THE CHEMISTRY HOP

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The Commonwealth of The Bahamas

Bahamas General Certificate of Secondary Education

CHEMISTRY SYLLABUS

Testing & Evaluation Section
Ministry of Education

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THE BAHAMAS GENERAL CERTIFICATE

OF

SECONDARY EDUCATION

CHEMISTRY EXAMINATION SYLLABUS

1. INTRODUCTION

The information contained in this syllabus, is intended to define the minimum requirements for preparing candidates for the Bahamas General Certificate of Secondary Education (BGCSE) Chemistry Examination.

The BGCSE Chemistry Examination is intended for students aged 16+ who have completed a course which satisfies the requirements of the syllabus.

The Scheme of Assessment is designed to assess the positive achievement of candidates of differing abilities.

The standard of the Examination will be equivalent to that of the G.C.E. 'O' level examinations, but is designed to provide certification for a larger population of students, and a grade range of A-G.

Through this examination candidates are being offered success through performance within their own ability range.

The Examination syllabus allows for the implementation of varied methods of instruction and assessment while helping the candidate to develop the skills and understanding needed to derive maximum benefit from the subject content.

Coverage of the subject content is intended for a period of approximately three (3) years, beginning in grade 10. The Examination includes written components and a practical component. The guidance offered through the syllabus is intended to enhance the performance of student and teacher alike.

AIMS

The Aims listed below include references to certain attributes and qualities which cannot and should not be assessed through formal examinations, but which do form an essential part of the Chemistry course. In this respect the Aims differ from the Assessment Objectives which all refer to qualities and competencies that can be assessed. These Aims are not listed in order of priority.

1. To stimulate and sustain curiosity, interest and enjoyment of the environment through studying Chemistry and its applications.

2. To develop an appreciation of the scientific, social, economic, environmental and technological contributions and applications of Chemistry.

3. To show that Chemistry is a coherent framework of knowledge based on fundamental theories of the structure and possesses of the Chemical world.

4. To foster the development of skills needed to better understand local technological advances and to pursue technologically oriented careers.

5. To develop techniques for solving problems through experiments, following a scientific approach by developing the skills of observation, experimentation, processing and interpretation of data, evaluation of evidence, recording and formulation of generalization and models.

6. To ensure that students can follow instructions including those relevant to complying with safety procedures.

7. To provide suitable knowledge, understanding and skills for students who wish to qualify for entry to fields of study or job training programmes that require a general understanding of Chemistry.

8. To foster the development of relevant skills for communication, improvisation and for working along with others.

9. To encourage students to apply, qualitatively and quantitatively, their knowledge and understanding of chemical principles to familiar and unfamiliar situations.

10. To encourage students to appreciate the developing and sometimes transitory nature of chemical knowledge, principles and models.

3. ASSESSMENT OBJECTIVES

CLUSTER OF ASSESSMENT OBJECTIVES		ASSESSMENT OBJECTIVES	TARGET WEIGHTING
KNOWLEDGE WITH UNDERSTANDING		Candidates should be able to show knowledge and understanding of scientific:	40%
	3.1	phenomena, facts, laws, definitions, concepts, theories, principles, models and generalizations.	
	3.2	vocabulary, terminology, conventions, symbols and units.	
	3.3	instructions and apparatus, including techniques of operation and aspects of safety.	
	3.4	methods of measurements of quantities and their appropriate units.	
	3.5	applications to technology affecting social, economic and environmental issues.	
	3.6	explanations of familiar facts, observations and phenomena in terms of laws, theories and models.	
HANDLING INFORMATION AND PROBLEM SOLVING		Candidates should be able to demonstrate skills and ability to:	40%
	3.7	translate information from one form to another;	
	3.8	use and interpret formulae;	
	3.9	communicate observations, ideas and arguments logically, concisely and in appropriate form;	
	3.10	make decisions and formulate conclusions based on examination of evidence and observations;	

CLUSTER OF ASSESSMENT OBJECTIVES	ASSESSMENT OBJECTIVES		TARGET WEIGHTING
HANDLING INFORMATION AND PROBLEM SOLVING (CONT'D)	3.11	select appropriate facts to illustrate a given principle, concept, law, theory, model or pattern;	
	3.12	relate scientific principles to everyday situations; explain and evaluate technological applications of Chemistry and their associated social economic and environmental implications;	
	3.13	suggest scientific explanations of unfamiliar facts, observations and phenomena;	
	3.14	apply scientific concepts and methods to solve problems, including appropriate calculations;	
	3.15	solve problems by designing, conducting and interpreting the results of simple experiments;	
	3.16	recognize that data from practical work is subject to various limitations.	

CLUSTER OF ASSESSMENT OBJECTIVES		ASSESSMENT OBJECTIVES	TARGET WEIGHTING
EXPERIMENTAL SKILLS AND INVESTIGATIONS		Candidates should be able to:	20%
	3.17	follow and carry out practical instructions accurately and safely;	
	3.18	observe, measure and record accurately and systematically;	
	3.19	recognize mistakes, misconceptions, unreliable data and assumptions;	
	3.20	select appropriate apparatus or materials necessary to achieve given tasks;	
	3.21	devise experiments for a stated purpose.	

4. SCHEME OF ASSESSMENT

The Examination will comprise of written papers and a practical component.

The design of the examination will allow candidates of a wide ability range to demonstrate what they know, understand and can do.

4.1 Differentiation

The purpose of this differentiated scheme of assessment, by using components that are designed to test particular parts of the ability range, is to examine candidates at levels at which they can demonstrate achievement and provide positive evidence of attainment.

It follows that if candidates are to obtain benefit from taking papers designed to meet their particular needs, centres must take care to ensure that each candidate is entered for the combination of papers for which he or she is most suited.

4.2 Scheme of Assessment

The scheme of assessment, relative to the BGCSE Chemistry is as follows:

There will be three written papers available and a practical assessment, of which papers 1, 2 and the practical assessment will be compulsory.

(i) Candidates will be awarded Grades C to G on the basis of their performance in components 1 and 2 together with the Practical Assessment.

(ii) Candidates who achieve a Grade C or D on the basis of their performance in (i) above and a Grade A or B mark on the optional extension paper will be awarded Grade A or B respectively. Internal Assessment will play an appropriate part in the award of Grades A and B.

