Syllabus	الإطار المنهجي
Chemistry	مادة الكيمياء
Bilingual Program	برنامج ثنائي اللغة
Grade: 11-12	الصف: ١١–١٢
2021/2022	٢٠٢١/٢٠٢٢

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 develop 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 validations and making sure of the suitability of the subject.
3. Apply scientific knowledge and procedures to the situations of the reality Life.
4. Recognize 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 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 the internet, DVDs and CD-ROMs.
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.
5. Using distance learning programs and platforms.

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. • Consider 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.
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.

الإطار المنهجي للصف الحادي عشر

Grade 11 Syllabus

Grade 11 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.
3. Appreciate, understand, and use methods of science.
4. See the relevance of Chemistry to everyday life.
5. Appreciate and understand the role of Chemistry in enabling materials to be used in the service of mankind.
6. Understand basic chemical concepts in sufficient depth to provide an adequate foundation for specialization.
7. Develop the spirit of inquiry and to continue the search for new ways in which materials may be used in the service of mankind.
8. Make use of chemical data, concepts, principles, and terminology in communicating chemical information.

How to use grade 11 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.

The numbering key: [Unit – Topic –Learning outcome]
e.g. Unit 1. (1. Atoms, molecules, and stoichiometry); Topic 1 (1.1 Relative masses of atoms and molecules); and a) is the first learning outcome (a) Define and use the terms relative atomic, isotopic, molecular and formula masses, based on the 12C scale.).

- **Practical experiments and activities:**

Show some examples of active learning activities and do not represent full -scale activities 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 explained in details in the student text book and in the teacher guide and training students in practical skills related to them. The teachers should get benefit from the student text book, teacher's resources pack from Hodder Education and teacher's digital resources from Cambridge that are recommended by MoE in the approved books list.

- **Resources for teachers to upgrade their knowledge and skills**

The main resources for the teachers are the text book and the teacher's guides. The two recommended teacher's guides in the approved books list (teacher's resources pack) from Hodder Education and teacher's digital resources from Cambridge provide the needed support for the teachers. They include the following:

1) Teaching guide for each chapter includes teaching plan for the chapter with resources available for each topic in the chapter, introduction about the topic, topic summary, suggested teaching methods, key terms, common misunderstandings and

misconceptions, methods for supporting struggling students, methods for challenging high achievers, homework suggestions and suggested activities and practical.
2) Answers to examination style questions (end-of-chapter questions).
3) Extra activities.
4) Homework with answer scheme.
5) Practical guidance.
6) Suggested websites.
7) Revision checklist.
8) Interactive tests.
9) Copies of diagrams and tables from text book.
10) Useful appendix.

There is also a list of approved supplementary resources for teachers that support them in their teaching. These resources include:

1) Cambridge international AS & A Level Complete Chemistry from Oxford University press which is **compulsory** for all teachers.
2) Chemistry for Cambridge international AS & A Level practical workbook from Cambridge University press which is **compulsory** for all teachers.
3) Chemistry for Cambridge international AS & A Level workbook from Cambridge University press which is **optional** for teachers.
4) Cambridge international AS & A Level Chemistry practical skills from Hodder Education which is **optional** for teachers.
5) Cambridge international AS & A Level Chemistry Students book whiteboard e-textbook from Hodder Education which is **optional** for teachers.

Some other resources as websites are listed in this syllabus can provide support for teachers for this syllabus. The range of resources covers a large area of this syllabus so it is well worth exploring these sites before the course starts to discover relevant resources that can be used or recommended to students when appropriate.

Grade 11 (Bilingual) Chemistry - Learning outcomes SEMESTER ONE			
Physical chemistry			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
1. **Atoms, molecules and stoichiometry**			
1.1 Relative masses of atoms and molecules	a) Define and use the terms relative atomic, isotopic, molecular and formula masses, based on the 12C scale.		1
1.2 Hydrated and anhydrous compounds	a) Understand and use the terms anhydrous, hydrated and water of crystallization.		1
1.3 The mole and the Avogadro constant	a) Define and use the term mole in terms of the Avogadro constant.		1
1.4 The calculation of empirical and molecular formulae	a) Define and use the terms empirical and molecular formula. b) Calculate empirical and molecular formulae, using combustion data or composition by mass.	**Exp1**: Finding the formula of hydrated copper sulfate	2
1.5 Reacting masses and volumes (of solutions and gases)	a) Write and construct balanced equations. b) Perform calculations, including use of the mole concept, involving: i. reacting masses (from formulae and equations). ii. volumes of gases (e.g. in the burning of hydrocarbons) iii. volumes and concentrations of solutions. iv. Limiting reagent and excess reagent. c) Deduce stoichiometric relationships from calculations such as those in 1.4(b).	**Exp2**: Using precipitates to work out chemical equations	4

