CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE CARIBBEAN ADVANCED PROFICIENCY EXAMINATION®

MAY/JUNE 2013

ENVIRONMENTAL SCIENCE

GENERAL COMMENTS

In Unit 1, overall performance was comparable with that of 2012 — 95 per cent of candidates achieved Grades I–V. In terms of module performance, candidates performed better on Module 3 (Sustainable Use of Natural Resources) and Module 2 (Human Population and the Environment) than on Module 1 (Fundamental Ecological Principles).

In Unit 2, 94 per cent of candidates achieved Grades I–V compared with 95 per cent in 2012. Candidates performed best on Module 1 (Agriculture and the Environment) followed by Module 2 (Energy and the Environment) and then Module 3 (Pollution and the Environment).

DETAILED COMMENTS

UNIT 1

Paper 01 – Multiple Choice

Paper 01 consisted of 45 multiple-choice items, 15 from each module. Candidates' performance on this paper was very good.

Paper 02 – Essay Questions

Overall candidates' performance was better in Module 3 and Module 2 than in Module 1.

Module 1: Fundamental Ecological Principles

Question 1

In this question, candidates were required to study a diagram which illustrated the nitrogen cycle. The processes occurring in the cycle were not named, but labelled as Process I, II and III. Candidates' performance on this question was not satisfactory.

In Part (a) (i), candidates were required to identify the type of bacteria which allowed each of the Processes I, II and III to occur. Too many candidates did not identify the type of bacteria, with some making an attempt to identify the processes, and doing so incorrectly.

Part (a) (ii) required candidates to identify three ways in which human beings may alter the nitrogen cycle. Responses illustrated that candidates' understanding of the nitrogen cycle was limited since few were able to identify the ways in which the nitrogen cycle could be altered.

Part (a) (iii) required candidates to justify the advice given to a farmer with respect to reducing the amount of money spent on nitrogen fertilizers by intercropping with legumes regularly. Many candidates could not justify the advice given to the farmer with respect to utilizing intercropping to reduce money spent on fertilizers.

Part (b) (i) required candidates to utilize information from a table to calculate the species diversity of insects in one of three ecosystems utilizing a given formula; it was not done very well.

Part (b) (ii) required candidates to use the information derived from the calculation in (b) (i), and that provided in the table to identify and justify the ecosystem which is likely to better withstand disturbance. This part was not well done; most candidates were unable to explain which ecosystem was likely to better withstand ecological disturbances.

Question 2

Candidates' performance on this question was satisfactory. Part (a) required candidates to outline the role of natural selection in the evolution and adaptation of species.

Part (b) (i) required candidates to examine a graph showing the percentage impact of human activities on aquatic and terrestrial ecosystems, and identify three deductions. This part was generally well done.

Part (b) (ii) required candidates to interpret the graph and identify the values of two anthropogenic impacts which have the highest impact on the terrestrial ecosystems. This question was well done but many candidates failed to identify and total the percentage values in addition to identifying the activity. The correct response should have been in the following format:

greatest total impact on terrestrial ecosystems:
pesticide use (40 %) + fertilizer use (30%) = 70%

Part (b) (iii) required candidates to explain why the discharge of sewage into aquatic ecosystems should not be encouraged. This part was generally well done.

In Part (c), candidates were expected to use a diagram which showed the relationship between the change in the number of fish and the change in the pH. Candidates were required to explain the distribution pattern of the fish with respect to the change in pH in the aquatic ecosystem. This question tested candidates' understanding of the concepts of *limiting factors*, *tolerance ranges* and *environmental resistance*. Most candidates offered explanations based on limiting factors and tolerance ranges; not many candidates offered explanations based on environmental resistance.

Module 2: Human Population

Question 3

Part (a) required candidates to distinguish between *human development index* (HDI) and *gender development index* (GDI). Candidates' performance on this part was satisfactory.

Part (b) required candidates to provide an explanation of how climate and economy affect human population density. This question was generally well done, with candidates identifying and explaining at least one of the two factors.

In Part (c), candidates were given a table outlining the percentage of the population in the urban areas of three countries. In Part (c) (i), they were required to describe the trends for each country based on the information in the table; most candidates were able to give satisfactory responses. However, some candidates missed the qualifier *each* and spoke about one or two countries, instead of all three. In Part (c) (ii), candidates were given the total population of Country B in 1980, and were required to calculate the number of people who lived in rural areas in 1980. Candidates' performance on this part was less than satisfactory. Many candidates erred in their calculation and too many of them did not include units in their responses.

