



CARIBBEAN EXAMINATIONS COUNCIL

**CSEC<sup>®</sup>**

# **Integrated Science**

**SYLLABUS  
SPECIMEN PAPER  
MARK SCHEME  
SUBJECT REPORTS**

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## **Integrated Science Syllabus Extract**

The CSEC Integrated Science syllabus is based on three themes – The Organism and Its Environment, The Home and Workplace, and Earth’s Place in the Universe – which adequately reflect the common areas of human activity and experience. These themes form the unifying points of the syllabus which should, therefore, be seen as a coherent unit.

The syllabus is redesigned with a greater emphasis on the integration and application of scientific concepts and principles. Such an approach is adopted to develop those long-term transferable skills of ethical conduct, team work, problem-solving, critical thinking, and innovation and communication. It encourages the use of various teaching and learning strategies to inculcate these skills that will prove useful in everyday life, while at the same time catering to multiple intelligence and different learning styles and needs.

The syllabus is arranged in three sections sub-divided into specific objectives, corresponding explanatory notes and suggested practical activities.

- Section A The Organism and Its Environment
- Section B The Home and Workplace
- Section C Earth’s Place in the Universe





**CARIBBEAN EXAMINATIONS COUNCIL**

**Caribbean Secondary Education Certificate®  
CSEC®**

# **INTEGRATED SCIENCE SYLLABUS**

**Effective for examinations from May–June 2017**

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Please note that the syllabus was revised and amendments are indicated by italics.

Issued 1983

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Please check the website [www.cxc.org](http://www.cxc.org) for updates on CXC's syllabuses.

# Integrated Science Syllabus

## ◆ RATIONALE

*The study of science provides the knowledge and skills which are intended to improve the quality of living. An understanding of science is central to young citizens' preparedness for life in modern society. It empowers individuals to engage in public discussions on issues related to science and technology; and to be critical consumers of scientific information related to everyday life. Integrated Science brings together the everyday context in which science operates. It encompasses biology, chemistry, physics, earth science, environmental science and technology.*

*The CSEC Integrated Science Syllabus is based on three themes, The Organism and Its Environment, The Home and Workplace, and Earth's Place in the Universe which adequately reflect the common areas of human activity and experience. These themes form the unifying points of the syllabus which should, therefore, be seen as a coherent unit. The syllabus is redesigned with a greater emphasis on the integration and application of scientific concepts and principles. The inquiry-based approach should be used to develop long-term transferable skills of ethical conduct, team work, problem-solving, critical thinking, and innovation and communication. This also encourages the use of modern technology and other teaching and learning strategies to inculcate these skills that are useful in everyday life, while at the same time catering to multiple intelligences, and different learning styles and needs. Integrated Science by the very nature of the subject facilitates the inquiry-based approach.*

*This syllabus will contribute to the development of the Ideal Caribbean Person, as articulated by the CARICOM Heads of Government, as someone who shows respect for human life and awareness of the importance of living in harmony with the environment; demonstrates multiple literacies; independent and critical thinking and the innovative application of science and technology to problem solving. In keeping with the UNESCO Pillars of Learning, this course of study will also contribute to a person who will learn how to do, learn to live together and learn to transform themselves and society.*

## ◆ AIMS

This syllabus aims to:

1. *develop scientifically and technologically literate students who will engage in public discussions on issues related to these fields;*
2. *use scientific knowledge and principles in everyday life situations;*
3. *increase awareness of the importance of living in harmony with the environment and appreciate the need to preserve the natural environment;*
4. *design and evaluate scientific inquiry;*

5. *interpret data and evidence scientifically;*
6. *develop critical thinking, problem-solving and collaborative skills;*
7. *develop competencies that will enable students to make appropriate decisions regarding health, safety and other everyday life problems; and,*
8. *Integrate information, communication and technological tools and skills.*

## ◆ SUGGESTED TIMETABLE ALLOCATION

It is recommended that a minimum of **five 40-minute periods per week over two academic years** be allocated to the study of the Integrated Science Syllabus. This should include at least one double period each week. A minimum of two periods per week should be devoted to practical activities.

### CLASS SIZE

*It is recommended that practical classes accommodate a maximum of **twenty-five** students.*

## ◆ ORGANISATION OF THE SYLLABUS

The syllabus is arranged in three **SECTIONS** sub-divided into specific objectives, corresponding explanatory notes and suggested practical activities.

- SECTION A - THE ORGANISM AND ITS ENVIRONMENT
- SECTION B - THE HOME AND WORKPLACE
- SECTION C - *EARTH'S PLACE IN THE UNIVERSE*

The arrangement of the syllabus does not necessarily represent a teaching order. Each section begins with a statement of general objectives that, along with the specific objectives, corresponding explanatory notes and suggested practical activities, are indicative of the content on which the examinations will be based. However, the specific objectives should not be treated in isolation as they are related to general objectives and syllabus aims.

## ◆ APPROACHES TO TEACHING THE SYLLABUS

*The organisation of each Section in the syllabus is designed to facilitate inquiry-based learning and to ensure that connections among concepts are established. Teachers should introduce concepts familiar to the students and ensure that their lessons stimulate the use of all of the senses during the teaching and learning process. This will help students view science as a dynamic and exciting investigative process.*

*The general and specific objectives indicate the scope of the content including practical work that should be covered. However, unfamiliar situations may be presented as stimulus material in examination questions.*



*This syllabus caters to varying teaching and learning styles, with specific attention being drawn to the interrelatedness of concepts. Whenever possible, a practical approach should be employed, with special attention to the identification of variables and to the use of controls in investigations. The need for repeated investigation and observations to arrive at meaningful conclusions should be emphasised.*

*Greater emphasis should be placed on the integration and application of scientific concepts and principles and less on the factual materials which encourage memorisation and short-term recall. Every opportunity should be made to relate the study of scientific principles to the environment.*

*The role of the teacher is to facilitate students' learning of accurate and unbiased information that will contribute to a more scientifically literate society that is capable of making educated and ethical decisions regarding the world we live in.*

## ◆ CERTIFICATION

The syllabus is offered for General Proficiency certification. A candidate's performance will be indicated on the certificate by an overall numerical grade on a six-point scale as well as a letter grade for each of three profile dimensions, namely, Knowledge and Comprehension, Use of Knowledge and Practical Skills,

## ◆ DEFINITION OF PROFILES DIMENSIONS

On completion of the syllabus, students are expected to develop skills under three profile dimensions:

1. Knowledge and Comprehension (KC);
2. Use of Knowledge (UK).
3. Practical Skills (PS);

### Knowledge and Comprehension (KC)

The ability to:

Knowledge identify, recall, state basic facts, concepts and principles;

Comprehension select appropriate ideas, match and compare and cite examples of facts, concepts and principles in familiar situations.

### Use of Knowledge (UK)

The ability to:

Application transform data accurately and appropriately; use common characteristics as a basis for classification; use formulae accurately;



Analysis and Interpretation	identify the component parts of a whole and interpret the relationships between those parts; identify casual factors and show how they interact with each other;
Synthesis	combine component parts to form a new meaningful whole; make predictions and solve problems;
Evaluation	make reasoned judgments and recommendations based on the value of ideas and information and their implications.

### **Experimental Skills (XS)**

The ability to:

Observation/Recording/Reporting	use the senses to perceive objects and events accurately; present a written and oral report, drawing or other graphical representation which is clear, concise, accurate and pertinent to the investigation; report and recheck unexpected results;
Drawing	make large, clear, labelled line representations of specimens, apparatus or models;
Manipulation/Measurement	set up and use carefully and competently simple laboratory apparatus and measuring instruments; appropriately prepare specimens and materials for observation/investigation;
Planning/Designing	develop hypotheses and devise means of carrying out investigations to test them; plan experimental procedures and operations within the time allotted in appropriate sequence of operations as a result of difficulties encountered in carrying out experiments or obtaining unexpected results;
Analysis and Interpretation	use experimental data to infer, predict and draw conclusions; identify trends and patterns; make necessary and accurate calculations and recognise the limitations and assumptions of data.

**Note:** In addition to the *Experimental* skills, candidates are expected to utilise the skills listed under the Use of Knowledge profile dimension in their practical work.

## ◆ **SKILLS AND ABILITIES TO BE ASSESSED**

*The syllabus is designed to foster the use of inquiry based learning through the application of the practical approach. Students will be guided to answer scientific questions by a process of making observations, asking questions and doing experiments. The CSEC Integrated Science syllabus focuses on the following skills.*

1. Planning and Designing (PD)

- (a) Ask questions: how, what, which, why or where. (Students must be guided by their teachers to ask scientific questions).

*Example: Will plants that are grown using organic fertilisers grow taller than those that are grown using inorganic fertilisers?*

- (b) Construct a hypothesis; the hypothesis must be clear, concise and testable.

*Example: Plants grown using organic fertiliser will grow taller than those grown using inorganic fertiliser.*

- (c) Design an experiment to test the hypothesis; experimental procedure must include the following:

- (i) an appropriate aim related to the hypothesis;
- (ii) list of materials and apparatus to be used;
- (iii) observations to be made or measurements to be taken;
- (iv) precautions to be taken;
- (v) method of controlling variables;
- (vi) clear and concise step by step procedure;
- (vii) display of results;
- (viii) use of results; and
- (ix) possible limitations.

2. Measurement and Manipulation (MM)

- (a) Student's ability to handle scientific equipment competently.

*The list of equipment is:*

- (i) Bunsen burner;
- (ii) Tripod stand with wire gauze;
- (iii) binocular and monocular light microscope;
- (iv) measuring cylinders (25-100cm<sup>3</sup>);
- (v) beaker (50-500cm<sup>3</sup>);
- (vi) thermometer;

- (vii) ruler;
  - (viii) stop watch/clock;
  - (ix) balance;
  - (x) boiling tube;
  - (xi) test tubes and test tube holders;
  - (xii) hand lens; and
  - (xiii) syringe.
- (b) Student's ability to take accurate measurements.
  - (c) Student's ability to use appropriate units.

### 3. Observation, Reporting and Recording (ORR)

#### (a) Recording

*Student's ability to record observations and to collect, organise and present data. Observations and data may be recorded in the following format:*

##### (i) Prose:

*Written description of observations in the correct tense.*

##### (ii) Table (Neatly enclosed):

- Numerical: physical quantities in heading, units stated in heading, symbols, decimal points;
- Non-numerical: headings correct, details present.

##### (iii) Graph

*Axes labelled, correct scales, correct plotting, smooth curves/best fit lines, key to explain symbols if more than one dependent variable is being plotted.*

*Drawing of apparatus as set up for use.*

#### (b) Reporting

*Student's ability to prepare a comprehensive written report on their assignments using the following format:*

- (i) **Date** (date of experiment and date of write-up).
- (ii) **Aim/Purpose** (what is the reason for doing the experiment).

- (iii) **Apparatus and Materials** (all equipment, chemicals and materials used in the experiment must be listed).
- (iv) **Method/Experimental Procedure** (logically sequenced, step-by-step procedure written in the past tense, passive voice).
- (v) **Results and Observations.**
- (vi) **Discussion and Conclusion.**

4. Analysis and Interpretation

Student's ability to:

- (a) identify patterns and trends;
- (b) make accurate calculations;
- (c) identify limitations and sources of error;
- (d) make a conclusion to either support or refute the hypothesis;
- (e) compare actual results with expected results based on background/theoretical knowledge if they are different;
- (f) suggest alternative methods or modification to existing methods; and
- (g) analyse and interpret results and observations and making conclusions.

5. Drawing (Dr)

The following guidelines should be used for drawing:

- (a) The drawing should be placed in a position on the page which will allow for neat and clear labelling.
- (b) If the drawing is included in the written material, it should be placed just before this material and should be referred to in your answer.
- (c) Drawings should be done in pencil. The use of coloured pencils is not recommended.
- (d) The drawing should be large enough so that all structures can be clearly drawn.
- (e) The drawing should be correctly proportioned and parts should be accurately positioned.
- (f) In order to get a smooth, unbroken line when drawing, lift the pencil from the paper as infrequently as possible until the line is completely drawn. This method will help to eliminate haphazard and sketchy lines.

- (g) *When a large number of small structures are present in a specimen, draw only a few of them carefully, showing structural detail.*
- (h) *Write labels in pencil.*
- (i) *Labels should be annotated (that is, accompanied by brief explanatory notes).*
- (j) *Label lines should never cross each other and should be horizontal where possible.*
- (k) *In drawings where only a few structures are being labelled, all labels should be written on the right of the drawing.*
- (l) *Drawings must have a full title. This is usually written below the drawing and underlined. The title tells the name of the structure or organism and the view from which the drawing was made.*

## ◆ FORMAT OF THE EXAMINATIONS

<b>Paper 01</b> (1 hour 15 minutes)	Sixty multiple-choice items drawn from all areas of the syllabus.
<b>Paper 02</b> (2 hours 30 minutes)	<p>Part A</p> <p>Four compulsory structured questions drawn from all areas of the syllabus. Question 1 will be a practical/investigative type question.</p> <p>Part B</p> <p>Two compulsory essay type questions.</p>
<b>Paper 031</b> School-Based Assessment	<i>The School-Based Assessment will evaluate the achievement of the candidates in the Practical Skills in the laboratory and field work. Candidates will be required to keep a laboratory notebook.</i>
<b>Paper 032</b> (School-Based Assessment For private candidates only) (2 hours 10 minutes)	<i>Alternative to the School-Based Assessment for private candidates. This paper will examine the same skills as those tested in Paper 031. The focus, therefore, will be on Experimental Skills and Use of Knowledge (Analysis and Interpretation). This is a practical examination.</i>

TABLE 1

ALLOCATION OF MARKS ACROSS PAPERS AND PROFILE DIMENSIONS/PROFILES	PAPER 01	PAPER 02	SBA PAPER 03	TOTAL
<i>Knowledge and Comprehension (KC)</i>	60	34	-	94
<i>Use of Knowledge (UK)</i>	-	58	30	88
<i>Experimental Skills (XS)</i>	-	8	<b>70</b>	<b>78</b>
<b>Total-Raw marks</b>	60	100	<b>100</b>	<b>260</b>
<b>Total-Weighted marks</b>	<b>60</b>	<b>100</b>	<b>40</b>	<b>200</b>
<b>Total %</b>	<b>30</b>	<b>50</b>	<b>20</b>	<b>100</b>

## ◆ REGULATIONS FOR PRIVATE CANDIDATES

Private candidates must be entered for examination through the Local Registrar in their respective territories and will be required to sit Papers 01, 02, and EITHER Paper 031 OR Paper 032.

Paper 032 is a practical examination. The Paper will be of 2 hours and 10 minutes duration and will consist of three questions. Questions will test the Experimental Skills and Use of Knowledge (Analysis and Interpretation) profiles and will incorporate written exercises and practical activities.

## ◆ REGULATIONS FOR RESIT CANDIDATES

Resit candidates must complete Papers 01 and 02 and Paper 03 of the examination for the year for which they re-register. Resit candidates may elect not to repeat the School-Based Assessment component, provided they rewrite the examination no later than two years following their first attempt.

*Candidates may opt to complete the School-Based Assessment (SBA) or may opt to reuse another SBA score which satisfies the condition below.*

*A candidate who rewrites the examination within two years may reuse the moderated SBA score earned in the previous sitting within the preceding two years. Candidates reusing SBA scores in this way must register as “Resit candidates” and provide the previous candidate number.*

All resit candidates may enter through schools, recognised educational institutions, or the Local Registrar’s Office.

## ◆ SECTION A: THE ORGANISM AND ITS ENVIRONMENT

### GENERAL OBJECTIVES

On completion of this Section, students should:

1. *be aware that matter is made up of particles;*
2. develop an appreciation for the interdependence of life processes;
3. understand the relationship between the organism and its environment;
4. understand the relationship between the structures and functions of the systems within an organism;
5. *appreciate the importance of proper sanitation; and,*
6. develop investigative and problem-solving skills.

### UNIT I: MATTER

#### SPECIFIC OBJECTIVES

#### EXPLANATORY NOTES

#### SUGGESTED PRACTICAL ACTIVITIES

Students should be able to:

- |   |  |   |
|---|--|---|
| 1. <i>explain the properties of the states of matter;</i>   | <i>Arrangement of particles; shape and volume; forces of attraction; movement of particles; change of state. Mention plasma.</i>   | <i>Simple experiments to illustrate.</i>  |
| 2. draw simple diagrams to show the structure of unspecialised plant and animal cells;  | Cell wall, cell membrane, nucleus, cytoplasm, vacuoles, mitochondria, <i>ribosomes</i> , chloroplast. Details of structures as seen in electron micrographs <u>not</u> required. | Construct models using plasticine or other materials found around the home or laboratory. |
| 3. explain the <i>function</i> of the cell wall, cell membrane, nucleus, chromosomes, cytoplasm, <i>ribosomes</i> , mitochondria, vacuoles and chloroplast; | <i>Simple treatment only. For example, chromosomes carry genetic information in DNA.</i>   |   |



## SECTION A

### UNIT I: MATTER (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
4. <i>discuss the importance of selected microbes; and</i>	<i>Virus, bacteria, fungi; Positive and negative effects.</i>	
5. <i>explain the processes of diffusion, osmosis and active transport.</i>	<i>Definition of terms.</i>  Importance of diffusion, osmosis <i>and active transport</i> in <i>moving</i> substances in and out of cells and from one cell to another in all living organisms. Reference to the cell membrane as a partially permeable membrane.  Refer to Sec. A, Unit IV, SO 1.	Carry out simple investigations to illustrate the movement of particles (molecules and ions).

## SECTION A

### UNIT II: REPRODUCTION AND GROWTH

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. distinguish between asexual and sexual reproduction;	Simple cell division - Details of meiosis and mitosis not required. Comparison of asexual and sexual reproduction, advantages and disadvantages of asexual reproduction (variety, <i>adaptation</i> , livestock and crops).	Examine and draw storage organs including corms, bulbs, rhizomes, runners, and cuttings.  Use models/charts of human reproductive system to locate and identify structures.
2. describe various methods of asexual reproduction in plants and animals;	Budding, cuttings, runners, tissue culture, cloning, <i>grafting</i> . <i>Refer to Sec. A, Unit III, SO 2.</i>	<i>Carry out one of the methods. Conduct research on the appropriateness of each method.</i>
3. describe the process of sexual reproduction in plants and in humans;	Flowers: names and functions of parts; pollination: types, advantages of cross pollination, agents of; fertilisation and development of seeds/fruits (outline); human reproductive systems: names and functions of parts.	<i>Draw and label cross section of various types of flowers.</i>  <i>Label the human reproductive systems.</i>
4. describe the menstrual cycle;	Roles of estrogen and progesterone; mention menopause.	
5. discuss ovulation, fertilisation, implantation, development of the foetus and birth;	<i>Simplified diagrams to illustrate processes.</i>	
6. discuss the advantages and disadvantages of various methods of birth control;	Natural, barrier, hormonal, surgical.	<i>Internet research for new methodologies.</i>

## SECTION A

### UNIT II: REPRODUCTION AND GROWTH (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
7. discuss the importance of pre and post natal care of mothers and babies;	The effects of nutrition, drugs, x-rays and diseases; advantages of breast feeding, and immunisation.  <i>Use of ultrasound.</i>  Refer to Sec. A, Unit IV, SO 3.	
8. discuss the causes, symptoms, prevention and control of sexually transmitted infections [STI's];	Herpes, Gonorrhoea, Syphilis, Hepatitis, AIDS.  Bacterial - Syphilis or Gonorrhoea; Viral - Herpes; Fungal – Candida.  <i>Refer to Sec. A, Unit I, SO 4.</i> <i>Refer to Sec. A, Unit IV, SO 5.</i>	Use charts/tables to compare information of STI's.
9. compare growth patterns in selected organisms; and	Seeds of annual plants - balsam, bean and corn (maize).  Germination in plants.	Plot graph of plant growth at regular intervals of one week and extrapolate to predict height at future time; construct and analyse graphs of height and weight with increase in age of boys and girls; attempt to verify prediction for plants and human beings.
10. discuss the need for human population control.	Effects of population pressures on quality of life, world food production and limited material resources; consideration of the effects of teenage pregnancy; birth control methods.	<i>Graphical representations of data showing effects of overpopulation.</i>

## SECTION A

### UNIT III: FOOD AND NUTRITION

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. describe the process of photosynthesis;	Definition, identification of substrate, conditions and products; word and chemical equations; outline of process; importance of light, ( <i>photo chemical reactions</i> ) chlorophyll, carbon dioxide and awareness that light energy can be converted to chemical energy.	Experiments to establish conditions for photosynthesis, tests for starch as a product of photosynthesis.
2. describe the methods used in the production of crops;	<i>Brief description of strip planting, contour ploughing, terracing, crop rotation, contouring, greenhouse farming, hydroponics; tissue culture, rooftop farming; indoor farming; organic farming; container gardening;</i> <i>Refer to Sec. A, Unit II, SO 2.</i>	<i>Visits to nearby farms; study of common agricultural practices needed to maintain crop growth; need for conservation.</i>
3. discuss food chains and food webs found in an environment;	<i>Producers, consumers (primary and secondary) decomposers, habitat, herbivores, carnivores, omnivores, population, community, ecosystem.</i>	<i>Observe plants and animals in a nearby area or on the school grounds and classify them as producers, consumers, decomposers, herbivores, carnivores.</i>  <i>Construct simple food chains and food webs in terrestrial and aquatic environments.</i>
4. explain the importance of food;	The Caribbean food groups, their sources and functions of their main nutrients. Food additives and their effect on health. Balanced and unbalanced diets. Balanced diet related to age, gender, <i>occupation/sport</i> ; PEM deficiency diseases, <i>diabetes</i> and obesity.	Food tests – <i>use local foods.</i>  Collect food labels to discern nutritive content.  Experiments to measure energy value of food.

## SECTION A

### UNIT III: FOOD AND NUTRITION (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
5. describe the conditions which promote the growth of microorganisms;	<i>Procedures for retarding and preventing the growth of bread mould. The effects of microorganisms in food. Refer to Sec. A, Unit I, SO 4.</i>	<i>Investigate growth of mould on bread under different conditions.</i>
6. discuss the principles used in food preservation;	<i>Methods – salting, drying, pickling, heating, refrigeration, adding sugar and treating with other preservatives.</i>	<i>Investigate one of the methods for preserving food.</i>
7. explain the process of digestion in humans; and	<i>Mechanical and chemical digestion; definition and role of enzymes; role of bile; enzymes active at different stages (salivary, amylase, pepsin, renin, pancreatic, lipase, pancreatic amylase, trypsin, maltase, lactase, sucrose, galatase), substrates and products; absorption; assimilation; egestion.</i>	<i>Label the digestive system and state the function of each part; identify enzymes, digestive juices and state acidity/alkalinity at each stage; experiments to show effects of temperature and pH on enzymes.</i>
8. explain the role of teeth in digestion in humans.	<i>Types of teeth and dental formula; relate structures to function and diet.  Care of teeth.</i>	<i>Draw and label a diagram of a vertical section of a tooth; examine models of individual teeth.</i>

## SECTION A

### UNIT IV: *TRANSPORT SYSTEMS*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. discuss the need for transport systems within a living organism;	Circulatory system: necessity, surface area/volume ratio; transport in plants, transpiration, movement of nutrients. <i>Refer to Sec. A, Unit I, SO 5.</i>	Experiments on diffusion with agar cubes of different sizes to show how surface area/volume ratio affects total diffusion. <i>Capillary action – use herbaceous plant in coloured water.</i>
2. relate the structures in transport systems to their functions;	Composition of blood and types of blood cells and their functions; structures of the heart; heart beat; names of <i>major blood vessels and organs associated with the circulatory system.</i>  <i>Function of stem-xylem and phloem (simple explanation). Refer to SO 1 above.</i>	<i>Examine the structures of a mammalian heart.</i>  <i>Draw or construct a model of a mammalian heart.</i>
3. identify the blood groups;	A, B, AB and O: antigen and antibody for each group, precaution in transfusion and handling; Rh factor - risk in pregnancy <i>and</i> precautions.	Use information gathered from clinics, hospitals and doctors.
4. explain possible causes of <i>cardiovascular diseases</i> ;	(a) <i>Hypertension</i> ; (b) <i>Heart attack</i> ; and (c) <i>Stroke</i> .	
5. explain how the principles of immunisation are used in the control of communicable diseases;	(a) <i>Natural</i> ; (b) <i>Artificial</i> ; (c) <i>Vaccines</i> ; (d) An awareness of AIDS as a disease which results from damages to the immune system; and (e) <i>Retroviral (HIV/AIDS)</i> .	Research on the effect of retrovirals on persons living with HIV/AIDS.

## SECTION A

### UNIT IV: *TRANSPORT SYSTEMS* (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
6. <i>discuss the physiological, social and economic effects of drug use;</i>	<p><i>Definition of drugs.</i></p> <p>(a) <i>Alcohol;</i> (b) <i>Prescription drugs;</i> (c) <i>Non-prescription drugs;</i> (d) <i>Illegal drugs;</i> (e) <i>Steroids;</i> (f) <i>Diet pills; and</i> (g) <i>Hormonal injections (HCG).</i></p> <p>Blood doping [increase the number of red blood cells].</p> <p>Refer to Sec. A, Unit II, SO 4, Sec. A, Unit VI, SO 2.</p>	Research and report on use and misuse of drugs.
7. <i>discuss the physiological effects of exercise;</i>	Effects on circulatory and respiratory systems, effects on balancing energy input and output.	<i>Investigate the effect of exercise on the pulse rate.</i>
8. <i>identify the major bones of the human skeleton;</i>	<i>Cranium clavicle, scapula, vertebral column, humerus, radius, ulna, rib cage, sternum, pelvic girdle, femur, tibia, fibula.</i>	
9. <i>relate the structure of the skeleton to its functions;</i>	<i>Movement, protection, support, breathing, protection of blood vessels.</i>	
10. <i>identify different joints in the human body; and</i>	<i>Hinge joint, fixed joint, ball and socket.</i>	
11. <i>explain how the skeletal muscles function in the movement of the limb.</i>	<p><i>Role of antagonistic muscles.</i></p> <p><i>Effect of exercise on muscle toning.</i></p> <p>Refer to Sec. A, Unit IV, SO 7.</p>	

## SECTION A

### UNIT V: RESPIRATION AND AIR POLLUTION

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. explain the mechanism of breathing;	Inhalation and exhalation, pressure and volume changes, role of ribcage and diaphragm; composition of inhaled and exhaled air; <i>structures of lungs.</i>  <i>Mention CPR.</i>  <i>Refer to Sec. B, Unit III, SO 9.</i>	<i>Bell jar demonstration.</i>  <i>Research usage of Ventilator machine.</i>
2. <i>discuss the process of gaseous exchange;</i>	<i>Features common to respiratory surfaces in humans and plants.</i>	<i>Diagrams of the structures of alveoli and stomata.</i>
3. discuss the importance of respiration to organisms;	Definition, substrate and products, word and chemical equation; site, types and importance of energy release; energy related to type of substrate.	Experiments to show release of energy and carbon dioxide by organisms.
4. <i>distinguish between aerobic and anaerobic respiration;</i>	<i>Compare amounts of energy produced, products and use; relevance of anaerobic respiration to sports and industries (bakeries/breweries).</i>	<i>Baking, wine production.</i>  <i>Field trips to related industries.</i>
5. identify the causes of air pollution;	<i>Fossil fuels, natural activities, fires, sulphur dioxide, carbon dioxide, methane, carbon monoxide, lead; affinity of carbon monoxide to haemoglobin of red blood cells.</i>  <i>Refer to Sec. A, Unit IV, SO 2.</i>	
6. discuss <i>problems</i> that are caused by air pollution; and	Allergies, lung cancer, <i>asthma</i> , other respiratory disorders, <i>emphysema</i> . <i>Acid rain, blocking stomata in plants.</i> <i>Refer to Sec. A, Unit II, SO 1.</i> <i>Refer to Sec. B, Unit I, SO 5.</i>	<i>Conduct research on cases of respiratory disorders associated with air pollution and smoking.</i>



## SECTION A

### UNIT V: RESPIRATION AND AIR POLLUTION (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
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Students should be able to:

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|--|--|--|
| 7. explain the effects of smoking on the respiratory system. | Importance of smoke free environments: <i>effect of second-hand smoke.</i> |  |
|--|--|--|

## SECTION A

### UNIT VI: EXCRETION

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. distinguish between excretion and egestion;	Definitions. <i>Refer to Sec. A, Unit III, SO 8.</i>	
2. explain the mechanism of excretion by the lungs, skin and kidneys <i>in humans</i> ; and	Relationship to metabolism, excretory organs and products; kidney – structure of tubule related to ultra-filtration and re-absorption; <i>Refer to Sec. A, Unit IV, SO 2.</i>  Osmoregulatory function of kidneys; dialysis. Relate structure of skin to its functions – <i>excretion, temperature control.</i> <i>Refer to Sec. B, Unit I, SO 5.</i>	Examine cross section diagrams/models of the skin and kidneys of human beings.  <i>Field trip to hospital – dialysis machine.</i>
3. identify the waste products of flowering plants and their methods of excretion.	Waste products of respiration and photosynthesis only. <i>Osmoregulation related to environmental factors; plants - waste products, gaseous exchange and its importance, leaf fall and storage in bark.</i> <i>Refer to Sec. A, Unit III, SO 1.</i>	

## SECTION A

### UNIT VII: SENSE ORGANS AND COORDINATION

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. describe the sense organs and their functions;	<i>Stimulus associated with sense organs. Refer to Sec. A, Unit IV, SO 2.</i>	
2. relate the structures of the mammalian eye to their functions;	Accommodation and control of amount of light entering eye.	Compare a model of the eye with a camera (Pin hole).
3. distinguish between natural and artificial lighting;	<i>Effects on colours of objects.</i>	
4. distinguish among transparent, translucent and opaque materials;		
5. describe how to separate white light into its component colours;		<i>Glass or water prisms can be used.</i>
6. explain sight defects and their corrections;	Long and short-sightedness; Effects of bright light and physical injury; Function of convex and concave lenses. <i>Glaucoma; cataracts.</i>	Carry out simple investigations using convex and concave lenses.
7. relate the structures of the mammalian ear to their functions;	The approximate audio frequency spectrum of the human ear; the effects of loudness and pitch on human beings.	Carry out simple investigations on pitch and loudness.
8. describe the structures and functions of the nervous system; and	<i>Simplified diagrams showing structures of brain and neurons.</i>  <i>Examples of voluntary and involuntary actions.</i>  <i>Mention malfunctioning of system, for example, paralysis; physical disabilities.</i>	Simple reflex arc, for example, knee jerk.

## SECTION A

### UNIT VII: *SENSE ORGANS AND COORDINATION (cont'd)*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
9. describe the functions of the endocrine system.	Endocrine – hormones as messengers; thyroid, pancreas, sex organs, adrenal glands and pituitary glands.	Structural diagram – identify location of organs; list hormones produced and their uses/effects.	

*Refer to Sec. A, Unit II, SO 4.*

## SECTION A

### UNIT VIII: HEALTH AND SANITATION

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
1. <i>discuss the need to practise good personal and community hygiene;</i>	<i>Elimination of body odours; social acceptance; prevention of infections; care of genitalia.</i>  <i>The importance of proper disposal of waste, adequate toilet and sewage disposal facilities, garbage collection and disposal.</i>		
2. discuss conditions that encourage the breeding of household pests and parasites;	Differentiate between pests, parasites and pathogens.  Cockroaches, flies, rats, mosquitoes.		
3. <i>suggest appropriate methods of control in the lifecycle of a mosquito or housefly;</i>	<i>Identification of stages in the lifecycle.</i>  <i>Biological, chemical and mechanical control.</i>		
4. discuss the implications of uncontrolled methods used to prevent food contamination;	Infections by pathogens; <i>Ways in which food is contaminated.</i>		
5. discuss control methods of pests;	Biological, mechanical, chemical and sanitary controls.		
6. discuss the different types of waste; and	Domestic, industrial, biological, <i>chemical</i> and electronic waste. <i>Reduce, reuse, and recycle.</i> Biogas production. Bio-degradable and non bio-degradable waste.		
<i>Refer to Sec. B, Unit III, SO 12.</i>			

## SECTION A

### UNIT VIII: HEALTH AND SANITATION (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
7. <i>discuss the impact of solid waste on the environment.</i>	Pollution of potable water, increase in pest population; prediction of their consequences; assessment of the effects of unsanitary conditions on the spread of pathogenic microorganisms and parasites such as worms.		

#### Suggested Teaching and Learning Activities

*To facilitate students' attainment of the objectives of this Syllabus, teachers are advised to engage students in the teaching and learning activities below. These activities are designed to promote inquiry-based learning and cater to students with various learning styles.*

- 1. Use video clips to introduce concepts such as osmosis, diffusion, fertilisation and implantation; and to support and reinforce learning.*
- 2. Have students cultivate local crops where possible and use a portfolio to present documentation.*
- 3. Arrange site visits and/or field trips such as to a brewer, hospital or farm when appropriate to enrich the learning experience.*
- 4. Invite guest lecturers and resource persons, for example, health professionals to engage students in interactive sessions on topics of interest such as the use of contraceptives and other issues related to health and sanitation.*
- 5. Organise debates on issues that impact on quality of life, for example, Rh factor and HIV-Aids.*
- 6. Make posters or flyers that depict critical issues or principles involved in topics, for example, food preservation.*
- 7. Design and construct models, for example, of different types of cells and teeth, the kidney, the heart and the skin.*
- 8. Have students collect and interpret data, and do representations [mathematical] where necessary on concepts such as growth patterns and enzymes.*
- 9. Conduct research and make presentations on topics such as the types of drugs and diseases, that lend themselves to these activities.*

## SECTION A

### UNIT VIII: HEALTH AND SANITATION (cont'd)

10. *Examine case studies, for example, on topics that relate to health and hygiene.*
11. *Identify credible sources on microbes.*
12. *Relate transport systems in plants and animals to transporting goods in everyday life.*
13. *Use the internet to examine 3D structures of atoms. Create models of structures of atoms using everyday recyclable materials.*
14. *Watch the video “Losing Paradise” <http://www.youtube.com/watch?v=vCanbznET3Y>. Ask students to write a report on how all stakeholders can tackle environmental issues [lack of recycling or accumulation of plastic waste].*
15. *Visit the Malaria website <http://nobelprize.org/educational/medicine/malaria> and play both the “Mosquito” and the “Parasite” games on the site. This will enable a better understanding of the diseases spread by mosquitoes.*
16. *Have students work in groups to write short newspaper articles on the human body systems and the diseases that affect each [for example, the reproductive system – STIs, prostate cancer, cervical cancer].*
17. *Interpret health data by investigating the number of persons in your country who suffer from diabetes and cancer. What are the causes, incidence rates and treatments available in your area? Research report should be provided by students.*
18. *Use role play to demonstrate the behaviour of energy particles in the different states of matter.*
19. *View the following websites to watch movies, play games and do quizzes and activities on topics such as states of matter, food chains and photosynthesis:*

*<http://www.brainpop.com/science/>*

*<http://www.bbcscience.net>*

## ◆ SECTION B: THE HOME AND WORKPLACE

### GENERAL OBJECTIVES

*On completion of this Section, students should:*

1. *appreciate the importance of energy in everyday life;*
2. understand the relationship between human beings and the environment in which they live and work;
3. *understand the need for appropriate physical conditions in the home and workplace;*
4. *understand the methods involved in the transfer of energy;*
5. *appreciate the importance of electrical energy in everyday life;*
6. understand the occurrence of accidents, hazardous situations and safety measures used in their prevention;
7. *appreciate the inter-conversion and conversion of mass energy and momentum; and*
8. develop investigative and problem solving skills.

### UNIT I: TEMPERATURE CONTROL AND VENTILATION

#### SPECIFIC OBJECTIVES

#### EXPLANATORY NOTES

#### SUGGESTED PRACTICAL ACTIVITIES

Students should be able to:

- |   |  |   |
|---|--|---|
| 1. describe the methods of heat transfer and their applications;                                      | Conduction, convection, radiation. Mention land and sea breezes.   | Perform simple experiments.   |
| 2. explain the principle by which thermostatically controlled household appliances operate;           | Electrical and gas ovens, electrical irons.  | Demonstration to illustrate the principle using a bimetallic strip.                           |
| 3. describe the <i>types</i> of thermometers <i>in relation to</i> the principles by which they work; | <i>Temperature and unit of measurement.</i><br><br><i>Clinical, laboratory, digital, minimum and maximum thermometers; alcohol and mercury thermometers.</i> | Perform simple experiments to demonstrate use. Safe handling techniques should be encouraged. |



## SECTION B

### UNIT I: TEMPERATURE CONTROL AND VENTILATION (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
4. explain the cooling effects of evaporation; and	Latent heat of vaporisation, sweating and metabolic rate. Refer to Sec. A, Unit VI, SO 2.	<i>Investigate the effects of wind, temperature and humidity of the area on evaporation and drying of materials.</i>
5. explain the need for proper ventilation.	Effects of ventilation. Include air conditioner and humidifier.	Identify features of buildings which promote ventilation.

## SECTION B

### UNIT II: CONSERVATION OF ENERGY

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. explain the concept <i>and unit of energy</i> ;	Energy as an ability to produce a change.	Activities involving change of state (chemical composition, temperature, and motion).
2. discuss the inter-conversion and conservation of mass energy;	Consideration that energy can be inter-converted, stored by physical or chemical means, put into motion or used to do work, for example, in the sun: nuclear reactors, bombs; energy supply in space; <i>mention</i> photosynthesis; methods used to save energy supply to vehicles and measures that may be taken to decrease the effects of the internal combustion engine on life and the environment.  Refer to Sec. A, Unit IV, SO 5.	Consider - telephones; springs; lamps; shock absorbers in vehicles; batteries; electric motors, calculators, computers.
3. discuss the transport and transfer of energy; and	Vehicular collisions; transfer of energy by a wave method; Energy reflected and brought to focus.	Moving stationary objects by means of rolling on swinging spheres. Use of ripple tank, shaking rope or slinky as demonstration; use of dish aerials, mirrors, headlamps.
4. explain the principles of momentum conservation.	Consider conservation of linear momentum (refer to vehicular collision).  <i>Use of formula (<math>p = m \times v</math>) to do simple calculations.</i>	Use the momentum conservation principle to predict the outcomes of collision. Use simple qualitative trolley experiments.

## SECTION B

### UNIT III: ELECTRICITY AND LIGHTING

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. discuss the use of good and poor conductors of electricity;	Definition of conductors (good, semi and poor). Use of rubber and plastics in covering electrical wires and connections.	Simple experiments to detect good, <i>semi</i> and poor conductors.
2. explain the relationship between voltage, current and resistance in circuits;	Use of formula $V=IR$ to find unknown; units of electricity: Ampere, Volt, Watt, and Ohm; mention symbols for ammeter, cell, lamps, resistors, switch, transformer, voltmeter and fuse.	<i>Set up circuits to show properties; draw diagrams of series and parallel circuits; calculate wattage given voltage and current; use ammeters and volt-meters to show how different resistances affect current.</i>
3. explain how a fuse works as a safety device;	Colour code in wiring plug and choice of flex; dangers of overloading circuit (overheating of wire that may cause insulation to burn).	Wiring of a plug.
4. calculate the amperage for fuses and flexes needed for household appliances;	Use of formula $I=W/V$ ; consider use of thick wires as overhead cables and for heavy-duty appliances. Energy consumption = power x time.	Work out size of fuses for appliances.
5. calculate the energy consumption of different electrical appliances;	The cost of using heating appliances (clothes iron, stoves) and non-heating appliances (radio, fluorescent bulbs, fans). Unit = 1 kWh.	<i>Use actual measurements on energy consumption (units on meter) from different appliances.</i>
6. calculate electricity bills;	Various costs which must be considered when making up electricity bills, including meter rentals and fuel adjustment charges.	Read both digital and analogue meters.

## SECTION B

### UNIT III: ELECTRICITY AND LIGHTING (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
7. discuss energy conservation measures;	Energy wastage in faulty electrical appliances. <i>Light Emitting Diode (LED), Liquid Crystal Display (LCD), Plasma.</i>	<i>Investigate energy use in school and present the results in a comparison table.</i>
8. compare the use of fluorescent tubes, LED bulbs and filament lamps in providing light;	Shadow formation, efficiency, ease of brightness control and similarity with daylight.	<i>Investigate the brightness of various filament lamps of different voltage.</i>
9. <i>evaluate first aid methods for treating accidents;</i>	<i>Electrical shock, burns and principles of mouth-to-mouth resuscitation.</i>  <i>Refer to Sec. A, Unit V, SO 1.</i>	
10. <i>discuss the various methods used in extinguishing fires;</i>	<i>Electrical, chemical and bush fires.</i>	<i>Design and make a simple carbon dioxide fire extinguisher.</i>
11. <i>discuss the hazards caused by careless handling of appliances and other equipment; and</i>	<i>Radiation and voltage hazards.</i>  <i>Radios, television sets, computers, mobiles and microwaves.</i>	
12. <i>evaluate conventional protective gear/wear.</i>	<i>Including in home, school and workplace.</i>  <i>Protective clothing – gloves, goggles, helmets, chest masks.</i>  <i>Refer to Sec. A, Unit VIII, SO 6.</i>	

## SECTION B

### UNIT IV: MACHINES AND MOVEMENT

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. <i>compare</i> the different types of levers;	Organising load, effort and fulcrum in three different ways.	Actual use or observation of the use of the hammer, bottle opener, crowbar, scissors, nutcracker, wheelbarrow, fishing rod, tweezers as levers; pulleys, wheels, hydraulic press, screw.
2. explain the functions of simple machines;	Levers, pulleys and inclined planes with reference to the way they make work easier; use as force multipliers for convenience of application of a force; simple machines used in or associated with vehicles, for example, motor cars, push carts, draglines, bicycles; simple levers in the mammalian skeleton.	
3. discuss the principles of mechanical advantage and energy conversion; and	Use of the equations: mechanical advantage = load ÷ effort; energy converted = force x distance moved in the direction of the force.	Use inclined planes to assist movement of objects from one level to another; perform calculations on mechanical advantage and energy conversion with respect to simple machines.
4. discuss factors that contribute to the inefficiencies of machines and ways of overcoming their influences.	The motorcar, lawnmower, bicycle; factors such as rusting, corrosion and friction.	

*Refer to Sec. B, Unit V, SO 8.*

## SECTION B

### UNIT V: METALS AND NON-METALS

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. relate the uses of metals and non-metals to their properties;	Metals, plastics and wood; properties such as electrical conductivity, thermal conductivity, melting point, density, tensile strength. Materials used in sports/sporting equipment.	
2. discuss the advantages and disadvantages of using plastics;	Negative effects on the environment.  <i>Recycling.</i>	
3. <i>compare the reactivity of metals;</i>	Aluminum (Al); Copper (Cu); Iron (Fe); Tin (Sn); Silver (Ag); Zinc (Zn).	Observe which metals react <i>with dilute acid</i> and which do not; Write simple word equations to show their reaction.
4. discuss the advantages and disadvantages of using cooking or canning utensils made of aluminum;	Consideration of toxicity and corrosion.	
5. discuss the benefits of using alloys to make household items;	Alloys and examples of alloys commonly found in the home and workplace - steel, brass, soft solder and <i>electroplating</i> .	
6. discuss the conditions which cause rusting;	Tarnishing as a chemical process (oxidative).	
7. identify the factors which affect the rate of rusting; and	Problems of rusting metal fixtures in houses located near the sea or an industrial plant.	<i>Controlled experiments to show that air and water are necessary for rusting.</i>

## SECTION B

### UNIT V: METALS AND NON METALS (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
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Students should be able to:

8. discuss the methods used to reduce or prevent rusting of iron or steel.

*The scientific principles involved in painting, covering with oil or plastic, electroplating; galvanizing, for commercial as well as household purposes.*

## SECTION B

### UNIT VI: ACIDS, BASES AND MIXTURES

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
1. discuss the uses of some common household chemicals;	Chemical and trade names; water as the most common chemical in the home; water as a solvent used in many household chemicals.  <i>Safety symbols - corrosive, toxic, flammable, explosive.</i>		
2. distinguish among acids, bases and salts;	The concept of pH.  Classification of household chemicals into acids, bases and salts.  Principle of neutralisation.	Simple investigations to determine the pH values of various brands of toothpaste and infer the effect of the pH on bacteria found in the mouth. Use pH paper. Simple experiments on neutralisation using droppers.  Experiments on stain removal - bicarbonate of soda for fruit stains; borax for fruit, wine and tea stains.	
3. distinguish among solutions, suspensions and colloids;	Classification of household chemicals in each category.	Simple preparations of solutions, suspensions and colloids.	
4. describe separation techniques;	Aqueous and non-aqueous solutions.  (a) Distillation. (b) Filtration. (c) Chromatography.  <i>Refer to Sec. C, Unit III, SO 2.</i>  <i>Desalination plants.</i>	<i>Plan and design</i> experiments on stain removal - turpentine for paint; methylated spirit for glass; acetone for nail polish.  Demonstrate ways of removing rust marks on clothing. <i>The use of stain removal pens and teeth whiteners.</i>	



## SECTION B

### UNIT VI: ACIDS, BASES AND MIXTURES (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
5. discuss the safe and economic use of some common household chemicals;	The action of disinfectants, antiseptics, deodorisers, <i>household bleach, hydrogen peroxide, vinegar.</i>		
6. explain the cleaning actions of scouring powders and detergents on household appliances;	Constituents of scouring powders and detergents, <i>rust removers, lime scale removers, oxidizing agents. Appliances made from Al, Cu, Fe, Sn, Ag, Zn.</i>		
7. distinguish between hard and soft water; and	Advantages and disadvantages of hard and soft water.	Experiment to determine degree of hardness of water.	
			Experiments to soften samples of hard water by (a) boiling (b) adding washing soda (c) distillation.
8. distinguish between soapy (soap) and soapless detergents.	<i>Mode of cleaning;</i> the effects of detergents on the environment; biodegradable and non-biodegradable detergents; <i>oxidizing agents used in laundering.</i>		

#### **Suggested Teaching and Learning Activities**

*To facilitate students' attainment of the objectives of this Syllabus, teachers are advised to engage students in the teaching and learning activities below. These activities are designed to promote inquiry-based learning and cater to students with various learning styles.*

- 1. Organise debate on issues that impact on quality of life, for example, food contamination and environmental wastes.*
- 2. Make posters and flyers on equations of reactions, alloys and their uses and the prevention of rusting.*

## SECTION B

### UNIT VI: ACIDS, BASES AND MIXTURES (cont'd)

3. Use video clips on concepts such as heat transfer, energy transfer separation techniques to enhance students learning.
4. Carry out investigations and interpret data of results obtained, for example, on the use of energy in the home/school and the hardness of water.
5. Invite guest lecturers to conduct demonstration workshops, for example, emergency medical services or fire department.
6. Design and construct models to demonstrate machines and movement, and new technology applications.
7. Organise visits to emergency medical services and the fire department/ Red Cross.
8. Research trade names of common household chemicals.
9. Conduct research on the use of salts in everyday life, for example, preservatives, controlling pests, medicines.
10. Invite a policeman to demonstrate the use of the breathalyser machine to test for alcohol.
11. Research, present, and discuss acid-base reactions and oxidation-reduction reactions in everyday life.
12. Create pamphlets to alert the school community on the dangers of chemicals used in everyday life.
13. Ask students to bring labels from home in order to stimulate discussions and analyse chemical information.
14. Use video clips to explain the application of electrolysis in electroplating, anodising and purification.
15. Engage students in activities to assess the impact of organic compounds used in everyday life on human health, society and the environment, for example, plastics, food additives, pharmaceuticals, detergents.
16. Have students display samples of alloys used at home.
17. Use different forms of presentations by students to demonstrate an understanding of the dangers of metals and non-metals on living systems and the environment.
18. View the following websites to watch movies, play games and do quizzes and activities on topics such as compound and mixtures, electricity and lighting and metals:

<http://www.brainpop.com/science/>



## SECTION B

### UNIT VI: ACIDS, BASES AND MIXTURES (cont'd)

<http://www.bbcscience.net>

19. Write an essay on how Direct Current [DC] and Alternating Current [AC] were discovered.
20. Why did the AC prevail? List the items in your homes that use AC and those that use DC.  
<http://www.teachersdomain.org/resource/phy03.sci.phys.mfw.acdc/>
21. To help students understand Ohm's law, allow them to observe the Ohm's law simulation at <http://micro.magnet.fsu.edu/electromag/java/ohmslaw/index.html>
22. Ask student to make a list of items in the home that require a transformer when plugged in and explain why this is so.
23. Discuss how raindrops and prisms have similar effect with light in forming rainbows and spectrum respectively using diagrams. Observe the simulation at the website.
24. Research assignment by students: In the Caribbean islands, note where the air conditioning units are typically placed in rooms. Where would heaters be located in rooms in cold countries? Explain the reason[s] for your decision using principles of Physics.

## ◆ SECTION C: EARTH'S PLACE IN THE UNIVERSE

### GENERAL OBJECTIVES

*On completion of this Section, students should:*

- 1. understand where we are in space;*
- 2. appreciate the motions within our solar system;*
- 3. understand the rationale for space exploration;*
- 4. appreciate that the soil and the sea are the two most important outdoor environments in the Caribbean;*
- 5. understand the nature of gravitational force;*
- 6. appreciate the impact of human use of natural resources on the environment;*
- 7. understand that positive human interventions are necessary for sustenance of life on this planet;*
- 8. develop investigative and problem-solving skills.*

### UNIT I: THE UNIVERSE AND OUR SOLAR SYSTEM

#### SPECIFIC OBJECTIVES

#### EXPLANATORY NOTES

#### SUGGESTED PRACTICAL ACTIVITIES

Students should be able to:

- |  |   |  |
|--|---|--|
| <i>1. identify the location of earth in the universe;</i>    | <i>(a) Milky way galaxy.<br/>(b) Many other galaxies.<br/>(c) Solar system.</i>   |  |
| <i>2. explain how bodies stay in orbit;</i>                  | <i>(a) Characteristics of space.<br/>(b) Satellites.</i>  | <i>Use models to show how planets orbit the sun.</i>   |
| <i>3. describe the solar system;</i>                         | <i>Planets, elliptical shape; the sun, distance of planets from the sun; number of moons; size of planets, ecliptic orbits.</i> | <i>Use the internet to observe different models of the solar system.<br/><br/>Make model of the solar system using recyclable materials.</i> |
| <i>4. explain how earth is affected by other bodies; and</i> | <i>(a) Day and night.<br/>(b) Eclipses – Solar and Lunar.</i>   | <i>Observation of moon over 30 day period noting changes in shape and percentage of light emitted.</i>                                       |

## SECTION C

### **UNIT I: THE UNIVERSE AND OUR SOLAR SYSTEM (cont'd)**

<b>SPECIFIC OBJECTIVES</b>	<b>EXPLANATORY NOTES</b>	<b>SUGGESTED PRACTICAL ACTIVITIES</b>
----------------------------	--------------------------	---------------------------------------

Students should be able to:

5. *discuss human's exploration of the universe.*

*Including:*

- (a) international space station;*
- and*
- (b) exploration of Mars.*

## SECTION C

### UNIT II: THE TERRESTRIAL ENVIRONMENT

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. discuss the factors which influence soil formation;	Physical and chemical weathering and biological action.	
2. compare the types and functions of soils;	Sand, loam and clay; drainage, air content.  <i>Soil profiles.</i>	Sedimentation tests. Percentage of air, pH of soils, drainage, water retention.  <i>Label diagram of soil profile.</i>
3. relate soil fertility to the physical and chemical properties of soil;	Presence of soil organisms (earthworms, <i>nematodes</i> ), soil pH, composition of humus.	Quantitative work with humus. Make inferences about plant growth after doing soil tests.
4. identify causes of soil erosion and methods of prevention;	Evaluation of the soil as an important natural resource.  <i>Impact on food production.</i>	
5. describe the oxygen, carbon, water and nitrogen cycles;	The role of decomposers including nitrogen-fixing bacteria in soil.	Construct models of various cycles <i>using recyclable materials.</i>
6. describe the various types of air masses;	Air masses affecting the Caribbean, the spread of Pollutants, radioactive fallout, volcanic dust, industrial waste, Sahara dust, landfill fumes.  <i>Refer to Sec. A, Unit V, SO 6.</i>	
7. distinguish among the four types of local fronts;	Consider how they affect weather.	Listen to weather reports and formulate charts to show variations.
8. describe the characteristics of a cyclonic storm;	(a) <i>Seasons.</i> (b) <i>Weather patterns.</i> (c) <i>Hurricanes.</i>	<i>Observe the hurricane tracks across the Caribbean.</i>
9. describe tidal waves;	<i>Brief description and the causes - underwater landslides, volcanoes and earthquakes, tsunami.</i>	

## SECTION C

### UNIT II: THE TERRESTRIAL ENVIRONMENT (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
10. explain the causes of the different types of volcanic eruptions;	The ecological consequences of volcanoes in the long and short-term. Include Kick-em-Jenny underwater volcano off the coast of Grenada.	Use models to show volcanic eruptions.
11. discuss the relationship between earthquakes and volcanoes; and	The function of the seismograph The Richter scale. Significance of the numbers on the Richter scale.	
12. describe how tides are formed.	The effects of tides ( <i>coastal erosion</i> ). Include high, low, spring, neap tides. <i>Refer Sec. C, Unit I, SO 4.</i>	Study of plant and animal life on seashores or river banks with respect to tidal patterns.

## SECTION C

### UNIT III: WATER AND THE AQUATIC ENVIRONMENT

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. explain the uses of water;	Role in life processes; uses in home (consider wastage and conservation).  Growing crops <i>including hydroponics</i> ; drinking, firefighting, generation of electricity. <i>Refer Sec. A, Unit II, SO 2.</i>	<i>Calculating water consumption over a 30 day period.</i>
2. describe methods of purifying water;	Sources of water; the treatment of seawater for domestic use.  <i>Refer to Sec. B, Unit VI, SO 4.</i>	Experiments to purify water by boiling, filtration, chlorination, distillation, and additives of alum and carbon.
3. discuss the chemical and physical properties of water;	Sea and fresh water. Effects of sea and fresh water on aquatic life.	<i>Comparing the physical properties of salt water and fresh water using boiling and melting points.</i>
4. state the conditions for flotation;	<i>Upthrust and density.</i>  Archimedes principle. The Plimsoll line on boats and ships.	Comparing sinking and floating of similar materials in fresh and seawater. Simple measurements of densities.
5. discuss the effects of water pollution on aquatic life;	Sources of pollution, for example, nitrates, phosphates, [eutrophication] various pesticides, oil spills.	<i>Investigate effects of the removal of oxygen from water.</i>
6. describe the various methods used locally for fishing;	Compare the various methods, including by hand; spears/harpoons; netting (trawling, purse seining, long-lining, dredging); lining; pots or traps; fish farming.	
7. describe the various navigational devices used at sea;	Compass as a device; how the magnetic compass works; safety standards set by regional boards. Sonar, radar, GPS.	<i>Make model of a compass.</i>



## SECTION C

### **UNIT III: WATER AND THE AQUATIC ENVIRONMENT (cont'd)**

<b>SPECIFIC OBJECTIVES</b>	<b>EXPLANATORY NOTES</b>	<b>SUGGESTED PRACTICAL ACTIVITIES</b>
Students should be able to:		
8. identify water safety devices; and	Life rafts and jackets, inflatable tubes.	
9. discuss the hazards associated with scuba-diving.	Respiratory problems: damage to membrane due to high pressure. The bends, nitrogen narcosis, embolism. <i>Refer to Sec. A, Unit V, SO 1.</i>	

## SECTION C

### UNIT IV: FOSSIL FUELS AND ALTERNATIVE SOURCES OF ENERGY

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. identify the various types of fossil fuels;		
2. identify the energy obtained from petroleum as stored energy;		
3. discuss problems associated with the use of fossil fuels;	Fossil fuels as a non-renewable resource; environmental effects of acid rain, global warming.  <i>Refer to Sec. A, Unit V, SO 6.</i>	
4. identify alternative sources of energy;	Solar, biogas, wind, wave, biofuels, geothermal, hydroelectric, biodiesel.	
5. discuss the uses of solar and wind energy;	Include water heating, solar cells (photovoltaic cells), solar cookers/cooking; air heating (cold temperature), lighting, solar driers (meat, fish, fruits, crops).	Make simple <i>models of solar cells, solar panels and wind turbines, using recyclable materials.</i>
6. discuss variables affecting solar and wind energy; and	(a) Conduction, convection and radiation. Refer to Sec. B, Unit I, SO 1.  (b) <i>Location – weather patterns.</i>	<i>Use simple models from SO5 in different locations and record findings.</i>
7. appraise the extent to which alternative sources of energy can be used in the Caribbean.	Loss of energy during conversion; Devices such as solar water heaters, solar cells.	

## SECTION C

### UNIT V: FORCES

#### SPECIFIC OBJECTIVES

#### EXPLANATORY NOTES

#### SUGGESTED PRACTICAL ACTIVITIES

Students should be able to:

- |  |  |  |
|--|--|--|
| 1. discuss the basic principles of forces; | <i>Types of forces – push, pull and twist.</i><br><br>Action-reaction principle applied in space transport ( <i>Newton’s first law</i> ); the forward motion of jet aircrafts. Relationship between shape of wings of planes and birds and lift forces they experience while moving through air; the importance of friction; motion of vehicles, road surfaces and tyres; the effects of wind speed and wind currents on the motion of aircraft. | Action-reaction principle, for example, releasing an inflated balloon, using a pair of spring balances; Demonstrate by blowing over strips of paper held at one end; use of ball on different surfaces; use of paper aircraft models and fan.  |
| 2. describe gravity as a force;            | Definition, centripetal forces ( <i>satellites</i> ); the relationship between height of the center of gravity of an object and its stability; the implications for stability on the loading of vehicles in relation to their center of gravity; reasons for maximum loading capacity and tare.  | Show how an object can escape the pull of gravity; throwing a ball up and observing its motion; releasing objects attached to suspended spring/ not attached to anything; using models to demonstrate how an object can escape the pull of gravity if given enough kinetic energy by whirling around the head a rubber band attached to a weak thread. |
| 3. explain centre of gravity; and          | Conditions for equilibrium under parallel forces.  | Use of cardboard cutouts of triangles, rectangles, circles and irregular shapes to arrive at the approximate position of the center of gravity of objects of <i>different</i> shapes; items such as pencils, rulers and solids with regular shapes should be used to locate the center of gravity.   |

## SECTION C

### UNIT V: FORCES (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
4. explain the types of equilibrium.	(a) Stable. (b) Unstable. (c) Neutral.	Use of small ball, a concave/convex dish, or a cone shaped object and a flat surface to demonstrate the three types of equilibrium; use of rule suspended by a spring balance and kept horizontal by known suspended weights to show that:  (i) the sum of the forces in one direction must equal the sum in the opposite direction;  (ii) the sum of the clockwise moments about a pivot must equal the sum of anti-clockwise movements.

#### Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, teachers are advised to engage students in the teaching and learning activities below. These activities are designed to promote inquiry-based learning and cater to students with various learning styles.

1. Visit the NASA website and view photographs of outer space from the Hubble space telescope.
2. Watch documentaries on various topics, for example, cycles in nature, tidal waves, volcanic eruptions, global warming and climate change.
3. Organise site visits and/or field trips to weather stations, seashores and riverbanks and water treatment plants to ascertain information on related concepts.
4. Organise debates of issues that impact human life, for example, effects of space travel on astronauts.
5. Create compost heap.
6. Invite guest lecturers or resource personnel to speak about fishing and/or water pollution.

## SECTION C

### UNIT V: FORCES (cont'd)

7. *Conduct demonstration experiments on soil profiles, magnetic attraction and repulsion, and the recompression chamber.*
8. *Make models to demonstrate the effects of the moon on the earth, for example, day and night and types of eclipses.*
9. *Conduct demonstration experiments on push and pull, balancing object and alternative energy.*
10. *Research and discuss evacuation and safety procedures during an earthquake.*
11. *Investigate Caribbean navigation devices.*
12. *Investigate the availability of alternative energy sources in the Caribbean.*
13. *Arrange a field trip to a petroleum industry complex and examine the chemical processes or view a video clip of the processes involved in the separation of crude oil.*
14. *The Caribbean is regarded as one of the world's biodiversity "hotspots". See website [http://hqweb.unep.org/geo/pdfs/Caribbean\\_EO\\_final.pdf](http://hqweb.unep.org/geo/pdfs/Caribbean_EO_final.pdf) . Make a collage which showcases the biodiversity in your country.*
15. *Write a one page plea from the viewpoint of an endangered species in your country. The plea should highlight its importance and why it should be protected.*
16. *Have students drop a heavy and a light book from the same height at the same time and observe if they land at the same time or not. Discussion should ensue about the leaning tower of Pisa experiment.*
17. *Is it easier or harder to balance a yardstick on your finger than a pencil or ruler? Perform the experiment and try to figure out why. Can you make a pencil easier to balance on your finger by adding weight at the top? Explain. "Centre of gravity: Pencil balance" from ZOOM should be viewed as a class activity.*
18. *What will it take to make a floating submarine sink to the bottom of a bathtub? Conduct an experiment based on your understanding of the factors that influence an object's buoyancy to test this interactive brainteaser from the NOVA website.*
19. *Divide the class into groups, with each group being assigned a different form of renewable energy to research and investigate its suitability in the Caribbean. Design scaled models of their renewable energy options assigned. Use the following websites to assist with this activity.*

*[http://www.teachersdomain.org/resource/phy03.sci.engin.systems.lp\\_renew/](http://www.teachersdomain.org/resource/phy03.sci.engin.systems.lp_renew/) "What is the design process?"*

## SECTION C

### UNIT V: FORCES (cont'd)

*<http://www.teachersdomain.org/resource/phy03.sci.engin.design.desprocess/caribbean-icons.org/profiles/rudranath.capildeo.htm>*

20. *The water cycle is the process that moves water around the Earth. In the video segment on the website below adopted from ZOOM, cast members use a homemade solar still to mimic this natural process, separating pure water from a saltwater mixture. The class can make this homemade solar still as a project and see the processes of condensation and evaporation and its relevance on planet earth. <http://www.teachersdomain.org/resource/ess05.sci.ess.watercyc.solarstill1/>*
21. *Create a small booklet highlighting the biography and the contribution of Professor Oliver Headley in the applications of solar energy in the Caribbean. See website <http://www.caribbean-icons-org/profiles/oliver-headley.htm>*

## ◆ GUIDELINES FOR SCHOOL-BASED ASSESSMENT

### RATIONALE

The School-Based Assessment (SBA) is an integral part of student assessment in the course covered by this syllabus. It is intended to assist students in developing certain knowledge, skills and attributes that are critical to the subject. The activities for the School-Based Assessment are linked to the ‘Suggested Practical Activities’ and should form part of the learning activities to enable the student to achieve the objectives of the syllabus.

During the course of study in the subject, students obtain marks for the competence they develop and demonstrate in undertaking the SBA assignments. These marks contribute to the final marks and grades that are awarded to students for their performance in the examination.

The guidelines provided in this syllabus for selecting appropriate tasks are intended to assist teachers and students in selecting assignments that are valid for the purpose of SBA. These guidelines are also intended to assist teachers in awarding marks according to the degree of achievement in the SBA component of the course. In order to ensure that the scores awarded by teachers are not out of line with CXC standards, the Council undertakes the moderation of a sample of the SBA assignments marked by teachers.

School-Based Assessment provides an opportunity to individualise a part of the curriculum to meet the needs of students. It facilitates feedback to the students at various stages of experience. This helps to build the self-confidence, and critical thinking and problem solving skills of the students as they proceed with their studies. School-Based Assessment further facilitates the development of essential communicative, investigative and practical skills that allow students to function more effectively in their chosen vocation. School-Based Assessment, therefore, makes a significant and unique contribution to the development of relevant skills of the students. It also provides an instrument for testing them and rewarding them for their achievements.

School-Based Assessment should be made in the context of normal practical coursework exercises. It is not intended that the exercises used for assessment should be artificial and meaningless. Assessment should only be made after the candidates have been taught the skills and given enough opportunity to develop them. Although CXC requires the reporting of 18 practical assignments for moderation, teachers are reminded that there is no upper limit to the number of assessments that should be conducted during the course of normal teaching.