Grade 11 (Bilingual) Chemistry - Learning outcomes SEMESTER ONE			
Physical chemistry			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
2. Atomic structure			
2.1 Particles in the atom	a) Identify and describe protons, neutrons and electrons in terms of their relative charges and relative masses. b) Deduce the numbers of protons, neutrons and electrons present in both atoms and ions given proton and nucleon numbers and charge.		2
2.2 Electrons: energy levels, atomic orbitals, ionization energy, electron affinity	a) Describe the number and relative energies of the *s*, *p* and *d* orbitals for the principal quantum numbers 1, 2 and 3 and the 4*s* and 4*p* orbitals. b) Describe and sketch the shapes of *s* and *p* orbitals. c) State the electronic configuration of atoms and ions given the proton number and charge, using the convention $1s^2$, $2s^2$, $2p^6$, etc. d) Explain and use the term ionization energy. e) Explain the factors influencing the ionization energies of elements. f) Explain the trends in ionization energies across a period and down a group of the Periodic Table. g) Deduce the electronic configurations of elements from successive ionization energy data. h) Interpret successive ionization energy data of an element in terms of the position of that element within the Periodic Table. i) Describe qualitatively (and indicate the periodicity in) the variations in atomic radius, ionic radius, melting point and electrical conductivity of the elements (group 2 and period 3 as examples). j) Explain qualitatively the variation in atomic radius and ionic radius.		10

Grade 11 (Bilingual) Chemistry - Learning outcomes SEMESTER ONE			
Physical chemistry			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
3. **Bonding in simple molecules**			
3.1 Covalent bonding / shapes & angles 3.2 Polarity of molecules	a) Understand the meaning of covalent bonding and dative bonding. b) Understand the concept of electronegativity and apply to explain the properties of molecules as bond polarity and dipole moments. c) Explain the shapes of and bond angles in molecules using model of electron-pair repulsion (including lone pairs) using simple example: BF_3, CO_2, CH_4, NH_3, H_2O, SF_6, PF_5. d) Describe hydrogen bonding using ammonia, hydrogen fluoride and water and its importance to the physical properties of substances. e) Know the terms *bond energy, bond length, bond polarity* and use them to compare relativities of covalent bonds. f) Describe intermolecular forces based on permanent and induced dipoles.		6
4. **Acid and base**			
4.1 Ionic equilibria	a) Show understanding of and Use, the Bronsted-Lowry theory of acids and bases, including the use of the Acid-I Base-I, acid-II base-II concept *(Conjugate Acid –Base pair).* b) Explain qualitatively the differences in behavior between strong and weak acids and bases and the pH values of their aqueous solutions in terms of the extent of dissociation. c) Introduce the concept of K_a, K_b, pK_a and pK_b and K_w. d) Finding the concentration of acid or base by titration.	**Exp3:** Making a standard solution of Na_2CO_3 (0.100 mol dm^{-3}) **Exp4:** Finding the concentration of HCl by titration with standard Na_2CO_3 (0.100 mol dm^{-3})	6

Grade 11 (Bilingual) Chemistry - Learning outcomes SEMESTER ONE			
Physical chemistry			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
5. **Rate of reaction**			
5.1 Rate of reaction	a) Construct and interpret a reaction pathway diagram, in term of the enthalpy change of the reaction of the activation energy. b) Explain and use the term rate of reaction. c) Explain qualitatively, in terms of collisions, the effect of concentration changes on the rate of a reaction. d) Explain and use the term activation energy, including reference to the Boltzmann distribution. e) Explain qualitatively, in term both of the Boltzmann distribution and collision frequency, the effect of temperature changes on the rate of a reaction. f) Explain and use the term catalysis. g) Explain that catalysis can be homogeneous or heterogeneous. h) Explain that, in the presence of a catalysis, a reaction has a different mechanism.	Any related experiment	6
6. **Equilibria**			
6.1 Chemical equilibria: reversible reactions; dynamic equilibrium	a) Explain, in terms of rates of the forward and reverse reactions, what is meant by a reversible reaction and dynamic equilibrium. b) State Le Chatelier's principle and apply it to deduce qualitatively (from appropriate information) the effects of changes in temperature, concentration or pressure on a system at equilibrium. c) State whether changes in temperature, concentration or pressure or the presence of a catalyst affect the value of the equilibrium constant for a reaction. d) Deduce expressions for equilibrium constants in terms of concentrations, K_c, and partial pressures, K_p (***treatment of the relationship between Kp and K_c is not required)***.	**Exp5:** Reversible reaction **Exp6**: Equilibrium and Le Chatelier's principle (Effect of Temperature on the position of equilibrium)	16