In Part (d), candidates were presented with a suite of four pictures labelled W, X, Y and Z. While the quality of the pictures was not optimal, most candidates were able to identify the two required environmental impacts from the pictures in Part (d) (i). Part (d) (ii) was generally well done; most candidates were able to explain one way by which one of the impacts could be mitigated. However, candidates are cautioned to follow the instructions given in questions. For example "... one way by which one of the impacts ..." meant that a comprehensive explanation of one impact was required.

Question 4

This question dealt with fertility rates, education levels and per capita waste production.

In Part (a), candidates were presented with information on the total fertility rates for women in a country, and were required to state four deductions which could be made from the graph about the relationship between total fertility rate and the level of education of women. Most candidates were able to furnish at least three accurate deductions.

In Part (b), candidates were required to suggest reasons to explain the relationship between the total fertility rate and the level of education of women in the country. This part was adequately done but some candidates were under the mistaken impression that the 'x' axis related to the age of the girls as opposed to the level of education of the girls. As a result, some responses drew a correlation between the age of the woman and her ability to bear children: '... the women in primary school have a low fertility rate, because they were too

young to bear [much] children ...'. These responses meant that candidates completely misread the graph, which was to their detriment.

Part (c) required candidates to explain the relationship between fertility rate and the country's ability to use its natural resources in a sustainable manner. This part was generally well done, with most candidates identifying cogent reasons. However, in many cases, candidates fell down on the expansion of the reason(s), by way of a comprehensive explanation.

Part (d) presented information on the per capita waste production of two countries – A and B. In Part (d) (i), candidates were required to define *per capita waste production*. This was attempted by most candidates, though many could not furnish a complete definition. Candidates may benefit from greater emphasis on the definition of terms and the use of appropriate terminology when answering this type of question.

In Part (d) (ii), candidates were asked to identify the country where waste production would have a greater impact on the environment; they were also required to support their answer by providing three reasons. The majority of candidates was able to identify Country A as the country whose per capita waste production would have a greater impact on the environment, but many were unable to adequately support their answer.

Module 3: Sustainable Use of Natural Resources

Question 5

In this question, candidates were presented with information on the effect of a government's policy on tax incentives on the use of natural resources. Candidates performed poorly.

Part (a) (i) required candidates to describe how a tax incentive worked to manage the use of a natural resource. Candidates' performance was unsatisfactory, as most of them either did not know what a tax incentive was or equated it to a form of taxation. As a result, the definition/explanation of the tax incentive was lacking: *A tax incentive will encourage persons to use the desired technology. This makes it cheaper to use, and will therefore reduce the amount of the natural resource needed by the population.*

Part (a) (ii) required candidates to calculate the average annual increase in solar water heaters for the first five years after the tax incentive policy was introduced. Many candidates faced challenges in reading off the graph and doing the calculation. This skill is one which needs to be focused on and enhanced during classroom sessions. Essentially, candidates needed to read off the following from the graph and complete the calculation:

$$\frac{\text{\# of water heaters at Year 5} - \text{\# of water heaters at Year 1}}{\text{Year 5} - \text{Year 1}}$$

In Part (a) (iii), candidates were required to evaluate the effectiveness of the tax incentive in changing the behaviour of the country's citizens with respect to natural resource use. Candidates performed poorly on this part, and most failed to utilize the actual values from the figure provided as required by the question. Candidates demonstrated limited skills at reading graphs and making inferences from graphs. This is an area of skill development that should be focused on during classroom sessions.

Part (b) provided candidates with two questions and corresponding answers which were incorrect. Candidates were required to provide the correct answer, and explain why the given response was incorrect.

(i) **Question**: What is the difference between a renewable and an inexhaustible resource?

Answer: There is no difference between these terms, they are the same thing.

Most candidates had difficulty distinguishing between renewable and inexhaustible resources, with many providing incorrect examples for either one or both. Accordingly, they could not identify that a renewable resource and an inexhaustible resource were not the same thing.

> A *renewable resource* is one which can be extracted and utilized, but if given enough time it can replenish itself, for example, trees. However, if the rate at which the renewable resource is consumed exceeds its renewal rate, renewal and sustainability will not be ensured.
>
> An *inexhaustible* resource is one that can never be used up, no matter the rate of consumption, for example, the sun.

(ii) **Question**: Explain how technological factors can affect natural resource use in the Caribbean.

Answer: Technological factors do affect natural resource use in the Caribbean. For example, issues such as population growth can have a big impact. As populations increase, they require more raw materials and so more resources will be used up to satisfy the growing population.

Most candidates were able to identify that population increase is not a technological factor, but the majority failed to properly articulate an explanation for their response.

Question 6

For Part (a), candidates were asked to present two arguments in support of the following statement:

> "*I don't understand why our teacher says that the landscape is a natural resource. You can't sell a mountain, or make anything out of a beach. I don't think that our teacher is correct about this*."