SUMMARY OF ASSESSMENT

COMPONENT	DURATION	TITLE	PERCENTAGE WEIGHTING
1	1 1/4 hour	Paper 1 (Multiple choice).	30%
2.	1 1/2 hour	Paper 2 (Structured and short answer).	50%
3.	1 1/4 hour	Paper 3 (Structured and free response).	
4		Practical Assessment.	20%

PAPER 1 — This will consist of 50 multiple-choice questions of the four (4) choice type.

PAPER 2 — This will consist of structured and short answer questions. Candidates will be required to answer all questions.

PAPER 3 — This will comprise structured questions and free response questions. The Paper will be divided into two (2) sections.

Section A will consist of a number of compulsory structured questions.

Section B will consist of a number of free-response questions allowing candidates some choice.

COMPONENT 4: Internal Assessment of Practical Work.

SUMMARY OF ASSESSMENT WEIGHTING AND AWARDING OF GRADES

For the award of grades C, D, E, F, G.

COMPONENT	DURATION	DESCRIPTION	PERCENTAGE WEIGHTING
1 (Paper 1)	1 1/4 hour	50 multiple choice (4 option) questions.	30%
2 (Paper 2)	1 1/2 hour	Structured and short answer questions.	50%
4		Internal Assessment of Practical Work	20%

For the award of Grade A, B providing grade C or D has been achieved in components 1, 2 and 4.

COMPONENT	DURATION	DESCRIPTION	PERCENTAGE WEIGHTING
3 (Paper 3)	1 1/4 hour	Structured questions and free-response questions.	
		Section A - Compulsory Questions.	40%
		Section B - Free Response.	40%
4		Internal Assessment of Practical Work.	20%

5. CHEMISTRY COURSE CONTENT

The content as set out below does not provide a teaching order. It does, however, represent the topics on which the candidate will be assessed.

TOPICS

5.1 Applications and Implications of Chemistry

The syllabus content should be covered in such a way so as to draw attention to the industrial, social, economic, environmental and technological aspects of Chemistry where relevant.

ref: - Mineral and energy resources
- Pollution control
- Adequate/inadequate world food supply
- Beneficial and antisocial effects of Chemistry

Because of the novel nature of this area of the syllabus, which should be included in the teaching of sections 5.2 to 5.12, more details have been given in section 5.13.

5.2 Techniques of Chemistry

2.1 Separation of mixtures and purification
2.2 Test for purity
2.3 Measurement

5.3 Nature of Matter

3.1 Kinetic Theory
3.2 Elements and Compounds
3.3 Atomic Structure
3.4 Bonding

5.4 The Mole Concept

5.5 Acids, Bases and Salts

5.1 Properties of Acids, Base and Salts.
5.2 Identification of Ions

5.6 Energy changes in Chemical Reactions

6.1 Heat energy
6.2 Electrical

5.7 Speed of Reaction

5.8 Redox Reactions

5.9 The Periodic Table

9.1 Periodic trends
9.2 Group trends and characteristics

5.10 Metals

10.1 Properties of Metals
10.2 Reactivity Series
10.3 Extraction of Metals

5.11 Non-Metals

11.1 Hydrogen
11.2 Oxygen
11.3 Nitrogen
11.4 Sulphur
11.5 Chlorine
11.6 Carbon

5.12. Organic Chemistry

5.13. Social, Economic, Environmental and Technological applications of Chemistry.

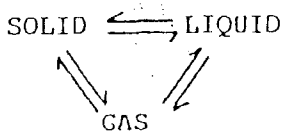
13.1 Mineral and Energy Sources
13.2 Pollution
13.3 Food Supply
13.4 Use and abuse of chemicals

COURSE CONTENT

The first column contains the Topic. The second column contains specific concepts and principles that are compulsory for all candidates which are titled Core Content.

The third column contains additional concepts and principles required to obtain grades A or B which are titled Extended Content.

TOPIC	CORE CONTENT	EXTENDED CONTENT
2. TECHNIQUES OF CHEMISTRY		
2.1 SEPARATION OF MIXTURE AND PURIFICATION	Solution, crystallization, distillation, filtration, centrifuging, decantation, and paper chromatography.	fractional distillation
2.2 TEST FOR PURITY	Melting points, boiling points.	
2.3 MEASUREMENT	The measurement of mass, temperature, volume, time and length, using appropriate apparatus.	

TOPIC	CORE CONTENT	EXTENDED CONTENT
3. THE NATURE OF MATTER		
3.1 KINETIC THEORY	1. The Particulate Nature of Matter	Elastic collision
	2. Temperature and its relationship to energy and motion.	
	3. Diffusion. Evidence for the movement of particles in liquids and gases.	Brownian motion. An experiment to illustrate Brownian motion.
	4. The particle packing of the three physical states of matter.	
	5. Terms related to changes of state.	
	6. A diagram relating the physical changes of state. 	

TOPIC	CORE CONTENT	EXTENDED CONTENT
KINETIC THEORY CONT'D	7. Given any number of gases and their relative masses list them in order, of their rate of diffusion.	Phrases "directly proportional" and " inversely proportional".
		Mathematical forms of Charles Law and Boyle's Law.
	8. Qualitative treatment of the effect that temperature will have on the volume of a gas.	Charles and Boyle's laws combined.
	9. Qualitative treatment of the effect that pressure will have on a gas.	Problems involving the combined Laws given the factors and calculate for the unknown. (Only simple numbers to be used).
	10. The conditions for r.t.p. and s.t.p.	
3.2 ELEMENTS AND COMPOUNDS	1. The difference between elements and compounds.	
	2. The molecule.	

TOPIC	CORE CONTENT	EXTENDED CONTENT
3.3 ATOMIC STRUCTURE	1. Brief history of the development of atomic theory.	
	2. The laws of: Conservation of Mass, Definite Proportions, and Multiple Proportions.	The basis for each of the laws.
	3. Contributors to the development of the atomic theory.	The hypotheses of each contributor.
	4. Metals and non-metals.	
	5. The relative mass and charge of protons, neutrons and electrons. Atomic number, mass number, isotopes and relative atomic mass.	
	6. Simple electronic structure of atoms limited to the first 20 elements with Lewis dot diagrams.	
	7. The relationship between the outer electronic structure and their groupings into families.	