The general Aims of this syllabus can only be achieved by using a practical approach. Skills that are not being assessed at a particular time should, therefore, not be neglected. Note also, that not all practicals are used for assessment. Students should be given the opportunity to develop their skills and to feel free to ask for assistance without penalty.

## PROCEDURES FOR CONDUCTING SBA

**SBA assessments should be made in the context of normal practical coursework exercises.** It is expected that the exercises would be designed to provide authentic learning experiences. Assessments should only be made after candidates have been taught the skills and given enough opportunity to develop them. **Eighteen** practicals over the two-year period would be considered the minimum number for candidates to develop their skills and on which to base realistic assessments.

Each skill must be assessed at **least two times** over the two-year period. Candidates should be encouraged to do corrections so that misconceptions will not persist. When assessing certain skills, especially those which require on-the-spot observation or involve looking at several behaviours or criteria, teachers are advised to select not more than two skills in any activity. The practical exercises selected for assessment should make adequate demands on the candidates and the skills assessed should be appropriate for the exercises done. For the assessment of written work, the practical activity selected should be one that can be completed in the time allotted for the class and **the notebooks should be collected at the end of the period.**

Candidates who have not been assessed over the two-year period will be deemed absent from the whole examination. Under special circumstances, candidates who have not been assessed at all points may, at the discretion of CXC, have their marks pro-rated (adjusted proportionately).

### 1. In preparation for an SBA practical, the teacher should:

- (a) select tasks related to a given syllabus objective. These tasks may be chosen from the “Suggested Practical Activities” and should fit in with the normal work being done in that class;
- (b) list the materials including quantities and equipment that will be needed for each student;
- (c) carry out the experiment beforehand, if possible, to ascertain the suitability of materials, and the kind of results (observations, readings) which will be obtained, noting especially any unusual or unexpected results;
- (d) list the steps which will be required by the candidates in performing the experiment. From this it will be clear to the teacher how the candidates should be arranged in the laboratory, whether any sharing of equipment or materials is necessary, the skills which can be assessed from the practical, and the instructions to be given;
- (e) list the skills that may be assessed (for example, observation/recording/reporting, analysis and interpretation). **No more than two practical skills should be assessed from any one activity;**
- (f) select the skills to be assessed on this occasion. Skills other than those required for that year should also be included for teaching purposes; and
- (g) work out the criteria for assessing each skill. This will form the basis of a mark scheme and a checklist.



**2. The teacher should carry out the assessment and record the marks.**

*This is the most critical step in the assessment process. For a teacher to produce marks that are reliable, the marking must be consistent for all candidates and the marks should reflect the standard of performance at the level. The teacher must be able to justify the marks, and this occurs when there is a fixed set of conditions, factors or criteria for which the teacher looks. Marks should be submitted electronically to CXC on a yearly basis on the SBA form provided. The forms should be dispatched through the Local Registrar to reach CXC by 30 April of the year of the examination.*

**ASSESSMENT OF PRACTICAL SKILLS**

*School-Based Assessment will assess skills under the profiles Experimental Skills and Use of Knowledge (Analysis and Interpretation only).*

*The assessment will be conducted during Terms 1 - 5 of the two-year period following the programme indicated in the Table below.*

**SBA SKILLS TO BE ASSESSED FOR CXC MODERATION**

PROFILE	SKILLS	YEAR 1		YEAR 2		TOTAL
		NO. OF TIMES SKILLS TO BE ASSESSED	MARKS	NO. OF TIMES SKILLS TO BE ASSESSED	MARKS	
XS	Manipulation/ Measurement	1	10	1	10	20
	Observation/ Recording/ Reporting	1	10	1	10	20
	Planning and Designing	1	10	1	10	20
	Drawing	1	10	-	-	10
UK	Analysis and Interpretation	1	10	1	20	30
	<b>TOTAL</b>	<b>5</b>	<b>50</b>	<b>4</b>	<b>50</b>	<b>100</b>

*Investigative project to be done in Year 2.*

*The investigative project would be assessed for two skills, Planning and Design and Analysis and Interpretation.*

## **Assessment of Investigation Skills**

### **Proposal (Planning and Design)**

*The maximum marks available for the Proposal is*

**10 marks**

*The format for this part is shown below.*

*Observation/Problem/Research question stated*

*Hypothesis*

**2 marks**

*Aim*

**1 mark**

*Materials and Apparatus*

**1 mark**

*Method*

**2 marks**

*Controlled variables*

**1 mark**

*Expected Results*

**2 marks**

*Assumptions, Precautions/ Limitations*

**1 mark**

**TOTAL**

**10 marks**

### **Implementation (Analysis and Interpretation)**

*The maximum marks available for the Implementation is*

**20 marks**

*The format for this part is shown below.*

*Method*

**1 mark**

*Results*

**4 marks**

*Discussion*

**5 marks**

*Limitation*

**3 marks**

*Reflection*

**5 marks**

*Conclusion*

**2 marks**

**TOTAL**

**20 marks**

## REPORTING FORMAT OF INVESTIGATION

### **PART A THE PROPOSAL (Planning and Design)**

**Statement of the Problem** – Can be an observation, a problem

**Hypothesis**

**Aim** – Should be related to the hypothesis

**Materials and Apparatus**

**Method** – Should also include variables

Assumptions/Precautions

Expected Results

### **PART B THE IMPLEMENTATION (Analysis and Interpretation)**

**Method** - Linked to Part A (change of tense)

**Results**

**Discussion** – Explanations/Interpretations/Trends

**Limitations**

**Reflections**

**Conclusion**

## CRITERIA FOR ASSESSING INVESTIGATIVE SKILLS

### **A. PLANNING AND DESIGN**

<b>HYPOTHESIS</b>		<b>2</b>
- Clearly stated	1	
- Testable	1	
<b>AIM</b>		<b>1</b>
- Related to hypothesis	1	
<b>MATERIALS AND APPARATUS</b>		<b>1</b>
- Appropriate materials and apparatus	1	
<b>METHOD</b>		<b>2</b>
- Suitable	1	
- At least one manipulated or responding variable	1	
<b>CONTROLLED VARIABLE</b>		<b>1</b>
-Controlled variable stated	1	
<b>EXPECTED RESULTS</b>		<b>2</b>
- Reasonable	1	
- Link with method	1	
<b>ASSUMPTIONS/PRECAUTIONS/POSSIBLE SOURCES OF ERRORS</b>		<b>1</b>
- Any one stated	1	

**TOTAL**

**(10)**



## B. ANALYSIS AND INTERPRETATION

<b>METHOD</b>		<b>1</b>
- <i>Linked to Proposal, Change of tense</i>		
<b>RESULTS</b>		<b>4</b>
- <i>Correct formulae and equations:</i>	2	
<i>Accurate (2)</i>		
<i>Acceptable (1)</i>		
- <i>Accuracy of data:</i>	2	
<i>Accurate (2)</i>		
<i>Acceptable (1)</i>		
<b>DISCUSSION</b>		<b>5</b>
- <i>Explanation</i>	2	
<i>Development of points:</i>		
<i>Thorough (2)</i>		
<i>Partial(1)</i>		
- <i>Interpretation</i>	2	
<i>Fully supported by data (2)</i>		
<i>Partially supported by data (1)</i>		
- <i>Trends</i>	1	
<i>Stated</i>		
<b>LIMITATIONS</b>		<b>3</b>
- <i>Sources of error identified</i>	1	
- <i>Precautions stated</i>	1	
- <i>Limitation stated</i>	1	
<b>REFLECTIONS</b>		<b>5</b>
- <i>Relevance between the experiment and real life</i>	1	
<i>(self, society or environment)</i>		
- <i>Impact of knowledge gain from experiment on self</i>	1	
- <i>Justification for any adjustment made during experiment</i>	1	
- <i>Communication of information</i>	2	
<i>(Use of appropriate scientific language, grammar and clarity</i>		
<i>of expression all of the time (2); some of the time (1)</i>		
<b>CONCLUSION</b>		<b>2</b>
- <i>Stated</i>	1	
- <i>Related to the aim</i>	1	
<b>TOTAL</b>		<b>(20)</b>

## EXEMPLAR OF INVESTIGATIVE PRACTICAL

### EXEMPLAR 1

#### PART A – THE PROPOSAL

**Observation:** Some textile materials fade or lose colour after being washed repeatedly. In some cases these fabrics including cotton, wool and linen, may be reused to make mats, cushions or other household decorations. How can these fabrics be made more brightly and creatively coloured? Which types of fabrics are best for dyeing with a selected natural dye that can be made from readily available plant materials?

**Hypothesis:** The woollen samples will have a more intense (brighter) colour when treated with the selected natural dye and a mordant, when compared with the linen fabric samples.

**Aim:** To determine which of three (3) strategies is best for providing brighter coloured fabrics after dyeing. To determine which type of fabric, cotton, wool or linen, produces a more intense colour when organic dyes are used with sodium chloride as a mordant.

#### Materials/Apparatus

Fabrics for dyeing: cotton, woollen and linen materials (6 x 6 cm<sup>2</sup> size samples)

1. Onion skin (6)
2. Beakers (4)
3. Filter paper
4. Filter funnel
5. Tripod and gauze
6. Glass rod
7. Scissors
8. Measuring cylinders
9. Tongs
10. Stopwatch
11. Potassium alumina sulfate
12. Balance

## **Method**

This method may require 5 days.

1. Prepare your fabric samples, two samples per type of material: Cotton, woollen and linen (6 x 6 cm<sup>2</sup> size samples each).
2. Weigh the fabric samples to be dyed.
3. In tap water, dissolve the alum (10% of mass of fabric to be dyed) in 300 cm<sup>3</sup> water.
4. Boil the fabric for about 45 – 60 minutes then leave overnight to cool.
5. Drain the fabric and leave in a dark area for 3 days.
6. Label three beakers, C for cotton, W for wool and L for linen and place a sample of each fabric type into the corresponding beaker.
7. Prepare a sample of onion skin dye by soaking the onion skins in water overnight, then boiling for about 5 minutes in 500 cm<sup>3</sup> water until the water becomes coloured).
8. Using the filter paper and funnel, filter the dye mixture.
9. Pour 50 cm<sup>3</sup> of filtrate on to the fabric (cotton samples) in the beaker (C) and leave for 5 minutes of boiling or until the colour appears in the fabric.
10. Carefully remove the sample fabric pieces with the tongs then rinse in the beaker until the water appears clean.
11. Thoroughly rinse using distilled water and allow the sample to air dry for a day.
12. Repeat steps 9-11 above with samples L and W.
13. Compare the colour of each piece of fabric.
14. Repeat this procedure and compare your results. Record your results in the table relative to the colour of the dye solution (For example, Yellow with greater intensity of dye; Yellow with less intensity of dye).

**Precautions:** Exercise all precautionary procedures regarding heating. Ensure proper filtering techniques are used.

## **Variables**

**Controlled:** Size of the materials, type of dye used, volume of each solution used, time allotted to selected portions of the procedure.

**Manipulated:** Type of fabric used.

**Responding:** The intensity of the colour.



## Expected Result

Strategy:

The fabric with the most intense colouration after the procedure will be considered the best fabric to use. If the woollen fabric is the one with the most intense colouration then the hypothesis will be accepted. If not then the hypothesis will be rejected.

## **PART B – THE IMPLEMENTATION**

### Introduction

Some textile materials lose some of their colour after being washed repeatedly. In some cases these materials including cotton, wool and linen, may be reused to make mats, cushions or other household decorations. How can these materials be made more brightly and creatively coloured? Which materials are best for dyeing with a selected natural dye that can be made from readily available plant materials?

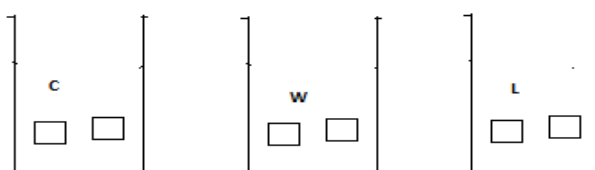
The success of a dye on a fabric is highly dependent on the nature of the dye as well as on the nature of the fabric. An acidic dye tends to work best on protein based fabrics such as wool or silk. The fibre reactive dye is generally better at staining non-protein based fabrics such as cotton and linen. In this experiment the relationship between the type of fabric and organic dye will be explored so as to offer an explanation to the observation made.

Some dyeing processes may require a mordant. The mordant allows for the fixing of the colour from the dye mixture into the fabric. Where a mordant is not essential, for dyeing to occur, the appearance of the outcome colour may be affected.

### Method

Two phases are in this process: (a) Mordanting the fabric and (b) Dyeing.

1. Prepare your fabric samples, two samples per type of material: Cotton, woollen and linen (6 x 6 cm<sup>2</sup> size samples each).
2. Weigh the fabric samples to be dyed.
3. In tap water, dissolve the alum (10% of mass of fabric to be dyed) in 300 cm<sup>3</sup> water.
4. Boil the fabric for about 45 – 60 minutes then leave overnight to cool.
5. Drain the fabric and leave in a dark area for 3 days.
6. Label three beakers, C for cotton, W for wool and L for linen and place a sample of each fabric type into the corresponding beaker.



Beakers with fabric samples

7. Prepare a sample of onion skin dye by soaking the onion skins in water overnight, then boiling for about 5 minutes in 500 cm<sup>3</sup> water until the water becomes coloured.
8. Using the filter paper and funnel, filter the dye mixture.
9. Pour 50 cm<sup>3</sup> of filtrate on to the fabric (cotton samples) in the beaker (C) and leave for 5 minutes of boiling or until the colour appears in the fabric.
10. Carefully remove the sample fabric pieces with the tongs then rinse in the beaker until the water appears clean.
11. Thoroughly rinse using distilled water and allow the sample to air dry for a day.
12. Repeat steps 9–11 above with samples L and W.
13. Compare the colour of each piece of fabric.
14. Repeat this procedure and compare your results. Record your results in the table relative to the colour of the dye solution (For example, Yellow with greater intensity of dye; Yellow with less intensity of dye).

**Precaution:** Exercise all precautionary procedures regarding heating of substances in the ball. Ensure proper filtering techniques are used.

### Results

The table below shows the colour of dye seen on each fabric type investigated.

Type of Fabric	Colour description due to dyeing	
	Trial 1	Trial 2
Cotton		
Wool		
Linen		

### Discussion

From this experiment it was noted that the cotton fabric had the brightest colour due to dyeing. This goes to show that the organic dye being fibre reactive may be used to stain these types of non-protein types of fabric. This is further assisted by the fact that the linen was also better stained than the wool.

The fact that organic dyes show covalent type bonding within its structure makes them similar in nature to the non-protein fabrics.

Clothing made from such materials will take a longer time to lose their colour as they were better stained in the first place.



### Limitation

Every effort was taken to ensure that the experiment was error free. However, there was one limitation. The concentration of the dye could not have been strong enough to properly stain the fabric in order to give a definitive colour distinction.

### Reflection

This experiment has taught me that the probability of clothing keeping their brightness is dependent on the type of fabric which makes it up and the nature of the dye used to colour it. The experiment was carried out as designed.

### Conclusion

Durability of colouring on fabric is dependent on the compatibility of the fabric and the dye used to stain the material.

<b>CRITERIA FOR ASSESSING INVESTIGATIVE SKILLS</b>	<b>PLANNING AND DESIGN</b>
<b>HYPOTHESIS</b>	<b>2</b>
- Clearly stated	1
- Testable	1
<b>AIM</b>	<b>1</b>
- <i>Related to hypothesis</i>	1
<b>MATERIALS AND APPARATUS</b>	<b>1</b>
- <i>Appropriate materials and apparatus</i>	1
<b>METHOD</b>	<b>2</b>
- Suitable	1
- <i>At least one manipulated or responding variable</i>	1
<b>CONTROLLED VARIABLE</b>	<b>1</b>
- <i>Controlled variable stated</i>	1
<b>EXPECTED RESULTS</b>	<b>2</b>
- <i>Reasonable</i>	1
- <i>Link with method</i>	1
<b>ASSUMPTIONS/PRECAUTIONS/POSSIBLE SOURCES OF ERRORS</b>	<b>1</b>
- <i>Any one stated</i>	1
<b>TOTAL</b>	<b>10</b>

### Implementation (Analysis and Interpretation)

The maximum marks available for Implementation is 20.

The format for this part is shown below.

Method	<i>1 mark</i>
Results	<i>4 marks</i>
Discussion	<i>5 marks</i>
Limitation	<i>3 marks</i>
Reflection	<i>5 marks</i>
<i>Conclusion</i>	<i>2 marks</i>
<b>TOTAL</b>	<b>20 marks</b>

## EXEMPLAR 2

### PART A: THE PROPOSAL

**Observation:** Farmers often choose larger seeds for propagating/replanting crops while discarding or rejecting smaller seeds. When asked, the typical farmer would say that bigger seeds give bigger crops. Is this only a myth? Will there be significant growth differences in crops propagated with larger or smaller seeds?

**Hypothesis:** Crops propagated from larger seeds will grow more than those propagated from smaller seeds.

**Aim:** To determine whether crops grown from larger seeds will grow more than crops grown from smaller seeds.

#### Materials/Apparatus

1. 8 peanuts with masses **greater than or equal to 5g**
2. 8 peanuts with masses **less than or equal to 3g**
3. 16 pots or planting bags (same size)
4. Loam soil
5. Hand trowel
6. Measuring cylinder
7. Tap water
8. Labelling tape
9. Permanent marker
10. Wheelbarrow
11. 30 cm ruler
12. Scale (that measures in grams)

#### Variables

Manipulated Variable: Size of seeds.

Responding Variable: Growth (length/height and number of leaves).

Controlled Variables: Equal amounts of water, soil and sunlight. Same type of soil. Same time/duration.

## Method

1. Collect loam soil in the wheelbarrow.
2. Use the hand trowel to mix the soil thoroughly while still in the wheelbarrow.
3. Three-quarters ( $\frac{3}{4}$ ) fill each pot/bag with the thoroughly mixed soil.
4. Examine the 16 shelled peanuts for defects (bites, scratches). Discard and replace samples where necessary.
5. Group peanuts into two groups according to size. The 8 peanuts that are  $\geq 5$ g will form the **L group** and those  $\leq 3$  g will form the **S group**.
6. Place **each** of the 8 large peanuts in separate pots. Each peanut should be covered with approximately 1 cm of soil. Use the tape and marker to label these eight pots '**L-1**' to '**L-8**'.
7. Repeat step 6 but with the smaller peanuts and label these pots '**S-1**' to '**S-8**'.
8. Use the measuring cylinder to gently add 40cm<sup>3</sup> of tap water to each pot. Repeat the watering process so that each pot is watered twice per day at approximately the same time daily.
9. Once the seeds have germinated, place all pots in open sunlight and continue to water twice per day.
10. Allow the experiment to proceed for 6 weeks.

## DATA CAPTURE

### 1. Height

- (a) Record the heights of each crop after each week (every 7 days). Tabulate the results for six weeks as shown below.

**TABLE 1: HEIGHTS OF PLANTS**

WEEK	<i>Heights in cm of Plants Grown from Seeds <math>\geq 5</math> g</i>								<i>Heights in cm of Plants Grown from Seeds <math>\leq 3</math> g</i>							
	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
1																
2																
3																
4																
5																
6																

- (b) Calculate the average heights for plants grown from peanuts  $\geq 5$  g for each week. Do the same for plants grown from seeds  $\leq 3$  g. Record the results in Table 2. **Round off values to one decimal place.**



**TABLE 2: AVERAGE HEIGHTS**

WEEK	<i>Average Heights in cm of Plants Grown from Seeds <math>\geq 5</math> g (Large)</i>	<i>Average Heights in cm of Plants Grown from Seeds <math>\leq 3</math> g (Small)</i>
1		
2		
3		
4		
5		
6		

- (c) Using weeks and average heights from Table 2, draw an appropriate graph to represent the growth of plants grown from larger seeds and those grown from smaller seeds. **Represent this data on ONE graph.**

**2. Number of Leaves**

- (a) Record the number of **fully opened leaves** of each crop each week (every 7 days) after sowing the seeds. Tabulate the results for 6 weeks as shown below.

**TABLE 3: NUMBER OF FULLY OPENED LEAVES**

WEEK	<i>Number of Leaves on Plants Grown from Seeds <math>\geq 5</math> g</i>								<i>Number of Leaves on Plants Grown from Seeds <math>\leq 3</math> g</i>							
	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
1																
2																
3																
4																
5																
6																

- (b) Calculate the average number of leaves found on plants grown from peanuts  $\geq 5$  g for each week. Do the same for plants grown from seeds  $\leq 3$  g. Tabulate the results in the table below. **Round off averages to the nearest whole number.**

**TABLE 4: AVERAGE NUMBER OF LEAVES**

WEEK	<i>Average Number of leaves Found on Plants Grown from Seeds <math>\geq 5</math> g</i>	<i>Average Number of leaves Found on Plants Grown from Seeds <math>\leq 3</math> g</i>
1		
2		
3		
4		
5		
6		

- (c) Using the weeks and average number of leaves from Table 4, draw an appropriate graph to represent the growth of plants grown from larger seeds and those grown from smaller seeds. **Represent this data on ONE graph. The Graph MUST be of a different type from the one drawn for height.**

**Precautions:** Handle the hand trowel with care. Take extreme care not to break the week old seedlings when measuring heights.

**Assumption:** Seeds were free from pest and parasites.

**Expected Results**

1. The plants grown from the larger seeds ( $\geq 5$  g) should grow taller than those grown from smaller seeds ( $\leq 3$  g) after a six-week period.
2. The plants grown from the larger seeds  $\geq 5$  g should have more leaves than those grown from smaller seeds  $\leq 3$  g after a six-week period.

## PART B: THE IMPLEMENTATION

### Introduction

Growth may be defined as a permanent increase in size. It is often measured using units of length or by counting numbers of structures.

Farmers normally plant larger seeds with the assumption that larger crops will be produced. This experiment investigates whether or not the size of seeds used for propagation make a difference in the growth of crops. Height differences for plants grown with small seeds will be compared with the heights of those from larger seeds. In addition, the number of leaves present will be counted as a function of growth over a period of time.

### Method

1. Loam soil was collected in the wheelbarrow.
2. The hand trowel was used to thoroughly mix the soil while it was still in the wheelbarrow.
3. Each pot was filled up to three quarters with the thoroughly mixed soil.
4. The 16 peanuts were examined for defects (bites, scratches). Defective samples were discarded and replaced where necessary.
5. Peanuts were grouped into two groups according to size. Eight peanuts with masses  $\geq 5$  g were piled together and considered the **L group** while eight peanuts with masses  $\leq 3$  g were piled together as the **S group**.
6. **Each** of the eight large peanuts was placed in separate pots. Each peanut was covered with approximately 1 cm of soil. The tape and marker were used to label these eight pots '**L-1**' to '**L-8**'.
7. Step 6 was repeated with the smaller peanuts and the pots were labelled '**S-1**' to '**S-8**'.
8. The measuring cylinder was used to gently add 40 cm<sup>3</sup> of tap water to each pot. The watering process was repeated so that each pot was watered twice per day at approximately the same time daily.
9. After the seeds germinated, they were placed in open sunlight and were watered twice per day.
10. The experiment continued for six weeks.

## Results

### 1. Height

**TABLE 1: HEIGHT OF PLANTS TAKEN OVER A SIX-WEEK PERIOD**

WEEK	<i>Heights in cm of Plants Grown from Seeds <math>\geq 5</math> g</i>								<i>Heights in cm of Plants Grown from Seeds <math>\leq 3</math> g</i>							
	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
1	2	1.5	2	3	3	2.5	2	3	1	1	2	1	2	2	1.5	1.5
2	3	2	3	4	4	3	3	3	2	2	2	2	3	2	2.5	2
3	4	3	4	5	5	3.5	3.5	5	3	3	3	4	5	4	4	5
4	6	6	5	6	7	6	5	6	5	5	5	5.5	7	6	5	6
5	8	7	6	8	9	7	7	8	6	6	7	7	8	7	7	7
6	10	9	8	9	11	10	9	11	7	8	7	8	9	8	8	8

**TABLE 2: AVERAGE HEIGHT OF PLANTS TAKEN OVER A SIX-WEEK PERIOD**

WEEK	<i>Average Heights in cm of Plants Grown from Seeds <math>\geq 5</math> g (Large)</i>	<i>Average Heights in cm of Plants Grown from Seeds <math>\leq 3</math>g (Small)</i>
1	2.4	1.5
2	3.1	2.2
3	4.1	3.9
4	5.9	5.7
5	7.5	6.9
6	9.6	7.9



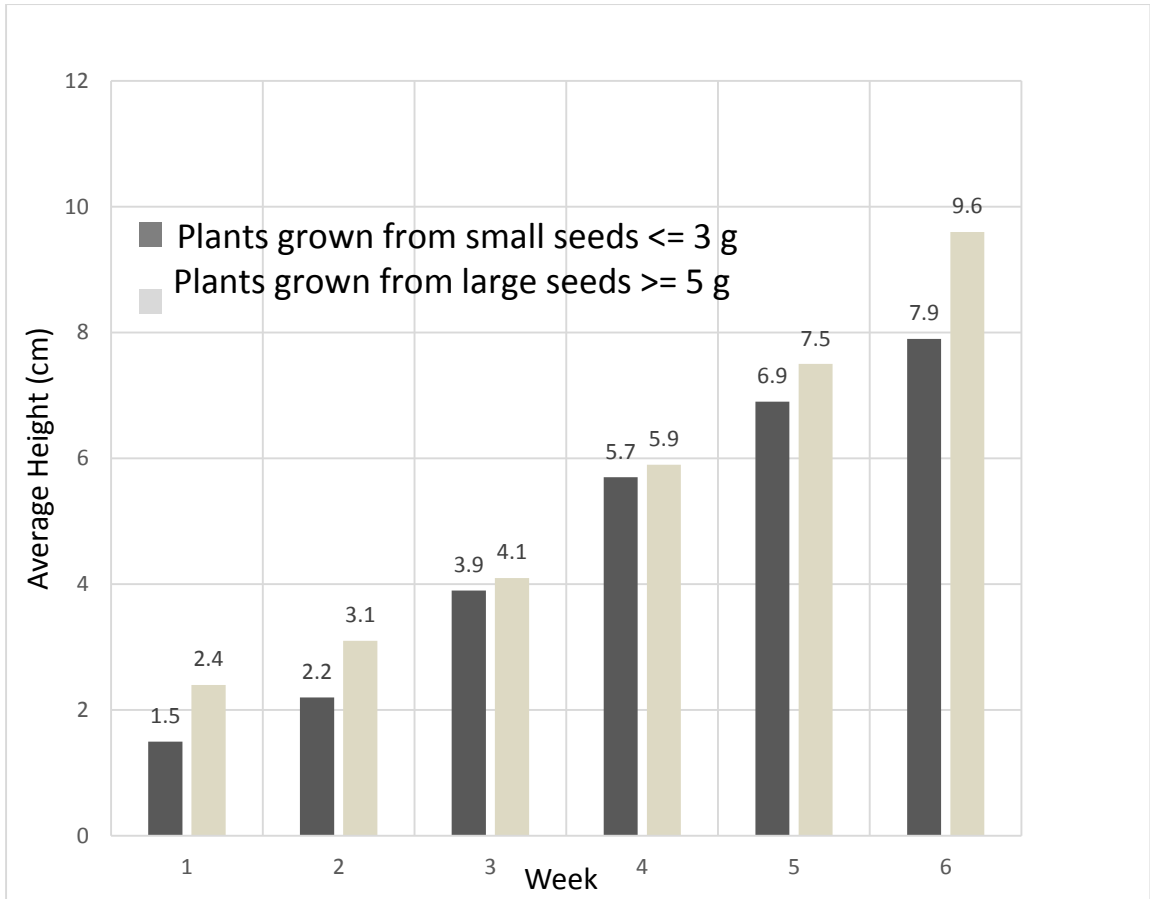


Figure 1: Average Height for Small Seeds and Large Seeds over a Six-week Period

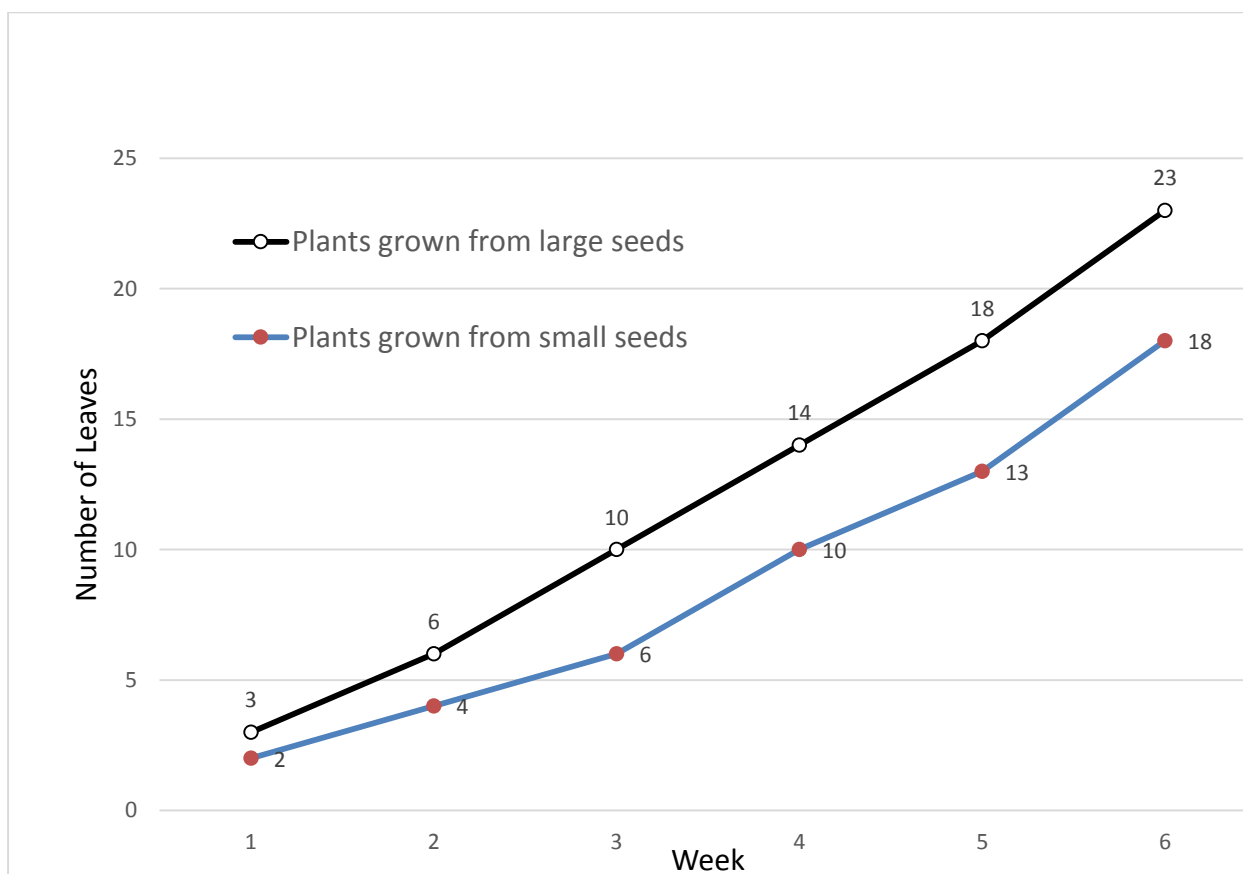
## 2. Number of Leaves

TABLE 3: NUMBER OF LEAVES ON PLANTS TAKEN OVER A SIX-WEEK PERIOD

WEEK	Number of Leaves on Plants Grown from Seeds ≥ 5g								Number of Leaves on Plants Grown from Seeds ≤ 3g							
	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
1	3	3	3	3	2	2	2	3	2	3	2	2	2	3	2	3
2	4	6	6	6	5	6	5	6	4	4	4	3	4	4	5	4
3	8	10	12	10	10	11	10	10	6	6	6	5	6	6	7	6
4	12	14	15	16	15	16	13	13	10	11	10	10	11	9	9	8
5	16	18	18	19	18	21	17	17	12	13	13	14	13	12	13	12
6	20	25	25	27	26	25	23	24	16	17	18	20	19	17	18	16

**TABLE 4: AVERAGE NUMBER OF LEAVES ON PLANTS TAKEN OVER A SIX-WEEK PERIOD**

WEEK	Average Number of Leaves Found on Plants Grown from Seeds $\geq 5$ g	Average Number of Leaves Found on Plants Grown from Seeds $\leq 3$ g
1	3	2
2	6	4
3	10	6
4	14	10
5	18	13
6	23	18



**Figure 2: Average Number of Leaves Found on Plants Grown from Small Seeds and Large Seeds over a Six-Week Period**

### Discussion

Growth is a permanent increase in size. Growth in plants originate from areas called meristems found in shoots or buds. The cells in these areas divide by a process called mitosis where each successive cell is identical to the original cell with respect to the number of chromosomes.

In this experiment, one would readily observe that plants grown from larger seeds tend to grow taller than those grown from smaller seeds (9.6 cm for larger seeds and 7.9 cm for smaller seeds) at the end of week six. The height of a plant is significant as taller plants have the advantage of trapping sunlight more efficiently as they outgrow competing weeds. This translates to an increase in the rate of photosynthesis. This is important to farmers as greater yields are expected when photosynthesis rates are higher.

Also, crops grown from larger seeds on average had more leaves at the end of six weeks (23 leaves) than crops grown from smaller seeds (18 leaves). This represents a difference of 27.8 per cent. (See Tables 3 and 4 and Graph 2).

Having leaves is advantageous to a plant. Leaves are the sites for photosynthesis. With more leaves, the rate of photosynthesis increases and so does the amount of food storage. This will result in more and/or bigger vegetables and fruits.

Greater numbers of leaves also provide better ground cover which reduces evaporation of ground water. Water is essential for photosynthesis. Therefore, more water which is needed for photosynthesis is available to plants with more leaves.

The fact that the growth rate was consistently greater in plants grown from larger seeds may speak to genetic influences and not environmental factors.

### **Limitations**

- Defects to internal structures could not be ascertained.
- Pest and parasites may have unknowingly attacked samples causing inaccurate results.
- No attention was given to the types or varieties of peanuts.
- Some varieties naturally grow larger so results could be skewed if more than one variety was in the sample.

### **Reflection**

This investigation has given me an appreciation for traditional farming in my country. The daunting task of helping relatives sort out larger seeds for planting was always a meaningless exercise to me until I did this investigation. I now understand their strategy. It means that less fertilisers could be used to boost growth because of the fact that larger seeds naturally grow larger. This investigation also revealed to me that plants grown from larger seeds produce more leaves so I now understand how we can produce more food in my country by simply selecting larger seeds for planting.

### **Conclusion**

Peanut plants produce bigger crops when larger seeds are used for propagation as opposed to when smaller seeds are used.

### General Notes to the Teacher/Student

1. Figures in this exemplar are not to be taken literally. Figures were deliberately not drawn to scale to discourage plagiarism. Your actual experimental data will differ.
2. This investigation could be modified to determine the relationship between the propagating seed size and fruit production/yields.
3. Other species of seeds may be substituted in this investigation. Depending on the species of plant seeds used, there would not be any significant growth differences or the conclusion stated above may be completely reversed.

### Safety

Teachers should observe all the following safety precautions before conducting laboratory work:

1. Investigations involving human blood and other fresh human material (for example, cheek cell, and saliva) should NOT be conducted.
2. Extreme care should be taken when handling live animals. Wild rodents should not be handled since they pass on disease by biting or through their urine. These diseases include leptospirosis.
3. A fire extinguisher or fire blanket must be readily accessible. Both teacher and student should know how to use them. The extinguisher purchased should be appropriate for a biology laboratory.
4. **A first aid kit should be kept in the laboratory and should be checked regularly.**
5. **Corrosive** solutions and inflammable solvents (for example, concentrated acids, alcohols) should be clearly labelled as such and handled with great care and should be locked away when not in use.
6. Candidates should know the correct way to light and use a Bunsen burner. Flints rather than matches are safer to use.
7. Electrical equipment and fittings should be regularly checked and serviced. Electrical outlets should be properly labelled (example 110v and 220v).
8. A laboratory safety manual should be available.
9. All safety precautions should be maintained regarding field trips.

### Audio-Visual Aids

The dynamic nature of Integrated Science requires the teacher to make use of a variety of resource materials as teaching aids. Audio-visual aids are particularly useful to reinforce and deepen understanding.

Teachers are encouraged to use the following aids:

1. Film projectors
2. Slide projectors
3. Overhead projectors
4. Videotape machines (VCR)
5. Tape recorders (Cassette)
6. CD-ROM and other interactive media
7. Multi-media projector
8. Camcorders
9. Digital cameras

Cost might prohibit departmental ownership but hardware may be kept in a common pool for use within a school or among a group of schools.

Sources or resource materials include:

1. Overseas information services, for example, USIS, UNESCO, and High Commissions;
2. Government ministries;
3. The media;
4. The Internet.

### ***Moderation of School-Based Assessment***

*The reliability (consistency) of the marks awarded by teachers on the School-Based Assessment is an important characteristic of high quality assessment. To assist in this process, the Council undertakes on-site moderation of the School-Based Assessment conducted by visiting external Moderators.*

*During the Term 2 of Year 2, the Moderator will make a second visit. Teachers must make available to the Moderator **ALL** Assessment Sheets (Record of Marks, Mark Schemes and the report on the Investigation). **Teachers are NOT required to submit to CXC samples of candidates' work, unless specifically requested to do so by the Council BUT will be required to submit the candidates' marks electronically.***

*The Moderator will remark the skills, and investigation reports for a sample of five candidates, who are selected using the guidelines listed below.*

1. *Candidates' total marks on the SBA are arranged in descending order (highest to lowest).*
2. *The sample comprises the work of the candidates scoring the:*
  - (a) *highest Total mark;*
  - (b) *middle Total mark;*
  - (c) *lowest Total mark;*
  - (d) *mark midway between the highest and middle Total mark; and*
  - (e) *mark midway between the middle and lowest Total mark.*
3. *The candidates selected above may be required to demonstrate some practical skills.*

*Teachers' marks may be adjusted as a result of the moderation and feedback will be provided by the Moderator to the teachers.*

*The Moderator may re-mark the assignments of additional candidates. Where the total number of candidates is five or fewer, the Moderator will remark **ALL**.*

*The Moderator will submit the Assessment Sheets, moderation of SBA Sample and the moderation reports to the Local Registrar by April 30 of the year of the examination. A copy of the Assessment Sheets and candidates' work must be retained by the school for three months after the examination results are published by CXC.*

*School-Based Assessment Record Sheets are available online via the CXC's website [www.cxc.org](http://www.cxc.org).*

*All School-Based Assessment Record of marks must be submitted online using the SBA data capture module of the Online Registration System (ORS).*

## **CRITERIA FOR THE ASSESSMENT OF EACH SBA SKILL**

The syllabus is grounded in the philosophy and methodology of all science disciplines. The teaching strategies that are recommended for its delivery are dictated by the scientist's approach to a task. A problem to be identified will be examined in the light of available evidence and suggestions or hypothesis as to its solution formulated. These will then be tested by repeated practical observations, modified or discarded as necessary until a hypothesis that does offer a solution is found.

The history of scientific thought shows that new ideas replace old ones that were previously accepted as factual. Students must be made to realise that no solution is final and infallible since modifications are continually made in light of new knowledge and technology.

## EXPERIMENTAL SKILLS:

### Observation/Recording/Reporting [ORR]

1. Organisation and Conciseness
  - (a) Logical sequence of the report.
  - (b) Sections named - Aim, Apparatus and Materials, Procedure/Method, Observation, Discussion, Conclusion - all present in correct sequence/correct content under each heading.
  - (c) Correct terminology and expressions - few or no grammatical errors.
  - (d) Proper use of tables.
2. Tables (Numerical)
  - (a) Physical quantity in heading.
  - (b) Units stated in heading.
  - (c) Abbreviations/symbols.
  - (d) Decimal points.
3. Tables (Non-Numerical)
  - (a) Headings correct.
  - (b) Attention to kinds of data.
  - (c) Details of data present.
4. Use of diagrams where appropriate (shading, three dimensional and free hand drawings are unacceptable).
5. Graphs
  - (a) Axes labelled.
  - (b) Appropriate scales used.
  - (c) Accurate plotting.
  - (d) Smooth curve or best straight line drawn.
6. Makes accurate recordings and observations.  
Significant changes recorded: extent or degree of change recorded.
7. Prose/other
  - (a) Attention to kinds of data.
  - (b) Attention to details of data.

### Analysis and Interpretation [A/I]

1. Summary data
  - (a) Accurately identify trends, patterns, relationships.
  - (b) Include labels and annotations of structures.



- (c) Make accurate calculations and draw logical conclusion.
  - (d) Makes predictions and logical inferences - limitations between observation and data - relationships between results and original hypothesis.
2. Evaluate data, including sources of error.

### Drawing [D]

1. Clarity - clean continuous lines of even thickness in pencil with no shading or unnecessary details. Reasonable size.
- (a) Make large drawing.
  - (b) Have clear accurate line representations.
  - (c) State title(s) adequately.
  - (d) Be two dimensional.
  - (e) Appropriate labelling and annotations.
2. Accuracy - faithfulness of reproduction, structures are typical of specimen.
- (a) Reasonable proportions.
  - (b) Magnification stated correctly.
  - (c) View stated correctly.
3. Labelling/ Labelling Lines.
- (a) Neat, drawn with a ruler.
  - (b) Straight and do not cross.
  - (c) Title listed.

### Planning and Designing [P/D]

1. Hypothesis
- (a) Clear statement of hypothesis on basis of observation(s).
  - (b) Testable/manageable.
2. Design
- (a) Generally workable/suitable.
  - (b) inclusion of apparatus/materials to be used.
  - (c) Description of procedures.
  - (d) Modification(s) where necessary.
  - (e) Attention to details can be duplicated.
  - (f) Precautions taken, repeated measurements, controls and limitations.



## Manipulation and Measurement [M/M]

1. Use of basic laboratory equipment with competence and skill.
  - (a) Handle selected measuring devices - balance, thermometer, measuring cylinder, burette, syringe, watch/clock or any timing device, voltmeter, ammeter, reagent bottles, Bunsen burner.
  - (b) Makes accurate reading.
2. Mastering of laboratory techniques - simple distillation, heating of solids and liquids in test tubes, detection of gases, filtration, constructing simple series and parallel electrical circuits.
3.
  - (a) Prepare biological materials for observation or investigation.
  - (b) Handle living things with care.

## CONVERSION OF MARKS

The 11-point scale ranges from 10 to 0 thus the maximum mark for each skill at any assessment point is 10. Always marking out of 10 or multiples of 10 make conversion easy but this is not necessary, as this may be readily calculated by hand or by means of a calculator. Conversion of the scale can be done for each assessment but this is not the only possibility. The raw marks out of the totals used must be recorded and these marks totalled for each skill and the conversion done only when their submission to CXC is required.

The following hypothetical results for the assessment of a student on a particular skill may be used as an example. If the marks obtained for observation/recording/reporting are:

5/7, 4/6, 5/5, 7/9, 6/8

The total marks are out of a possible 35 marks. This may be converted by calculation as follows:

$$\frac{27}{35} \times 10 = 7.71 \text{ (approximately)}$$
$$= 8 \text{ for CXC purposes}$$

## VALIDITY AND RELIABILITY OF TEACHERS MARKS

The reliability of marks awarded is a significant factor in SBA and has far-reaching implications for the candidate's final grade. Teachers are asked to note the following:

1. The criteria for assessing a skill should be clearly identified. A mark scheme must be submitted with the sample of books sent for moderation. Failure to do this could result in the candidates being unavoidably penalised.
2. The relationship between the SBA marks in the practical workbooks and those submitted to CXC on the SBA forms must be clearly shown. It is important that the marks awarded reflect the degree of mastery of the skills assessed.
3. Workbooks should contain all practical work and those exercises used for SBA marks should be clearly identified.
4. The standard of marking must be consistent, hence the need for a mark scheme.
5. Collaboration among teachers especially in the same centre is urged to minimise the discrepancy in the standard of assessment between teachers.

## RECORD-KEEPING

Each candidate is required to keep a practical workbook containing all practicals done over the two-year period prior to the examination. Those assessed for CXC will be used to determine the standard of marking by the teacher. A mark scheme must be sent with each set of books. All practicals should be dated and an index made by the candidates of the practicals done. Those assessed for CXC should be clearly indicated along with the marks awarded for each skill.

Candidates' workbooks should be durable and neatness should be encouraged. The pages should be numbered and all exercises should be dated. The workbook should contain a contents page providing the following information concerning the practicals:

1. page number;
2. date;
3. aim of practical;
4. an indication by an asterisk, of which practicals were assessed for CXC; and
5. the skills assessed.

### Teachers

An example of the teacher's records follows:

#### **Recording Marks for SBA**

#### **TEACHER'S MARK BOOK**

SKILLS	OBSERVATION RECORDING/ REPORTING			DRAWING			MANIPULATION/ MEASUREMENT			ANALYSIS AND INTERPRETATION			TOTAL YR1
	31/11	14/4	Avg. (10)	2/12	23/2	Avg. (10)	15/10	1/5	Avg. (10)	11/3	9/5	Avg. (10)	
NAMES													40
Allen, Veronica	6	8	7	2	8	5	8	10	9	6	7	7	28
Williams, Ann	4	4	4	7	7	7	6	9	8	7	9	8	27
Cuthbert, Bryan	5	5	5	3	10	7	9	7	8	3	8	6	26
Moore, Jason	9	9	9	2	3	3	0	8	7	5	7	6	25
Worte, Stewart	3	6	5	9	0	5	3	5	4	4	5	5	19

The average for each skill and total figures will be transferred to the CXC School-Based Assessment Form and the latter will be submitted to CXC by April 30 of the year of examination.

**Note that no special assessment exercises need to be planned.** The teachers will, as is customary, be recording periodic "marks" for all students. The difference is that, since these "marks" will now contribute to an assessment external to the school, they need to be more carefully arranged to clearly stated criteria.

## **The Record Card**

The SBA Record Book will show each candidate's average mark for each skill/quality at the end of the year. Where the candidate's total mark includes a decimal of .5 or above, the total should be resolved upwards to the nearest whole number. Where the candidate's total mark includes a decimal less than .5, the total should be rounded to the nearest whole number. The Record Card should be completed in duplicate. The original of the Card is to be submitted to CXC and the copy retained by the school.

SBA Record Card should be dispatched through the Local Registrar to reach CXC by April 30 of the year of the examination.

A sample of the Record Card is included in Appendix 1 to this syllabus.

Teachers will also be expected to supply to CXC a record of tasks set for School-Based Assessment and the corresponding mark schemes used.

## ◆ RESOURCES

The following is a list of books, which may be used for CXC's Integrated Science syllabus. This list is neither exhaustive nor prescriptive but indicates some possible sources which teachers and students may use as appropriate.

Atwaroo-Ali, L.	<i>CXC Biology</i> , Oxford: Macmillan Publishers Limited, 2003.
Avison, J., Neeranjan, D. and Henry, D.	<i>Physics for CSEC</i> , London: Nelson Thornes Limited, 2007.
Chapman, S., Luttig, D., Murray, J., Ritchie, E., and Tindale, A.	<i>Chemistry for CSEC</i> , London: Nelson Thornes Limited, 2009.
Chung-Harris, T.	<i>CXC Integrated Science</i> , Oxford: Macmillan Caribbean, 2005.
Farley, A., and Trotz, C.	<i>CXC Physics</i> , Oxford: Macmillan Education, 2007.
Gadd, P.	<i>CXC Human and Social Biology</i> , Oxford: Macmillan Education, 2007.
Kirby, P., Madhosingh, L., and Morrison, K.	<i>Biology for CSEC</i> , London: Nelson Thornes Limited, 2008.
Koh, A., Hong, C., and Jai, L. M.	<i>CSEC Integrated Science</i> , Trinidad and Tobago: Caribbean Educational Publishers, 2008.
Potter, S. and Oliver, R.	<i>Integrated Science for CSEC</i> , London: Pearson Longman Publishing, 2003.
Ragoobirsingh, D.	<i>Longman Human and Social Biology for CSEC</i> , London: Pearson Education Limited, 2007.
Taylor, M., and Chung-Harris, T.	<i>CXC Chemistry</i> , Oxford: Macmillan Education, 2006.

## ◆ GLOSSARY OF EXAMINATION TERMS

WORD/TERM	DEFINITION/MEANING	NOTES
annotate	Add a brief note to a label.	(Simple phrase or a few words only; UK)
apply	Use knowledge/principles to solve problems.	(make inferences/ conclusions; UK)
appraise	To judge the quality or worth of.	(UK)
assess	Present reasons for the importance of particular structures relationships or processes.	(compare the advantages and disadvantages or the merits and demerits of a particular relationship or process; UK)
calculate	Arrive at the solution to a numerical problem.	(steps should be shown; units must be included; UK)
classify	Divide into groups according to observable characteristics.	(UK)
comment	State opinion or view with supporting reasons.	(UK)
compare	State similarities and differences.	(an explanation of the significance of each similarity and difference stated may be required for comparisons which are other than structural, KC/UK)
construct	Use a specific format to make and/or draw a graph, histogram, pie chart or other representation using data or material provided or drawn from practical investigations, build (for example, a model), draw scale diagram.	(such representations should normally bear a title, appropriate headings and legend; UK)

<b>WORD/TERM</b>	<b>DEFINITION/MEANING</b>	<b>NOTES</b>
deduce	Make a logical connection between two or more pieces of information; use data to arrive at a conclusion.	(UK)
define	State concisely the meaning of a word or term.	This should include the defining equation/formula where relevant; (KC).
demonstrate	Show clearly by giving proof or evidence; direct attention to.	(KC)
derive	To deduce; determine or extract from data by a set of logical steps some relationship, formula or result.	(This relationship may be general or specific). (UK)
describe	Provide detailed factual information of the appearance or arrangement of a specific structure or the sequence of a specific process.	Descriptions may be in words, drawings or diagrams or any appropriate combination. Drawings or diagrams should be annotated to show appropriate detail where necessary; ( KC)
determine	Find the value of a physical quantity.	(PS)
design	Plan, and present with appropriate practical detail.	(Where hypotheses are stated or when tests are to be conducted, possible outcomes should be clearly stated and/or the way in which data will be analyzed and presented; PS).
develop	Expand or elaborate an idea or argument with supporting reasons.	(KC/UK)
differentiate/distinguish (between/among)	State or explain briefly those differences between or among items which can be used to define the items or place them into separate categories.	(KC)

<b>WORD/TERM</b>	<b>DEFINITION/MEANING</b>	<b>NOTES</b>
discuss	Present reasoned arguments; consider points both for and against; explain the relative merits of a case.	(UK)
draw	Make a line representation from specimens or apparatus that shows an accurate relationship between the parts.	(In case of drawings from specimens, the magnification must always be stated. A diagram is a simplified representation showing the relationship between components; KC/UK).
estimate	Make an approximate quantitative judgment.	
evaluate	Weigh evidence and make judgments based on given criteria.	(The use of logical supporting reasons for a particular point of view is more important than the view held; usually both sides of an argument should be considered; UK).
explain	Give reasons based on recall; account for.	(KC)
find	Locate a feature or obtain as from a graph.	(UK)
formulate	To express in a formula or in a systematic manner.	(UK)
identify	Name or point out specific components or features.	(KC)
illustrate	Show clearly by using appropriate examples or diagrams, sketches.	(KC/UK)
investigate	Use simple systematic procedures to observe, record data and draw logical conclusions.	(PS)



<b>WORD/TERM</b>	<b>DEFINITION/MEANING</b>	<b>NOTES</b>
justify	To prove a statement or claim true.	(UK)
label	Add names to identify structures or parts indicated by pointers.	(UK)
list	Itemise without detail.	(KC)
measure	Take accurate quantitative readings using appropriate instrument.	(PS)
name	Give only the name of.	(No additional information is required).
note	Write down observations.	(PS)
observe	Pay attention to details which characterise a specimen, reaction or change taking place; to examine and note scientifically.	(Observations may involve all the senses and/or extensions of them, but would normally exclude the sense of taste) (PS).
plan	Prepare to conduct an exercise.	(PS)
predict	Use information provided to arrive at a likely conclusion or suggest a possible outcome.	(UK)
record	Write an accurate description of the full range of observations made during a given procedure.	This includes the values for any variable being investigated where appropriate recorded data may be depicted in graphs, histograms or tables; (PS).
relate	Show connections between; explain how one set of facts or data depend on others or are determined by them.	(UK)
sketch	Make a simple freehand diagram showing relevant proportions and any important details.	(KC)

<b>WORD/TERM</b>	<b>DEFINITION/MEANING</b>	<b>NOTES</b>
state	Provide factual information in concise terms, omitting explanation.	(KC)
suggest	Offer an explanation deduced from information or previous knowledge.	(No correct or incorrect solution is presumed but suggestions must be acceptable within the limits of scientific knowledge; UK).
suggest an hypothesis	Provide a generalisation which offers a likely explanation for a set of data or observations.	(UK)
test	To find out by following set procedures.	(PS)

## ◆ NOTE TO TEACHERS

### MEASUREMENT

The SI system is used in this syllabus and will be used in all examination papers. Common multiples and sub-multiples of base units (for example, kilometres, centimetres and millimetres) will also be used.

### SCHOOL-BASED ASSESSMENT

#### Preparing the Candidate

During Term 1 of the two-year period, teachers should ensure that the candidates are familiar with the assessment criteria and the mark scheme. Involving the candidates in practice assessments might accomplish this.

The teacher should also ensure during the first term that all candidates use their practical notebooks to record the relevant activities and that such records are made in a systematic way.

#### Assessing 'Manipulation/Measurement' and 'Observation'

In assessing 'Manipulation/Measurement' and 'Observation' the teacher should ensure that the candidate has had at least two prior experiences in manipulating/measuring or observing with the apparatus or in making other observations for recording, before the candidate is assessed on these criteria.

#### Sample of Teachers' Records

The following three pages are samples of the Record Card and Record Book.

CARIBBEAN EXAMINATIONS COUNCIL

SCHOOL BASED ASSESSMENT IN INTEGRATED SCIENCE

NAME OF SCHOOL: \_\_\_\_\_ SCHOOL CODE: \_\_\_\_\_ YEAR OF FINAL EXAMINATION: \_\_\_\_\_

NAME OF TEACHER: \_\_\_\_\_ COUNTRY: \_\_\_\_\_

CANDIDATES NUMBERS	CANDIDATES NAMES	YEAR I						YEAR II					GRAND TOTAL <i>100</i>	REMARKS
		O/R/R	Dr	M/M	A/I	P/D	TOTAL YEAR 1	O/R/R	M/M	A/I	P/D	TOTAL YEAR 2		
		10	10	10	10	10	50	10	10	20	10	50		

TEACHER'S SIGNATURE: \_\_\_\_\_

PRINCIPAL'S NAME: \_\_\_\_\_

DATE: \_\_\_\_\_

PRINCIPAL'S SIGNATURE: \_\_\_\_\_

## ◆ SOME GUIDELINES CONCERNING PRACTICAL WORK

It is a syllabus requirement that practical work be done from all *three* sections of the syllabus.

The work done is to be recorded in a practical notebook. To satisfy syllabus stipulations, a minimum of eighteen (18) such pieces of work should be written up. There is no maximum limit. Each write-up should reflect the candidate's own work and analysis. When practical work is done in groups, the candidates must still write up his or her own report.

### KINDS OF PRACTICAL WORK

Practical work usually falls into three broad categories that sometimes overlap. The categories are described below.

#### Practical Exercises

These are the types that are most often done. They are usually done to help students develop certain practical skills or gain insights into scientific concepts.

#### Investigations/Information Gathering

In this kind of work, students use their skills to investigate a problem or to find out about a certain phenomenon *or* area of interest. Investigations are best done in areas in which students are interested. There is much scope for planning and designing in this kind of experiment.

#### Technology

Students may also be interested in using their knowledge of science in making simple devices or in solving simple problems. Emphasis is on using readily available materials (even discards) and appropriate techniques of a very simple nature. Devices constructed should usually be tested by the student and performance data recorded and evaluated.

**A minimum of one (1) practical exercise must be of a technological nature and a minimum of four (4) must be investigative.** In writing up practical exercises, candidates must be encouraged to discuss the relevance of their work and be made aware of the limitations of their methods and conclusions.

## ◆ SUGGESTED CHEMICALS/MATERIALS LIST

Acetone	Sodium Sulphate
Agar	Starch
Agar, Nutrient	Steel wool
Aluminium foil	Sucrose
Ammonia solution	Sulphuric Acid
Benedict's solution	Turpentine
Bicarbonate indicator solution	Universal indicator paper
Cobalt Chloride	Universal indicator solution
Calcium Carbonate, precipitated	Zinc (granulated)
Charcoal powder	
Chloroform	
Copper, thick wire/strings/ turnings	
Copper Sulphate	
Crude oil	
Ethanol	
Ethanoic (acetic) acid	
Formaldehyde solution	
Glucose	
Hydrochloric Acid (dilute)	
Hydrogen Peroxide (20 volume)	
Iodine	
Iron filings	
Iron Nails	
Lead foil	
Litmus paper, blue	
Litmus paper, red	
Magnesium ribbon	
Manganese Dioxide	
Methylated spirit	
Nitric Acid	
Phenolphthalein	
Potassium Iodide/Sodium Iodide	
Potassium Nitrate	
Potassium Permanganate	
Pyrogallol 40% w/v	
Silver Chloride/nitrate	
Sodium Carbonate	
Sodium Carbonate hydrated (washing soda)	
Sodium Chloride	
Sodium Hydrogen Carbonate (baking soda)	
Sodium Hydroxide (caustic soda)	

## ◆ SUGGESTED EQUIPMENT LIST

Abrasives	Mirrors, plane (concave, $f = 15$ cm; convex, $f = 15$ cm)
Ammeters	<i>Multimedia projectors</i>
Aquaria	Needles, dissecting
Balances (range 1 kg, sensitivity 0.1 g)	Nets for collecting specimens
Balances, spring (10N, 100N)	*Oscilloscope
Beakers, 250 cm <sup>2</sup> (graduated)	Paper, chromatography
Beakers, 400 cm <sup>3</sup> /500 cm <sup>3</sup> (graduated)	Paper, filter
Bell jars with bungs (solid, one hole, two holes)	Pipettes
Borers, cork	Plugs, 3-pin
Bottles, dropping	Poster board (for displaying charts and articles)
Bottles, reagent, assorted	Potometres
Boxes, ray	Power packs (main or batteries) low voltage d.c
Brass	Press, plant
Bronze	Prism, triangular and rectangular
Buckets, plastic, with covers	Pulleys (single, stepped, block and tackle)
Burners, Bunsen or alcohol	Pumps, filter
Box Camera	Quadrats
Carbon microphone	Racks, test tube
Cardboard (for making charts)	Resistors (assorted 1ohm up to 1000 ohm at 1W rating)
Clock (or stopwatch)	Ripple tanks (with accessories for demonstrating rectilinear propagation plane and curved reflection, refraction, diffraction)
Compasses, magnetic	Rules, metre/half metre
<i>Computer</i>	Scalpels/razor blades/knives/scissors
Coverslips	Shelves, beehive
Crocodile clips	Skeleton, mammalian, complete
Crucibles with lids	Slides, microscope (plain)
Cylinders, measuring, assorted	Slides, prepared <ul style="list-style-type: none"> <li>• Leaf, T.S;</li> <li>• Human Blood smear</li> <li>• Dicot root, T.S.;</li> </ul>
Desiccators	Sockets, lamp
Dishes, petri, glass	Solar system, model of
Droppers, teat	Solder
<i>E – beam</i>	Sonometer (commercial or improvised – a guitar can work)
Ear, model of	Stands, retort with clamps

## SUGGESTED EQUIPMENT LIST (Cont'd)

Eye, model of	Stands, tripod (heights must be suitable for use with Bunsen burners)
<i>Flash Drives</i>	Switches
Flasks, conical 250 ml	Telephone, earpiece and mouthpiece
Forceps	Thermometers -10°C - 110°C
Funnels, filter	Tongs, crucible
Fuses household	Trays, sorting
Heart, model of	Trolleys
Hi-fi equipment data (catalogues of)	Test Tubes (assorted sizes)
Holders, lens (convex)	Tubes, Y-piece connectors
Holders, mirror	Capillary Tubing
Holders, test tube	Glass Tubing (assorted lengths)
Jars, gas with cover plates	Rubber Tubing
Jars, with plastic screw top lids	Vertebrae (different types)
Lamps, low voltage	Voltmeter (d.c. dual range 0 - 5v, 0 - 15v)
Lenses, concave cylindrical	White metal
Lenses, concave spherical	Electrical Wire (flex) colour coded, connecting
Lenses, convex cylindrical	Wire gauzes with insulated centres
Lenses, convex spherical (f=5 cm, f = 30 cm)	Nichrome Wire (assorted) 1056 ohm m <sup>-1</sup> – 156 ohm -1
Lenses, hand, large (x 6 or more)	
Lungs, bell jar model of	
Magnets, bar	
Masses, sets of (10, 100, 200, 500, 1000g)	
*Metre, joule	
Microscope, light, Magnification x 300	

Items with an asterisk (\*) need not be bought but may be borrowed for the relevant lesson.



# CARIBBEAN EXAMINATIONS COUNCIL

Caribbean Secondary Education Certificate®  
CSEC®



## INTEGRATED SCIENCE

### Specimen Papers and Mark Schemes/Keys

**Specimen Papers:**

Paper 01  
Paper 02  
Paper 03/2

**Mark Schemes and Key:**

Paper 01  
Paper 02  
Paper 03/2



TEST CODE **01230010**

**SPEC 2015/01230010**

**CARIBBEAN EXAMINATIONS COUNCIL  
CARIBBEAN SECONDARY EDUCATION CERTIFICATE®  
EXAMINATION**

**INTEGRATED SCIENCE**

**Paper 01 – General Proficiency**

*1 hour 15 minutes*

**READ THE FOLLOWING INSTRUCTIONS CAREFULLY.**

1. This test consists of 60 items. You will have 1 hour and 15 minutes to answer them.
2. In addition to this test booklet, you should have an answer sheet.
3. Each item in this test has four suggested answers lettered (A), (B), (C), (D). Read each item you are about to answer and decide which choice is best.
4. On your answer sheet, find the number which corresponds to your item and shade the space having the same letter as the answer you have chosen. Look at the sample item below.

Sample Item

Benzene dissolves stains caused by

- (A) tar
- (B) fruit
- (C) paint
- (D) starch

Sample Answer



The correct answer to this item is “tar”, so (A) has been shaded.

5. If you want to change your answer, erase it completely before you fill in your new choice.
6. When you are told to begin, turn the page and work as quickly and as carefully as you can. If you cannot answer an item, go on to the next one. You may return to that item later.
7. Figures are not necessarily drawn to scale.

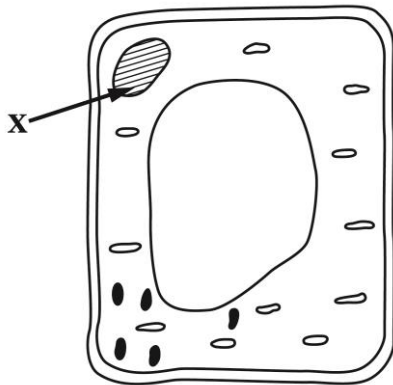
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**DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.**

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1. Energy for cell activities is produced in the
- (A) nucleus
  - (B) vacuole
  - (C) ribosomes
  - (D) mitochondria

Item 2 refers to the following diagram of the plant cell.



2. The structure labelled X is the
- (A) vacuole
  - (B) nucleus
  - (C) chloroplast
  - (D) mitochondrion
3. Which of the following structures is associated with sexual reproduction?
- (A) Bulbs
  - (B) Corms
  - (C) Flower
  - (D) Rhizomes

Items 4-5 refer to the following types of birth control methods.

- (A) Natural
  - (B) Barrier
  - (C) Hormonal
  - (D) Surgical
4. A condom is an example of which type of birth control?
5. A vasectomy is an example of which type of birth control method?