Most candidates were able to identify that the landscape (and beach) were essential natural resources for the Caribbean region. However, many missed that the question required a comprehensive explanation of the non-consumptive uses of the landscape as a natural resource (for example, aesthetic, spiritual, recreational, economic, tourism). While it was not intended for there to be a discussion on mountains or beaches specifically, answers regarding the non-consumptive or intrinsic value of the resource were accepted.

Part (b) required candidates to explain by way of an example, the term *non-consumptive* use of natural resources. While the overall responses were an improvement on preceding years, there was still evidence that candidates were not completely familiar with the meaning of this term. This could be seen by the examples posited for non-consumptive uses of natural resources.

> *A non-consumptive use of a natural resource is one where the use of the resource does not deplete its quality or quantity. Examples include ecotourism activities such as whale-watching, canopy walkways and zip-lining, bioprospecting and research.*

Part (c) was unquestionably the best performing part of this question, with most candidates identifying a named natural resource for a named country. Most were also able to adequately explain the importance of this resource to the country. It was also apparent that both teachers and students needed a wider understanding of the occurrence and distribution of resources in the Caribbean region.

Part (d) (i) required candidates to utilize the information provided in tabular format on land area under forest cover to identify the five-year period which saw the greatest decline in forest cover. Candidates were required to show all working in deriving their answer, an instruction which was ignored by many candidates. In Part (d) (ii), candidates were given the total area of the country in order to calculate the percentage of the country under forest cover in 2005. Candidates did not perform as well as expected on this part, with many candidates making mistakes in this simple calculation.

$$\frac{224{,}000}{512{,}800} \times 100 = 43.7\ \%$$

It may be concluded that candidates demonstrated limited skills at manipulating data and performing calculations. This is another area of skill development that should be focused on during classroom sessions.

Part (d) (iii) was well done. Candidates were asked to give two reasons to support the assertion by an eco-group that the government should promote natural resource conservation with respect to the rate of loss of forest cover. Candidates identified reasons such as *the prevention of depletion/degradation of natural resources, the conservation of ecological components and endangered/threatened species, as well as the protection of the resource for its aesthetic, cultural and sacred values*. In addition, candidates demonstrated knowledge of an impressive array of conservation tools, and many gave examples to support their answer.

Paper 031 – School-Based Assessment (SBA)

The overall presentation of the SBA for Unit 1 continues to show improvement. There was evidence of some very thorough work on the part of the students and also some evidence of effective teacher guidance.

While there was some improvement in the literature review component there were still many instances where the literature review was merely a listing of literature without discussion and relevance to the chosen topic.

The methodology frequently did not describe how the variables and parameters would be measured, observed and recorded. Also, very frequently students used a questionnaire survey that was not always appropriate and, where they were appropriate, the questions were not formulated to yield the information pertaining to the stated objectives.

Some of the SBAs submitted did not demonstrate adequate field investigation and did not demonstrate much creativity and skills in the Presentation of Data; often the presentation was limited to a number of graphs that were inappropriate and photographs without titles. Students are encouraged to use a variety of formats for the presentation of data. Other tools such as sketches, maps and data trends should also be encouraged.

While the analysis was fairly adequate in some instances and was based on the data presented, it could have benefited from more variation in techniques (other than percentages).

The Discussion of Findings in some instances lacked depth of interpretation. Often they were not based on actual findings in the research. It would be helpful here to recall some of the most significant findings.

In a few instances, recommendations were based solely on limitations of the activity. Limitations are not recommendations, and are more appropriately addressed in the

methodology. In general, similar to Discussion of Findings, recommendations were not always based on actual findings of the particular research but, instead, on some generalized information on the topic, perhaps from research on a similar topic or from the literature.

While the communication of information was generally good, there is still the need for greater improvement. There are still too many instances where students demonstrate very poor standards of writing and communication skills for the CAPE level. It would be helpful if students use the terminology associated with the study of Environmental Science in order to improve the overall quality of the SBAs. Less use of colloquial expressions and improvements in grammar will also improve the quality of the SBAs.

In several instances, the conventional format for references was not applied. Additionally, textbooks and websites were intermixed. In some cases for website references, only the search engine was mentioned. Students should reference website URLs in their entirety. References should be numbered, and follow the format which is utilized in the most recent edition of the CAPE Environmental Science syllabus.

Paper 032 – Alternative to School-Based Assessment

Question 1

Candidates were presented with data, in a tabular format, of the population size and feeding relationships of selected species of mangrove at a site.