TOPIC	CORE CONTENT	EXTENDED CONTENT
ATOMIC STRUCTURE CONT'D	8. The idea that electrons are responsible for chemical behaviour.	
	9. Elements have relative attractions for electrons.	
	10. Electronegative, electropositive and relate this to the elements in a Periodic Table.	
	11. The formation of (+) and (-) ions to obtain stable electronic configurations.	Electronic configurations of (+) and (-) ions.

TOPIC	CORE CONTENT	EXTENDED CONTENT
3.4 BONDING	1. Bonding as an attractive force between particles.	
	2. Ionic, covalent bond and examples and properties of substances exhibiting that bonding.	A metallic bond. Metallic bonding to explain electrical conductivity. Dative covalent bonding. Predict type of bonding.
4 THE MOLE CONCEPT	1. Symbols for the first 20 elements of the periodic table, and the symbol for other common elements --- Bromine, Iodine, Copper, Lead, Zinc, Manganese, Iron, Gold, Mercury, Silver, Tin.	
	2. Valency of an element.	
	3. Formulae of compounds using the valency of the element).	
	4. Radicals.	

TOPIC	CORE CONTENT	EXTENDED CONTENT
4. THE MOLE CONCEPT CONT'D	12. Molar mass of a compound given its formula and a table or relative atomic masses.	Calculations using equations (in terms of masses, reactants and products) and relate the results to the Law of Conservation of Mass.
	13. Law of Conservation of Mass.	Percentage composition of a compound. given its formula.
	14. Empirical formula and molecular formula.	Derivations of Empirical and molecular formulae of compounds.
	15. Solute, solvent and solution and solubility of solutes.	Concentration of a solution in moles per cubic decimetre and in grams per cubic decimetre.
	Problems involving concentrations of solutions given data. (Not calculating molarity of solutions.)	mol/dm^3 and g/dm^3 and $mol\ dm^{-3}$ and $g\ dm^{-3}$ as units of concentration.
		Mass of a solid required to make up a given volume of solution knowing the final concentration of the solution.
	16. One mole of any gas occupies the same volume at room temperature and pressure, and standard temperature and pressure.	Balanced chemical equations involving volumes of gases.

TOPIC	CORE CONTENT	EXTENDED CONTENT
5 ACIDS, BASES and SALTS		
5.1 PROPERTIES OF ACIDS, BASES AND SALTS.	1.Characteristic of acids and bases.	
	2.The meaning of the terms acid and alkali in terms of the ions they contain or produce in aqueous solution.	
	3.A qualitative treatment of the use of indicators and the pH scale to determine acidity, alkalinity and neutrality.	Strength and concentration of an acid or base.
		Calculations of molarity, volume and number of moles.
	4.Basicity of an acid.	
	5.Neutralization reaction(titration)	Simple stoichiometric calculations involving neutralization reactions.
	6.Metallic and non-metallic oxides (ref. oxygen 11.2)	
	7.Normal salt and acid salt.	
	8.Preparation of salts.	[*] see below
	I. Preparation of soluble salts by the action of acids with metals soluble and insoluble bases, and carbonates.	
	II. Preparation of insoluble salts by precipitation.	

[*]

$$\frac{\text{(Molarity of acid) X (volume of acid)}}{\text{(Molarity of base) X(volume of base)}} = \frac{\text{No. Moles acid in balanced equation}}{\text{No. Moles based in balanced equation}}$$

TOPIC	CORE CONTENT	EXTENDED CONTENT
5.2 IDENTIFICATION OF IONS	1. Anions: HCO_3^-, CO^{2-} Cl^-, SO_4^{2-}	
	2. Cations: Li^+, Na^+ K^+, Ca^{2+} Ba^{2+}, Pb^{2+}, Cu^{2+} NH_4^+, Fe^{2+}, Fe^{3+} Mg^{2+}, Zn^{2+}.	SO_3^{2-}, NO_3^-, I^-, NO_2^-, S^{2-}
6. ENERGY CHANGES IN CHEMICAL REACTIONS		
6.1 HEAT ENERGY	1. Exothermic and endothermic reactions.	Determination of heat of combustion and heat of Neutralization energy curves.
6.2 ELECTRICAL	2. Ions, electrolyte, electrodes and electrolysis.	Reactions occurring at the Anode and Cathode.
	3. Properties of electrolytes. Diagrams of electrolysis of compounds. Uses of electrolysis - e.g. Electroplating.	
		Demonstrate an understanding of why ionic compounds conduct when fused or in solution, but not when solid.
		Complete ion electron equations at the Anode and Cathode.
		Rationalize changes in pH of a solution with reference to the formation of NaOH and the comparison between electrolysis of $CuSO_4$ with inert or copper electrodes

TOPIC	CORE CONTENT	EXTENDED CONTENT
7. SPEED OF REACTION	1. Collision theory and experiments to affect the rate.	Energy diagrams catalyst.
	2. Haber and Contact processes. Reversible reactions. Suitable conditions, temperature, pressure (if any) and catalysts.	Conservation of energy, Le Chatelier's Principle, 'Optimum conditions.'
	3. Equilibrium with respect to reversible reactions.	Explanations for the effects of concentration, pressure particle size, catalysts and temperature on rates of chemical reactions.
8. REDOX REACTIONS		
	1. Oxidation, reduction (it would be useful if the historical origin of these two terms could be explained).	
	2. "LEO" and "GER" electron transfer as related to oxidation and reduction.	
	3. "Oxidation" of a metal showing the transfer of electrons.	Half-reactions showing the element that lost/gained electrons.
		Oxidizing/Reducing Agents.

TOPIC	CORE CONTENT	EXTENDED CONTENT
9. PERIODIC TABLE		
9.1 PERIODIC TRENDS	1. The Periodic Table as a method of classifying elements.	Comparison and form of oxides and halides formed by periods 2 and 3.
	2. The change from metallic to non-metallic character across a Period.	
9.2 GROUP TRENDS AND CHARACTERISTICS	1. Lithium, sodium and potassium.	
	2. Beryllium, magnesium, calcium.	
	3. Carbon, silicon.	
	4. Oxygen, sulphur.	
	5. Fluorine , chlorine bromine and iodine. Helium, neon and argon.	
		General characteristics of first series transition elements.
10. METALS		
10.1 PROPERTIES OF METALS	1. Their general chemical and physical properties related to their uses.	
	2. Reference to iron iron alloys, aluminium, copper zinc (corrosion/ prevention).	