6. Which of the following sexually transmitted infections are caused by viruses?
- I. AIDS
  - II. Herpes
  - III. Syphilis
- (A) I and II only
  - (B) I and III only
  - (C) II and III only
  - (D) I, II and III

7. The products of photosynthesis are
- I. Glucose
  - II. Oxygen
  - III. Carbon dioxide
- (A) I and II only
  - (B) I and III only
  - (C) II and III only
  - (D) I, II and III

8. Primary consumers feed on
- (A) herbivores
  - (B) producers
  - (C) carnivores
  - (D) omnivores

9. Which of the following enzymes digests fats?
- (A) Pepsin
  - (B) Lipase
  - (C) Renin
  - (D) Maltase

10. Which of the following arteries carry deoxygenated blood?
- (A) Renal artery
  - (B) Hepatic artery
  - (C) Coronary artery
  - (D) Pulmonary artery

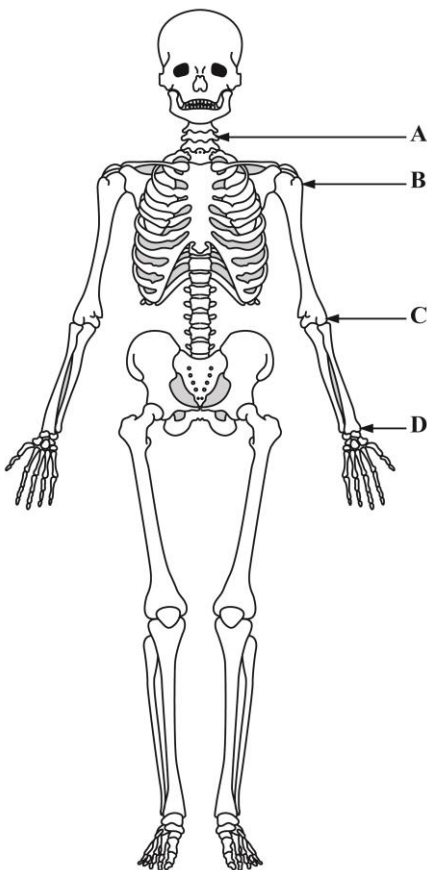
11. Which of the following blood groups is known as the universal recipient?

- (A) A
- (B) B
- (C) AB
- (D) O

12. Which of the following bones is NOT located in the leg?

- (A) Ulna
- (B) Tibia
- (C) Fibula
- (D) Femur

Item 13 refers to the following diagram of a human skeleton.



13. Which of the parts labelled A, B, C, D is a hinge joint?

14. The products of respiration are

- I. water
- II. oxygen
- III. carbon dioxide

- (A) I and II only
- (B) I and III only
- (C) II and III only
- (D) I, II and III

15. Which of the following pollutant gases has an affinity for the haemoglobin in red blood cells?

- I. Carbon dioxide
- II. Sulphur dioxide
- III. Carbon monoxide

- (A) I only
- (B) III only
- (C) I and II only
- (D) II and III only

16. Which of the following is NOT an excretory organ?

- (A) Skin
- (B) Lungs
- (C) Kidney
- (D) Stomach

17. Which of the following are characteristics of sense organs?

- I. Receive stimuli
- II. Contain specialized receptor cells
- III. Detect changes in the environment

- (A) I and II only
- (B) I and III only
- (C) II and III only
- (D) I, II and III

18. The function of the iris in the eye is to

- (A) focus rays of light
- (B) alter the shape of the lens
- (C) control the amount of light entering
- (D) keep the eyeball in shape

19. Which of the following is secreted by the endocrine system?
- I. Bile
  - II. Enzymes
  - III. Hormones
- (A) I only
  - (B) III only
  - (C) I and II only
  - (D) II and III only
20. Which of the following are stages in the life cycle of a mosquito?
- I. Egg
  - II. Pupa
  - III. Larva
- (A) I and II only
  - (B) I and III only
  - (C) II and III only
  - (D) I, II and III only
21. Which of the following conditions are MOST likely to encourage the growth of microorganisms on food?
- I. Warm
  - II. Dry
  - III. Damp
- (A) I and II only
  - (B) I and III only
  - (C) II and III only
  - (D) I, II and III
22. The use of another organism to control a pest is referred to as
- (A) chemical control
  - (B) sanitary control
  - (C) biological control
  - (D) mechanical control
23. The collision of molecules within a substance results in the transfer of energy by
- (A) radiation
  - (B) convection
  - (C) conduction
  - (D) evaporation
24. Liquids and gases normally expand when heated and contract when cooled. This behaviour explains the working of a
- (A) water pump
  - (B) thermometer
  - (C) vacuum cleaner
  - (D) tyre pressure gauge
25. Which of the following conditions are MOST likely to cause a person to produce the greatest amount of sweat?
- (A) Hot and dry
  - (B) Hot and humid
  - (C) Humid and cool
  - (D) Warm and humid
26. The unit of energy is the
- (A) watt
  - (B) gram
  - (C) joule
  - (D) meter
- Item 27 refers to the following energy conversion sequence.
- Chemical → Electrical → Mechanical → Heat
27. The energy conversion sequence is MOST likely to occur in a
- (A) solar light
  - (B) car engine
  - (C) solar water heater
  - (D) diesel-powered generator
28. The formula  $p = mv$  is used to calculate
- (A) speed
  - (B) energy
  - (C) momentum
  - (D) temperature

29. Which of the following does NOT conduct electricity?

- (A) Tin
- (B) Iron
- (C) Plastic
- (D) Copper

30. Voltage equals

- (A) Current x Resistance
- (B)  $\frac{\text{Current}}{\text{Resistance}}$
- (C)  $\frac{\text{Resistance}}{\text{Current}}$
- (D) Current + Resistance

31. Which of the following is a safety device?

- (A) Fuse
- (B) Plug
- (C) Bulb
- (D) Switch

32. Which of the following is the first action which should be taken to prevent an electrical shock?

- (A) Call the fire service
- (B) Turn off the electricity
- (C) Throw water on the person
- (D) Cover the person with a blanket

33. Which of the following is NOT needed to start a fire?

- (A) Heat
- (B) Fuel
- (C) Oxygen
- (D) Nitrogen

Item 34 refers to the following picture of protective gear worn by a welder.



34. The purpose of the protective gear is to shield the welder's

- (A) ears
- (B) eyes
- (C) head
- (D) nose

35. A Class 2 lever has the

- (A) fulcrum and effort in the middle
- (B) fulcrum between the effort and load
- (C) effort between the load and the fulcrum
- (D) load between the fulcrum and the effort

36. Which of the following machines is MOST likely to make the loading of a truck easier?

- (A) Pulley
- (B) Lever
- (C) Wheelbarrow
- (D) Incline plane

37. Which of the following is an advantage of using plastics?

- (A) They are combustible.
- (B) They are non-corrosive.
- (C) They are non-biodegradable.
- (D) They give off toxic fumes when burnt.

38. Which of the following metals is the LEAST reactive?

- (A) Silver
- (B) Copper
- (C) Sodium
- (D) Aluminium

39. Stainless steel is an alloy of
- (A) iron and carbon
  - (B) copper and zinc
  - (C) copper and tin
  - (D) lead and nickel
40. Which of the following will not reduce or prevent rusting?
- (A) Painting
  - (B) Washing
  - (C) Galvanizing
  - (D) Electroplating

Item 41 refers to the following safety symbol.



41. The safety symbol indicates that a substance is
- (A) toxic
  - (B) explosive
  - (C) corrosive
  - (D) flammable
42. A solution with a pH of 5 is a
- (A) weak acid
  - (B) strong acid
  - (C) strong alkali
  - (D) neutral solution
43. A mixture of starch and water is a
- (A) colloid
  - (B) solvent
  - (C) solution
  - (D) suspension

44. Which of the following techniques is used to separate the colours that are found in black ink?
- (A) Filtration
  - (B) Distillation
  - (C) Chromatography
  - (D) Solvent extraction
45. The major cause of the seasons on earth is the
- (A) constant tilt of the earth's rotational axis with respect to its orbit around the sun
  - (B) periodic wobbling of the earth on its axis of rotation
  - (C) changing distance of the earth from the sun at different times of the year
  - (D) changing relative positions of the earth, moon and the sun
46. A cycle of moon phases can be seen from earth because the
- (A) moon's axis is tilted
  - (B) moon spins on its axis
  - (C) moon revolves around the earth
  - (D) moon's distance from the earth changes at a predictable rate
47. Which of the following statements about the moon is correct?
- (A) It is a planet.
  - (B) It orbits around the sun.
  - (C) It is a satellite of the earth.
  - (D) It has oceans of water.
48. Which of the following keeps the planets in the solar system in orbit around the sun?
- (A) Thermal energy
  - (B) Gravitational force
  - (C) Atmospheric pressure
  - (D) Electromagnetic energy

GO ON TO THE NEXT PAGE

49. The display of horizons on a vertical cross section through the soil is termed the soil
- (A) bed
  - (B) layer
  - (C) profile
  - (D) strata chart
50. Finely divided, partially decomposed organic matter found in soil is called
- (A) silt
  - (B) sand
  - (C) loam
  - (D) humus
51. Two major processes that occur in the carbon cycle are
- (A) weathering and erosion
  - (B) fixation and denitrification
  - (C) evaporation and transpiration
  - (D) photosynthesis and respiration
52. The LEAST effective way to purify water is
- (A) boiling
  - (B) filtration
  - (C) distillation
  - (D) chlorination
53. Which of the following is LEAST likely to be a source of water pollution?
- (A) Storm water
  - (B) Untreated sewage
  - (C) Agricultural runoff from farms
  - (D) Effluent from industries and factories
54. Which of the following navigational devices depends on artificial satellites to determine locations?
- (A) GPS
  - (B) Sonar
  - (C) Radar
  - (D) Compass
55. Which of the following is true about the 'greenhouse effect'?
- I. It makes the earth cooler
  - II. It is associated with carbon dioxide gas
  - III. It is caused by heat trapped in the atmosphere
- (A) I and II only
  - (B) I and III only
  - (C) II and III only
  - (D) I, II and III
56. Which of the following gases is NOT believed to contribute to the increase in global temperatures via the greenhouse effect?
- (A) Oxygen
  - (B) Methane
  - (C) Nitrous oxide
  - (D) Carbon dioxide
57. Which of the following systems uses a non-renewable resource to generate electricity?
- (A) Geothermal plants using steam
  - (B) Wind turbines using air movement
  - (C) Solar panels using the sun's radiation
  - (D) Nuclear power plants using radioactive elements
58. Which of the following is NOT considered an alternative source of energy?
- (A) Solar
  - (B) Wind
  - (C) Gasoline
  - (D) Geothermal



**59.** The weight of a body acts through a single point called the

- (A) edge
- (B) fulcrum
- (C) moment
- (D) centre of gravity

**60.** There are three states of equilibrium. Which of the following is NOT one of these states?

- (A) Stable
- (B) Regular
- (C) Neutral
- (D) Unstable

**END OF TEST**

**IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.**

**CSEC INTEGRATED SCIENCE**

**Specimen - Paper 01**

**2015**

<b>QUESTION NUMBER</b>	<b>KEY</b>	<b>SYLLABUS OBJECTIVE</b>
1	D	A. I. 3
2	B	A. I. 2
3	C	A. II. 1
4	B	A. II. 6
5	D	A. II. 6
6	A	A. II. 8
7	A	A. III. 1
8	B	A. III. 3
9	B	A. III. 8
10	D	A. IV. 2
11	C	A. IV. 3
12	A	A. IV. 8
13	C	A. IV. 10
14	B	A. V. 3
15	B	A. V. 5
16	D	A. VI. 2
17	D	A. VII. 1
18	C	A. VII. 2
19	B	A. VII. 9
20	D	A. VIII. 3
21	B	A. VIII. 4
22	C	A. VIII. 5
23	C	B. I. 1
24	B	B. I. 3
25	B	B. I. 4
26	C	B. II. 1
27	B	B. II. 2
28	C	B. II. 4
29	C	B. III. 1
30	A	B. III. 2

<b>QUESTION NUMBER</b>	<b>KEY</b>	<b>SYLLABUS OBJECTIVE</b>
31	A	B. III. 3
32	B	B. III. 9
33	D	B. III. 10
34	B	B. III. 12
35	D	B. IV. 1
36	D	B. IV. 3
37	B	B. V. 2
38	A	B. V. 3
39	A	B. V. 5
40	B	B. V. 8
41	C	B. VI. 1
42	A	B. VI. 2
43	A	B. VI. 3
44	C	B. VI. 4
45	A	C. I. 3
46	C	C. I. 3
47	C	C. I. 4
48	B	C. I. 4
49	C	C. II. 2
50	D	C. II. 3
51	D	C. II. 5
52	B	C. III. 2
53	A	C. III. 5
54	A	C. III. 8
55	C	C. IV. 3
56	A	C. IV. 4
57	D	C. IV. 4
58	C	C. V. 3
59	D	C. V. 4
60	B	C. IV. 3



TEST CODE **01230020**

**SPEC 2015/01230020**

**C A R I B B E A N E X A M I N A T I O N S C O U N C I L**

**C A R I B B E A N S E C O N D A R Y E D U C A T I O N C E R T I F I C A T E<sup>®</sup>  
E X A M I N A T I O N**

**SPECIMEN PAPER**

**I N T E G R A T E D S C I E N C E**

**Paper 02 – General Proficiency**

*2 Hours 30 minutes*

**READ THE FOLLOWING INSTRUCTIONS CAREFULLY.**

1. This paper consists of SIX questions in TWO sections: A and B.
2. SECTION A consists of FOUR questions. Answer ALL questions. Section A is worth 70 marks.
3. SECTION B consists of TWO questions. Answer ALL questions. Section B is worth 30 marks.
4. Write your answer in the space provided in this answer booklet.

**DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.**

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**SECTION A**

**Answer ALL FOUR questions.**

1. (a) (i) Distinguish between 'd.c. current' and 'a.c. current'.

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**(2 marks)**

- (ii) State the name of a material that is suitable for insulating electrical wires.

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**(1 mark)**

- (b) A local electricity company charges \$1.00 per kWh for the first 2000 kWh and \$3.50 for every kWh afterwards. A fuel adjustment charge of \$0.50 per kWh is added to all electricity bills. If Mrs Brown's previous monthly meter reading was 17 800 kWh and the current monthly meter reading is 20 300 kWh, calculate the electricity bill for Mrs Brown for the current month.

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**(5 marks)**

**GO ON TO THE NEXT PAGE**

- (c) Table 1 shows the electricity usage for the Brown family for the period July to December.

**TABLE 1: ELECTRICITY USAGE FOR THE BROWN FAMILY, JULY–DECEMBER**

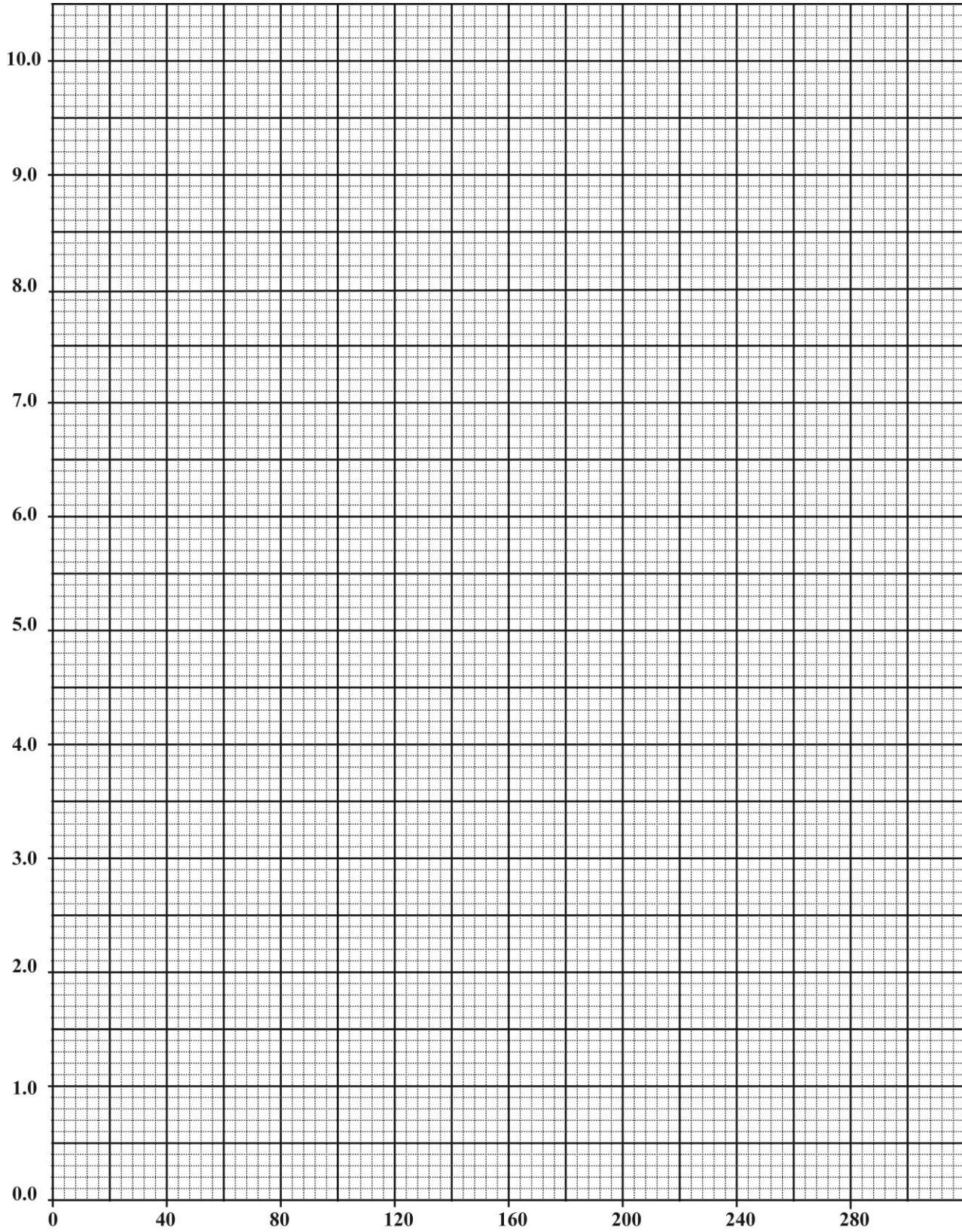
<b>Month</b>	<b>Jul.</b>	<b>Aug.</b>	<b>Sept.</b>	<b>Oct.</b>	<b>Nov.</b>	<b>Dec.</b>
Electricity Usage (kwh)	1000	1500	1800	2000	2500	4000

- (i) Use the grid on **page 4** to plot a graph to show the data in the table. **(5 marks)**

- (ii) Write a suitable title for the graph.

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**(1 mark)**



GO ON TO THE NEXT PAGE

(d) (i) Define the term 'machine'.

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**(1 mark)**

(ii) State the formula used to calculate the mechanical advantage of a machine.

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**(1 mark)**

(iii) Suggest ONE energy conservation measure the Brown family may use to prevent high electricity usage such as that seen in December.

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**(1 mark)**

(iv) Plan and design an experiment to determine which type of lever (a first class lever or a second class lever) is more efficient for lifting a specific weight. Use the following headings in your response.

Hypothesis

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**(2 marks)**

Procedure

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**(5 marks)**

GO ON TO THE NEXT PAGE

Manipulated Variable

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**(1 mark)**

**Total 25 marks**



2. Table 2 shows the results of food tests conducted on two local foods.

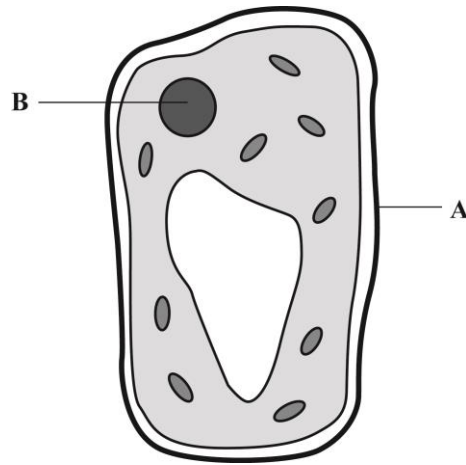
**TABLE 2: RESULTS OF FOOD TESTS ON LOCAL FOODS**

Food	Food Test	Results	Deduction
Breadfruit	Potassium/iodide test	Blue black colour	_____
Green peas	_____	_____	Protein

(a) Complete Table 2.

**(3 marks)**

(b) Figure 1 shows a diagram of a typical cell found in the green pea.



**Figure 1: Typical plant cell**

State the name of the parts labelled A and B.

A .....

B .....

**(2 marks)**

- (c) (i) Explain the principle of 'salting' in food preservation.

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**(2 marks)**

- (ii) Other than 'salting', suggest ONE method suitable for the preservation of breadfruit and ONE method suitable for the preservation of green peas.

Breadfruit

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**(1 mark)**

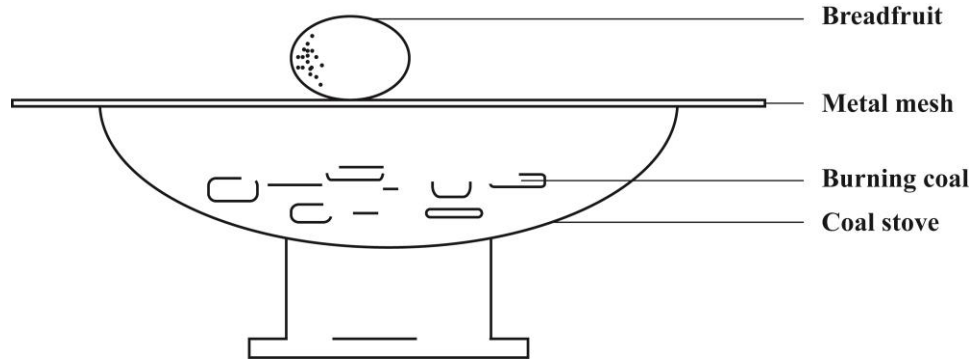
Green peas

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**(1 mark)**

(d) Figure 2 shows a breadfruit being roasted.



**Figure 2: A breadfruit being roasted**

(i) Identify TWO properties of the metal used to make the mesh that makes it suitable for the purpose it is being used for.

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**(2 marks)**

- (ii) Describe TWO processes by which the breadfruit receives heat energy from the stove.

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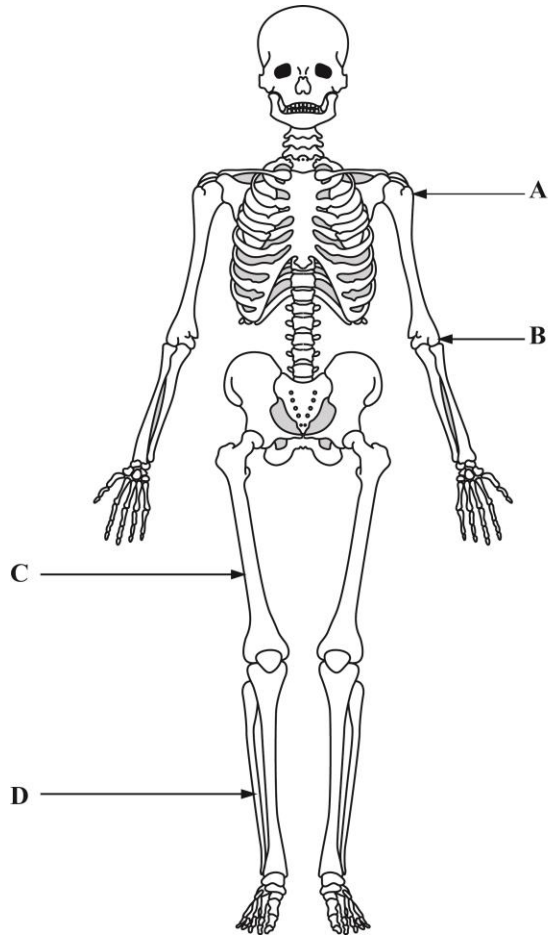
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**(4 marks)**

**Total 15 marks**

3. Figure 3 is a diagram of a human skeleton.



**Figure 3: Diagram of the human skeletal system**

(a) (i) State the name of the types of joints labelled A and B.

A .....

B .....

**(2 marks)**

(ii) State the name of the bones labelled C and D.

C .....

D .....

**(2 marks)**

(iii) One of the functions of the skeleton is to protect the organs of the circulatory and respiratory systems. State ONE function, **other** than protection, of the skeletal system.

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**(1 mark)**

(b) Discuss the physiological effects of exercise on the circulatory and the respiratory systems.

Circulatory system: .....

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Respiratory system: .....

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**(6 marks)**

- (c) Sam has a disease that causes the ciliary muscles of the eye to malfunction. Explain what effect this disease may have on Sam's ability to view objects.

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**(4 marks)**

**Total 15 marks**

4. (a) Define the following terms:

(i) Centre of gravity

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**(1 mark)**

(ii) Stable equilibrium

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**(1 mark)**

(b) A load of 50 N is applied 10 m away from the fulcrum of a lever. What is the distance at which an effort of 100 N should be applied to ensure that the lever remains at equilibrium?

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**(5 marks)**



(c) Define the following terms:

(i) Energy

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**(1 mark)**

(ii) Momentum

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**(1 mark)**

(d) (i) State ONE energy conversion that takes place when a solar powered car is in motion.

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**(1 mark)**

- (d) (ii) An SUV weighing 2 000 kg travelling north with a velocity of 5 m/s collides head-on with a truck weighing 4 000 kg and travelling south at a velocity of 2 m/s. Calculate the velocity of the vehicles after the collision.

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**(5 marks)**

**TOTAL 15 marks**

**SECTION B**

**Answer BOTH questions.**

**Write your answer on the pages provided at the end of each question.**

5. (a) State the name of TWO household chemicals that are acidic and TWO household chemicals that are basic. Briefly describe a simple procedure that may be used to determine the pH of the chemicals.

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**(7 marks)**

**GO ON TO THE NEXT PAGE**

- (b) Using examples, explain how the principles of neutralization and solvent extraction are applied to stain removal.

Neutralization: .....

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Solvent extraction: .....

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**(8 marks)**

**Total 15 marks**

6. (a) State ONE use of water and describe TWO stages in the purification of water for domestic use.

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**(7 marks)**

- (b) Identify TWO industrial pollutant gases and explain how ‘eutrophication’ affects aquatic life.

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**(8 marks)**

**Total 15 marks**

**END OF TEST**

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L  
H E A D Q U A R T E R S

C A R I B B E A N   S E C O N D A R Y   E D U C A T I O N   C E R T I F I C A T E<sup>®</sup>  
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S P E C I M E N   P A P E R

K E Y   A N D   M A R K   S C H E M E



**Integrated Science  
Specimen Paper  
Paper 02 – General Proficiency  
Key and Mark Scheme**

Ques	Syll Ref	Possible Response	Instructions or Comments	Marks		
				KC	UK	XS
1(a) (i)	B.III.2	d.c current occurs when the flow of current in a circuit is in one direction (1) a.c current occurs when the flow of current is one direction at first and then switches to another direction (1)	<b>1 mark for each correct definition</b>	2		
(ii)	B.III.1	Plastic, rubber	<b>Any one 1 mark</b>	1		
(b)	B.III.6	Energy used $20,300 - 17,800 = 2500$ Kwh (1) $1^{st}$ 2000 kWh @ \$11.00 = \$2000.00 (1) Remaining 500 kWh @ \$13.50 = \$1,750.00 (1) Fuel adjustment 2500 @ \$0.50 = \$1,250.00 (1) Total Cost: $\$2000.00 + 1750.00 + 1250.00 = \$5,000.00$ (1)	<b>1 mark for each stage correctly calculated</b>		5	
(c) (i)	B.III.6	Axis x-axis - month (1) y-axis - electricity usage (1)  Correct plotting (3 marks) 5-6 points correctly plotted - 3 3-4 points correctly plotted - 2 1-2 points correctly plotted - 1	<b>1 mark for each stage correctly calculated</b>		5	
(c) (ii)	B.III.6	Title: Graph to show electricity usage per month			1	

**Integrated Science  
Specimen Paper  
Paper 02 – General Proficiency  
Key and Mark Scheme**

Ques	Syll Ref	Possible Response	Instructions or Comments	Marks		
				KC	UK	XS
1(d) (i)	B.IV.2	A machine is a device which makes it easier to do work		1		
(ii)	B.IV.3	MA = $\frac{\text{Load}}{\text{Effort}}$		1		
(iii)	B.III.7	Use energy efficient appliances Turn off lights and appliances when not in use Clean AC units regularly	<b>Any one 1 mark each</b>		1	
(iv)	B.IV.1	<u>Hypothesis:</u> The first class lever is more efficient than the second class lever when lifting a heavy box  <u>Procedure:</u> Use the first class lever to lift a 10 kg box. (1) Measure and record the effort used by the first class lever. (1) Use a second class lever to lift the same 10 kg box. (1) Measure and record the effort used by the second class lever. (1) The lever which uses the least effort to lift the box is the more efficient lever. (1)  <u>Manipulated Variable:</u> Type of lever				2
						5
						1
			<b>TOTAL</b>	<b>5</b>	<b>12</b>	<b>8</b>

**Integrated Science  
Specimen Paper  
Paper 02 – General Proficiency  
Key and Mark Scheme**

Ques	Syll Ref	Possible Response	Instructions or Comments	Marks		
				KC	UK	XS
2(a) (i)	A.III.4	Starch present (1) Biuret reagent/copper sulphate and sodium hydroxide solution (1) Purple stain (1)	<b>1 mark each</b>	3		
(b)	A.I.3	A - Cell wall B - Nucleus	<b>1 mark each</b>	2		
(c) (i)	A.III.7	Salt removes the moisture (1) by a process of osmosis. (1)			2	
(ii)	A.III.7	Breadfruit: Pickling/heating Green Peas: Canning	<b>1 mark each</b>		2	
(d) (i)	B.V.1	High melting point Good conductor of heat	<b>1 mark for each property</b> (Accept malleable and high tensile strength)		2	
(ii)	B.I.1	Conduction: The transfer of heat from the metal mesh to the breadfruit  Convection: The transfer of heat from the hot air to the breadfruit  Radiation: The transfer of heat directly from the coal to the breadfruit	<b>1 mark for naming the process and 1 mark for describing the process</b>  <b>2 x 2 = 4 marks</b>			4
<b>TOTAL</b>				<b>5</b>	<b>10</b>	

**Integrated Science  
Specimen Paper  
Paper 02 – General Proficiency  
Key and Mark Scheme**

Ques	Syll Ref	Possible Response	Instructions or Comments	Marks		
				KC	UK	XS
3(a) (i)	A.IV.10	A – Ball and socket joint B – Hinge joint	<b>1 mark for each</b>	2		
(ii)	A.IV.8	C Femur D Fibula	<b>1 mark for each</b>	2		
(iii)	A.IV.9	Movement, support, blood cell production	<b>Any one, 1 mark</b>	1		
(b)	A.IV.7	Circulatory system: Heart rate increases, red blood cells count increases, this allows the circulatory system to transport more oxygen through the body to meet the increased oxygen demand caused by the exercise  Respiratory system: Increase in breathing rate to increase oxygen intake and to eliminate excess carbon dioxide. Strengthening of the respiratory muscles	<b>Full discussion 3 marks</b>  <b>Partial discussion 1-2 marks</b>		3	
(c)	A.VII.2	This malfunction may result in Sam's eye being <u>unable to accommodate objects which means he would not be able to focus</u> (1) on objects properly. It also means that objects would appear blurry to him. The muscles <u>may not be able to contract enough</u> (1) to give the lens its <u>rounded shape</u> for <u>close object focus</u> . (1) Similarly the muscles may not be able to <u>relax enough</u> to give the lens an <u>elongated shape</u> for <u>distant object focus</u> . (1)			4	
			<b>TOTAL</b>	<b>5</b>	<b>10</b>	

**Integrated Science  
Specimen Paper  
Paper 02 – General Proficiency  
Key and Mark Scheme**

Ques	Syll Ref	Possible Response	Instructions or Comments	Marks		
				KC	UK	XS
4 (a)	C.V.3	(i) Centre of gravity: The point at which all of the weight of an object appears to be concentrated  (ii) Stable equilibrium: When an object is at rest and not falling over	<b>1 mark for each definition</b>	2		
(b)	C.V.4	Force x Distance = Force x Distance (1)  $50 \times 10 = 100 \times (1)$ $500 = 100 \times (1)$ $= \frac{500}{100} (1)$ $= 5 \text{ m} (1)$			5	
(c)	B.II.2	(i) Energy is the capacity to do work. (ii) Momentum is the term used to describe an object in motion.		1		
(d) (i)	B.II.2	Solar → electrical Electrical → mechanical Mechanical → kinetic	<b>Any conversion 1 mark</b>	1		
(ii)	B.II.4	Momentum is conserved therefore momentum before collision = momentum after collision  <u>Before</u> $2000 \times 5 - 4000 \times 2 (1)$ $10000 - 8000$ $= 2000 \text{ kg m/s} (1)$ <u>After</u> $6000 \times V = 2000$ $V = \frac{2000}{6000} (1)$ $V = 0.33 \text{ m/s} (1)$			5	
			<b>TOTAL</b>	<b>5</b>	<b>10</b>	

**Integrated Science  
Specimen Paper  
Paper 02 – General Proficiency  
Key and Mark Scheme**

Ques	Syll Ref	Possible Response	Instructions or Comments	Marks		
				KC	UK	XS
5 (a)	B.VI.1 B.VI.2	<p>Acidic: Vinegar (lime juice); hydrogen peroxide, toilet bowl cleaners</p> <p>Basic: Toothpaste, dishwashing liquid, antacids</p> <p>Procedure</p> <ul style="list-style-type: none"> <li>• Dissolve chemical in water</li> <li>• Use pH paper OR add pH indicator</li> <li>• Match the colour against the pH indicator chart to determine the pH</li> </ul>	<p><b>1 mark each</b></p> <p><b>1 mark for each part</b></p>	4		
(b)	B.VI.2	<p>Neutralization: This process is the reaction between an acid and a base to produce a salt and water <b>(1)</b>; Some stains, for example, fruit stains are acidic <b>(1)</b> and if a base such as bicarbonate of soda is applied to the stain <b>(1)</b>, the stain is neutralized and removed. <b>(1)</b></p> <p>Solvent extraction: Some stains are aqueous and some are non-aqueous. <b>(1)</b> Likewise some solvents are aqueous and some are non-aqueous. <b>(1)</b> Aqueous solvents will dissolve in aqueous substances and non-aqueous solvents will dissolve in non-aqueous substances, <b>(1)</b> for example, paint is a non-aqueous substance so a non-aqueous solvent such as turpentine may be used to dissolve the paint stain. <b>(1)</b></p>	<p><b>Full explanation 4 marks</b></p> <p><b>Partial explanation 1-3 marks</b></p>		4	4
<b>TOTAL</b>				<b>7</b>	<b>8</b>	

**Integrated Science  
Specimen Paper  
Paper 02 – General Proficiency  
Key and Mark Scheme**

Ques	Syll Ref	Possible Response	Instructions or Comments	Marks		
				KC	UK	XS
6 (a)	C.III.1	Use: Cooking, cleaning, agriculture	<b>Any one use 1 mark</b>	1		
	C.III.2	Filtration: Water is passed through a bed of gravel and sent to remove small solid particles.  Chlorination: The addition of chlorine to remove microorganisms.  Aeration: The pumping of the water through tiny holes to improve the taste.	<b>1 mark for name of method; 2 marks for description</b>  <b>Any TWO stages 2 marks each</b>	6		
(b)	C.III.5	Oil spills, pesticides, fertilizers, industrial waste and domestic waste	<b>1 mark for each source</b>		2	
	C.III.5	Run-off from agricultural crops contains chemicals such as phosphates and nitrates. (1) These chemicals encourage the growth of aquatic plants including algae. (1) Rapid growth of algae covers the source of the water (1) preventing the light from reaching aquatic life. (1) This prevents aquatic plants from photosynthesizing and results in their death. (1) The lack of oxygen results in aquatic animals not having enough oxygen for respiration, causing their death. (1)			6	
			<b>TOTAL</b>	<b>7</b>	<b>8</b>	



TEST CODE **01230032**

**SPEC 2015/01230032**

**C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L**  
**C A R I B B E A N   S E C O N D A R Y   E D U C A T I O N   C E R T I F I C A T E<sup>®</sup>**  
**E X A M I N A T I O N**

**SPECIMEN PAPER**

**INTEGRATED SCIENCE**

**Paper 032 – General Proficiency**

**Alternative to SBA**

*2 hours 10 minutes*

**READ THE FOLLOWING INSTRUCTIONS CAREFULLY.**

1. Answer ALL questions.
2. Write your answers in the spaces provided in this booklet.

**DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.**

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**Answer ALL questions.**

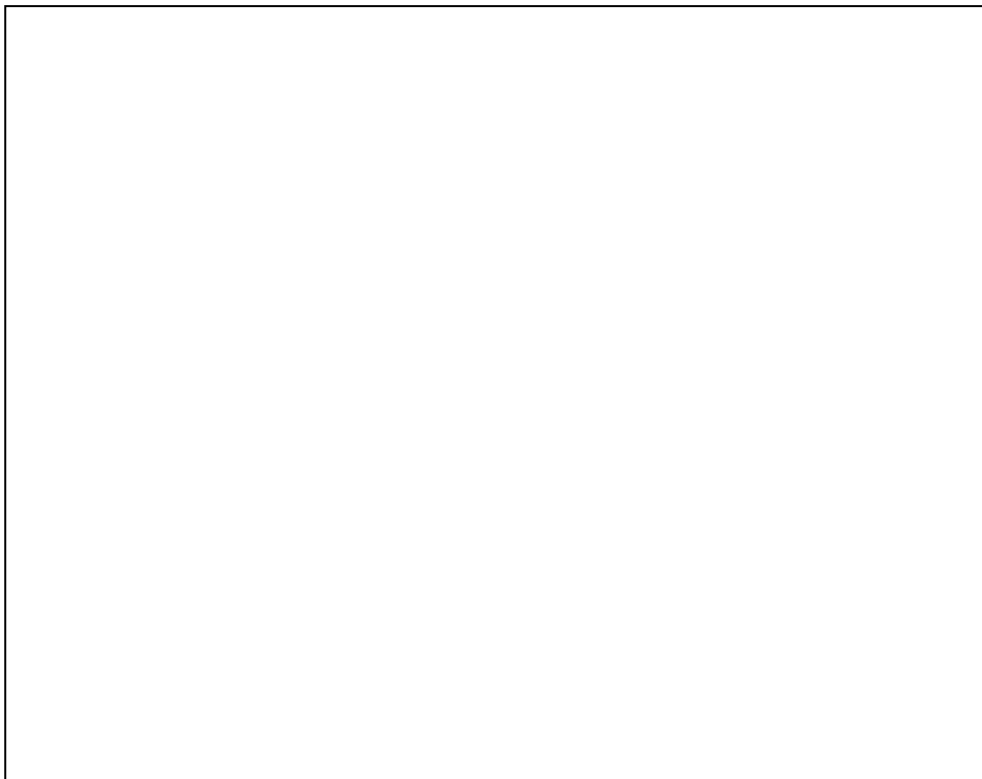
**1** (a) You are provided with the following materials and apparatus:

- 4 potato strips each of 5.0 cm in length
- 2 boiling tubes
- Solution X
- Solution Y
- Spatula
- Stopwatch

Procedure

1. Fill one boiling tube with Solution X and place two potato strips inside the tube.
2. Fill one boiling tube with Solution Y and place two potato strips inside the tube.
3. Start the stopwatch immediately.
4. For a period of 30 minutes, remove the potato strips every 5 minutes and measure them,
  - (i) Construct a suitable table and record your observation.

**(2 marks)**



**(5 marks)**

(ii) Give the table a suitable title.

.....  
.....

(1 mark)

(iii) State the name the process which is occurring in the experiment.

.....  
.....

(1 mark)

(b) You are provided with the following materials and apparatus:

- Benedict's solution
- Potassium iodide solution
- Biuret reagent
- Ethanol
- A mixture of cereal and milk
- Test tubes

Use the reagent to investigate the food nutrients found in the cereal and milk as instructed below.

**TABLE 1: RESULTS OF FOOD TESTS**

<b>Food Test</b>	<b>Observation</b>	<b>Inference</b>
1. Place approximately 5 cm <sup>3</sup> of the mixture of cereal and milk in a test tube; add three drops of iodine		
2. Place approximately 5 cm <sup>3</sup> of the mixture of cereal and milk in a test tube; add three drops of Biuret reagent		
3. Place approximately 5 cm <sup>3</sup> of the mixture of cereal and milk in a test tube; add 2 cm <sup>3</sup> of ethanol and shake		
4. Place approximately 5 cm <sup>3</sup> of the mixture of cereal and milk in a test tube and three drops of Benedict's solution		

Record your observations and inferences in the table.

(16 marks)

**Total 25 marks**

2 Malik finds that after playing football, his white shorts usually has grass stains. His friends suggested that he use one of the following chemicals to remove the grass stains: acetone, ethanol, turpentine, methylated spirits. Plan and design an experiment to help Malik determine which chemical is MOST suitable for removing the grass stains.

(a) Write a suitable hypothesis for the experiment.

.....  
.....  
.....  
.....

**(2 marks)**

(b) Use the following headings to describe a procedure that Malik may use to conduct the experiment.

Manipulated Variable

.....  
**(1 mark)**

Controlled Variable

.....  
**(1 mark)**

Responding Variable

.....  
**(1 mark)**

Procedure

.....

.....

.....

.....

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**(4 marks)**

Limitations

.....

.....

.....

**(1 mark)**

- (c) (i) A group of students conducted an experiment to determine where in the reactivity series an unknown metal X belonged. They were provided with dilute hydrochloric acid, aluminum, copper, metal X and iron. The table below shows the observations of the students. Complete the table.

**TABLE 2: REACTION OF METALS AND ACID**

<b>Metal</b>	<b>Observation</b>	<b>Inference</b>
Cu		
Al		
Fe		
X	Moderate amount of fizzing	

**(10 marks)**

- (ii) Write a word equation for the reaction between aluminium and hydrochloric acid.

.....  
.....

**(3 marks)**

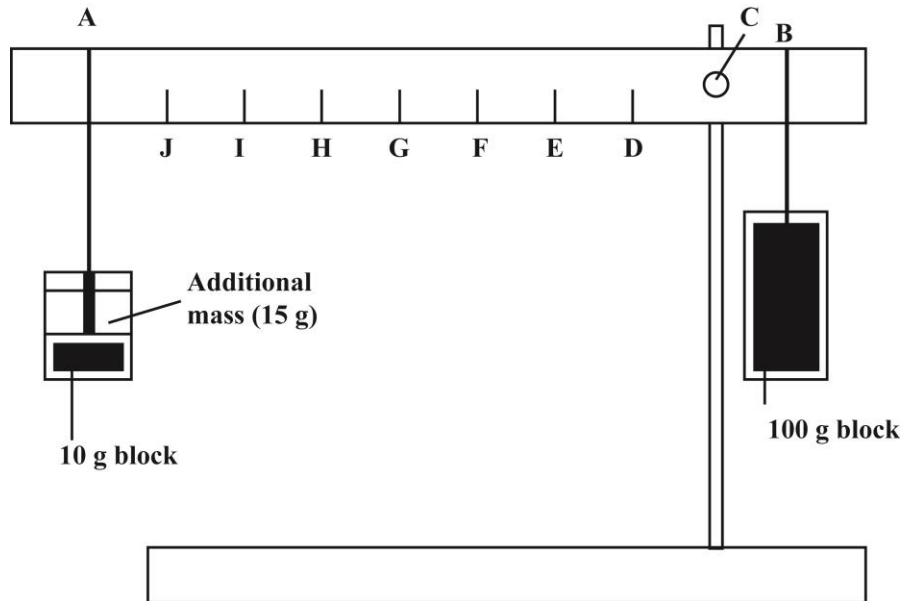
- (iii) Based on the results in the table, arrange the metals in order of **decreasing** reactivity.

.....  
.....  
.....

**(2 marks)**

**Total 25 marks**

- 3 Jameel constructs a lever which has a fulcrum at C and a load of 100 g at B as shown in **Figure 1**. He tried to balance the lever by applying an effort at A with a 10 g block, but he found that 15 g of additional mass was required.



**Figure 1: Diagram of Lever**

- (a) Jameel is interested in finding the values of masses which will balance the lever when they are hung at points D–J so he creates Table 1. Complete the table by using your ruler to measure the distance from the fulcrum, C, to the points D, E, F, G, H, I and J in Figure 1. **(5 marks)**

**TABLE 3: MASS REQUIRED TO BALANCE LEVER AND DISTANCE OF EFFORT FROM FULCRUM**

Position of Effort	Distance of Effort from Fulcrum (cm)	Mass required to Balance Lever (g)
A	8.1	25
J		29
I		33
H		40
G		50
F		67
E		100
D		200

- (b) Write a hypothesis relating the distance of the effort from the fulcrum and the mass required to balance the lever.

.....  
.....

(2 marks)

- (c) (i) On the grid **provided on page 9**, plot a line graph of Jameel's results for the distance of the effort from the fulcrum against the mass required to balance the lever. (4 marks)
- (ii) Label the axes on the graph. (2 marks)

- (d) (i) Extend your graph to read the point where the load is 250 g. Mark this point with an X. (2 marks)
- (ii) Using the graph, determine the value of the distance from the fulcrum for a load of 250 g. Draw TWO dotted lines in the appropriate places on the graph to assist you with your reading. (4 marks)

- (e) From your graph, state how the effort changes as the distance from the fulcrum increases.

.....  
.....

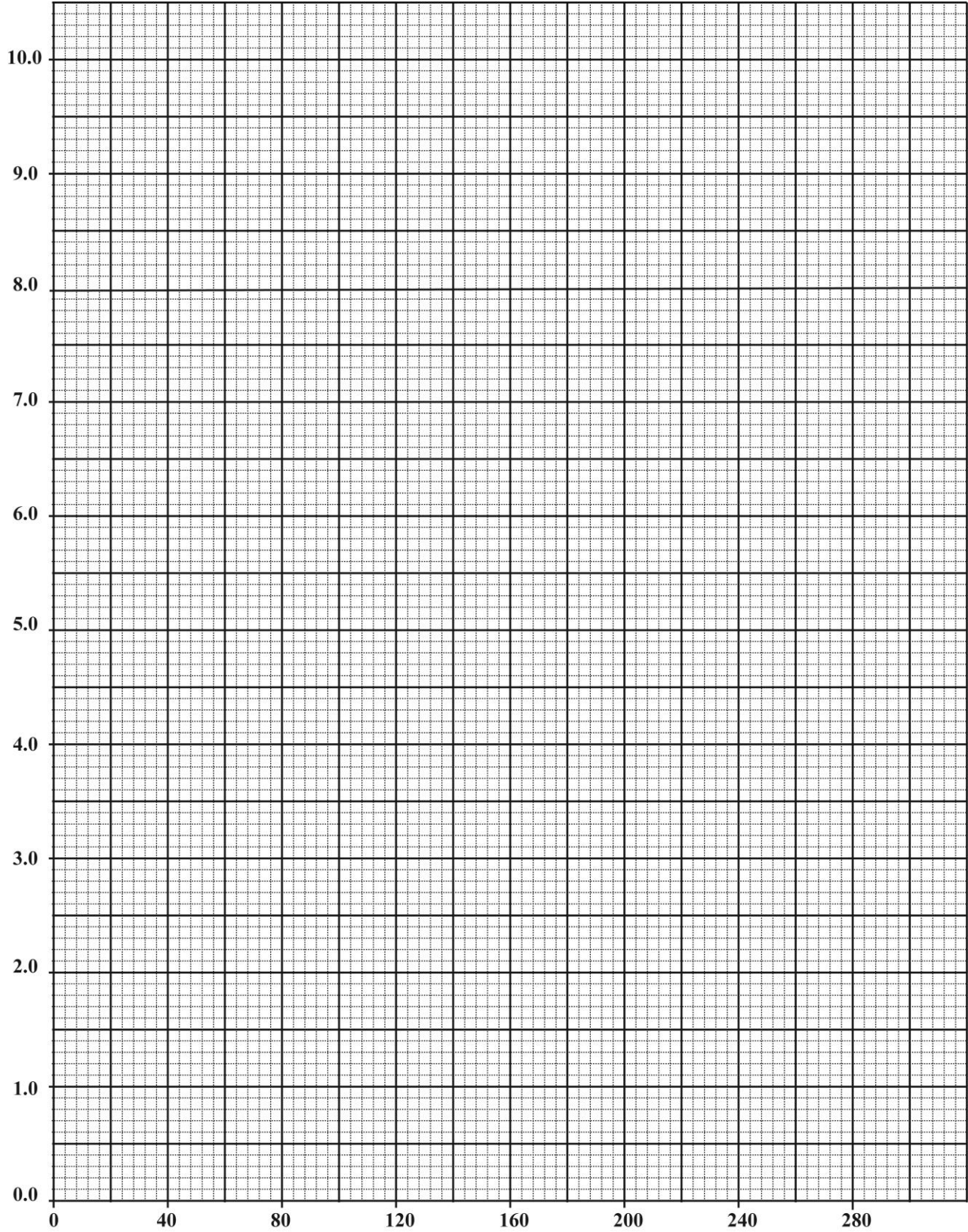
(1 mark)

- (f) Figure 2 is a picture of one of the masses used by Jameel. In the box **provided on page 10**, draw a two-dimensional diagram of the mass. Include the following in your diagram:

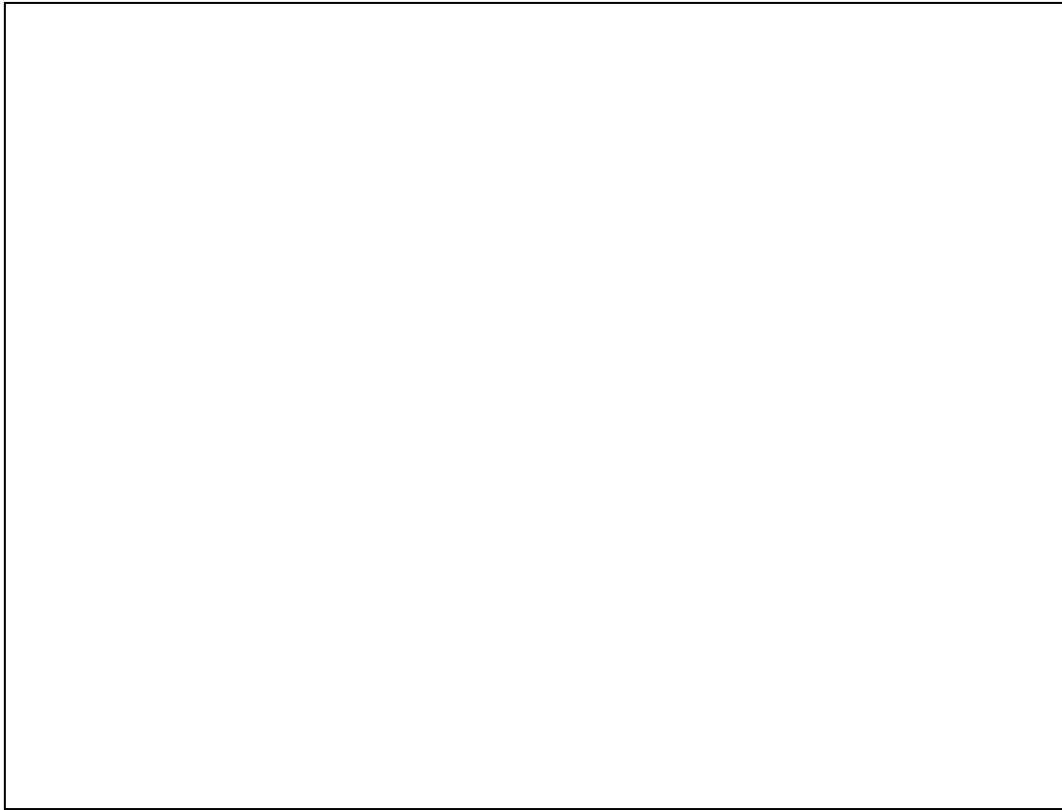
- The magnification
- Clear lines
- A title for the drawing



**Figure 2: One of the Masses used by Jameel**







**(5 marks)**

**Total 25 marks**

**END OF TEST**

**IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.**

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L  
H E A D Q U A R T E R S

C A R I B B E A N   S E C O N D A R Y   E D U C A T I O N   C E R T I F I C A T E<sup>®</sup>  
E X A M I N A T I O N

I N T E G R A T E D   S C I E N C E

P a p e r   0 3 2   -   G e n e r a l   P r o f i c i e n c y

S P E C I M E N   P A P E R

K E Y   A N D   M A R K   S C H E M E

**Integrated Science  
Specimen Paper  
Paper 032 - General Proficiency  
Key and Mark Scheme**

Ques	Syll Ref	Possible Response	Instructions/ Comments	UK	XS																										
1(a)		Filling of boiling tubes and adding the potato strips  Table: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th rowspan="2">Time (Mins)</th> <th colspan="2">Length of Strips</th> </tr> <tr> <th>Solution X</th> <th>Solution Y</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>5.0</td> <td>5.0</td> </tr> <tr> <td>5</td> <td></td> <td></td> </tr> <tr> <td>10</td> <td></td> <td></td> </tr> <tr> <td>15</td> <td></td> <td></td> </tr> <tr> <td>20</td> <td></td> <td></td> </tr> <tr> <td>25</td> <td></td> <td></td> </tr> <tr> <td>30</td> <td></td> <td></td> </tr> </tbody> </table>	Time (Mins)	Length of Strips		Solution X	Solution Y	0	5.0	5.0	5			10			15			20			25			30			ORR Headings (2) MM measurements (1) ORR recording data (2)		2
Time (Mins)	Length of Strips																														
	Solution X	Solution Y																													
0	5.0	5.0																													
5																															
10																															
15																															
20																															
25																															
30																															
		Suitable title of table  Process - Osmosis	1 mark  1 mark	1	1																										
(b)		Ability to measure 5 cm <sup>3</sup> of cereal and milk (2)  Ability to add testing reagents to the mixture (2)			4																										
		ORR - Observations Reporting and Recording: Accuracy of Observations and Details of Observations	<b>2 marks for each test</b> <b>4 x 2 = 8 marks</b>		8																										
		Use of knowledge: correct inferences from observations	<b>1 mark for each test</b> <b>4 x 1 = 4 marks</b>	4																											
<b>TOTAL</b>				<b>5</b>	<b>20</b>																										

**Integrated Science  
Specimen Paper  
Paper 032 - General Proficiency  
Key and Mark Scheme**

Ques	Syll Ref	Possible Response	Instructions/ Comments		
				UK	XS
2 (a)	B.VI.4	Hypothesis - Clearly stated (1) - Testable/manageable (1)			2
(b)	B.VI.4	Manipulated Variable: Solvent/chemical used			1
		Controlled Variable: Time, volume of solvent used, size of stain			1
		Responding Variable: Disappearance of stain			1
		Procedure: Take 3 large beakers and add 100 cm <sup>3</sup> of each solvent/chemical to the beaker (1) Cut 6 stained pieces of the same size from the shorts (1) Place 2 pieces of the stained cloth into each beaker (1) Start the stopwatch immediately and record the time it takes for the stain to dissolve (1)			4
	B.VI.4	Limitations: Getting equal amounts of stain for each solvent			1

**Integrated Science  
Specimen Paper  
Paper 032 - General Proficiency  
Key and Mark Scheme**

Ques	Syll Ref	Possible Response	Instructions/ Comments	UK	XS
(c) (i)	B.V.3	<p>Inferences</p> <p>Cu: Copper does not react with dilute hydrochloric acid</p> <p>Al: Reacts with dilute hydrochloric acid</p> <p>Fe: Reacts with dilute hydrochloric acid</p> <p>X: Reacts with dilute hydrochloric acid</p>	<b>1 mark for each inference</b>		4
	B.V.3	<p>Observations</p> <p>Cu: Reaction mixture did not bubble or fizz</p> <p>Al: the mixture bubbled and fizzed rapidly, the texture was warm</p> <p>Fe: The mixture fizzed and bubbled slowly</p>		<b>2 marks for each observation</b>	6
(c) (ii)	B.V.3	Iron + hydrochloric acid (1) → Iron chloride (1) + Hydrogen gas (1)		3	
(c) (iii)	B.V.3	<p>Descending Order:</p> <p>Al, X, Fe, Cu</p>	<p><b>3-4 correct = 2 marks</b></p> <p><b>1-2 correct = 1 mark</b></p>	2	
<b>TOTAL</b>				<b>5</b>	<b>20</b>

Integrated Science  
Specimen Paper  
Paper 032 - General Proficiency  
Key and Mark Scheme

Ques	Syll Ref	Possible Response	Instructions/ Comments	UK	XS																
3 (a)	C.V.4	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td>A</td><td>8.1</td></tr> <tr><td>J</td><td>7.1</td></tr> <tr><td>I</td><td>6.1</td></tr> <tr><td>H</td><td>5.1</td></tr> <tr><td>G</td><td>4.1</td></tr> <tr><td>F</td><td>3.1</td></tr> <tr><td>E</td><td>2.1</td></tr> <tr><td>D</td><td>1.1</td></tr> </table>	A	8.1	J	7.1	I	6.1	H	5.1	G	4.1	F	3.1	E	2.1	D	1.1	<p><b>Correct significance</b> - 1 mark 7 points - 4 marks 5-6 points - 3 marks 3-4 points - 2 marks 1-2 points - 1 mark</p>		5
A	8.1																				
J	7.1																				
I	6.1																				
H	5.1																				
G	4.1																				
F	3.1																				
E	2.1																				
D	1.1																				
(b)	C.V.4	<ul style="list-style-type: none"> <li>• Hypothesis links the two variables</li> <li>• Hypothesis is measurable</li> </ul>		2																	
(c) (i)	C.V.4	<p>Correct plotting of points</p>	<p>7-8 points - 3 marks 4-6 points - 2 marks 1-3 points - 1 mark</p>		4																
	C.V.4	Fine line through points	<p><b>Fine line and points</b> - 1 mark</p>																		
(c) (ii)	C.V.4	Correct labelling of axes x - mass; y - distance	<p><b>Label must include unit</b></p>		2																
(d) (i)	C.V.4	<ul style="list-style-type: none"> <li>• Smooth line extended (1)</li> <li>• Point marked (1)</li> </ul>		2																	
(d) (ii)	C.V.4	<ul style="list-style-type: none"> <li>• Reading from the graph (1)</li> <li>• Correct unit (1)</li> <li>• Correct x value (1)</li> <li>• Correct y value (1)</li> </ul>	Expected 0.6 cm		4																
(e)	C.V.4	<u>Small decrease</u> in effort results in <u>large increases</u> in distance from fulcrum	<p>Small effort - large distance Decrease → Increase <b>1 mark</b></p>	1																	
(f)	C.V.4	<ul style="list-style-type: none"> <li>• The magnification</li> <li>• Clear lines</li> <li>• A title for the drawing</li> </ul>	<p><b>2 marks</b> <b>2 marks</b> <b>1 mark</b></p>		5																
<b>TOTAL</b>				<b>5</b>	<b>20</b>																

CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE  
SECONDARY EDUCATION CERTIFICATE EXAMINATIONS

JUNE 2004

INTEGRATED SCIENCE

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**INTEGRATED SCIENCE**  
**GENERAL PROFICIENCY EXAMINATIONS**  
**JUNE 2004**

**GENERAL COMMENTS**

The CSEC examination in Integrated Science (Single Award) is at present offered, at the Basic and General Proficiencies. The June 2004 Examinations, at each proficiency, consisted of four papers: Paper 01, the Multiple Choice paper; Paper 02, the Structured-question paper; Paper 03/1, the School Based Assessment; Paper 03/2, the alternative to the School Based Assessment.

The Candidate entries for the General Proficiency, in June 2004 increased from 16 944 in 2003 to 17 524 in 2004 representing a three percent increase. The entries at the Basic proficiency decreased from 560 in 2003 to 466 in 2004, a 17 percent decrease.

Overall performance of candidates in the examination was satisfactory. There was an increase in the number of candidates achieving Grades I to III at the General Proficiency: from approximately 75 percent in June 2003 to 79 percent in 2004. At the Basic proficiency there was a significant decrease from 58 percent achieving grades I to III in 2003 to 42 percent in 2004.

**DETAILED COMMENTS**

**Basic and General Proficiencies**

**Paper 01 - Multiple Choice**

Paper 01 of both the General and Basic Proficiencies consisted of 60 Multiple Choice items. At the General Proficiency, performance on Paper 01 remained on par with that in 2003. The mean score for the paper in June 2003 was 31.54, or 52.6 percent, and the mean in June 2004 was 32.12, or 53.5 percent. At the Basic proficiency, the mean score for the paper in June 2003 was 32.95, or 54.9 percent, and the mean in June 2004 was 34.39, or 57.3 percent.

At the General Proficiency, one item, from Specific Objective, B. VII. 10 of the syllabus presented some difficulty for candidates ( $p < 0.20$ ). This objective tested candidates' ability to determine methods of reducing rusting of iron.

At the Basic proficiency, one item, from Specific Objective, A. VI. 4 of the syllabus presented some difficulty for candidates ( $p < 0.20$ ). This objective tested candidates' knowledge of the mammalian eye.

**General proficiency**

**Paper 02 - Structured Questions**

Paper 02 comprised six, short-answer, structured questions - each worth 15 marks and with a paper total of 90. The mean score for Paper 02 at the General Proficiency was 29.66, a marginal decline from 31.75 in 2003.

**Question 1**

Question 1 tested the candidates' knowledge of food groups and dietary requirements. The performance on this question was satisfactory with about 60 percent of the candidates scoring eight or more of the fifteen marks.

Approximately 35 percent of the candidates scored full marks on Part (a). They were awarded full marks for identifying the food groups present in both cans. For example, the following gained full marks: protein, carbohydrates and fats; or food from animals, fats and oils.



In Part (b), only 25 percent of the candidates identified one food group that was not present in Food 1. Credited responses were: vitamins, minerals, roughage/dietary fibre; or staples/vegetables, legumes, fruit. Where candidates identified a specific food (for example potatoes or beans) rather than a food group, they gained no mark.

Performance in Part (c) was satisfactory. Candidates were asked to identify, with reasons, the can of food that they would recommend for three individuals with different nutritional deficiencies. Food 2 was correctly recommended for each individual but the reasons varied. It was recommended for the undernourished person because it contained a wider range of food groups. For the individual with scurvy, it provided the needed vitamin C while the PEM victim received the carbohydrate and protein which were lacking in their diet.

Performance on Part (d) was unsatisfactory. There were many divergent responses that failed to lock into the need for much energy for farming activities. Candidates who suggested the inclusion of carbohydrates in the farmer's diet were expected to reason that carbohydrates would supply the much needed energy. Alternatively, the farmer using Food 1 should add vitamins or minerals to his diet to ensure the efficient functioning of the body, free of disease.

Candidates performed poorly on parts (e) and (g) but most answered part (f) correctly. Starch, corn-starch and sugar were the answers accepted in (e) as the products of photosynthesis, but too many chose any ingredient on the label on Food-can 1 that seemed to have been produced by a plant. In Part (f) candidates were asked to identify one food additive in Food 1. The majority correctly chose one of: monosodium glutamate, sodium chloride and artificial flavouring.

Few candidates identified the stomach as the region of the digestive system where digestion of Food 1 would begin. Most candidates wrote that digestion would begin in the mouth. While mechanical digestion of the foods in Can I begin in the mouth, chemical digestion of this food begins in the stomach since it contains no starch.

## Question 2

Performance of candidates on Question 2 was satisfactory. It tested their knowledge of hard and soft water; neutralization; removal of stains; pollution of the ecosystem; and their skills in planning and designing.

An example of a good answer to Part (a) was: "soap does not lather with hard water as easily as with soft water." Best performance was exhibited in Part (b) where candidates displayed good planning and designing skills with many of them indicating the importance of controlling variables. Most candidates were able to achieve at least three out of the four possible marks. In the better responses candidates pointed out the need for the same volume of soap solution, and the same volume of water in each trial. They indicated that hard water would not lather as much as soft water and described a measurable or objective means of determining the degree of lather formation.

Detergents A and B in Part (c) (i) were soapy and soap-less detergents. In (c) (ii) candidates were expected to explain that detergents with less foam were biodegradable and caused less pollution of the river and the death of fewer fish. Many were familiar with the term, 'eutrophication'.

Few candidates gained the two available marks for their definition of neutralization. Performance on Part (d) (ii) was better than (d) (i), however, some candidates used brand names such as Chlorox and Marvex in their answer rather than the common names 'bleach, kerosene or borax'.