In Part (a), candidates were required to differentiate between *species diversity* and *species abundance*. The majority of candidates were able to define *species diversity*, but few were able to correctly define and contrast the two concepts.

Part (b) required candidates to utilize the information from the table to construct a pyramid of numbers to reflect the trophic levels for Site A. Too few candidates were able to correctly answer this question. Many disregarded the data regarding number of organisms at the site, and drew a classic pyramid, instead of a spindle-shaped one, which would have reflected the data provided.

In Part (c), candidates were asked to outline an appropriate method to estimate the size of the mangrove population. Few candidates were able to identify, and even fewer could explain sampling techniques for immobile organisms, for example, transects and quadrats. Instead, candidates identified sampling techniques for mobile organisms, such as the capture-recapture method and the sweep-net. This is an important skill which needs to be addressed for future candidates.

Part (d) required candidates to identify two limitations to the method listed in (c) and most candidates were unable to state correct limitations.

Part (e) required candidates to give a detailed explanation of the effects to the ecosystem, if a predator of the butterfly that produces the caterpillars of Species A was introduced into the ecosystem. Many candidates attempted this question, but many did not give an answer commensurate with the marks allocated for the section. Candidates are reminded that the marks allocated for a question are a useful guide to answering the question.

Question 2

Part (a) required candidates to define the terms *total fertility rate* and *replacement level fertility*. Few candidates were able to satisfactorily provide a definition for one or both terms, with most candidates giving incomplete or incorrect responses. Candidates may benefit from greater emphasis on definitions and terminology and the use of appropriate terminology when answering this type of question.

Part (b) required candidates to refer to the age–sex structure diagram presented to calculate the

(i) number of people in the pre-reproductive age group for the country

(ii) percentage of the population in the pre-reproductive age group if the total population of the country was 72.5 million.

Candidates did not perform well on this part because they had difficulty identifying the pre-reproductive age group and reading the required data off the age–sex structure diagram. While the calculation required for Part (b) (ii) was a simple percentage calculation, most candidates failed to adequately respond to the question. The point is to be made again that most candidates continue to perform poorly on questions requiring calculations. In addition, many candidates had difficulty working with large numbers (millions, billions) and including appropriate units in their responses. Candidates need to pay greater attention to their basic mathematical skills and on how to execute mathematical calculations using data from tables or graphs.

Part (c) required that candidates explain how the population of the country would change over the next ten years. This part was poorly done, with few candidates recognizing that the pyramid was a constrictive pyramid, because the pre-reproductive age group (0–14 years) comprised a smaller percentage than the reproductive (15–44) and post reproductive age groups. The population was therefore an aging one, expected to decrease in the next ten years as fewer persons would move into the reproductive age group.

Part (d) required candidates to analyse tabulated data on the per capita water consumption between developing and developed countries. In Part (d) (i), candidates were required to calculate the per capita water consumption between developing and developed countries. This part was not well done. Part (d) (ii) required candidates to explain the environmental impact associated with high per capita water consumption. This question was moderately done, but

many candidates gave responses which associated increased per capita water consumption with increased pollution. It should be remembered that an increase in per capita water consumption concerns an increase in demand for water, and the need to meet the demand. Impacts should therefore stem from this circumstance.

In Part (d) (iii), candidates were asked to account for the difference in per capita water consumption between developing and developed countries. This part was poorly done, with candidates supplying reasons why developing *instead of* developed countries had higher per capita water consumption. This was despite clear evidence in the table to the contrary, once again demonstrating the inability of many candidates to interpret, analyse and synthesize data presented to them. Therefore, despite higher levels of total population by developing countries, their per capita water consumption is lower than developed countries for many reasons including increased uses for industrial, agricultural and domestic uses, access and availability of water, lack of infrastructure to bring water to users, level of economic development and urbanization.

Question 3

Data were presented in tabular format outlining the amount of fish harvested from a mangrove ecosystem, and the fishing effort in terms of number of boats used.

Part (a) (i) required candidates to use information provided to draw a graph illustrating the data provided in the table. This part was generally well done but candidates lost marks on the details of the graph, such as title, label and scale. Candidates should be aware that when asked to plot a graph, marks are generally awarded as follows:

- An appropriate title — this must be given for the graph
- Correct labelling of horizontal and vertical axes
- Correct labelling of graphs
- Use of an appropriate scale on each axis
- Plotting of all points correctly, and utilizing the dot and circle to identify each point plotted
- Drawing a smooth curve through all points

Part (a) (ii), which required candidates to describe five trends observed from the graph drawn in Part (a) (i), was also well done. Most candidates identified the relationship between the amount of fish harvested and the fishing effort in terms of number of boats used. In Part (a) (iii), candidates were asked to describe the term *maximum sustainable yield* (MSY). The majority of candidates could not provide a satisfactory explanation of the term, that is, *the largest amount of a resource which can be harvested without causing a decline in its stock*. Candidates may therefore benefit from greater emphasis on definitions and terminology. When asked in Part (a) (iv) to utilize the data from the table to identify the maximum sustainable yield, almost all candidates were able to pinpoint 4500 kg as the MSY.