Grade 11 (Bilingual) Chemistry - Learning outcomes SEMESTER ONE			
Physical chemistry			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
	e) Calculate the values of equilibrium constants in terms of concentrations or partial pressures from appropriate data. f) Calculate the quantities present at equilibrium, given appropriate data (such calculations will not require the solving of quadratic equations). g) Describe and explain the conditions used in the Haber process and the contact process, as examples of the importance of an understanding of chemical equilibrium in the chemical industry. * *Note Processes are not in detail*		

Grade 11 (Bilingual) Chemistry - Learning outcomes SEMESTER TWO			
Organic chemistry			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
7. **Introduction to organic chemistry**			
7.1 Formulae, functional groups and the naming of organic compounds	a) Interpret and use the general, structural, displayed and skeletal formulae of the following classes of compound: i. Alkanes and alkenes. ii. Halogenoalkanes. iii. Alcohols (including primary, secondary and tertiary). iv. Aldehydes and ketones *(functional isomerism).* v. Carboxylic acids and esters. vi. Amines (primary only), nitriles. *(Candidates will be expected to recognize the shape of the benzene ring when it is present in organic compounds).* b) Understand and use systematic nomenclature of simple aliphatic organic molecules with functional groups detailed in this syllabus up to six carbon atoms ***(six plus six for esters and amides, straight chains only).*** c) Deduce the possible isomers for an organic molecule of known molecular formula. Deduce the molecular formula of a compound, given its structural, displayed or skeletal formula.	**Exp8**: Comparing the rates of hydrolysis of halogenoalkanes by aqueous silver nitrate	10
7.2 Isomerism: structural and stereoisomerism	a) Describe structural isomerism and its division into chain, positional and functional group isomerism *exclusively ester and carboxylic acid and aldehyde and ketone).* b) Describe stereoisomerism and its division into geometrical (cis-trans)		2

Grade 11 (Bilingual) Chemistry - Learning outcomes SEMESTER TWO			
Organic chemistry			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
8. **Alkanes**			
8.1 Alkanes	a) Explain the general unreactivity of alkanes, including towards polar reagents. b) Describe the chemistry of alkanes as exemplified by the following reactions of ethane: i. Combustion. ii. Substitution by chlorine and by bromine. c) Describe the mechanism of free radical substitution at methyl groups with particular reference to the initiation, propagation and termination reactions. (The mechanism of the reaction of chlorine and bromine with methane).		4
9. **Alkenes**			
9.1 Alkenes	a) Describe the chemistry of alkenes as exemplified, where relevant, by the following reactions of ethene and propene (including the Markovnikov's addition of asymmetric electrophiles to alkenes using propene as an example). i. Addition of hydrogen, steam, hydrogen halides and halogens. ii. Oxidation by cold dilute acidified manganate (VII) ions to form the diols. b) Explain the mechanism of addition of bromine to ethene.		4
10. **Halogenoalkanes**			
10.1 Halogenoalkanes	a) Recall the chemistry of halogenoalkanes as exemplified by: i. The following nucleophilic substitution reactions of bromoethane: Hydrolysis, formation of nitriles, formation of primary amines by reaction with ammonia. ii. The elimination of hydrogen bromide from 2-bromopropane.		6

Grade 11 (Bilingual) Chemistry - Learning outcomes SEMESTER TWO			
Organic chemistry			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
11. **Alcohols**			
11.1 Alcohols	a) Draw and classify alcohols into primary, secondary and tertiary b) Recall the chemistry of alcohols in the following reactions: i. Classify alcohols into primary, secondary and tertiary alcohols. ii. Combustion. iii. Substitution to give halogenoalkanes. iv. Dehydration to alkenes. c) Deduce the presence of a $CH_3CH(OH)$– group in an alcohol from its reaction with alkaline aqueous iodine to form tri-iodomethane.	**Exp9**: Oxidation of Alcohols Using Acidified Oxidizing Agents	6
12. **Aldehydes and Ketones**			
12.1 Aldehydes and Ketones	a) Describe: i. The formation of aldehydes and ketones from primary and secondary Alcohols respectively using $Cr_2O_7^{2-}/H^+$. ii. The reduction of aldehydes and ketones, e.g., using $NaBH_4$ or $LiAlH_4$. iii. The reaction of aldehydes and ketones with HCN and NaCN. b) Describe the mechanism of the nucleophilic addition reactions of hydrogen cyanide with aldehydes and ketones. c) Distinguish between aldehyde and ketone by using Fehling's and Tollens' reagents. d) Describe the reaction of CH_3CO– compounds with alkaline aqueous iodine to give tri-iodomethane.	**Exp11:** Testing Ketones Using Iodine Alkaline Solution (Iodoform Reaction	8
13. **Carboxylic acids**			
13.1 Carboxylic acids	a) Describe the formation of carboxylic acids from alcohols, aldehydes and nitriles. b) Describe the reactions of carboxylic acids in the formation of: i. Salts, by the use of reactive metals, alkalis or carbonates. ii. Alkyl esters. iii. Alcohols, by use of $LiAlH_4$.	**Exp10**: Reaction of Alcohol with Carboxylic Acids (Esterification)	4