### Question 3

Question 3 evaluated the candidates' understanding of the concepts of fitness and health in relation to diet, exercise and substance abuse. In Parts (a) and (b) they were asked to state, with reasons, two factors that an over-fifties team of rugby players should consider before commencing their vigorous activity. The expected responses were factors such as: age, health and diet. Many candidates could not link the factors they selected in (a) to appropriate effects. For example, advancing age might be associated with a malfunctioning heart or brittle bones making the individual less able to cope with vigorous activity.

Many candidates achieved full marks for part (c). Acceptable responses included: increased muscle mass or muscle development; loss of weight or fat; reduced heart rate; increased lung capacity; increased flexibility and agility; improved circulation and a stronger heart.

Many candidates could not correctly link a food group or nutrient to its correct function, for example, some incorrectly cited protein as an 'energy source' and carbohydrate for 'building the body'. Others used the terms 'vitamins', minerals and nutrients interchangeably. Candidates displayed many misconceptions about steroids, and about their use and effects on the human body. In appropriate answers candidates indicated that steroids should not be taken because they could harm the body; because using them was a form of cheating; or that using them showed poor sportsmanship.

### Question 4

This question tested the candidates' understanding of excretion; the relationship between photosynthesis and respiration and the role of leaves in transpiration. There were many misconceptions and vague responses; and a general lack of knowledge was displayed by the candidates. Overall performance was unsatisfactory.

In Part (a) fewer than half of the candidates correctly defined excretion as the removal of waste products of metabolism from the cells. In (b) candidates were given credit only when both waste products for a particular organism were given correctly. For example, "waste product of photosynthesis: oxygen and glucose" failed to gain the available mark.

In part (c) (i) most candidates identified the night as the time that carbon dioxide would leave the plant but many failed to give the correct reason. The following response would have gained full credit:

During the day the carbon dioxide released by respiration is immediately used in photosynthesis. During the night when light is absent and photosynthesis stops, all the carbon dioxide produced in respiration is released.

In Part (c) candidates were asked to explain why a few of the leaves should be removed from a plant before it is transplanted. Full marks were awarded to those who responded that plants lose water through the leaves and by reducing the number of leaves water loss will be reduced, ensuring sufficient water for growth and photosynthesis.

Performance on (c) (iii) and (iv) was better than in the other parts of (c). In (iii) most candidates identified the sunny day for greater water loss but few gave a satisfactory reason. Processes affected by water loss included growth, photosynthesis, movement of substances and production of flowers and fruits.

### Question 5

In Part (a) candidates were asked to state the energy changes in two situations. Few gained the 3 available marks for the correct energy transformations: electrical energy to heat energy to light energy; light energy to heat energy.

Part (b) tested candidates' ability to read and interpret a line graph and to draw inferences from the information presented. Most candidates gained at least half of the marks awarded for this part of the question. Parts (b) (i) and (ii) were well done with most candidates correctly stating the temperature of naphthalene as 100° C and room temperature on the day of the experiment as 30° C. In (b) (iii) most candidates recognized that the wax cooled by 20° C, or started to solidify between A and B. Some candidates confused this cooling process with melting, or stated that 'the wax dropped'. These responses were not credited. In response to (b) (iv), most candidates correctly stated that the temperature remained constant, however, a few of them stated that 'the wax remained constant'.

In Part (c) candidates were given a terrestrial food web and their understanding of the feeding relationships within a community was tested. Many candidates identified the source of energy for the web as green plants rather than the sun, light or sunlight. They also correctly identified the process during which energy is used by producers as photosynthesis. The word equation for photosynthesis was not thoroughly mastered and most candidates gained only one of the two marks available for this part of the question. Many candidates identified at least one consequence of the death of the beetles in the food web, however, the mention of two or more logical consequences were required for the award of 2 marks.

### Question 6

In Part (a) (i) most candidates stated that in order to use an appliance at an alternative voltage to that for which it was designed a transformer was needed. To calculate the power rating of the iron the formula  $P = VA$  was correctly applied:  $P = 120 \times 9 = 1080$  watts. The correct unit was not always included in the answer.

Many candidates failed to recognise the circuit symbol for a fuse and were therefore unable to explain its purpose. Performance on Part (iv) was satisfactory with candidates stating the total current flowing, however, there were instances of errors in this simple addition. Candidates were required to choose a fuse of suitable rating for the given circuit. Although many candidates correctly selected the 30A fuse recommended by the mother, they were unable to give a logical explanation for their selection.

Many candidates had difficulty answering Part (b) (i) where they were required to state the energy changes occurring as fuel was converted to electrical energy. Part (b) (ii) was very well done. Most candidates understood the concept of non-renewable energy sources. Part (c) was fairly well done with most candidates using the information correctly to choose the more efficient energy conversion. Some experienced difficulty expressing the reasons for their choice.

## **Basic Proficiency**

### **Paper 02 - Structured Questions**

Paper 02 comprised six, short-answer, structured questions - each worth 15 marks and with a paper total of 90. The mean score for Paper 02 at the Basic Proficiency was 26.27, a marked decline from 32.51 in 2003.

### Question 1

Question 1 tested the candidates' knowledge of sports and the surfaces upon which they are played; materials and the properties of materials used for equipment; and alloys. The overall performance in this question was satisfactory.

Parts (a) (i) and (iii) were well done with candidates finding the correct averages and selecting tennis as the game requiring the greater bounce of the ball. Performance in Part (ii) was unsatisfactory. Few candidates were able to state that the reason for repeated measurements was for accuracy of results. In Part (a) (iv) candidates ignored the information given in the table and used their own knowledge.

Part (b) (i) was well done with the expected responses of strength or weight being given as the important property of a cricket bat. In (b) (ii), however, candidates ignored the word 'most' and stated two or more words from the list for the important property of a tennis ball.

Poor performance was demonstrated in Part (c). In Part (c) (i) where candidates were asked to state the properties of the materials which made them suitable for the manufacture of sporting equipment, they gave examples of the equipment instead, gaining no marks. The following properties were expected:

- |    |                 |              |
|----|-----------------|--------------|
| a) | Aluminium alloy | Light/strong |
| b) | Wood            | Strong       |
| c) | Plastic         | Light        |

Many candidates failed to give a suitable definition of an alloy. Examiners expected the simple statement that an alloy is a material consisting of a mixture two metals or a mixture of a metal with a non metal. Few gave steel, brass, or bronze as examples of alloys but incorrectly gave metals such as silver, copper, zinc and aluminium.

### Question 2

This question tested the candidates' knowledge of the parts and functions of the eye; and reflex actions. Performance was generally unsatisfactory.

The type of action shown in the given figure was well known - reflex action. Candidates, however, were unable to transfer the information from the stimulus material to a new situation in (a) (ii).

Part (b) was poorly answered, with candidates showing a marked lack of knowledge of hormones and glands. The endocrine gland activated in the dreaded anticipation of an impending accident is the adrenal gland and the hormone secreted is adrenaline. Candidates incorrectly identified the sense organ used to detect the danger as 'sight' rather than the eye.

Candidates knew the names of parts of the eye but were unable to accurately label them on the diagram given. They could not compare the eye with the camera although it was evident that some candidates knew the functions of the parts of the eye.

### Question 3

This question tested the candidates' knowledge of the skin; the physiology of sweating; and the relationship between sweating and urination at different temperatures.

Performance in part (a) (i) was unsatisfactory. Many candidates were unable to identify the sweat gland or the sweat duct despite the stimulus given. Part (a) (ii) was well done with most candidates correctly naming excretory products in sweat - salt, water and urea. Part (a) (iii) presented some challenge for the candidates. Few placed the arrow appropriately, on the sweat duct, with the arrow-head pointing upwards although there was some indication that they knew the correct path.

Part (b) (i) was well known. Candidates readily indicated that James would sweat more on a hot day and gained the available mark. For Part (b) (ii), however, few candidates were able to give the physiological reason for the increased sweating on a hot day - to cool the body.

Parts (c) (i) and (ii) were well done. The majority of candidates wrote that evaporation was the process by which the face became dry and that the salt in the sweat would be left on the face. As in (b) (ii) candidates were challenged by the explanation. Water, the solvent, evaporated leaving salt, the solute, behind.

In Part (d) candidates demonstrated some knowledge that when it is cool sweating is less and therefore the body must lose the excess water via more frequent urination. They were unable to relate the need for water loss to the need for osmo-regulation in the body.

#### Question 4

Question 4 tested the candidates' understanding of acids, bases and the concept of pH. Many candidates knew at least one characteristic of an acid but few gave correct examples of an acid or a base.

Many achieved full marks for the bar chart. In some cases, however, candidates attempted to plot histograms. In (b) (ii) candidates were required to name one chemical from Table 3 for each of the pH categories: acidic, basic, neutral. Many candidates failed to follow the instructions, presenting examples that were not found in the table. Candidates need to improve their test-taking skills through careful reading of questions and precisely following all instructions given.

In Part (c) (i) candidates were not able to define neutralisation using simple scientific terminology. Neutralization is the process by which an acid reacts with a base to produce a salt and water. Many were unaware that the sting of a bee is acidic and therefore can be neutralized by an alkali.

For the pH value of antacids, any alkaline value between 8 and 14 gained the mark. A simple statement was required in response to Part (b) (ii), for example: antacids neutralize the excess acid in the stomach.

#### Question 5

Question 5 tested the candidates' knowledge and understanding of gravity, centre of gravity and tyre traction. Performance on this question was less than satisfactory.

For Part (a) (i) a simple definition of gravity was expected such as: force which pulls objects towards the earth. Almost every candidate failed to give an adequate response to Part (a) (ii), that is: point through which the weight of an object acts.

In Part (b) where L was the more stable can, candidates were unable to draw appropriate plumb lines on the figures given. Most candidates found this question challenging. In can L, examiners expected a vertical line drawn through the centre of gravity, passing through the base of the can indicating the stability of the can. In can M, a vertical line was expected, drawn through the centre of gravity, passing outside the base, indicating the instability of the can.

In Part (c), candidates were given a figure of two identical Sports Utility Vehicles. Sports gear was stored inside Vehicle X, while the sports gear carried by Vehicle Y was placed on the rack at the top. In Part (c) (i), candidates correctly selected vehicle Y as having the higher centre of gravity. They also reasoned that it was wiser to carry the gear inside because this would result in a lower centre of gravity for the vehicle conferring greater stability. In (c) (iii) the changing of the tyres was important for the safety of the passengers. New tyres offer greater friction, less stopping distance and less likelihood of skidding. The form of energy stored in gasoline was widely known to be chemical energy. There was a range of possible responses for (c) (iii) b). Credited responses were: mechanical, heat, sound, kinetic, electrical and light energy.

### Question 6

Question 6 tested candidates' knowledge of ventilation; electrical insulation materials; safety hazards associated with un-insulated wires; overcrowding; and evaporation of alcohol placed on the surface of the body.

Although most candidates appreciated that ventilation involved air circulation and gained one mark, they failed to gain the second mark by stating that fresh air replaces the stale air. Candidates presented acceptable ways of improving ventilation such as: more windows, use of fans and the use of air-condition units.

In Part (a) (iii) most candidates suggested appropriate poor conductors for insulating the steam pipes. They were, however, unable to explain why insulating the pipes would make the workers in the room more comfortable. Very few of them realised that proper insulation would cause the room to become cooler, and that there would be less radiation of heat from the pipes.

Most candidates correctly identified plastic as a suitable material for insulating electrical wires. They also recognized that it is the non-conducting property of plastic that made it suitable for insulation.

In Part (b) the un-insulated wire was deemed to be a safety hazard because it increased the risk of electric shock from exposed wires. Overcrowding made the spread of disease easier. Most candidates responded accurately.

Candidates correctly identified the process by which water disappeared from the skin as evaporation. They failed, however, to recognize that vaporisation takes heat energy from the body and that this leads to the lowering of the body temperature. Part (b) (iv) also proved to be challenging. Candidates could not explain that the use of the fan caused an increase in the rate of evaporation of alcohol and consequently the rapid lowering of the body temperature.

## **General Proficiency**

### **Paper 3/2 Alternative to the School Based Assessment**

The performance of candidates on Paper 3/2 was poor. Some candidates did not have the practical skills necessary to successfully complete this paper and a small percentage of them failed to attempt either of the questions.

### Question 1

In Question 1, candidates were required to conduct a neutralisation experiment and to record temperature changes at regular intervals during the reaction. Few candidates were able to construct an appropriate table to record their observations. Once results were obtained, however, candidates performed well in Part (c). They were able to accurately plot the graph of their results, scoring at least six of the nine available marks.

In part (d), candidates were required to use their graph to determine the volume of acid that was added when the maximum temperature change occurred. Few of them were able to gain the mark for this question. About 30 percent of the candidates mastered the word equation for the reaction but only a few could determine whether the reaction was exothermic or endothermic with an appropriate explanation.

### Question 2

In Part (a) candidates were required to make a large, labelled diagram of an onion. The drawing skills displayed were poor. It was evident that candidates had little practice in drawing specimens.

In Part (b) candidates were asked to carry out food tests on each of four foods and to use their observations to draw conclusions. About 10 percent

of the candidates read the instructions carefully enough to conduct four different food tests on each of four foods. The majority of candidates performed less than the required number of food tests. Correct inferences on the presence or absence of nutrients were, therefore, rarely encountered.

Candidates followed the trend of poor performance in Part (c). They were unable to evaluate their observations and conclusions to determine which foods had the greatest range of nutrients.

A reasonable degree of competence in practical work is required for candidates to perform adequately in Paper 3/2. It is an alternative way of testing the candidates' experimental skills and not an alternative to the development of those skills.

### **General and Basic Proficiencies**

#### **Paper 03 - School Based Assessment**

The candidates' performance in the School Based Assessment was satisfactory. However, improvement in the area of Analysis and Interpretation is needed. Mark schemes were submitted by most teachers and were generally satisfactory.

#### Observation, Recording and Reporting

- The following format should be used for Laboratory Reports:
  - Title
  - Aim
  - Apparatus and Materials/Diagram
  - Method
  - Results/Observations
  - Discussion and Conclusion
- Reporting should be concise and tables and graphs used wherever these would clarify the report.
- When numerical tables are used, units should be stated in the headings, and decimal points should be consistent.
- In non-numerical tables, all **details** of the data should be recorded.
- On graphs: axes should be labelled; appropriate scales used; smooth curve or best-fit line drawn except in the case of growth curves.
- Where prose is used for the recording of observations, students should carefully record ALL details of the data.

#### Drawing

- For the assessment of drawing skills, students should be required to make drawings of specimens, slides or models. Textbook drawings and drawings from an overhead projector are unacceptable for the assessment of this skill.
- Drawings should be labelled; given a suitable title (and view where relevant); and have the magnification stated.
- Diagrams of apparatus should not be free-hand and each diagram should be given a title and appropriate labels.
- Students should draw specimens and diagrams with clean, clear, continuous lines using sharpened pencils. Shading and sketching are unacceptable and students should not use coloured pencils in their drawings.
- Label lines should not cross each other nor bear arrowheads.



### Analysis and Interpretation

- Some laboratory exercises chosen for assessment of analysis and interpretation of results were unsuitable. For example: 'Testing milk for protein', 'Observing diffusion'.
- Conclusions should be linked to the aim of the experiment and the data obtained rather than general statements about the topic.
- Background information used in the discussion of results should be relevant and directly related to the aim of the experiment.
- Calculations should be preceded by the formulae used and units must be stated.
- Sources of error and any assumptions made should be stated.
- Analysis and Interpretation should not be assessed through the use of topic questions from the textbook. Questions should be used sparingly, and if used, should only guide the students in the analysis and interpretation of their results, and in identifying trends, patterns and relationships. Even when guiding questions are used, the student's discussion should be written in prose with appropriate paragraphing, and not as numbered question responses.

### Planning and Designing

- Technological designs are unsuitable at this level for the development and assessment of planning and designing skills.
- The experiments used in the assessment of the planning and designing (P/D) skills should not be conventional textbook experiments. Students first develop a hypothesis based on an observation, then, they design their own scientific experiment to test the hypothesis.
- Laboratory exercises such as: 'making soap', 'investigating the reactivity of metals', and 'making a model of the lung', are unsuitable for testing P/D skills. These are conventional activities found in most textbooks.
- Students need not carry out the experiments which they design.
- A hypothesis is a statement and should not be written as a question.
- The aim should be directly related to the hypothesis

### Recommendations to Teachers

- A contents page should be included in each student's laboratory book. The following headings should be used:

Lab number	Page	Description of Lab	Date	Skill assessed
------------	------	--------------------	------	----------------

- All pages in the Laboratory book should be numbered.
- Each activity should begin on a new page and should be properly dated. The date of the experiment and the date of assessment by the teacher should be recorded.
- The skill assessed and marks allotted should be written next to the laboratory exercise and in the contents page.
- All skills should be marked out of six, or scaled to six.
- No more than two skills should be assessed in any one exercise.



- All skills but P/D must be assessed at least four times over the two-year period. P/D should be assessed at least twice over the two years.
- The mark scheme used to assess skills should combine components from (a) and (b) as outlined in the syllabus.
- Graphs may be assessed for the ORR skill but not Drawing or A/I skills.
- The formulation of a hypothesis is required only in designed experiments.

**CARIBBEAN EXAMINATIONS COUNCIL**

**REPORT ON CANDIDATES' WORK IN THE  
SECONDARY EDUCATION CERTIFICATE EXAMINATIONS  
JUNE 2005**

**INTEGRATED SCIENCE**

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**INTEGRATED SCIENCE**  
**GENERAL AND BASIC PROFICIENCY EXAMINATIONS**  
**JUNE 2005**

**GENERAL COMMENTS**

The CSEC examination in Integrated Science (Single Award) is at present offered at the Basic and General Proficiency. The June 2005 Examination consisted of three papers: Paper 01 – Multiple choice; Paper 02 – Short answer questions and Paper 03 – the School-Based Assessment.

The number of candidates writing the examinations at the General Proficiency Level increased by 12 per cent from 15 929 in June 2004 to 17 766 in June 2005. At the Basic Proficiency Level, the number of candidates increased by 17 per cent from 370 in June 2004 to 398 in June 2005. The overall performance of candidates in the 2005 examinations was consistent with the performance in 2004. The number of candidates achieving Grades I to III remained at 80 per cent at the General Proficiency Level and at 40 per cent at the Basic Proficiency Level.

**DETAILED COMMENTS**

**Paper 01 – Multiple Choice**

Paper 01 consisted of 60 Multiple Choice items. Performance on this paper remained on par with Paper 01 in 2004. The mean score for the General Proficiency Level in June 2005 was 33, or 55 per cent, and the mean in June 2004 was 32, or 53 per cent. The mean score for the Basic Proficiency Level in June 2005 was 29 or 48 per cent and the mean score in June 2004 was 34, or 57 per cent.

**General Proficiency**

**Paper 02 – Structured Questions**

Paper 02 comprised six, short-answer, structured questions. The maximum mark for each question was 15 and the maximum mark for the paper was 90 marks. The mean score for Paper 02 was 34, or 38 per cent.

**Question 1**

Question 1 (a) tested the candidates' knowledge of the structures associated with breathing and the mechanisms of inhalation and exhalation. Question 1 (b) tested the ability to apply knowledge about the respiratory system and environmental pollutants.

Approximately ninety-five per cent of the candidates attempted this question. Over 60 per cent obtained a mark of between 8 and 15 with about 5 per cent obtaining the maximum 15 marks.

Although the model representing the respiratory system in 1 (a) (i) was well known, a few candidates interpreted the stimulus material to be reproductive, circulatory or excretory organs. Candidates tended to generalize and did not use appropriate terminology to give a reason for the answer. Candidates were awarded marks if they identified two lungs or the trachea leading to two bronchi. Partial credit was awarded when they stated the "two balloons" or "two tubes" instead of lungs or bronchi as better representatives. Candidates tended to confuse the inhalation and exhalation processes in (a) (iv) and (v), especially with reference to the position of the diaphragm during these processes.

In (b), the majority of candidates were able to extract accurate readings from the bar graph. However, a few candidates were confused about the cement plant, mistaking it for an organism or living thing. Many candidates correctly noted the presence of pollutants given off from the plant and the likely effect of making bronchitis more severe.

### **Recommendation**

Candidates should be exposed to an appropriate model that explains inhalation and exhalation so that they can visualize this internal mechanism. Candidates need to understand the effect of the changes in pressure and volume associated with the breathing mechanism.

### **Question 2**

This question tested objectives C. III. 1, 2, 3 and B. III. 1 of the syllabus.

This question tested candidates' knowledge and understanding of the elasticity of three types of strings under different loads and the application of this understanding to practical situations. It also tested their understanding of

- (i) the properties of aluminum metal as it relates to its use in protective headgear and
- (ii) the conditions that favour fungal growth on sports wear and preventative measures that can be taken.

Although the majority of the candidates attempted this question, only a few of them gave satisfactory responses.

Part (a) (i) of the question was generally not well done. The expected response was 'length' or 'thickness of string'. The weaker candidates incorrectly responded that the "load" and "elasticity" must be controlled as a feature of the strings. This indicated both a lack of understanding of the term control, when used in the context of an experiment and a lack of good comprehension skills, since "load" is not a feature of the string.

Part (a) (ii) showed a similar trend as Part (a) (i) with great confusion as to what should be done. Many used the terms "measure the string", "check the string" and "measure the elasticity" very loosely. 'Measure the length of the string' was the acceptable response.

In Part (a) (iii), many candidates had difficulty interpreting the graph. Some candidates repeated the experimental procedure instead of giving reasons for the shape. Very few were able to identify the straight-line part and the curved part of the graph in their responses. This indicates a lack of understanding of what happens when a string is stretched until it reaches its elastic limit.

Part (a) (iv) was not well done. Only a few candidates were able to attain full marks with the majority unable to express their responses in clear statements. Many candidates simply transcribed the question as their response. A common misconception was that String P (instead of R) was able to withstand the greatest load because its line was the highest on the graph and vice-versa for String R. Only a few candidates were able to identify and compare the points at which deformation took place in the three strings.

Part (a) (v) was reasonably well done. The weaker candidates had some difficulty in expressing their responses clearly. Force was frequently interchanged with strength, power, load and weight. The question required candidates to focus on the properties of the two strings; however, many responses focused on the speed of the tennis ball. Although two of the strings were used for the rackets, many candidates listed all three strings in their responses.

Part (b) (i) was generally well done with many candidates correctly identifying 'light weight' and 'strong' as properties. Some of the poor responses however included, "**metals, zinc, copper, brass, magnesium, bauxite and alloys**" as properties of aluminum and did not relate the properties of the metal to its protective function in the headgear as stated in the question.

Part (b) (ii) and Part (b) (iii) were generally well answered with the majority of candidates scoring maximum marks in these two sections.

### **Recommendation**

Based on the common misconceptions encountered in the responses to this question, candidates need to

- understand terms such as 'control' in relation to variables in experiments and 'property' of substances with respect to their function or use
- understand the importance of each step in a practical activity (Emphasis should be placed on giving reasons for performing each step in a procedure.)
- develop a sound science vocabulary; thus, minimizing the need for using 'street science terms' when answering questions
- conduct simple experiments on elastic limits, plotting and reading load extension graphs and importantly, interpreting these graphs, for example, curved line at end indicates elastic limit has been reached
- evaluate the quality of sporting materials based on their elasticity and strength.

### **Question 3**

This question tested objectives B. V. 3, 5, 6, 7 & 8.

Generally, the responses throughout the paper showed that the majority of candidates had some basic knowledge and understanding about the topic.

Part (a) – Reading the analogue meter was not well done.

- The direction of the dials was not generally known.
- The place value also created a problem.
- The stimuli given by labelling of the dials, first and second meter readings, were ignored. This could explain why the values derived were placed in the wrong spaces.

In Part (b), many candidates were able to calculate the costs; however, they need to be reminded to show all necessary working.

Part (c) (i) presented some difficulty. Few candidates achieved maximum marks because of the incorrect units, that is, they multiplied the watt used by the appliance, by the time in hours used, but the column heading required that the answer be in kWh.

Part (c) (ii) was well done; candidates were aware of the ways of conserving energy in the home but did not pay full attention to the reference in the question to those appliances specifically mentioned in the Table 1.

Part (d) (i) presented some difficulty. Candidates generally understood that a fuse is a protective device in an electrical system. However, they needed to be more precise in indicating, “protect from high voltage”, “protect from current surges.”

In a large number of responses, the definition of a fuse was confined to

- (i) physical description, that is, glass tube with wire and metal ends; piece of wire in a circuit
- (ii) for example, something (an object or appliance,) used to control or regulate current in electrical appliances.

These, however, do not suggest limiting current flow by destruction of the fuse as expected.

In Part (d) (ii), the function of a fuse was well understood. However, the direction of current flow was largely confused, as many responses incorrectly suggested that it was after the hairdryer became overheated that the fuse blew.

Part (d) (iii) was well done by the candidates. Water as a conductor of electricity and the consequence of water being used to put out electrical fire was fairly well known.

Part (d) (iv) was well done by the candidates. Candidates were aware of the methods used for putting out an electrical fire. Acceptable responses included CO<sub>2</sub> and foam fire extinguishers, fire blanket, and sand.

### **Recommendations**

Candidates need

- to understand that conservation is not just about any alternative way, but involves practical cost-effective alternatives. This showed in some of the suggestions, for example, to “hire a washer person” rather than using the washing machine.
- to pay full attention to the units in calculations
- to pay attention to stimulus materials.

### **Question 4**

This question tested the candidates’ knowledge of the effect of boiling and freezing on contaminated water and the candidates’ analysis and evaluation skills.

In Part (a) (i), the candidates were required to explain why contaminated water should be boiled. Any response which suggested that boiling would kill organisms present in the water was credited, for example, to destroy germs, bacteria or harmful organisms. Most of the candidates were able to give a correct response.

Many candidates were unable to give a response to Part (a) (ii) which indicated they knew that many organisms are not destroyed by freezing.

Some responses credited were:

- “Yes, because freezing only slows down the bacteria while boiling kills them.”
- “Freezing slows down the growth process but they are alive.”

Some responses not credited were:

- "Freezing preserves things."
- "When water freezes, bacteria can't get in."

Part (a) (iii) was fairly well done. Responses credited included

- "broken or cracked pipelines"
- "dirty storage tanks/storage tanks with dead organisms."

A vague answer such as "water becoming contaminated from the pipeline" was not credited.

Part (a) (iv) required the candidates to name one disease that individuals may be exposed to if they drink contaminated water. Any water borne disease was credited, for example, typhoid, cholera, dysentery, gastroenteritis.

However, symptoms were not credited, for example, diarrhoea.

Part (b) (i) described steps taken to carry out an experiment to compare two brands of mouthwash, S and L. The candidates were asked to give reasons for the steps. This was poorly done.

Many candidates were unable to identify 37°C as body temperature and therefore it would be the ideal/best/suitable temperature for the bacteria to grow.

Parts (b) (ii) to (b) (v) were based on a bar graph comparing the bacterial growth in three agar plates, one with mouthwash S, one with mouthwash L and the third without any mouthwash. The candidates were required to analyze and evaluate the data. These questions were fairly well done.

### **Recommendation**

Candidates need more opportunities to analyze and evaluate experimental data in its various forms, for example, graphs, charts or tables.

### **Question 5**

This question examined the candidates' understanding of

- (i) the structure and function of the kidney and associated organs and
- (ii) the role of insulin and glucose in the body.

Few candidates performed satisfactorily in this question.

In Part (b), the majority of candidates had little knowledge of how urea is formed or excreted. Common misconceptions included excretion of whole protein molecules instead of a simple molecule, urea. Answers not credited included "protein is let out as waste" or "more protein in the diet leads to more urea." Credited answers included "urea is not reabsorbed by the kidney/nephron" and "urea is excreted by the kidney."

Part (b) (ii) was fairly well done with a large percentage of candidates offering creditable answers such as "malfunctioning pancreas." A common misconception was "malfunctioning kidney."

Most candidates achieved a good score in Part (b) (iii) with the majority of responses demonstrating an understanding of the function of the collecting duct/ureter and bladder.

Parts (b) (iv) and (v) were fairly well known by most candidates. However, there seems to be confusion with the terms 'glucose' and 'energy'. Most candidates used these two terms interchangeably.

## **Recommendation**

Candidates are urged to pay close attention to the proper use of scientific terms and the correct spelling of these terms and to spelling in general.

## **Question 6**

This question tested the candidates' knowledge of the relationship between fronts and weather patterns as well as their knowledge of tides and certain organisms in the sea.

The response to Part (a) (i) of the question was not satisfactorily answered as most candidates were unable to define the term 'front'.

Part (a) (ii) was satisfactorily done and most candidates were able to gain at least three of the four marks.

Part (a) (iii) was not satisfactorily answered. Although candidates were aware of the correlation between 'fronts' and 'weather patterns,' they ignored the stimulus material, and held firmly to the Caribbean being hot and the U.S.A. being cold.

More than 90 per cent of the candidates attempted Part (b) of the question. However, there was some confusion as many candidates felt that the height of waves determined whether it was high or low tide.

Part (c) (i) was poorly done. Most candidates assumed that the organisms were found there because the rocks provided food and protection.

Part (c) (ii) was well done. Most candidates indicated that the features were necessary to prevent the organisms from being washed away.

Part (c) (iii) was well done. Most candidates were able to name one other organism likely to be found in Region B.



## DETAILED COMMENTS

### Basic Proficiency

#### Paper 2 – Structured Questions

##### Question 1

This question tested the candidates' knowledge of reproduction. The overall performance on this question was satisfactory.

The performance in Parts (a) (i) and (ii) which referred to definitions and examples of sexual and asexual reproduction was generally unsatisfactory.

In Part (a) (i), candidates had tremendous difficulty in distinguishing between sexual and asexual reproduction. Few responses were correct. Responses credited included:

- Sexual reproduction involves both parents while asexual reproduction involves one parent.
- Sexual reproduction involves the fusion of gametes while asexual reproduction has no fusion of gametes.
- Sexual reproduction produces offspring with different genes while asexual reproduction produces offspring with identical genes.
- Sexual reproduction produces new organisms that are not identical to the parents or each other while asexual reproduction produces new organisms that are identical to the parents and each other.

In Part (a) (ii), candidates were asked to give one example of each type of sexual and asexual reproduction. The responses to this also were generally unsatisfactory.

Responses credited:

- Asexual reproduction, for example, cuttings, corms, runners, rhizomes, tissue cultures (orchids), bulbs
- Sexual reproduction (plants), for example, development of seed/plant from flowers, pollination (wind/cross/insect)
- Sexual reproduction (animals), for example, development of a baby from a fertilized egg

In Part (b), candidates were provided with a graph representing the growth of two plants of the same species, with the leaves of Plant A broader than those of Plant B.

In Part (b) (i), candidates were asked to complete the table, inserting the heights of Plants A and B in the spaces provided. This was very well done with most candidates accurately recording the heights required. Responses credited:

- |                        |                        |
|------------------------|------------------------|
| – Plant A, Week 2 - 30 | – Plant B, Week 3 - 58 |
| – Plant A, Week 4 - 45 | – Plant B, Week 5 - 60 |

In Part (b) (ii), candidates were required to make inferences from the graph as to which plant would be best for a farmer who wants to sell at the market every four weeks. Responses credited:

- The plant that should be grown for market is Plant B.
- One reason for the answer in (b) (i) is that Plant B will be bigger or taller than Plant A.

Part (c) stated that a farmer wants to produce plants that are identical to their parents:

In Part (c) (i), candidates were asked to state which method of reproduction he should choose to produce the plants – this was poorly done. Response credited was – asexual reproduction.

In Part (c) (ii), candidates were asked to provide one reason for their answer in (c) (i). This was also poorly done.

Responses credited:

- Do not involve combination of genes which could cause variations.
- Cuttings do not involve fusion of gametes.
- No variation occurs in asexual reproduction.
- Is easier to reproduce to get identical plants.
- Produces large numbers of offspring, therefore, a lot will survive.
- Produces new independent organisms more quickly.

## **Question 2**

The performance of candidates on this question was satisfactory. It tested candidates' knowledge of exercise and energy requirements, effects of exercise on the body and the effect of air [wind] on sporting activities.

The stimulus provided in Part (a) was a table listing various sports and their energy values.

Part (a) (i) and (a) (ii) were generally well done with most candidates being able to provide a correct response.

Responses credited:

- Swimming was the sport requiring the greatest amount of energy.
- Swimming and cycling were the two sports that were ideal for persons who want to lose weight quickly.

The performance in (a) (iii) was unsatisfactory. Few candidates were able to state the reason why exercise improves the respiratory and circulatory systems.

Responses credited:

- Respiratory system  
Exercise promotes the development of stronger lungs, increased lung capacity and increased efficiency in breathing.
- Circulatory system  
Exercise promotes improvement in the flow of the blood and strengthening of the heart muscle.

In Part (b), candidates were provided with a stimulus diagram that showed an athlete throwing a javelin.

Parts (b) (i) and (b) (ii) were fairly well done with some candidates being able to provide a correct definition of energy and name one type of stored energy.

Responses credited:

- Energy is the capacity to do work.
- Types of stored energy, for example, chemical energy, potential energy, nuclear energy, solar energy, fat, or specific examples such as glucose.

Part (b) (iii) required candidates to plot a graph of distance against angle using information provided in Table 3. This was fairly well done. However some candidates had difficulty in accurately plotting the graph. Responses credited included:

- Axes accurately placed and values listed
- Points correctly plotted
- Straight lines linking points

Part (b) (iv) required candidates to determine the best angle at which to throw the javelin. Many candidates presented the correct response of 30 degrees and achieved full marks.

Part (b) (v) required candidates to explain why the angle in (b) (iv) gives the athlete the throw with the longest distance. Only a few candidates were able to provide acceptable explanations.

Responses credited:

- More power is produced at this angle.
- A large force is provided.

Part (b) (vi) required candidates to suggest how wind direction affects the distance of the throw. Most candidates were only able to provide one of the two possible explanations.

Responses credited:

- If the wind is blowing in the opposite direction to the throw of the javelin, the distances will be shorter and the wind pushes back the javelin.
- If the wind is blowing in the same direction as the throw of the javelin, the distances will be longer and the wind pushes the javelin forward.

### **Question 3**

This question tested the candidates' knowledge and understanding of the heart and the circulatory system. The question proved to be very challenging. There were many vague responses, and a lack of responses for some parts. A general lack of knowledge was displayed by many of the candidates.

The performance in (a) (i) was unsatisfactory. Many candidates were unable to identify Organ A as the lungs despite the stimulus diagram given. Many stated that it was the head or brain because it was above the heart.

Part (a) (ii) required candidates to give TWO reasons for identifying **Organ A as the lungs**. For candidates who were able to answer (a) (i), they had difficulty in relating the pulmonary vessels to pathways from the right ventricle to the lung and from the lung to the left atrium.

In Part (b) (i) and (b) (ii), candidates had to draw arrows on the diagram to show the direction of blood flow (i) from the heart to the cells of the body and (ii) between the heart and Organ A. The majority of candidates were unable to complete this task. Students should be reminded that arrows contain a pointed head [this shows direction] and not straight lines.

In Part (c) (i), candidates were required to identify **Vessel B as the aorta**. Many students seemed unfamiliar with the circulatory system and were unable to gain this mark. In Part (c) (ii), some students were able to gain a mark by correctly suggesting one difference between an artery [Vessel B] and a capillary.

Responses credited:

- Thinner blood vessel
- No outer layers
- Less muscle than blood vessel B
- Less fibers than blood vessel B

In Part (d) (i), about 50 per cent of candidates were able to suggest that there would be a decreased blood flow or a decrease in blood pressure through B if the muscle at C [left ventricle] was weakened.

In Part (d) (ii), many students failed to achieve marks for giving a reason to (d) (i) , for example, Muscle C [left ventricle] need to provide the force for blood to flow through to Vessel B.

In Part (e) (i), most candidates were unable to suggest that **cells may die or function inefficiently** when too little blood flows to them.

In Part (e) (ii), only 5 per cent of candidates were able to relate **decreased food or oxygen supply** as a reason for (e) (i).

Part (f) proved to be the most difficult section with very few candidates naming **diffusion** or **osmosis** as the processes by which substances in the blood enter the cells of the body.

In Part (g), many candidates correctly stated one cause of heart attack.

Responses credited:

- Too much saturated animal fats
- Too much cholesterol
- Too much salt
- Stress
- Inherited tendencies
- Obesity
- High blood pressure
- Presence of a blood clot in the coronary artery
- Narrowing of the coronary artery reducing blood flow to the heart muscle

#### **Question 4**

This question assessed several properties of light – effect of light on colour, shadow formation, the spectrum and effects of UV radiation on humans.

This topic was not well known by the candidates.

Part (a) (i) was fairly well done. However, some candidates misinterpreted the ‘cost of lighting’ to mean the cost of purchasing the lamps.

Response credited: Fluorescent lighting is cheaper/more economical than filament lighting.

In Part (a) (ii), most candidates seemed to understand the concept of sharp and soft shadows but were unable to describe them.

Responses credited:

- Filament lamps provided sharper/bigger/better/darker shadows.
- Fluorescent lamps provide softer shadows.

Part (b) (i) was poorly done with candidates showing an inability to use the data in the table to explain the effect of different lighting on the red lipstick.

Responses credited:

- Fluorescent light is deficient in red light.
- Less red light is reflected by the lipstick.

The majority of candidates responded appropriately to Parts (b) (ii) and (c).

Responses credited:

- (b) (ii) Filament lamp
- (c) More red light from the fluorescent lamp or normal amount of red light from the filament lamp

In Part (d), only about 50 per cent of the candidates responded to this section; and of this number, most drew an incorrect representation of the shadow formed on the screen.

Responses credited:

- Drawing of a circular shadow on the screen
- Size of shadow according to light rays entering

In Part (e), the majority of candidates seemed to lack knowledge of the order of colours in the light spectrum, similarly in Part (f) where they had to determine the colour of the red pigment in white light and in green light.

Responses credited:

- (e) Colours at the end of the spectrum are red and violet.
- (f) (i) In white light, it appears red while in green light it appears black.

Responses credited:

- (g) (i) Sunglass Y
- (g) (ii) a) Protection against dangers of UV radiation (partial credit)  
b) UV radiation damages the retina (the light sensitive cells of the eye)

### **Question 5**

This question tested the candidates' understanding of the reactivity of metals and its relationship to their properties as well as the use of plastics.

Part (a) showed the results of an experiment conducted to compare the reactivity of four metals A, B, C, and D. Figure 17 showed the amount of effervescence released by each metal.

The performance in (a) (i) was satisfactory. Most candidates provided answers that implied the control of the experimental conditions.

Response credited: **Control of variables**

Part (a) (ii) was generally fairly well done. Most candidates were able to give the order of reactivity of the four metals.

Response credited: **C Ø A Ø D Ø B**

Part (a) (iii) was poorly done. Most candidates were not able to write the word equation for the reaction stated.

Response credited:



In Part (b), candidates were presented with Table 5 which listed the order of reactivity of eight metals.

The performance in Part (b) (i) was satisfactory. However, some candidates did not relate the suitability of copper in the manufacture of utensils to its property identified in the table, but rather, stated other properties such as good conductivity.

Response credited: Copper is not very reactive.

In Part (b) (ii), candidates were asked to state which metal was most appropriate for the canning of juices. Several candidates provided a correct response.

Response credited: Aluminium

Part (b) (iii) was poorly done. Most candidates could not express a reason for their choice in (b) (ii). Responses credited:

- Aluminium is very light.
- Aluminium is un-reactive due to its oxide coat.

Part (c) (i) required candidates to state two uses of plastics. This was generally well done with most candidates being able to provide correct responses. Many candidates relied on real life experiences to provide examples of uses of plastics.

Responses credited:

- Covering of cables [insulation]
- Manufacture of containers [bowls/dustbins/food containers/disposable cups]
- Used as packing material
- Wrapping film
- Clothes/clothing material

Part (c) (ii) required candidates to state one advantage and one disadvantage of plastics. This was fairly well done as candidates utilized everyday experiences to provide correct responses.

Responses credited:

**Advantages**

- Light
- Non-conductor
- Cheaper
- Can be recycled
- Provides shelter/covering

**Disadvantages**

- Non-biodegradable
- Can cause pollution
- Creates waste and litter
- Impacts on environmental sanitation

### **Question 6**

This question tested the candidates' knowledge of 'force' and 'moments'.

Part (a) (i) required candidates to define the term 'force'. This was widely known and most candidates were able to give a correct response.

Response credited: Force is defined as a push or pull.

Part (a) (ii) required candidates to name the 'turning effect of a force'. Most candidates demonstrated little knowledge of the term 'turning effect'. In most cases the word 'movement' was given as the particular response.

Response credited: The turning effect of a force is known as the moment of a force.

In Part (a) (iii), candidates were provided with a stimulus diagram in Figure 8.

Responses credited:

- The rule would turn in a clockwise direction.
- To turn in an anti-clockwise direction, you would need to hang the object on the other side of C.

Parts (b) (i) and (ii) were poorly answered. Candidates were unable to calculate 'moments'. They seemed not to know the appropriate formula to be used. Most displayed little or no knowledge of how to find the mass of a small fruit using the given arrangement in Figure 9.

Responses credited:

- (i)  $50 \times 20 = 25 \times d$ ; the calculated distance is 20 cm.
- (ii) Experiment to find mass of a small fruit; procedures –
  1. On balance rule, hang fruit by string in position [d] [i].
  2. Hang 50 g mass [m1] on other side, in position [d2], where rule is balanced.
  3. Calculate the mass of the fruit [m2] using the formula  $m_1 \times d_1 = m_2 \times d_2$ .
  4. Repeat the procedure using different distances for d1.
  5. Find the average mass.

Part (c) was fairly done. A stimulus diagram showing the use of a crowbar was provided.

In Part (c) (i), most candidates were able to interpret the stimulus diagram and provide a correct response. However, most of them were unable to give the correct reason for the chosen arrangement.

Responses credited:

- Diagram B requires less effort to move the load
- Less force or larger distance between E and F

Parts (c) (ii) and (c) (iii) were poorly done.

In Part (c) (ii), most candidates could not state the process of the body which provided energy.

Response credited: Respiration provides the energy needed to operate the crowbar.

In Part (c) (iii), most candidates could not write the word equation for the process of respiration.

Response credited: Glucose + Oxygen  $\rightarrow$  Carbon Dioxide + Water + Energy

Overall, this question proved to be very challenging for the majority of candidates and as such the overall performance was unsatisfactory.

## **School-Based Assessment**

### **Overall Performance**

The overall performance at the General Proficiency Level was fair. However, greater effort seems to be needed in Analysis/Interpretation and Planning/Design. Generally, notebooks and the mark schemes were submitted. However, Student Instruction Information Sheets were missing.

At Basic Proficiency, the overall performance was fair. However, the practical activities assessed were too simple and all the skills were not assessed.

### **Recommendation to Teachers**

- All laboratory books should have a contents page with the following format and headings.

<b>Lab No.</b>	<b>Page</b>	<b>Description of Laboratory Exercise</b>	<b>Date</b>	<b>Skills Assessed</b>

- The pages of the laboratory notebook should be numbered.
- Each activity should begin on a new page and be properly dated.
- The skills assessed and marks allocated should be written next to the laboratory exercise and in the contents page.
- **All skills must be marked out of six (6).** Skills marked out of other totals should be scaled to six.
- Dates when the practicals were assessed should be included.
- All skills except P/D should be assessed at least four (4) times over the two-year period. P/D should be assessed at least twice over the two-year period.
- **The mark scheme used to assess skills must include components from (a) and (b) as outlined in the syllabus.**

### **Observation, Recording, Reporting (ORR)**

- Proper laboratory format should be used, for example,
  - Title
  - Aim
  - Apparatus/Materials
  - Diagram
  - Method
  - Results/Observations
  - Discussion
  - Conclusion
- Reporting should be concise and observations should be recorded in a suitable format. The use of tables is recommended whenever possible.
- Numerical tables should have the physical quantity and units stated in the heading, and the number of decimal places should be consistent.



- Non-numerical tables should have appropriate headings. Details of data recorded should include all observations, for example, the solution turned from blue to green to orange upon heating.
- Graphs should have axes labelled, appropriate scale, points plotted accurately and a **smooth curve or best fit line drawn**. (Only growth curves have the points joined dot-to-dot.)
- Where prose is used to record observations, details of data are necessary.

### **Analysis and Interpretation (A/I)**

- Laboratory exercises chosen for assessment were too simple, for example, ‘testing milk for protein’.
- Laboratory exercises should lend themselves to the **identification of trends, patterns and relationships**.
- Inferences **must be linked** to the results/observations.
- Evaluations should not be general statements. **Conclusions need to be linked to the aim stated and the data obtained**.
- Calculations shown must include formulae and units.
- Questions from the textbook should not be used as A/I labs. Laboratory exercises must be carried out and the data generated analyzed and interpreted.

### **Planning and Designing (P/D)**

- P/D laboratory exercises need to be more original whereby students are required to formulate a hypothesis and design a **scientific experiment** to test the hypothesis.
- P/D laboratory exercises need not be done for proven scientific facts, for example, ‘Moisture and air are needed for rusting’ and ‘Sunlight and water are necessary for germination’.
- **Textbook laboratory exercises are not acceptable**.
- Some laboratory exercises do not lend themselves for assessment as P/D laboratory exercises, for example, ‘making soap’, ‘Reactivity of metals’ and ‘Model of Lungs’.
- **A hypothesis is a statement and should not be written in the form of a question**.
- Students should be encouraged to write an Aim, which is directly linked to the hypothesis.
- Procedure should reflect a direct link with the hypothesis.
- Procedure should include the number of times the experiment is to be repeated and any precautions to be taken.
- **P/D laboratory exercises do not have to be carried out**. If they are executed they can be used to assess other skills and the plan should then be modified if necessary.

**CARIBBEAN EXAMINATIONS COUNCIL**

**REPORT ON CANDIDATES' WORK IN THE  
SECONDARY EDUCATION CERTIFICATE EXAMINATIONS**

**JUNE 2006**

**INTEGRATED SCIENCE**

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**INTEGRATED SCIENCE**  
**GENERAL AND BASIC PROFICIENCY EXAMINATIONS**  
**JUNE 2006**

**GENERAL COMMENTS**

The CSEC examination in Integrated Science (Single Award) was offered at the Basic and General Proficiency Levels. The Basic Proficiency Level was offered for the final time. The June 2006 examination consisted of three papers; Paper 01 – Multiple Choice; Paper 02 – Short-response questions and Paper 03 – the School-Based Assessment.

The number of candidates writing the examinations at the General Proficiency Level increased by 479 from 19,763 in 2005. At the Basic Proficiency Level, the number of candidates decreased significantly, from 727 in 2005 to 342 in 2006.

The overall performance of candidates in the 2006 examinations was consistent with the performance in 2005. At the General Proficiency Level, 77.1% of the candidates earned Grades I to III while at the Basic Proficiency, 44.4% earned these grades.

**DETAILED COMMENTS**

**Paper 01 – Multiple Choice**

Paper 01 consisted of 60 multiple choice items. The mean score earned at the Basic Proficiency Level increased by 6.5% from 47.9% in 2005 to 54.4% in 2006. At the General Proficiency Level, the mean score increased by 2% from 55.2% in 2005 to 57.2% in 2006.

**General Proficiency**

**Paper 02**

Paper 02 comprised of six, short-answer, structured questions. The maximum mark for each question was 15 and the maximum mark for the paper was 90 marks. The mean score for Paper 02 was 35.6%.

Question 1

Question 1 tested candidates' knowledge of the reactions between aluminium and hydrochloric acid; iron and water; rusting; the relevant word equations; and factors that result in rusting. The knowledge questions were followed by questions on the causes and control measures of respiratory ailments. It also included the results of a laboratory experiment based on the reaction of different metals with hydrochloric acid and tested the candidates' analytical skills.

Generally, the responses were poor. Few candidates earned full marks. There were a few "no responses". Candidates had difficulties in answering the question correctly. It was noted that approximately fifty per cent of candidates scored below seven marks.

Question 1(a) and (b) tested the candidates' knowledge of reactions between aluminium and hydrochloric acid; iron and water and the completion of the respective word equations. Also tested was the chemical process by which rusting takes place and the word equation for the formation of rust. This section constituted the knowledge profile and was poorly done. Very few candidates earned full marks in this profile.

The concept of equations was not clearly understood by some of the candidates. Some candidates rewrote the words from the questions as their answers and there was a clear indication that the answers to this section were not known.

The latter part of the question required use of knowledge skills and was answered much better than the knowledge profile. Most candidates writing Question 1(b)(iii) were able to explain to some extent why rusting of the gate occurred rapidly. This was worth two marks and most of the candidates were unable to earn the full two marks. They were unable to present the accredited answers as either water and salt or moisture and salt. In addition, for this question most candidates wrote 'seablast' as causing the gate to rust. 'Seablast', without a scientific explanation was not accepted. However if it was qualified by water or salt, it was accepted as correct.

Parts (c)(ii) and (iii) dealt with the rusting of kitchen windows. The materials that were used included aluminium, steel and plastic. The question required candidates to state the type of material used to make the kitchen and the bedroom windows and to explain their choice of material with respect to rusting or not rusting.

Candidates answered this section well. Most candidates knew that the plastic and aluminium would not rust as much as steel would rust. However, candidates were confused about 'the reason the steel rusted'. Most of the candidates indicated that steel will rust but did not identify the conditions of rusting or that steel is an alloy containing iron.

Parts (d)(i) and (ii) dealt with a family living close to several factories and the children being affected by respiratory ailments, as well as the family moving to the beach to live. Candidates were required to suggest reasons for the respiratory ailments as well as to suggest reasons for the decline of respiratory ailments on moving to the beach to live. Generally this question was answered well by most candidates, however, weaker candidates had some difficulties because the terms 'respiratory ailments' and 'decline in frequency' were misunderstood.

Parts (e)(i), (ii) and (iii) dealt with an experiment carried out using 1 gram of metal X, Y and Z and 5 cm<sup>3</sup> of hydrochloric acid which was added to 3 separate test tubes. Candidates were asked to arrange the metals in order of increasing reactivity and to name a metal which is not reactive with hydrochloric acid. In addition candidates were required to give the reason for the addition of 5 cm<sup>3</sup> of hydrochloric acid to each of the three metals. The majority of the candidates answered (e)(i) very well. In (e)(ii), some of the candidates were unable to suggest the correct name of the metal which is not reactive with hydrochloric acid. The acceptable answers were the coinage metals: silver, gold, copper and platinum. For (e)(iii), answers were either 'control or accuracy'. However, these terms were not fully understood by some candidates. Many candidates responded correctly to this part.

### **Recommendations**

- (i) Teachers must emphasise the importance of the terms accuracy and control in experiments.
- (ii) Students should be encouraged to use scientific terms correctly and avoid non-scientific terms.
- (iii) Students should be encouraged to express themselves clearly, concisely and scientifically.
- (iv) Students should have more practice sessions at school in answering knowledge and use of knowledge questions.

## Question 2

This question tested the candidates' knowledge of energy, energy types, energy conversions and the causes and treatment of inefficiency in machines. This question also tested the candidates' ability to perform calculations.

The candidates' responses to the question were poor.

Part (a)(i) required the candidates to define energy and Part (a)(ii) required the candidates to name two forms of energy. These parts were well done.

Part (b)(i) presented the candidates with three activities and required them to state the energy conversions for the activities. Less than fifty per cent of the candidates were able to identify the correct energy conversions for the activities.

Part (b)(ii) presented the candidates with a see-saw scenario and required them to calculate the distance one child would have to sit from the middle for the see-saw to balance. Most candidates were able to give the correct answer, but of those with the correct answer less than twenty per cent showed working.

In Part (b)(iii), candidates were asked to state the class of lever that the see-saw represented. This part was very well done with over ninety per cent of the candidates correctly answering first class lever.

In Part (c), the candidates were asked to calculate the mechanical advantage of a machine. This part was poorly done with less than fifty per cent of the candidates giving the correct answer. Of those who answered correctly, very few were able to show working.

Part (d)(i) required candidates to know the causes of inefficiency in machines. This part was poorly done.

Part (d)(ii) required candidates to know the methods used to reduce the inefficiency of machines. Those candidates who correctly answered (d)(i) were able to answer correctly (d)(ii).

## **Recommendation**

Teachers should explain the importance of showing working with calculations.

## Question 3

This question tested the candidates' understanding and ability to use knowledge relevant to the circulatory system.

Part (a)(i) tested the candidates' knowledge of the functions of the circulatory system. Most of the candidates stated less than the four functions required by the question.

In Part (b)(i), many candidates responded, "The animal will 'bleed to death'". This was the most common response and far too general. The expected responses included death due to insufficient oxygen taken to the tissues.

Part (b)(ii) was done well by the majority of candidates. Many candidates answered "the lumen and the thickness of the wall". They did not specify that A had a thicker wall than B, and that A had a smaller lumen than B as expected.

Some common misconceptions that occurred were that candidates identified A as an artery with plaque and B (a vein) as a healthy blood vessel.

A few candidates incorrectly identified the blood vessel as a xylem and phloem. Also many candidates gave functional differences between A and B, as their answer.

In Part (b)(iii), less than fifty per cent of the candidates were able to correctly identify the blood vessel.

Part (c)(i) was generally well done. Most candidates listed the name of the foods, salted fish and fried potato chips. A few candidates wrote a sentence stating that these were examples of greasy, oily and salty foods.

Part (c)(ii) posed a moderate amount of difficulty. Many candidates were unable to identify factors not related to the diet, that could contribute to hypertension.

Part (c)(iii) revealed a common misconception that moderate exercise would have adverse effects such as fainting, increased blood pressure, heart attack and strokes. Candidates who performed well were able to cite lowered cholesterol levels, improved breathing rates, reduced stress levels, improved blood flow, improved circulation, 'strengthening of the heart', and increased lung activity as ways in which moderate exercise can effect the body.

Part (c)(iv) posed the greatest degree of difficulty to candidates. Candidates responded that weaker heart muscles would make the blood pressure in the heart increase. Very few candidates gave a reason.

### **Recommendations**

Students need to

- (i) understand clearly the differences in structures and function between plant and animal circulatory systems
- (ii) understand that exercise in its many forms generally improves bodily functions in many ways and should generally be considered in a positive light
- (iii) develop a thorough understanding of the nature of the circulatory systems
- (iv) conceptualise that structure mirrors function and that deficiencies in structure almost always mirror deficiencies in function
- (v) conduct simple experiments with pumps and hoses to serve as analogies to the circulatory systems in animals showing how defect deficiencies in these apparatus affect its efficient functioning.

### **Question 4**

This question examined candidates' understanding and use of knowledge relating to the topic, Nutrition. The area examined included:

- (i) Balanced diet
- (ii) Food nutrients and their uses
- (iii) Digestion of food substances

In general, this question was well done.

Part (a) examined candidates' understanding of the concept of a balanced diet. Many candidates were unable to state correctly a definition of the term 'balanced diet'. The expected response was:

A balanced diet is one with the correct proportion of each food nutrient depending on the person's age, sex and occupation.

A few responses included the conditions of a balanced diet, for example, sex and occupation.

Part (b) was fairly well done with most candidates gaining maximum marks. However, some candidates did not understand the term 'nutrient'.

In Part (c), candidates were expected to choose and justify a lunch option for (i) – an athlete and (ii) – a pregnant woman.

Some candidates were unable to justify their option. Candidates were expected to state the nutrients found in the lunch option and the increased need for that nutrient by the individual involved.

Expected responses included:

Part (c)(i) Option C for athletes because it contained foods high in carbohydrates which provide energy or high in proteins to help build up muscles to repair damaged tissues.

(ii) Option B for pregnant women because it contained foods high in iron/protein/vitamins for development/growth and/or good health of the body.

In Part (d), some candidates explained aspects of mechanical digestion instead of chemical digestion as required.

Good responses included:

- Protein is chemically broken down by the enzyme pepsin into polypeptides which is further broken down into amino acids, before absorption.
- Fat is broken down by the enzyme lipase to fatty acids and glycerol.

### **Recommendations**

Students should

- (i) place more emphasis on using correct scientific terms
- (ii) use the stimulus material presented to answer the questions.

### **Question 5**

This question tested the candidates understanding of the differences between pests and parasites, the methods of pest control and the feeding relationship between organisms in a community. The majority of responses ranged from fair to satisfactory. Few candidates obtained full marks.

In Part (a)(i), the candidates were required, to describe in tabular form, the characteristics of pests and parasites. Many candidates provided the expected responses which included:

- Parasites live in or on other living organisms
- Parasites depend directly on other organisms for food.

Many candidates stated that ‘Parasites live off other organisms’ rather than ‘Parasites live in or on the organisms’. Some candidates gave examples of parasites and pests rather than answer the question.

Part (a)(ii) required the candidate to name TWO common household pests. Most candidates were able to name two pests: rats, mice, termites, housefly, cockroach, bed bugs, mosquitoes and ants. Pests and vague responses such as dogs, cats, bugs, lizards and wasps were not accepted.

In Part (b)(i), the candidates were required to suggest TWO factors that might be responsible for the increase in the number of flies in a rural community near a small river where kitchen gardens, livestock rearing and fishing were done.

Expected responses included:

Manure heaps, accumulation of garbage, the presence of fish, waste matter from livestock and unwanted parts of fishes.

Vague answers such as dirty conditions, place was not clean, disposal of garbage, livestock, gardening or fishing are unacceptable.

In Part (b)(ii), the candidates were asked for ONE method other than the use of insecticide to control the number of flies. Expected responses included:

- Proper disposal of garbage
- Use of disinfectants
- Cleaning the pens/washing the livestock
- Use of fly bait
- Use of sticky fly paper
- Biological method

In Part (c), the candidates were told that after spraying with a particular insecticide, the gardener observed that even though large numbers of blossoms were produced by the vegetable plants there was a decrease in the number of vegetables produced.

Part (c)(i) required the candidates to explain why there was a decrease in the produce from the garden. Based on the information provided, the expected response was ‘The insecticide killed the insects responsible for pollination and therefore fertilisation could not take place’.

Rarely did the responses reflect an understanding of the role of insects in the production of fruits.

Part (c)(ii) required the candidates to explain why there was also a decrease in the population of fish in the river. Many responses correctly suggested that the river had been polluted by the insecticide and the fish were killed or moved away from the sea.

In Part (d)(i), a food web was provided and the candidates asked to state the effect on the weed population and the spider population if the insect population was reduced. Any response indicating that the weed population would increase while the spider population would decrease was credited.

Part (d)(ii) required the candidates to choose and write ONE food chain from the food web provided. Most candidates were able to write a food chain with at least three organisms. Common mistakes made were:

- Not starting the chain with the weeds



- Using arrows pointing in the wrong direction
- Not using arrows at all
- Using arrows pointing to the correct organism but organisms listed in descending order through the trophic levels.

### **Recommendations**

Teachers should

- emphasise that all food chains must begin with a green plant (producer)
- encourage use of scientific terms and proper names of organisms
- emphasise the effects of removing any organism from a food web.

### **Question 6**

This question tested the candidates' knowledge of refraction, reflection, methods of fishing and colour.

Generally, the response to this question was poor with about five per cent of candidates failing to attempt any part of the question.

Part (a) of the question assessed the candidates' knowledge and understanding of the behaviour of light rays – reflection (from a mirror surface) and refraction (through a body of water). Many candidates displayed satisfactory knowledge of the pathway of a light ray under reflection, but knowledge of the pathway of a ray of light under refraction was poorly portrayed. Most candidates who attempted this part knew that the ray of light bent, however, they were unable to show this occurrence in relation to the normal.

Part (b)(i) was well done. Many candidates identified the actual position of the fish as below the point X.

Part (b)(ii) was poorly done, as many candidates could not relate the occurrence to the refraction of light. Some of the misconceptions included – water magnified the size of the fish, poor eyesight of the fisherman.

Part (b)(iii) was well done, as many candidates were able to indicate that the fisherman should have aimed below the apparent position of the fish. Answers accepted included – Below X, In front of X, Before X, Bottom of X, Under X, Ahead of X – all of which seemed reasonable in relation to 'Below X' as the preferred answer and as indicated in the stimulus material.

In Part (c), about 50 per cent of the candidates accurately indicated a method of catching deep-sea fish. Responses accepted for method of deep-sea fishing included – trawl nets, trawling, long liner, towlines, fish pots, fish traps, drift/drag net. Poor responses included – big nets, casting nets, seines, fishing rod and harpoon.

In Part (d), the lack of knowledge resulted in about twenty per cent of the candidates being able to identify dispersion or diffraction as a term used for the splitting of a ray of light. Poor responses included – chromatography, prisms, refraction and rainbow.

Part (e) required candidates to give a definition of a primary colour – 'colour that cannot be formed by mixing' was given in about fifteen per cent of responses. Other responses accepted were – colours

mixed/combined/used to make secondary (another, other) colours. Colours from which different colours (meaning other than primary colour) are formed were also accepted.

In Part (f), the expected answers are: X – Yellow; Y – Magenta; Z – White. Only about thirty per cent of the candidates correctly answered this part.

Candidate responses to Part (g) were poor. Generally, candidates were unable to distinguish the effect of coloured light on pigments.

### **Recommendations**

Students should

- (i) investigate through practical activities – rays of light through prism and other mediums; coloured lights and pigments
- (ii) apply their knowledge to everyday experiences.

## **DETAILED COMMENTS**

### **Basic Proficiency**

#### **Paper 02**

#### **Question 1**

This question tested the candidates understanding of and ability to use knowledge relating to the endocrine and nervous systems. The overall performance on this question was satisfactory.

Part (a) presented candidates with an incomplete table (Table 1: Stimuli, their Receptors and Effectors) and they were expected to supply the missing information. Performance in this section was satisfactory.

In Part (b) candidates were asked to state one major difference between the ways in which these systems coordinate the activities of the body. Most candidates could not earn full marks, as they were unable to give one difference. Acceptable answers dealt with differences in both structure and function of the two systems.

In Part (c), candidates were asked to explain what is meant by the term 'reflex action'. This part was generally well done with most candidates being able to provide an accurate explanation of the term 'automatic or involuntary action' – occurs without thought, very quick response, the knee jerk.

Parts (d)(i) and (ii) referred to Table 1 in (a) where candidates were asked to identify one reflex action in the Table and give a reason for their choice. Most candidates were able to correctly identify Action C (Without thinking, Ms Cato quickly drops the hot pot cover). Many of the candidates were able to validate their choice with a reason – the action happened quickly or without conscious thought.

Part (e)(i) referred to Activity B in Table 1 with candidates being asked to state whether the activity would increase or decrease the level of adrenaline in Indar's body. The correct response was that the level of adrenaline would be increased. Many candidates seemed not to have read the question carefully and responded with answers of yes or no and as such did not earn marks.

Parts (e)(ii) and (iii) were not well done. Candidates were unable to identify the adrenal glands as the endocrine organ responsible for the production of adrenaline and that these glands were located above

the kidneys in the upper back of the abdomen. This reflected a general lack of knowledge of the endocrine system.

### **Recommendations**

Teachers should

- (i) use diagrams or drawings of the endocrine and nervous systems in doing comparison.
- (ii) emphasise the function of the spinal cord in reflex actions.

### **Question 2**

This question tested candidates' understanding of the respiratory system and their ability to read and interpret graphical data. It was attempted by over 80 per cent of the candidates and the performance was generally satisfactory.

Part (a) required candidates to distinguish between 'breathing' and 'respiration'. Quite a number of candidates confused respiration with perspiration and gave definitions that referred to 'sweat'. Most were able to give accurate definitions of the term 'breathing'; however, the definitions/descriptions of 'respiration' proved difficult. Also many of the candidates seemed not to have understood what the term 'distinguish' meant. Few candidates showed awareness that respiration occurs in the cells.

Parts (b), (c) and (d) which related to Figure 1 were fairly well done. Candidates were able to read and interpret the graph given, and compute correctly from the graphical data.

Part (e) which required candidates to give one reason for the change in the number of cases of lung disease in Town A between 1996 and 1997 was not well done.

Part (f) was satisfactorily done. Candidates were asked to state what advice they would give to a family who wanted to move from Town B to Town A. Candidates were able to give both the advice and the reference; many of the candidates were able to link the advice to the specific reference.

In Part (g), candidates were asked to explain why it was important for an individual to have healthy lungs. Most candidates were able to provide a correct response using their knowledge of the function(s) of the lungs.