Additionally, in Part (a) (v), most candidates could identify at least two reasons why it is advisable to harvest below the MSY, but many failed to engage in the more detailed explanation required by the question. Part (a) (vi) was well done with most candidates identifying cogent reasons on how human population growth may impact on the fish resource.

Part (b) (i) required candidates to identify an appropriate measure which can be implemented to protect and conserve the mangrove ecosystem. This part was well done. Part (b) (ii) required candidates to explain how the measure identified in Part (b) (i) would work to protect and conserve the mangrove ecosystem; it was also well done by candidates.

This question was very well done by most candidates and was the highest scoring of the three questions on the paper.

UNIT 2

Paper 01 – Multiple Choice

Paper 01 consisted of 45 multiple-choice items, 15 items from each module. Candidates' performance on this paper was good.

Paper 02 – Essay Questions

Module 1: Agriculture and the Environment

Question 1

Part (a) (i) was done well; most candidates were able to list three features of sustainable agriculture. However, it should be noted that a significant number of candidates had the right idea but were unable to use the proper terminology.

Part (a) (ii) required candidates to study Figure 1, which provided the results of a survey to determine the public's perception of the level of importance of a variety of different threats to sustainable agriculture. Most candidates were able to make appropriate deductions from the graph. A significant number of candidates were not clear as to what exactly they were reading from the graph — that it was people's opinions about natural disasters in a particular country, not the actual number of natural disasters that occurred.

Part (a) (iii) was generally done poorly by most candidates; many erroneously equated *external shocks* with a natural disaster, something that would destroy crops. Candidates were often not aware of what constituted an *external shock* and how this would threaten sustainable agriculture. The good responses to this question were not only able to identify suitable external shocks like *price fluctuations* and *external market demand*, but also to indicate why they would be a threat to sustainable agriculture. Average answers did not include this explanation.

Part (b) was generally well done. It required candidates to justify how agriculture could contribute to the economies of Caribbean countries.

Question 2

Part (a) tested candidates' ability to read and interpret a graph depicting fish production from traditional fishing grounds and aquaculture as well as to suggest reasons for the trends in the graph and some environmental impacts of aquaculture. Part (b) tested candidates understanding in certain areas of sustainable agriculture.

Part (a) (i) was generally done well. Difficulty with reading graphs again was evident in some responses. The weaker responses confused the two lines, or simply described the points on the graph, rather than an overall trend. Part (a) (ii) was also generally well done; most candidates were able to correctly relate increasing levels of aquaculture to a variety of reasons. It should be noted that most responses indicated that the candidates were thinking of the graph as illustrating the yield from a specific farm, rather than the industry as a whole. Most of the responses centred around things that would increase one farm's yield, like using growth hormones. Few responses suggested reasons that would be more applicable to an industry, like noting the declining traditional fishery which would encourage more fishermen to consider aquaculture. Part (a) (iii) was not a problem for most candidates. The impacts of aquaculture on the environment were well presented and seemed to be clear to the majority of candidates.

Part (b) (i) was answered correctly by most candidates, who were able to identify the characteristics of commercial agriculture systems. Part (b) (ii) was less well done, though many candidates were able to answer this part correctly, a significant number did not distinguish sustainable methods suitable for hilly terrain. Responses simply presented a variety of sustainable methods, even those that were not applicable to the terrain given in the question.

Question 3

Part (a) tested candidates' knowledge of the operation of a proton exchange fuel cell. Candidates were required to identify some of the inputs and outputs of such a fuel cell, given a semi-labelled diagram. This was somewhat hit or miss, but many candidates were at least able to get one of the components correct.

Part (b) was poorly done. Candidates were required to explain the concept of *secondary energy source* using the fuel cell as an example. Many candidates did not understand the concept of secondary energy source, and in addition, appeared to have very little understanding about fuel cells. This made it difficult for an appropriate connection to be made. The better responses were not only able to define the term, but were able to clearly identify the characteristics of a fuel cell that made it a secondary energy source.

