CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE SECONDARY EDUCATION CERTIFICATE EXAMINATIONS

JUNE 2004

INTEGRATED SCIENCE

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GENERAL PROFICIENCY EXAMINATIONS
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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 inter-changeably. 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 pant 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 x 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.