TOPIC	CORE CONTENT	EXTENDED CONTENT
10.2 REACTIVITY SERIES (Electrochemical series)	1. Sodium, calcium, magnesium, aluminium, zinc, iron, lead, (hydrogen) and copper. Their relative reactivity illustrated, where appropriate, by the following reactions:	
	a) Their reactions with oxygen, water and/or steam and dilute hydrochloric acid.	(a) Their displacement from aqueous solutions and from their oxides.
	b) The action of heat on their carbonates and their nitrates.	(b) The halogens in the reactivity series i.e. iodine, bromide, chlorine, fluorine.
		(c) Reduction of their oxides by hydrogen and by carbon.
		(d) Use of standard electrode potentials to predict reactions.
10.3 EXTRACTION OF METALS	1. General principles related to the reactivity series.	
	2. The essential reactions involved in the industrial production of aluminium (from pure Al_2O_3 (Electrolytic extraction of aluminium) and iron (from haematite). (Extraction by heat-Blast furnace Schematic diagram for industrial processes.	

TOPIC	CORE CONTENT	EXTENDED CONTENT
11 NON-METALS 11.1 HYDROGEN	1. A product of the reaction between a) reactive metals and water and/or steam. b) metals and acids.	
	2. Identification, properties and uses.	
	3. Water. Causes of hardness, its effect on soaps and detergent and its removal. Pollution of water. An outline of the purification and recycling of water.	
11.2 OXYGEN	1. Preparation from hydrogen peroxide. Identification, properties and uses.	
	2. Classification of oxides as acidic, basic, amphoteric or neutral.	Chemical equations of reactions involving acidic/ basic/amphoteric and neutral oxides.
	3. Rusting, combustion and respiration. The approximate composition by volume of the air: its variability and common pollutants. Rust prevention: painting, galvanizing.	

TOPIC	CORE CONTENT	EXTENDED CONTENT
11.3 NITROGEN	1. Uses of nitrogen. ref. Haber process 5.7.2. Uses of ammonia and of ammonium salts.	Nitrogen cycle.
	2. The displacement of ammonia from its salts. Identification of ammonia and its reactions with (a) acids (b) aqueous solutions of Al^{3+}, Cu^{2+}, Fe^{2+}, Fe^{3+} Zn^{2+} (formulae of complexes are not required).	Manufacture, uses and properties of nitric acid.
11.4 SULPHUR	1. ref Contact process 5.7.2.	Extraction of sulphur by the Frasch process.
	2. The reactions of sulphuric acid a) as an acid, b) as an oxidizing agent with special reference to copper, c) as a dehydrating reagent with sugar and hydrated copper copper(II) sulphate.	

TOPIC	CORE CONTENT	EXTENDED CONTENT
11.5 CHLORINE	1. The oxidation of hydrochloric acid to chlorine. Identification of chlorine and its reactions with metals Br^- (aq), I^- (aq), and the conversion of Fe^{2+} to Fe^{3+}.	
	2. Outline manufacture of chlorine by the electrolysis of brine.	Equations involving the electrolytic process.
	3. The uses of chlorine.	
11.6 CARBON	1) Structure of diamond and graphite related to their properties and uses.	
	2) The reducing properties of carbon and of carbon monoxide.	
	3) Carbon monoxide as a product of incomplete combustion. Its poisonous nature.	
	4) Carbon dioxide - a product of respiration and the complete combustion of carbon compounds. Identification of carbon dioxide and its uses.	

TOPIC	CORE CONTENT	EXTENDED CONTENT
CARBON CONT'D	5. Carbonates - their thermal decomposition related to the reactivity series.	The relative solubilities of the hydrogencarbonate and the carbonate of calcium with reference to hard and soft water.
	6. The industrial importance of calcium carbonate, e.g. in the production iron.	

TOPIC	CORE CONTENT	EXTENDED CONTENT
12. ORGANIC CHEMISTRY	1. Coal, natural gas and petroleum as fuels and how they came to be.	Fractional distillation and cracking of crude oil as a source of organic compounds.
	2. The structure and names of the unbranched alkanes containing up to four carbon atoms.	The concept of isomerism, illustrated by C_4H_{10}.
	3. The concept of homologous series, including general characteristics.	
	4. Alkanes. Substitution reaction with bromine.	Combustion - incomplete and complete.
	5. Structure of alkenes: ethene and propene only. The formation of poly(ethene) as an example of addition polymerization of monomer units.	Addition reactions of Br_2, Cl_2 for alkenes.
		Condensation of polymers. e.g. nylon
	6. Alcohols, typified by ethanol, its formation by fermentation, its uses and its oxidation to ethanoic acid.	Carbohydrates - sugars -glucose, fructose.
		Structure of ethanoic acid/ esterification/reaction with ethanol.

TOPIC	CORE CONTENT	EXTENDED CONTENT
13. SOCIAL, ECONOMIC. ENVIRONMENTAL AND TECHNOLOGICAL APPLICATIONS OF CHEMISTRY		
13.1 MINERAL AND ENERGY SOURCES	1. The sea as a source of magnesium, bromine and common salt. Rocks as a source of bauxite, haematite and rock salt and other ores.	
	2. Finite nature of supplies of fossil fuels, gas, oil, coal, aragonite and minerals. Alternative sources of energy. e.g. solar, nuclear.	Reasons for and against nuclear energy as an alternative source.
	3. The chemical and economic importance of conserving and recycling materials such as iron and aluminium.	

TOPIC	CORE CONTENT	EXTENDED CONTENT
13.2 POLLUTION	1. Air pollution. The harmful effect of sulphur dioxide on metals, stonework and living things. The poisonous nature of carbon monoxide, nitrogen oxides and lead compounds. The non-biodegradable nature of many plastics.	Effects of acid gases, and acid rain from sulphur dioxide and nitrogen dioxide.
	2. The reduction of pollution e.g. smokeless zones, lead-free petrol. Dangers of asbestos, destruction of ozone layer, preventative measures.	
	3. Harmful effects of untreated sewage, chemical waste, fertilizers, pesticides and detergents.	
13.3 FOOD SUPPLY	1. The need for fertilizers. The importance of N, P and K to plant life.	The manufacture of nitrogenous fertilizers. Explanation of what happens to N, P and K fertilizers in soil. Reasons for and against fertilizers.
	2. The need for food preservatives such as salt, sulphur dioxide and ethanoic acid.	