Yearly plan for grade 11

	Grade 11– semester one		Grade 11– semester two
1	Atoms, molecules and stoichiometry	7	An introduction to organic chemistry
2	Atomic structure	8	Alkanes
3	Bonding in simple molecules	9	Alkenes
4	Acids and Bases	10	Halogenoalkanes
5	Rates of Reaction	11	Alcohols
6	Equilibria	12	Aldehydes and Ketones
		13	Carboxylic acids

Resources for teachers to upgrade their knowledge and skills

Teacher support	http://www.cie.org.uk/teaching-and-learning/
How to teach	https://www.international.heacademy.ac.uk/
Past paper resource	http://papers.xtremepapers.com/CIE www.s-cool.co.uk/
Teaching strategies	http://www.teachthought.com/pedagogy/instructional-strategies/50-teaching-strategies-to-jumpstart-your-teacher-brain/

References:

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3. Cambridge International AS and A Level Chemistry, Peter Cann and Peter Hughes. Hodder education, 2015.
4. Cambridge International AS and A Level Chemistry, Teacher's CD, Peter Cann and Peter Hughes. Hodder education, 2015
5. Cambridge International AS and A Level Chemistry, second edition, Lawrie Ryan and Roger Norris. Cambridge University Press. 2014
6. Cambridge International AS and A Level Chemistry, Teacher's resource CD-ROM, Mike Wooster, Lawrie Ryan and Roger Norris. Cambridge University Press. 2014.
7. Chemistry Syllabus, Caribbean Examinations Council, Caenwood Centre, Jamaica, 2013. www.cxc.org
8. Chemistry in context for Cambridge International AS and A level, sixth edition, 2015, Graham Hill and John Holman, Oxford University Press.
9. Essential knowledge and skill statements. www. bradford-pathways.org.uk
10. https://education.ohio.gov/getattachment/Topics/Teaching/Educator-Evaluation-System/How-to-Design-and-Select-Quality-Assessments/DOK-Compared-to-Blooms-Taxonomy.pdf.aspx.
11. https://www.csun.edu/science/ref/reasoning/questions_blooms/blooms.html
12. International AS and A-level Chemistry syllabus (9620). 2016. Version 1.0. Oxford International AQA Examinations, United Kingdom. oxfordaqaexams.org.uk

الإطار المنهجي للصف الثاني عشر

Grade 12 Syllabus

Grade 12 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.
3. Appreciate, understand and use methods of science.
4. See the relevance of Chemistry to everyday life.
5. Appreciate and understand the role of Chemistry in enabling materials to be used in the service of mankind.
6. Understand basic chemical concepts in sufficient depth to provide an adequate foundation for specialization.
7. Develop the spirit of inquiry and to continue the search for new ways in which materials may be used in the service of mankind.
8. Make use of chemical data, concepts, principles and terminology in communicating chemical information.

How to use grade 12 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.

The numbering key :[Unit – Topic –Learning outcome]

1.1 e.g. **Unit 1**. (1. An introduction to the chemistry of transition elements); **Topic 1** (1.1 General physical properties of the first set of transition elements, titanium to copper); and **a) is the first learning outcome** (a) Explain what is meant by a transition element, in terms of d-block elements forming one or more stable ions with incomplete d orbitals).

- **Practical experiments and activities:**

Show some examples of active learning activities and do not represent full -scale activities 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 explained in details in the student text book and in the teacher guide and training students in practical skills related to them. The teachers should get benefit from the student text book, teacher's guide (CD) from Hodder Education and teacher's resource CD-ROM from Cambridge that are recommended by MOE in the approved books list.

- **Resources for teachers to upgrade their knowledge and skills**

The main resources for the teachers are the text book and the teacher's guides. The two recommended teacher's guides in the approved books list (teacher's guide (CD) from Hodder Education and teacher's resource CD-ROM from Cambridge) provide the needed support for the teachers. They include the following:

11) Teaching guide for each chapter includes teaching plan for the chapter with resources available for each topic in the chapter, introduction about the topic, topic summary, suggested teaching methods, key terms, common misunderstandings and misconceptions, methods for supporting struggling students, methods for challenging high achievers, homework suggestions and suggested activities and practical.
12) Answers to examination style questions (end-of-chapter questions).
13) Extra activities.