In Part (h), candidates were asked to describe how oxygen from the lungs entered the blood stream. This part presented great difficulty, as candidates seemed to have misconceptions of how oxygen enters the blood stream from the lungs. The concept of 'diffusion of gases' across the 'respiratory surface' was generally not evident.

### **Recommendations**

Teachers should

- (i) after explaining 'breathing' and 'respiration', provide students with comparative tables requiring them to supply the missing information. This would help to identify any misconceptions
- (ii) use diagrams/drawings/charts and models to explain the two terms
- (iii) include assessment work where graphical interpretations and evaluations have to be made

- (iv) include basic graph work – structure.

### Question 3

This question tested the candidates' knowledge of hurricanes, the energy conversions that occur within a hurricane as well as volcanoes, and their effects. The overall performance on this question was generally satisfactory with some centres producing very good responses.

Part (a) of the question was generally well done. Candidates were asked to define the term 'energy'. Responses credited – the ability to produce a change, the ability to do work.

Part (b) provided a photograph (Figure 2) which showed a satellite view of a hurricane taken from above it.

In Part (b)(i), candidates were required to name the part of the hurricane labelled X in Figure 2. Most candidates provided the correct response – the eye.

In Part (b)(ii), candidates were required to state the other main features of the hurricane that could be seen in the photograph. This part proved to be challenging as candidates confused the vortex with clouds.

Responses credited – swirling winds, strong winds, winds, vortex.

In Part (c), a photograph taken during the passing of a hurricane through a Caribbean country (Figure 3) was provided. Candidates were required to draw an arrow on the photograph to indicate the direction in which the wind was blowing. This part was well done with most candidates drawing the arrow in the right direction.

In Part (d), data for wind speed and storm surges for hurricanes was provided in Table 2.

In Part (d)(i) candidates were asked to define a 'storm surge'. This proved to be somewhat difficult as few candidates were able to respond correctly.

Response credited – large waves.

In Part (d)(ii), candidates were asked to indicate how storm surges are produced. Again most candidates found difficulty in providing a correct response.

Response credited – produced by the force of the hurricane winds.

Part (e) provided Figure 4 which showed a ship that was washed ashore during a storm surge with the information that the anchor held until the wind speed reached about  $200 \text{ kmh}^{-1}$ .

In Part (e)(i), candidates were asked to make reference to Table 2 given in Part (d) and determine the approximate height of the storm surge when the ship was washed ashore. This was fairly well done with many candidates being able to interpret the graphical data correctly.

Responses credited – 2.5m to 3.5m.

In Part (e)(ii), candidates were asked to determine with reference to Table 2 in Part (d) the category of a hurricane with wind speed at  $200 \text{ kmh}$ . This section was fairly well done with many candidates correctly interpreting this graphical data.

Response credited – Category 3.

In Part (f), candidates were asked to suggest one reason why the wind speed of a hurricane falls after it passes over a large land mass. This was fairly well done. Candidates were able to relate the energy conversion of the hurricane as it passed over land.

Responses credited were – Energy is converted, results, for example, in trees being uprooted, roofs blown off, over warm water the amount of energy in the hurricanes increases while over the cooler land it decreases, mountains on land reduces the speed of the hurricane and therefore decreases the energy.

In Part (g), candidates were told that in studying patterns of settlement in a certain Caribbean island, it was observed that large numbers of people have set up farms on the slopes of volcanic mountains.

In Part (g)(i), candidates were required to define a volcano.

Response credited – An opening in the earth's crust through which molten rock, rock fragments, gases are ejected from deep within the earth.

Some candidates gave descriptive explanations for the definition of the volcano and these were awarded partial credit.

In Part (g)(ii), candidates were required to suggest why farms have been set up on the slopes of volcanic mountains. This was fairly well done.

Response credited – Fertile soil from the emissions of volcanic ash is found along the slopes.

In Part (g)(iii), candidates were asked to state which component of the emissions from a volcano is most likely to damage the respiratory system. Generally, this was not well done.

Responses credited – ash, dust, smoke.

#### Question 4

The performance of candidates on this question was satisfactory. It tested candidates understanding of fossil fuels, sources of energy, energy conversion, principles of combustion and heat transfer.

Part (a) related to 'fossil fuels' as non-renewable sources of energy.

In Part (a)(i), candidates were required to name two fossil fuels. Performance on this part was satisfactory with most candidates correctly identifying one fossil fuel.

Responses credited – petroleum, crude oil, coal, peat.

In Part (a)(ii), candidates were asked to state what is meant by the term 'non-renewable' when describing a source of energy. This was generally well done by most candidates.

Response credited – Once it is used to supply energy needs, it cannot be replaced.

Part (a)(iii) was fairly well done with the majority of the candidates being able to identify one renewable source of energy.

Responses credited – solar energy, wind, biomass, geothermal, wave.

The stimulus, Figure 5, provided in Part (b) showed two burning candles, A and B, with Candle B covered with a jar.

The performance in (b)(i) was unsatisfactory with many candidates being unable to name the fuel that was burnt.

Part (b)(ii) required candidates to state the energy conversion that takes place as the candles burn. This was done poorly. Responses were primarily incomplete with candidates limiting their response to heat and light only. Chemical energy was for the most part omitted.

Response credited – Chemical → heat + light.

In Part (b)(iii), few candidates were able to name two substances that are produced while the candles burn. Most candidates incorrectly stated wax and smoke.

Response credited – Carbon dioxide + water.

In Part (c)(i), about half of the candidates suggested that the candle burns initially because there was some oxygen/air present.

Part (c)(ii) was satisfactorily done. Candidates responded that the candle stops burning because the oxygen or air that was present was used up or that neither oxygen nor air was present.

The stimulus in Part (d), Figure 6, showed a lighted candle between a black and white screen, with candle wax sticking two identical pieces of cork to the screens.

Part (d)(i) was poorly done with few candidates naming the process by which heat travels from the candle to the screens.

Response credited – radiation.

Part (d)(ii) a) was very well done. Most candidates were able to provide a correct response indicating that the cork would fall first from the black screen.

The performance in (d)(ii) b) was satisfactory. Most candidates provided answers that implied the cork falls first from the black screen because it absorbs radiated heat or energy more efficiently. Many candidates could not properly explain absorption of heat energy and many used words such as 'attraction' and 'draw in of heat'.

### **Recommendations**

- (i) Students need to perform, analyse and interpret experiments based on
  - (a) effect of heat energy on light and dark coloured objects
  - (b) combustion.
- (ii) Students should be exposed to
  - (a) audio-visual material on fossil fuels
  - (b) field trips or tours of energy based companies or museum.

### Question 5

This question tested candidates' understanding of the basic principles involved in production of colours and different components of the visible spectrum. This question also tested candidates' understanding of the importance of colour in the process of photosynthesis. The practical component of the question tested candidates' knowledge of the action of solvents in stain removal processes.

Generally the performance on this question was satisfactory.

Part (a) required candidates to state four of the colours seen when a prism is placed in the path of a ray of white light and the emerging ray is focused on a screen. This was generally well done. Responses credited – red, orange, yellow, green, indigo, violet.

The stimulus in Part (b), Table 3, presented some primary and secondary colours of light. Candidates were asked to classify the colours in Table 3 as either primary or secondary colours. This part was also fairly well done.

The stimulus in Part (c), Figure 7, showed a stage set with three coloured lights focused on a white screen. The performance in this part was fair.

In Part (c)(i), candidates were required to state the colour appearing on the screen when the red and blue lights were switched on.

Response expected – magenta.

In Part (c)(ii), candidates were required to state the colour appearing on the screen when the green and blue lights were switched on.

Response credited – cyan.

Part (d) required candidates to suggest two situations, other than stage lighting, where colour mixing principles are used. This was poorly done as most candidates could not identify any situation in everyday life.

Responses credited – television, photography, painting, decorating, dyeing.

Part (e) related to the process of photosynthesis in the leaves of plants. This part was poorly done by most candidates.

In Part (e)(i), candidates were required to name the green pigment in leaves.

Responses credited – chlorophyll or chloroplast.

In Part (e)(ii), candidates were required to complete the word equation for the process of photosynthesis.

Responses credited – carbon dioxide, glucose.

In Part (e)(iii), candidates were required to state the energy changes that take place during photosynthesis.

Response credited – light energy → chemical energy.

In Part (f), candidates were required to suggest an appropriate method for removing the green pigment stain from grass on clothes.

Responses credited – use of a suitable solvent or substance to remove or dissolve the stain; use of alcohol or non-solvent.

### **Recommendation**

Teachers should conduct more laboratory sessions focusing on colour.

### **Question 6**

This question tested candidates' understanding and ability to use knowledge relating to water sports and water safety, the feeding relationships among aquatic organisms, as well as the advantages and disadvantages of plastics.

Performance on this question was generally satisfactory with some candidates providing excellent responses.

Part (a) referred to Caribbean tourists who enjoy scuba diving and boating activities.

In Part (a)(i), candidates were required to name two hazards associated with scuba diving. Most candidates were able to provide a correct answer.

Responses credited – the 'bends' or air bubbles in the blood vessel, nitrogen narcosis, decompression sickness, damage to the eardrum.

In Part (a)(ii), candidates were required to identify two water-safety devices which should be kept on a boat. Most candidates were able to identify only one device.

Responses credited – life raft, life jackets and inflatable tubes.

A few candidates associated safety with general safety and gave responses such as 'first aid kit'. These responses were not credited.

Part (b) stated that a scuba diver observed the following organisms underwater: seaweed, shark, small fish, barracuda.

In Part (b)(i), candidates were required to construct a food chain using the organisms listed. Most candidates were able to construct the food chain correctly.

Response credited – seaweed → small fish → barracuda → shark.

In Part (b)(ii), candidates were asked to identify a carnivore, herbivore and producers in the food chain. This part was generally well done as most candidates were able to provide the correct answers.

Responses credited – one carnivore such as barracuda, shark; one herbivore such as small fish; one producer such as seaweed.

In Part (c), Figure 8 showed a river running through an industrialised town. The river contained garbage consisting mainly of assorted plastic objects. Dead fish were seen floating in the river.

In Part (c)(i), candidates were required to suggest a reason for the death of the fish. This part was poorly done as most candidates failed to use the stimulus diagram provided.

Responses credited – chemical pollution from the factories, effluent released, pollution of the water, fishes trapped in the plastic debris.



In Part (c)(ii), candidates were asked to suggest two ways in which the amount of plastic from the town may be reduced. This section was widely known.

Responses credited – recycle plastics/used biodegradable materials instead/use recyclable materials instead, for example, glass/proper disposal of garbage/charge a tax for pollution/educate residents about proper disposal and the effects of pollution.

Part (d) required candidates to state one advantage and one disadvantage of using plastics.

It was evident that most candidates did not know the advantages and disadvantages of plastic. They placed emphasis on the use(s) of plastic rather than the nature/properties of plastic.

Responses credited – Advantages – light, cheaper, readily available or non-corrosive;  
Disadvantages – non-biodegradable or combustible.

### **Recommendations**

- (i) Practise the construction of food chains with arrows inserted correctly.
- (ii) Use more stimulus materials in school assessments.

## **Paper 03 – School-Based Assessment**

### **Overall Performance**

The overall performance at the General Proficiency Level was fair. However, greater effort seems to be needed in Analysis/Interpretation and Planning/Design. Generally, notebooks and the mark schemes were submitted. However, Student Instruction Information Sheets were missing.

At Basic Proficiency, the overall performance was fair. However, the practical activities assessed were too simple and all the skills were not assessed.

### **Recommendation to Teachers**

- All laboratory report books should have a contents page with the following format and headings.

Lab No.	Page	Description of Laboratory Exercise	Date	Skills Assessed

- The pages of the laboratory notebook should be numbered.
- Each activity should begin on a new page and be properly dated.
- The skills assessed and marks allocated should be written next to the laboratory exercise and in the contents page.
- The maximum mark to be awarded to each skill is 6 marks. Skills marked out of other totals should be scaled to six.
- Dates when the practicals were assessed should be included.

- All skills except P/D should be assessed at least four times over the two-year period. P/D should be assessed at least twice over the two-year period.
- **The mark scheme used to assess skills must include components from (a) and (b) as outlined in the syllabus.**

### **Observation, Reading, Reporting (ORR)**

- Proper laboratory format should be used, for example:  
  
Title  
Aim  
Apparatus/Materials  
Diagram  
Method  
Results/Observations  
Discussion  
Conclusion
- Reporting should be concise and observations should be recorded in a suitable format. The use of tables is recommended whenever possible.
- Numerical tables should have the physical quantity and units stated in the heading, and the number of decimal places should be consistent.
- Non-numerical tables should have appropriate headings. Details of data recorded should include all observations, for example, the solution turned from blue to green to orange upon heating.
- Graphs should have axes labelled, appropriate scale, points plotted accurately and a **smooth curve or best fit line drawn**. (Only growth curves have the points joined dot-to-dot).
- Where prose is used to record observations, details of data are necessary.

### **Analysis and Interpretation (A/I)**

- Laboratory exercises chosen for assessment were too simple, for example, 'testing milk for protein'.
- Laboratory exercises should lend themselves to the **identification of trends, patterns and relationships**.
- Inferences **must be linked** to the results/observations.
- Evaluations should not be general statements. **Conclusions need to be linked to the aim stated and the data obtained**.
- Calculations shown must include formulae and units.
- Questions from the textbook should not be used as A/I laboratory exercises. Laboratory exercises must be carried out and the data generated analysed and interpreted.

### **Planning and Designing (P/D)**

- P/D laboratory exercises need to be more original whereby students are required to formulate a hypothesis and design a **scientific experiment** to test the hypothesis.
- P/D laboratory exercises need not to be done for proven scientific facts, for example, 'Moisture and air are needed for rusting' and 'Sunlight and water are necessary for germination'.
- **Textbook laboratory exercises are not acceptable.**
- Some laboratory exercises do not lend themselves for assessment as P/D laboratory exercises, for example, 'making soap', 'reactivity of metals' and 'model of lungs'.
- **A hypothesis is a statement and should not be written in the form of a question.**
- Students should be encouraged to write an aim, which is directly linked to the hypothesis.
- Procedure should reflect a direct link with the hypothesis.
- Procedure should include the number of times the experiment is to be repeated and any precautions to be taken.
- **P/D laboratory exercises do not have to be carried out.** If they are executed they can be used to assess other skills and the plan should then be modified as necessary.

**CARIBBEAN EXAMINATIONS COUNCIL**

**REPORT ON CANDIDATES' WORK IN THE  
SECONDARY EDUCATION CERTIFICATE EXAMINATIONS**

**JUNE 2007**

**INTEGRATED SCIENCE**

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**INTEGRATED SCIENCE**  
**GENERAL PROFICIENCY EXAMINATION**  
**JUNE 2007**

**GENERAL COMMENTS**

The CSEC examination in Integrated Science (Single Award) was offered this year (2007) at the General Proficiency Level only. This examination consisted of three papers: Paper 01 – Multiple Choice, Paper 02 – short-response questions and Paper 03 – the School-Based Assessment or Paper 03/2 – the Practical Paper (Alternative to the SBA).

In 2007, 19 665 candidates wrote the examination. This was comparable to the candidate population of June 2006. There was a general improvement in candidates' performance in 2007 when compared with 2006, with approximately 82 per cent of the candidates earning Grades I to III compared with 77 per cent in 2006.

**Paper 01 – Multiple Choice**

Paper 01 consisted of 60 multiple-choice items. The mean score earned increased by approximately 3.1 per cent, from 57.2 per cent in 2006 to 60.3 per cent in 2007.

**Paper 02 – Structured Paper**

Paper 02 consisted of six, short-answer, structured questions. The maximum mark for each question was 15 and the maximum mark for the paper was 90. The mean score for Paper 02 increased by approximately 1.1 per cent, from 35.6 per cent in 2006 to 36.7 per cent in 2007.

**DETAILED COMMENTS**

**Paper 02**

Question 1

This question tested the candidates' ability to use information provided in tabular form to construct a graph showing plant growth over a period. It also tested the candidates' knowledge of plant parts and their ability to measure.

Part (a) (i) tested the candidates' knowledge on the construction of graphs, using information given from a table. The response to this question was fair. Two curved lines were expected; however, some candidates constructed various types of graphs, for example, line, bar and histograms. More attention needs to be given to the relevant areas of the syllabus. Some candidates had difficulty in labelling the axes and plotting correctly the points. Part (a) (ii) required a candidate to find an appropriate title for the constructed graph and was fairly well done.

Parts (b) (i) and (ii) were based on using and interpreting data obtained from the graph. Parts (b) (iii) and (iv) focussed on the use of knowledge of the conditions necessary for effective plant growth, such as the process of photosynthesis. Some candidates, after naming the two conditions necessary for plant growth in (b) (iii), encountered difficulty in giving an appropriate explanation in (b) (iv) for the two named conditions. They were required to be specific in terms of the process involved (photosynthesis), and also to use more scientific terms (for example, increasing rate of photosynthesis or preventing deficiency disease).

Part (c) (i) required candidates to label parts on the plant: A – leaf and B – cotyledon. Most candidates labelled A (leaf) correctly, but did not give the correct answer to B. Part (c) (ii) required candidates to determine the length of the stem in the diagram provided. Too many candidates gave the incorrect length.

### **Recommendations**

1. Students need to understand the details about the axes of a graph, such as:
  - (i) Choosing the appropriate axis, X and Y, for each variable
  - (ii) Naming the axis and labelling with the corresponding units required
  - (iii) Ensuring equal spacing of the units on each axis.
2. Emphasis should be placed on the fact that the two main variables to be plotted on the graph should be given in the title.
3. More attention should be given to the construction of graphs and their use for deriving and extrapolating data.
4. Special attention should be given to observing and identifying the various parts of plants as they develop from a dry seed into a mature plant.
5. Students should be encouraged to use scientific terms in their responses.

### **Question 2**

This question tested the candidates' knowledge of water-safety devices, floating and sinking, ethical and unethical practices related to performance enhancement, and nutrition relative to performance. This question was attempted by most candidates. Some of the candidates earned more than half the maximum score.

Part (a) required the candidates to name one of the two water-safety devices correctly. Some candidates in their responses seemed to have confused water-safety practices and water-safety devices. Additionally, some candidates were unable to differentiate between water recreational floatation equipment and water safety devices.

For Part (b) (i) many candidates were able to correctly identify the learner floating in sea water but were not able to give a reason in Part (b) (ii).

In Part (c), many candidates were able to relate the use of oxygen to the term "aerobic" activity.

Part (d) required candidates to use knowledge related to performance enhancement in athletes. The use of steroids and named hormones, for example, testosterone, were the most frequent acceptable responses. Some candidates confused techniques used for performance with swimming techniques such as "butterfly" and the backstroke.

Blood boosting which was an acceptable answer, was named by candidates most frequently as the unethical technique that improved the performance of swimmers. Weaker responses concentrated on explaining the removal and replacement of blood.

Part (d) (iv) – Candidates were able to correctly answer this section of the question.

Part (d) (vi) – Candidates who had an understanding of the functions of the nutrients were able to answer this section correctly. Many candidates incorrectly stated that proteins were needed primarily to provide energy for the body. It was expected that carbohydrates would be directly linked with energy production instead.

Part (e) – Some candidates were able to indicate that “stitches” or “cramps” would be experienced as a result of eating a heavy meal before a race. However, they were unable to explain the cramp. Unacceptable vague responses included “drowsing”, “vomiting” or “becoming tired”. In general, this section of the question was not properly answered.

### **Recommendations**

1. It is recommended that a practical or hands-on method be used to teach floatation concepts. Emphasis should be placed on the comprehension and correct usage of the relevant scientific terms, such as “upthrust” and “density”.
2. Clear distinction needs to be made between food nutrients and the type of foods which contain these nutrients. Emphasis should be placed on the roles of the nutrients.

### **Question 3**

This question tested the candidates’ knowledge of hormones and their functions, reflex action, as well as their ability to distinguish between “voluntary” and “involuntary” responses to visual situations. It was attempted by most of the candidates. Some responses were satisfactory.

Few candidates responded accurately to Part (a) (i). Several responses incorrectly indicated that a hormone was a feeling between a male and female. Several candidates indicated where hormones were produced instead of what they were.

Part (a) (ii) was generally well done. Candidates were able to state appropriate examples with oestrogen and progesterone being the most popular; however, many candidates incorrectly spelt these words.

Part (b) (i) was, in general, not well done. Some common misconceptions or incomplete understandings were that the pancreas lowers glucose instead of insulin and the ovary causes secondary sexual characteristics instead of the hormones oestrogen and progesterone. Many responses correctly indicated the hormones involved, but did not indicate their roles. Part (b) (ii) was generally well done. Many candidates correctly gave carbohydrate as their response. The question asked for food nutrient, but some candidates inadequately indicated sweets as a nutrient.

Some responses to Part (c) (i) correctly indicated that a “reflex action” is a quick, sudden, immediate or fast response, but needed also to point out that it was an automatic or involuntary response and did not involve thinking.

Part (c) (ii) was a simple, single-answer question with many of the responses correctly identifying Picture A as showing the activity where reflex action is taking place.

Part (c) (iii) seemed challenging to many of the candidates. Many candidates described what was seen in the pictures instead of giving the expected reason, that is, reference to the act of not thinking or automatic and quick response as in Picture A, compared to Picture B in which the boy thought of saving the vase.

Responses to part (c) (iv) were generally inappropriate. Many candidates gave the brain as the sense organ instead of the eyes as expected.

### **Recommendations**

In general, candidates showed inadequate knowledge of the topic tested by this question. Many did not respond to parts of the question. More attention needs to be given to the teaching of this unfamiliar aspect of the syllabus. Students could be provided with opportunities for analysing everyday-life activities that involve voluntary and involuntary responses.

#### Question 4

Part (a) tested the candidates' knowledge of the physical and chemical properties of water, while Part (b) explored their ability to recall the processes of water purification. Part (c) (i) examined candidates' ability to identify and draw a food chain, while Parts (c) (ii) to (v) examined the candidates' understanding of various farming and industrial practices and how these may each have had effects on the aquatic environment. Part (d) tested the candidates' ability to relate poor environmental conditions with ethical economic practices. This question was attempted by most of the candidates with the majority of them giving satisfactory responses.

Part (a) of this question realised the poorest response as many candidates showed little knowledge of the chemical properties of water. Correct responses indicated chemical reactions in photosynthesis and with metals. Although more candidates were able to identify physical properties, many were unable to differentiate between physical and chemical properties as their responses were incorrectly placed.

Parts (b) (i) and (ii) were generally well done with many candidates correctly identifying processes involved in water purification and describing how each process is carried out. However, in Part (b) (i), the common name for the processes was inadequately identified. Instead of naming the process, explanations were given. There was a display of very poor spelling. Chlorination was a popular response with candidates correctly identifying its role in killing micro-organisms such as bacteria. Sedimentation and filtration were also identified, however, some candidates cited domestic methods such as boiling which would not be practical on the large-scale company operations as indicated in the question.

Part (c) (i) was adequately answered by many candidates; however, some misconceptions relating to food chains were quite apparent. These **misunderstandings** included:

- (i) The arrows used in a food chain point away from the organism doing the eating rather than indicating the **flow of energy** from one trophic level to another and vice versa;

For example, *water weed* ← *small fish*

rather than (with direction of the arrow):

*water weed* → *small fish*

- (ii) Drawing a food chain literally meant to draw the organisms.

The majority of candidates were unable to differentiate between a food chain and a food web. Emphasis must be placed on constructing food chains **beginning with the producer**, plants.

In Parts (c) (iv) and (v), many candidates recognised industrial waste as being a possible source of water pollution and consequently affecting aquatic life. In Part (d), some students inadequately stated that the dead fish should not be sold because of the presence of bacteria and simply because the fish was dead. However, many of the candidates recognised that due to possible contamination, it would not be ethical to collect and sell the dead fish.

#### Recommendations

An inquiry approach to this topic could be taken while teaching. Students could be given scenarios involving projects that generate wastes. They could be guided through the questioning to infer the impacts on individuals and community activities and consider the related ethical issues. Students could also benefit from the construction of suitable models that reflect safe and ethical ways of dealing with wastes generated within communities.



### Question 5

This question tested the candidates' knowledge and ability to use knowledge relating to controlling temperature, conduction, convection, use of a bimetallic strip and ventilation.

In Part (a), many candidates seemed to encounter difficulty in drawing a diagram to represent how the metallic strips were expected to expand as their temperature increased. A few of the candidates **incorrectly** thought that the strips would separate.

In explaining the term "thermostat" in Part (b) (i), about 50 per cent of the candidates used the term "measure" or "check" temperature or heat instead of indicating that a thermostat is a device used for **controlling** the temperature of an appliance. Many of the responses suggested that the candidates confused the term 'thermostat' with thermometer or thermos flask. Many of the candidates incorrectly suggested that a thermostat controls current or electricity.

In Part (b) (ii) many of the candidates **erroneously** assumed that if the strip is heated then current is flowing so the circuit is closed.

Part (e) (i) – This seemed to be the most difficult part of the question for candidates. Most candidates had difficulty using the appropriate terms:

For the cause of

- "increased levels of mould and mildew", many candidates indicated that moisture was necessary but many thought that rain water had to get in from outside for the mould to grow.
- "headaches", the most popular answer was heat. The expected answers included fumes from paint and the accumulation of carbon dioxide.
- "allergies", many candidates strayed from the concept of ventilation and attributed the allergies to something that was eaten.

Part (e) (ii) was also fairly well done; opening of windows, use of fans and air conditioning were acceptable.

### **Recommendations**

A practical approach to this topic could be taken while teaching. Models of thermostats corresponding to different temperatures could be made, compared, drawn and explained. Simulations depicting the appearance of thermostats while an appliance is in use can be considered where possible.

### Question 6

Generally, candidates performed unsatisfactorily on this question. Many candidates scored less than half of the available points. The majority of candidates scored well in Part (a). Some candidates confused a force with energy and some incorrectly equated a force with pressure.

Part (b) was not well done. The majority of candidates were unable to give adequate responses to Parts (b) (i) and (ii). In Part (b) (i), candidates confused gravitational force with magnetic force, while some stated consequences of gravitational force. These responses were not accepted. Acceptable responses indicated that the gravitational force is the force with which a large object, for example, the earth or moon attracts another object. Friction is a force that "opposes motion" was an acceptable response to Part (b) (ii).

Many candidates were unable to score marks in Part (c) (i). Most candidates described how to set up the diagram rather than describe or explain how to manipulate the apparatus to determine the mass of the unknown (mango).

Part (d) was fairly well done. Most candidates were able to correctly define the term “machine”.

Generally, Part (e) (i) was well done with only a few candidates unable to label the parts correctly.

### **Recommendations**

A practical approach should be taken in teaching the concept of machines. In practical activities students can use a metre rule, strings and known masses, to find the masses of various small objects. Use of the appropriate equation should be emphasised.

## **Paper 03 – School-Based Assessment**

### **Overall Performance**

The overall performance was fair. Greater effort is needed in the development of the skills of Analysis/Interpretation and Planning/Design. Generally, notebooks and mark schemes were submitted. In many cases the student instruction sheets were not submitted.

### **Recommendations to Teachers**

- All laboratory report books should have a contents page with the following format and headings.

<b>Lab. No.</b>	<b>Page</b>	<b>Description of Laboratory Exercise</b>	<b>Date</b>	<b>Skills Assessed</b>

- The pages of the laboratory notebook should be numbered.
- Each activity should begin on a new page and be properly dated.
- The skills assessed and marks allocated should be written next to the laboratory report and on the contents page.
- The maximum mark to be awarded to each skill is 6 marks. Skills marked out of other totals should be scaled to six.
- The dates when each practical was assessed should be included in laboratory reports.
- All skills except P/D should be assessed at least four times over the two-year period. P/D should be assessed at least twice over the two-year period.
- **The mark scheme used to assess skills must include components of (a) and (b) as outlined in the syllabus.**

### **Observations, Recording and Reporting (ORR)**

- Proper laboratory format should be used, for example:  
Title  
Aim  
Apparatus/Materials  
Diagram  
Method  
Results/Observations  
Discussion  
Conclusion
- Reporting should be concise and observations should be recorded in a suitable format. The use of tables is recommended whenever possible.
- Numerical tables should have the physical quantities and units stated in the heading, and the number of decimal places should be consistent.
- Non-numerical tables should have appropriate headings. Details of data recorded should include all observations, for example, the solution turned from blue to green to orange upon heating.
- Graphs should have axes labelled, appropriate scales, points plotted accurately and a **smooth curve or best fit line drawn**. (Only growth curves should have the points joined dot-to-dot.)
- Where prose is used to record observations, details of data are necessary.

### **Analysis and Interpretation (A/I)**

- For assessing this skill, avoid choosing laboratory exercises that are too simple, for example, 'testing milk for protein'.
- Laboratory exercises must lend themselves to the identification of trends, patterns and relationships.
- Inferences must be linked to the results/observations.
- Evaluations should not be general statements. Conclusions need to be linked to the aim of the laboratory activity stated and the data obtained.
- Calculations shown must include formulae and units.
- Questions from the textbook should not be used as A/I laboratory exercises. Laboratory exercises must be carried out and the data generated should be analysed and interpreted.

### **Planning and Design (P/D)**

- P/D laboratory exercises need to be more original whereby students are required to formulate a hypothesis and design a scientific experiment to test the hypothesis.
- P/D laboratory exercises do not have to be done to prove a scientific fact. If they are carried out they can be used to assess other skills and the plan can be modified as necessary.
- **Textbook laboratory exercises are not acceptable as P/D experiments.**

- Some laboratory exercises did not lend themselves for assessment as P/D laboratory exercises, for example, 'making soap', 'reactivity of metals' and 'model of lungs'.
- **A hypothesis is a statement and should not be written in the form of a question.**
- Procedures should reflect a direct link with the hypothesis.
- Procedures should include the number of times the experiment is to be repeated and any precautions to be taken.

### **Paper 03/2 – Alternative to the SBA**

#### Question 1

##### **Observations, Recording and Reporting (ORR)**

For this skill, candidates achieved an average of 4.5 out of 9. Some candidates did not adequately indicate their observations pertaining to the contents of the tube. Many inadequately used terms such as murky, dirty and cloudy instead of recording the observed colour.

The drawing of the boiling tube with the contents was in general, well done; however, the labelling needed improvement.

##### **Manipulation and Measurement**

In general, it was evident from the candidates' responses that they effectively used the materials provided. The candidates were able to carry out the instructions.

##### **Analysis and Interpretation (A/I)**

Analysis and interpretation relative to the candidates' ability to determine the pH from the colour chart was generally well done.

##### **Planning and Design (P/D)**

The skill was not well demonstrated by many candidates. Some candidates did not adequately indicate the hypothesis and state the required precautions.

#### Question 2

##### **Observations, Recording and Reporting (ORR)**

For this skill many candidates responded satisfactorily. Their tables were usually correct except for the data concerning volume of HCl. Instead of an accumulative value, for example, 5, 10, 15 and 20, many candidates wrote, 5, 5, 5 and 5.

##### **Manipulation and Measurement**

It was evident from the responses that the candidates were able to carry out the instructions.

##### **Analysis and Interpretation (A/I)**

Some candidates seemed challenged in writing the expected word equation and in identifying the type of reaction involved. The interpretation of the graph to give the correct quantity of acid by extrapolation also seemed to be a challenge for the candidates.

**CARIBBEAN EXAMINATIONS COUNCIL**

**REPORT ON CANDIDATES' WORK IN THE  
SECONDARY EDUCATION CERTIFICATE EXAMINATIONS**

**JUNE 2008**

**INTEGRATED SCIENCE**

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**INTEGRATED SCIENCE**  
**GENERAL PROFICIENCY EXAMINATION**  
**JUNE 2008**

**GENERAL COMMENTS**

The CSEC examination in Integrated Science (Single Award) was offered at the General Proficiency Level in 2008. The June 2008 examination consisted of three papers: Paper 01 – Multiple Choice; Paper 02 – Short-response questions and Paper 03 – School-Based Assessment.

The number of candidates entering for this examination was approximately twenty thousand, an increase in the number of candidates when compared to 2007. The overall performance of candidates in 2008 examinations was consistent with the performance in 2007. At the General Proficiency level, approximately 86 per cent of the candidates earned Grades I to III.

**DETAILED COMMENTS**

**Paper 01 – Multiple Choice**

Paper 01 consisted of 60 multiple-choice items. The mean score earned decreased by 4 per cent from 45 per cent in 2007 to 42 per cent in 2008.

**Paper 02 – Structured Paper**

Paper 02 consisted of 6 short-answer, structured questions. The maximum mark for each question was 15 marks and the maximum mark for the paper was 90 marks. The mean score earned on this paper was 63 per cent.

Question 1

This question tested the candidates' understanding of the importance of respiration, the mechanism of inhalation and exhalation and their ability to distinguish between inhaled and exhaled air.

Part (a) which required the sequencing of persons based on the amount of energy required was attempted by most candidates and was generally well done.

Part (b) which required a comparison of possible breathing rates was also generally well done. It required the candidates to identify the activity in which the individual would have the highest breathing rate: 100 metre sprint race was the correct answer.

Part (c) related breathing rates with the comparative movement of the respiratory structures. Many candidates did not identify the expected structures such as ribs, lungs and diaphragm.

Part (d) (i) was fairly well done by many candidates. The most common correct response given was "aerobic respiration occurs in the presence of oxygen and anaerobic occurs in the absence of oxygen." Other acceptable answers included "aerobic respiration produces carbon dioxide and anaerobic respiration produces lactic acid." Common unacceptable/incorrect responses included: aerobic respiration occurring in plants or living things and anaerobic respiration occurring in animals or non-living things and aerobic respiration uses more oxygen than anaerobic respiration.

For part (d) (ii) many candidates correctly indicated that the activity in which anaerobic respiration might be necessary was the 100 metre sprint race. In some responses, however, the knowledge of less energy is produced in anaerobic respiration as compared to aerobic respiration was often incorrectly

applied to justify that the activity requiring the least energy – working at the computer was the answer to this part.

Part (d) (iii) which tested candidates' ability to compare and contrast respiration was not well done by many of the candidates. An acceptable response is "the continued need for energy in the absence of oxygen" or "a backup supply of energy."

Some erroneous ideas included:

- *Anaerobic respiration is the same as breathing or ventilation*
- *Anaerobic respiration provides oxygen during the race to oxidize lactic acid*
- *Anaerobic respiration alone provides energy for the race*
- *Oxygen is not needed during the race*

Part (d) (iv) tested candidates' ability to distinguish between inhaled and exhaled air. This part was generally not well done.

Example of acceptable responses:

<b>Inhaled air</b>	<b>Exhaled air</b>
More or higher percent oxygen (or 21% oxygen)	Less or lower percent oxygen (or 16 % oxygen)
Less carbon dioxide (or 0.03% carbon dioxide)	More carbon dioxide (or 4.0% carbon dioxide)

Part (e) tested candidates' ability to account for the difference between inhaled and exhaled air with respect to the process of respiration. This part was generally not well done. Many of the responses only indicated that inhaled air had oxygen or more oxygen and exhaled air had carbon dioxide or more carbon dioxide. Few responses made correct reference to respiration rate being higher and demanding more oxygen or mentioned the difference in temperature as related to the higher metabolic rate or the loss of moisture due to higher metabolic rate.

### **Recommendations**

In general, more attention needs to be given to the structures of the respiratory system as required by the Integrated Science syllabus. The use of models depicting the movement of the ribs and diaphragm and accounting for volume changes in the lungs during breathing is encouraged.

### **Question 2**

This question tested the candidates' ability to classify simple machines that are used in everyday life and interpret the graphical relationship between load and mechanical advantage.

For Part (a) many candidates were able to correctly identify the lever and pulley. Some candidates, however, incorrectly named the lever as an inclined plane. With respect to how the lever makes work easy, acceptable responses include "by allowing the use of a smaller force over a longer distance" and the "use of little or less effort." Unacceptable responses included "prevents you from using your teeth" and "allows you to open a bottle."

For the pulley, it was expected that students would have looked at the redirection of the effort to move the load or compare the upward lifting with pulling downwards. Many candidates, however, did not focus as expected on the use of the effort to move the load.

For Part (b) many candidates were able to classify the levers. For (ii) some candidates were able to correctly identify the load as the nail, the curve on the crowbar as the fulcrum and the handle of the crowbar as the area where the effort would be applied.

In Part (c) candidates were provided with a graph of Mechanical Advantage against Load.

Part (c) (i) in which candidates were required to estimate the Mechanical Advantage was very well done by many candidates. For (ii) the relevant equation  $M.A. = \text{Load}/\text{Effort}$  was widely known.

For Part (iii) many candidates gave the acceptable response that “as the load increases, the mechanical advantage decreases” in describing the trend shown on the graph.

Part (iv) in which a reason was required for the trend depicted by the graph, was not well done. Not many candidates indicated the expected response of “a reduction of the efficiency of the machine” or that “friction could have affected the machine.”

For Part (d) (i) many candidates correctly predicted that the scissors left by the kitchen sink would rust. For (ii) many of the candidates, however, did not indicate the possible effect of rusting on the efficiency of this machine.

### **Recommendations**

As students are guided through how to identify and interpret trends and patterns in graphs, questions should also be posed. The students should also be encouraged to make inferences or propose explanations for the trends.

### **Question 3**

This question tested the candidates’ understanding of earth movements and their effects. It required the use of this knowledge for making inferences about the movements of persons and other observations such as air pollution and safety during natural disasters.

Most of the candidates gave satisfactory responses to this question.

For Part (a) most candidates gave the expected response of a volcano.

For Part (b) some candidates confused the meaning of the terms lava, lever and larva. Acceptable responses indicated that lava is a mixture of molten or hot rocks, and gases.

Parts (c) and (d) were fairly well done by some candidates. Appropriate responses included fear of eruption and high temperature of surroundings and pollution, as possible reasons for migration. Appropriate precautions such as wearing of protective clothes and the sealing of windows and doors were commonly indicated.

Parts (e) to (g) were also fairly well done. However, candidates need to be aware that there may be both negative and positive economic results from some natural disasters: Economic benefits seemed to have been interpreted by some candidates as relevant only to government, example the governments’ receiving of funding or financial aid from other countries after a hurricane.

### **Recommendations**

Teachers should engage students in discussions that encourage a more complete analysis of consequences of each natural disaster studied. Economic benefits may be related to the nation’s, as well as individual’s, financial development or gains, for example, “farmers could get better yields from their crops due to more fertile soil.”

### **Question 4**

This question tested the candidates’ understanding of the importance of the nervous system and hormones in coordinating, facilitating balance and general development of the body.



This question was attempted by most of the candidates with the majority of them giving satisfactory responses. Part (a) was fairly well done; many responses were not complete for the functions of the brain, eyes, muscles and semi-circular canal. Complete responses for the brain for example, indicated the cognitive interpreting aspect as well as the coordinating aspect. For Part (b) many candidates gave the correct response of adrenaline.

For Part (c) (i) many candidates gave the correct response of levels 3 and 5 for (i), and “more stability or balance” for (ii).

For Part (d) many candidates seemed to have had difficulty remembering the specific names of the hormones, and used inappropriate terms such as the emotional hormone, facial hormone or testes hormone for testosterone.

### **Recommendations**

More attention needs to be given towards

- reducing candidates’ spelling errors for scientific names
- encouraging candidates to focus on the instructional words in the questions
- engaging students in activities that will provide practice in answering analysis, use of knowledge type questions

### **Question 5**

This question tested the candidates’ knowledge about fishing, feeding relationships among some aquatic organisms and their ability to infer possible effects of pollution and the need for substances that support life.

In Part (a) many candidates drew a food web instead of a food chain. Some candidates did not start the food chain with a producer. In some responses, the arrows were placed in the incorrect direction.

Part (b) was fairly well done with a large percentage of candidates offering creditable responses such as “small plants and algae.” A common misconception, however, was “larvae” as producers.

Few candidates were able to state two effects on the organisms in Part (c), such as increase in the population of the algae and/or small plants and the decrease in population of small fish.

Candidates’ performance in Part (d) was satisfactory. The majority of candidates were able to identify two methods that could be used by the villagers to catch fish in the river.

Part (e) (i) was fairly well done by many candidates.

Part (e) (ii) was not well done; the majority of candidates were unable to justify the response given in (e) (i). The reason was given in terms of ‘deep sea fish’ rather than ‘deep sea waters’. Very few candidates saw the commercial aspect.

The performance in (f) (i) was satisfactory with a high percentage of candidates giving a correct response that the fish would die.

Part (f) (ii) was fairly well done by candidates. However, some candidates did not indicate the importance of oxygen as required.

Part (g) was not well done. Over 50 per cent of the candidates gave inaccurate or inadequate responses such as ‘the water should be left in the sun for a while to kill the microorganisms’, or ‘the

sun will evaporate the pollutants from the water' instead of the expected response indicating the role of the sun in increasing the temperature, evaporation and the collection of the water.

### **Recommendations**

Students should be exposed to the practical components of this topic by observing the use of the apparatus for purifying polluted water by the sun's energy.

Construction of food chains and food webs of habitats emphasizing the meaning and direction of the arrows should be practised.

### **Question 6**

This question tested the candidates' understanding of friction and bounce and their ability to relate the properties of materials with their use in sports.

Parts (a) (i) tested the candidates' knowledge of the terms friction and bounce and their ability to relate these terms to playing surfaces. Many candidates had a fair idea of the definitions of the terms friction and bounce, however, few were able to make the necessary relationship with the playing surfaces. Part (b) (i), (ii), (iii) and (iv) were not well done by many candidates. Some candidates indicated the correct response of A for the surface with the highest bounce and B for the smoothest surface.

For part (c) some candidates correctly gave the function of the midsole for cushioning the feet and rubber as a suitable material; and the outsole for preventing skidding and plastic or rubber as suitable materials for the outsole.

## **Paper 03/2 – Practical Paper**

Paper 03/2 consisted of 2 compulsory practical-based structured questions. Each question was divided in parts that measured a particular skill. The maximum mark for each question was 27 marks.

### **Question 1**

- (a) Parts (i) and (ii) required the candidates to accurately measure the original length of a spring and a rubber band. This was generally well done except for those candidates who measured in millimeters and in inches rather than centimeters.
- (b)
  - (i) Candidates were expected to transfer data from Table 1 to Table 2. When recording the load at zero grams, some candidates inappropriately responded with a different value with the words "nil" or "zero.": Numerical values were required.
  - (iii) Generally the data for Section (iii) was well recorded. However, some candidates recorded the original length, instead of the new length for each load.
  - (iv) While most candidates were able to calculate the extension of the spring, some wrote the new length of the spring instead.
  - (vii) Similar problems as indicated in (iv) were observed with the treatment obtained from the rubber band.
- (c) For Parts (c) and (d) few candidates produced a good graphical representation of the data.
- (d) Most graphs did not have a title even though the axes were labelled.

- (e) Some candidates plotted load against length instead of against extension of the spring. Candidates made a common error of dividing by the smaller number instead of the greatest load (100mg). Some candidates did not seem to understand the concept of division by 100.
- (f) Some candidates did not use their recorded results to deduce which material was more elastic as required.
- (g) Most candidates correctly identified the extension of the spring as the dependent variable.

### Question 2

- (a)
  - (i) Generally, drawings were satisfactory, however candidates needed to refrain from shading.
  - (ii) Many candidates did not write an appropriate title for the drawings.
  - (iii) Many candidates were not able to indicate the magnification.
- (b) Table 3 was generally well done however some candidates added the length of the strips together instead of calculating the change in length.
- (c) Some candidates inappropriately drew in three dimension instead of the expected two dimensional representation.
- (d) Students generally gave good observations. However, they generally did not account for the type of medium.
- (e) A greater understanding and a more detailed explanation of the process of osmosis was needed as it related to the observations.
- (f) For (f) and (g) candidates were unable to differentiate between the different types of variables.
- (g) Candidates were able to relate the use of the three strips to the accuracy or repeatability or replication of the results.

### Recommendations

- More practice is suggested for the construction of graphs from practical activities involving the collection of data. Teachers are encouraged to remind students to write appropriate titles for all drawings, graphs and tables.
- Students should be encouraged to pay attention to the scientific drawing style and should also be encouraged to draw in two dimensions instead of in three dimensions.

## **Paper 03 – School Based Assessment**

### Overall performance

The overall performance on the School-Based Assessment at the General Proficiency level was fair. However, greater attention is needed in developing the skills of Analysis and Interpretation and Planning/Designing. Generally, notebooks and mark schemes were submitted. In most cases student instruction sheets were not submitted.

### Recommendations to Teachers

- All Laboratory report books should have a content page with the following format and headings.

Lab No	Page	Description of Laboratory Exercise	Date	Skills Assessed

- The pages of the laboratory notebook should be numbered.
- Each activity should begin on a new page and be properly dated.
- The skills assessed and marks allocated should be written next to the laboratory report and in the contents page.
- The maximum mark to be awarded to each skill is 6 marks. Skills marked out of other totals should be scaled to six.
- The dates when the practicals were assessed should be included in laboratory reports.
- All skills except Planning Design (P/D) should be assessed at least four times over the two year period. P/D should be assessed at least twice over the two year period.

### Observations, Recording and reporting (ORR)

- Proper laboratory format should be used, for example:
  - Title
  - Aim
  - Apparatus/Material
  - Diagram
  - Method
  - Results/Observation
  - Discussion
  - Conclusion
- Reporting should be concise and observations should be recorded in a suitable format. The use of tables is recommended whenever possible.
- Numerical tables should have the physical quantities and units stated in the heading, and the number of decimal places should be consistent.
- Non-numerical tables should have appropriate headings. Details of data recorded should include all observations for example, the solution turned from blue to green to orange upon heating.
- Graphs should have axes labeled, appropriate scales, points plotted accurately and a **smooth curve or best fit line drawn.** ( Only growth curves should have the points joined dot to dot.)
- Where prose is used to record observations, details of data are necessary.

### **Analysis and Interpretation (A/I)**

- The laboratory exercises chosen for assessment were too simple, for example ‘testing milk for protein’.
- Laboratory exercises must lend themselves to the identification of trends, patterns and relationships.
- Inferences must be linked to the results and/or observations.
- The evaluation should not be general statements. Conclusions need to be linked to the aim of the lab stated and the data obtained.
- Calculations shown must include formulae and units.
- Questions from the textbook should not be used as A/I laboratory exercises. Laboratory exercises must be carried out and the data generated analysed and interpreted.

### **Planning and Design (P/D)**

- P/D laboratory exercises need to be more original whereby students are required to formulate a hypothesis and design a scientific experiment to test the hypothesis.
- P/D laboratory exercises do not have to be done to prove a scientific fact. If they are carried out they can be used to assess other skills and the plan can be modified as necessary.
- Textbook laboratory exercises are not acceptable as P/D experiments.
- Some laboratory exercises did not lend themselves for assessment as P/D laboratory exercises, for example ‘making soap’, ‘reactivity of metals’ and model of lungs’.
- A hypothesis is a statement and should not be written in the form of a question.
- Procedures should reflect a direct link with the hypothesis.
- Procedures should include the number of times the experiment is to be repeated and any precautions to be taken.

### **General Comments on the SBA Moderation Exercise**

- The majority of the SBAs were barely satisfactory with very few outstanding ones. Some of the activities done were typical textbook activities which would not effectively engage students in developing their inquiry skills. One such example is “To find the temperature of hot and cold water.” This activity is too simple for developing students’ analysis and interpretation skills. Students rarely evaluated data and did not always suggest limitations and sources of error.
- Diagrams of laboratory equipment and symbols were unsatisfactory as they were not drawn using standard scientific format and notation. Several chemical equations were written using an equal sign (=) instead of the standard arrow ( $\rightarrow$ ).
- Many students repeated the method and observations in the discussion section and did not offer explanations for their results. It was also observed that some centres used inappropriate specimens for drawing skills. For example, marking of the drawing of a house and the drawing of simple laboratory apparatus. Many students provided explanations for data which was not presented.

- There appeared to be confusion between the terms rusting and corrosion. It should be noted that rusting is a form of corrosion but not all corrosion is due to rusting.
- Generally students' spelling needed much improvement.
- A table of contents with the date, page number and the skills assessed is expected in each lab book. This has been often absent.
- Teachers are encouraged to provide appropriate feedback to their students. This could facilitate the improvement of the students over time.
- There needs to be improved understanding about the requirement for P/D. More novel situations than is presented in standard labs are required. The following are NOT suitable for P/D.
  1. Temperature affects how fast sugar dissolved in water.
  2. Water is necessary for germination.
  3. Air and water are needed for rusting.
  4. Salt water is more dense than fresh water.
  5. White light consists of red, green and blue light.
- More attention needs to be given to the criteria for marking A/I and ORR. These were often confused.

### **Checklist for Integrated Science SBAs**

#### **1. Laboratory Notebooks**

- Lab book no longer than 9" x 12"
- All pages securely bounded
- All pages and labs numbered according to table of contents
- Include student's name and registration number on the cover.
- Each lab includes the date it was done
- Inserted pages (e.g. drawings and graphs) are secured
- Drawings and graphs included in appendix are accurately referenced and or identified.

#### **2. Table of Contents for Laboratory Notebook**

- Title of experiment
- Date of activity
- Page number of activity
- Lab number
- Skills assessed
- Marks awarded

**3. Observation, Recording and Reporting Skill**

- Reports written in logical sequence
- All sections named
- Reports in third person, past tense and passive voice
- Report in concise form
- Appropriate form of observation presented
- Graphs drawn on graph paper
- At least two marks for ORR each year

**4. Drawing Skill**

- Large, clear and fully labelled including title, magnification and view
- Includes fruits, seeds, flowers, storage organs and organisms
- Each drawing is on a clean page with no writing
- Pencil only used for all drawings

**5. Analysis and Interpretation Skill**

- Discussion does not include raw data
- Explanations for all observations discussed
- Trends/ patterns/ relationships identified
- Predictions/ Inferences made
- Calculations are accurate and relevant
- Data evaluated
- Sources of error/ limitations included

**6. Planning and Designing Skill**

- Textbooks labs NOT included
- Hypothesis stated
- Hypothesis based on observation and is testable and manageable
- Design is workable
- Includes sufficient detail for duplication
- Includes precautions, repeated trials and controls

**7. Marking Scheme**

- Concise
- States results and or observations expected
- States inferences expected
- Final score out of six (6)
- Breakdown of marks clearly indicated
- Appropriate to skill being assessed

**CARIBBEAN EXAMINATIONS COUNCIL**

**REPORT ON CANDIDATES' WORK IN THE  
SECONDARY EDUCATION CERTIFICATE EXAMINATION**

**JUNE 2009**

**INTEGRATED SCIENCE  
(SINGLE-AWARD)**



**INTEGRATED SCIENCE  
(Single-Award)**

**GENERAL PROFICIENCY EXAMINATION**

**JUNE 2009**

**GENERAL COMMENTS**

The CSEC examination in Integrated Science (Single Award) was offered at the General Proficiency Level in 2009. The June 2009 examination consisted of three papers; Paper 01 – Multiple Choice; Paper 02 – Structured Questions and Paper 03 – School-Based Assessment.

A Paper 03/2 – Practical Paper was taken by private candidates.

The number of candidates entered for this examination was approximately 20 000, an increase when compared to 2008. The overall performance of candidates in the 2009 examinations was consistent with the performance in 2008. At the General Proficiency level approximately 89 per cent of the candidates earned Grades I to III.

**DETAILED COMMENTS**

**Paper 01 – Multiple Choice**

Paper 01 consisted of sixty (60) multiple choice items which tested the knowledge and comprehension profile. The mean score increased from 41 in 2008 to 43 in 2009. The performance on the questions from Sections A and B of the syllabus was very good while that for Sections C and D was only satisfactory.

**Paper 02 – Structured Response Questions**

Paper 02 consisted of six (6) short-answer, structured questions. The maximum mark for each question was 15 marks and the maximum mark for the paper was 90 marks. The mean score earned on this paper was 63.50.

Question 1

This question tested the candidates' understanding of sexual and asexual reproduction and their importance as well as conditions which influence population changes. In general, this question was not very well done.

For part (a) many candidates correctly identified the structures – petal, bud, fruit and stem in Figure 1. However, for part (b) many candidates were unable to state the differences between the diagrams in Figures 1 and 2. Examples of satisfactory responses were: the absence of fruits, leaves and flowers from Figure 2 as compared to Figure 1 and Figure 2 is microscopic while Figure 1 is not. Most candidates only provided partial responses such as the plant in Figure 1 was reproducing

by sexual reproduction and they did not state the expected parallel point that the organism in Figure 2 reproduced asexually.

For part (c) some candidates did not identify the names of the structures, as required, but gave definitions and characteristics of sexual and asexual reproduction. Part (d) was not well answered. In part (d) (iii) with respect to the advantage of producing genetically identical plants, most candidates responded appropriately in terms of mass production/yield/quantity. However, few candidates responded with satisfactory responses such as, “If the parent plant is superior then the offspring will also be genetically superior” and “if the parent is good, then all of the offspring will be good”.

With respect to the disadvantage of producing genetically identical plants, some candidates responded correctly by stating that there would be a lack of variety because the fruits produced would have the same characteristics.

Parts (e), (i) and (ii) were generally well answered. For part (e) (iii) few candidates responded as expected to indicate that ‘the population would decrease because proteins will be denatured by the high temperature’. Partial response provided by the candidates were “it was too hot for the organisms to survive”; “it was too hot” and “the organism could not withstand the high temperature”.

### **Recommendation**

Candidates should be encouraged to express differences in terms of parallel points to improve completeness of responses.

### **Question 2**

This question tested candidates’ understanding and ability to use knowledge relevant to the following areas:

- Nutrient content of foods
- Nutrition requirements of different age groups and
- Food contamination and precautionary measures to prevent it

This question was fairly well done by most of the candidates. Part (a), (c) and (e) were generally well done.

For part (b) some candidates:

- confused ‘function’ with ‘nutrients’ – for example, ‘carrots for good eyesight’ instead of ‘carrots contains vitamins’.
- failed to identify the major nutrients in the stated plant, minor nutrients were identified instead.

For part (c) a few candidates were unable to differentiate

For part (d)

- Many candidates ticked more than the required two boxes for each age group as the criteria for the food selection.
- Some candidates selected one criterion for each person.
- Some candidates repeated the criteria instead of giving the reasons in (d) (ii); for example, vitamins and minerals instead of the reason for which the age group required the nutrient.

The expected responses for part (d) were:

*Five-year-old child*

- Vitamins and minerals – for growth and development
- Energy content of food – more energy/lot of energy required due to active lifestyle, for example, running and playing.

*Seventy-five-year-old man*

- Vitamins and minerals – for maintenance of good health
- Softness of food – loss of teeth/problems resulting from mechanical digestion.

Few candidates indicated correctly that a person of seventy-five years old required less energy due to their decreased activity. Part (e) was done well by many candidates; however a small percentage did not see it as a safety question. Responses on ‘time management’, nutritional needs of the five and seventy-five year old’ and ‘safety in the kitchen’ with respect to fires were popular as opposed to ‘sanitary practices’ and ‘food contamination’ which were expected.

### **Recommendations:**

1. Teachers should pay attention to the spelling of science vocabulary. Suggested activities: word search, anagrams and spelling quizzes.
2. Attention should be given to examples of foods that contain vitamins and minerals as **major** sources of nutrients.
3. Students must be able to distinguish between ‘nutrients’ and ‘foods’.
4. Encourage students to read the entire question before attempting to answer any section of the question.
5. In working through with then students past examination questions, teachers should discuss strategies for identifying and responding appropriately to key words in the questions.

### Question 3

This question tested the candidates' understanding of temperature, the thermometer, expansion of materials as well as the need for appropriate physical conditions such as ventilation and sanitation in the home and workplace.

Overall, this question was satisfactorily attempted by many candidates. For part (a) (i), many candidates responded correctly and included responses such as narrow constriction for clinical thermometer.

For part (a) (ii) many candidates explained rather than gave the requested names of the processes: evaporation and cooling.

For part (b) many candidates correctly indicated metal A as the least expanded metal represented in the graphs presented.

Most candidates responded appropriately to part (c) (i); responses included 'installing extractor fans' and 'more windows or doors'.

#### **Recommendations:**

1. More attention should be given to analysis and synthesis which require students to think and provide explanations for their designs.
2. Students should be encouraged during lessons to pay attention to instructional terms such as "state" to avoid providing explanations when not requested.

### Question 4

This question tested candidates' understanding of concepts related to energy conversion and factors affecting man's use of energy. Emphasis was placed on the use of solar energy as an alternate source to fossil fuels. Students were expected to exhibit a working knowledge of how a solar water heater is constructed and functions. This question further tested the candidate's knowledge of the process of fractional distillation; the problems associated with the use of fossil fuels; solar energy and the methods of heat transfer.

Generally the responses ranged from weak to fair.

Parts (a) (i) to (iii) were not well done by many candidates. The performance in (a) (ii) was satisfactory; many candidates explained the processes for B (condensation) and C (boiling or evaporation) instead of naming the process as required by the question.

In (a) (iii) candidates showed that they did not understand the concept of fractional distillation.

Part (b) (i) was well done, many candidates showed a good knowledge of the environmental effects of the use of fossil fuels.

Candidate's performance in (b) (ii) was poor. The majority of candidates misunderstood "limit the use" and as a result gave responses opposite to what was expected. They instead gave answers which would promote the use of solar energy.

Part (c) (i) was fairly well done by candidates. Most candidates knew the heat transfer methods but were not sure of the correct response required based on the stimulus provided.

Part (c) (ii) was well done. Most candidates were able to correctly state the purpose of the black paint. However, some candidates could not give the correct explanations of increasing the absorption of heat energy; some inappropriately used words such as “*attraction, contract and draw in of heat*”.

Performance of many candidates in (c) (iii), (iv) and (v) was poor. For part (c) (v), reasons given for the material of choice for a cover of the solar water heater very rarely indicated that the choice was essentially to allow the transfer of heat energy by radiation.

The performance in (c) (vi) was satisfactory with a high percentage of candidates giving creditable responses. Many candidates showed an understanding of appropriate uses of the water from the solar water heater and gave answers such as washing and bathing. However, a few candidates incorrectly indicated that the water could have been used to sterilize objects.

In (c) (vii) many candidates showed an understanding of the preferential reasons for using a solar water heater above a heat or electrical water heater. Reasons such as conservation of fossil fuels and cleaner or cheaper source of energy were acceptable.

### **Recommendations**

1. Students require more practice sessions at school answering questions that require them to demonstrate knowledge and use of knowledge.
2. Teachers and students should place more emphasis on the use of correct scientific terms.
3. Students should be exposed to the practical components of this topic; suggestions are:
  - Design, build and use simple water heaters at school.
  - Perform simple experiments to illustrate the idea of separation by distillation.
  - Tours to distilleries and houses equipped with solar heaters.
  - Perform simple experiments to demonstrate the different methods of heat transfer.

### **Question 5**

This question tested the candidates’

For part (d) (i) some candidates seemed not to have understood the meaning of the term 'hypothesis' and wrote statements or questions which inappropriately referred to a title, method or aim of an experiment. In part (ii), many candidates did not understand the term 'variables'. For Part (d) (iii) most candidates who constructed tables placed the headings in inappropriate positions.

### **Recommendation**

Students need practice in tabulating data. Special emphasis needs to be placed on assigning appropriate column and row headings.

### Question 6

This question tested candidates' understanding of some basic concepts involved in motion on land, centre of gravity and scientific principles relevant to road safety practices.

This question was attempted by many candidates. Knowledge and comprehension were weak overall for this question.

Part (a) of the question was attempted by almost all candidates; however, most candidates failed to give a proper definition of centre of gravity (for example, "the point in a body at which all the weight acts or the body balances")

Part (b) was not attempted by most candidates. There was little evidence that candidates were familiar with this method of determining the centre of gravity.

Part (c) required the marking of the likely position of the centre of gravity of Figure 9 and was well done by most candidates.

For part (d) many candidates provided unclear responses with a general idea of balance. Complete responses indicated that "with one bag, her centre of gravity would shift to one side making it difficult to balance (more effort would be required to remain stable).

Part (e) (i) seemed to pose a great difficulty for most candidates. Candidates did not distinguish between the two types of equilibrium.

Part (e) (ii) – (v) was well done with most candidates gaining marks in this section.

### **Recommendation:**

- Teachers should engage students in more activities for determining the centre of gravity.

### **General Recommendations**

Students should be exposed to the practical components of topics in general; emphasizing the relationship between the properties of materials and their uses as well as safety precautions and reasons for them. More attention needs to be given to:

- The naming of parts of plants and their function in sexual and asexual reproduction.
- Reducing students' spelling errors for scientific names.
- Encouraging students to focus on the instructional words in questions from past examination papers.

- Encouraging students to participate in activities that will assist in the development of their ability to apply scientific concepts to everyday life.

Teachers should also provide practice in answering analysis and use of knowledge type questions.

### **Paper 03 – School-Based Assessment**

#### **Overall performance**

The overall performance in the School-Based Assessment was fair. However, greater effort is needed in Analysis and Interpretation and Planning/Design. Generally notebooks and mark schemes were submitted. In most cases student instruction sheets were not submitted.

#### **Recommendation to Teachers**

- All laboratory report books should have a content page with the following format and headings.

<b>Lab No</b>	<b>Page</b>	<b>Description of laboratory exercise</b>	<b>Date</b>	<b>Skills Assessed</b>

- The pages of the laboratory notebook should be numbered
- Each activity should begin on a new page and be properly dated.
- The skills assessed and marks allocated should be written next to the laboratory report and in the contents page.
- The maximum mark to be awarded to each skill is 6 marks. Skills marked out of other totals should be scaled to six.
- Dates when the practicals were assessed should be included in laboratory reports.
- All skills except P/D should be assessed at least four times over the two-year period. P/D should be assessed at least twice over the two-year period.
- **The marks scheme used to assess skills must include components of (a) and (b) as outlined in the syllabus.**

#### **Observations, Recording and Reporting (ORR)**

- Proper laboratory format should be used, for example:

Title

Aim

Apparatus/Material

Diagram

Method

Results/Observation

Discussion

Conclusion

- Reporting should be concise and observations should be recorded in a suitable format. The use of tables is recommended whenever possible.
- Numerical tables should have the physical quantities and units stated in the heading, and the number of decimal places should be consistent.
- Non-numerical tables should have appropriate headings. Details of data recorded should include all observations, for example, the solution turned from blue to green to orange upon heating.
- Graphs should have axes labelled, appropriate scales, points plotted accurately and a **smooth curve or best fit line drawn**. (Only growth curves should have the points joined dot to dot.)
- Where prose is used to record observations, details of data are necessary.

### **Analysis and Interpretation (A/I)**

- Laboratory exercises chosen for assessment were often too simple, for example, ‘testing milk for protein’.
- Laboratory exercises must lend themselves to the identification of trends, patterns and relationships.
- Inferences must be linked to the results/observations.
- Evaluation should not be general statements. Conclusions need to be linked to the aim of the lab stated and the data obtained.
- Calculations shown must include formulae and units.
- Questions from the textbook should not be used as A/I laboratory exercises. Laboratory exercises must be carried out and the data generated analysed and interpreted.

### **Planning and Design (P/D)**

- P/D laboratory exercises need to be more original, whereby students are required to formulate a hypothesis and design a scientific experiment to test the hypothesis.



- P/D laboratory exercises should not be done to prove a scientific fact. If they are carried out they can be used to assess other skills and the plan can be modified as necessary.
- **Textbook laboratory exercises are not acceptable as P/D experiments.**
- Some laboratory exercise did not lend themselves for assessment as P/D laboratory exercises, for example ‘making soap’, ‘reactivity of metals’ and ‘model of lungs’.
- **A hypothesis is a statement and should not be written in the form of a question.**
- Procedures should reflect a direct link with the hypothesis.
- Procedures should include the number of times the experiment is to be repeated and any precautions to be taken.

**Checklist for guiding teachers in the performance, marking and submission of Integrated Science SBAs.**

**1. LAB BOOKS**

- Laboratory book is no longer than 9” x 12”.
- All pages are securely bound.
- All pages and labs are numbered according to table of contents.
- Student’s name and registration number are included on the cover.
- Each lab includes the date on which it was done.
- Inserted pages (e.g. drawings and graphs) are secured.
- Drawings and graphs included in appendix are accurately referenced and/or identified.

