Chemistry

1. Introduction

Chemistry deals with the composition, structures and properties of matter, the interactions between different types of matter, and the relationship between matter and energy. At HKUGAC, it is possible to acquire relevant conceptual and procedural knowledge of chemistry from everyday experience. A study of chemistry also helps to develop understanding and appreciation of developments in engineering, medicine and other related scientific and technological fields. Furthermore, learning about the contributions, issues and problems related to innovations in chemistry will help students develop an understanding of the relationship between science, technology, society and the environment.

1.1 Teaching methods

Teachers will provide students with an appropriate level of curriculum and reasonable expectations to suit the capabilities of the students and to engage them in the process of learning.

1.1.1 Contextual approach

Throughout the senior secondary curriculum, students can develop their interest on certain compulsory topics. With a solid chemistry background, students can then make good choices as they progress to the school-based investigative study.

1.1.2 Scientific investigations

Students are expected to make use of their knowledge and understanding of chemistry, together with generic skills − including, but not limited to, creativity, critical thinking, communication and problem-solving − to engage in a group-based 20 hours of experimental investigative study.

1.1.3 Problem-based learning

A series of training is provided to train students' appropriate strategies to deal with issues that may arise. Students are expected to clarify and analyze problems related to chemistry, during which they apply knowledge and principles of chemistry to solve problems or suggest creative ideas or solutions to problems.

1.1.4 Embedding of learning in real-life issues

By reading the latest research and industry products, students will be expected to appreciate the relationship between chemistry and other disciplines, and to be aware of the interconnections among science, technology, society and the environment in contemporary issues, thereby becoming responsible citizens.

1.2 Assessment

A variety of approaches and styles will be used for designing homework to motivate students and offer interesting and challenging tasks for students to do. Types of homework will include oral reports on observation, model-making, google forms, writing laboratory reports, past paper drilling and many other forms of written work. A combination of assessment methods such as checklists, quizzes, uniform tests, oral presentations, self-assessment and peer feedback will be used to report students' achievement. Teachers will also provide constructive feedback, written or verbal, to help students understand their strengths and /or weaknesses and to enhance student learning in everyday classroom lessons. The focus of the assessment is on why they do not learn well and how to help them to improve rather than just to use assessments to find out what knowledge students have learned. Recognition will be given to students with outstanding performance and encouraging remarks and praise will also be given to those who have made attempts to improve. While a school-based assessment (SBA) project will be done from S5 to S6 for students to sit the HKDSE Chemistry examination. Students will be guided to finish practical related tasks and non-practical related tasks.

2. The aims and objectives

The curriculum is designed to enable students to:

1. develop interest and maintain a sense of wonder and curiosity about chemistry;
2. construct and apply knowledge of chemistry, and appreciate the relationship between chemistry and other disciplines;
3. understand and evaluate the social, ethical, economic, environmental and technological implications of chemistry, and develop an attitude of responsible citizenship.

3. Curriculum

The curriculum emphasizes to strengthen students' ability to:

1. understand of the nature of scientific inquiry in chemistry;
2. develop them to be a person who can think scientifically, critically and creatively, and solve problems individually and collaboratively in chemistry-related contexts;
3. develop open-mindedness, objectivity and pro-activeness.

3.1 Curriculum framework

		Topics
Compulsory Part	**S4**	Planet Earth ➢ describe processes such as fractional distillation of liquefied air, preparation of chemicals from sea water and the calcium cycle.
		Microscopic world I (Revision from S3) ➢ identify the bonding and structure of some chemical compounds ➢ predict the chemical and physical properties of different structures
		Metals ➢ design appropriate experiment to identify the reactivity of different metals ➢ illustrate the factors that speed up / slow down the corrosion of metals ➢ balance chemical and ionic equations
		Reacting masses ➢ determine the empirical formula and molecular formula of chemical compound ➢ determine the molar concentration of a solution ➢ determine the molar volume of gas ➢ identify the limiting reactant in a chemical reaction
		Acids and Bases ➢ identify acids and bases ➢ predict chemical reactions between acids/bases with different chemical compounds ➢ illustrate acidity and alkalinity with pH value ➢ prepare different chemical salts by using different chemical reactions ➢ analyse the amount of chemicals in a certain sample quantitatively
		Fossil Fuels and carbon compounds ➢ identify organic compounds ➢ understand the refining of petroleum ➢ predict the chemical reactions of different alkanes and alkenes ➢ understand the formation of polymer
		Microscopic world II ➢ predict the shape of a molecule ➢ illustrate polarity of a molecule ➢ predict the strength of intermolecular forces based on dipole moment
Compulsory Part	**S5**	Redox reaction ➢ identify redox reaction by determining oxidation number ➢ identify oxidizing agent / reducing agent ➢ illustrate the importance of redox reaction and its applications
		Chemical cells and electrolysis ➢ understand the structure of a chemical cell and electrolytic cell ➢ determine the factors that can maximize the potentials of different cells
		Chemical reactions and energy ➢ understand the conservation of energy ➢ identify the difference between exothermic and endothermic reactions ➢ interpret the meaning of $\Delta^{o}H$
		Rate of reaction ➢ determine the rate of reaction ➢ identify the factors that affect the rate of reaction

