الإطار المنهجي لمادة الكيمياء

Chemistry Syllabus

Grades (9-10)-Bilingual Program

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Contents

Introduction

Science plays a major role in the evolution of knowledge. It empowers us to use creative and independent approaches to problem solving. It arouses our natural curiosity and enables us to meet diverse and ever expanding challenges. It enhances our ability to inquire, seek answers, research and interpret data. These skills lead to the construction of theories and laws that help us to explain natural phenomena and exercise control over our environment. Science is, thus, an integral component of a balanced education.

This syllabus focus on the content essential for preparing students to be engaged and productive citizens. A good foundation in the sciences will help citizens to respond to the challenges of a rapidly changing world using the scientific approach. It addresses, in addition to a specific knowledge base, the development of related skills and attitudes. Critical thinking, enquiry and reasoning are emphasized to ensure that students develop the ability to work creatively, think analytically and solve problems. The syllabus also ensure that students become aware of their moral, social, and ethical responsibilities, as well as, the benefits intrinsic to the practical application of scientific knowledge to careers in the scientific field. Teaching these standards requires teaching methods that are varied and experiential. Effective lessons will concert and incorporate with: Practical work and the science standards, the place of information and communications technology in the science standards, teaching about science, technology and society, the mathematical requirements of the science standards.

The overall aims of science standards are that students should:

1. develop and sustain an interest in science and its applications.
2. have a sound and systematic knowledge of important scientific facts, concepts and principles, and possess the skills needed to apply these in new and changing situations in a range of personal, domestic, industrial and environmental contexts.
3. recognize the importance of the application of scientific knowledge in the modern world and be aware of the moral, ethical, social and environmental implications.
4. develop relevant attitudes, such as a concern for accuracy and precision, objectivity, integrity, enquiry, initiative and inventiveness.
5. develop an understanding of the scientific skills essential for both further study and everyday life.
6. plan, design and perform experiments to test theories and hypotheses.
7. be proficient in the use of a range of scientific methods and techniques and in handling apparatus.
8. develop the ability to work independently and collaboratively with others when necessary.
9. integrate Information and Communication Technology (ICT) tools and skills.

Important Skills:

- Scientific enquiry skills: Scientific enquiry, which ensures the development of scientific skills, intellectual and practical, should be integrated in the learning of the scientific content across all the science branches. Scientific enquiry skills include the following:

1. Carry out the practical experiments to developed the practical skills which will be mentioned in details below.
2. Find secondary information sources such as the resources available in the public libraries and on the Internet and use these after validation and making sure of the suitability of the subject.
3. Apply Scientific knowledge and procedures to the situations of the reality Life.
4. Recognizes the importance of cooperative teamwork, put work plans, distributes responsibilities and regulates and sets specific targets for work.

- Know how scientists are working:

1. Realize that with science we can bring great benefits to humanity also if it is abused can cause serious damage to the environment.
2. know how scientists are carrying out their work, such as environmental monitoring and control of industrial processes.
3. Know how scientists publish and present their ideas and results in order to encourage debate and development.
4. know that science could lead to the emergence of ethical considerations, and discuss them.
5. know that there are many questions and considerations that cannot be answered by Science.
6. trace the historical development of some key scientific models and knows what contributions Scientists presented in this development.

- Processing and delivery of information

1. present qualitative and quantitative data using a variety of methods, such as descriptive texts, graphics, images, tables, and maps with the use of technology methods and computer when it is appropriate, then analyse and explain these date to extract conclusions from them.
2. use mathematical relationships routinely to calculate the quantities.
3. do calculations based on data taken from the graphs, and distinguishes between Independent and dependent variables.
4. handle data and writes reports about the results.
5. use symbolic equations to represent chemical reactions and simple physical relationships.

6. use the appropriate methods to deliver scientific information.

- ICT application:

This syllabus provides students with a wide range of opportunities to use ICT in their study of science in order to play a full part in modern society, students need to be confident and effective users of ICT. Opportunities for ICT include:

1. gathering information from digital resources and the internet.
2. using spreadsheets and other software to process data.
3. using animations and simulations to visualize scientific ideas.
4. using software to present ideas and information on paper and on screen.

Skills and abilities to be assessed:

The skills students are expected to develop on completion of this syllabus, have been grouped under three main headings:

1. knowledge and understanding.
2. application of knowledge and understanding, analysis and evaluation of information.
3. scientific enquiry skills and procedures.

1. Knowledge and understanding

Assessment Objectives	Skills: The ability to
Knowledge	• identify, remember and grasp the meaning of basic facts, concepts and principles.
Understanding	• select appropriate ideas, match, compare and cite examples of facts, concepts and principles in familiar situations; • explain familiar phenomena in terms of theories, models, laws and principles.

Questions testing these skills will often begin with one of the following words: define, state, describe, explain.

2. Application of knowledge and understanding, analysis and evaluation of information

Assessment Objectives	Skills: The ability to
Application	• use facts, concepts, principles and procedures in unfamiliar situations. • transform data accurately and appropriately • use common characteristics as a basis for classification • use information to identify patterns, report trends and draw inferences. • use formulae accurately
Analysis and Interpretation	• identify and recognize the component parts of a whole and interpret the relationships between those parts; • identify causal factors and show how they interact with each other; • infer, predict and draw conclusions; • make necessary and accurate calculations and recognize the limitations and assumptions of data. • present reasoned explanations for phenomena, patterns and relationships
Synthesis	• combine component parts to form a new meaningful whole; • make predictions and solve problems. • locate, select, organize and present information from a variety of sources.
Evaluation	• make reasoned judgments and recommendations based on the value of ideas and information and their implications.

Questions testing these skills will often begin with one of the following words: predict, suggest, calculate or determine.