Part (c) was also not well done. In this question, candidates were asked to discuss the feasibility of fuel cell use in the Caribbean, while focusing on the reliability of supply and economic factors. While some candidates were able to give some possible advantages of fuel cell use, in some cases this was not done in the context of supply and economy as required in the question. In addition, many candidates could not correctly assess the reliability of fuel cells in the Caribbean context. It seemed that many candidates had learned about the fuel cell technology, but its application/applicability to the Caribbean was not well understood. Teachers should ensure that sufficient coverage is given to the applicability of alternative energies in the Caribbean context.

Part (d) was moderately done. Candidates were generally able to outline the production and transmission of electricity using the combustion of a fossil fuel. A significant number of candidates did not fully understand how fossil fuels are used to create electricity — a noticeable number of responses suggested that it was 'heated fuel' that turned the turbines of the generators.

Parts (e) (i) and (ii) were generally well done. Most candidates were able to construct a suitable sketch of the tabulated data and identify two trends from it.

Question 4

Parts (a) (i) and (ii) required candidates to demonstrate some experimental planning and design skills by outlining the steps and precautions a student would have to take to conduct an experiment to determine which of two bulbs was more efficient. Candidates generally performed well on these questions. However, many of them could not distinguish between an experimental *step* and a *precaution*. A significant number of candidates used the same answers for both parts. More emphasis should be placed on this distinction during planning and design exercises by teachers and students. Part (a) (iii) provided some data from the experiment and asked candidates to determine which bulb was more efficient and from the data, to explain why. Most candidates were able to do this effectively. It appeared that the biggest difficulty for many was in the use of English to clearly explain their findings/conclusions. This should be practised by using more writing activities during SBAs.

Parts (b) (i) and (ii) were not generally done well. These questions required candidates to illustrate their understanding of the various costs involved in generating electricity. Many candidates were not able to use the appropriate terminology to define the types of costs they meant. A variety of synonyms were used. In the second part of the question, candidates had challenges developing points to support their answers. Those who attempted this question did not distinguish between *economic factors*, *social factors* and *political factors*. Many answers focused solely on economic factors, those that mentioned the others often spoke to their monetary cost alone.

Module 3: Pollution of the Environment

Question 5

Part (a) tested candidates' understanding of two similar terms, *pollutant* and *pollution*, by asking them to distinguish between the two. Candidates were generally not able to do this well; they used circular arguments such as 'pollution is caused by pollutants'.

Part (b) (i) required candidates to read a double y-axis graph containing data on the population and per capita gross national income for a Caribbean country, in order to determine the overall rates of increase in the per capita GNI over two different time periods.

This part was poorly done. Candidates were not able to read the graph to obtain the appropriate points, particularly given that this was a double y-axis graph. Candidates should ensure that they have a ruler in the examination so that they can get accurate readings from the various axes on a graph. Of the candidates that could read the graph accurately, many neglected to actually find the rate. Candidates should be aware that *rate* is a measurement against time. The average response determined the absolute difference between the two points; the good response followed that up by calculating the rate of increase.

Part (b) (ii) was generally well done. Most candidates were able to identify and discuss the likely causes for a rise in pollution, given the information provided in the graph.

Part (c) (i) was also generally well done; most candidates could correctly identify the group of chemicals associated with the Montreal Protocol.

Part (c) (ii) was poorly done. Many candidates could not describe how the Montreal Protocol works (or any protocol, for that matter), or give a reason as to why this protocol was more successful than any other. Responses often mixed up the Montreal and Kyoto Protocols. Teachers should ensure a good grounding in how international agreements work in general, with specific information about individual protocols, in particular the two most well-known, the Montreal and Kyoto Protocols.

Question 6

This question tested candidates' understanding of water pollution and their skills in planning and design. In Part (a), candidates were required to outline a plan to determine the source of pollution in a river, given certain stimulus. The responses were on the whole too vague; very few gave specific information. In addition, candidates could not use this information to explain how their results would allow for a conclusion to be drawn. This kind of exercise is well suited to discussions on SBAs, and should be encouraged.

Part (b) was done correctly by most candidates; it was not a problem for them to identify three pollutants likely to be found in rivers.

Part (c) was moderately done; many candidates could not explain how contaminants could move from a landfill to fish far downstream. Quite often responses would speak about bioaccumulation and biomagnification, but completely ignore how the contaminants got into the river in the first place.

Part (d) was not a problem for most candidates; they were able to suggest suitable methods to alleviate pollution in a river. Candidates should be reminded that solutions given should be reasonable. For example, suggestions like moving everyone in the village is not a practical solution.

Part (e) was poorly done. Many responses could not clearly connect methane, its ability to absorb light in the IR wavelengths and the greenhouse effect. In addition, there was a lot of confusion about global warming and ozone depletion. Many responses incorrectly suggested that methane had something to do with ozone depletion.