		➢ design experiments for to determine the rate of reaction
		<u>Chemical equilibrium</u> ➢ understand the meaning of equilibrium ➢ determine the equilibrium constant of a chemical reaction ➢ determine factors affecting the equilibrium constant
		<u>Chemistry of carbon compounds</u> ➢ identify organic compounds from its homologous series ➢ classify structural, geometrical isomerism ➢ identify enantiomers with chiral carbon
		<u>Patterns in Chemical World</u> ➢ identify the trends of bonding and structures in Period 2 ➢ understand the trends of oxides of Period 3 elements and their properties ➢ understand the general properties of transition metals and their usage

Elective Part	**S6**	<u>Industrial Chemistry</u> ➢ determine the rate equation from experimental results ➢ determine the activation energy of a chemical reaction from the rate constant ➢ identify different types of catalyst ➢ understand the conversion of materials in industrial process
		<u>Analytical Chemistry</u> ➢ detect the presence of come typical chemical species ➢ separate and purify chemical species from its mixture ➢ analyze chemicals quantitatively by gravimetric and volumetric methods ➢ understand the daily application of analytical chemistry

3.2 Delivery Schedule

<table>
<tr><th>1st Term</th><th>S.4</th><th>S.5</th><th>S.6</th></tr>
<tr><td>Week 1A</td><td rowspan="2">Planet Earth</td><td rowspan="2">Microscopic World II</td><td rowspan="5">Industrial Chemistry</td></tr>
<tr><td>Week 1B</td></tr>
<tr><td>Week 2A</td><td rowspan="5">Metals
+ Reacting Masses</td><td rowspan="6">Simple Chemical Cells and Redox Reactions</td></tr>
<tr><td>Week 2B</td></tr>
<tr><td>Week 3A</td></tr>
<tr><td>Week 3B</td></tr>
<tr><td>Week 4A</td><td rowspan="5">Analytical Chemistry</td></tr>
<tr><td>Week 4B</td></tr>
<tr><td>Week 5A</td><td rowspan="8">Acids and Bases (I)</td></tr>
<tr><td>Week 5B</td><td rowspan="4">Redox reactions in chemical cells and electrolysis</td></tr>
<tr><td>Week 6A</td></tr>
<tr><td>Week 6B</td></tr>
<tr><td>Week 7A</td><td rowspan="4">Consolidation</td></tr>
<tr><td>Week 7B</td></tr>
<tr><td>Week 8A</td><td rowspan="2">Chemical Reactions and Energy</td></tr>
<tr><td>Week 8B</td></tr>
<tr><td>Week 9A</td><td rowspan="2">Exam</td><td rowspan="2">Exam</td><td rowspan="2">Mock Exam</td></tr>
<tr><td>Week 9B</td></tr>
</table>

<table>
<tr><th>2nd Term</th><th>S.4</th><th>S.5</th><th>S.6</th></tr>
<tr><td>Week 1A</td><td rowspan="3">Acids and Bases (II)</td><td rowspan="2">Chemical Reactions and Energy</td><td rowspan="20">Consolidation + Post Mock + Final DSE Prep</td></tr>
<tr><td>Week 1B</td></tr>
<tr><td>Week 2A</td><td rowspan="3">Rate of Reaction</td></tr>
<tr><td>Week 2B</td><td rowspan="12">Fossil Fuels and Carbon Compounds</td></tr>
<tr><td>Week 3A</td></tr>
<tr><td>Week 3B</td><td rowspan="4">Chemical Equilibrium</td></tr>
<tr><td>Week 4A</td></tr>
<tr><td>Week 4B</td></tr>
<tr><td>Week 5A</td></tr>
<tr><td>Week 5B</td><td rowspan="8">Chemistry of Carbon Compounds</td></tr>
<tr><td>Week 6A</td></tr>
<tr><td>Week 6B</td></tr>
<tr><td>Week 7A</td></tr>
<tr><td>Week 7B</td></tr>
<tr><td>Week 8A</td></tr>
<tr><td>Week 8B</td><td rowspan="3">Microscopic World II</td></tr>
<tr><td>Week 9A</td><td rowspan="2">Patterns in the Chemical World</td></tr>
<tr><td>Week 9B</td></tr>
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4. Assessment

4.1 Assessment Criteria

4.1.1 Assessment of knowledge and understanding

Students should be able to demonstrate knowledge and understanding in relation to
1. phenomena, facts and concepts in science;
2. scientific vocabulary and terminology;
3. application of concepts to familiar and unfamiliar situations;
4. application of science in society and students' everyday life.