3. Scientific enquiry skills and investigations.

Assessment Objectives	Skills: The ability to
Planning and designing a practical procedure	• identify problems, make predictions, and design a practical procedure to answer a question, solve a problem or test a hypothesis. • select and use suitable apparatus for carrying out experiments accurately and safely. • take into account possible sources of errors and danger in the design of an experiment; • evaluating experimental procedures and identifying weaknesses and develop realistic strategies for improvement • Work in a way that is committed to ethical and moral standards such as honesty and authenticity of his results and writing of the used references.
Control	• use experimental controls where appropriate; • Appreciate that, unless certain variables are controlled, experimental results may not be valid • Recognize the need to choose appropriate sample sizes, and study control groups where necessary.
Risk assessment	• Identify possible hazards in practical situations, the risks associated with these hazards, and methods of minimizing the risks.
Manipulation and measurement	• follow a detailed set or sequence of instructions; • make measurements with due regard for precision and accuracy; • handle chemicals and living organisms with care; • assemble and use simple apparatus and measuring instruments.
Observation, recording and reporting	• select observations relevant to the particular activity; • make accurate observations and minimise experimental errors • record observations, measurements, methods and techniques with due regard for precision, accuracy and units; • record and report unexpected results; • select and use appropriate models of recording data or observations, for example, graphs, tables, diagrams and drawings; • organize and present information, ideas, descriptions and arguments clearly and logically in a complete report, using spelling, punctuation, grammar and scientific terminology with an acceptable degree of accuracy;

Assessment Objectives	Skills: The ability to
Analyzing and interpreting data	• Appreciate when it is appropriate to calculate a mean, calculate a mean from a set of at least three results and recognize when it is appropriate to ignore anomalous results in calculating a mean. • Recognize patterns in data, form hypotheses and deduce relationships. • Use and interpret tabular and graphical representations of data. • Evaluate data, considering its repeatability, reproducibility and validity in presenting and justifying conclusions.
Making conclusions	• Draw conclusions that are consistent with the evidence obtained and support them with scientific explanations
Drawing	• make clear, accurate line representations of specimens, with no shading or unnecessary details; and with clean continuous lines. • label drawings accurately and use label lines which do not cross each other or carry arrowheads or dots • make drawings which are large enough to display specific details • calculate the magnification of the drawings.

Chemistry Syllabus

The chemistry syllabus allows students to work individually and with others in practical, field and interactive activities that are related to theoretical concepts. It is expected that students will apply investigative and problem-solving skills, effectively communicate scientific information and appreciate the contribution that a study of chemistry makes to their understanding of the world. The syllabus places greater emphasis on the understanding and application of chemical concepts and principles and different learning styles and needs, so that students will develop skills that will be of long term value in an increasingly technological world, rather than focusing on large quantities of factual information. Through the principles of chemistry, students will understand everyday life, nature and technology, and the significance of the well-being of man and the environment.

Aims: Chemistry syllabus enables students to:

1. appreciate and understand natural phenomena and the ways in which materials behave.
2. be aware of the power, impact and influence which Chemistry has in a modern scientific world and to emphasize that there is a responsibility that Chemistry be used for the good of the society and for the preservation of the environment.
4. appreciate, understand and use methods of science.
5. see the relevance of Chemistry to everyday life.
6. appreciate and understand the role of Chemistry in enabling materials to be used in the service of mankind.
7. understand basic chemical concepts in sufficient depth to provide an adequate foundation for specialization.
8. develop the spirit of inquiry and to continue the search for new ways in which materials may be used in the service of mankind.
9. make use of chemical data, concepts, principles and terminology in communicating chemical information.

How to use this syllabus

This syllabus is arranged according to the following manner:

Outcomes:

Indicate the scope of the content, including practical work which will be examined as well. However, practical work should not necessarily be limited to these objectives.

1- The numbering key :[Unit – Topic –Learning outcome]
2- (S) skill objective.

Practical experiments and activities:

Show some examples of active learning activities and do not represent full scale activities that can be done. It is recommended that all of the suggested laboratory-related activities, such as conducting experiments must be done. Other activities like making field trips and viewing audio-visual materials, can be done also. Take into account the sufficient time to carry out the practical experiments determined in this syllabus and train students in practical skills related to them. The teachers should get benefit from the student text books, teacher's resources, practical workbooks and the interactive digital resources, that are recommended by MOE in the approved books list. The teachers should include the practical lessons in the semester plan.

Grade 9 (Bilingual) Chemistry - Learning outcomes

Semester 1

Subtopics	Learning Outcomes		Practical activities	Number of lessons
1. The particulate nature of matter.				
1. The particulate nature of matter.	1.1.1	State the distinguishing properties of solids, liquids and gases.		4
	1.1.2	Describe the structure of solids, liquids and gases in terms of particle separation, arrangement and motion**.**		
	1.1.3	Describe changes of state in terms of melting, boiling, evaporation, freezing, and condensation.		
	1.1.4	Explain changes of state in terms of kinetic particle theory, including the interpretation of heating and cooling curves		
	1.1.5	Describe qualitatively the pressure and temperature of a gas in terms of the motion of its particles.		
	1.1.6	Explain diffusion.	Adding drop of ink in cold water and hot water	
	1.1.7	Explain dependence of rate of diffusion on molecular mass.	Mixing HCl gas and NH_3 gas in glass tube ,observe the ring formed inside the tube	
2. Experimental techniques				
1. Measurement	2.1.1	Name, suggest and use appropriate apparatus and tools for the measurement of time, temperature, mass and volume, including:		9

