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 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.