14) Homework with answer scheme.
15) Practical guidance.
16) Suggested websites.
17) Revision checklist.
18) Interactive tests.
19) Copies of diagrams and tables from text book.
20) Useful appendix.

Some other resources as websites are listed in this syllabus can provide support for teachers for this syllabus. The range of resources covers a large area of this syllabus so it is well worth exploring these sites before the course starts to discover relevant resources that can be used or recommended to students when appropriate.

Chemistry Grade 12 (Bilingual) - Learning outcomes SEMESTER ONE			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
Inorganic Chemistry			
1. Introduction to the chemistry of transition elements			
1.1 General physical properties of the first set of transition elements	a) Explain what is meant by a transition element, in terms of *d*-block **elements forming one or more stable ions with an incomplete d orbital**. b) Explain why Sc and Zn are not transitional elements. c) State the electronic configuration, using Argon core and energy boxes as well, of each of the first row of transition elements and of their ions. **[the student must know that the order of energy levels 4*s* < 3*d* holds only as far as Calcium. From Sc to Zn, the 3*d* could be written before 4*s*. This is because when electron start filing the 3d its energy decreases faster than the decrease rate of 4*s* energy. Moreover, when 3*d* elements lose electrons, 4*s* loses first. However, 4*s* could be written before 3d because the 4*s* has lower energy than 3d when 3*d* is empty.** d) Write the electronic configuration of Cr and Cu and explain these exceptions. e) Contrast, qualitatively, the melting points and densities of the transition elements with those of calcium as a typical s-block element. The student has to understand what happens to the atomic size/radii across the period from Sc to Zn, so they will be able to explain the change in density. f) Describe the tendency of transition elements to have variable oxidation states . g) State the electronic configuration for a given transition atoms or ions. h) Predict from a given electronic configuration, the likely oxidation states of a transition element. Highest Oxidation State for a Transition metal = Number of Unpaired d-electrons + 2 s-orbital electrons. **<u>Note this can be implemented from Sc to Mn only</u>**		6

Chemistry Grade 12 (Bilingual) - Learning outcomes SEMESTER ONE			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
1.2 General chemical properties of the first set of transition elements, titanium to copper	a) Define the terms: ligand and complex ion. b) Work out the oxidation number of transition metals in complexes containing the following ligands; H_2O, NH_3, OH^-, CN^-, SCN^-, Cl^-. c) Explain why transition metals can form complex ions. d) Describe the coordination sphere of transition metal complexes as linear, octahedral, tetrahedral, or square planar [Describe and draw the shapes of complex ions with 6,4 and 2 coordination numbers. [use platinum and $[Ni(CN)_4]^{2-}$ only as example of square planar, draw *cis* and *trans* isomers of platinum only]. e) Describe and explain the reactions of transition elements with ligands to form complexes, including the complexes of copper (+2) and cobalt (+2) ions with water and ammonia molecules and hydroxide and chloride ions [concentrated HCl]. f) Note: The colors of solutions should be discussed and provided to the students. Annex no.1 shows the reactions required. g) Classify complexes as Monodentate and Bidentate [Bidentate examples ethylene diamine (en) and ethane dioate (ox). The student must draw each for copper and iron only.	**Practical 24.2** Complexes and ligand exchange **Practical 24.1** Precipitation of hydroxides of copper (+2), iron (+2) and iron(+3).	5
Organic Chemistry			
2. **Arenes and Phenols**			
2.1 Arenes and phenols	a) Draw and name according to the IUPAC system the structural, displayed and skeletal formulae of the following classes of compound: i. Arenes ii. Halogenoarenes iii. Phenols b) Systematically, name simple aromatic molecules with **one** benzene ring and one or more simple substituents or functional groups like: Cl, Br, I, alkyl groups, OH, COOH, NO_2, NH_2, CHO, COC. c) Draw positional isomers of benzene [ortho, meta and para]		10