Subtopics	Learning Outcomes		Practical activities	Number of lessons
		stopwatches, thermometers, balances, burettes, volumetric pipettes, volumetric pipettes, measuring cylinders, and gas syringes		
	2.1.2	Describe the following terms: Solvent, solute, solution, saturated solution, residue, and filtrate.		
2. Acid-base titrations	2.2.1	Describe an acid-base titration to include the use of a: Burette, volumetric pipette, and suitable indicator,		
	2.2.2	Describe how to identify the end-point of a titration using indicator		
3. Chromatography	2.2.3	Describe how paper chromatography is used to separate mixtures of soluble coloured substances, using a suitable solvent	Investigation of food dyes by chromatography.	
	2.2.2	Interpret simple chromatograms to identify: (a) unknown substances by comparison with known substances (b) pure and impure substances		
	2.2.4	State and use the equation for Rf : $Rf = \frac{\text{distance travelled by substance}}{\text{distance travelled by solvent}}$	Identify different dissolved solids by interpreting chromatogram	
3. Separation and purification	2.3.1	Describe and explain methods of separation and purification using: a suitable solvent , filtration , crystallization , simple distillation and fractional distillation	-For crystallization make supersaturation of $CuSO_4$ solution with heating then leave it cooled	

Subtopics	Learning Outcomes		Practical activities	Number of lessons
			-Separating insoluble solids from liquids by filtration -Separating a soluble solid from water to obtain the solid	
	2.3.2	Suggest suitable separation and purification techniques, given information about the substances involved.		
3.The Periodic Table				
1.The Periodic Table	3.1.1	Describe the Periodic Table as an arrangement of elements in periods and groups in order of increasing proton number/atomic number.		6
	3.1.2	Describe the change from metallic to non-metallic character across a period.		
	3.1.3	Describe the relationship between group number and the charge of the ions formed from elements in that group		
	3.1.4	Explain similarities in the chemical properties of elements in the same group of the Periodic Table in terms of their electronic configuration		
2. Group I properties	3.2.1	Describe the Group I alkali metals, lithium, sodium and potassium, as relatively soft metals with general trends down the group, limited to: a)decreasing melting point b)increasing density c)increasing reactivity	Show the students demo video for the reaction of sodium and potassium with water to see which is more reactive	

Subtopics	Learning Outcomes		Practical activities	Number of lessons
	3.2.2	Predict the properties of other elements in Group I, given data, where appropriate.		
3. Group VII properties	3.3.1	Describe the Group VII halogens, chlorine, bromine and iodine, as diatomic non-metals with general trends down thr group, limited to: a) increasing density b) decreasing reactivity		
	3.3.2	Predict the properties of other elements in Group VII, given data where appropriate.		
	3.3.3	Describe and explain the displacement reactions of halogens with other halide ions		
4.Transition elements	3.4.1	Describe the transition elements as a collection of metals having high **densities**, **high melting points** and **forming colored compounds**, and which, as elements and compounds, often act as catalysts.		
	3.4.2	Know that transition elements have variable oxidation states.		
5. Noble gases	3.5.1	Describe the noble gases, in Group VIII, as being uncreative, monatomic gases and explain this in terms of electronic structure.		
	3.5.2	State the uses of the noble gases in providing an inert atmosphere, i.e. argon in lamps, helium for filling balloons		
4.Atoms, elements and compounds				

Subtopics	Learning Outcomes		Practical activities	Number of lessons
1.Atomic structure and periodic table	4.1.1	Describe the structure of the atom as a central nucleus containing neutrons and protons surrounded by electrons in shells.	Modelling atomic structure	14
	4.1.2	State the relative charges and approximate relative masses of protons, neutrons and electrons.		
	4.1.3	Define *proton number* (atomic number) as the number of protons in the nucleus of an atom		
	4.1.4	Define *nucleon number* (mass number) as the total number of protons and neutrons in the nucleus of an atom.		
	4.1.6	Describe the build-up of electrons in 'shells' and determine the electronic configuration of elements and their ions with protons number 1 to 20, e.g. 2,8,3 (The ideas of the distribution of electrons in s and p orbitals and in d block elements are not required.)		
	4.1.7	State that: Group VIII noble gases have a full outer shell, the number of outer shell electrons is equal to the group number in Groups I to VII, and the number of occupied electron shells is equal to the period number		

Subtopics	Learning Outcomes		Practical activities	Number of lessons
2.Isotopes	4.2.1	Define isotopes as different atoms of the same element that have the same number of protons but different numbers of neutrons.		
	4.2.2	State that isotopes of the same element have the same chemical properties because they have the same number of electrons and therefore the same electronic configuration		
	4.2.3	Interpret and use symbols for atoms, e.g. $^{12}_{6}C$, and ions, e.g. $^{35}_{17}Cl^{-}$		
	4.2.4	Calculate the relative atomic mass of an element from the relative masses and abundances of its isotopes		
3.Elements, compounds and mixtures	4.3.1	Describe the differences between elements, compounds and mixtures.		
4. Ions and ionic bonds	4.4.1	Describe the formation of ions by electron loss or gain.		
	4.4.2	Describe the formation of ionic bonds between metallic and non-metallic elements.		
	4.4.3	Describe the formation of ionic bonds between elements from Groups I and VII, including the use of dot-and-cross diagrams		
	4.4.4	Describe the properties of ionic compounds: (a) high melting points and boiling points (b) good electrical conductivity when aqueous or molten and poor when solid		
	4.4.5	Describe the lattice structure of ionic compounds as a regular arrangement of alternating positive and negative ions.		

Subtopics	Learning Outcomes		Practical activities	Number of lessons
4. Molecules and covalent bonds	4.4.1	State that a covalent bond is formed when a pair of electrons is shared between two atoms leading to noble gas electronic configurations		
	4.4.2	Describe the formation of covalent bonds in simple molecules, including H_2, Cl_2, H_2O, CH_4, NH_3 and HCl. Use dot-and-cross diagrams to show the electronic configurations in these and similar molecules	Modelling the bonding in covalent substances.	
	4.4.2	Describe the electron arrangement in more complex covalent molecules such as N_2, C_2H_4, CH_3OH and CO_2. Use dot-and-cross diagrams to show the electronic configurations in these and similar molecules		
	4.4.3	Describe the differences in volatility, solubility and electrical conductivity between ionic and covalent compounds.		
	4.4.4	Describe in terms of structure and bonding the properties of simple molecular compounds: (a) low melting points and boiling points (b) poor electrical conductivit		
5. Giant covalent structures	4.5.1	Describe the giant covalent structures of graphite and diamond.		
	4.5.2	Describe the macromolecular structure of silicon(IV) oxide (silicon dioxide).		
	4.5.3	Relate their structures to their uses, e.g. graphite as a lubricant and a conductor, and diamond in cutting tools.		
	4.5.4	Describe the similarity in properties		

Subtopics	Learning Outcomes		Practical activities	Number of lessons
		between diamond and silicon(IV) oxide ,related to their structures.		
6. Metallic bonding	4.6.1	List the general physical properties of metals.		
	4.6.2	Describe metallic bonding as a lattice of positive ions in a 'sea of electrons' and use this to describe the electrical conductivity and malleability of metals.	Modelling metallic crystal structure.	