TOPIC	CORE CONTENT	EXTENDED CONTENT
13.4 USE AND ABUSE OF CHEMICALS	1. The use of chemicals in the prevention and treatment of illness. The potentially harmful effect of some chemicals, e.g. alcohol, pesticides and fertilizers, narcotics controlled substances. Terms: medicine, drug, antacid, analgesic.	Reasons for and against pesticides.

6 TECHNIQUES OF ASSESSMENT (Types of Questions)

This section describes the various methods used in the testing of the assessment objectives for BGCSE Chemistry.

6.1 OBJECTIVE QUESTIONS (PAPER 1)

Objective questions (Multiple Choice) will be of the four-option type and will all be compulsory. Objective questions test a wide ability range and achieve a wide coverage of the syllabus.

6.2 SHORT ANSWER QUESTIONS (PAPER 2)

A short-answer question is one to which the answer can be given in a single word, a well constructed sentence, a diagram and/or a short calculation.

Short-answer questions test a wide ability range and achieve a wide coverage of the syllabus.

6.3 STRUCTURED QUESTIONS (PAPER 2 AND PAPER 3)

Each structured question may be illustrated by drawings, diagrams, data etc. Clear guidance will be given as to the pattern of response required in each part of the question.

The structuring of the questions may be linear, with each item (or part) depending on the previous one, or, branched, with each item (or part) depending on a common stem and independent of other items.

Structured questions have an incline of difficulty and test a wide ability range.

6.4 FREE-RESPONSE QUESTIONS (PAPER 3)

Free-response questions (short paragraph completion type) will comprise one section of the optional paper.

Free-response questions require the candidate to explain, discuss or perform a calculation on material for which the examiner has not provided a pattern of response. The candidate is expected to demonstrate communication, planning and organizational skills. These questions will be designed to test the upper end of the ability range.

6.5 ORAL QUESTIONS

Oral questions may be used in conjunction with the internal assessment of practical skills (e.g. by the external moderator).

6.6 CONTINUOUS INTERNAL ASSESSMENT OF PRACTICAL WORK (COMPONENT 4)

This will comprise practical as well as written assignments; and may involve any combination of objective, short-answer, structured and free-response questions.

Details for assessing coursework is given in the section "Internal Assessment of Practical Skills."

6.7 ALTERNATIVE TO INTERNAL ASSESSMENT OF PRACTICAL WORK (COMPONENT 4)

External candidates will be expected to write an examination to test their practical skills. This paper will not exceed 2 hours in length.

Internal candidates experiencing extenuating circumstances may with the approval of the Examination Board be allowed to write this examination.

7. INTERNAL ASSESSMENT OF PRACTICAL SKILLS

The information which follows is provided to assist teachers in making valid and reliable assessment of the experimental skills specified in the assessment objectives of the examination.
Attention is drawn to the 'Handbook on Internal Assessment of Practical Work'.

The experimental skills A to D to be assessed are given below:

A. Using and organising techniques, apparatus and materials.

B. Observing, measuring and recording.

C. Handling experimental observations and data.

D. Planning, carrying out and evaluating investigations.

The four skills carry equal weighting.

All assessments must be based upon experimental work carried out by the candidates.

It is expected that the teaching and assessment of experimental skills will take place throughout the course, but that the actual assessment which will contribute to the examination grade should be conducted during the second and third year of the course.

The assessment scores finally recorded for each skill on the Assessment Sheet (Appendix A) must represent the candidate's best two marks for each skill.

For candidates who miss the assessment of a given skill through no fault of their own, for example because of illness, or through lack of facilities and who cannot be assessed on another occasion, Ministry of Education procedures for special consideration should be followed as specified in the current Handbook for Centres. However, candidates who for no good reason are absent from an assessment of a given skill, should be given a mark of 0 on that occasion.

Teachers must ensure that they can make available to the moderator the evidence for the two assessments of each skill for each candidate.
For skills A to D, inclusive, information about the tasks set and how the marks were awarded will be required. For skills B, C and D, the candidate's written work will also be required.

EXPERIMENTAL SKILLS AND ASSESSMENT OBJECTIVES

Experimental Skills	Assessment Objectives
A Using and organising techniques, apparatus and materials.	(3.3, 3.17, 3.20)
B Observing, measuring and recording.	(3.4, 3.18, 3.19)
C Handling experimental observations and data.	(3.7, 3.9, 3.16)
D Planning, carrying out and evaluating investigations.	(3.10, 3.15, 3.21)

7.1 Criteria for Internal Assessment of Practical Skills

Each skill must be assessed on a six (6) point scale, level 6 being the highest level of achievement.

Each of the skills is defined in terms of three levels of achievement at scores of 2, 4, or 6.

A score of 0 is available if there is no evidence of positive achievement for a skill.

For candidates who do not meet the criteria for a score of 2, a score of 1 is available if there is some evidence of positive achievement.

A score of 3 is available for candidates who go beyond the level defined for 2, but who do not meet fully the criteria for 4.

Similarly, a score of 5 is available for those who go beyond the level defined for 4, but do not meet fully the criteria for 6.

Skill A - USING AND ORGANIZING TECHNIQUES, APPARATUS AND MATERIALS

Score

1 *

2 - Follows written, diagrammatic or oral instructions to perform a single practical operation.

Uses familiar apparatus and materials adequately, needing reminders on points of safety.

3 *

4 - Follows written, diagrammatic or oral instructions to perform an experiment involving a series of step-by-step practical operations.

Uses familiar apparatus, materials and techniques adequately and safely.

5 *

6 - Follows written, diagrammatic or oral instructions to perform an experiment involving a series of practical operations where there may be a need to modify or adjust one step in the light of the effect of a previous step.

Uses familiar apparatus, materials and techniques safely, correctly and methodically.

* See the explanation under 7.1, Criteria for Internal Assessment of Practical Skills.

SKILL B OBSERVING, MEASURING AND RECORDING

Score

1*

2 - Makes observations or readings given detailed instructions.

Records results in an appropriate manner given a detailed format.

3*

4 - Make relevant observations or measurements having been given an outline format or brief guidelines.

Records results in an appropriate manner given an outline format.

