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 EXAMINATIONS

JUNE 2008

INTEGRATED SCIENCE

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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 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:

Inhaled air	**Exhaled air**
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. = Load/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.

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- 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 (→).
- 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