Grade 9 (Bilingual) Chemistry- Learning outcomes
Semester 2

Subtopics	Learning Outcomes		Practical activities	Suggested number of lessons
5. Chemical reactions				
1.Physical and chemical changes	5.1.1	Identify physical and chemical changes, and describe the differences between them		6
2.Rate of reaction	5.2.1	Describe the effect on the rate of reaction of: a. Changing the concentration of solutions b. Changing the pressure of gases c. Changing the surface area of solids d. Changing the temperature Adding or removing a catalyst, including enzymes	The effect of temperature on reaction rate	
	5.2.2	Describe collision theory		
	5.2.3	Explain the effects of various factors on reaction rate using collision theory		
	5.2.4	Interpret data, including graphs, from rate of reaction experiments		
	5.2.5	Describe practical methods for investigating the rate of a reaction including change in mass of reactant or a product and the formation of a gas		

Subtopics	Learning Outcomes		Practical activities	Suggested number of lessons
6. Stoichiometry				
1. Formulae	6.1.1	Use the symbols of the elements and write the formulae of simple compounds		11
	6.1.2	Determine the formula of an ionic compound from the charges on the ions present.		
	6.1.3	Define empirical formula of a compound as the simplest whole number ratio of the different atoms or ions in a compound		
	6.1.4	Deduce the formula of a simple compound from the relative numbers of atoms present.		
	6.1.5	Construct word equations and symbol equations including ionic equations, to show how reactants form products including state symbol.		
2.Relative masses of atoms and molecules	6.2.1	Describe *relative atomic mass*, A_r , as the average mass of f the isotopes of an element compared to 1/12th of the mass of an atom of ^{12}C		
	6.2.2	Define relative molecular mass, M_r , as the sum of the relative atomic masses. Relative formula mass, M_r , will be used for ionic compounds		
3. The mole and the Avogadro constant	6.3.1	Define the *mole* and the *Avogadro Constant.*		
	6.3.2	Use the molar gas volume, taken as 24 dm^3 at room temperature and pressure.		
	6.3.3	Calculate stoichiometric reacting masses, volumes of gases at r.t.p, volume of solutions and concentrations of solutions expressed in g/ dm^3 and mol / dm^3 , including conversion between cm^3 and dm^3.	Determining the concentration of a hydrochloric acid solution.	
	6.3.4	Calculate empirical formulae.		
	6.3.5	Calculate molecular formulae.		

Subtopics	Learning Outcomes		Practical activities	Suggested number of lessons
	6.3.6	Use the relationship amount of substance (mol) = mass (g) molar mass (g /mol) to calculate: (a) amount of substance (b) mass (c) molar mass (d) relative atomic mass or relative molecular/formula mass (e) number of particles, using the value of the Avogadro constant		
7. Acid, base and salts				
1. The characteristic properties of acids and bases.	7.1.1	Define *acids* and *bases* in terms of proton transfer, limited to aqueous solutions.		10
	7.1.2	Describe the characteristic properties of acids as reactions with metals, bases, carbonates and effect on litmus, thymolphthalein, and methyl orange		
	7.1.3	State that bases are oxides or hydroxides of metals and that alkalis are soluble bases		
	7.1.4	Describe alkalis in terms of their effect on : litmus, thymolphthalein and methyl orange		
	7.1.5	Describe the characteristic properties of bases as reactions with acids and with ammonium salts and effect on litmus and methyl orange.		
	7.1.6	Define weak and strong acids and bases.		
	7.1.7	State that aqueous solutions of acids contain H^+ ions and aqueous solutions of alkalis contain OH^- ions.		
	7.1.8	Describe the neutralization reaction between an acid and an alkali to produce water, $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$		

Subtopics	Learning Outcomes		Practical activities	Suggested number of lessons
	7.1.9	Describe how to compare hydrogen ion concentration, neutrality, relative acidity and relative alkalinity in terms of colour and pH using universal indicator paper	Testing the pH of everyday substances. Measuring the pH for solutions like juice,Milk ,detergent , tooth paste solution , Vinegar …. etc	
2. Oxides	7.2.1	Classify oxides as acidic, including SO_2 and CO_2, or basic, including CuO and CaO, related to metallic and non-metallic character		
	7.2.3	Describe amphoteric oxides as oxides that react with acids and with bases to produce a salt and water		
3. Preparation of salts	7.3.1	Describe the preparation, separation and purification of soluble salts by reaction of an acid with: (a) an alkali by titration (b) excess metal (c) excess insoluble base (d) excess insoluble carbonate	Quick and easy copper (II) sulfate crystals.	
	7.3.2	Describe the general solubility rules for salts: (a) sodium, potassium and ammonium salts are soluble (b) nitrates are soluble (c) chlorides are soluble, except lead and silver (d) sulfates are soluble, except barium, calcium and lead (e) carbonates are insoluble, except sodium, potassium and ammonium		

