination papers except for Year 9.
- The order of discharge at electrodes (refer to appendix C) will be given with the Year 10, and Year 11 Levels 1-2 annual examination papers.
- A list of polyatomic ions and their charges (refer to appendix D), as well as solubility rules (refer to appendix E) will be given with all annual examination papers except for the Year 11 Levels 2-3 paper.
- 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.

Broad learning outcomes (BLOs)

The BLOs in this syllabus are listed in the MySchools portal. Teachers are encouraged to fill in these tickable BLOs according to the performance of the students. BLOs need to be filled in at a time indicated by the school administration.

School-Based Assessments (SBA)

- It is recommended for SBA to be marked out of 100 as indicated in the SEC06 Chemistry syllabus.
- The SBA tasks for each scholastic year are given in the table below:

	Year 9	**Year 10**	**Year 11**
Recommended number of SBA tasks of which:	5	5	3
• Experiment tasks	3	3	2
• Investigation tasks	2		
• Tasks such as fieldwork, site visit, project, other experiments and investigations, etc.	A number of tasks to add up to the recommended number.		

- Experiment tasks must be based on different learning outcomes.
- Investigation and experiment tasks may be based on the same learning outcomes; however they must be based on different assessment criteria.
- SBA tasks related to experiments and investigations must be based on learning outcome 1 in conjunction with any other learning outcome/s.
- Other SBA tasks may be selected from any or a combination of the learning outcomes.
- SBA for all scholastic years must be pegged at Levels 1-2-3. The higher level shall have a larger allocation of marks.

Annual examinations

The Year 9, Year 10, and Year 11 examination papers will have:

- a duration of 2 hours.
- 10 to 15 graded compulsory questions without sections.
- a total of 100 marks.

The Year 9 examination paper:

- will be set for Levels 1-2-3,
- shall have about 30% Level 1, 30% Level 2, and 40% Level 3 content,
- will include content related to learning outcomes 1, 2, 3, 4, and 9 as well as assessment criteria 10.2a but excluding assessment criteria 1.3c, 1.3m,1.3n, and 1.3s.

The Year 10 examination paper:

- will be set for Levels 1-2-3,
- shall have about 30% Level 1, 30% Level 2, and 40% Level 3 content,
- will include content related to learning outcomes 1, 5, 6, 7, 8, and 10.

The Year 11 examination paper:

- set at Levels 1-2 shall have about 40% Level 1 content and 60% Level 2 content,
- set at Levels 2-3 shall have about 40% Level 2 content and 60% Level 3 content,
- will include content related to all learning outcomes.

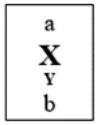
Appendices

Appendix A – Periodic Table. *(All annual papers.)*

PERIODIC TABLE OF THE ELEMENTS

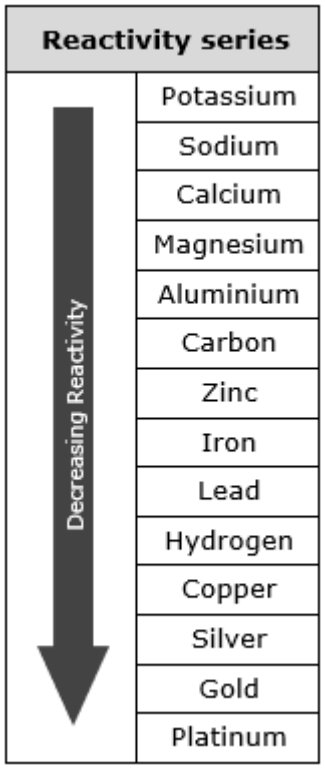
1	2											3	4	5	6	7	0
							1 **H** Hydrogen 1										4 **He** Helium 2
7 **Li** Lithium 3	9 **Be** Beryllium 4											11 **B** Boron 5	12 **C** Carbon 6	14 **N** Nitrogen 7	16 **O** Oxygen 8	19 **F** Fluorine 9	20 **Ne** Neon 10
23 **Na** Sodium 11	24 **Mg** Magnesium 12											27 **Al** Aluminium 13	28 **Si** Silicon 14	31 **P** Phosphorus 15	32 **S** Sulfur 16	35.5 **Cl** Chlorine 17	40 **Ar** Argon 18
39 **K** Potassium 19	40 **Ca** Calcium 20	45 **Sc** Scandium 21	48 **Ti** Titanium 22	51 **V** Vanadium 23	52 **Cr** Chromium 24	55 **Mn** Manganese 25	56 **Fe** Iron 26	59 **Co** Cobalt 27	59 **Ni** Nickel 28	63.5 **Cu** Copper 29	65 **Zn** Zinc 30	70 **Ga** Gallium 31	73 **Ge** Germanium 32	75 **As** Arsenic 33	79 **Se** Selenium 34	80 **Br** Bromine 35	84 **Kr** Krypton 36
85 **Rb** Rubidium 37	88 **Sr** Strontium 38	89 **Y** Yttrium 39	91 **Zr** Zirconium 40	93 **Nb** Niobium 41	96 **Mo** Molybdenum 42	99 **Tc** Technetium 43	101 **Ru** Ruthenium 44	103 **Rh** Rhodium 45	106 **Pd** Palladium 46	108 **Ag** Silver 47	112 **Cd** Cadmium 48	115 **In** Indium 49	119 **Sn** Tin 50	122 **Sb** Antimony 51	128 **Te** Tellurium 52	127 **I** Iodine 53	131 **Xe** Xenon 54
133 **Cs** Caesium 55	137 **Ba** Barium 56	139 **La** Lanthanum 57	178 **Hf** Hafnium 72	181 **Ta** Tantalum 73	184 **W** Tungsten 74	186 **Re** Rhenium 75	190 **Os** Osmium 76	192 **Ir** Iridium 77	195 **Pt** Platinum 78	197 **Au** Gold 79	201 **Hg** Mercury 80	204 **Tl** Thallium 81	207 **Pb** Lead 82	209 **Bi** Bismuth 83	210 **Po** Polonium 84	210 **At** Astatine 85	222 **Rn** Radon 86

Key:



relative atomic mass
SYMBOL
Name
atomic number

Appendix B - Reactivity Series. *(All annual papers except Year 9.)*



Appendix C - Order of discharge at electrodes. (*Year 10 and Year 11 Levels 1-2 annual papers.*)

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. (*All annual papers except Year 11 Levels 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. (*All annual papers except Year 11 Levels 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. (*Will NOT be given in any examination paper.*)

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. (*Will NOT be given in any examination paper.*)

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

Appendix H – Cross-Curricular Themes

Cross-Curricular Theme	Symbol	Theme Learning Outcomes
Digital Literacy		• Information Management • Communication • Collaboration • Use of Digital Media • Managing Learning • Managing Internet Use • Computational Thinking
Education for Diversity		• Self-Awareness • Social Change • Communicating for Diversity
Education for Entrepreneurship, Creativity, and Innovation		• Personal • Interpersonal • Cognitive • Practical
Education for Sustainable Development		• Learning to Know • Learning to Do • Learning to Be • Learning to Live Together
Learning to Learn and Cooperative Learning		• Social Learning • Personal Learning • Cognitive Learning • Creative Learning
Literacy		• Listening and speaking • Expressive language • Reading and understanding • Writing • Accuracy • Planning and reflection

Adapted from: http://www.schoolslearningoutcomes.edu.mt/en/category/cross-curricular-themes