**2. TABLE OF CONTENTS**

- Title of experiment
- Date of activity
- Page number of activity
- Lab number
- Skills assessed
- Marks awarded

**3. OBSERVATIONS, RECORDING AND REPORTING**

- Reports are written in logical sequence.
- All sections are named.
- Reports are written in third person, past tense and passive voice.

- Report is written in concise form.
- Appropriate form of observation is presented.
- Graphs are drawn on graph paper.
- At least two labs are marked for ORR each year.

#### 4. **DRAWINGS**

- Large, clear and fully labelled including title, magnification and view
- Includes fruits, seeds, flowers, storage organs and organisms. *NOT* laboratory apparatus and non-living objects
- Each drawing is on a clean page with no writing on the page
- Pencil only used for all drawings

#### 5. **ANALYSIS AND INTERPRETATION**

- Discussion does not include raw data.
- Explanations for all observations are discussed.
- Trends/patterns/relationships are identified.
- Predictions/Inferences are made.
- Calculations are accurate and relevant.
- Data are evaluated.
-

- States expected inferences
- Final score out of six (6)
- Breakdown of marks clearly indicated
- Appropriate to skill being assessed

### **Paper 03/2 – Practical Paper**

#### Question 1

Question 1 tested the candidates' knowledge of chromatography. This question was generally well done and attempted by most candidates.

This section was fairly well done with most candidates easily setting up the experiment. However, severe blotting indicated that few candidates may have added ink instead of the solvent at intervals.

In some centres the ink did not spread as it was expected to. Generally, a good spread of more than 3 cm in diameter was expected over the half-hour period.

In recording values in the table for 1(e) candidates stated the actual time the reading was taken instead of the time intervals. The units (minutes) were generally not stated.

Recording the description of colours was generally well done. Marks were awarded if colour seen was stated. Although candidates were able to deduce that the ink was composed of different colours, many did not infer that the different colours moved at different rates on the filter paper.

Candidates attached their filter paper and recorded the results in the table.

Several candidates were unable to produce a two-dimensional diagram. Teachers must ensure that two-dimensional drawings are practised without shading and label lines must be straight without arrowheads. Labels must accompany each diagram.

Candidates generally understood the concept of the aim of an experiment and most answers were well stated.

The conclusion was sometimes not relevant to the observation or linked to the aim. It was not specific enough for full marks to be awarded. Detailed colours of the spread needed to be accounted for. Candidates generally stated observations instead of conclusions.

Many candidates confused the aim and hypothesis. Teachers should emphasize the difference between the aim and hypothesis. A hypothesis is a statement indicating a suggested explanation for an observable phenomenon.

In part (k) candidates were not specific in stating the variable, for example, stating 'ethanol' instead of 'amount of ethanol'.

## Question 2

### **Part A**

Part A tested whether candidates could set up a series circuit using different materials in it to take current and voltage readings.

In some examination centres, bulbs were not provided to candidates and they therefore only recorded voltage and resistance readings in the table. Instructions did not indicate that bulbs were required; hence many candidates attempted the question without using bulbs. In such instances candidates were not penalised.

For the table in part (d) recorded values were not consistent with respect to significant figures. Teachers should make students aware of the importance of significant figures.

### **Part B**

This part of the question tested the candidates' knowledge of Ohm's law. Candidates were expected to manipulate the equation used to calculate resistance in the circuit.

Most candidates were able to correctly deduce which were conductors and insulators in part (a) of the experiment: that W and Y were conductors and Y and Z were insulators.

Many candidates seemed confused about which values to use in the calculation of resistance. They did not know how to manipulate the equation  $V = I \times R$ . Substitution of values was well done only where it was correctly rearranged. Many candidates did not record the unit for resistance (ohms).

Candidates generally confused the hypothesis with the aim. A hypothesis is a statement indicating a suggested explanation for an observable phenomenon.

Most candidates were able to state the relationship between the wattage, voltage and current. The word or symbol equation  $P = I \times V$  was accepted.

Some candidates failed to attempt parts (b) and (d), the parts of the question that required the use of the equation.

Teachers should ensure that students have sufficient practice in the manipulation of equations, particularly when using data derived from experiments.

**CARIBBEAN EXAMINATIONS COUNCIL**

**REPORT ON CANDIDATES' WORK IN THE  
SECONDARY EDUCATION CERTIFICATE EXAMINATION**

**MAY/JUNE 2010**

**INTEGRATED SCIENCE  
(SINGLE AWARD)  
GENERAL PROFICIENCY**

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## GENERAL COMMENTS

The CSEC examination in Integrated Science (Single Award) was offered at the General Proficiency Level in June 2010. The examination consisted of the following papers: Paper 01 – Multiple Choice; Paper 02 – Short-Response Questions; Paper 03 – School-Based Assessment and Paper 03/2 – Practical Paper - which was taken by private candidates.

The number of candidates entering for this examination was approximately 23,000. There was an increase in the number of candidates entered for the examination when compared with 2009. The overall performance of candidates in the 2010 examination was consistent with performance in 2009.

The CSEC Integrated Science continues to be well received across the Caribbean, as indicated by its increasing population over the years. This subject therefore contributes, as intended, to meeting the needs of the secondary level schools in the area of science education.

The CSEC Integrated Science syllabus is designed to “*allow students to work individually and cooperatively, utilising theoretical concepts of the course in interactive and practical activities*”.

(CXC Integrated Science Syllabus, 2009; p.1)

Within the school system, a variety of strategies could be explored for optimizing the benefits that may be derived from implementing the CSEC Integrated Science syllabus. For example, levels of collaboration among teachers who are often subject specialists in the areas of Biology, Chemistry and/or Physics could facilitate team planning and/or teaching and encourage adequate integration among topics often associated with the single subjects. Students’ performance on topics usually associated with Physics is likely to improve if this strategy is employed. Improved syllabus coverage in the less popular areas of the syllabus could be an objective while this and other strategies are considered.

## DETAILED COMMENTS

### Paper 01 – Multiple Choice

Paper 01 consisted of 60 multiple choice items. The mean score earned at the General Proficiency Level increased by approximately 2.8 from 43.2 in 2009 to 46.0 in 2010.

### Paper 02 – Short-Response Questions

Paper 02 consisted of six short-answer, structured questions. The maximum mark for each question was 15 and the maximum mark for the paper was 90. The mean score earned on this paper was approximately 62.6.

#### Question 1

This question tested candidates’ understanding of the structure and function of the circulatory system of humans and how substances move in plants. It also tested candidates’ understanding and ability to apply the concept of ‘centre of gravity’.

In general, this question was fairly well answered with many candidates scoring most of the available marks.

Part (a) required candidates to give a reason for the transport system in a child and a plant. Some candidates adequately indicated that the system was responsible for the movement of substances (water, minerals, food, oxygen, etc) around the plant or the child. However, some candidates gave broad, ambiguous answers such as 'to stay alive or to grow' which were inadequate because the specific reason for the transport system was not indicated.

For Part (b), candidates were asked to name the processes that allow water to move in and out of the plant. Many candidates correctly named osmosis (at Z) or transpiration (at Y). However, very few indicated whether or not the process identified was occurring at Y or Z. Frequent incorrect answers included photosynthesis, transportation, xylem and phloem which are parts and not processes.

In Part (c), candidates were required to use arrows to show how (i) blood is circulated through a child's body and (ii) water moves into and out of a plant.

*Transport in the child:* A good response for the circulation of blood in the child used three arrows to show movement/complete circulation from the heart to legs and back to the heart, and from the head to the heart and back. Many candidates provided this correct response. Some common incomplete responses included the arrows drawn from the head to the heart and from the heart to legs but none drawn showing the blood returning to the heart.

*Transport in the plant:* A good response for the movement of water into and out of a plant displayed arrows moving from the soil to the root, then up the stem and the third arrow drawn through the leaf and out. Common erroneous responses showed arrows (representing the water) not starting from the soil and then entering the root, but starting from the air or the base of the stem, omitting the root.

For Part (d), for which the candidates were required to name the organ that pumps blood through the human body, some responses correctly indicated the heart; a few students inappropriately indicated the circulatory system as the answer; while some responses also indicated incorrect organs such as the lungs and kidneys.

For Part (e), candidates were required to put a point G on the diagram of the child to show the centre of gravity of the child. An acceptable answer showed 'G' in the abdomen of the child. Some candidates incorrectly showed 'G' outside of the child's body or in the wrong position of the body.

For Part (f), some candidates were able, as required, to draw a vertical arrow from Point G pointing downward to show the direction of the centre of gravity.

For Part (g), candidates were required to state two features of the circulatory system that allow blood to move from the child's leg to the heart. Good responses gave the features as (1) the cardiac muscle of the heart (that pump the blood around the body) and (2) the valves of the veins (which prevented the flow of blood backwards and ensured that the blood returned to the heart).

## Recommendations

1. Students could be engaged in more activities in which they diagrammatically represent and interpret the movement of substances throughout living things to the levels of completeness required by the relevant syllabus objectives.
2. To develop their ability to present drawings or graphical representations, especially related to forces and motion, students could be guided through instruction in using points and arrows appropriately.

## Question 2

This question tested candidates' understanding and ability to apply their knowledge of the conditions that encourage the breeding of household pests and the need for community hygiene. It also tested their understanding of water purification. In general, the responses to this question were very good with many candidates scoring full marks. There were very few non-responses.

For Part (a), a few candidates incorrectly named 'pets' (e.g. dogs and cats) instead of 'pests'. The acceptable responses for pests included houseflies, cockroaches and rats.

For Part (b), for which candidates were required to describe how the named pest affect humans, the acceptable responses indicated that humans may get diseases caused by the bacteria or virus which may be spread by the pests. Other acceptable responses included reference to 'damage of household items and furniture'. Many of the candidates' responses — such as 'spreading sickness or disease' by pests — were vague and required the show of a more scientific understanding of how the pathogens are carried by the pests.

For Part (c), most candidates provided acceptable responses for two methods of controlling household pests. Acceptable responses were:

- Removing sources of food; proper storage of food
- Using poison (e.g. pesticide or insecticide)
- Using traps (e.g. rat traps)
- Cleaning and disposal of garbage
- Biological methods (e.g. using cats to kill rats)

Part (d) which required the identification of an object, from Figure 4, which may encourage breeding of mosquitoes, was also well done by many candidates. The expected responses included tyres, cans and jars.

For Part (e), ways of reducing the incidence of dengue fever were well known by many candidates who provided acceptable responses such as getting rid of mosquitoes by removing objects which can collect water, for example, tyres, and empty cans; spraying; covering open empty objects, using methods of controlling mosquito breeding.

For Part (f), which required candidates to name two other diseases spread by mosquitoes, 'Malaria' was the most popular response. Other acceptable responses included *Yellow Fever*, *West Nile Virus*, *Dog heartworm disease*, *Encephalitis* and *Lymphatic filariasis*.



In Part (g), in which candidates were required to name two impurities that may be present in rainwater collected from the roof in containers, many responses were good. Acceptable responses included ‘*animal droppings/faeces, dust, leaves and dead insects. Mosquito larvae and ‘bacteria’* were also acceptable.

Part (h) required candidates to suggest two ways that can make collected rainwater safe for drinking. Most candidates were able to supply the expected responses ‘boiling’ and ‘adding bleach/chlorine’. The most appropriate responses indicated filtering (straining) then boiling. Distillation and also adding a purifying agent such as bleach were acceptable. Filtration was not acceptable because, by itself, that process would not make the impure water safe for drinking.

### **Recommendations**

1. In addressing the relevant syllabus objectives, greater emphasis could be given to understanding the concept ‘pests’ in order to prevent confusion between the terms *pets* or *parasites*. The role of pests in spreading disease under unsanitary conditions must be considered in relation to the spread of pathogenic microorganisms.
2. In general, as required through the relevant syllabus objective, in discussing conditions that encourage the breeding and control of household pests and parasites, it is important that clear explanations are considered for the role of these organisms, so that the use of selected methods can be justified.
3. A review of current prevalent diseases in the Caribbean should be considered in an attempt to elicit and correct ideas of candidates that may be unscientific though consistent with some erroneous cultural views.

### Question 3

This question tested candidates’ understanding of the importance of diet and exercise and their ability to use their knowledge to analyse recommendations and explain related observations. This question was attempted by most of the candidates and some responses were satisfactory.

For Part (a) (i), in which candidates were required to indicate the effect of weightlifting on the muscles of the body, many candidates stated acceptable responses. The expected response was “*increase in muscle mass or strength*”.

Increase in fitness (for overall body functioning) and efficiency of circulation or breathing were acceptable responses for suggesting one benefit of aerobics and running that cannot be gained by weight lifting.

For Part (b) (i), the candidates were required to indicate two food groups associated with lean meats, peas, rice and sweet potatoes. This part was also generally well done with candidates suggesting two of the following acceptable responses: *staples, food from animals and/or legumes, carbohydrates and proteins*.

For Part (b) (ii), many candidates indicated correctly the function of each of the named food groups; for example, “*protein needed for growth or muscle building*”, and “*carbohydrates are needed for energy*.”

For Part (c) (i), many candidates indicated the appropriate responses that showed an understanding that in running, more oxygen was needed with increased energy demand. For Part (ii), many candidates indicated the

appropriate responses that showed an understanding that in exercising, the heart beats faster as there is need for more oxygen and nutrients with the increased energy demand.

For (d) (i), in which candidates were to name one physical factor other than fitness, that a father must consider when joining his daughter in doing exercises, many responses indicated the expected responses of *age, sex (gender) or diet*. The expected reason was that the factor named, affects the persons health and ability to exercise.

Part d (ii) was generally well done. An acceptable response indicated that fat was used up in the body because of the increased activities, increased energy demand/need and that fat is converted to carbohydrate and used in providing energy.

For Part (e), most candidates responded correctly by indicating three of the following possible negative effects of steroids on (Sophia's body): *High blood pressure, heart disease, liver damage, cancer, stroke and blood clots, digestive problems, headaches, joint pains, female developing male characteristics, nervous problems, increased heart rate, kidney failure and possible harm to foetus during pregnancy*.

### **Recommendations**

1. Students need to be able to differentiate between positive and negative effects. Discussions about effects can therefore involve identifying disadvantages of the features when considering negative effects and advantages of other features when considering positive effects. Also, identifying what makes a situation negative or positive can be explored with students.
2. Some unscientific explanations are sometimes provided by candidates, for example, "fat was turned into muscle" and fat was "melted" during exercise and changed into sweat. In discussions with students and through the construction of relevant probing questions, attempts can be made to elicit such ideas and the appropriate explanations developed. Assignments involving Internet and textbook searches on these ideas could be prepared and the findings discussed within the context of the relevant syllabus requirements.

### Question 4

This question tested candidates' understanding of the concept 'stable equilibrium' and the structure and function of parts of the nervous system. It required comprehension of how energy is obtained from food, the parts of the eye and an understanding and application of corrective measures for an identifiable eye defect based on information provided.

In general, this question was not very well done by most candidates. For Part (a), Sueling (lying flat when compared to the other persons upright or sitting) was successfully identified by most of the candidates as having the most stable equilibrium. Some candidates provided correct reasons, indicating that Sueling's whole body was spread out or lying on the floor and had the lowest centre of gravity.

Part (b) examined candidates' ability to relate stimuli with the appropriate sensory organ and major coordinating role during rehearsal for a concert. Few candidates provided the expected responses to indicate that in (i) light is the stimulus for the eye; (ii) relative to the stimulus sound, the major coordinating role of the

ear was for balancing to avoid falling and (iii) relative to movement, the sense organ is the ear (with the semicircular canals of the inner ear) which assists in balancing to avoid falling.

Many candidates did not indicate that light stimulates the eye; sight (instead of light) was often the inadequate response for the stimulus. The ear detects sound enabling movement to a beat/rhythm. Many candidates did not relate their responses to the rehearsal described in the question but made general statements.

For Part (c), candidates were expected to demonstrate their understanding that energy is obtained from food, for example, carbohydrates or fats, and that glucose is used in the process of respiration to provide energy for movement.

For Part (d), some candidates provided correct responses indicating L as lens and M as retina in Figure 6.

Part (e) was generally well done. Most candidates correctly stated the condition for the paper being read from arm's length, as farsightedness or hypermetropia. Other acceptable responses indicated that *the image formed behind the retina; the eyeball was too short; or the lens was too thin/flat*. For (ii), many correctly identified convex lens as the solution. Some candidates incorrectly indicated short-sightedness and also identified the wrong corrective lens, that is, concave and diverging, instead of convex or converging lens.

Many of the responses inadequately/vaguely identified the corrective measure as using medicated glasses or glasses prescribed by a doctor. Some candidates also stated that the condition may be corrected with the use of eye-drops.

Part (f) was fairly well done. Many candidates correctly responded to this part of the question, indicating a precaution that can be taken to prevent damage to the eyes when reading late into the night. Correct responses were:

- The use of brighter or more light
- Resting the eye (e.g. at intervals during reading period)
- Not using too much light to damage the eye
- The use of fluorescent light
- The use of desk/reading lamps
- Consuming foods high in Vitamin A

## **Recommendations**

1. More instructional emphasis appears to be necessary regarding the application of the concept of centre of gravity in everyday life situations. Examples involving a wide variety of objects and situations should be utilized. Considering objects of different heights and widths, cases can be analysed in terms of the position of the centre of gravity (extent to which it is raised from the ground), the base area of the objects compared to their height and position of the centre of gravity.
2. Structured questions and related hands-on experiences should be used to prepare candidates to apply their knowledge in this area to everyday life situations.

### Question 5

This question tested candidates' ability to read an electricity meter and calculate the cost of electricity from information provided. It also tested their knowledge of energy conservation strategies, parts of an electrical circuit and energy changes in an electrical appliance.

Part (a) (i) was relatively well done. Many candidates correctly indicated 'measuring the quantity of electricity used' as the function of the electricity meter.

For (a) (ii), while some candidates indicated the correct reading of 23,209 kWh, others provided a variety of incorrect subtraction calculations. For (a) (iii), in calculating the amount of electricity used for the month, many candidates incorrectly added, instead of subtracting, the two readings for June 1st and June 30th. The unit (kWh) was left out in many instances.

For (a) (iv), in calculating the cost of electricity for the month, many candidates correctly used the value from (iii) (the amount of electricity for June) and multiplied it by 70 cents. Some candidates made errors in the basic multiplication of the correct values.

For Part (b) (i), some candidates supplied the correct answers of 21.6 kWh for the refrigerator and 3 (hours) associated with the electric kettle. In (b) (ii), many candidates correctly provided three of the following (or other acceptable) measures which family members could implement to reduce energy consumption:

- Using energy efficient appliances
- Using appliances only when necessary
- Keeping refrigerator door closed when not in use
- Turning off electrical appliances (e.g. television) when not in use
- Switching off lights when not in use

For (b) (iii), few candidates displayed the required ability to determine which appliance consumed more or less energy and which appliance reduced/increased the electricity bill based on the duration it was used.

For Part (c), in distinguishing between a 'switch' and a 'fuse', many candidates stated the function of a switch. However, many were unable to demonstrate clear understanding of the function of a fuse. The expected response was "*the fuse is a protective device (protecting against voltage/current overload); this is not the designed role of the switch, which is used for simply turning on or off an appliance.*"

There were many incorrect responses with regard to the purpose of a fuse; for example, the fuse was sometimes inappropriately equated to a bulb, resistor, transformer or capacitor.

Part (d), which required candidates to state the energy changes that take place when an electric oven is used in a solar powered home, was generally not well done. Few candidates had the correct responses of solar energy to electric energy to heat energy. Many candidates inappropriately indicated (based on their responses) that solar energy was equivalent to light energy, heat energy or nuclear energy.

## Recommendations

1. Students need to be exposed to the practical areas of topics as much as possible; emphasis should be placed on the importance and functions of components as required in the syllabus. Attention should be given to providing examples of simple circuits, switches and fuses (exercising all safety precautions).
2. The making of simple solar cells, solar panels and solar cookers are suggested practical activities.

### Question 6

This question tested candidates' understanding of the concepts of 'linear momentum', 'gravitational potential energy' and 'energy' in general. It required the calculation of momentum associated with colliding bodies as well as the identification of the type of energy present before, during and after the collision.

For Part (a), many candidates appeared not to have knowledge of the concept of the conservation of 'linear momentum'. Few candidates indicated the expected response that *the concept of the conservation of 'linear momentum' refers to the fact that when two objects collide, the total momentum before the collision is equal to the total momentum after the collision.*

Part (b) (i) was attempted by some candidates. Acceptable responses were that the truck moved backwards (or in the direction of the trolley); both the truck and trolley would move together in the direction of the trolley.

Parts (ii) and (iii) were well done by a few candidates who provided the response of 40 kg m/s for (ii). For (iii), acceptable responses included: "the truck and trolley would come to a stop upon collision, or they could move away from each other".

Part (c) (i) was not well done. The expected response in defining energy was "the *capacity* or *ability* to do work". Some candidates equated energy to respiration. Several possible misconceptions were reflected through incorrect statements that energy is a "substance, force, power, strength and electricity". Acceptable answers for the unit of energy were '*Joules and Kilojoules*', *Kilowatt hour* or *their corresponding symbols: J, kJ, and kWh* for (ii). Many candidates incorrectly gave units and symbols of voltage, current, resistance and force, showing lack of or incomplete understanding of these terms.

Part (d) tested candidates' knowledge and understanding of various forms of energy associated with the trolley collision. Candidates needed to be able to state the form of energy as it related to a trolley colliding with a stationary toy truck (i) before, (ii) during and (iii) after the collision. Few candidates gave adequate responses to indicate: (i) kinetic energy in trolley or potential energy in truck, (ii) potential, sound or heat, (iii) kinetic (or heat).

For Part (e), in explaining where the gravitational potential energy of the toy truck came from, very few candidates fully indicated that gravitational potential energy is the energy possessed by an object due to (or because of) its position in a gravitational field.

Many candidates apparently understood the relationship between gravitational potential energy and gravity. However, they did not indicate that this energy depended on the *position* of the object in the gravitational field.

## Recommendations

Students need to be more exposed to this area of the syllabus which seeks to develop their appreciation for the importance of energy in everyday life as well as a general understanding of the principles of conservation of mass energy.

Students need to be guided through activities using toy moving and stationary objects to model vehicular or other forms of collisions. The concrete experiences can be converted (or translated) to relevant linear momentum problems requiring the calculation (with use of the appropriate formula where necessary) and descriptions of the movements in terms of the momentum of the objects before, after and during collisions.

1. *Using Knowledge*

Students appear to require more practice in applying scientific knowledge to everyday life situations. They need to have practice through relevant structured questions and related hands-on experiences and practical examples through scenarios and cases, to adequately prepare them to apply their knowledge in everyday life situations.

2. *Improving Language Skills: Grammar and Spelling*

Candidates need to be reminded about the need for proper grammar, sentence construction and spelling. Marks are more accessible when answers are communicated effectively. Teachers can incorporate these elements as part of their evaluation of student's work. Occasional or regular spelling quizzes or games with scientific terms may also help.

Structured questions requiring the use of a variety of sources (online and texts) could assist students in identifying relevant myths (for correction through class discussions) compared with the scientific facts from authentic sources. This may be necessary given the wide scope of information accessible to students in this information age.

3. *Understanding and Using Scientific Terms*

The use of scientific terms (to the level guided by the syllabus should be encouraged). Terms such as energy, force, power, strength and electricity should be appropriately used. In the case of diseases, the use of scientific terms should be encouraged and preferably used when responding to questions.

4. *Distinguishing between Terms*

Students need more practice in distinguishing between related and sometimes unrelated concepts and should be guided in expressing differences in terms of parallel points to improve completeness of responses. There is a need to guide students through appropriate activities to distinguish between the following listed pairs of terms.

- Stable and unstable equilibrium
- Sight and light
- Far-sightedness and short-sightedness
- Retina and lens
- Fuse and switch
- Solar energy and light
- Energy and respiration
- Energy and power
- Force and power
- Conservation of energy and conservation of linear momentum

- Transport of energy and transfer of energy
- Pets and pests
- Pests and parasites

5. *Improving Mathematical Skills.*

Students require practice in using formulae for working out values. Accuracy and use of appropriate units should be encouraged.

### **Report on Paper 03/2 – Alternative to School-Based Assessment**

This paper consisted of two questions which tested all five practical (SBA) skills. Most candidates attempted both questions and the majority followed the instructions provided to perform the required activities.

Question 1 provided candidates with a bean and okra, and required that they measure and draw them, as well as perform food tests.

Question 2 required the use of a small 100g mass and wood set up with different surfaces and slopes. Candidates were required to follow the instructions provided and to use their results to calculate frictional force. This question also required that candidates plot a graph of frictional force against height for calculated values of frictional force corresponding to different heights.

#### **Manipulation and Measurement**

- The basic skills of manipulation and measurement evident in candidates' responses were not well developed in some instances. The term 'diameter' might not have been adequately known by some candidates. For Question 2, many candidates appeared to have measured the required heights appropriately.

#### **Observation Reporting and Recording (ORR)**

- The skill of Observation Reporting and Recording (ORR) was fairly well developed. Most candidates were able to get at least half of the marks with regard to consistency in decimal points.
- Very few candidates were able to write a suitable title in both questions.
- For Table 2, used to record the food test results, the observation skills reflected by the candidates were satisfactory.

#### **Analysis and Interpretation**

- For constructing the graph of frictional force against height in Question 2, some candidates appeared not to have known
  - which variable goes on which axis
  - how to label the graph and axes, inclusive of units
- Many candidates were able to derive accurate information from the graph.



### **Drawing Skills**

- This skill was fairly well developed; many candidates scored most of the available marks for questions 1a and 2c.

### **Analysis and Interpretation**

- Relative to Question 1(e), for many candidates, analysis and interpretation skills appeared to be under-developed. Most candidates were able to classify the ochro as a fruit and the bean as a seed, however, they did not justify their answers.
- Many candidates received most of the marks for the calculations in Question 2.

### **Planning & Designing**

This skill needed to be further developed by many of the candidates especially in regard to the area of writing a suitable hypothesis as in question (1) (g) and variables as in question (2) (e). Few candidates appeared to be knowledgeable about what makes a good hypothesis.

### **Recommendations**

- Students appear to need more guidance in determining what information a proper title should provide. This may require engaging them in activities where they are required to interpret information from tables, design tables, and construct as well as provide headings for tables. Discussions of the titles and their suitability for the associated columns and rows of data could also be helpful.
- More practice in drawing biological and non-biological drawings, bearing in mind the criteria for good drawings, should help to develop candidates' drawing skills.
- It is important that the syllabus be reviewed by teachers and candidates and that definitions for the required skills for development in candidates be used as a guide for instruction.
- In general, candidates can benefit from engagement in more relevant practical work as guided by the syllabus (in terms of content, skills and attitude development), observing all safety precautions.
- Candidates can also benefit from more instructional experiences in providing appropriate labels for axes, plotting points and connecting them appropriately.

### **Paper 03/1 – School-Based Assessment**

#### Overall performance

Overall performance at the General Proficiency Level was satisfactory. However, there is a need for candidates to be guided in developing the skills of Analysis and Interpretation and Planning and Design.

- Generally, notebooks and mark schemes were submitted. In most cases, student instruction sheets were not submitted.



- Some of the activities represented in the laboratory notebooks were typical textbook activities which did not engage students in developing sufficiently, their inquiry skills.
- Many centres provided laboratory notebooks that were not very neat, well organized and easy to mark. Many SBAs needed to be tidier and more organized. A few centres provided some acceptable books. Many centres provided laboratory notebooks that needed to include a table of contents with the date, page number and the skills assessed for each assignment.
- Generally, candidates' spelling required much improvement.
- Many books did not reflect the provision of appropriate feedback to candidates. It is likely that this accounted for the fact that there was no noticeable improvement over the assessment period for some candidates.
- In some cases, the scores provided in the laboratory notebooks for some skills, appeared too lenient.

### **Comments on Drawing, Planning and Design, and Analysis and Interpretation**

#### ***Drawings (D)***

##### Key positive points

- The majority of drawings were of adequate size.
- The label lines, in most cases, touched the correct parts of the drawings.
- The majority of drawings were two-dimensional.

##### Key negative points

- There is a need for the drawing of more biological specimens.
- In a few cases, arrow heads were attached to label lines.
- Titles in many cases were inappropriately written and positioned.
- Many of the candidates did not demonstrate an adequate understanding of how to calculate magnification.

#### **Recommendations**

- All titles should be placed at the bottom of each drawing and there should be a statement informing the reader of what the drawing represents. In addition, the view and accurate magnification should be clearly identified within the title.
- The use of arrow heads should be avoided. In addition, a ruler should be used to draw all label lines and they should be parallel to each other. Label lines on the same side of the drawing should stop at the same point.

- The labels, written in print (script), should be started at the end of the label line. They should never be printed on the label line. The labels should either be upper **or** lower case but **never** a combination of both.
- The lines of the drawings should always be clear, distinct and continuous; that is, students should avoid shading, double lines and sketching at all times.
- Drawing should be of specimens. Diagrams and natural cycles are not to be presented as SBA drawings.

### ***Planning and Design (PD)***

#### Key positive points

- The assignments chosen for planning and design reflected a clear understanding of what is acceptable for such assignments.
- Most Planning and Design assignments were generally workable.
- Most assignments assessed in this category illustrated a clear role of the control.

#### Key negative points

- Too many assignments were taken from textbooks without any modifications.
- Some of the assignments were not marked.

### **Recommendations**

- The hypothesis should be clearly stated and be a specific statement or prediction which is different from the aim of the experiment. Also, it should be: (a) suitable, that is, an experiment can be performed to test the hypothesis; and (b) manageable, that is, it should be realistic.
- The procedure of the experiment should be clearly written and demonstrate scientific skills which can be used to prove or disprove the hypothesis.
- In regard to attention to detail, candidates should be precise and concise. For example, there should be specific quantities assigned to each type of measurement used such as volume, temperature, length, mass, etc.
- The steps of the procedure should be in logical sequence.
- Format of expected data/results should be clearly presented. Candidates are not expected to carry out the experiment; however, the way in which they intend to present their results should be written clearly, for example; tables can be used with the appropriate headings and title, prose can also be used to identify the expected data.

- Precautions refer to the steps used to ensure accuracy and safety, which do not affect the experiment. They should also be clearly identified.
- In instances where the candidate actually carried out the activity, they should indicate if the entire procedure or measurements of the experiment were repeated to verify consistency and accuracy.
- There should also be a control and it should always be clearly identified.

### ***Analysis and Interpretation (AI)***

In general, there has been a decline in the standards of the practicals assessed for Analysis and Interpretation. Teachers must be made more aware of the criteria used to assess this particular skill. Another area of concern is the use of guided questions as opposed to encouraging students to evaluate the data obtained. Many of the guided questions were inappropriate for the AI skill since they only required definitions and were often not related to the aim of the experiment.

### **Recommendations**

- Laboratory exercises chosen for assessment were too simple, for example 'testing milk for protein'.
- Laboratory exercises must lend themselves to the identification of trends, patterns and relationships.
- Inferences must be linked to the results/observations.
- Evaluations should not be general statements. Conclusions need to be linked to the aim of the lab stated and the data obtained.
- Calculations shown must include formulae and units.
- Questions from the textbook should not be used as AI laboratory exercises.
- Laboratory exercises must be carried out and the data generated, analysed and interpreted.

**C A R I B B E A N E X A M I N A T I O N S C O U N C I L**

**REPORT ON CANDIDATES' WORK IN THE  
SECONDARY EDUCATION CERTIFICATE EXAMINATION**

**MAY/JUNE 2011**

**INTEGRATED SCIENCE  
(SINGLE AWARD)  
GENERAL PROFICIENCY EXAMINATION**

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## GENERAL COMMENTS

The CSEC examination in Integrated Science (Single Award) was offered at the General Proficiency level in 2011. The June 2011 examination consisted of the following papers: Paper 01 — Multiple Choice; Paper 02 — Short-Response Questions; Paper 03 — School-Based Assessment and Paper 032 — Practical Paper (taken by private candidates)

Approximately 22,822 candidates sat the examination. There was an increase in the number of candidates entered for the examination when compared with 2010. Performance in 2011 was comparable with that of 2010.

Integrated Science continues to be well received across the Caribbean, as indicated by its increasing population over the years. This subject therefore contributes, as intended, to meeting the needs of our secondary level schools in the area of science education.

The CSEC Integrated Science syllabus is designed to *allow students to work individually and cooperatively, utilizing theoretical concepts of the course in interactive and practical activities* (CXC Integrated Science Syllabus, 2011, p.1).

There has been a noticeable improvement in candidates' performance in some physics-based topics (for example, electricity). It is important that within the school system, a variety of strategies continue to be explored for optimizing the benefits that may be derived from implementing the CSEC Integrated Science syllabus. Strategies promoting collaboration among teachers who are often subject specialists in the areas of Biology, Chemistry and/or Physics are anticipated to be beneficial to students as they could facilitate team planning and/or teaching and encourage adequate integration among topics often associated with the single subjects. Analysing environmental scenarios and phenomena as a whole, in an integrated manner, relevant to the syllabus may, further assist students in appreciating the relevance of science to everyday life.

## DETAILED COMMENTS

### Paper 01 – Multiple Choice

Paper 01 consisted of 60 multiple-choice items. The mean score earned at the General Proficiency level decreased by approximately 4 per cent from 61 per cent in 2010 to 57 per cent in 2011.

### Paper 02 – Short-Response Questions

Paper 02 consisted of three short-answer, structured questions, one data analysis question and two essay questions. The maximum mark for Question 1, the data analysis question, was 25 marks while Questions 2–6 were worth 15 marks each; the maximum marks for the paper was 100. The mean score earned on this paper was approximately 56 per cent.

### Question 1

This question tested candidates' understanding of the process of photosynthesis, energy, alternative sources of energy and pollution. In addition, this question tested candidates' data analysis skills. The question was fairly well answered with many candidates scoring most of the available marks.

For Part (a) (i), many candidates correctly identified chemical energy as the kind of energy that is stored when green plants make food. Some responses incorrectly identified kinetic energy.

For Part (a) (ii), in which candidates were asked to name the substance that is combined with carbon dioxide during photosynthesis, many responses correctly indicated water but others though reflecting an acquaintance with the equation for photosynthesis, incorrectly pointed to reactants (input/output substances or energy) such as sunlight, glucose, oxygen and chlorophyll, rather than water.

For Part (b), in which candidates were asked to describe how plants and animals may become fossil fuels, some responses showed a fair idea of how fossil fuels were formed, but few candidates gave complete answers. Many of the responses indicated only one part of the process, that is, either *buried in the soil* or *decayed and left in the soil/earth*. Few candidates indicated *heat energy* and *pressure* as conditions involved in fossil fuel formation. Many candidates stated that it was simply 'death and decay/decomposition of plants and animals'. Many candidates ignored the time — *millions of years* as a factor in the formation of fossil fuels. Only a small number of candidates included correctly that *plants became coal* and *animals became oil*.

For Part (c), in which candidates were required to name two alternative sources of energy which may be used for generating electricity for a flat tropical country, some candidates gave appropriate responses such as *solar*, *geothermal*, *wave*, *tides*, *nuclear* and *biomass* sources. However, some responses indicated inappropriately 'water energy/hydroelectricity', not factoring in the fact that the country was flat or that water needed to fall from a height in order to generate hydroelectricity. This part of the question was generally well done.

For Part (d), which required candidates to give a disadvantage of each alternative energy source given in Part (c), many responses were satisfactory and were followed in many instances by appropriate disadvantages. Unsatisfactory responses did not link the alternative energy sources to the disadvantages. For example, in Part (c), a typical response may be *solar energy* as an alternative energy source and in Part (d), an appropriate response would be *during periods of bad weather or during the rainy season, less solar energy would be captured*.

Part (e) tested candidates' understanding and ability to use knowledge about fossil fuels and problems associated with them. For Part (e) (i), the most common correct response was *carbon monoxide*, one of the pollutants added to the atmosphere because of the increase in the number of vehicles. *Noise pollution*, *smoke*, *fumes from petrol and lubricants* as well as *oxides of nitrogen* were among the appropriate/acceptable responses.

For Part (e) (ii), some candidates were not able to link the pollutant to its negative effect on the environment as required. While some candidates were able to state *acid rain*, *global warming*, *death of plants and animals* (loss of biodiversity), they were unable to make the link between specific pollutants and their negative effect.

For Part (e) (iii), some candidates indicated two of the following points as expected for the two negative effects of increased levels of carbon dioxide on the Caribbean environment: *global warming*, *climate change*, *rise in sea level*, *increasing acidity of oceans*, *increased erosion of limestone*. For Part (e) (iv), common correct responses included *skin cancer*, *cancer*, *various respiratory infections/diseases* and *death* (effects of the pollutants on health).

For Part (f) (i), candidates were required to plot and interpret a graph. This part of the question was generally well done. A smooth curve (fine line) was expected and not broken, thick, jagged or double lines as seen in some cases.

Parts (f) (ii) and (f) (iii) were generally well done. For Part (f) (iv) the expected response was 1977–1983. The correct response for (f) (vi) was China.

### Recommendations

- Students could benefit from practice in answering questions relating to different contexts; teachers should give them opportunities to apply their knowledge paying attention to certain key conditions and elements.
- Candidates need more practice analysing data from graphs.

### Question 2

This question tested candidates' understanding of the structural similarities and differences of cells of two common organisms: plant (grass) and animal (rabbit), as well as their understanding of food chains and the structure of a tooth. This question was fairly well answered by most candidates.

For Part (a) (i), many candidates correctly stated similarities between the cells of plants (grass) and animals (rabbit). Acceptable answers included *presence of nucleus, a vacuole, cytoplasm and cell membrane* in both cases.

For Part (a) (ii), many candidates correctly stated differences between the cells of plants (grass) and animals (rabbit). Acceptable answers included *cell wall, larger vacuole, and chloroplast*, found in plant cells

For Part (b) (i), many responses correctly indicated grass as the producer; and correctly explained as required in Part (b) (ii), that the grass is a producer *because it manufactures food through photosynthesis*.

For Part (b) (iii), the likely effect on the food chain if a drought kills all the grass in that area was satisfactorily indicated by many candidates. Satisfactory responses included *the rabbits will eventually die* or *there would be a decrease in the number of rabbits*.

Part (c) (i), was fairly well done by many candidates, however much attention needs to be given to the spelling of the names of the parts of the tooth. The expected responses were:

- A: Crown
- B: Root
- C: Dentine
- D: Enamel

For Part (c) (ii), the type of tooth shown was correctly identified by many candidates as a *molar*.

In Part (c) (iii), one other type of tooth was also correctly identified by most candidates.

For Part (c) (iv), many candidates correctly suggested two features of a rabbit's tooth that make them suitable for its diet. Acceptable responses included *flat surface for crushing and grinding*; and *sharp teeth for cutting*.

### Question 3

This question tested candidates' understanding of heat transfer, reflex action and sea breeze formation. Overall, this question which was highly integrated was not well done.

For Part (a) (i), in which candidates were required to suggest how energy is transferred, many responses contained merely the definition of heat transfer methods and not the expected *radiation* as well as by *absorption of heat energy by the handle of the hammer*.

Part (a) (ii), which required candidates to explain the difference in the temperature of the handle of the hammer and the nail, was not well done. The appropriate response was: *More of the heat energy absorbed is stored inside the nail than the wood because the nail is a better conductor of heat energy. This heat energy is easily conducted to the hand by the nail.*

Part (a) (iii), which required candidates to explain how the nervous system caused the carpenter to automatically drop the hot nail, was not well done. An acceptable response was:

- The nervous system controls reflex action
- Receptors stimulated by the hot nail
- Impulses/messages pass along nerve cells to the spinal cord and signals to the muscles in hand/effector to move the hand

Part (a) (iv) required candidates to name the process by which heat energy is transferred from the nail to the carpenter's hand. The process of conduction was correctly named by some candidates.

For Part (a) (v), in which candidates were required to explain the role of the gloves in preventing the carpenter's hand from being burnt by the hot nail, some responses correctly indicated that the *glove acted as an insulator to prevent the transfer of heat energy to the skin*.

Part (b) (i) required the meaning for the term *convection* as it relates to heat energy. The acceptable responses indicated that *convection occurs when heat energy is transferred (transported) as fluid/liquid or gas from one place to another*.

For Part (b) (ii), candidates were required to indicate the most likely direction of airflow by placing arrows in the diagram provided to represent the formation of sea breeze. Many candidates correctly placed the arrows in the clockwise direction.

For Part (b) (iii), candidates were required to explain why air flows in the direction that they indicated in the diagram. An acceptable response for this part was:

*During the day the sun warms the land faster than the sea; the land heats up the air above it; warm air above the land rises into the atmosphere; the air from the sea is cooler than the land and moves onto the land to replace the air that had risen.*

While many candidates showed some knowledge of the formation of sea breezes, only a few candidates correctly suggested that *during the day the sun warms the land faster than the sea, and that the land heats up the air above it*.



#### Question 4

This question tested candidates' knowledge of good conductors and insulators as well as the relationship among voltage, current and resistance in circuits and safety in the use of electrical equipment and appliances.

Most candidates attempted this question. Many candidates correctly indicated *aluminum and copper* for Part (a) (i) and *plastic, rubber or wood* for Part (a) (ii).

Part (b) required an understanding of calculating voltage and current. For Part (b) (i), the correct value was given by many candidates. Some candidates however wrote the calculation  $1.5V \times 4$  cells but provided the incorrect answer or left off the unit. The correct answer is  $6V$ .

Part (b) (ii) was not well done as candidates wrote incorrect values (for example, 0.25, 0.625, 2000) and some of them showed inappropriate calculations. Correct and acceptable responses included: *0V, 0A, no current, no voltage, circuit open* so no current obtained/flowing. For Part b (iii), some candidates indicated the acceptable response of the *reading on the ammeter would increase* when the circuit was closed.

For Part (b) (iv), the expected formula was ( $V=IR$ ,  $I=V/R$  or  $R=V/I$ ) Some candidates provided one of these formulas. Popular incorrect responses included 'Ohm's Law', 'Power and Wattage' or 'Watts'.

In Part b (v), candidates were required to substitute the correct values in the formula provided in Part (b) (iv), to calculate the current in the circuit and to include the correct unit. This part was fairly well done.

Many candidates provided one of the following correct responses as a reason why it is beneficial to use a fuse in the circuit in (b) (vi):

- To protect from overheating
- Limit, control or reduce the flow of current or electricity
- Prevent short circuit

A popular incorrect response was 'the prevention of shock/electric shock'.

For Parts (c) (i) and (ii) which required two precautions for preventing electrical shock or fire when the radio is connected to the electrical outlets, many candidates inappropriately gave responses related to the conservation of energy or the reduction of energy consumption for example, *do not play the radio all day, unplug the radio once not in use*.

Acceptable responses included:

- Avoid wetting the radio
- Check the power cord to ensure there are no breaks
- Pull plug out of the outlet by holding the plug and not the wire
- If the radio is dropped and parts become exposed, do not touch the parts
- Check that the input voltage of the mains and radio match
- Do not overload the circuit
- Use a surge protector

For Part (d), some responses did not appear to reflect an understanding of the difference between an electrical fire and other types of fires. In this part, candidates were required to identify the most appropriate fire extinguisher to put out an electrical fire. Popular incorrect responses included;

- Water
- Gas extinguisher
- Wet cloth
- Cloth
- Bush/green bush
- Carbon monoxide
- Carbonate/carbonated/hydrogenated
- Oxygen/oxygenated
- Nitrogen

Correct responses included:

- Use a carbon dioxide extinguisher
- Use a powder extinguisher
- Use sand

Part (e) was fairly well done by some candidates. Some responses however suggested that some candidates inadequately/incorrectly interpreted protective gear as any equipment for example, fire hoses and fire extinguishers.

### **Recommendations**

- Candidates could be further guided in practising simple calculations using the required equations.
- Candidates need to be encouraged to read questions clearly, paying attention to key words that should guide responses.
- Candidates require more practice in using scientific expressions that are related to the content of the syllabus.

### Question 5

This question tested candidates' understanding and ability to use their knowledge of respiration, physiological effects of exercise, sense organs and coordination.

Part (a) was generally well done. The correct labels for the diagram of the eye were:

- A: Lens
- B: Iris
- C: Retina

For Part (b), many candidates reflected very limited knowledge of the function of the lens and iris. Many of them inadequately indicated that the lens merely allowed light to enter the eye and only a small percentage of candidates used the terms *refract*, *focus*, or *image*. For the iris, there were many candidates who inappropriately wrote that its function was to 'protect the eye' rather than the correct response that *it controls the amount of light entering the eye*.

Part (c) (i) was extremely well done with many candidates scoring full marks. The function of the lungs and heart, circulation of the blood, and need for oxygenated blood to release energy, were well known. Many candidates were able to relate this to the physical exertion implied in the question.

Part (c) (ii) was not done as well, with some candidates describing general body structures such as the arms and legs and other candidates describing the nose or mouth instead of the sense organs, eye, ear and skin. For Part (c) (ii), *eye for seeing and determining direction* and *ear for balance* were acceptable responses for explaining which two sense organs enabled Fred to run up the slope.

Candidates who scored highly on this question displayed an ability to be creative in coordinating the functions of the senses with a physical activity, so that information about structure and function was linked with an understanding of the interaction of body systems.

### Recommendations

- In general, candidates require more practice in spelling the names of the organs of the body
- Students can be engaged in activities and discussions about sense organs and their functions.
- Teachers could include in classroom activities, the use of models or interactive software so the structure and function of parts of the eye can be demonstrated to students in a practical way. The role of the lens and the iris can be given more attention.

### Question 6

This question tested candidates' understanding and ability to use knowledge relevant to properties of metals, factors affecting rate of rusting and methods used to reduce the rusting of iron. Most candidates attempted this question, however, only some responses were satisfactory overall.

For Part (a), candidates' knowledge of the reaction of metals with acids and the relative reactivity of aluminium, iron and copper was very limited. This part in general was not well done with many candidates using inappropriate terms such as, 'rust', 'melt' and 'dissolve' to describe the reaction of the metals with dilute sulphuric acid. Some candidates stated the uses of the three metals although this was not related to the question. Other candidates simply stated that there was a change with no explanation. Frequent erroneous responses in comparing the reactivity of the metals with acid included:

- The reaction got hot
- Electricity was generated
- The metals rusted
- It exploded

Few candidates were able to give an adequate comparison of the reactions of the three metals with sulphuric acid and relate this to their position in the reactivity series. The better responses noted that *aluminium reacts very rapidly with sulphuric acid giving off hydrogen gas, because it is very high in the reactivity series compared to iron whereas copper had no reaction with the acid since it is lower than hydrogen in the reactivity series.*

Part (b) required candidates to suggest two precautions that should be taken when carrying out the reaction of aluminium with sulphuric acid, giving reasons. Many candidates gained full marks for this part of the question. Some candidates inadequately stated general laboratory safety rules as precautions for this experiment. The acceptable responses included:

- Pour acid carefully (reason — to avoid burns)
- Point the mouth of the test tube away from people (reason — to avoid accidents)
- Use protective gear (reason — to protect the body)

For Part (c), candidates were required to indicate why it is dangerous to react sodium and potassium with sulphuric acid. Many of the responses correctly noted that the reaction was dangerous because it would cause an explosion or a fire. Many responses seemed not to recognize that this danger was related to the high position and thus reactivity of sodium and potassium in the reactivity series. A common error was that the metals were strong acids.

Part (d) was the most popular part of this question with most candidates being able to identify *rusting* as the threat to the iron windows. Some candidates did not identify that *oxygen and water contributed to rusting* as required, while other candidates stated that sea salt present in the sea blast/air causes rust rather than accelerates the rusting process. Many of the better responses stated that *the paint slowed down the rusting process by forming a barrier between the iron and the oxygen and water*.

### **Recommendation**

Scientific vocabulary must be used and emphasized in the teaching and learning of scientific concepts; for example, in this question, some candidates inappropriately used words such as ‘hard’ and ‘big’ reaction to mean a *violent/vigorous reaction*; ‘rot’ and ‘deteriorate’ were used to describe the *rusting of iron*; ‘bubbles of gas’ was inadequately used to describe the *evolution of hydrogen gas*.

### **General Recommendations for Teachers**

- Overall, students could benefit from more practice on relevant structured questions, essays and data analysis items. These items could relate to practical or hands-on experiences to facilitate understanding of concrete and abstract scientific concepts and an improvement in their ability to apply their scientific knowledge to everyday life situations.
- Using models of organs where necessary, safe improvised equipment and appropriate software, students, guided by teachers could benefit from greater exposure to the practical areas of topics.
- As much as possible emphasis should be placed on the importance and functions of components as required in the syllabus. For example, attention should be given to providing examples of simple circuits, switches and fuses (exercising all safety precautions).
- Students need to be reminded about the need for performing accurate calculations and including units where required. A response is not complete without the required unit (where unit(s) is applicable). Students also require practice in using formulae for working out values.
- Students need to be reminded about the need for communicating clearly in responding to questions; they should use the appropriate scientific terms and labels where required. Attention should be paid to spelling, and unscientific abbreviations and shortened terms should be avoided. The use of scientific terms (to the level guided by the syllabus) should be encouraged.
- Students could be reminded during assessment activities to clearly number each question and its parts as they write their responses. They could also be reminded to write in the space provided for the question being answered.

There continues to be a need to guide students through the appropriate activities to distinguish between certain problematic pairs of terms. Students need more practice distinguishing between these related and sometimes unrelated concepts. *Among other terms of the syllabus, students need to be guided towards understanding clearly the differences between:*

- Eye and sight
- Skin and feel
- Rot and rust
- Protective gear and general equipment
- Reactants and factors that change the rate of a reaction

### **Paper 032 — Alternative to School-Based Assessment (SBA)**

Paper 032 consisted of three questions; this was the first year that candidates did not have to perform a practical examination but rather were given a practical-based paper to sit in an examination room to write. This paper was designed to engage and test the skills normally assessed over approximately two years by the SBA component of the syllabus. The following skills were assessed: ORR, PD, D, AI, and MM.

#### Question 1

This question was well done by a few candidates. It required the drawing of a home-made balance, in two dimensions, assembled from the materials provided in a figure.

Good diagrams had correct labels, clear lines, were two-dimensional and carried an appropriate title. For Part (b), both arrows (for A and B), should have pointed down from the dot. For Part (c) (i), the correct answer was *clockwise* to describe the side to which A would fall when released.

For Part (c) (ii), the expected response was *it experiences only a clockwise moment*. *Anticlockwise* was the expected response for Part (c) (iii).

For Part (d), candidates were required to plot a line graph using data provided, draw the best-fit straight line and extend the line to cut the vertical axis. Many candidates were able to construct the graph and gained points here. Responses could be improved with greater attention to more accurate scales, correct axes and title.

#### Question 2

Part (a) required candidates to measure, from a figure, the length of potato strips that were placed in a Petri dish containing water. In Part (b), candidates were required to account for the recorded changes in length at the beginning and end of the experiment and to name the process that is responsible for the change in length of the potato strips.

Parts (c), (d) and (e) required candidates to display knowledge of critical practical skills in relation to the experimental set-up in the question. The overall performance on this question was fair.

### Question 3

This question tested candidates' drawing skills and the ability to measure, record and report in tabular form. For Part (a), candidates were required to draw and label a diagram of one of the measuring cylinders used in the experiment.

For Part (b) (i), candidates were required to state clearly, *it is more appropriate to use measuring cylinders in the experiment* and for Part (b) (ii), they were required to state three precautions to be taken when using measuring cylinders to ensure accurate results. Responses to Part (b) reflected limited knowledge of critical practical skills.

In Parts (c) and (d), candidates were required to display knowledge of critical practical skills in relation to the experiment set-up in one question.

The overall performance on this question was poor as candidates were unable to display knowledge of critical practical skills as they related to the specific experiment.

### **Paper 031 – School-Based Assessment**

Overall, performance was satisfactory. However, greater effort is needed in developing drawing skills. The following comments should be borne in mind:

- Generally, notebooks and mark schemes were submitted. In some cases, student instruction sheets were not submitted.
- Generally, marks were recorded in the laboratory exercise books.
- A wide range of items were assessed for drawing.
- There were quite a few innovative ideas used for planning and designing
- Many centres provided laboratory notebooks that were not very neat, well organized and easy to mark. Many SBAs needed to be tidier and more organized. A few centres provided some acceptable books. Many centres provided laboratory notebooks that needed to include a table of contents with the date, page number and the skills assessed for each assignment.
- Generally, students' spelling required much improvement
- Many books did not reflect the provision of appropriate feedback to students. It is likely that this accounted for the fact that there was no noticeable improvement over the assessment period for some students.

### Drawing (D)

#### *Key Positive Points*

The majority of drawings were of adequate size.

The label lines, in most cases, touched the correct parts of the drawings.

The majority of drawings were two-dimensional

### *Key Negative Points*

- There is a need for the drawing of more biological specimens
- In a few cases, arrowheads were attached to label lines.
- Titles in many cases were inappropriately written and positioned
- Many students did not demonstrate an adequate understanding of how to calculate magnification.
- The various parts in a drawing must be proportional.

### **Recommendations**

- All titles should be placed at the bottom of each drawing and there should be a statement informing the reader of what the drawing represents. In addition, the view and accurate magnification should be clearly identified within the title.
- The use of arrowheads should be avoided, In addition, a ruler should be used to draw all label lines and they should be parallel to each other. Label lines on the same side of the drawing should stop at the same point.
- To make provisions for larger drawings, each drawing should be restricted to a single page.
- The labels, written in print (script), should be started at the end of the label line. They should never be printed on the label line. The labels should either be upper or lower case but *never* a combination of both.
- The lines of the drawings should always be clear, distinct and continuous; that is, students should avoid shading, double lines and sketching at all times.
- Drawings should be about half page or more.
- Illustrations such as flow charts and cycles should not be submitted as drawings.

### Planning and Design (PD)

#### *Key Positive Points*

- The assignments chosen for planning and design reflected a clear understanding of what is acceptable for such assignments.
- Most planning and design assignments were generally workable.
- Most assignments assessed in this category illustrated a clear role of the control.
- Most hypotheses were tenable

### *Key Negative Points*

- Verification assignments (laboratory exercise where concepts and known principles are proven) should not be assessed for PD.
- Critical aspects of planning and design such as precautions, controls, limitations and repeated measurements were omitted.

### **Recommendations**

- The hypothesis should be clearly stated and should be a specific statement or prediction which is different from the aim of the experiment. Also, it should be: (a) suitable, that is, an experiment can be performed to test the hypothesis, and (b) manageable, that is, it should be realistic.
- The procedure of the experiment should be clearly written and demonstrate scientific skills which can be used to prove or disprove the hypothesis.
- In regard to attention to detail, students should be precise and concise. For example, there should be specific quantities assigned to each type of measurement used such as volume, temperature, length and mass.
- The steps of the procedure should be in logical sequence.
- Format of expected data/results should be clearly presented. Students are not expected to carry out the experiment; however, the way in which they intend to present their results should be written clearly, for example, tables can be used with the appropriate headings and title, prose can also be used to identify the expected data.
- Precautions refer to the steps used to ensure accuracy and safety, which do not affect the experiment. They should also be clearly identified.
- In instances where students actually carried out the activity, they should indicate if the entire procedure or measurements of the experiment were repeated to verify consistency and accuracy.

### Analysis and Interpretation (AI)

#### *Key Positive Points*

The use of guided questions for the A/I has been reduced and students are being encouraged to evaluate their results and observations.

#### *Key Negative Points*

Predictions and inferences were not directly linked to trends, patterns and relationships in the laboratory exercises.

Critical aspects such as sources of error, precautions and limitations were omitted.



## **Recommendations**

- Laboratory exercises must lend themselves to the identification of trends, patterns and relationships.
- Inferences must be linked to the results/observations.
- Evaluations should not be general statements; conclusions need to be linked to the aim of the lab and the data obtained.
- Calculations shown must include formulae and units.
- Questions from the textbook should not be used as A/I laboratory exercises.
- Laboratory exercises must be carried out and the data generated, analysed and interpreted.
- At least two A/I laboratory exercises must be assessed per year.

**REPORT ON CANDIDATES' WORK IN THE  
CARIBBEAN SECONDARY EDUCATION CERTIFICATE<sup>®</sup> EXAMINATION**

**MAY/JUNE 2012**

**INTEGRATED SCIENCE  
(SINGLE AWARD)  
GENERAL PROFICIENCY EXAMINATION**

## GENERAL COMMENTS

The CSEC examination in Integrated Science (Single Award) was offered at the General Proficiency level in 2012. The examination consisted of the following papers: Paper 01 — Multiple Choice; Paper 02 — Short Response questions; Paper 03 — School-Based Assessment and Paper 032 — Practical Paper (taken by private candidates). Approximately 24,203 candidates entered for the 2012 examination which is an increase of 1,881 candidates over 2011.

Encouraging collaboration and executing delivery with strategies such as team planning and/or teaching among teachers who are often subject specialists in the areas of Biology; Chemistry and Physics may facilitate integration among topics often associated with the single science subjects. Understanding the underlying science of environmental phenomena, while encouraging the relevance of science in everyday life, may lead to lifestyle changes required to address issues like global warming and ensuring climate change.

## DETAILED COMMENTS

### Paper 01 — Multiple Choice

Paper 01 consisted of 60 multiple-choice items. The mean score of 58.62 was similar to that of 2011 which was 58.22.

### Paper 02 — Short-Response Questions

Paper 02 consisted of three short-answer, structured questions, one data analysis question and two essay questions. The maximum mark for Question 1, the data analysis question, was 25, while Questions 2–6 were worth 15 marks each. The mean score earned on this paper was approximately 61 per cent.

#### Question 1

This question tested candidates' understanding of the process of rusting, neutralization, and health and safety procedures in handling hazardous household chemicals as well as the relationship between soil structure and its properties. It also tested candidates' data analysis skills. The question was fairly well done, many candidates scored more than half of the available marks.

Part (a) tested candidates' knowledge of factors which cause and affect the rate of rusting and the methods which can be used to reduce or prevent rusting of iron and steel. Many candidates responded by stating 'coating' methods and while painting is the most practical solution, other coating methods such as oiling, electroplating and galvanizing were accepted. A few candidates answered that the steel should be cleaned regularly.

In Part (a) (ii), it was a challenge for candidates to explain that the barrier excluded moisture (water) and oxygen from coming into contact with the steel. While credit was given to those who substituted air for oxygen, candidates should be made aware that the chemistry of rusting uses both the oxygen (from the air) and moisture (either as water or water vapour in the air). Many candidates were able to state that *excess moisture, presence of oxygen and salts can accelerate rusting* in Part (a) (iii).

In Parts (b) (i) and (ii), many candidates were able to give at least one correct hazard and the safety equipment which should be used. Candidates answered by identifying *corrosion/burns/irritation to the outside of the body including the eyes and the respiratory system if inhaled*; however, a few candidates incorrectly identified the effects of the chemicals on the concrete. Many candidates correctly identified gloves, goggles, respirators and protective clothes/boots.

There were a few correct answers for Part (b) (iii) where the expected answer was that *lye has the higher pH than the acid*.

In Part (c) (i), very few candidates stated *neutralization* which was the expected answer. The word equation in Part (c) (ii) was poorly answered with some of the products being left out or incorrect product(s) being substituted. Instead of the answer in Part (c) (iii) being about the *use of calcium by the body*, many candidates incorrectly gave answers about how calcium gets into the body, for example, digestion, absorption and transportation by the blood.

The majority of candidates displayed the observation, recording and reporting (ORR) skills needed to take readings and record them in the table in Part (d) (i), and many candidates were able to plot the data from the table correctly for Part (d) (ii).

In Part (d) (iii), some candidates were unable to label the axes of the graph correctly and most candidates were able to make an appropriate table for the graph in Part (d) (iv). In Part (d) (v), the majority of candidates were able to make a statement about the inverse relationship between the height of the lather and the sample strength.

For Parts (e) (i) and (ii), many candidates were able to explain that *sand is less tightly packed than clay* or that *the particles in sand are larger than the particles in clay so the spaces between them are larger and consequently the sand is more porous*. Part (e) (ii) provided the opportunity for many candidates to earn at least one mark as any of the following answers were accepted: *adding manure, compost, organic fertilizer, crop rotation, planting trees, addition of lime/limestone, tillage, ploughing and mulching*.

## Recommendations

- Candidates need more practice plotting and analysing data from graphs.
- Candidates should be encouraged to answer the questions using scientific terms.

## Question 2

This question tested candidates' knowledge and understanding of the digestive system in humans as well as the relationship between food and nutrition. It was attempted by almost all of the candidates with just over half of them giving satisfactory responses.

Part (a) (i) tested candidates' knowledge of the anatomy of the digestive tract (namely the stomach and the pancreas). Most candidates gave satisfactory responses. Part (a) (ii) tested candidates' knowledge of the physiology of the digestive tract and most candidates were able to correctly identify the *small intestines* as the part where the most nutrients are absorbed.

Part (b) tested candidates' knowledge of the dental formula. It was generally poorly done with few candidates being awarded full marks.

Part (c) (i) focused on candidates' knowledge of the energy value of foods; it was attempted by most candidates and only a few candidates computed the energy values for the nutrients correctly. Some common mistakes were:

- converting energy values into grams and kilograms
- adding numbers horizontally then vertically to derive totals
- multiplying horizontally then incorrectly adding vertically
- dividing horizontally then incorrectly adding vertically

Some candidates used the values and the calculated results in the table, as required by the question, but many of them made conclusions about the samples using their general knowledge of food nutrients without doing any calculations.

Part (c) (ii) tested candidates' knowledge of the function/importance of carbohydrates, proteins and fats. This part was attempted by most candidates, some of whom gave satisfactory responses. The first two parts of the question were generally well done by most candidates; many candidates experienced the greatest challenge in linking the absence of stored bile to the emulsification of fats and hence did not know that a low fat diet was most suitable for a person whose gall bladder was removed.

Part (d) was attempted by almost all candidates with a great majority of them giving the correct response. The expected response was *cramps from low blood flow when the blood is diverted to the digestive system*, responses such as nausea and dizziness were accepted.

### **Recommendation**

More work should be done in the classroom on the labelling of diagrams of the digestive system and the functions of its various parts.

### Question 3

This question tested candidates' understanding of the structure of the heart and the physiological effects of exercise on heart rate and the respiratory system. Respiratory ailments that are caused by smoke and the effects of smoke on the physical environment were also tested. The question was attempted by most candidates.

Part (a) (i) was not done well. Generally, most candidates could not identify and label the different structures of the heart, apart from the ventricle. Many candidates were able to correctly answer Part (a) (ii). While most candidates successfully attempted Part (b) (i), it was clear that some candidates did not understand the term *trend*. The analytical skills required in Parts (b) (ii) and (iii) were well demonstrated by most candidates. Part (b) (iv) was not done very well as most candidates compared the heart rate in the boys and did not give reasons for the change in heart rate.

For Part (c) (i) most candidates recognized that the movement of the rib cage would be vigorous. For Part (c) (ii), most candidates understood that the body benefited from regular exercise but failed to mention the immediate benefit to the muscles of more oxygen and nutrients from increased blood flow. Part (d) (i) was well attempted and with many accurate responses; however, some candidates seemed to have confused the smoke from the clippings with cigarette smoke and gave answers such as 'second-hand smoke and tar in lungs'. Part (d) (ii) was well attempted. While most candidates understood that a negative effect of smoke on the physical environment was being asked for, only some candidates chose *air pollution, global warming and the effects of global warming*.

### **Recommendation**

More work should be done in the classroom on labelling diagrams of the heart.

### Question 4

This question tested candidates' knowledge of simple machines. The concepts of mechanical advantage, distance multiplier and levers were tested. It was attempted by many candidates with few giving satisfactory responses.

Parts (a) (i) required a definition of a simple machine, which was answered correctly by many candidates. As levers and pulleys were excluded, appropriate answers for Part (a) (ii) included any one of the following:

- inclined plane
- screw
- gear
- windlass
- wheel and axle

Most candidates were unable to state the formula for mechanical advantage as required in Part (a) (iii) where load/effort or distance moved by effort/distance moved by load were acceptable. The calculation in Part (a) (iv) was also poorly done.

Part (a) (v) tested candidates' ability to explain why less energy is used when a pulley is lubricated. The appropriate answer was *friction is reduced by lubrication so less energy is used (or lost)*. Also accepted were answers which explained that *lubrication caused freer movement* in the pulley. Many candidates did not seem to associate *squeaking sound* with *energy loss due to friction* and concentrated on vague ideas about the weight on the pulley.