Subtopics	Learning Outcomes		Practical activities	Suggested number of lessons
		(f) hydroxides are insoluble, except sodium, potassium, ammonium and calcium (partially)		
	7.3.2	Describe the preparation of insoluble salts by precipitation		
	7.3.3	Define a hydrated substance as a substance that is chemically combined with water and an anhydrous substance as a substance containing no water	observe the changes in color - Copper sulfate anhydrous white with water turns blue this on heat turns white	
8. Identification of ions and gases				
1. Identification of ions and gases	9.1.1	Describe tests using aqueous sodium hydroxide and aqueous ammonia to identify the aqueous cations: (a) aluminium, Al^{3+} (b) ammonium, NH^{4+} (c) calcium, Ca^{2+} (d) chromium(III), Cr^{3+} (e) copper(II), Cu^{2+} (f) iron(II), Fe^{2+} (g) iron(III), Fe^{3+}, (h) zinc, Zn^{2+}	Chemical tests for cations	6
	9.1.2	Describe tests to identify the anions: (a) carbonate, CO_3^{2-}, by reaction with dilute acid and then testing for carbon dioxide gas (b) chloride, Cl^-, bromide, Br^-, and iodide, I^-, by acidifying with dilute nitric acid then adding aqueous silver nitrate (c) nitrate, NO_3^-, reduction with aluminium foil and aqueous sodium hydroxide and then testing for ammonia gas (d) sulfate, SO_4^{2-}, by acidifying with dilute nitric acid and then adding aqueous barium nitrate	Chemical tests for anions.	

Subtopics	Learning Outcomes		Practical activities	Suggested number of lessons
		(e) sulfite, SO_3^{2-}, by reaction with acidified aqueous potassium manganate(VII)		
	9.1.3	Describe tests to identify the gases: (a) ammonia, NH_3, using damp red litmus paper (b) carbon dioxide, CO_2, using limewater (c) chlorine, Cl_2, using damp litmus paper (d) hydrogen, H_2, using a lighted splint (e) oxygen, O_2, using a glowing splint (f) sulfur dioxide, SO_2, using acidified aqueous potassium manganate(VII)	Chemicals test for gases.	
	9.1.4	Describe the use of a flame test to identify the cations: (a) lithium, Li^+, (b) sodium, Na^+ (c) potassium, K^+ (d) calcium, Ca^{2+} (e) barium, Ba^{2+} (f) copper(II), Cu^{2+}	Using flame tests to identify metals	

Grade 10 (Bilingual) Chemistry- Learning outcomes

Semester 1

Subtopics	Learning Outcomes		Suggested teaching and learning activities + Practical work	Number of lessons
1.Chemical energetic				
1. Exothermic and endothermic reactions	1.1.1	State that an exothermic reaction transfers thermal energy to the surroundings leading to an increase in the temperature of the surroundings	Exothermic and endothermic reactions.	6
	1.1.2	State that an endothermic reaction takes in thermal energy from the surroundings leading to a decrease in the temperature of the surroundings		
	1.1.3	Interpret energy level diagrams showing exothermic an endothermic reactions.		
	1.1.4	Calculate the energy of a reaction using bond energies		
	1.1.5	State that the transfer of thermal energy during a reaction is called the enthalpy change, ΔH, of the reaction. ΔH is negative for exothermic reactions and positive for endothermic reactions		
	1.1.6	Define activation energy, Ea , as the minimum energy that colliding particles must have to react		
	1.1.7	Draw and label reaction pathway diagrams for exothermic and endothermic reactions using information provided, to include: (a) reactants (b) products (c) enthalpy change of the reaction, ΔH (d) activation energy, Ea		

Subtopics	Learning Outcomes		Suggested teaching and learning activities + Practical work	Number of lessons
	1.1.8	State that bond breaking is an endothermic process and bond making is an exothermic process and explain the enthalpy change of a reaction in terms of bond breaking and bond making		
2. Energy transfer	1.2.1	Describe the release of heat energy by burning fuels		
	1.2.2	State the use of hydrogen as a fuel		
	1.2.3	Describe the use of hydrogen as a fuel reacting with oxygen to generate electricity in a fuel cell (Details of the construction and operation of a fuel cell are not required.)		
2. Chemical reactions				
1.Reversible reactions and equilibrium	2.1.1	Describe how changing the conditions can change the direction of a reversible reaction for: (a) the effect of heat on hydrated compounds (b) the addition of water to anhydrous compounds limited to copper(II) sulfate and cobalt(II) chloride		6
	2.1.2	Predict the effect of changing the conditions (concentration, temperature and pressure) on other reversible reactions.	Cobalt chloride in hot water and in cold water	
	2.1.3	State that a reversible reaction in a closed system is at equilibrium when: (a) the rate of the forward reaction is equal to the rate of the reverse reaction (b) the concentrations of reactants and products are no longer changing		

Subtopics	Learning Outcomes		Suggested teaching and learning activities + Practical work	Number of lessons
	2.1.4	Predict and explain, for a reversible reaction, how the position of equilibrium is affected by: (a) changing temperature (b) changing pressure (c) changing concentration (d) using a catalyst using information provided		
	2.1.5	Describe and explain the essential conditions for the manufacture of ammonia by the Haber process including the sources of the hydrogen and nitrogen, i.e. hydrocarbons or steam and air.		
	2.1.6	Describe the manufacture of sulfuric acid by the Contact process, including essential conditions and reactions		
3. Redox				
1. Redox	3.1.1	Use a Roman numeral to indicate the oxidation number of an element in a compound		5
	3.1.2	Define *oxidation* and *reduction* in terms of oxygen loss/gain.	Burning Mg ribbon	
	3.1.3	Define *redox* in terms of electron transfer.	Zn metal with $CuSO_4$ solution	
	3.1.4	Identify oxidation and reduction in redox reactions		
	3.1.5	Identify redox reactions by the colour changes involved when using acidified aqueous potassium manganate(VII) or aqueous potassium iodide	$FeCl_2$ with $KMnO_4$ solution	
	3.1.6	Define *oxidizing agent* as a substance, which oxidizes another substance during a redox reaction. And *reducing agent* as a substance which reduces another substance during a redox reaction		