5*

6 - Makes relevant observations or measurements to a degree of accuracy appropriate to the instruments or techniques used.

Records results in an appropriate manner given no format.

*See the explanation under 7.1, criteria for Internal Assessment of Practical Skills.

Skill C - HANDLING EXPERIMENTAL OBSERVATIONS AND DATA.

Score

1 *

2 - Processes results in an appropriate manner given a detailed format.

Draws an obvious qualitative conclusion from the results of an experiment.

3 *

4 - Processes results in an appropriate manner given an outline format.

Recognizes and comments on anomalous results.

Draws qualitative conclusions which are consistent with obtained results and deduces patterns in data.

5 *

6 - Processes results in an appropriate manner given no format

Deals appropriately with anomalous or inconsistent results

Recognizes and comments on possible sources of experimental error.

Expresses conclusions as generalizations or patterns where appropriate.

* See the explanation under 7.1. Criteria for Internal Assessment of Practical Skills.

Skill D - PLANNING, CARRYING OUT AND EVALUATING INVESTIGATIONS

Score

1 *

2 - Suggests and carries out a simple experimental strategy to investigate a given practical problem.

Attempts 'trial and error' modification in the light of the experimental work carried out.

3 *

4 - Specifies and carries out a sequence of activities to investigate a given practical problem.

In a situation where there are two variables, recognizes the need to keep one of them constant while the other is being changed.

Comments critically on the original plan, and implements appropriate changes in the light of the experimental work carried out.

5 *

6 - Analyses a practical problem systematically, produces a logical plan and carries out the investigation.

In a given situation recognizes that there are a number of variables and attempts to control them.

Evaluates chosen procedures, suggests/implements modifications where appropriate and shows a systematic approach in dealing with unexpected results.

* See the explanation under 7.1, Criteria for Internal Assessment of Practical Skills.

Areas which might be suitable for Assessment

The following is a partial list of suggested practical exercises that can be used to assess experimental skills A - D.
It must be strongly stressed that the following examples do not form a prescribed list of exercises but are provided only as illustrative material.

(a) Rate of decomposition of dilute hydrogen peroxide/manganese(IV) oxide. Effect of time, temperature and concentration.

(b) Determination of the formula of salt hydrates, e.g. magnesium sulphate.

(c) Precipitation of hydroxides using aqueous ammonia or sodium hydroxide solution.

(d) Rate of reaction between calcium carbonate and dilute acid.

(e) Separation of mixtures including solid/solid and liquid/liquid.

(f) Preparation of crystals of a soluble salt.

(g) Investigation of reacting masses, e.g. reduction of copper(II) oxide.

(h) Investigation of electroplating.

(i) Simple cation/anion analysis.

(j) Investigation of the reaction between ammonium compounds and bases.

(k) Investigation of the reaction between solid carbonates and dilute acids to produce carbon dioxide.

(l) Rate of production of hydrogen from dilute acid and magnesium using a gas syringe.

(m) Investigation of the hardness of various types of water.

(n) Investigation of redox reactions, e.g. iron(II) compounds to iron(III) compounds with various oxidizing agents.

(o) Investigation of the order of reactivity of metals.

(p) Investigation of the decomposition of metal nitrates and metal carbonates.

7.2 NOTES FOR GUIDANCE ON INTERNAL ASSESSMENT OF PRACTICAL WORK

(see Handbook on Internal Assessment of Practical Work for more detail)

The following notes are intended to provide teachers with information to help them make valid and reliable assessments of the skills of their candidates.

The assessments should be based on the principle of positive achievement. Candidates should be given opportunities to demonstrate what they understand and can do.

It is expected that candidates will have had opportunities to acquire a given skill before assessment takes place, but each assessed experiment itself must be new to the students.

It is not expected that all of the practical work undertaken by a candidate will be assessed.

Assessments can be carried out at any time during the course, but the actual marks which will contribute to the examination grade should be obtained from assessment during the second and third year of the course.
However, at whatever stage assessments are done, the standards applied must be those expected at the end of the course as exemplified in the criteria for the skills.

Assessments should normally be made by the person responsible for teaching the candidates.

It is recognized that a given practical task is unlikely to provide opportunities for all aspects of the criteria at a given level for a particular skill to be satisfied. For example, there may not be any anomalous results (Skill C). However, by using a range of practical work, teachers should ensure that opportunities are provided for all aspects of the criteria to be satisfied during the course.

The educational value of extended experimental investigations is widely recognized. Where such investigations are used assessment purposes, teachers should make sure that candidates have ample opportunity for displaying the skills required by the Scheme of Assessment.

It is not necessary for all candidates in a centre, or in a teaching group within a centre, to be assessed on exactly the same practical work, although teachers may well wish to make use of work that is undertaken by all of their candidates.

When an assessment is carried out on group work, the teacher must ensure that the individual contribution of each candidate can be assessed.

Skill A may not generate a written product from the candidates. It will often be assessed by watching the candidates carrying out practical work.

Skills B, C and D will usually generate a written product from the candidates. This product will provide evidence for moderation.

Raw scores for individual practical assessments may be given to candidates as part of the normal feedback from the teacher. The final, internally moderated, total score, which is submitted to the Ministry of Education, should not be given to the candidate.

7.3 MODERATION

(a) INTERNAL MODERATION

When several teachers in a centre are involved in internal assessment, arrangements must be made within the centre for all candidates to be assessed to a common standard.

It is essential that within each centre the marks for each skill assigned within different teaching groups (e.g., different classes) are moderated internally for the whole centre entry. The centre assessments will then be subject to external moderation.

(b) EXTERNAL MODERATION

Assessment sheets (see Appendix A) are to be submitted to the Ministry of Education no later than the specified date in the year of the examination. For external moderation the Ministry of Education will require, for a specified sample, evidence which must include for skills A to D inclusive, information about the tasks set and how the marks were awarded. In addition, for skills B, C, and D a specified sample of candidates' written work will be required. A further sample may be required. All records and supporting written work should be retained until after the publication of results.

Centres may find it convenient to use loose-leaf A4 file paper for assessed written work. This is because examples will be sent through the post for moderation and postage bills are likely to be large if whole exercise books are sent.

The samples sent to the moderator should have the sheets stapled together in the top left hand corner and should be clearly labelled with the centre number and the candidate's name and number. On each piece of work the skill(s) assessed and the mark awarded to each skill must be stated. Authenticated photocopies of the sample required would be acceptable.