Paper 031 – School-Based Assessment (SBA)

There continues to be improvement in the overall presentation of SBAs. The overall quality and content can still be improved by choosing topics that lend themselves to more scientific and investigative activities.

The literature review is still an area of concern in many of the pieces submitted. Too often the literature review is either irrelevant or inadequate. There is an immediate need for students to improve their writing and expression skills. This severely affects the quality of the report and at times is not reflective of what is expected at the CAPE level.

The methodology frequently did not describe how the variables and parameters would be measured, observed and recorded. Also, very frequently students used a questionnaire survey that was not appropriate and, where they were appropriate, the questions were not formulated to yield the information pertaining to the stated objectives.

Some of the SBAs submitted did not demonstrate adequate field investigation and did not demonstrate much creativity and skill in the presentation of data. Often, the presentation was limited to a number of graphs of similar type, graphs that were inappropriate, and photographs without titles. Students are encouraged to use a variety of formats for the presentation of data.

While the analysis was fairly adequate in some instances and was based on the data presented, it could have benefited from more variation in techniques (other than percentages).

The discussion of findings in some instances lacked depth of interpretation. Often they were based not on actual findings of the particular research but on some generalized information on the topic, perhaps from research on a similar topic or from the literature.

The conclusion in many instances simply revisited the purpose. However, similar to the discussion of findings, it was often based on generalized information on the topic but not the actual findings in the research.

While the communication of information was generally good, there is still need for greater improvement in this aspect. There are still too many instances where students demonstrated a very poor standard of writing and communication skills for the CAPE level. It would be helpful if students use the terminology associated with the study of Environmental Science in order to improve the overall quality of the SBAs. Less use of colloquial expressions will also improve the quality of SBAs.

Recommendations

- Each activity of the SBA must relate to at least one specific objective.
- Site visits should include experimental work, a field trip where students observe a process, for example, a wastewater treatment plant is not a site visit.
- Site visits need to be more specific and parameters chosen for observation must be more amenable to measurements.
- In addition to stating what is going on or taking place at the site, students must say what they will do at the site.
- The final report for the journal must be informed by the laboratory exercises and the site visits.
- Follow-up activities should indicate what the student will do after each site visit and on the next site visit.
- The research title should be more concise and focused.
- The purpose of the project should be clearly outlined and the variables should be clearly defined.
- Greater attention should be paid to the relevance and appropriateness of the literature review.
- The methods of investigation section must provide specific information about how each variable/parameter will be measured. This can include a list of apparatus and essential steps for collection of the data.
- Careful observations should be taken during laboratory and site visits. Observations are not only the numbers, but can include things like the weather conditions or the specific colour change in a laboratory test. Often, observations of the surroundings at a site can help the student explain the results they get from that site.
- Data presentation should be emphasized. Diagrams and illustrations need to be more appropriate and well integrated in the text to increase their effectiveness. They should be properly labelled, titled and scaled as appropriate. Diagrams, photographs, line drawings and tables all must have a caption to indicate what is being presented. A very useful technique is to present a summary table of data gathered in the field visits and laboratory exercises. In this way the researcher can view the data ‘at a glance’ and can perhaps glean patterns or essential points. A summary table can be useful in guiding the analysis, and the table itself can be used as an analytical technique.
- Data analysis requires the use of appropriate statistical tools to give improved results. If such tools are used, then this should be specified in the text. For example, the results are presented as the average +/- the standard deviation.

- Discussion of the project findings should present the student's interpretation of their **own** results (not results found in a reference), and what explanation the student can give for an observation. For example, if the data indicates that there is more of a certain species of plant in one area, the discussion should give some indication of why that might be so. Research in the literature can also help students to find reasonable explanations for the things that they observe in the laboratory or the field.
- Discussion of Findings, Conclusion and Recommendations should be based only on what was presented in the literature review and the data that is collected, presented and analysed. No new material should be introduced at this stage.
- Conclusions must always be included in the project report. They must be clear, based on the students' own findings, valid and related to the purpose of the project. It is not simply a restatement of the project objectives.
- Recommendations must be based on the students' own findings and must be fully derived from findings. Recommendations and limitations are two different things.
- Bibliographic references should be written using a consistent convention. There should be at least four up-to-date references. It is recommended that use be made of the style and format contained in the syllabus when writing bibliographic references.

Paper 032 – Alternative to School-Based Assessment

There is still room for improvement with regard to the depth and breadth of coverage of certain areas of the syllabus. Greater effort must be made by candidates to improve their ability to organize, apply and communicate information.

Question 1

Candidates' performance on this question was very poor. They were required to demonstrate understanding of organic and commercial farming techniques, as well as the environmental impacts of same. In addition, the question required the plan and design of a simple experiment to determine which of these two farming techniques would have higher productivity.