Oral questioning, class assignments, module tests and examination can be used to allow students to demonstrate their understanding and creative ideas.

4.1.2 Application of scientific processes

Students should be able to
1. ask relevant questions, identify problems and formulate hypotheses for investigations;
2. select and apply facts and concepts learnt to solve problems;
3. plan scientific investigations individually and collaboratively with appropriate instruments and methods;
4. collect and analyze data, make further predictions, draw conclusions and present scientific information effectively.

Project work provides excellent opportunities for students to apply what they have learnt. Investigative projects, in particular, are suitable for assessing enquiry skills such as identifying problems, formulating hypotheses and designing strategies to solve problems scientifically and creatively.

4.1.3 Assessment of experimental skills

Students should be able to
1. handle apparatus and chemicals safely and properly;
2. carry out instructions for experiments;
3. observe and describe objects and experimental results accurately;
4. select appropriate apparatus and suggest experimental procedures.

The most suitable methods for assessing science skills are practical assessment. Students are required to perform numbers of practical tasks. They are expected to make use of their knowledge and understanding of science in performing these tasks. Through these practical tasks, students' practical, process and generic skills will be developed and assessed.

4.1.4 Assessment of attitudes

Students should
1. develop curiosity and interest in science;
2. be aware of the importance of the safety of oneself and others in the laboratory and be committed to safe practices in daily life;
3. develop personal integrity through honest recording of experimental data;
4. develop an awareness of scientific advancement and its social, economic, environmental and technological implications;
5. be willing to communicate and comment on issues related to science and respect the decisions of others;
6. develop a positive attitude in enhancing personal and community health;
7. show concern for the care of the environment and a willingness to contribute to it.

Attitudes such as curiosity, perseverance, care and concern for living things, and co-operation with others are important in science learning. As these attitudes take time to develop, their assessment should take place over a period of time to show the progress that students have made. Some common means of assessing attitudes include, observing behaviour, asking students to write essays, and using questionnaires.

4.2 Weighting of component parts

S.3

<table>
<tr><td rowspan="3">T1 CA</td><td>Assignment</td><td rowspan="3">30%</td><td rowspan="3">Term 1 CA Grade</td></tr>
<tr><td>Past Paper Drilling</td></tr>
<tr><td>Uniform Test</td></tr>
<tr><td rowspan="3">T2 CA</td><td>Assignment</td><td rowspan="3">30%</td><td rowspan="3">Term 2 CA Grade</td></tr>
<tr><td>Past Paper Drilling</td></tr>
<tr><td>Uniform Test</td></tr>
<tr><td colspan="2">Examination</td><td>40%</td><td>Exam Grade</td></tr>
<tr><td colspan="2"></td><td>100%</td><td>Year Grade</td></tr>
</table>

S.4-S.5

Term 1		
Quizzes	40%	Term 1 CA Grade
Assignment		
Uniform Test		
Examination	60%	Exam Grade
Total weighting	50%	Year Grade

Term 2		
Quizzes	40%	Term 2 CA Grade
Assignment		
Uniform Test		
Examination	60%	Exam Grade
Total weighting	50%	Year Grade

S.6

Term 1		
Homework (Assignments, Past Paper Drilling)	40%	Term Grade
Uniform Test & Quiz		
Pre-Mock		
Examination	60%	Exam Grade
Total weighting	100%	Year Grade

4.3 Grading system

S3

7	≧90.5%
6	≧84.5%
5	≧74.5%
4	≧62.5%
3	≧49.5%
2	≧39.5%
1	≧0%

S4 – S6

7	≧84.5%
6	≧79.5%
5	≧69.5%
4	≧59.5%
3	≧49.5%
2	≧39.5%
1	≧0%

4.4 School-based assessment for the HKDSE Chemistry examination

As stipulated in the Chemistry Curriculum and Assessment Guide (Secondary 4-6) from HKEAA, there is a school-based assessment (SBA) component constituting part of the public assessment of the subjects.

SBA should be an integral part of the learning and teaching process, and involves assessment of students' performance at different times during their courses. It must be emphasised that a series of mini examinations is not intended. With SBA, teachers can provide appropriate feedback to students so as to help consolidate the learning of concepts related to chemistry and scientific investigative skills, and foster the development of generic skills such as creativity, critical thinking, communication and problem-solving.

For students sitting for the HKDSE Chemistry examination in 2012 and onwards, the mark of SBA in practical related tasks will contribute to 20% of the final subject mark, which the public examination contributes to 80%.