Subtopics	Learning Outcomes		Suggested teaching and learning activities + Practical work	Number of lessons
	3.1.7	Identify oxidizing agents and reducing agents in redox reactions		
4. Electrolysis				
1.Electrolysis	4.1.1	Define electrolysis as the breakdown of an ionic compound, molten or in aqueous solution, by the passage of electricity.	The conductivity of liquids and aqueous solutions.	7
	4.1.2	Identify in simple electrolytic cells: (a) the anode as the positive electrode (b) the cathode as the negative electrode (c) the electrolyte as the molten or aqueous substance that undergoes electrolysis		
	4.1.3	Identify the products formed at the electrodes and describe the observations made during the electrolysis of: (a) molten lead(II) bromide (b) concentrated aqueous sodium chloride (c) dilute sulfuric acid using inert electrodes made of platinum or carbon/ graphite	The electrolysis of concentrated sodium chloride solution.	
	4.1.4	State the general principle that metal or hydrogen are formed at the negative electrode (cathode) and that nonmetal (other than hydrogen) are formed at the positive electrode (anode).		
	4.1.5	Predict the products of the electrolysis of a special binary compound in the molten state.		
	4.1.6	Outline the uses of electroplating.	Electroplating copper with nickel	
	4.1.7	Describe how metals are electroplated		

Subtopics	Learning Outcomes		Suggested teaching and learning activities + Practical work	Number of lessons
	4.1.8	Identify the products formed at the electrodes and describe the observations made during the electrolysis of aqueous copper(II) sulfate using inert carbon/ graphite electrodes and when using copper electrodes	Electrolysis of copper (II) sulfate solution.	
	4.1.9	Construct ionic half-equations for reactions at the anode (to show oxidation) and at the cathode (to show reduction).		
5. Reactivity series				
1. Reactivity series	2.1.1	State the order of the reactivity series as: potassium, sodium, calcium, magnesium, aluminium, carbon, zinc, iron, hydrogen, copper, silver, gold		12
	2.1.2	Describe the reactions, if any, of: (a) potassium, sodium and calcium with cold water (b) magnesium with steam (c) magnesium, zinc, iron, copper, silver and gold with dilute hydrochloric acid and explain these reactions in terms of the position of the metals in the reactivity series		
	2.1.3	Describe the relative reactivities of metals in terms of their tendency to form positive ions, by displacement reactions, if any, with the aqueous ions of magnesium, zinc, iron, copper and silver	Displacement reactions of metals.	
	2.1.4	Deduce an order of reactivity from a given set of experimental results		
	2.1.5	Account for the apparent unreactivity of aluminum in terms of the oxide layer which adheres to the metal		

Subtopics	Learning Outcomes		Suggested teaching and learning activities + Practical work	Number of lessons
2.Corrosion of metals	2.2.1	State the conditions required for the rusting of iron and steel to form hydrated iron(III) oxide		
	2.2.2	State some common barrier methods of rust preventing and describe how these methods prevent rusting by excluding oxygen or water		
	2.2.3	Describe the use of zinc in galvanising as an example of a barrier method and sacrificial protection		
	2.2.4	Explain sacrificial protection in terms of the reactivity series and in terms of electron loss		
2. Extraction of metals	2.2.1	Describe the ease in obtaining metals from their ores by relating the elements to the reactivity series	Extracting metals with charcoal.	
	2.2.2	Describe the essential reactions in the extraction of iron from hematite		
	2.2.3	Describe the manufacture of lime (calcium oxide) from calcium carbonate (limestone) in terms of thermal decomposition		
	2.2.4	Describe the conversion of iron into steel using basic oxides and oxygen		
	2.2.5	Describe in outline, the extraction of aluminum from bauxite including the role of cryolite and the reactions at the electrodes.		
3.Uses of metals	2.3.1	Describe the uses of metals in terms of their physical properties, including: (a) aluminium in the manufacture of aircraft because of its low density		

Subtopics	Learning Outcomes		Suggested teaching and learning activities + Practical work	Number of lessons
		(b) aluminium in the manufacture of overhead electrical cables because of its low density and good electrical conductivity (c) aluminium in food containers because of its resistance to corrosion (d) copper in electrical wiring because of its good electrical conductivity and ductility		
4.Alloys and their properties	2.4.1	Describe an alloy as a mixture of a metal with other elements, including: (a) brass as a mixture of copper and zinc (b) stainless steel as a mixture of iron and other elements such as chromium, nickel and carbon		
	2.4.2	Explain in terms of structure how alloys can be harder and stronger than the pure metals because the different sized atoms in alloys mean the layers can no longer slide over each other		
	2.4.3	Identify representations of alloys from diagrams of structure		

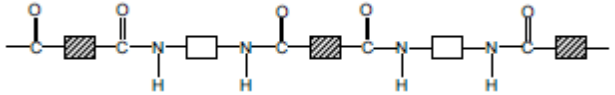
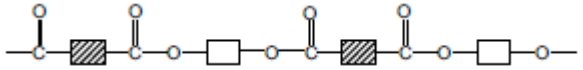
Grade 10 (Bilingual) Chemistry- Learning outcomes
Semester 2

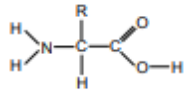
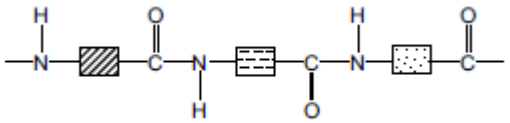
Subtopics	Learning Outcomes		Suggested teaching and learning activities + Practical work	Number of lessons
6. Organic Chemistry				
1. Formulae, functional groups and terminology	6.1.1	Describe the concept of homologous series as 'family' of similar compounds with similar chemical properties due to the presence of the same functional group.		22
	6.1.2	Identify a functional group as an atom or group of atoms that determine the chemical properties of a homologous series		
	6.1.3	Write and interpret general formulae of compounds in the same homologous series, limited to: (a) alkanes, $C_n H_{2n+2}$ (b) alkenes, $C_n H_{2n}$ (c) alcohols, $C_n H_{2n+1}OH$ (d) carboxylic acids, $C_n H_{2n+1}COOH$		
	6.1.4	State that a saturated compound has molecules in which all carbon–carbon bonds are single bonds		
	6.1.5	State that an unsaturated compound has molecules in which one or more carbon–carbon bonds are not single bonds		
	6.1.6	Describe the general characteristics of a homologous series as: (a) having the same functional group (b) having the same general formula (c) differing from one member to the next by a $–CH_2–$ unit (d) displaying a trend in physical properties (e) sharing similar chemical properties		