Chemistry Grade 12 (Bilingual) - Learning outcomes SEMESTER ONE			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
	d) Describe and explain the shape of, and bond angles in benzene molecules in terms of σ and π bonds. **Support the idea of benzene structure from the X-ray model.** e) Discuss the physical properties of benzene. f) Describe the chemistry of arenes as exemplified by the following reactions of benzene: I. Substitution reactions with • Chlorine • Bromine. • Nitration • Friedel-Craft's alkylation and acylation. II. Complete oxidation of the sidechain to give a benzoic acid. III. Addition reactions discussing the following reactions specifically; • Hydrogenation of the benzene ring to form a cyclohexane ring. **[The orientation effect of different substituents is not required]** g) Describe the mechanism of electrophilic substitution in arenes, as exemplified by the formation of nitrobenzene, bromobenzene, chlorobenzene, alkyl benzene and acyl benzene. Note: **[no need to discuss the mesomers in the mechanism]** h) Interpret the difference in reactivity between benzene and chlorobenzene, nitrobenzene and phenol. i) Predict whether halogenation will occur in the sidechain or in the aromatic ring in arenes depending on reaction conditions. j) Discuss phenol in term of the followings: i. Naming phenols systematically ii. Reaction of phenol with Na, NaOH, 3 moles of Br_2 and 3 moles of Cl_2.		

Chemistry Grade 12 (Bilingual) - Learning outcomes SEMESTER ONE			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
Organic Chemistry			
3. **Carboxylic acids**			
3.1 Carboxylic acids	g) Draw and name according to the IUPAC system some carboxylic acids with some substituents like [OH, Cl, Br, I, and alkyl groups] h) Describe the reactions of carboxylic acids in the following terms: • Formation of salts, by the use of reactive metals, alkalis or carbonates. • Formation of esters. • Reduction of carboxylic acids to alcohols, by use of $LiAlH_4$. i) Recognise and explain that some carboxylic acids can be further oxidised: • the oxidation of methanoic acid, HCO_2H, with Fehling's and Tollens' reagents • the oxidation of ethanedioic acid, HO_2CCO_2H, with warm acidified manganate (VII). j) Explain the relative acidities of carboxylic acids, phenols and alcohols. k) Use the concept of **electronegativity** to explain the acidities of chlorine-substituted ethanoic acids. Discuss the meaning of Ka and pKa related to acidity. l) Describe the formation of carboxylic acids from nitriles	Practical 26.1 The reactions of carboxylic acids with metals, carbonates	6
3.2 Acyl chlorides	a) Name and draw some acyl chloride generally according to IUPAC rules. b) Describe the reactions of carboxylic acids to make acyl chlorides using PCl_5, $SOCl_2$ and PCl_3 c) Discuss the physical properties of acyl chlorides. d) Describe the hydrolysis of acyl chlorides and compare it with hydrolysis of chloroalkanes. e) Describe the reactions of acyl chlorides with alcohols, phenols, ammonia and primary amines [nucleophilic substitution reactions]. f) Explain the relative ease of hydrolysis of acyl chlorides, alkyl chlorides and aryl chlorides. g) Explain the mechanism of nucleophilic substitution of acyl chlorides with ammonia, and water		6

Chemistry Grade 12 (Bilingual) - Learning outcomes SEMESTER ONE			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
Organic Chemistry			
4. **Nitrogen Compounds**			
4.1 Primary amines	e) Distinguish between amines, amides, nitriles and amino acids [in term of the functional groups] f) Draw and name some primary amines, amides and nitriles following IUPAC rules Classify amines to primary, secondary and tertiary using different examples [use structural, displayed and skeletal formulae] g) Describe the formation of alkyl amines by; • the reaction of ammonia with halogenoalkanes • the reduction of amides with LiAlH4 • the reduction of nitriles with LiAlH4 or H2/Ni) • the reduction of nitrobenzene with tin/concentrated HCl) to form phenyl amine. h) Explain the relative basicity of ammonia, ethylamine, diethylamine and phenyl amine in terms of their structures. [discuss the availability of lone pair of electrons, the electron donating groups such as alkyl groups and the electron withdrawing group such as benzene. [no need to discuss the basicity of tertiary amines] i) Describe the reactions of amines as bases [with water and HCl] j) Explain that NH_2 is an electron donating group, so it increases the electron density of the delocalised ring of benzene. As a result, the positions 2,4 and 6 are directed. k) Describe the reaction of phenyl amine with: • aqueous bromine • nitrous acid to give the diazonium salt and phenol. l) Describe the coupling of benzenediazonium chloride and phenol and the use of similar reactions in the formation of dyestuff.[no need to discuss the colours	Try to find different classes of amines and make reactions between them and water, then check the solutions produced in term of pH and the effect on litmus papers.	6
4.2 Amides and amino acids	a) Explain the properties of amides and recognise that they are neutral b) Draw the hydrogen bonding between amides' molecules c) Describe the formation of amides from the reaction between NH_3 or RNH_2 and RCOCl. d) Describe the hydrolysis of amide by acid such as HCl or by alkali such as NaOH. e) Discuss the meaning of amino acids using Glycine, Alanine and Serine as examples f) Explain the physical properties of amino acids in term of zwitterion. g) Explain the acid/base properties of amino acids and the formation of zwitterions. h) Describe the formation of peptide bonds between amino acids to give di- and tri-peptides. i)		6