8. MATHEMATICAL REQUIREMENTS FOR C - G CANDIDATES

Add, subtract, multiply and divide.

Understand and use decimals, fractions, averages, percentages, ratios.

Recognize and use expressions in decimal and scientific notation.

Recognize the variability and unreliability in experimental measurements.

Make approximations and estimates.

Undertake mensuration of a triangle, rectangle, cuboid and cylinder.

Substitute numbers for letters in simple equations.

Solve simple equations.

Interpret graphs and charts.

Use positive whole number indices.

Make approximate evaluations of numerical expressions.

Use direct proportions.

ADDITIONAL MATHEMATICAL SKILLS REQUIRED FOR STUDENTS ATTEMPTING GRADES A - B

Manipulate simple equations and find their solutions.

Select appropriate axes and scales for graph plotting.

Choose by inspection the best straight line or curve that will fit through a set of points on a graph.

Determine the gradient (slope) and intercept of a linear graph.

Use inverse proportions.

Use negative whole number indices.

9. GLOSSARY OF TERMS USED IN SCIENCE PAPERS

It is hoped that the glossary will prove helpful to candidates as a guide, i.e. it is neither exhaustive nor definitive. The glossary has been deliberately kept brief not only with respect to the number of terms included but also to the descriptions of their meanings. Candidates should appreciate that the meaning of a term must depend, in part, on its context.

1. DEFINE (the term(s)...) is intended literally, only a formal statement or equivalent paraphrase being required.

2. WHAT DO YOU UNDERSTAND BY/What is meant by (the term(s)...) normally implies that a definition should be given, together with some relevant comment on the significance or context or the term(s) concerned, especially where two or more terms are included in the question. The amount of supplementary comment intended should be interpreted in the light of the indicated mark value.

3. STATE implies a concise answer with little or no supporting argument, e.g. a numerical answer that can readily be obtained "by inspection'.

4. LIST requires a number of points, generally each of one word, with no elaboration. Where a given number of points is specified this should not be exceeded.

5. EXPLAIN may imply reasoning or some reference to theory, depending on the context.

6. DESCRIBE requires the candidate to state in words (using diagrams where appropriate) the main points of the topic. It is often used with reference either to particular phenomena or to particular experiments. In the former instance, the term usually implies that the answer should include reference to (visual) observations associated with the phenomena.

In other contexts, **DESCRIBE** and **GIVE AN ACCOUNT OF** should be interpreted more generally, i.e. the candidate has greater discretion about the nature and the organization of the material to be included in the answer. **DESCRIBE** and **EXPLAIN** may be coupled, as may **STATE** and **EXPLAIN**.

7. **DISCUSS** requires the candidate to give a critical account of the points involved in the topic.

8. **OUTLINE** implies brevity, i.e. restricting the answer to giving essentials.

9. **PREDICT** or **DEDUCE** implies that the candidate is not expected to produce the required answer by recall but by making a logical connection between other pieces of information. Such information may be wholly given in the question or may depend on answers extracted in an early part of the question.

   These terms imply a concise answer with no supporting statement required.

10. **SUGGEST** is used in two main contexts, (i.e. either to imply that there is no unique answer (e.g. in Chemistry, two or more substances may satisfy the given conditions describing an 'unknown'), or to imply that candidates are expected to apply their general knowledge to a 'novel' situation, one that may be formally 'not in the syllabus'.

11. **FIND** is a general term that may variously be interpreted as CALCULATE, MEASURE, DETERMINE, etc.

12. **CALCULATE** is used when a numerical answer is required. In general, working should be shown, especially where two or more steps are involved.

13. **MEASURE** implies that the quantity concerned can be directly obtained from a suitable measuring instrument e.g. length, using a rule, or mass, using a balance.

14. **DETERMINE** often implies that the quantity concerned cannot be measured directly but is obtained by calculation, substituting measured or known values of other quantities into a standard formula, e.g. volume, the formula of an ionic compound.

15. **ESTIMATE** implies a reasoned order of magnitude statement or calculation of the quantity concerned making such simplifying assumptions as may be necessary about points of principle and about the values of quantities not otherwise included in the question.

16. **SKETCH** when applied to graph work, implies that the shape and/or position of the curve need only be qualitatively correct, BUT candidates should be aware that, depending on the context, some quantitative aspects may be looked for, e.g. passing through the origin, having an intercept.

    In diagrams, **SKETCH** implies that a simple, freehand drawing is acceptable: nevertheless, care should be taken over proportions and the clear exposition of important details.

10. GRADE DESCRIPTIONS

The following grade descriptions are intended to give a general indication of the standards likely to have been achieved by candidates awarded Grades C and F. In practice, the grade awarded will depend upon the extent to which the candidate has met the objectives overall, and this might conceal weakness in some aspect of the examination which is balanced by superior performance in some other.

Assessment Objective	A typical candidate for the Award of a minimum Grade F might know and have been able to demonstrate knowledge and understanding of how to:	A typical candidate for the Award of a minimum Grade C might know and have been able to demonstrate knowledge and understanding of how to:
3.1, 3.3, 3.4 Facts, vocabulary conventions, physical quantities and units in which they are measured requirements for safety,	(a) State the conditions for r.t.p. and s.t.p.	State the fact that liquid and solid metals conduct electricity.
	(b) use of the word 'equation'	use the term 'molarity'
	(c) use a spatula for handling solid chemicals.	heat liquids liquids in test tube safely.
	(d) State the fact that the mass of an element is measured in grams.	State the unit of concentration mol dm^{-3}

Assessment Objective	A typical candidate for the Award of a minimum Grade F might know and have been able to demonstrate knowledge and understanding of how to:	A typical candidate for the Award of a minimum Grade C might know and have been able to demonstrate knowledge and understanding of how to:
3.1 Definitions and laws.	(a) define element and compound.	define the mole stating how many particles are found in one mole of substance.
3.1 Information presented in various forms.	(a) use a simple straight line graph.	interpret and analyze data given a pie chart.
3.13 The uses, applications implications of physical facts and principles.	(a) write "word' equations. (b) State that there are chemicals with harmful effects related to air pollution.	write simple balanced chemical equations. describe the manufacture of ammonia using the Haber process.
3.8 Use given formulae.	(a) convert temperature from the Celsius scale to the Kelvin Scale.	use following equation to solve solve for dilution $M_1V_1 = M_2V_2$ with appropriate units.
3.12 Apply laws and principles.	(a) solve simple problems given Avogadro's Gas Laws.	apply the theory of kinetic energy to the movement of molecules in solids, liquids and gases.