Subtopics	Learning Outcomes		Suggested teaching and learning activities + Practical work	Number of lessons
2. Naming organic compounds	6.2.1	Name and draw the structural and displayed formulae of unbranched: (a) alkanes (b) alkenes, including but-1-ene and but-2-ene (c) alcohols, including propan-1-ol, propan-2-ol, butan-1-ol and butan-2-ol (d) carboxylic acids containing up to four carbon atoms per molecule		
	6.2.2	State the type of compound present, given a chemical name ending in -ane, -ene, -ol, or -oic acid or from a molecular formula or displayed formula		
3. Alkanes	6.3.1	State that hydrocarbons are compounds that contain hydrogen and carbon only		
	6.3.2	Describe the properties of alkanes as being generally unreactive, except in terms of combustion and substitution by chlorine		
	6.3.3	State that in a substitution reaction one atom or group of atoms is replaced by another atom or group of atoms		
	6.3.4	Describe substitution reactions of alkanes with chlorine.		
	6.3.5	State that the bonding in alkanes is single covalent and that alkanes are saturated hydrocarbons		
4. Alkenes	6.4.1	State that the bonding in alkenes includes a double carbon–carbon covalent bond and that alkenes are unsaturated hydrocarbons		
	6.4.2	Describe the manufacture of alkenes and hydrogen by the cracking of larger alkane molecules using a high temperature and a catalyst	Cracking hydrocarbons	

Subtopics	Learning Outcomes		Suggested teaching and learning activities + Practical work	Number of lessons
	6.4.3	Describe the properties of alkenes in terms of addition reactions with: (a) bromine or aqueous bromine (b) hydrogen in the presence of a nickel catalyst (c) steam in the presence of an acid catalyst and draw the structural or displayed formulae of the products		
	6.4.4	Describe the test to distinguish between saturated and unsaturated hydrocarbons by their reaction with aqueous bromine	Alkene with Bromine water or with $KMnO_4$	
5. Fuels	6.5.1	Name the fossil fuels: coal , natural gas and petroleum		
	6.5.2	Name methane as the main constituent of natural gas		
	6.5.3	Describe petroleum as a mixture of hydrocarbons and its separation into useful fractions by fractional distillation		
	6.5.4	Describe how the properties of fractions obtained from petroleum change from the bottom to the top of the fractionating column, limited to: (a) decreasing chain length (b) higher volatility (c) lower boiling points (d) lower viscosity		
	6.5.5	Name the uses of the fractions as: (a) refinery gas fraction for gas used in heating and cooking (b) gasoline /petrol fraction for fuel used in cars (c) naphtha fraction as a chemical feedstock (d) kerosene /paraffin fraction for jet fuel (e) diesel oil/ gas oil fraction for fuel used in diesel engines		

Subtopics	Learning Outcomes		Suggested teaching and learning activities + Practical work	Number of lessons
		(f) fuel oil fraction for fuel used in ships and home heating systems (g) lubricating oil fraction for lubricants, waxes and polishes (h) bitumen fraction for making roads		
6. Alcohols	6.6.1	Describe the manufacture of ethanol by: (a) fermentation of aqueous glucose at 25–35°C in the presence of yeast and in the absence of oxygen (b) catalytic addition of steam to ethene at 300°C and 6000kPa /60 atm in the presence of an acid catalyst	The manufacture of ethanol by fermentation	
	6.6.2	Describe the advantages and disadvantages of the manufacture of ethanol by: (a) fermentation (b) catalytic addition of steam to ethene		
	6.6.3	Describe the properties of ethanol in terms of burning.		
	6.6.4	Name the uses of ethanol as a solvent and as a fuel.		
7. Carboxylic acids				
	67.1	Describe the formation of ethanoic acid by the oxidation of ethanol: (a) with acidified aqueous potassium manganate(VII) (b) by bacterial oxidation during vinegar production		
	6.7.2	Describe ethanoic acid as a typical weak acid.		
	6.7.3	Describe the reaction of ethanoic acid with: (a) metals (b) bases		

Subtopics	Learning Outcomes		Suggested teaching and learning activities + Practical work	Number of lessons
		(c) carbonates including names and formulae of the salts produced		
	6.7.4	Describe the reaction of a carboxylic acid with an alcohol in the presence of a catalyst to give an ester.	Making esters from alcohols and acids	
8. Polymers	6.8.1	Define polymers as large molecules built up from small units (monomers).		
	6.8.2	Describe the formation of poly(ethene) as an example of addition polymerisation using ethene monomers		
	6.8.3	Explain the differences between condensation and Addition polymerization		
	6.8.4	Deduce the structure of the polymer product from a given alkene and *vice versa*		
	6.8.5	Identify the repeat units and/or linkages in addition polymers and in condensation polymers		
	6.8.6	Describe the environmental challenges caused by plastics, limited to: (a) disposal in land fill sites (b) accumulation in oceans (c) formation of toxic gases from burning	Comparing the physical properties of polymers and the implications for recycling	
	6.8.7	Describe and draw the structure of: (a) nylon, a polyamide  b) PET, a polyester 		