Chemistry Grade 12 (Bilingual) - Learning outcomes SEMESTER ONE			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
Organic Chemistry			
5. **Polymers**			
5.1 Polymers and addition polymerisation	a) Discuss the formation of polyethene **[the mechanism is not required]** b) Use different examples of addition polymers to demonstrate the meaning of polymers. c) Explain the meaning of polymerisation in general d) Discuss the addition polymerisation using different example **[uses of polymers are not required]** e) Deduce the monomers of a given structure of addition polymer.		2
5.2 Polymers and condensation Polymerisation	a) Describe the formation of i. Polypeptide eg. any Protein ii. Polyamide eg. Nylon 6,6, Nylon 6,10, and Kevlar iii. Polyester eg. Terylene and Polylactice acid b) Describe the effect of the polar groups in condensation polymers like Kevlar, Nylon and Terylene c) Draw the intermolecular forces between the polar groups of polyamide polymer chains. d) Deduce the repeat unit/s of a condensation polymer obtained from a given structure.		3
5.3 Polymers and our lives	a) Discuss the following polymers briefly • Conducting polymers [draw the monomer and the polymer of polyethyne. Deduce that the conducting polymer should have a delocalized electron]. State some uses of conducting polymers] • Teflon. [discuss its properties and why it is non-sticking surface b) Discuss the uses of Kevlar		1

Chemistry Grade 12 (Bilingual) - Learning outcomes SEMESTER TWO			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
Physical Chemistry			
6. Chemical energetics			
6.1 Enthalpy change	a) Explain that chemical reactions are accompanied by energy changes, principally in the form of heat energy. b) The energy changes can be exothermic (ΔH is negative) or endothermic (ΔH is positive) c) Explain the energy profiles of exothermic and endothermic reactions. d) State that when bonds break energy is required, while energy is released when bonds form. Give some examples to demonstrate these definitions. e.g. ❖ The lattice dissociation enthalpy is the enthalpy change needed to convert 1 mole of solid crystal into its scattered gaseous ions. Lattice dissociation enthalpies are always positive. ❖ The lattice formation enthalpy is the enthalpy change produced when 1 mole of solid crystal is formed from its scattered gaseous ions. Lattice formation enthalpies are always negative. e) Explain the terms of enthalpy change of reaction and standard conditions, with particular reference to: i. Solution ii. Neutralisation iii. Combustion iv. Formation v. Atomisation vi. Hydration	**Practical 6.1** Finding an enthalpy change of reaction. **Note**: **Practical 6.2** Finding an enthalpy change of combustion. **Practical 6.3** Finding the enthalpy change of neutralization.	6

Chemistry Grade 12 (Bilingual) - Learning outcomes SEMESTER TWO			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
	f) Calculate enthalpy changes from appropriate experimental results, including the use of the relationship enthalpy change, (**$n.\Delta H = -m.c.\Delta T$). [n stands for moles; m stands for water mass and T stands for temperature].** With reference to i. Solution ii. Neutralisation iii. Combustion **Notes** ➢ **All calculations should be rounded to three decimal places.** ➢ **In giving questions make sure that the mass of solute should be small [not more that 10 % of the water]** ➢ **The mass of solution should be considered the mass of water, so the specific heat capacity of the solution is 4.18 J/g.^{o}C** ➢ **Water density is 1g/cm^{3}**		
6.2 Hess's Law	a) State the Hess's law b) Apply Hess' Law to construct simple energy cycles, and carry out calculations involving such cycles and relevant energy terms, with particular reference to determining enthalpy changes that cannot be found by direct experiment e.g. ❖ enthalpy changes of formation ❖ enthalpy changes of combustion c) Implement Hess's law using summation equations method for different reactions		8

Chemistry Grade 12 (Bilingual) - Learning outcomes SEMESTER TWO			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
Physical Chemistry			
7. **Quantitative Kinetics**			
7.1 Rate of reactions	d) Explain the following terms i. rate equation ii. order of reaction iii. rate constant iv. half-life of a reaction e) Write the formula of rate of reaction and find out its unit. [use the products concentrations and reactants concentrations and explain why a negative sign should be added to the formula when using the reactants' concentrations] f) Analyse the graphs of zero order, first order and second order and explain the half-life in each g) Show that the half-life of a first-order reaction is independent of concentration. h) Work out the order of reaction from a **given graph** [zero order, first order and second order only] i) Work out the order of reaction from **a given data** [zero order, first order and second order only] j) Work out the rate of reaction from a given data using the formula **(rate = K $[R_1]^n [R_2]^m$)** **[R stands for reactants, n and m are the orders of R_1 and R_2 respectively** k) Calculate the numerical value of a rate constant from a set of given data l) Work out the initial rate of a reaction from a given graph, by drawing a tangent from the initial time [t0], then work out the **gradient** using the following formula $$R = \frac{[Conc_2 - Conc_1]}{[t_2 - t_1]}$$	**Practical 22.1** Finding the order of reaction with respect to the concentration of $H^+_{(aq)}$ ions for an acid –carbonate reaction **Note: you can use your own method**	6