Assessment Objective	A typical candidate for the Award of a minimum Grade F might know and have been able to demonstrate knowledge and understanding of how to:	A typical candidate for the Award of a minimum Grade C might know and have been able to demonstrate knowledge and understanding of how to:
3.6 Explain phenomena in terms theories and models.	(a) explain the diffusion of solids, liquids and gases.	explain diffusion and how it relates to temperature and energy of the particles.
	(b) describe endothermic and exothermic reactions.	draw simple energy level diagrams for endothermic and exothermic.
3.15 Solve problems by designing, conducting and interpreting the results of simple experiments.	(a) Separate a suitable mixture by filteration.	Select apparatus to collect gas over water or in a gas syringe.
	(b) Determine by experimentation the most effective method for measuring small and large quantities of liquid.	Perform experiment and draw graphs showing rate of decomposition of dilute hydrogen peroxide/ manganese(IV) oxide against time, temperature or concentration. Analysis of results necessary.

Assessment Objective	A typical candidate for the Award of a minimum Grade F might know and have been able to demonstrate knowledge and understanding of how to:	A typical candidate for the Award of a minimum Grade C might know and have been able to demonstrate knowledge and understanding of how to:
3.19 Recognize mistakes, misconceptions unreliable data, and assumptions.	(a) Identify a doubtful point on a straight line graph.	Offer reasons for discrepancy between expected and actual results when pH of water is measured.
3.10 Draw conclusions and formulate generalizations.	Select given experimental data and a series of possible conclusions or generalizations, a likely conclusion and support the choice with simple reasons (e.g. cation/anion analysis).	Establish, given experimental data, evidence of a relationship between variables and draw an appropriate generalization from the relationship. * Use of Periodic or group properties.

APPENDIX A

MINISTRY OF EDUCATION

BAHAMAS GENERAL CERTIFICATE OF SECONDARY EDUCATION

INTERNAL ASSESSMENT OF EXPERIMENTAL SKILLS

Subject Name _____ Subject No. _____

Centre Name _____ Centre No. _____

Candidate Name	Candidate No.	Internally Moderated Mark for each Skill								Total Mark	Comments (if necessary)
		Skill A (6)	(6)	Skill B (6)	(6)	Skill C (6)	(6)	Skill D (6)	(6)		

Total number of Candidates on this sheet _____

Total number of Candidates entered by the Centre _____

Sheet _____ of _____

Name of Internal Moderator (BLOCK CAPITALS PLEASE)

_____

Signature of Internal Moderator _____

DATA SHEET

The Periodic Table of the Elements

IA	IIA	IIIA	IVA	VA	VIA	VIIA	VIIIA	IB	IIB	IIIB	IVB	VB	VIB	VIIB	NOBLE GASES
														1 H 1.00794[a]	2 He 4.002602[r]
3 Li 6.941[r]	4 Be 9.01218									5 B 10.811[a]	6 C 12.011	7 N 14.0067	8 O 15.9994[r]	9 F 18.998403	10 Ne 20.179
11 Na 22.98977	12 Mg 24.305									13 Al 26.98154	14 Si 28.0855[r]	15 P 30.97376	16 S 32.066[a]	17 Cl 35.453	18 Ar 39.948
19 K 39.0983	20 Ca 40.078[a]	21 Sc 44.95591	22 Ti 47.88[r]	23 V 50.9415	24 Cr 51.9961[a]	25 Mn 54.9380	26 Fe 55.847[r]	27 Co 58.9332	28 Ni 58.69	29 Cu 63.546[r]	30 Zn 65.39[r]	31 Ga 69.723[a]	32 Ge 72.59[r]	33 As 74.9216	34 Se 78.96[r]	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678[r]	38 Sr 87.62	39 Y 88.9059	40 Zr 91.224[r]	41 Nb 92.9064	42 Mo 95.94[r]	43 Tc (98)	44 Ru 101.07[r]	45 Rh 102.9055	46 Pd 106.42	47 Ag 107.8682[r]	48 Cd 112.41	49 In 114.82	50 Sn 118.710[a]	51 Sb 121.75[r]	52 Te 127.60[r]	53 I 126.9045	54 Xe 131.29[r]
55 Cs 132.9054	56 Ba 137.33	57 **La 138.9055[r]	72 Hf 178.49[r]	73 Ta 180.9479	74 W 183.85[r]	75 Re 186.207	76 Os 190.2	77 Ir 192.22[r]	78 Pt 195.08[r]	79 Au 196.9665	80 Hg 200.59[r]	81 Tl 204.383	82 Pb 207.2	83 Bi 208.9804	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.0254	89 ▼Ac 227.0278	104 Unq§ (261)	105 Unp§ (262)	106 Unh§ (263)												

**Lanthanides

58 Ce 140.12	59 Pr 140.9077	60 Nd 144.24[r]	61 Pm (145)	62 Sm 150.36[r]	63 Eu 151.96	64 Gd 157.25[r]	65 Tb 158.9254	66 Dy 162.50[r]	67 Ho 164.9304	68 Er 167.26[r]	69 Tm 168.9342	70 Yb 173.04[r]	71 Lu 174.967

▼Actinides

90 Th 232.0381	91 Pa 231.0359	92 U 238.0289	93 Np [237.0]	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

The volume of one mole of any gas is 24 dm^3 (litres) at room temperature and pressure (r.t.p.)

RECOMMENDED TEXTBOOKS

1. A New First Chemistry - Ramsden
   Stanley Thomas Publishers Ltd.
   1985

2. Review Chemistry - Amsco

AND AT LEAST ONE OF THE FOLLOWING

3. Nuffield Co-ordinated Sciences - Chemistry
   Andrew Hunt
   Longman Group - UK 1988

4. Thinking Chemistry - Lewis and Wallen
   Oxford

5. GCSE Chemistry John Murray

6. Chemistry by Concept - Antony Spiers,
   Derek Stebbens
   Heinemann Educational Books
   1974