Subtopics	Learning Outcomes		Suggested teaching and learning activities + Practical work	Number of lessons
		The full name for PET, polyethylene terephthalate, is not required		
	6.8.8	Describe proteins as natural polyamides and that they are formed from amino acid monomers with the general structure: 		
	6.8.9	Describe the structure of proteins as:  .		
7.Chemistry of the environment				
1. Water	7.1.2	Explain that distilled water is used in practical chemistry rather than tap water because it contains fewer chemical impurities		5
	7.1.3	Describe the treatment of the domestic water supply in terms of: (a) sedimentation and filtration to remove solids (b) use of carbon to remove tastes and odours (c) chlorination to kill microbe		
2. Air quality and climate	7.2.1	State the composition of clean, dry air as being approximately 78% nitrogen, 21% oxygen and the remainder as being a mixture of noble gases and carbon dioxide		

Subtopics	Learning Outcomes		Suggested teaching and learning activities + Practical work	Number of lessons
	7.2.4	State the source of each of these air pollutants, limited to: (a) carbon dioxide from the complete combustion of carbon-containing fuels (b) carbon monoxide and particulates from the incomplete combustion of carbon-containing fuels (c) methane from the decomposition of vegetation and waste gases from digestion in animals (d) oxides of nitrogen from car engines (e) sulfur dioxide from the combustion of fossil fuels which contain sulfur compounds		
	7.2.5	Explain how oxides of nitrogen form in car engines and describe their removal by catalytic converters, e.g. $2CO + 2NO \rightarrow 2CO_2 + N_2$		
	7.2.6	State the adverse effect of these air pollutants, limited to: (a) carbon dioxide: higher levels of carbon dioxide leading to increased global warming, which leads to climate change (b) carbon monoxide: toxic gas (c) particulates: increased risk of respiratory problems and cancer (d) methane: higher levels of methane leading to increased global warming, which leads to climate change (e) oxides of nitrogen: acid rain, photochemical smog and respiratory problems (f) sulfur dioxide: acid rain		

Subtopics	Learning Outcomes		Suggested teaching and learning activities + Practical work	Number of lessons
	7.2.8	State and explain strategies to reduce the effects of these environmental issues, limited to: (a) climate change: planting trees, reduction in livestock farming, decreasing use of fossil fuels, increasing use of hydrogen and renewable energy, e.g. wind, solar (b) acid rain: use of catalytic converters in vehicles, reducing emissions of sulfur dioxide by using low-sulfur fuels and flue gas (c) desulfurisation with calcium oxide		
3. Nitrogen and fertilizers	7.3.1	State that ammonium salts and nitrates are used as fertilisers		
	7.3.2	Describe the use of NPK fertilisers to provide the elements nitrogen, phosphorus and potassium for improved plant growth		

Yearly plan

Semester 1 (YEAR 9)	Semester 2 (YEAR 9)	Semester 1 (YEAR 10)	Semester 2 (YEAR 10)
1. The particulate nature of matter. **2.** Experimental techniques **3.** The Periodic Table **4.** Atoms, elements and compounds	**5.** Chemical reactions **6.** Stoichiometry **7.** Acid, base and salts **8.** Identification of ions and gases	1. Chemical energetic 2. Chemical reactions 3. Redox 4. electrolysis 5. Reactivity series	6. Organic Chemistry 7. Chemistry of the environment

Resources for teachers to upgrade their knowledge and skills

www.chemguide.co.uk
www.xtremepapers.com
www.nclark.net > chemistry
www.ocr.org.uk
www.rsc.org
www.chemcollective.org
http://phet.colorado.edu/

References:

1. Bloom's Taxonomy of action verbs: http://www.educatorstechnology.com.
2. Cambridge IGCSE chemistry syllabus (0620). 2016. Cambridge International Examinations, United Kingdom. www.cie.org.uk
3. Cambridge IGCSE chemistry syllabus (0620). 2020. Cambridge International Examinations, United Kingdom. www.cie.org.uk
4. Chemistry for Cambridge IGCSE, fifth edition, Richard Harwood, Ian Lodge & Chris Millington. Cambridge University Press. 2021
5. Cambridge IGCSE Chemistry, Fourth edition, Bryan Earl and L. D. R. Wiford. Hodder education, 2021.
6. Cambridge IGCSE Chemistry, Chris Sunley and Sam Goodman. Collins, 2021.
7. Cambridge IGCSE Chemistry, Tan YinToon, Chen Ling Kwong, and John Sadler. Marshall Cavendish Education, 2021.
8. Cambridge IGCSE & O level Complete Chemistry, Fourth edition, RoseMarie Gallagher, Paul Ingram, Livien Khor, Nerissa Puntawe and Suriyani Rahamat. Oxford University Press, 2021.
9. Cambridge IGCSE & O level Complete Chemistry, Fourth edition, RoseMarie Gallagher, Paul Ingram, Livien Khor, Nerissa Puntawe and Suriyani Rahamat. Oxford University Press, 2021.
10. Cambridge IGCSE & O level Essential Chemistry, Fourth edition, Roger Norris, Lawrie Ryan (Ed.), Onn May Ling (Ed.), Mei Chew (Ed.), Bhavna Narayanan (Ed.). Oxford University Press, 2021.
11. Chemistry Syllabus, Caribbean Examinations Council, Caenwood Centre, Jamaica, 2013. www.cxc.org
12. Essential knowledge and skill statements. www. bradford-pathways.org.uk
13. https://education.ohio.gov/getattachment/Topics/Teaching/Educator-Evaluation-System/How-to-Design-and-Select-Quality-Assessments/DOK-Compared-to-Blooms-Taxonomy.pdf.aspx
14. https://www.csun.edu/science/ref/reasoning/questions_blooms/blooms.html
15. Oxford AQA International GCSE Chemistry Syllabus (9202). 2015. Version 1.0. Oxford International AQA Examinations, United Kingdom. oxfordaqaexams.org.uk
16. Science/chemistry Standards in Qatar. Ministry of education and higher education, Qatar. http://www.edu.gov.qa.

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End of Chemistry Syllabus