Chemistry Grade 12 (Bilingual) - Learning outcomes SEMESTER TWO			
Topic	**Learning objectives**	**Practical activities**	**Number of lessons**
Physical Chemistry			
8. **Quantitative Equilibria**			
8.1 Acid base equilibrium	a) Recall the definition of equilibrium. b) Write the dissociation reaction of water. c) Write the expression of K_w then work out its unit. d) State that the only factor that affects the value of K_w is temperature. e) Write the expressions of K_a and K_b then work out their units. f) Work out the values of K_a and K_b for weak acids and weakbases, respectively. g) Calculate the values of $[H^+ (aq)]$ and $[OH^- (aq)]$ of strong acids, weak acids, strong bases and weak bases. h) Calculate the values of pH of strong acids, weak acids, strong bases and weak bases. i) Work out the value of pK_a and discuss the relationship between K_a and pK_a j) Explain and describe the titration curves [the 4 types], in term of strength of acid and base. k) Discuss which indicator/s is/are suitable for acid-base titrations from appropriate data. l) Define the term buffer. m) Explain how buffer solutions can control the change in pH using acidic buffers and basic buffers. n) Calculate the pH of buffer solutions from given appropriate data [acidic buffer and basic buffer]. Note: You can use Henderson – Hasselbalch equations.	**Practical 21.2** How pH Varies during titration. **Note:** **Practically, it is not necessary to implement all types of titrations. [it is recommended to implement the strong acid-strong base and strong acid weak base titrations] or weak acid strong base titration**	14

Chemistry Grade 12 (Bilingual) - Learning outcomes SEMESTER TWO				
Topic		**Learning objectives**	**Practical activities**	**Number of lessons**
Physical Chemistry				
9. **Electrochemistry**				
9.1	Voltage cells	c) Explain the redox reactions showing the transfer of electrons from the reducing agent to the oxidizing agent. d) State that these reactions can be implemented to build up an electrochemical cell/voltage cell. e) Draw and label an electrochemical cell showing the followings. i. Oxidizing agent ii. Reducing agent iii. The electrolyte in each solution iv. The salt bridge v. The electrodes vi. The wire vii. The voltmeter f) Explain the direction of electrons flow in an electrochemical cell. g) Explain the need for a standard electrode. h) State the standard conditions. i) Draw and label the standard hydrogen electrode and state that its E^{Θ} is zero. j) Explain how we can calculate the E^{Θ} of different elements. k) Explain how the E^{Θ} series can be used **[You can use the annex no.2]** l) Describe what would happen to the anode electrode and the cathode electrode during the reactions that occur in a cell. m) Explain how to write a cell diagram/notation/ short – hand. n) Calculate the standard e.m.f of a cell [E^{Θ}_{cell}] using appropriate data. o) Using E^{Θ}_{cell} values to measure the feasibility of reactions.	**Practical 20.1** Measuring electrodes potentials **Note: You can use any available and safe electrodes and solutions** **You can design your own experiments for this topic**	6
9.2	Electrolysis	a) Predict the identity of the substance/s liberated during electrolysis of • Molten group **I** halides • Concentrated solutions of NaCl, H_2SO_4 and NaOH		4

Yearly plan for grade 12

	Grade 12– semester one		Grade 12– semester two
1	An introduction to the chemistry of transition elements	6	Chemical energetics
2	Arenes and phenols	7	Reaction kinetics
3	Carboxylic acid and derivatives	8	Equilibria
4	Nitrogen compounds	9	Electrochemistry
5	Polymerization		

Resources for teachers to upgrade their knowledge and skills

Teacher support	http://www.cie.org.uk/teaching-and-learning/
How to teach	https://www.international.heacademy.ac.uk/
Past paper resource	http://papers.xtremepapers.com/CIE www.s-cool.co.uk/
Teaching strategies	http://www.teachthought.com/pedagogy/instructional-strategies/50-teaching-strategies-to-jumpstart-your-teacher-brain/

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End Of Chemistry Syllabus