Candidates were provided with a diagram of the bones, joints and muscles of a forearm lifting an object and they were required to explain how the movement of the forearm when lifting the object can be referred to as a distance multiplier. Many candidates explained how the muscle, bone and joint worked to move the load but there were very few candidates who mentioned the *ratio of distance moved by load to effort being greater than one* or the *load to effort ratio being less than one*.

In Part (b) (ii), few candidates were able to identify the forearm, elbow joint and biceps as a third class lever. For Part (c), many candidates were unable to identify the *person who has done the lifting as the effort*, the *person lifted as the load* and the *knife edge as the fulcrum*.

### **Recommendation**

More work needs to be done in the classroom on simple machines.

### Question 5

This question tested candidates' knowledge about safety hazards in the laboratory as well as their understanding of safety measures related to electricity and fires. A large number of candidates attempted this question, and approximately half of them scored more than 7 out of a possible 15 marks.

Part (a) was attempted by most candidates; however, many interpreted the question as requiring general safety rules for the laboratory, failing to refer to the diagram to identify the safety hazards. Approximately half of the responses to this part were satisfactory. Some candidates also confused safety hazards with safety practices, frequently interchanging the terms.

Part (b) was attempted by almost all candidates. Most candidates were able to identify water as the method used to extinguish bush fires. The method used to extinguish electrical fires posed some difficulty for candidates. Incorrect responses such as sand, oxygen extinguisher, water extinguisher and unplugging the power source or supply were most frequently stated. Correct responses included *class B and C extinguishers*.

Part (c) was attempted by the majority of candidates. While most candidates were able to state correctly that using water was inappropriate many were unable to provide a suitable explanation. Some candidates stated that water cannot be used since it contains oxygen which would act as a fuel; other candidates stated that oil and water do not mix without explaining that the oil is less dense and would remain on the water and hence spread causing the fire to spread as well.

Many candidates attempted Part (d); the responses given indicated that they did not know the difference between the causes of electrical shock and the methods used to prevent electrical shocks.

Part (e) was attempted by almost all candidates with the majority answering correctly.

#### Question 6

This question tested candidates' knowledge of photosynthesis and the effect of increased carbon dioxide on the environment, as well as their understanding of the impact of human activities on the environment with respect to carbon dioxide pollution. It was attempted by almost all of the candidates, with about one third of them scoring more than 7 out of a possible 15 marks.

Part (a) was generally well done, with the majority of candidates scoring at least half of the marks. However, many candidates had problems with expressing themselves and made general statements.

Part (b) was not done very well. The majority of candidates concentrated on the government dealing with the traffic problem or building more schools closer to the Lee's home. Many just repeated their responses from Part (a).

Part (c) required candidates to name and to describe a specific process; some candidates named the process only. Many candidates simply stated short phrases instead of describing the process of photosynthesis. A few candidates incorrectly described the process as respiration, transpiration, osmosis, reproduction or pollination.



A large number of candidates answered Part (d) poorly. Many candidates did not seem to understand what the question was asking, while others had many wrong ideas about the effects of the buildup of carbon dioxide in the atmosphere. Many candidates believe that a buildup of carbon dioxide in the atmosphere would cause respiratory diseases such as bronchitis, emphysema, lung cancer and asthma. Other incorrect ideas included destruction of the ozone layer, contribute to smog, have a bad smell and would cause people to suffocate. Many candidates who mentioned global warming failed to expand on the point.

### **Recommendations**

Students should be taught to answer essay questions. Many responded in point form, often without any further explanation or development.

### **General Recommendations for Teachers**

- Students need to be able to express themselves accurately using the jargon of science and appropriate scientific terms and labels (guided by the syllabus) as necessary. This is a science examination and using scientific principles when answering questions requires the practice of comprehensive self-expression. Again, emphasis should be placed on scientific principles when answering questions, communicating clearly using correct spelling and grammar avoiding unscientific abbreviations and shortened terms.
- Accurate calculations using formulae and including appropriate units require practice. A quantity without the required unit is meaningless.
- In an oral examination or in the classroom, teachers can tease the whole answer from students. Students can only gain from more practice on relevant structured questions, essays and data analysis items.
- Use of commercial laboratory equipment, models, home-made equipment and appropriate software in the laboratory to devise practical or hands-on experience. These should involve the application of scientific knowledge to everyday life situations thus supporting understanding of both concrete and abstract scientific concepts.

### **Paper 032 — Alternative to School-Based Assessment (SBA)**

Paper 032 consisted of three questions and was designed to engage and test the skills normally assessed by the SBA component of the syllabus. The following skills were assessed: ORR, PD, D, AI, and MM.

### Question 1

This question was not done very well. It required candidates to display their observation, reporting and recording (ORR) skills by completing a table in Parts (a) (i) and (a) (ii), recording observations in Part (a) (iv), stating an appropriate title for the experiment in Part (a) (v) and describing an experiment in Part (b) (i). Candidates were also required to display their measurement (MM) skills by measuring the length of the potato strips in the diagram for Part (a) (vi) and their analysis and interpretation (AI) skills by providing explanations in Parts (a) (vi), (a) (vii) and (a) (viii). Candidates displayed a total lack of exposure to practical assignments in answering the question.

### **Recommendation**

Candidates taking the alternative paper must be exposed to laboratory activities.

### Question 2

This question required candidates to display all five SBA skills: measurement and manipulation (MM) for Parts (a) (iv) and (v); observation, reporting and recording (ORR) in Parts (a) (i), (a) (ii), (b) (i) and (b) (ii); analysis and interpretation (AI) in Part (a) (iv); planning and designing (PD) for Part (c) (i) and; Drawing (D) for Part (c) (iii). The question was also poorly done indicating a lack of exposure to practical assignments.

### Question 3

This question required candidates to display the following SBA skills: measurement and manipulation (MM) in Part (a); observation, reporting and recording (ORR) in Part (c); planning and designing (PD) in Part (b); analysis and interpretation (AI) in Part (d) and Drawing (D), in Part (f). The question was also poorly done indicating a lack of exposure to practical assignments.

## **Paper 031 — School-Based Assessment**

The overall performance was satisfactory; however, greater focus and effort need to be placed on analysis and interpretation (AI) and planning and development (PD) skills.

### Drawing D

#### Strengths

- The majority of drawings were of adequate size.
- The label lines, in most cases, touched the correct parts of the drawings.
- The majority of drawings were two dimensional.

### Weaknesses

- There is a need for the drawing of more biological specimens.
- In a few cases, arrowheads were attached to label lines.
- Titles in many cases were inappropriately written and positioned.
- Many students did not demonstrate an adequate understanding of how to calculate magnification.
- The various parts in a drawing must be proportional. This was not the case.

### **Recommendations**

- All titles should be placed at the bottom of each drawing and there should be a statement informing the reader of what the drawing represents. In addition, the view and accurate magnification should be clearly identified within the title.
- The use of arrowheads should be avoided, in addition, a ruler should be used to draw all label lines and they should be parallel to each other. Label lines on the same side of the drawing should stop at the same point.
- To make provisions for larger drawings, each drawing should be restricted to a single page.
- The labels, written in print (script), should start at the end of the label line. They should never be printed on the label lines. The labels should either be upper or lower case but never a combination of both.
- The lines of the drawings should always be clear, distinct and continuous, that is, students should avoid shading double lines and sketching at all times.
- Drawings should be about half a page or more.
- Illustrations such as flow charts and cycles should not be submitted as drawings.

### **Planning and Design (PD)**

#### Strengths

- The assignments chosen for planning and design reflected a clear understanding of what is acceptable for such assignments.

- Most planning and design assignments were generally workable.
- Most assignments assessed in this category illustrated a clear role of the control.
- Most hypotheses were tenable

### Weaknesses

- Verification assignments (laboratory exercises where concepts and known principles are proven) should not be assessed for PD.
- Critical aspects of planning and design such as precautions, controls, limitations and repeated measurements were omitted.

### **Recommendations**

- The hypothesis should be clearly stated and should be a specific statement or prediction which is different from the aim of the experiment. Also, it should be: (a) suitable, that is, an experiment can be performed to test the hypothesis, and (b) manageable, that is, it should be realistic.
- The procedure of the experiment should be clearly written and demonstrate scientific skills, which can be used to prove or disprove the hypothesis.
- In regard to attention to detail, students should be precise and concise. For example, there should be specific quantities assigned to each type of measurement used such as volume, temperature, length and mass.
- The steps of the procedure should be in logical sequence.
- Format of expected data/results should be clearly presented. Students are not expected to carry out the experiment; however, the way in which they intend to present their results should be written clearly, for example, tables can be used with the appropriate headings and title, prose can also be used to record the expected data.
- Precautions refer to the steps used to ensure accuracy and safety, which do not affect the experiment. They should also be clearly identified.
- In instances where students actually carried out the activity, they should indicate if the entire procedure or measurements of the experiment were repeated to verify consistency and accuracy.
- Laboratory activities that lend themselves for assessment of the PD skill should be chosen.

## **Analysis and Interpretation**

### **Strength**

- The use of guided questions for the AI has been reduced and students are being encouraged to evaluate their results and observations.

### **Weaknesses**

- Predictions and inference were not directly linked to trends, patterns and relationships in the laboratory exercises.
- Critical aspects such as sources of error, precautions and limitations were omitted.

## **Recommendations**

- Laboratory exercises must lend themselves to the identification of trends, patterns and relationships.
- Inferences must be linked to the results/observations.
- Evaluations should not be general statements; conclusions need to be linked to the aim of the laboratory exercise and the data obtained.
- Calculations shown must include formulae and units.
- Questions from textbooks should not be used as AI laboratory exercises.
- Laboratory exercises must be carried out and the data presented, analysed and interpreted.
- At least two AI laboratory exercises must be assessed per year.

**C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L**

**REPORT ON CANDIDATES' WORK IN THE  
CARIBBEAN SECONDARY EDUCATION CERTIFICATE®  
EXAMINATION**

**MAY/JUNE 2013**

**INTEGRATED SCIENCE  
(SINGLE AWARD)  
GENERAL PROFICIENCY EXAMINATION**

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## GENERAL COMMENTS

The CSEC examination in Integrated Science was again offered at the General Proficiency in 2013. The June 2013 examination consisted of three papers, Paper 01 — Multiple Choice; Paper 02 — a data analysis question, short response questions, and essay questions, and Paper 031 — School-Based Assessment. Paper 032, the alternative to the School-Based Assessment is a Practical Paper written by private candidates.

The number of candidates entering for this examination was 22,967 compared to 23,790 in 2012, a four per cent decrease in candidate entries. The overall performance of candidates in the 2013 examinations was comparable with the performance in 2012. Seventy-nine per cent of the candidates earned Grades I to III.

## DETAILED COMMENTS

### Paper 01 — Multiple Choice

Paper 01 consisted of 60 multiple choice items with a total weighted score of 90 marks. The mean score of 53.35 was similar to that of 2012 which was 52.77.

### Paper 02 — Structured Paper

Paper 02 consisted of three short-answer, structured questions, one data analysis question and two essay questions. The maximum mark for Question 1, the data analysis question, was 25 marks while Questions 2 to 6 were worth 15 marks each, a maximum of 100 marks with a total weighted score of 150 marks. The mean score earned on this paper was approximately 59.04 and is similar to mean score for 2012 which was 60.68.

### Paper 02

#### Question 1

This question tested the candidates' understanding of breathing, and respiration and their ability to apply their scientific knowledge and skills in interpreting tabulated information and a graph that compared the number of deaths of smokers and non-smokers. Overall this question was fairly well done by few candidates.

For Part (a) (i), which required candidates to describe how the chest muscles and rib-cage moved during inhalation and exhalation, some candidates provided complete and acceptable responses that indicated how the muscles contract and relax, and the up and out and the down and in movement of the ribs/rib-cage corresponding to inhalation and exhalation. Many candidates focused on the movement of the diaphragm although the question focused on the intercostal muscles; also, many candidates were not clear in indicating which action was associated with inhalation or exhalation, they mentioned 'in and out' and 'up and down' instead of 'up and out' and 'down and in' which more accurately describe the movement of the ribs/ribcage during inhalation and exhalation respectively.

For Part (a) (ii), where the candidates were required to suggest how Riki's breathing rate changed while running up and down the hill, many responses inadequately indicated that the rate changed instead of providing the expected response "breathing rate increased", clearly indicating how the rate changed.

For Part (a) (iii) in which candidates were required to give a reason for their answer in (a) (ii), satisfactory responses indicated that the body would require more energy and/ or oxygen. For Part (a) (iv), in which candidates were required to explain how the movement of Riki's diaphragm allowed breathing in during singing or strenuous activities, many candidates did not mention the role of

pressure changes and mainly focused on the movement of the diaphragm and the volume/space created. Good responses to this part indicated that during strenuous exercise the diaphragm moves down, resulting in an increase in volume of the lungs and lowering its pressure; air rushes into the lungs with the greater pressure on the outside of the lungs.

Most candidates attempted Part (b) and correctly responded that a higher percentage of oxygen is present in inhaled air than in exhaled air, and a lower percentage of carbon dioxide would be found in inhaled air in comparison with higher percentage of carbon dioxide in exhaled air. However, there is the need for candidates to pay greater attention to the gases involved in respiration. Some candidates appeared to confuse oxygen with carbon dioxide.

For Part (c) (i) many candidates did not display knowledge of the type of respiration associated with the production of lactic acid; only a few candidates correctly stated the expected response of 'anaerobic respiration'.

For Part (c) (ii) many candidates correctly wrote the word equation for the process of respiration that involves oxygen. For Part (c) (iii) many candidates correctly wrote carbohydrates; however, quite a few candidates inadequately stated 'protein'. Some responses were inadequately stated as food examples such as 'orange' 'fruit' and 'energy drinks'.

Part (d) (i) to (vii) required candidates to plot a graph from the data provided in a table, label the axes on the graph, and state its title, infer information from the graph, draw conclusions based on the trend of the graph and state a comparison of the lungs of smokers and non-smokers.

Overall, the candidates' responses to this part reflected a need for improvement in their graph skills. Some candidates accurately labelled the y – axis as "number of smokers" and correctly made readings from their graphs. For Part (d) (vi), most candidates accurately concluded that smoking tobacco lowers life expectancy. For Part (d) (vii) most candidates correctly indicated that the lungs of smokers were more likely to be blackened, develop cancer and have reduced breathing capacity. A large number of candidates responded that the lungs would become damaged, which was too vague an answer and needed further elaboration. Also some candidates said the lungs would become 'weak' which also needed elaboration.

## **Recommendations**

- Students need to practice drawing graphs, paying attention to the quality of the lines resulting from the connection of the points.
- Students could benefit from more guidance or practice in writing appropriate titles for graphs as well as reading off the points on the graph.

## **Question 2**

This question tested candidates' understanding and ability to apply their knowledge relative to the benefits of alloys and plastics as well as conditions that cause rusting. This question was widely attempted; however, it was not very well done by many candidates.

In Part (a), in which candidates were required to distinguish between corrosion and rusting, some candidates confused corrosion with corruption, collision, erosion, irritation, and explosion. Acceptable answers indicated that corrosion involves the chemical reaction between any metal and any substance in the environment; while rusting requires oxygen and it is the oxidation of iron.



Some aspects of Part (b) (i) to (vii) were not well done by candidates. For Part (b) (i), many candidates did not indicate B, which was the acceptable response. In providing the reason required in (b) (ii) some candidates inappropriately included as the cause of rusting: the presence of carbon dioxide; only water; only oxygen and salt. Acceptable responses pointed to the presence of both water and oxygen as the cause of rusting. For Part (b) (iii), many candidates appeared not to be aware that calcium chloride is used as a drying agent.

For Part (b) (iv), the acceptable responses were C or A. For Part (b) (v) many candidates gave the first part of the answer indicating that rusting would not occur with exposed stainless steel nails. The majority of the candidates seemed not to have known the relevant properties of an alloy; stainless steel being an alloy could account for a tendency to resist rusting was the expected response. Only a few responses linked the absence of rusting with the fact that steel is an alloy.

For Part (b) (vi) some candidates provided acceptable responses, which included pot, pans, knives and refrigerator. For (b) (vii) acceptable responses included painting, oiling, plastic coating, electroplating, galvanizing, or tin plating as a method for preventing rusting.

For Part (c), based on the scenario provided, candidates were required to indicate the advantages and disadvantages of using a plastic tap instead of brass tap. Many of the candidates provided acceptable responses indicating advantages of plastic such as usually *less expensive and does not corrode* and disadvantages such as plastic is usually *non-biodegradable and produces toxic fumes when burnt*.

### **Recommendation**

- To facilitate a deeper understanding of experimental procedures and the uses of functions of reagents/materials such as calcium chloride, students need to be exposed to the practical aspects of topics as much as possible as the topic is taught.
- Through recommended practical activities and planning and designing experiences, students could develop a better grasp of experimental controls and identifying controlled variables in an experiment.

### Question 3

This question tested candidates' understanding of reproduction in plants and human beings, their ability to interpret and infer from plant growth patterns as well as their ability to apply population control strategies for problem solving.

This question was well done by many candidates. For Parts (a) (i) and (ii), the responses were fair. Many candidates showed weaknesses relative to spelling, labelling and differentiating the different parts of the female and male reproductive systems.

For (i) the acceptable responses were: X = ovary; Y = uterus; Z = cervix. For (ii) the most common acceptable responses were: Testes, penis, prostate gland and scrotum.

Part (b) was not very well done by many candidates. This part required candidates to explain how a plant presented in a drawing may be reproduced asexually and sexually. Some candidates appeared not to be clear about the meanings or difference between the terms **asexual and sexual** reproduction. Many candidates confused self-pollination and asexual reproduction. Candidates seemed to be more knowledgeable about sexual reproduction in plants than asexual reproduction. Acceptable responses for asexual reproduction usually included the planting of cuttings from the branch. Acceptable responses for sexual reproduction identified the salient points such as pollination, the recognition of both male and female sexual reproductive structures of the flower, seed production and the involvement of the ovary. Commendably, a few candidates expressed clear statements describing the

entire process of sexual reproduction in plants notably pollination followed by fertilization and germination.

Part (c) was fairly well done by some candidates. Acceptable responses indicated that to assist with overpopulation in a country, individuals in a country could practise family planning and the government could encourage education programmes about contraceptives.

Part (d) was fairly well done by most candidates. Candidates were able to read and deduce information from the graph as required in Parts (i), (ii) and (iii) and to accurately provide reasons for the difference in the minimum heights reached by the two seedlings.

### **Recommendation**

- To support instruction, activities could be organized to allow students to translate the recommended biological terms for the reproductive organs from the colloquial terms or jargon used within their region. It is recommended that students be more exposed to models, drawings, and computer software in order to assist in memorizing correct terms.
- It is recommended that when teaching the topic drawings and flowcharts be used to show processes such as sexual reproduction in plants.

### Question 4

This question tested candidates' understanding of the methods of heat transfer and their applications as well as candidates' understanding of the need for proper ventilation.

Part (a) (i) required candidates to distinguish among conduction, convection and radiation of heat energy. The acceptable responses included an indication that conduction involves the transfer of heat energy from molecule to molecule, or from particle to particle; convection involves the transfer of heat energy by movement of the fluid (liquid or gas) while radiation involves the transfer of heat energy via electromagnetic waves. Not many responses referred to the movement of particles as required for conduction.

For Part (a) (ii), which required examples of a conductor and an insulator, acceptable responses were pots and electrical wires for conductors, and rubber and cloth for insulators.

Part (b) was fairly well done by many candidates. For Part (b) (i) which required candidates to indicate the method by which the heat energy is transferred from outside of the pot to the inside of the pot, many candidates correctly indicated 'conduction'. For (b) (ii) some candidates also provided the expected response of 'convection', correctly indicating the method by which heat energy is transferred from the bottom of the water to the top of the water. Some incorrect responses were: transpiration, evaporation and boiling.

Part (c) (i) required candidates to suggest the aim of the experiment. The acceptable response was: "To determine the rate of conduction of different materials". This part was fairly well done by candidates. For Parts (c) (ii) and (iii) most candidates responded correctly, identifying Rod C in the figure as the best conductor and Rod E the best insulator.

For (c) (iv), in which candidates were required to list two variables that must be held constant in the experiment, the acceptable responses included two of the following points: Rods of equal length and thickness, rods exposed to same amount of heat energy, same amount of wax used and/or thumbtack of same size used. For (c) (v), which required an explanation for the constant heating of the beaker in the experiment, the acceptable responses pointed to the need for the heat energy to be transferred to the other end of the rods as a result of the end in the water being hotter than the end out of the beaker for the duration of the experiment.

Part (d) required candidates to provide a scientific explanation for a warehouse becoming cooler after its renovation involving the construction of a higher roof. This part was fairly well done by many candidates. The acceptable response was: "Hot air rises (from the bottom) by convection and cool air replaces the hot air (at the bottom) making it cooler".

### **Recommendation**

- Regarding conduction, it is recommended that attention be given to the required level of detail (making reference to particles of the substance) during instruction, to facilitate the development of students' understanding of conduction and convection to the appropriate depth.
- During instruction students could benefit from being engaged in activities that emphasize the scientific explanation for everyday life observations resulting from processes such as convection.

### Question 5

This question tested candidates' knowledge of the respiratory, circulatory and nervous systems and their ability to apply their knowledge to a practical life situation. It tested candidates' ability to relate the uses of metals and non-metals to their properties. It also tested their understanding of the advantages and disadvantages of using plastics.

Part (a), which required candidates to state three differences between transport of nutrients in plants and humans, was widely known by candidates. The acceptable responses included an indication of: A heart in humans, while there is no heart in plants but transpiration pull (in plants); xylem and phloem in plants but veins, arteries, capillaries in animals; blood/blood cells in humans while instead of blood, there is water and cell sap in plants.

Part (b) required candidates to explain how a person's circulatory and respiratory systems enabled the performance of daily rides in a rocky terrain. Complete responses included a candidates' recognition that the respiratory system facilitates release of energy, increased breathing, increased blood flow or more oxygen; that the circulatory system transports blood with oxygen and glucose to muscles and removes waste, such as carbon dioxide.

Very few candidates were able to distinguish between the circulatory and respiratory systems. Although the systems are interrelated in their functions in some respects, many responses reflected a confusion of the specific functions of these systems. In many responses candidates did not indicate the increase in activities associated with the increased energy demands as expected, although some responses reflected knowledge about oxygen and blood flow to support general activities.

Part (c) required candidates to describe the role of the nervous system in facilitating the ride. Acceptable responses indicated that the eye receives light (stimulus); the brain interprets or processes information relative to seeing; nerve cells conduct messages to and from the brain and the brain coordinates for appropriate balance or movement.

Part (d) required candidates to identify two materials for making the bicycle frame as well as to indicate the properties that make these materials suitable. This part of the question was correctly answered by many candidates. Acceptable answers included metal (e.g. iron) for its high tensile strength or being malleable; and plastic for being light weight.

### Question 6

This question tested candidates' understanding of electricity and lighting, and devices and their applications in household appliances as well as safety. It also tested candidates' understanding of the separation of the colours of light.

Most candidates attempted this question, however only a few responses were satisfactory. Part (a), in which candidates were required to name three primary colours of light in the rainbow, was generally well done with most candidates correctly indicating at least two of the primary colours. Many candidates named red, green and blue. However a common incorrect response was yellow.

For Part (b), in which candidates were required to indicate how secondary colours could be created with spotlights on a white wall, some candidates provided acceptable responses that included: the shining of spotlights to get cyan from blue and green; yellow from red and green and magenta from red and blue. Many of the candidates' responses confused the mixing of light with the mixing of pigments.

Part (c) was not well done by many candidates. For Part (c) (i), in which candidates were required to calculate the current in an extension cord that was used to power a 60W bulb, the formula of  $I=W/V$  to provide an answer of 0.5 A was correctly applied by some candidates. Many candidates provided incorrect units such as ohms and volts for current. In addition, an incorrect equation was used by some candidates.

For Part (c) (ii), in which candidates were required to explain the safety of the situation based on the information provided, acceptable responses included the danger of overloading the small wires in the electrical extension cord and the possibility of water getting into contact with the electrical circuit thus causing a fire or resulting in electrical shock.

For Part (c) (iii), in which candidates were required to indicate a device that prevents house wiring from burning and to explain how it works, fuse or circuit breakers were acceptable devices.

### **Paper 031 – School-Based Assessment**

The overall performance was satisfactory. However greater focus and effort need to be placed on Analysis and Interpretation (AI) and Planning and Designing (PD) skills.

The general recommendations below, which were also provided in previous reports, for improving practical or inquiry skills, continue to be applicable. Much attention needs to be given to developing the planning and designing skills.

#### **General Recommendations to Teachers** (*refer to previous reports*)

All laboratory report books should have a content page with the following format and headings.

<b>Lab No</b>	<b>Page</b>	<b>Description of Laboratory Exercise</b>	<b>Date</b>	<b>Skills Assessed</b>

- The pages of the laboratory notebook should be numbered.
- Each activity should begin on a new page and be properly dated.

- The skills assessed and marks allocated should be written next to the laboratory report and on the contents page.
- The maximum mark to be awarded to each skill is 10 marks. Skills marked out of other totals should be scaled to 10.
- Dates when each practical was assessed should be included in laboratory reports.

### **Observations, Recording and reporting (ORR)**

- Proper laboratory format should be used, for example:

Title  
Aim  
Apparatus/Material  
Diagram  
Method  
Results/Observation  
Discussion  
Conclusion

- Reporting should be concise and observations should be recorded in a suitable format. The use of tables is recommended whenever possible.
- Numerical tables should have the physical quantities and units stated in the heading, and the number of decimal places should be consistent.
- Non-numerical tables should have appropriate headings. Details of data recorded should include all observations, for example, the solution turned from blue to green to orange upon heating.
- Graphs should have axes labelled, appropriate scales, points plotted accurately and a smooth **curve or best fit line drawn**. (Only growth curves should have the points joined dot to dot.)
- Where prose is used to record observations, details of data are necessary.

### **Analysis and Interpretation (A/I)**

- Laboratory exercises must lend themselves to the identification of trends, patterns and relationships.
- Inferences must be linked to the results/ observations.
- Evaluation should not be general statements. Conclusions need to be linked to the aim of the lab stated and the data obtained.
- Calculations shown must include formulae and units.
- Questions from the textbook should not be used as A/I laboratory exercises. Laboratory exercise must be carried out and the data generated must be analysed and interpreted.

### **Planning and Design (P/D)**

- P/D laboratory exercises need to be original. Students are required to formulate a hypothesis and design a scientific experiment to test the hypothesis.
- P/D laboratory exercise does not have to be done to prove a scientific fact. If they are carried out they can be used to assess other skills and the plan can be modified as necessary.
- **Textbook laboratory exercises are not acceptable as P/D experiments.**
- Some laboratory exercises did not lend themselves for assessment as P/D laboratory exercises, for example 'making soap', 'reactivity of metals' and model of lungs'.
- **A hypothesis is a statement and should not be written in the form of a question.**
- Procedures should reflect a direct link with the hypothesis.
- Procedures should include the number of times the experiment is to be repeated and any precautions to be taken.

## Drawings

- All titles should be placed at the bottom of each drawing and there should be a statement informing the reader of what the drawing represents. In addition, the view and accurate magnification should be clearly identified within the title.
- The use of arrow-heads should be avoided. In addition, a ruler should be used to draw all label lines and they should be parallel to each other. Label lines on the same side of the drawing should stop at the same point. The label lines should touch the appropriate parts of the drawings.
- The labels, written in print (script), should be started at the end of the label line. They should never be printed on the label line. The labels should either be upper **or** lower case but **never** a mixture of both
- The lines of the drawings should always be clear, distinct and continuous; that is, students should avoid shading, double lines and sketching at all times.
- The drawings should be two dimensional.
- Drawing should preferably be done from specimens. Diagrams and natural cycles are not to be presented as SBA drawings.

### **Paper 032 – Alternative to School-Based Assessment (SBA)**

Paper 032 consisted of three questions and was designed to test the skills normally assessed by the SBA component of the syllabus. The following skills were assessed: Drawing, Observation/Recording/Reporting, Manipulation/Measurement, Planning/Designing, and Analysis & Interpretation. Most candidates attempted the questions.

Question 1 provided candidates with a diagram of fruits, including a cut tomato. Candidates were required to measure the diameter of the tomato. They were required to write an aim for an experiment involving the placing of iodine solutions on each fruit. They were also required to construct a table for recording the data, to formulate conclusions based on the colour changes provided, as well as plan and design an experiment. This question was fairly well done by a few candidates.

Question 2 required the reading of volumes from diagrams of measuring cylinders, description of the procedure for verifying Archimedes' principle using the list of materials provided, as well as drawing a diagram to illustrate the procedure, and stating an appropriate title. They were also required to draw a graph from the data provided, label the axes, calculate slope and write a statement on the relationship between the mass of an object and the volume of water displaced by that object. This question was poorly done, as candidates were unable to demonstrate their knowledge and use of critical SBA skills.

Question 3 involved the investigation of the relationship between the load-to-effort ratio and the ratio of the distance A to the distance B in first-class levers. It involved taking measurements, constructing a table, making calculations, and identifying the position of the centre of gravity on a rule. This question was poorly done. Most candidates were unable to show their use of the relevant SBA skills to answer the question.

Overall, the performance of candidates on the Paper 032 was poor. Most candidates were unable to demonstrate the required SBA skills. Recommendations for skill development are provided in the general feedback on SBA.

### **COMMENTS**

The attainment of scientific literacy for all learners continues to be an essential objective in the 21<sup>st</sup> century. Across our region, the CSEC Integrated Science syllabus is intended to contribute to science education for promoting the development of problem- solving and investigative skills: This subject allows Caribbean secondary students the opportunity “to pursue a science course in the interest of a



well-rounded general education”; providing support for science related subjects and further studies related to certain careers (CXC Integrated Science Syllabus, 2009, p. 1).

Integrated Science is a popular choice in many secondary schools. As a single science or complementary subject it continues to be well received across the Caribbean as evident through its wide access by students and schools from across our region. To facilitate the implementation of the CSEC Integrated Science syllabus it is important that within the school system, a variety of strategies for optimally benefiting from the presence of teachers with specialization in different areas of science continue to be explored.

Relative to CSEC Integrated Science within the school, two areas for special attention are: (a) the utilization of syllabus guidance on improving the quality of candidates’ responses; and (b) collaboration in the promotion of strategies to strengthen an integrated approach to instruction by teachers who are often subject-specialists.

- *Syllabus guidance:* In implementing the syllabus during instruction, greater attention needs to be given to the explanatory notes and activities which provide some guidance for the scope and level of treatment of the topics and objectives outlined in the syllabus. This can assist candidates to provide more adequate and scientific responses; and may also guard against the provision of responses that may be too vague, unscientific or below the expected level of the syllabus.
- *Collaboration to support unpopular content areas:* Some areas/topics in science may be more popular than others among science educators who are often subject specialists in the areas of Biology, Chemistry and/or Physics. Collaborative strategies that incorporate sharing of resources and teaching strategies could provide instructional support among educators. Team planning and/or teaching could be encouraged to allow for enhanced integration among science topics often associated with the single subjects.

## **Recommendations**

The following recommendations can be considered for shaping instruction that addresses some of the weaknesses reflected in the candidates’ responses, as well as to support teaching and learning in general, as guided by the syllabus:

### *1. Using scientific knowledge in everyday life contexts*

With reference to the biological systems, students appear to require more instruction in developing and applying scientific knowledge to everyday life situations. In addition to using diagrams and models to understand structures and functions, learners at this level, appear to need more practice through relevant structured questions that focus on the relative demands and involvement of body structures and specific systems in real life activities.

The use of selected authentic experiences online, and incorporating relevant multimedia presentations and three-dimensional illustrations could support interesting discussions and contribute to better understanding of the body in a dynamic and more realistic sense.

### *2. Improving language skills: Spelling of scientific words*

Students need to be reminded about the need for correct spelling of scientific words. Responses are enhanced when answers are communicated effectively, and words are recognizable. Incorrect spelling of terms may distort answers beyond recognition.

3. *Understanding and using scientific terms*

The use of scientific terms (to the level guided by the syllabus should be encouraged). Terms such as the scientific names of human reproductive parts (including the genitals) need to be used in responses instead of a range of unscientific terms that may be used across the territories.

4. *Distinguishing between terms*

In comparing or distinguishing between terms, students also need to be guided (through practice) in expressing differences (or points) in terms of parallel points to improve completeness of responses.

Among other terms of the syllabus, students need to be guided towards understanding clearly the differences between the following listed pairs of terms:

- Corrosion and rusting
- Materials and property
- Metal and alloy
- Iron and steel
- Industrial and household equipment
- Intercostal muscles and ribs
- Asexual and sexual reproduction
- Self-pollination and asexual reproduction
- Ohms and amps
- Nutrient and food name

5. *Selecting appropriate formulae and using correct units:*

For problem solving, students require practice in using formulae for working out values.

Accuracy in calculations and use of appropriate units should be encouraged.



**C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L**

**REPORT ON CANDIDATES' WORK IN THE  
CARIBBEAN SECONDARY EDUCATION CERTIFICATE®  
EXAMINATION**

**MAY/JUNE 2014**

**INTEGRATED SCIENCE  
(SINGLE AWARD)  
GENERAL PROFICIENCY EXAMINATION**

## **GENERAL COMMENTS**

The CSEC examination in Integrated Science was again offered at the General Proficiency in 2014. The June 2014 examinations consisted of three papers, Paper 01 – Multiple Choice; Paper 02 – a data analysis question, short-response questions, and essay questions; and. Paper 031 – School-Based Assessment. Paper 03/2, the alternative to the School-Based Assessment is a Practical Paper written by private candidates.

The number of candidates entered for this examination was 21,737 compared to 22,967 in 2013, a five per cent decrease in candidate entries. The overall performance of candidates in the 2014 examinations was comparable with the performance in 2013. Seventy-eight per cent of the candidates earned Grades I to III.

## **DETAILED COMMENTS**

### **Paper 01 — Multiple Choice**

Paper 01 consisted of 60 multiple choice items with a total weighted score of 90 marks. The mean score of 54.93 was similar to that of 2013 which was 53.35.

### **Paper 02 — Structured Paper**

Paper 02 consisted of one data analysis question, three short-answer, structured questions and two essay questions. The maximum mark for Question 1, the data analysis question, was 25 marks while Questions 2 to 6 were worth 15 marks each, a maximum of 100 marks with a total weighted score of 150 marks. The mean score earned on this paper was approximately 59.24 and is similar to mean score for 2013 which was 59.04.

### Question 1

This question tested candidates' understanding and ability to use knowledge about water cycle, water purification, metals, and electricity. In general, this question was fairly well done.

For Part (a) (i), in the diagram of the water cycle, many candidates correctly identified "A" as condensation, "B" as precipitation and "C" as evaporation. For Part (a) (ii) the use of water was correctly stated by many candidates; uses such as cooking, bathing, washing and agricultural uses were acceptable.

For Part (a) (iii) many candidates correctly indicated that sickness can result from the presence of bacteria, harmful microorganisms or pathogenic organisms found in the water. There were a few students that were quite general in stating that the water was "not clean", "dirty" or "contaminated"; these responses could be more precise, although they hint at the expected responses.

For Part (a) (iv) many candidates adequately named TWO methods involved in the treating of river water: the common responses included boiling, filtration, chlorination, and distillation.

For Part (b) (i), one effect that the cutting of the forest could have on the water cycle was correctly indicated by some candidates who suggested that it would reduce the water vapour entering the atmosphere; and reduce precipitation. For this part, the expected responses should be relevant to the water cycle. However some responses were not specific to water cycle inadequately stating instead, the general effects of the cutting of the forest.

For Part (b) (ii), candidates were required to indicate how the planting of the poisonous trees would affect the food webs in the forest. Among the acceptable responses were less herbivores, less carnivores, less omnivores and consumers turning to other sources of food.

Part (c) required an understanding of problems associated with the use of fossil fuels.

Candidates were asked to state ONE benefit to the environment of using hydroelectric power in Part (c) (i). Lower levels of carbon dioxide, or less global warming, were acceptable responses. Part (c) (ii), required ONE negative effect on the environment, of building the dam. Acceptable responses were deforestation, disruption of ecosystems, and soil erosion.

More water vapour in the air or more precipitation, were acceptable responses for Part (c) (iii) which asked candidates to state ONE way the dam may affect the water cycle.

For making the uninsulated electrical lines, copper or aluminium are acceptable responses for Part (c) (iv). Electrical shock or danger to low flying aircraft were acceptable responses for electrical hazards in Part (v).

Part (d) required the plotting, reading, and interpretation of a graph.

Acceptable graphs were smooth curve with fine line marks.

For Part (iv) that required candidates to state an appropriate title of the graph, the expected response was “Graph of carbon dioxide dissolved in the oceans vs. year”

For Part (vi) many candidates correctly concluded that the level of carbon dioxide increased over the period.

## Question 2

This question tested candidates’ understanding and ability to use knowledge about acids, bases and salts, digestion in human beings, the action of a solvent in stain removal and safety practices associated with working with chemicals.

For Part (a), examples of acceptable responses for properties of acids included: “has a pH of less than 7; has a sour taste; and react with a base to form salt and water”. Acceptable responses for properties of bases

included: “has a pH greater than 7; has a soapy feel; and react with an acid to form salt and water”. A common *erroneous* response was “acids have a *pH* of 7 and under”.

For Part (b) hydrochloric acid was a common correct response for ONE example of acid in the digestive system, while for a base bile was an expected response.

For Part (c) (i) many candidates appeared not to be aware of pH as “concentration of hydrogen ions” in solution; many candidates instead acceptably referred to pH as an indication of alkalinity/acidity of substances.

For Part (c) (ii), the correct response for the substance that is not an acid was baking soda.

For Part (d) (i) many candidates correctly indicated that bleach would discolour a coloured garment and not dissolve the paint. In some responses, although appropriate substances were suggested to remove paint for Part (d) (ii), some candidates seemed not to have recognized that such substances acted as solvents.

Part (e) required two safety precautions that can be taken during the removal of the paint. Masks, goggles and gloves were the most common safety equipment correctly named. Many candidates however indicated vague or incorrect actions such as “keep away from eyes” or “face” but did not suggest what the safety precaution might be in order to effect this.

Candidates’ performance on this question was less than satisfactory.

### **Recommendations**

- A simple treatment of the chemical properties of acids and bases should be undertaken including neutralisation reactions. During lessons students could be engaged in discussions and activities aimed at highlighting the significance of a pH of 7 (indicating neutral; which is not acidic, nor basic).

- An integrated approach taking into consideration the application of knowledge about “acids”, “bases” and their properties while teaching and learning the topic of digestion, can be helpful for facilitating the development of students’ ability to use knowledge in this area.
- The link between effectiveness of digestive enzymes and pH should be emphasized during teaching of the digestive process.
- The concept of pH may be approached from a practical standpoint by examining a variety of common household substances including neutral substances.

### Question 3

This question was fairly well done. It tested the candidates’ ability to distinguish between a plant cell and an animal cell and their knowledge about the storage of genetic information. Candidates were also required to distinguish between osmosis and diffusion and use this knowledge to suggest a solution to the problem of wilting lettuce. Finally, the question tested the candidates’ knowledge of the likely effects of damaged heart and stomach muscles on the structure and function of these two organs and the overall body.

Part (a) was generally well answered: Cell B or Figure 4 was the correct response for Part (a) (i). Among the correct responses for Part (a) (ii) were: “Cell A has no cell wall, while Cell B has a cell wall; Chloroplast absent in Cell A, while present in Cell B; Smaller vacuole(s) in Cell A while large vacuole in Cell B; or central nucleus in Cell A, while nucleus at side in Cell B. For Part (b) (iii), many candidates correctly indicated “nucleus”; For Part (iv) the expected response, “red blood cell” was provided by some candidates, however many candidates inadequately stated “blood cells”.

In Part (b) (i) many incomplete contrasts were made by candidates in distinguishing between “diffusion” and “osmosis”. The expected responses indicated that “osmosis occurs across selectively (or partially) permeable

membrane while diffusion does not require a membrane”. For Part (b) (ii) some candidates were able to identify osmosis as the process that resulted in lettuce becoming firm.

For Part (b) (iii) many candidates seemed unable to apply the key concepts relating to osmosis with some inadequately citing the water "feeding" and "providing nutrients" for the lettuce. Acceptable responses included: “water entered through a cell membrane” as well as “movement of the water across a concentration gradient.”

Part (b) (iv) was well answered by many candidates who correctly stated “refrigeration” or “placing in a bowl/ bucket of water”. Most candidates attempted Part (c). However, only a fraction of these responses adequately related to the effect on the structure of the stomach due to damage from the stomach muscle. Acceptable responses included “damaged or deformed walls and glands”, “wall perforation” and “ulcers”. For the effect on the function, many candidates inadequately stated the normal functions of organs and not the **effect** of the defect on the functioning of organs. Some candidates inadequately attributed the fitting responses for the “Effect on the function of the organ” to the “overall effect on the body”.

### **Recommendations**

- During instruction, increased attention needs to be given to addressing possible misconceptions of students relating to osmosis and diffusion; some candidates erroneously viewed diffusion as being relevant only to gases.
- When teaching “cells” (plant and animal cells), the functions/importance of the organelles as outlined in the syllabus should be emphasized.

#### Question 4

This question tested candidates' understanding of the use of good and poor conductors of electricity, colour code in wiring a plug and energy consumption of different electrical appliances. Overall, this question was poorly done.

For Part (a) most candidates correctly distinguished between a conductor and an insulator. Acceptable contrasts included: "conductor as a material which readily allows an electric current or heat energy to flow"; while "insulator is a material that does not readily allow an electric current or heat energy to flow".

Part (b) was fairly well done with many candidates identifying a pot as an example of the use of a conductor in the kitchen. A kitchen towel, mittens or pot handles made out of wood or plastic were acceptable responses as examples of insulators in the kitchen.

For Part (c) many candidates correctly identified the colours of the earth wire as yellow/green as well as the neutral wire as being blue in colour. The expected response/colour for live wire was brown.

Part (d) was not well done by many candidates. Many candidates did not (as was necessary) convert the power rating of the appliances from watts to kilowatts by dividing by 1000; then multiplying the answer by the time used to obtain the energy consumed per day by each appliance. However many candidates added as required, the individual energy consumption values to obtain the total energy consumption values.

Part (e) was well done by many candidates. Most candidates were able to correctly identify TWO ways in which energy can be conserved in the home. For this part, the most popular acceptable responses were to (1) unplug appliances that are not in use; (2) use energy saving bulbs (fluorescent bulbs); (3) turn off lights when not in use; and (4) hand wash clothes instead of using the washing machine.



### Question 5

This question was an essay type question that tested candidates' knowledge of the components of air. It also tested their knowledge and understanding of causes/sources of pollution and its effects on organisms in two specified communities. Overall, this question was poorly done.

Part (a) was generally well done. Most candidates scored full marks for this part. The most popular responses for components of air included oxygen, nitrogen and carbon dioxide.

Part (b) (i) required candidates to suggest two likely pollutants that would be present in each of the two different communities presented. For Community A (agricultural community) acceptable pollutants indicated by some candidates included: fertilizers, pesticides and organic waste; and for Community B (near an industrial town); acceptable pollutants included carbon monoxides, sulphur dioxide, oxides of nitrogen, smoke and industrial chemicals.

Part (b) (ii) required candidates to describe the source(s) of **one** pollutant and how it could be distributed in the environment for **each** community. In this part, many candidates' responses were either incomplete with only the source or one community being discussed. Generally, candidates who named an appropriate pollutant, were able to identify its source. However, how the pollutant may be distributed (example by wind or by entering river) was frequently omitted by candidates. Distribution methods such as by the wind, diffusion, and convection currents were acceptable for the air pollutants.

Part (b) (iii) asked for effects that pollutants would have on the organisms in the two communities. Descriptions of eutrophication resulting from the use of fertilizers were very popular responses. The effects of sulphur dioxide and nitrogen oxides, pollutants from the industrial community were generally well explained.

Many candidates related death and sickness to every suggested pollutant. Only a small percentage of these candidates identified as required specific effects. For example, in relation to Community A, respiratory

ailments resulting from smoke; cancers or poisoning due to pesticides, disease or death linked to organic waste; in relation to Community B, death and poisoning due to Carbon monoxide; and acid rain and the effects of acid rain, due to oxides of sulphur.

### **Recommendations**

- The distribution of common pollutants and their effects in the environment do not seem to be well known by students. Lessons on pollution could engage students in case studies that can facilitate each learner making a clear link between pollutants and their effects on organisms. Activities can encourage students to provide more than simple/vague general statements such as “the organisms will be affected” or “get sick”, but specify the effects.

### Question 6

This question tested candidates' understanding and ability to use knowledge relevant to the transfer of heat energy, variables affecting solar energy transfer and the extent to which solar energy can be used as an alternative source of energy. Overall this question was poorly done.

For Part (a) many candidates were able to correctly identify the methods by which heat energy is transferred as conduction, convection and radiation. However the descriptions of the processes provided by many candidates were either incorrect or incomplete.

For Part (b)-(c) many candidates did not use the information provided to answer the question but instead opted inadequately to write about an experimental procedure that was familiar to them like using 'clothing', 'paints' and even information about 'chromatography' instead of the "coloured solutions". Also inadequately, some candidates wrote about temperature measurements that were not clearly initial or final temperatures and there was no controlling for time in many answers. Few candidates included most of the following points to provide an acceptable response:

- Placing containers with coloured water in sunlight
- Taking initial temperature of water in each container
- Leaving the samples in the sunlight for a fixed period of time
- Taking final temperatures of the sample
- Using containers of identical/the same size
- Using the same amount of each coloured sample
- Leaving all the samples in sunlight for the same period of time
- Exposing all the containers to the same intensity of light

For Part (d), candidates appeared not to be familiar with solar energy use in the Caribbean. This part of the question required candidates to describe TWO problems that may be faced by people who want to use solar energy in the Caribbean.

Example of acceptable responses include: “Costly to store the solar energy because devices are large or use costly materials; and solar energy is not available during the night or heavy overcast conditions because of day and night cycle as well as weather. Some candidates who pointed to the expense did not relate this expense to the technology, and cost of the panels.

### **General Recommendations**

- Students may need increased practice in answering structured or essay questions; giving attention to all instructional words before answering a question. These practice items could incorporate case studies (relevant to local and international situations), or relate to practical or hands-on experiences to facilitate understanding of concrete and abstract science concepts. It may be useful to engage learners in case studies and discussions that allow them to apply their knowledge relative to:
  - Self (the human body)
  - Community (varying types as necessary)
  - Caribbean region

- *Addressing misconceptions:*

Increased attention may need to be given to addressing possible misconceptions or erroneous ideas about relevant science concepts. This may require the use of strategies that engage learners in appropriate hands-on and minds-on activities.

- *Including unit where applicable and improving mathematical skills*

Students need to be reminded about the need for performing accurate calculations, and including units, as well as showing working where required.

- *Distinguishing between terms*

More practice may be needed by students in distinguishing between some pairs of scientific terms as well as some non-technical terms. Students may need guidance for understanding the difference between the following pairs of terms:

- Diffusion and osmosis
- Acid and base
- Conductor and insulator
- Pollution and pollutants
- Watts and Amps
- Component and property

- More practice may also be needed by students in using and explaining these terms:

- Precaution
- Description

- Ozone layer
- Greenhouse effect

### **Paper 031 – School-Based Assessment**

The overall performance was satisfactory. However greater focus and effort need to be placed on Analysis and Interpretation (AI) and Planning and Designing (PD) skills.

The general recommendations below, which were also provided in previous reports, for improving practical or inquiry skills, continue to be applicable. Much attention needs to be given to developing the planning and designing skills.

#### **General Recommendations to Teachers** (*refer to previous reports*)

All laboratory report books should have a content page with the following format and headings.

<b>Lab No</b>	<b>Page</b>	<b>Description of Laboratory Exercise</b>	<b>Date</b>	<b>Skills Assessed</b>

- The pages of the laboratory notebook should be numbered.
- Each activity should begin on a new page and be properly dated.
- The skills assessed and marks allocated should be written next to the laboratory report and on the contents page.
- The maximum mark to be awarded to each skill is 10 marks. Skills marked out of other totals should be scaled to 10.
- Dates when each practical was assessed should be included in laboratory reports.

### Observations, Recording and reporting (ORR)

- Proper laboratory format should be used. For example:

Title

Aim

Apparatus/Material

Diagram

Method

Results/Observation

Discussion

Conclusion

- Reporting should be concise and observations should be recorded in a suitable format. The use of tables is recommended whenever possible.
- Numerical tables should have the physical quantities and units stated in the heading, and the number of decimal places should be consistent.
- Non-numerical tables should have appropriate headings. Details of data recorded should include all observations, for example, the solution turned from blue to green to orange upon heating.
- Graphs should have axes labelled, appropriate scales, points plotted accurately and a smooth **curve or best fit line drawn**. (Only growth curves should have the points joined dot to dot.)
- Where prose is used to record observations, details of data are necessary.

### Analysis and Interpretation (A/I)

- Laboratory exercises must lend themselves to the identification of trends, patterns and relationships.
- Inferences must be linked to the results/ observations.
- Evaluation should not be general statements. Conclusions need to be linked to the aim of the lab stated and the data obtained.

- Calculations shown must include formulae and units.
- Questions from the textbook should not be used as A/I laboratory exercises. Laboratory exercise must be carried out and the data generated must be analysed and interpreted.

### Planning and Design (P/D)

- P/D laboratory exercises need to be original. Students are required to formulate a hypothesis and design a scientific experiment to test the hypothesis.
- P/D laboratory exercise does not have to be done to prove a scientific fact. If they are carried out they can be used to assess other skills and the plan can be modified as necessary.
- **Textbook laboratory exercises are not acceptable as P/D experiments.**
- Some laboratory exercises did not lend themselves for assessment as P/D laboratory exercises, for example 'making soap', 'reactivity of metals' and model of lungs'.
- **A hypothesis is a statement and should not be written in the form of a question.**
- Procedures should reflect a direct link with the hypothesis.
- Procedures should include the number of times the experiment is to be repeated and any precautions to be taken.

### Drawings

- All titles should be placed at the bottom of each drawing and there should be a statement informing the reader of what the drawing represents. In addition, the view and accurate magnification should be clearly identified within the title.
- The use of arrow-heads should be avoided. In addition, a ruler should be used to draw all label lines and they should be parallel to each other. Label lines on the same side of the drawing should stop at the same point. The label lines should touch the appropriate parts of the drawings.
- The labels, written in print (script), should be started at the end of the label line. They should never be printed on the label line. The labels should either be upper **or** lower case but **never** a mixture of both

- The lines of the drawings should always be clear, distinct and continuous; that is, students should avoid shading, double lines and sketching at all times.
- The drawings should be two dimensional.
- Drawing should preferably be done from specimens. Diagrams and natural cycles are not to be presented as SBA drawings.

### **Paper 032 – Alternative to School-Based Assessment (SBA)**

Paper 032 consisted of three questions and was designed to test the skills normally assessed by the SBA component of the syllabus. The following skills were assessed: Drawing, Observation/Recording/Reporting, Manipulation/Measurement, Planning/Designing, and Analysis & Interpretation. Most candidates attempted the questions.

#### Question 1

Part (a) required candidates to measure, from a diagram provided, the height and width of a fruit. Candidates were also required to make a drawing of the fruit.

Good drawings were proportional, of an appropriate size, and drawn with clear/tidy lines.

For Part (b) candidates were required to infer from observations of food tests the nutrient(s) present or absent and to record the inferences in a table. Part (c) required the naming of the process photosynthesis for Part (c) (i) and the identification of nutrients, based on the information provided for Part (c) (ii).

Part (d) (i) required candidates to formulate a hypothesis, state variables to be held constant and precautions to be taken. Good hypotheses were testable, manageable and linked two relevant variables. For Part (d) (ii) acceptable variables that could be controlled included temperature, humidity, size of fruit, and stage of



development of fruit. Overall performance on this question was poor as candidates were unable to demonstrate their knowledge and use of critical SBA skills.

### Question 2

This question tested the candidates' understanding of how to plan and design an experiment. It required the candidates to write an aim and outline a suitable procedure for carrying out an activity to find out which of four unknown metals is the best conductor of heat energy. It also required the candidates to state THREE variables that are to be kept constant and precautions that should be taken. For part (a) (iii) acceptable variables that must be kept constant included length and thickness of rod, temperature of water, amount of paraffin used, size of thumbtack and same depth of immersion of all the rods. Overall performance on this question was poor as candidates were unable to demonstrate their knowledge and use of critical SBA skills.

### Question 3

This question tested the candidates' ability to measure, and use readings to plot a graph. They were also required to draw a two dimensional diagram of a pulley system from a diagram. Overall performance on this question was satisfactory, most candidates were able to take accurate measurements and plot the graph.

Overall, the performance of candidates on the Paper 032 was poor. Most candidates were unable to demonstrate the required SBA skills. Recommendations for skill development are provided in the general feedback on SBA.

## **COMMENTS**

The attainment of scientific literacy for all learners continues to be an essential objective in the 21<sup>st</sup> century. Across our region, the CSEC Integrated Science syllabus is intended to contribute to science education for promoting the development of problem- solving and investigative skills: This subject allows Caribbean secondary students the opportunity “to pursue a science course in the interest of a well-rounded general

education”; providing support for science related subjects and further studies related to certain careers (CXC Integrated Science Syllabus, 2009, p. 1).

Integrated Science is a popular choice in many secondary schools. As a single science or complementary subject it continues to be well received across the Caribbean as evident through its wide access by students and schools from across our region. To facilitate the implementation of the CSEC Integrated Science syllabus it is important that within the school system, a variety of strategies for optimally benefiting from the leave presence of teachers with specialization in different areas of science continue to be explored.

Relative to CSEC Integrated Science within the school, two areas for special attention are: (a) the utilization of syllabus guidance on improving the quality of candidates’ responses; and (b) collaboration in the promotion of strategies to strengthen an integrated approach to instruction by teachers who are often subject-specialists.

- *Syllabus guidance*: In implementing the syllabus during instruction, greater attention needs to be given to the explanatory notes and activities which provide some guidance for the scope and level of treatment of the topics and objectives outlined in the syllabus. This can assist candidates to provide more adequate and scientific responses; and may also guard against the provision of responses that may be too vague, unscientific or below the expected level of the syllabus.
- *Collaboration to support unpopular content areas*: Some areas/topics in science may be more popular than others among science educators who are often subject specialists in the areas of Biology, Chemistry and/or Physics. Collaborative strategies that incorporate sharing of resources and teaching strategies could provide instructional support among educators. Team planning and/or teaching could be encouraged to allow for enhanced integration among science topics often associated with the single subjects.

## **Recommendations**

The following recommendations can be considered for shaping instruction that addresses some of the weaknesses reflected in the candidates' responses, as well as to support teaching and learning in general, as guided by the syllabus:

### 1. *Using scientific knowledge in everyday life contexts*

With reference to the biological systems, students appear to require more instruction in developing and applying scientific knowledge to everyday life situations. In addition to using diagrams and models to understand structures and functions, learners at this level, appear to need more practice through relevant structured questions that focus on the relative demands and involvement of body structures and specific systems in real life activities.

The use of selected authentic experiences online, and incorporating relevant multimedia presentations and three-dimensional illustrations could support interesting discussions and contribute to better understanding of the body in a dynamic and more realistic sense.

### 2. *Improving language skills: Spelling of scientific words*

Students need to be reminded about the need for correct spelling of scientific words. Responses are enhanced when answers are communicated effectively, and words are recognizable. Incorrect spelling of terms may distort answers beyond recognition.

### 3. *Understanding and using scientific terms*

The use of scientific terms (to the level guided by the syllabus should be encouraged). Terms such as the scientific names of human reproductive parts (including the genitals) need to be used in responses instead of a range of unscientific terms that may be used across the territories.

4. *Distinguishing between terms*

In comparing or distinguishing between terms, students also need to be guided (through practice) in expressing differences (or points) in terms of parallel points to improve completeness of responses.

Among other terms of the syllabus, students need to be guided towards understanding clearly the differences between the following listed pairs of terms:

- (a) Corrosion and rusting
- (b) Materials and property
- (c) Metal and alloy
- (d) Iron and steel
- (e) Industrial and household equipment
- (f) Intercostal muscles and ribs
- (g) Asexual and sexual reproduction
- (h) Self-pollination and asexual reproduction
- (i) Ohms and amps
- (j) Nutrient and food name

5. *Selecting appropriate formulae and using correct units:*

For problem solving, students require practice in using formulae for working out values.

Accuracy in calculations and use of appropriate units should be encouraged.

**C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L**

**REPORT ON CANDIDATES' WORK IN THE  
CARIBBEAN SECONDARY EDUCATION CERTIFICATE®  
EXAMINATION**

**MAY/JUNE 2015**

**INTEGRATED SCIENCE  
(SINGLE AWARD)  
GENERAL PROFICIENCY EXAMINATION**

## GENERAL COMMENTS

The CSEC examination in Integrated Science was again offered at the General Proficiency in 2015. The June 2015 examinations consisted of three papers, Paper 01 – Multiple Choice; Paper 02 – Structured/Essay Questions; and Paper 031 – School-Based Assessment. Paper 032, the Alternative to School-Based Assessment is a practical paper written by private candidates.

The number of candidates entered for this examination was 21147 compared to 21737 in 2014, a three per cent decrease in candidate entries. The overall performance of candidates in the 2015 examinations was comparable with performance in 2014. Seventy-one per cent of the candidates earned Grades I to III.

## DETAILED COMMENTS

### Paper 01 — Multiple Choice

Paper 01 consisted of 60 multiple-choice items with a total weighted score of 90 marks. The mean score for was 52.22.

### Paper 02 — Structured/Essay Paper

Paper 02 consisted of one data analysis question, three short-answer, structured questions and two essay questions. The maximum mark for Question 1, the data analysis question, was 25 marks while Questions 2 to 6 were worth 15 marks each, a maximum of 100 marks with a total weighted score of 150 marks. The mean score earned on this paper was 58.69, similar to the mean score for 2014 which was 59.24.

#### Question 1

This question dealt with candidates' ability to analyse data, draw and label a graph and make inferences. It also tested candidates' knowledge of soils, food webs, photosynthesis, respiration and the effects of deforestation.

Part (a) (i) required candidates to state why ponds in the flat sandy fields dry up faster than those on the clayey hillsides. Many candidates were able to give correct responses, however, some candidates were not able to link the smaller size of clay particles with the pore spacing (compactness) and the ability of the soil to retain water, or 'water flows faster' as reasons. Good responses were:

- Sandy soils have large pores and retain less water than clay.
- Clay has smaller particles than sand; in clay there are smaller spaces for water to pass through, unlike sand.
- The clay soil has particles that are very close together, allowing for high water retention.

Part (a) (ii) tested candidates' ability to use their knowledge to draw conclusions about the effect(s) that cutting down the trees on the hillside will have on the farm. This part of the question was well done by most candidates. The most popular responses were *erosion, landslides and flooding*. Most candidates were able to link the cutting down of the trees with erosion or landslides as *the lack of cover and roots on the ground will leave the soil 'bare' for erosion and prone to landslides*. However, some candidates wrongly stated 'deforestation'.

Part (a) (iii) assessed candidates' knowledge of food webs and feeding relationships. This part was fairly well done. Many candidates were unable to draw the correct direction of the arrows although they had the correct links.

Part (a) (iv) assessed candidates' knowledge about herbivores, carnivores and omnivores present in the table. This part was well done by the majority of candidates.

Part (b) (i) asked candidates about the process used by living things to obtain energy. It was poorly done as only a few candidates correctly stated *respiration*. Part (b) (ii) asked candidates to name the process by which plants make food. This was well done by most candidates.

Part (b) (iii) asked candidates to write a word equation for the process by which plants make food. Many candidates were able to earn marks here. Some candidates wrote a chemical equation for photosynthesis and so were unable to obtain the marks.

Part (b) (iv) required candidates to name one form in which plants use nitrogen present in the soil. This part proved challenging for most candidates and was poorly done; candidates were unable to state *nitrates* or *nitrites*.

Part (c) (i) assessed the ability of candidates to plot a graph on the grid, using the scales provided and the data in the table. Some candidates were unable to get marks for plotting the points which required them to determine the exact division represented by the pH value.

In Part (c) (ii), many candidates lost marks because of the inability to make neat, fine lines and points. Many candidates continue to incorrectly use dots without circles when plotting points. Accepted plotting point symbols are x's or circled dots.

Part (c) (iii) asked candidates to label the axes. Many candidates correctly labelled *pH of soil sample* and *field*, however, far too many candidates labelled axes as simply 'x' and 'y'.

For Part (c) (iv), candidates were asked to suggest an appropriate title for the graph. This was fairly well done, but some candidates only mentioned one aspect of the title, 'pH of soil samples', and not '*fields*' or '*fields across the farm*' or '*across the farm*'.

Part (c) (v) asked candidates to determine from the graph, which is the most suitable field to grow corn. Many candidates were able to earn this mark by interpolating from the graph *field (3) with neutral pH of 7*.

In Part (c) (vi), many candidates were able to earn the mark by determining from the graph that *field (7) is best for growing citrus at acid pH of 5*.

## **Recommendations**

Emphasis should be placed on

- plotting graphs, with correct symbols
- using graph scales
- neatness and the use of fine lines and points
- labelling axes
- obtaining results from the graph by accurately interpolating points.

## **Question 2**

This question tested candidates' ability to differentiate between excretion and egestion, their knowledge of the excretory system, metabolic waste and their effects on the environment, and their knowledge of the methods of making water safe for drinking.

In Part (a), candidates were asked to distinguish between *excretion* and *egestion*. Approximately 50 per cent of candidates were able to correctly differentiate between the two terms. Many candidates had an idea that both processes produced waste but were unable to identify the type of waste associated with each process. Some candidates gave examples of metabolic waste but did not use the term *metabolic waste* in the definition of excretion. In such cases, candidates were awarded the marks.

Part (b) (i) required candidates to label parts of the excretory system. Most candidates labelled the lungs and kidney correctly. Approximately half of the candidates labelled the bladder incorrectly, labelling it as the gall bladder, while many had difficulty labelling the ureter correctly. Ureter was generally spelt incorrectly; sometimes it was unclear whether it was urethra or uterus.

For Part (b) (ii), candidates had to state the function of the bladder. Many candidates correctly stated that *the bladder held, collected or stored liquid waste made by the body, or urine*. A significant number of candidates stated that *the bladder controlled the release of waste, or was the place where urine exited the body*.

Part (c) (i) required candidates to name an excretory product present in the atmosphere. The majority of candidates could not name an excretory product, such as *carbon dioxide, methane, oxygen*, etc. Responses such as 'urine', 'sweat' and 'animal odours' were quite common. 'Fertilizer' and 'pesticide' were also common responses given by many candidates.

Part (c) (ii) required candidates to name an excretory product present in the soil. The majority of candidates ignored or simply did not understand the term *excretory* in the question. Candidates gave a common response such as fertilizer and pesticides. Many candidates gave the answers faeces, manure, cow mould and nitrogen. Another common response was animal waste.

In Part (c) (iii), candidates were required to give an advantage and a disadvantage of the excretory product named in Part (c) (ii). Few correct answers were given in Part (c) (ii), which led to few correspondingly correct answers for this part of the question. Many candidates gave fertilizers or faeces in Part (c) (ii) and were awarded marks for valid advantages and disadvantages related to faeces and fertilizer.

Candidates were required in Part (c) (iv) to explain how water in the stream could be made safe for drinking. Many candidates gave the methods without explaining how these methods work to make water safe and, as such, only earned two out of four marks. The majority of answers was about boiling and adding chlorine, however, a few candidates gave responses such as distillation, reverse osmosis and the use of ultra violet light. Candidates, to a lesser extent, outlined the process that takes place in water treatment plants.

Candidates' performance on this question was less than satisfactory.

## **Recommendations**

Emphasis must be placed on

- distinguishing between excretion and egestion and the type of waste produced in each case
- the organs of the excretory system and their functions
- the relationship between the presence of waste substances and their effects on the environment
- linking the reasons why a particular process or method is employed in water treatment.

## **Question 3**

This question tested candidates' knowledge of forces and centre of gravity. It also tested candidates' knowledge of the endocrine system.

For Part (a) (i), many candidates gave the correct definition as *a push or a pull*. However, some candidates strayed from the scientific definition. A common mistake was to define force as 'making someone to do something against their will'. Candidates also confused force with energy, power and pressure.