In Part (a), candidates had to explain why organic farming is more affordable to a small farmer. This part of the question was fairly well done; the responses indicated that many candidates had an understanding of the operations of organic farming and why these were cheaper. However, some responses were not detailed enough and so did not receive full marks. Candidates are reminded to use the mark allocation as an indication of the depth or extent of response that is required.

Part (b) required candidates to list three environmental impacts of commercial farming. This was generally well done; most candidates were able to list these correctly.

In Part (c), candidates had to choose one of the impacts listed in Part (b) and outline how this impact occurs. This part was also fairly well done; where candidates did not perform well, it was due to responses that did not address the whole issue. For example, a response might have spoken about eutrophication, but did not mention how the nutrients got into the water bodies in the first place.

Part (d) was poorly done by most candidates. The responses suggested that candidates did not have a strong grasp of how to go about setting up a simple experiment. In some cases, even the identification of the manipulated, responding and control variables was limited. The most common problem was an inability to specify how exactly the more productive farm would be identified; the responding variable of *crop yield* was not often identified specifically. For example, a significant number of candidates indicated that the most productive farm would be the organic farm because it was 'healthier'. The 'healthiness' of the crop is what was used as the indicator of productivity. Candidates' understanding of the characteristics of organic versus commercial farming was also weak; many candidates indicated that the organic farm would be more productive.

Question 2

This question tested candidates' ability to construct an appropriate graph to represent data in a table as well as to identify the trend in the graph. In addition, the question required candidates to demonstrate their understanding of energy conservation, and how this may be achieved using alternative technology (fluorescent bulbs) and renewable energy (solar power). This question was fairly well done by the majority of candidates, primarily because of the significant number of marks allocated to the plotting of the graph. Candidates who performed poorly on this question had difficulty plotting an appropriate graph.

Performance on Part (a) was very poor. Candidates could not define the term *kWh*. Most of the responses simply stated the meaning of the abbreviation, but not its definition.

Candidates performed best on Part (b) and because it and the associated Part (c) were worth half of the marks, candidates who performed well on Part (b) also did well on the question overall. Some candidates had difficulty plotting an appropriate line graph to represent the data. Candidates should be aware that when asked to plot a graph, marks are generally awarded as follows:

- An appropriate title
- Correct labelling of horizontal vertical axes
- Correct labelling of graph
- Use of an appropriate scale on each axis
- Plotting of all points correctly
- Drawing a smooth curve through all points

Part (c) (i) was well done; just about all the candidates could define *energy conservation* correctly.

Parts (c) (ii) and (iii) were done moderately well; most candidates could give at least some of the reasons why use of fluorescent bulbs and solar energy would result in energy conservation. Generally, candidates who lost marks on this question did not fully answer the question or gave responses that did not clearly explain how the energy conservation would occur.

Question 3

This question tested candidates' ability to determine suitable water quality testing points given a sketch map as stimulus, describe water quality testing protocols, and demonstrate their understanding of the type of pollutants produced by organic and commercial farming to predict the likely concentrations of common water quality parameters. This question was poorly done by most candidates.

Part (a) (i) was done fairly well; most candidates were able to correctly define the term *pollutant*. The most common error candidates made was not specifying that pollutants were harmful substances in the environment; they stated only that they were 'substances'.

Part (a) (ii) was done poorly by most candidates. It was clear that the concepts of point and non-point sources of pollution were unfamiliar to many.

Part (b) was done well on the whole; many candidates were able to choose correct points. Candidates should note that suitable points would have had to be impacted by the various farms, but not impacted by the houses. Points that were chosen below the housing areas were not suitable as it would be impossible to determine if the level of pollution was caused by the farm or the houses.

Part (c) was very poorly done; Some candidates did not even attempt it. It is clear that many candidates writing this paper have little or no experience with actual laboratory methods. This puts these candidates at a distinct disadvantage because this paper requires a full awareness of all the methods one would have come across in labs at a school.

Part (d) was fairly well done although some candidates seemed to run out of time and did not submit any response for this part. Of those who did, a significant number were able to correctly match the high nitrates and phosphates and low BOD and faecal coliform levels with the commercial farm using water soluble fertilizers. Unfortunately, of the candidates who correctly matched the river to the water sample, some of these did not receive full marks because their answers were incomplete. The response required candidates to fully use the data in the table to come to a conclusion *and explain it*. This part was sometimes left undone or was not done at the appropriate level. On the other hand, some candidates who did not

arrive at the correct match had equated ‘organic’ farming with ‘clean’ and so chose the incorrect river for Sample B.