4.4.1 SBA Requirement

The SBA of Chemistry and Combined Science (Chemistry part) covers the assessment of students' performances in practical work in their S5 and S6 years of the course. Candidates are required to perform a stipulated amount of practical work, which may include designing experiments, reporting and interpreting experimental results, etc. The work should be integrated closely with the curriculum and form a part of the normal learning and teaching process. Apart from these, candidates attempting the HKDSE Chemistry examination may also be required to design and conduct a group-based experimental investigative study with a view to solving an authentic problem. They are expected to make use of their knowledge and understanding of chemistry in performing such an investigative study, through which their generic skills, practical skills, process skills and reporting skills, etc. would be developed and assessed.

4.4.2 Assessment Requirement for Chemistry

For each candidate attempting the HKDSE Chemistry examination for the first time, the minimum numbers of assessments and the weightings in subject required in S5 and S6 for the SBA are summarized in the table below:

	Minimum number of assessments*	Weighting in subject
S5	2	10%
S6	2	10%

* Over the two years of S5 and S6, there should be at least one assessment for Volumetric Analysis (VA), one assessment for Qualitative Analysis (QA) and two assessments for Other Experiments (EXPT).
* Investigative Study (IS) can be done in lieu of Other Experiments (EXPT). In this case, one assessment on 'proposal' and one assessment on 'process and report' should be performed. These two assessments can satisfy the minimum requirement for Other Experiments (EXPT).

5. Role of parents at home and homework

Efficient time management is essential for students to be successful in the subject. Students are encouraged to come to each lesson with full preparation according to the guided task given and questions to be asked as a means to promote effective learning. Homework consolidates, reinforces and strengthens concepts learnt in class and helps teachers assess the performance of students. Parents are encouraged to talk to their son or daughter about the work done in class and the current learning topics in order to have a better understanding of the learning situation in the subject.

6. Guidelines for using Artificial Intelligence (AI)

Guideline on AI-assisted Learning

Artificial intelligence (AI), including Generative AI, could serve as an effective tool for assisting science learning. This section provides examples of using AI to assist learning in science and general reminders.

Examples of AI-assisted learning in science

1. Research and organization of information
Information such as scientific concepts, real-life examples, and data, could be obtained from generative AI. AI could also be used to organize large amounts of information for clear presentation.

2. Feedback
Generative AI could provide feedback on student work based on given criteria to improve the quality of work and assess the accuracy.

3. Language support
By inputting the work in generative AI, the grammar and clarity of the work could be checked.

4. Exploration and brainstorming
Exploration of topics and generation of ideas for project work could be achieved using generative AI.

General reminders for using AI in science

1. Verification of information
Students should assess the accuracy of scientific concepts and the reliability of examples/data with their judgment and other sources. Information obtained from generative AI may not always be correct.

2. Learning effectiveness
There are multiple ways of learning. AI is not the only way for students to learn. Students should consider different learning styles and make good use of different learning strategies, instead of solely relying on AI. Moreover, information obtained from AI should be processed cognitively by students, instead of simply performing "copy and paste".

3. Quality of prompts
Prompts inputted into generative AI should be specific. More details and conditions allow responses that better suit your needs to be generated.

Guideline on ethical use of AI (Important)

General guideline

Respect Intellectual Property
Students must observe copyright laws and understand the importance of giving proper credit to the original creators of any content they use or modify. When using AI-generated text or other content, students must properly **cite the source** and **acknowledge the use of the AI tool**.

Avoid Misinformation
Students should recognize the potential dangers of AI-generated content, including the spread of **misinformation**. Students should **cross-reference** AI-generated content with reliable sources and think

critically about the information's validity.

Privacy and Security
Students must be aware of **privacy** and **security** concerns when using AI tools. Students need to protect their **personal information** and use secure platforms when accessing these tools. Students should be informed about the data collection and use practices of AI tool providers and be mindful of the potential risks associated with sharing personal data.

AI policy in science
Penalty will be given to students with inappropriate use of AI in their work including assignments, projects, etc.

- Students are suggested to keep the original work before being modified by AI. The original work may be requested to be submitted to verify the originality of the submitted work.
- Mark penalty could be given for work with content generated by AI without proper citation and acknowledgment. A zero mark could be given in serious cases. Follow-ups and further disciplinary actions could be taken.
- Students may be asked to redo and resubmit their work if the AI policy is violated.

AI and School-based Assessment (SBA)
This section summarizes the information about SBA related to AI.

- Students should not copy works generated by AI tools and present them as their own as such an act is considered plagiarism.
- Students should acknowledge the use of AI in SBA properly.
- Severe penalties could be given to students for proven plagiarism. A candidate may be disqualified from the subject concerned or the whole HKDSE Examination, or receive a mark or grade penalty.

Other Reminders

- Students should consult their subject teachers for anything uncertain about the use of AI in science subjects.