Overall, candidates performed well on Part (a) (ii). Most candidates were able to correctly state two effects of a force on a body.



For Part (a) (iii), the majority of candidates knew the unit of force as the *newton (N)*. Many candidates could not spell the word *Newton* correctly and opted to use terms such as ‘*Neutron*’, ‘*Neurone*’, ‘*Neuton*’, and ‘*Noutes*’.

Part (b) was clearly understood by most candidates. Candidates were able to explain correctly what is meant by a frictional force.

Responses to Part (c) (i) showed that candidates had a full understanding of the variables of an experiment; most candidates were able to clearly identify the controlled variables of the experiment.

Candidates used limited scientific jargon to answer Part (c) (ii). Most responses were not clearly expressed but implied. An accepted response was that *oil reduces friction between the axle and the wheel and so the net force acting on the car was greater*. Implied answers were ‘the oil caused the car to run smoothly’, ‘the axle was loosened’, ‘oil makes the axle slippery’. However very few candidates suggested that the net force acting on the car was greater. The answers given were based on everyday experiences.

Part (c) (iii) was clearly misunderstood by most candidates. Very few candidates understood that the ability of friction to slow down a moving object was an advantage. Unaccepted responses were ‘it caused the car to speed up’, ‘allows an object to move faster’, ‘it becomes faster’. For the disadvantage of friction, many candidates did not understand that *friction can cause wear and tear on an object*. Hence, very few correct answers were given.

Part (d) (i) required candidates to explain the effect of changing of the car tyres on the centre of gravity of the body of the car. Accepted responses included that *the centre of gravity was raised* or *the tyres made the car higher*. Some candidates included the answer for the next question in this part of the response.

Part (d) (ii) was understood by most candidates with answers such as *the car became unstable*, *the car became less stable*, *the car became unbalanced* being given. However, it became clear that candidates did not relate the change in the centre of gravity with the instability of the car.

In Part (e) (i), some candidates were able to make the connection between the adrenal gland, the brain and the muscles. Too many candidates related the effect of the hormone adrenaline to the cliché “flight or fright” without understanding the concept. Also some candidates related the father’s reaction in the circumstance to a reflex action without understanding that the brain would not be involved in such an action.

## **Recommendations**

Emphasis must be placed on

- the use of scientific and technical jargon
- teaching the correct spelling of key words and concepts during classroom lessons
- teaching concepts on forces and motion in the syllabus.

## Question 4

This question examined candidates’ understanding of and ability to use knowledge about microorganisms with special emphasis on bread mould and preservation methods. Generally, the question was very well done.

For Part (a) (i), candidates were asked to define the term *microorganism*. Most candidates were able to give the correct answer; however some candidates used the word ‘particles’ to describe microorganisms. Also, some mentioned that a telescope is used to investigate microorganisms. Other candidates proceeded to give examples of microorganisms instead of a definition.

Most candidates were able to answer Part (a) (ii) with many of them stating that *refrigeration or keeping bread cool will help to reduce the growth of mould*. A few misinterpreted the question and gave responses to indicate an increase in mould growth instead.

In Part (b) (i), candidates were required to name the organism used to make bread commercially. Despite the fact that the vast majority of candidates gave *yeast* as the correct response, some responded incorrectly by stating that wheat, flour or even water was the microorganism responsible. The spelling of the word yeast posed a serious challenge for many candidates who went from 'yest' to 'yeist' to 'heist'.

For Part (b) (ii), candidates were asked to use their observations to determine three conditions necessary for mould growth, and even though cues were given in the experiment, many candidates provided responses that were not even conditions, such as 'petri dish' and 'refrigerator'. Nonetheless, the majority of candidates was able to supply *water/moisture and air* as two of the three suitable responses. *Warmth or suitable temperature* seemed not to be known by many candidates.

For Part (b) (iii), most candidates were able to state the effect of refrigeration on mould growth. The correct response was *a reduction in the growth of the mould*.

Most candidates only got one of the two marks for Part (b) (iv) because they did not explain the need for oxygen for respiration or air needed for dispersal or the ability of mould to respire anaerobically.

Most candidates were able to answer Part (c) correctly, stating that *Terrance would become sick or ill if he were to eat bread with mould*. Other correct responses were *some persons may even experience allergic reactions and respiratory problems*.

Many candidates were able to get at least one of the two marks for Part (d). *Refrigeration and addition of salt* were the two most common preservation methods named.

For Part (e), many candidates were unable to provide the correct response. A correct response is that *mould spores are likely to be present in the air and the bread may have suitable conditions for mould growth*.

## **Recommendations**

Teachers should constantly remind students that

- Mould spores are always present in air, and that refrigeration does not stop spoilage.
- Even though some moulds respire aerobically, there are still some moulds that can also respire anaerobically.
- Eating mould on bread may have serious adverse effects on persons.
- There are many other methods of preserving foods. These include smoking, pickling, vacuum packing, canning, bottling, drying or adding sugar.
- Moulds are fungi which fall in separate parts of the classification scheme of microorganisms and should not be confused at any time with bacteria.

## **Question 5**

This compulsory, essay type question tested candidates' knowledge and understanding of Caribbean food groups and their importance in providing nutrients to the body. It also tested their knowledge of simple machines (tools) and factors that affect the efficiency of these tools. Responses to this question indicated that it was quite popular with candidates, with the allotted response space often being completely utilized.

The majority of candidates who attempted Part (a) was able to identify that *Mr Brown's food provided him with energy*. A smaller proportion, however, was able to explain that *the food contained carbohydrates and that breakdown of the carbohydrates released energy*. Only a small percentage of candidates were able to identify that *Mr Brown led an active lifestyle and therefore his energy demands/needs were high*. About 25

per cent of candidates erroneously identified protein as the nutrient supplying the needed energy. A similar proportion also erroneously explained that ‘starch/carbohydrates provide protein and/or fats’.

Part (b) was generally well done with most candidates attaining the six allocated marks. Many candidates, however, failed to recognize that staples were already in Mr Brown’s diet and that three other food groups were needed. ‘Protein from food from animals’ was a popular response. There was an obvious misconception in candidates’ understanding between food groups and nutrients since some candidates erroneously identified vitamins, minerals, proteins, meat, carbohydrates and water as Caribbean food groups. They were, however, able to correctly explain the importance of the nutrients vitamins, minerals and protein although the actual food group they came from was not identified. Another very common misconception in candidates’ responses was that protein were a good source of energy and that it builds strong bones and teeth.

Part (c) required candidates to state four machines (tools) that are made of metal and explain one factor that may reduce the efficiency of the machine (tool). Responses regarding examples of machines (tools) were expected to focus on the fact that Mr Brown was a carpenter although any appropriate simple machine was accepted. Whilst the majority of responses correctly identified examples of machines (tools), the remainder misinterpreted the question and included washers, tractors, backhoes, forklifts, cranes and cars as tools. Discussion of one factor that reduced the efficiency of the machines (tools) posed a challenge to the majority of candidates. The term *efficiency* either was misunderstood or candidates had no knowledge of its meaning. Many of the responses involved explanations and arguments in reference to the use of manual versus electrical/powered tools. Misconceptions also centred on the energy demands of manual tools being higher than that for powered tools. The most common correctly stated factors for this part were *rusting* or *corrosion* and *friction*. Many candidates were unable to explain, however, how these factors actually affected the efficiency of the tools.

## Recommendations

- The six Caribbean food groups may be taught to students at an early stage using group activities, projects and displays in an effort to reinforce this concept. The difference between a food group, the actual nutrient it contains and the importance/function of the nutrient must be clearly distinguished. Tabular presentations may assist students in gaining knowledge and their understanding of the concept. Specific examples of nutrients from food groups should also be included, for example, vitamins — A, B C; minerals — iron, calcium; sugars, and starches.
- Types of simple machines and examples should be discussed in relation to everyday applications, for example, workers/tradesmen using simple machines. Factors affecting efficiency and how these reduce efficiency of machines should also be discussed using terminology such as force, effort, work and load.

## Question 6

This question tested candidates’ knowledge of how petroleum and coal are formed, advantages and disadvantages of solar energy and the negative effects of gasoline use on the environment. The question also tested candidates’ knowledge of alternative energy sources.

For Part (a), many candidates had problems explaining how petroleum and coal are formed. Many candidates did not know that *coal is derived from plants only* and *petroleum from both plants and animals*. Many candidates did not know the difference between coal and charcoal. Their explanation for how coal was formed was directly related to charcoal making.

Candidates also misunderstood *how petroleum was formed* and explained the ‘processing of petroleum’. They continue to explain the refining process of crude petroleum in a distillation column. There was also confusion about *formed* being thought of as ‘found’ as it relates to petroleum and coal.

For Part (b), many candidates described two advantages and two disadvantages of using solar energy. Some

candidates gave the response that the excess solar energy would damage the battery thus causing it to explode. Others stated that it is renewable and the energy could be captured as long as it is day. Many candidates did not understand that it is solar energy which will be converted to electrical energy in the car.

For Part (c), the majority of candidates gave at least one negative effect of petroleum on the local environment. Candidates focused on the health effects of the gases expelled on humans instead of the environment for the second negative effect. Some candidates stated that the one driving the car would spend a lot of money buying gas. Many candidates did not focus their answer towards the local environment.

Many candidates responded to Part (d) by giving coal, petroleum, potential energy, kinetic energy and even electricity as alternate sources to petroleum. While candidates were aware of the renewable, they were not sure which was easily available in the Caribbean and many could not explain why these energy sources were considered available.

### **Recommendations**

Teachers must make clear

- the difference between fossil fuel formation and refining
- the difference between sources and types of energy
- the availability of alternative sources of energy in the region in particular and the world in general
- the scientific reasons for using alternative sources of energy

### **Paper 031 – School-Based Assessment**

Overall performance was satisfactory. However greater focus and effort need to be placed on Analysis and Interpretation (A/I) and Planning and Designing (P/D) skills.

The general recommendations that follow, which were also provided in previous reports, for improving practical or inquiry skills, continue to be applicable. Much attention needs to be given to developing the planning and designing skills.

### **Recommendations to Teachers**

All laboratory report books should have a content page with the following format and headings.

<b>Lab No.</b>	<b>Page</b>	<b>Description of Laboratory Exercise</b>	<b>Date</b>	<b>Skills Assessed</b>

- The pages of the laboratory notebook should be numbered.
- Each activity should begin on a new page and be properly dated.
- The skills assessed and marks allocated should be written next to the laboratory report and on the contents page.
- The maximum mark to be awarded to each skill is 10. Skills marked out of other totals should be scaled to 10.
- Dates when each practical was assessed should be included in laboratory reports.

### **Observations, Recording and Reporting (ORR)**

- Proper laboratory format should be used. For example:  
Title  
Aim  
Apparatus/Material  
Diagram  
Method  
Results/Observation  
Discussion  
Conclusion
- Reporting should be concise and observations should be recorded in a suitable format. The use of tables is recommended whenever possible.
- Numerical tables should have the physical quantities and units stated in the heading, and the number of decimal places should be consistent.
- Non-numerical tables should have appropriate headings. Details of data recorded should include all observations, for example, the solution turned from blue to green to orange upon heating.
- Graphs should have axes labelled, appropriate scales, points plotted accurately and a smooth curve or best fit line drawn. (Only growth curves should have the points joined dot to dot.)
- Where prose is used to record observations, details of data are necessary.

### **Analysis and Interpretation (A/I)**

- Laboratory exercises must lend themselves to the identification of trends, patterns and relationships.
- Inferences must be linked to the results/ observations.
- Evaluation should not be general statements. Conclusions need to be linked to the aim of the lab stated and the data obtained.
- Calculations shown must include formulae and units.
- Questions from the textbook should not be used as A/I laboratory exercises. Laboratory exercises must be carried out and the data generated must be analysed and interpreted.

### **Planning and Design (P/D)**

- P/D laboratory exercises need to be original. Students are required to formulate a hypothesis and design a scientific experiment to test the hypothesis.
- P/D laboratory exercises do not have to be done to prove a scientific fact. If they are carried out they can be used to assess other skills and the plans can be modified as necessary.
- Textbook laboratory exercises are not acceptable as P/D experiments.
- Some laboratory exercises did not lend themselves for assessment as P/D laboratory exercises, for example, 'making soap', 'reactivity of metals' and 'model of lungs'.
- *A hypothesis is a statement and should not be written in the form of a question.*
- Procedures should reflect a direct link with the hypothesis.
- Procedures should include the number of times the experiment is to be repeated and any precautions to be taken.

### **Drawings**

- All titles should be placed at the bottom of each drawing and there should be a statement informing the reader of what the drawing represents. In addition, the view and accurate magnification should be clearly identified within the title.
- The use of arrowheads should be avoided. In addition, a ruler should be used to draw all label lines and they should be parallel to each other. Label lines on the same side of the drawing should stop at the same point. The label lines should touch the appropriate parts of the drawings.
- The labels, written in print (script), should be started at the end of the label line. They should never be printed on the label line. The labels should be either upper or lower case but never a mixture of both

- The lines of the drawings should always be clear, distinct and continuous; that is, students should avoid shading, double lines and sketching at all times.
- The drawings should be two dimensional.
- Drawings should preferably be done from specimens. Diagrams and natural cycles are not to be presented as SBA drawings.

### **Paper 032 – Alternative to School-Based Assessment (SBA)**

#### Question 1

This question tested the following practical skills; Analysis and Interpretation (A/I), Observation, Reporting and Recording (ORR), Measurement and Manipulation, (MM) and Planning and Designing (P/D).

Candidates were required, in Part (a), to explain the purpose of the water and the paper in an experiment set up to monitor the growth of a seedling. Many candidates saw *the role of water* as helping in growth but not *as a necessity for the process of germination and growth*. Most answers focused on the seedling rather than the seed. Few candidates saw *the paper as providing adequate or sufficient moisture for the seed*. Some saw its purpose as just to ‘soak up’ the water or to give ‘support’.

Part (b) was well done. Generally, correct labelling was observed.

The attempts on Part (c) were fair. Most candidates gave one observable difference between the root and shoot. The focuses were on the growth of root downwards and shoot upwards.

Part (d) required candidates to design a table to record the length of the root and shoot. Some candidates seemed confused and gave pictographs instead of a table. Many scored one mark for ‘rows and columns’. Most inaccurately gave *root* and *shoot* as column headings. They failed to state the length or height in the column headings; responses were generally poor.

For Part (e), many candidates failed to include in their title the height of the root and shoot but it was generally a fair effort.

For Part (f), the measurement for the root and shoot for the most part was incorrect. Many candidates gave the correct measurement for the shoot but fell short about one or two millimeters for the root. Few candidates stated units or gave significant figures for their measurement. Nevertheless the responses were fair because many candidates were able to score two marks out of four marks.

Part (g) was very poorly done. Many candidates gave aims instead of hypotheses. Many seemed not to know the difference between the hypothesis and the aim. Many candidates did not write the procedure in logical order. Many precautions were about the safety of the experimenter rather than ensuring that the results were accurate.

#### Question 2

This question tested the following practical skills: Observation, Reporting and Recording (ORR), Analysis and Interpretation (A/I), Drawing (D) and Measurement and Manipulation, (MM).

Part (a) (i) required candidates to outline an experimental procedure. Many managed to formulate at least the beginning four steps (as outlined in the mark scheme) but very few candidates mentioned the latter two which dealt with *the recording of results* and *the repeating of the procedure for other metals*. Overall, responses to Part (a) (i) were fair.

Part (a) (ii) required candidates to write a suitable aim for the experiment. This was satisfactorily done.

Part (a) (iii) was fairly well done. Most candidates did not score the two marks assigned for placing suitable headings in the table. Generally, they scored with the first column's heading as *metals* but for the second column, they failed to make the connection with metal and hydrochloric acid, for example, *Reaction of metals*.

Parts (a) (iv) and (v) were poorly done. Candidates seemed to have little understanding of variables. Therefore, they were unable to name the variables in the experiment that should be kept constant, and the one that is responding.

For Part (b) (i), candidates were required to place the metals in order of reactivity. This was very well done with most candidates scoring maximum marks.

Part (b) (ii) was also well done. Most candidates were able to state two metals suitable for making cooking utensils.

For Part (b) (iii), candidates gave precautions that would prevent harm to them (safety) rather than steps that would ensure accuracy of results. They gave responses such as 'wearing protective gear to avoid burns' and 'prevent chemicals from getting into the eye'.

Part (b) (iv) tested candidates' drawing skills. Candidates had an array of drawings for a test tube. Some candidates included scale or gradients thus drawing cylinders for test tubes. Overall, candidates' responses were fair.

Part (b) was fairly well done. Candidates were able to identify the gas given off as *hydrogen*.

For Part (b) (vi), most candidates were able to name the metal for making cans for orange juice. Few named types of metals rather than letter C.

In Part (c), candidates were required to determine the volume of gas given off during the experiment. The general response was very poor. Few candidates gave the correct reading. Some of the readings given were:  $8.5 \text{ cm}^3$ ,  $6.5 \text{ cm}^3$  and  $35 \text{ cm}^3$ . This is an indication that candidates do not know how to measure the volume. The precautions given (for example, wear face mask) were focused on the safety of the investigator rather than on steps that should be taken to improve the accuracy of the results.

### Question 3

This question tested the following practical skills: Observation, Reporting and Recording (ORR), Measurement and Manipulation, (MM) Analysis and Interpretation (A/I), and Planning and Designing (P/D).

For Part (a), most candidates were able to determine the ammeter readings. In addition, they were competent in the use of significant figures. Most candidates scored maximum marks.

For Part (b) (i), candidates were able to show knowledge of plotting a linear graph, but in some instances they were not able to identify the axes properly.

Candidates in Part (b) (ii) encountered problems drawing a line of best fit; they seemed unfamiliar with this terminology and did not understand the concept of a line of best fit. Generally, this part was very poorly done.

In Part (b) (iii), candidates labelled the axes as 'y' and 'x' respectively, paying no attention to the two variables and their units. Though the question was properly phrased, candidates seemed not to have the competent mathematical background that would have enabled them to show their knowledge of this.

Candidates seemed confused with Part (b) (iv); it was poorly answered. Many scored one mark for extending the line but failed to show evidence of reading the graph to obtain the x and y value. Instead, they looked at the pattern in the table and treated it like a number sequence question.

The two dimensional drawing of the variable resistor in Part (c) was poorly answered. Only a very small number of candidates were able to gain the two marks for this question. The drawing skills of using clear lines and appropriate magnification were poorly displayed.

### **Recommendation**

Some amount of practical work should be mandatory for candidates sitting this examination. This is to ensure that they acquire the knowledge, skills and understanding to perform competently in this examination.



**CARIBBEAN EXAMINATIONS COUNCIL**

**REPORT ON CANDIDATES' WORK IN THE  
CARIBBEAN SECONDARY EDUCATION CERTIFICATE®  
EXAMINATION**

**MAY/JUNE 2017**

**INTEGRATED SCIENCE  
GENERAL PROFICIENCY**

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## GENERAL COMMENTS

In 2017, the CSEC examination in Integrated Science was offered at the General Proficiency level. The examination, which was administered in May/June 2017, consisted of three papers, Paper 01 — Multiple Choice; Paper 02 – Data analysis, short-response questions, and essay questions; and Paper 03 — School-Based Assessment. Paper 032, the Alternative to School-Based Assessment, is a practical paper written by private candidates.

The number of candidates entered for this examination was 20 947 compared with 21 322 in 2016, a two per cent decrease in candidate entries. The overall performance of candidates in the Integrated Science 2017 examination was satisfactory, and comparable with performance in 2016. Sixty per cent of the candidates earned Grades I to III.

## DETAILED COMMENTS

### Paper 01 – Multiple Choice

Paper 01 consisted of 60 multiple-choice items with a total weighted score of 90 marks. The mean score was 33.39 compared with 55.81 in 2016.

### Paper 02 – Structured Essay Questions

Paper 02 consisted of three short-answer, structured questions, one data analysis question and two essay items. The mean score earned on this paper was 35.01, compared with 50.63 for 2016.

#### Question 1

This question tested candidates' ability to analyse data, construct a graph and make inferences. It also tested candidates' understanding and ability to use knowledge about weather and volcanoes.

In Parts (a) (i), (ii) and (iii), many candidates provided correct responses for the connection between atmospheric conditions and weather. However, many candidates were unable to explain the physical conditions that support the formation of a hurricane in Part (a) (iv).

Part (b) (i) required candidates to know the hazards faced by people during volcanic eruptions. This part of the question was well done by most candidates. The most common acceptable responses were *danger to people and property by lava and hot, poisonous gases*.

Part (b) (ii) tested candidates' ability to use their knowledge about submarine volcanic eruptions and link this to changes in coastal ecology. Many candidates ignored the coastal ecology aspect and submitted responses to changes in marine ecology from submarine volcanic eruptions.

Part (c) (i) required candidates to plot a graph on a grid, using the scales provided, from the data in the table (Atmospheric Temperature (°C) vs time). Some candidates were unable to

accurately plot the points which required them to determine the division represented by the atmospheric temperature value. Part (c) (ii) required candidates to illustrate the trend of the data by drawing the line of best fit on the graphs. Many candidates did not properly draw the required neat, fine lines and points. In plotting the points, many candidates inadequately used dots without circles. Acceptable plotting point symbols are the  $x$  or a circled dot. For Part (c) (iii), many responses were correctly labelled *Atmospheric Temperature (°C)* and *Time*; however, many candidates inadequately labelled the axes as simply  $x$  and  $y$ .

For Part (c) (iv), candidates were required to suggest an appropriate title for the graph. This was fairly well done, but some candidates only mentioned one aspect of the title, *Atmospheric Temperature (°C)* and not *Time*. Parts (c) (v) and (vi) required candidates to determine values from the graph, and even though the questions specifically stated *drawing dotted lines to read its value*, some candidates showed no indication of how they determined the readings on the graph.

### **Recommendations**

During practical activities involving graphs, emphasis should be placed on

- the plotting graphs, with correct symbols
- using appropriate graph scales
- neatness and the use of fine lines and points
- the labelling of axes
- obtaining results from the graph by accurately interpolating points.

### Question 2

This question tested candidates' knowledge of blood vessels, the relationship between pulse and exercise and their ability to analyse data to make inferences and predictions, as well as conduct an investigation.

For Part (a) (i), candidates were required to state the name and function of one major blood vessel. Stating the name and function was generally well done. While most candidates were familiar with arteries and veins, many could not describe a feature of any one as required in Part (a) (ii).

For Part (b) (i), candidates were required to define *pulse rate*. Many candidates gave correct definitions, but could not identify two variables held constant, in Part (b) (ii) from the procedure and data given.

In Parts (c) and (d), analysing the data to make inferences was very well done. However, many candidates were unable to give appropriate reasons for their conclusions in Part (d).

Part (e) which required candidates to make a connection between health and pulse rate was well done. The most popular correct responses were *lifestyle diseases*.

## Recommendations

During instruction and practical activities emphasis must be placed on

- the ability to justify an inference or prediction using accepted theory.
- the importance of variables held constant in investigations to minimize errors.

### Question 3

This question tested candidates' knowledge and use of knowledge regarding the properties of metals and non-metals and how these properties determine the use of metals and non-metals in technology. The corrosion of metals was tested with emphasis on knowledge of the rusting of iron.

In Part (a) (i), candidates were required to identify a metal based on the physical properties given: electrical conductivity, melting point and density. Many candidates successfully identified the metal element.

Overall, candidates performed well on Part (a) (ii) which required them to state two uses of metals and non-metals.

For Part (b), many candidates correctly identified the *use of plastic for handles and aluminium for the body of cooking pots*; however, fewer explained *the use of plastic as an insulator and aluminium as a conductor in cooking pots* for the additional mark.

In Part (c), many candidates successfully identified *moisture and oxygen, and suggested the salt would accelerate rusting*; however, some still used layman's terms and explanations. For example, candidates used the layman term '*sea blast*' instead of referring to water, moisture and salt.

Part (e) required candidates to describe two ways of preventing rusting in iron window bars. Many candidates correctly identified painting and electroplating while others scored the mark with the scientific but impractical use of oil and grease. An innovative and practical answer was to *wipe away water from the bars*.

## Recommendations

During instruction, much attention should be given to

- clarifying the use of scientific and technical jargon and relating these to 'street science' and the practical application of scientific knowledge
- the correct spelling of key words. Concepts should also be taught during classroom lessons.

#### Question 4

This question examined candidates' understanding and ability to use knowledge about fossil fuels and alternative energies.

In Part (a) (i), candidates were asked to define the term *fossil fuels* and give two examples. Few candidates mentioned the ancient aspect or the process/conditions of formation, while many were aware that they were the remains of plants and animals.

In Part (a) (ii), many candidates were aware that greenhouse gases, global warming and climate change were the result of fossil fuel use, but there seemed to be a widespread misconception that fossil fuels contribute to ozone layer depletion.

For Part (b) (i), candidates were required to name two alternative energy sources. Many candidates successfully answered, although some stated solar energy even though the question specifically said *energy sources other than solar energy*. Also, a few candidates confused charcoal with coal.

For (b) (ii), candidates were required to discuss two advantages and one disadvantage of using solar energy. Many candidates were able to state the advantage/disadvantage but were unable to explain in any detail. A few seemed to confuse global warming disadvantages with the use of solar energy, for example, they made statement such as "It will be too hot and dangerous and people can get skin cancer."

#### **Recommendation**

Teachers can engage students in suitable activities that stimulate discussions and explanations, with reasons to justify conclusions. It is important that the distinction be made between fossilized coal and charcoal.

#### Question 5

This question tested candidates' knowledge of a working circuit, including the symbols of commonly used components such as a switch, bulb and cell, and the use of wiring colour codes. The question also tested candidates' knowledge of conductors, insulators and devices that prevent circuit overloading. Safety precautions employed in the situation of a broken insulation on an electrical cord were also tested.

Part (a) (i) required candidates to draw a functional circuit for testing if a material is a conductor. Symbols for wires, cells, bulbs and switches were required. The majority of candidates drew the correct circuit with wires in series; however, candidates had some difficulty using the correct symbols for bulb, switch and battery (cell). Frequent omissions of the circle over the bulb were seen. A minority of candidates erroneously drew parallel circuits for the testing of the materials.

Part (a) (ii) was well answered, with candidates correctly stating examples of conductors and a smaller percentage correctly stating examples of non-conductors.

In Part (a) (iii), many candidates correctly identified a fuse or circuit breaker as the device, however, the explanation of how the device worked was lacking in the majority of responses.

The vast majority of candidates were able to recognize and correctly state two required hazards in Part (b) (i).

For Part (b) (ii), many candidates were able to state correctly the three pieces of protective gear, with a significant majority correctly stating two of the required three protective gear. No marks were awarded for vague responses that stated eyeglasses, thick gloves, cloth gloves and long sleeve shirts as protective gear.

Part (b) (iii) was poorly answered, with few candidates correctly indicating blue connects to neutral, brown to live and green to earth or ground. Common misconceptions were blue connects to negative and brown connects to positive. There were a number of no-responses to this part of the question.

### **Recommendations**

- Carry out practical experiments to test the conductivity of materials and draw the accompanying circuit diagrams with complete symbols of the components in a circuit.
- The following must be made clear:
  - Electrical safety gear worn on the hands and feet must all have an insulating property.
  - Safety eyewear must be very specific, for example, safety goggles and not glasses.

### Question 6

This question tested candidates' understanding and ability to use knowledge to state the differences between the nervous system and the endocrine system, to outline reflex actions, and to explain short-sightedness.

Part (a) tested candidate's ability to recall the differences between the nervous system and the endocrine system. Most candidates lacked the relevant information about these two systems to give reasonable differences.

For Part (b), which tested the candidate's ability to recall the components of the reflex arc/action, most candidates were unable to provide a description starting with receptors sensing heat/pain and ending with the reflex action. A fair number of candidates were able to give a sense that the brain was not involved but were unable to explain fully. The majority of candidates responded by saying that the nerves sensed the heat and sent a message to the brain and that the brain gave the signal to drop the pot. This demonstrated a complete lack of understanding of reflex actions.

Part (c) tested candidates' ability to explain and describe, with the use of diagrams, the condition of short-sightedness and how it can be corrected using spectacles. Most candidates scored the most marks in this section of the question. However, a significant number of candidates were at a loss in providing details, such as what causes short-sightedness and the type of lens that can be used to correct it. Similarly, a significant number of candidates had difficulty drawing the eye to represent the lens and retina and to show light being focused in front of the retina to demonstrate short-sightedness. In quite a few cases, candidates drew concave lens and labelled them convex lens and vice versa. Many candidates used terms such as 'light does not reach the retina' instead of saying that *in short-sightedness, light is focused in front of the retina when distant objects are viewed*.

### **Recommendations**

Appropriate instructional activities involving relevant local case studies, scenarios and associated practical experiences can be incorporated in lessons to highlight the

- difference between concave and convex lens and their application with respect to correcting eye defects such as short-sightedness and long-sightedness
- drawing of diagrams.

### **Paper 032 – Alternative to School Based Assessment (SBA)**

Paper 032 consisted of three questions. It tested candidates' practical skills in the areas of Observation, Recording and Reporting (ORR), Planning and Designing (PD), Drawing (D), Analysis and Interpretation (AI), and Manipulation and Measurement (MM).

#### Question 1

This question tested candidates' practical/experimental skills, emphasizing, planning and designing, measuring and recording.

For Part (a) (i), candidates were required to develop a hypothesis about how the upthrust on a wooden cylinder changes as it is lowered into the water. Many candidates seemed unaware that a hypothesis must be testable and link only two variables. Probably, as a result, in Part (a) (ii), candidates could not identify manipulated and responding variables.

Parts (b) (i) and (ii) were well done; many responses had the correct length and unit. For Part (b) (iii), many candidates performed the activity correctly and recorded the results, but failed to calculate the results. Many candidates were able to record the units for the quantities in the table.

Part (c) was poorly done by many candidates who seemed unable to calculate magnification or do a scientific drawing.

## Question 2

This question tested candidates' practical/experimental skills reflected through outlining a procedure, writing a conclusion, designing a control, and explaining the cause and methods of softening water.

Part (a) required candidates to outline an experimental procedure. This part was fairly well done; however, many candidates gave incomplete responses that did not include the steps required for indicating the recording of results. In addition, they repeated the procedure.

In Part (b), candidates were required to determine the heights of bubbles from given diagrams and place these heights in a table. This required two readings and some candidates seemed unaware that the measuring cylinder could be read to 1 ml. This section was poorly done.

Part (c) tested candidates' ability to analyse data by making a conclusion. In this section, candidates responded fairly well as their conclusions were based on their calculations.

In Part (d), candidates were required to describe a suitable control for the experiment. This was poorly done. Many candidates seemed unaware of what is a control in an experiment.

For Part (e), in which candidates were required to explain the role of the Epsom salt in the experiment, few seemed to know that the Epsom salt would cause the hardness.

In Parts (f) and (g), many candidates seemed to lack knowledge of the elements found in hard water and ways to soften hard water.

## Question 3

This question tested candidates' practical skills as reflected through their ability to estimate the size of an area using a grid.

For Part (a), candidates were able to correctly estimate the areas in the grids. Many candidates scored maximum marks in this section.

For Part (b), a few candidates were able to design a table with headings, including units, to record the results.

## **Recommendation**

Students could benefit from engaging in practical work as recommended by the Integrated Science syllabus. This is necessary for facilitating the development of practical skills along with the required knowledge and attitudes in science.

## **Further Recommendations**

For Papers 02 and 032, students could benefit from more practice with relevant structured questions, essays and data analysis items. These instructional items could also relate to practical or hands-on experiences, incorporating everyday life (local, regional and global)



scenarios and case studies to facilitate understanding and the ability to use knowledge of concrete and abstract scientific concepts.

Additionally, learners can be guided through appropriate activities to facilitate the development of scientific knowledge, processes, and inquiry skills.

The spelling of scientific terms as well as the appropriate use of the jargon of science should be emphasized. Terms need to be discussed with students, giving consideration to how these terms are used in scientific or technical contexts.

In further addressing learners' needs in order to improve their practical skills with relevant content knowledge development, the following strategies could be incorporated through science lessons:

- Use of models (where necessary)
- Participation in planning and implementation of relevant science projects
- Incorporation and use of improvised equipment and appropriate software guided by teachers

**CARIBBEAN EXAMINATIONS COUNCIL**

**REPORT ON CANDIDATES' WORK IN THE  
CARIBBEAN SECONDARY EDUCATION CERTIFICATE®  
EXAMINATION**

**MAY/JUNE 2018**

**INTEGRATED SCIENCE  
GENERAL PROFICIENCY**

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## GENERAL COMMENTS

In 2018, the CSEC examination in Integrated Science (single award) was offered at the General Proficiency level. The examination, which was administered in May/June 2018, consisted of three papers: Paper 01 — Multiple Choice; Paper 02 — Data analysis, short-response, and essay questions; and Paper 031 — School-Based Assessment. Paper 032, the Alternative to School-Based Assessment, was written by private candidates.

There was a small decrease in the number of candidates who wrote the examination in 2018 when compared with 2017. In 2018 there were 19 856 candidates who wrote the examination while in 2017 there were 20 946.

Integrated Science continues to be a popular subject across schools in the Caribbean. The subject contributes in a significant way towards making science accessible to all students at the secondary level and thereby plays a meaningful role in the attainment of scientifically and technologically literate societies.

*Integrated Science brings together the everyday context in which science operates. It encompasses biology, chemistry, physics, earth science, environmental science and technology.*

(CXC Integrated Science Syllabus, 2017 p.1)

Emphasizing the importance of collaboration, problem solving, and decision-making, it is important that within the school system a variety of strategies continue to be explored for maximizing the benefits that may be derived from implementing the CSEC Integrated Science syllabus. Recognizing the interrelations among scientific concepts and promoting collaborative strategies (including team planning) among teachers from the specialist/major areas of Biology, Chemistry and/or Physics are anticipated to be beneficial to teaching and learning.

While in the ideal situation scientific knowledge should be incorporated seamlessly into one's general knowledge, it is important to emphasize to children that there are different ways of thinking. In Integrated Science examinations, the answers to questions should use scientific facts, data and concepts as far as possible. It is not sufficient to make generalized statements without supporting them with scientific principles and data. There is also the need to be specific, providing as much detail as possible, in the time and space provided. For example, when asked about the effect of air pollutants on humans, answers should include specific named respiratory and/or other named general illnesses rather than just stating "person will get sick".

To access supporting information on this subject the CXC website (<http://www.cxc.org/>) can be visited periodically.

The overall performance of candidates in the examination was satisfactory, and comparable with performance in 2017. There was a very slight decrease from 47.85 per cent in 2017 to 46.89 per cent in 2018.

## DETAILED COMMENTS

### Paper 01 – Multiple Choice

Paper 01 consisted of 60 multiple-choice items. The mean score increased very slightly from 55.66 per cent in 2017 to 56.63 per cent in 2018.

### Paper 02 – Structured/Essay Questions

Paper 02 consisted of three short-answer, structured questions, one data analysis question and two essay items. The maximum mark for Question 1 was 25 marks and for Questions 2 to 6, 15 marks each; the maximum mark for the paper was 100 marks. The mean score earned on this paper was 31.74 per cent, dropping slightly from 35.01 per cent in 2017.

#### Question 1

This question tested candidates' ability to analyse data, construct a graph and make inferences. It also tested candidates' ability to use knowledge about the processes/mechanism of convection for the exchange of gases.

In Part (a), many candidates provided correct responses for convection and radiation. Part (b) (i) required candidates to give three weather conditions for the fastest drying time. Most candidates gave windy, sunny/sunshine/heat. However, very few were able to state dry/low humidity as a reason. Part (b) (ii) tested candidates' ability to understand how surface area affects drying time. Candidates often implied the importance of increase surface area with very few explicitly describing the mechanism where a large surface area increases evaporation by allowing the water molecules to escape easily into the air and escape from the surface, whereas inside the rolled up wet towel the water molecules are either trapped in saturated air or by a wet surface with little chance of escape.

Part (c) required candidates to use their knowledge of convection to explain natural ventilation. This question was not well answered and while credit was given for stating the contribution to natural ventilation from wind, a complete answer required an explanation of the mechanism of convection which causes natural ventilation to occur. Very few explained that the expansion and rising of hot air allowed the hot air to escape through the vents so the air could be replaced by colder air.

Part (d) required an explanation of the effects of a lack of ventilation. This part was fairly well answered; however, a number of candidates had difficulty expressing themselves properly. Some recognized a problem with the depletion of oxygen and consequent build-up of carbon dioxide in the room, but many failed to explicitly connect this to respiratory problems/failure. Many stated that heat will build up in the room but failed to connect this with a specific effect on health like heatstroke.

Part (e) required candidates to plot a graph on a grid, using the scales provided, from the data in the table. In Parts (e) (i) and (ii), candidates showed improvement in accurately plotting the points on the graph. Yet many continue to use dots only instead of x's or circles with dots.

Straight lines were sometimes not drawn with the use of a ruler, and points and lines were thick in some instances. Although the question clearly stated that the graph should be extended to the axis, some candidates did not do so making it impossible to read the starting distance in Part (e) (v). Many labelled both axes of the graph; however, some candidates omitted the units in Part (e) (iii). Candidates were able to choose a suitable title that related both quantities given in the data in Part (e) (iv). The question clearly stated that the distances should be determined from the graph yet many candidates showed no evidence on the graph page of having read the distance at three minutes and when timing started. Thus, Part (e) (v) was poorly done as it was evident that candidates had difficulty reading off the graph as the answers were also left blank.

### **Recommendations**

During practical activities involving graphs, emphasis needs to be placed on plotting graphs with correct symbols, neatness and the use of fine lines and points, the labelling of axes and obtaining results from the graph by accurate interpolation and extrapolation.

### Question 2

This question tested candidates' knowledge on pest and pest control with emphasis on insects.

Part (a) required candidates to identify two household pests and was very well done.

In Part (b), many candidates were unable to define the term *parasite*, often resorting to vague statements that could apply to other or any ecological relationship.

From the answers in Part (c), it was clear that many candidates were unfamiliar with the complete metamorphosis cycle. Credit was given for stating maggots instead of larva but worms was an unacceptable answer.

Part (d) was fairly well done but there was the tendency to be vague when discussing the harmful effect of chemical sprays. Some candidates did not give any details and simply wrote that people will get sick.

Parts (e) to (f) were well done. However, the spelling of leptospirosis was a challenge in Part (f) (ii).

### **Recommendations**

During instruction and practical activities, emphasis must be placed on the importance of understanding the life cycles of pests in developing effective pest control measures.

### Question 3

This question tested candidates' knowledge of the ears, involuntary and voluntary actions.

In Part (a), many candidates had difficulty explaining the functions of the pinna and the effect of shape and size on hearing. It was clear that scientific knowledge was lacking which was evident in the non-scientific general knowledge descriptions and explanations, and confusion of functions of the other parts of the ear.

Part (b) tested candidates' knowledge regarding the fact that normal ears of dogs and humans operate in different frequency ranges and specifically that dogs can hear higher frequencies than humans. This section was not well done as many candidates did not mention frequency of pitch in their answer and gave vague explanations such as "dogs' ears are more sensitive than humans".

Part (c) (i) was well done, with many candidates recognizing that permanent hearing loss can result from prolonged loud sounds through headphones, though few stated that temporary loss can also result from short bursts of loud sounds. Fewer indicated that prolonged use of headphones with less loud sounds can also cause temporary and permanent damage to the ears. In Parts (c) (ii) and (iii), some candidates recognized the actions described in the question as voluntary and involuntary, but many were unable to successfully give a detailed explanation of the neural pathways in these actions and the role of the brain in responding only in voluntary actions

### **Recommendations**

During instruction, much attention should be given to the structure of the ear and the functions of the parts as well as the mechanism, neural pathways and roles of different components of the nervous system in performing involuntary and voluntary actions.

### Question 4

This question tested candidates' knowledge of simple machines with emphasis on levers and pulleys.

Part (a) (i), was done quite well and candidates were able to identify the effort, load and fulcrum in a lever. Some candidates labelled both the effort and load simply as 'force,' failing to distinguish these as separate and individual forces. In Part (a) (ii), candidates were able to identify the type of lever as first class. Class 1 was also an accepted answer. For Part (a) (iii), some candidates incorrectly gave examples, rather than the category of other simple machines.

In Parts (b) (i) and (ii), very few candidates wrote the formula for mechanical advantage (MA). ( $MA = \text{Load}/\text{Effort}$ ). However, full credit was given when candidates substituted the values given to find the appropriate answer ( $1000 \text{ N}/250 \text{ N} = 4$ ). Many candidates were familiar with the equation for work done ( $\text{Work done} = \text{Force} \times \text{Distance moved}$ ) and were able to correctly substitute the values given to get the answers. A large number of candidates could not be awarded full marks because they omitted the joule as the unit of work.

Part (c) (i) was fairly done as some candidates were able to suggest the causes for the loss of efficiency due to rusting/corrosion of axle, stretching/slipping of the rope etc. However, Part

(c) (ii) was poorly done by candidates as they were unable to explain how friction decreases the efficiency of a pulley giving descriptions of friction with a failure to link it efficiency or energy converted and lost as heat.

### **Recommendations**

During instruction and practical activities, emphasis must be placed on the following:

- The description and working of simple machines and examples
- How friction affects the efficiency of machines
- Clearly stated formulae in calculations
- Always stating units of quantities in a calculation

### Question 5

This question tested candidates' knowledge of excretion in plants and animals.

Part (a) required candidates to distinguish between egestion and excretion with Part (b) following up and requiring them to identify waste products in animals and plants. Both parts were generally well done.

In Part (c), some candidates failed to give details about the excretion of waste products and the structures involved. Many gave very short answers only identifying the waste products when the question clearly asked for an outline of the process of excretion in plants and animals. While the question was about general excretion in plants, it was specific to the lungs in animals, yet some candidates gave general excretion answers for animals. In answering free response questions, it is expected that detailed explanations and relevant information will be included. Candidates need to remember that this section of the paper calls for responses which are logically composed, as they continue to provide responses which are more suitable for the structured section. It was clear that there is a problem in organizing the answer.

### **Recommendations**

During instruction, much attention should be given to practice in answering free response questions; answers should be planned before being written out.

### Question 6

This question tested candidates' understanding of volcanoes and tides.

Part (a), which tested the impact of volcanic products, was extremely well done, as many candidates obtained the full seven marks. In Part (b), however, few candidates seemed to have knowledge of the mechanism which cause the tides. There was also a noticeable lack of scientific drawing skills. Very little effort was made to relate how high and low tides affect organisms differently as answers were generally very vague. Candidates were only able to give general effects of the sea.

## Recommendations

Appropriate instructional activities, scenarios and associated practical experiences can be incorporated in to lessons to highlight

- the role of the moon and sun and the mechanisms which cause tides
- the requirements of scientific drawings.

Paper 031 consisted of practical work at the school administered and marked by teachers but moderated by external assessors. The mean score earned increased from 66.86 per cent in 2017 to 69.01 per cent in 2018.

### **Paper 031 –School-Based Assessment**

Paper 031 consisted of practical work administered and marked by teachers but moderated by external assessor. The mean score earned increased from 66.86 per cent in 2017 to 69.01 per cent in 2018.

### **Paper 032 – Alternative to School-Based Assessment**

In 2018, Paper 032 consisted of three questions. This paper tested candidates' practical skills in the areas of Observation, Recording and Reporting (ORR), Planning and Designing (PD), Drawing (D), Analysis and Interpretation (AI), and Manipulation and Measurement (MM). It was done by private candidates. The mean score earned increased from 30.11 per cent in 2017 to 34.84 per cent in 2018.

#### Question 1

This question tested candidates' practical/experimental skills, emphasizing planning and designing, manipulation, measuring and recording.

For Part (a) (i), candidates were required to carry out a procedure and record the result of an investigation on the effect of pH on enzyme activity. Many candidates failed to record the correct unit for volume in the space provided in the table header and proceeded to write the unit in every line of the table. However, they were not penalized for this poor recording skill. Candidates were given a clear ten- step procedure to follow involving the addition of solutions with a total volume of around 14 ml. Any precipitate produced would be measured and recorded. Though many candidates performed satisfactorily, some had abnormal results. In Parts (a) (ii) and (iii), many candidates gave superficial explanations of the data obtained in Part (a) (i). Since this was a conclusion drawn from data analysis, marks were awarded only for explanations consistent with the data recorded in Table 1.

Part (b) was poorly done; many responses did not present a valid hypothesis and simply copied the procedure given in Part (a) (i) without any modification as required to perform the investigation in this section of the question. Many candidates seemed to have little understanding of the different variables and how to identify them in an investigation. Some



candidates did not know the data to be collected, which was not unexpected as they were unable to formulate a hypothesis.

### **Recommendations**

Appropriate instructional activities, scenarios and associated practical experiences can be incorporated into lessons to highlight.

- the importance of scientific integrity in recording the results obtained in an investigation accurately
- practicing planning and designing skills.

### Question 2

This question tested candidates' practical/experimental skills and required them to draw a graph from data given, and to explain trends.

Part (a) required candidates to draw a graph with two lines. This part was very well done, with correct labels and trend lines. Many candidates were able to give detailed explanations for the difference in the two trend lines and were clear that the mould would grow faster, covering more area and starting to grow at an earlier date at higher temperature.

In Part (b), candidates were required to measure the height of the mould in the diagram given. Many candidates were able to successfully measure and record the answer with the correct unit in Part (b) (i) and draw a diagram in Part (b) (ii). However, few candidates were able to calculate the magnification in Part (b) (iii).

### **Recommendations**

Appropriate instructional activities, scenarios and associated practical experiences can be incorporated in lessons to highlight

- practicing the scientific drawing skills.

### Question 3

This question tested candidates' ability to measure the length of potato strips using a graduated grid and to construct a table to record the results. Many candidates were able to construct suitable tables and record the results accurately. However, there were many cases when the unit was put on every line instead of the table header.

### **Recommendation**

Students could benefit from engaging in practical work recommended/suggested by the Integrated Science syllabus. This is necessary for facilitating the development of practical skills along with the required knowledge and attitudes in science.

### **Further Recommendations**

For Papers 02 and 032, candidates could benefit from more practice in doing relevant structured questions, essays and data analysis items. It is important for candidates to understand that essay responses require a logical sequence of ideas.

Instructional items could also relate to practical or hands-on experiences, incorporating everyday life (local, regional and global) scenarios/cases to facilitate understanding and the ability to use knowledge of concrete and abstract scientific concepts.

Additionally, students can be guided through appropriate activities to facilitate the development of scientific knowledge, processes, and inquiry skills.

The spelling of scientific terms as well as the appropriate use of the jargon of science needs to be facilitated in the classroom. Terms need to be discussed with students, giving consideration to how these terms are used in scientific or technical contexts.

The following strategies could be incorporated into science lessons to help students improve their practical skills and enhance their knowledge:

- Use of models (where necessary)
- Participation in planning and implementation of relevant science projects
- Incorporation/use of improvised equipment and appropriate software guided by teachers
- Use of appropriate convention in recording the results of an investigation especially the skills involved in producing graphs
- Analysis of data using graphs.

**CARIBBEAN EXAMINATIONS COUNCIL**

**REPORT ON CANDIDATES' WORK IN THE  
CARIBBEAN SECONDARY EDUCATION CERTIFICATE<sup>®</sup>  
EXAMINATION**

**MAY/JUNE 2019**

**INTEGRATED SCIENCE  
GENERAL PROFICIENCY**

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## GENERAL COMMENTS

The CSEC examination in Integrated Science was offered at the General Proficiency level in May/June 2019 and consisted of three papers, Paper 01 — Multiple Choice; Paper 02 — Data analysis, short-response and essay questions; and Paper 03 — School-Based Assessment. Paper 032 — Alternative to School-Based Assessment — was taken by private candidates.

In 2019 there was a small decrease in the number of candidates sitting the examination. There were approximately 17 965 candidates who sat the examination in 2018 compared with approximately 16 864 candidates in 2019.

Paper 02 consisted of three short-answer, structured questions, one data analysis question and two essay items. The maximum mark for Question 1 was 25 marks and Questions 2 to 6 were worth 15 marks each. The mean score earned on this paper was 27.47 per cent, dropping slightly from 31.74 per cent in 2018.

Paper 031 consisted of practical work at schools administered and marked by teachers but moderated by external assessors. The mean score earned increased from 69.02 per cent in 2018 to 71.36 per cent in 2019.

Paper 032, done by private candidates, consisted of a practical examination with three questions, one of which involved manipulation of apparatus. The mean score earned increased from 34.67 per cent in 2018 to 48.43 per cent in 2019.

The CSEC Integrated Science continues to be a popular subject across schools in the Caribbean. This subject therefore contributes in a significant way towards making science accessible to all students at the secondary level and thereby plays a meaningful role in attaining scientifically and technologically literate societies. *Integrated Science brings together the everyday context in which science operates. It encompasses biology, chemistry, physics, earth science, environmental science and technology.* (CXC Integrated Science Syllabus, 2017; p.1)

Emphasizing the importance of collaboration, problem-solving, and decision-making, it is important that within the school system, a variety of strategies continue to be explored for maximizing the benefits that may be derived from implementing the CSEC Integrated Science syllabus. Recognizing the interrelations among scientific concepts and promoting collaborative strategies (including team planning) among teachers from the specialist/major areas of Biology, Chemistry and/or Physics are deemed to be beneficial to teaching and learning.

While in the ideal, scientific knowledge should be incorporated seamlessly into one's general knowledge, it is important to emphasize to students that there are different ways of thinking. In Integrated Science examinations, the answers to questions should use scientific facts, data and concepts as far as possible. It is not sufficient to make generalized statements without supporting them with scientific principles and data. There is also the need to be specific with as much detail as possible in the time and space provided. For example, when asked about the effect of poor ventilation on humans, answers should include specific named physiological effects rather than just writing, for example, 'person will get sick'.

## DETAILED COMMENTS

The percentage of candidates earning acceptable grades (Grades I–III) was approximately 61.74 per cent compared with 62.29 per cent in 2018. The overall performance of candidates was satisfactory and comparable with performance in 2018.

### Paper 01 — Multiple Choice

Paper 01 consisted of 60 multiple choice items. The mean score in 2019 was 60.21 per cent, a slight increase compared with 2018 when the mean score was 58.06 per cent.

### Paper 02 — Structured/Essay Questions

#### Question 1

This question tested candidates' ability to analyse data, construct a graph and make inferences. It also tested candidates' understanding and their ability to use knowledge about the processes/mechanism of reproduction and growth in plants, as well as ventilation in buildings. The mean mark was 8.89 out of 25.

In Parts (a) (i) to (iv), many candidates provided correct responses on the advantage and mechanisms of sexual reproduction in flowering plants. Part (a) (v) required knowledge of the cooling effect when water evaporates and the plant structures and mechanisms involved in the movement of water from the ground to air, through the plant tissues. While some candidates were able to provide comprehensive explanations, many candidates provided vague and generalized statements; for example, 'the air is damp'. In Part (a) (vi), many candidates were able to explain or imply that both sunlight and water are essential for growth in plants.

Part (b) (i) required that candidates give three effects of poor ventilation on humans. Most candidates gave answers which reflected knowledge of the body overheating/dehydrating or fungal infections. Some were unable to be awarded marks because their answers involved non-human issues. Part (b) (ii) tested candidates' ability to explain how to modify a structure for better ventilation. Many candidates often implied or stated that ventilation is increased through higher air flow and therefore suggested modifications such as more/larger doors and windows and/or wall spaces and/or fans. Candidates very rarely stated that raising the roof or making roof modifications can also accomplish the desired results. There were a significant number of answers which suggested relocation or modifying the surroundings, both of which should have been recognized as unacceptable based on the phrasing of the question.

Part (c) required candidates to plot a graph on a grid, using the scales provided, from the data in the table. For Part (c) (i), candidates did fairly well in providing a title; most of them gave suitable titles that related both quantities given in the data. In Part (c) (ii), improvement in accurately plotting the points on the graph was observed. Yet many continue to use dots only instead of x's or circles with dots. Straight lines were sometimes

not drawn in Part (c) (iii), with the use of a ruler, and points and lines were thick in some instances. Although the question clearly stated that the graph should be extended to the axis, some candidates did not do so, making it impossible to use the graph to *determine the average circumference of the trees at planting* as was required for Part (c) (vi). With regard to Part (c) (iv), many labelled both axes of the graph; however, some candidates still omitted the units. Parts (c) (v) and (vi) were poorly done. The question clearly stated that candidates needed to make determinations from the graph, yet many candidates showed no evidence on the graph page of having read the graph. It is clear that some method other than reading the graph was used, as there were a number of candidates who had not extended the line on the graph yet gave answers. It was also evident that some candidates had difficulty reading off the graph as these provided no responses to those parts of the question.

### **Recommendations**

During practical activities involving graphs, emphasis needs to be placed on the following:

- Plotting graphs, with correct symbols
- Neatness and the use of fine lines and points
- Drawing the best fit line after plotting points
- Labelling of axes on a graph
- Obtaining results from the graph by accurate interpolation and extrapolation

### Question 2

This question tested candidates' knowledge of food chains, purifying sea water, the Archimedes' principle, the ecological impact of fishing and natural disasters. The mean mark was 4.85 out of 15.

Part (a) required candidates to identify the producer and carnivore in a food chain and was very well done. In Part (b), many candidates were unable to fully explain the process of obtaining pure water from sea water. It was very clear that many candidates were not able to explain the mechanism of distillation or reverse osmosis. Many candidates resorted to explaining the process of purifying fresh water by settling and disinfecting.

From the responses in Part (c) (i), it was clear that the vast majority of candidates was unfamiliar with Archimedes' principle. It was expected that the forces acting on the two floating blocks with different densities would have been used in Part (c) (ii), to provide an explanation.

Parts (d) and (e) were very well done, with some excellent explanations of the positive and negative aspects of natural disasters on fishing. There were also some great answers on the impact of fishing methods.

### **Recommendation**

During instruction and practical activities emphasis should be placed on the importance of understanding Archimedes' principle and applying it to the science of floating and sinking.

### Question 3

This question tested candidates' knowledge of the enzymes in the digestive system, softening hard water and neutralization reactions. The mean mark was 3.52 out of 15.

In Part (a), many candidates were able to identify the mouth and gall bladder as alkaline environments and the stomach as acid, as well as to correctly name a stomach enzyme. Part (b) required candidates to recognize, from the stimulus material, that the spring water was hard water and that they use that knowledge to explain the disadvantages of hard water and methods of softening it. Many candidates seemed unfamiliar with how hard water lathers with soap and how to soften the water.

Part (c) was well done, with many candidates defining neutralization correctly and giving an example of a household substance suitable for neutralizing an acid. Part (c) (iii) was also well-done, as candidates demonstrated understanding of safety precautions when handling spilled acid.

### **Recommendations**

During instruction, much attention should be given to performing activities with hard and soft water and explaining the chemistry of hardness.

### Question 4

This question tested candidates' knowledge of simple machines and the energy conversions involved in the use of these simple machines. The mean mark was 2.57 out of 15.

Part (a) (i) was poorly done as the vast majority of candidates was unable to correctly state the definition for the efficiency of a machine. In Part (a) (ii), many candidates were able to list the correct factor affecting efficiency and the correct method for increasing efficiency. The question required candidates to correctly tie the factor to the method in order to secure the mark.

For Part (b) (i), some candidates were able to recommend the simple machine used in the question as either the pulley or inclined plane; however, many candidates resorted to identifying forklifts and other engine-powered vehicles used in industry. It is quite possible that these candidates were unaware of the category of devices called simple machines in science. Part (b) (ii) was not well done by many candidates. Instead of stating the principles of force upon which the machine named in Part (b) (i) works, some candidates either named the parts of the machine, gave a description of the machine or outlined a procedure regarding how to use the machine. In Part (b) (iii), some candidates were able to give a reason why the lever was not the best simple machine to lift the engine onto the truck. The responses given focused on the safety hazard involved with the use of the lever, with a few candidates citing that the required distance or height to be moved presented a difficulty.

In Part (b) (iv), though some candidates were not able to recall the formula for calculating gravitational potential energy ( $E_p = mgh$ ), others realized that the Force (weight) is represented by  $(mg)$  and so multiplied weight by

the distance in metres. Most candidates were able to substitute correctly into the formula and multiply the force of 2500 N by the distance of 1.5 metres in Part (b) (v). Part (b) (vi) was not answered well by many candidates, as they could not make the connection between the potential energy gained and the work done by the engine.

Part (c) was satisfactorily done as some candidates were able to give three reasons why the implementation of solar panels in a diesel engine can cause problems. They were able to state that no sunlight would be available at night, that the panels are expensive, that the panels were not capable of producing sufficient energy and that the cloud cover can pose problems. Many candidates mentioned the weather without linking it to cloudy skies or rain. This was too vague to be accepted.

### **Recommendations**

During instruction and practical activities emphasis should be placed on the following:

- The description and working of simple machines and examples.
- How friction affects the efficiency of machines.
- In calculations, formula used should be clearly stated.
- Units of quantities in a calculation should always be stated.

### Question 5

This question tested candidates' knowledge of respiration, the circulatory system and their ability to calculate the mechanical energy of a machine. The mean mark was 2.72 out of 15.

Part (a) required candidates to link the use of oxygen in muscles to the process of respiration and to describe how the circulatory system transports oxygen to the muscles. Both Parts (a) (i) and (ii) were generally well done. While the responses in Part (b) (ii) were better than those in Part (b) (i), many answers in both parts were often superficial and brief. Some candidates failed to give details on how changes in arteries cause hypertension or to mention the relationship between diet and these changes.

The calculations of mechanical advantage in Part (c) were well done, but it is clear that a few candidates could not distinguish between the forces in the machine as load or effort.

### **Recommendations**

During instruction, much attention should be given to the following:

- Practice in answering free response questions.
- Answers to free response questions should be planned before being written out and details should be included.



### Question 6

This question tested candidates' understanding of the safety hazards of electrical equipment, their ability to calculate resistance and their knowledge of conductors and insulators. The mean mark was 4.92 out of 15.

In Part (a), many candidates were able to give the two hazards resulting from the interaction of the flood water on the appliance. Overall, this part was satisfactorily done. In Part (b), many candidates were able to give the safety procedures that can be adopted to prevent further accidents. Candidates also used practical examples to further explain their answers. In Part (c), many candidates were able to use the formula given to make the correct substitutions, in order to arrive at the answer. It was evident though that the unit for resistance (ohm  $\Omega$ ) was not recalled accurately.

In Part (d), candidates were able to recall the terms *conductors* and *insulators*. In the cases where the terms were not used, they were able to give examples of materials which act as conductors and insulators. Candidates were also able to state the differences regarding how both function. This part was answered well by candidates.

### **Recommendations**

During instruction and practical activities emphasis should be placed on the use and manipulation of formula and representation of units in answers.

## **Paper 032 — Alternative to School-Based Assessment**

Paper 032 consisted of three questions. It tested candidates' practical skills and their knowledge.

### Question 1

This question tested candidates' practical/experimental skills: emphasizing, planning and designing, measurement and manipulation, observation, reporting and recording, analysis and interpretation and drawing. The mean mark was 11.23 out of 24.

For Part (a) (i), candidates were required to carry out a procedure and to record the result of an investigation on which of two soil samples retains more water. Candidates were given a clear ten-step procedure to follow which involved weighing 50 g of each sample and adding 100 g of water. The mixture would then be drained by filtering with cotton wool, the filtrate collected and its volume measured and recorded in a given blank table. Though most candidates performed the tasks satisfactorily, a few had abnormal results.

In Part (a) (ii), many candidates gave a very generalized rewritten procedure as precautions. Candidates ought to be made aware that *precautions* in a scientific investigation are *special procedures and safety efforts taken to make results obtained as precise as possible*. For example, writing 'read the measuring accurately' becomes a precaution if it is worded as follows: *place the measuring cylinder on a level surface or read the measuring*

*cylinder at eye level*. In Part (a) (iii), many candidates were unable to identify the variables in the investigation. It may be helpful for candidates to use a simple rubric to identify the categories:

- Manipulated — quantity changed by the investigator
- Responding — quantity which the investigator expects to change
- Variable held constant — quantities which can change but are not actually changed in this investigation

In Part (a) (iv), following the rules of scientific drawing proved challenging. However, most candidates were able to do so satisfactorily. In Part (a) (v), the majority of candidates was able to determine a suitable title for the diagram. Candidates should note that the contents of the conclusion are related to the objective but must reflect the actual results obtained even if it is contrary to what one expects.

Parts (a) (vii) to (ix) required candidates to use their knowledge of soils to support their conclusion. They were also expected to apply this knowledge to the real world of agriculture. This was well done by many candidates as they were able to apply their knowledge of the characteristics of different soil types.

In Part (a) (x), many candidates seemed unable to identify errors in an investigation. They were unable to appreciate that errors are not mistakes an investigator makes but rather the imperfectness of the investigator's techniques and the inability of the instruments used to give precision.

### **Recommendations**

Appropriate instructional activities, scenarios and associated practical experiences can be incorporated into lessons to highlight the following:

- The importance of scientific integrity in recording the results obtained in an investigation despite the fact that candidates may feel that the results are incorrect or at variance with their knowledge
- Practice in planning and designing activities
- The application of scientific knowledge to real-world problems and solutions

### Question 2

This question tested candidates' practical/experimental skills through drawing, designing a table for recording results, making a hypothesis and taking a reading. The mean mark was 9.41 out of 18.

Parts (a) (i) to (iii) required candidates to draw and label a specimen from a photograph and to make a measurement of the specimen. Once again, most candidates demonstrated the ability to follow the rules of scientific drawing. There was marked improvement in correct labelling and measurement and candidates seemed aware of the importance of including the unit of measurement. In Part (a) (iv), some candidates seemed to think that their ability to recall food tests was being tested instead of their ability to construct a suitable table for recording the results of the food test. As a result, candidates constructed the table with appropriate physical

structure but missed the column headings even though Part (a) (v) required the results of these food tests. No marks were lost for giving the results in Part (a) (iv) if the correct headings (Observation and Conclusion) were included.

Parts (b) (i) and (ii) required candidates to develop a hypothesis and identify the manipulated and responding variables. Many candidates seemed unable to satisfactorily identify two variables that would form a testable relationship. In Part (b) (iii), most candidates were able to give the correct reading presented on the bathroom balance.

### **Recommendations**

Appropriate instructional activities, scenarios and associated practical experiences can be incorporated in lessons to highlight the following:

- Practising the skills of scientific drawing
- Practising designing tables to record results in investigations
- Developing hypotheses and clearly identifying the variable and the testable relationship

### Question 3

This question tested candidates' practical skills with respect to reading a linear scale, recording results in a table and performing average calculations. It was extremely well done. However, there were many cases when the unit of measurement was put on every line in the table instead of on the table header and/or in only one column of the table header. The mean mark was 3.75 out of 8.

### **Recommendation**

Appropriate instructional activities, scenarios and associated practical experiences can be incorporated into lessons to highlight practice in designing tables to record results in investigations.

### **Further Recommendations**

- Candidates could benefit from engaging in practical work recommended/suggested by the Integrated Science syllabus. This is necessary for facilitating the development of practical skills along with the required knowledge and attitudes in science.
- For Papers 02 and 032, candidates could benefit from more practice in doing relevant structured questions, essays and data analysis items. It is important for candidates to understand that essay responses require a logical sequence of ideas and that such a structure cannot be successfully replaced by a few words and/or incomplete and disjointed sentences.

- Instructional items could also relate to practical or hands-on experiences incorporating everyday life (local, regional and global) scenarios to facilitate understanding and the ability to use knowledge of concrete and abstract scientific concepts.
- Additionally, learners can be guided through appropriate activities to facilitate the development of scientific knowledge, processes and inquiry skills.
- The correct spelling of scientific terms and appropriate use of the jargon of science needs to be facilitated in the classroom. Terms need to be discussed with students, giving consideration to how these terms are used in scientific or technical contexts.
- At present, clear and legible handwriting is the mode of communication, so it is important for candidates to practise their writing skills.
- To further address learners' needs and improve their practical skills regarding relevant content knowledge development, the following strategies could be incorporated:
  - Use of models (where necessary)
  - Participation in planning and implementation of relevant science projects
  - Use of improvised equipment and appropriate software guided by teachers
  - Use of appropriate convention in recording the results of an investigation, especially the skills involved in producing graphs
  - Analysis of data using graphs and the ability to interpolate and extrapolate