CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE CARIBBEAN ADVANCED PROFICIENCY EXAMINATION MAY/JUNE 2009

ENVIRONMENTAL SCIENCE

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INTRODUCTION

Environmental Science is a two-unit subject with each Unit consisting of three Modules. Unit 1 - Fundamental Ecological Principles, People and the Environment and Sustainable Use of Natural Resources; Unit II – Sustainable Agriculture, Sustainable Energy Use and Pollution of the Environment. Both Units are examined by three papers. Paper 01 and 02 are external examinations, while Paper 03 is the Internal Assessment and is examined internally by the teacher and moderated by CXC.

For the first time Paper 01 of both Unit 1 and Unit 2 consisted of multiple-choice items. Paper 01 consisted of 45 compulsory multiple-choice items with fifteen items based on the contents of each Module. This paper contributed 30 per cent to the total score for the Unit.

Paper 02 consisted of nine questions, three based on each Module. Candidates were required to answer two questions from each Module. Each question contributed 20 marks to the total of 120 marks for the paper. This paper contributes 40 per cent to the total score for the Unit.

Paper 03, the Internal Assessment, contributed 90 marks or 30 per cent to the total for the Unit. Unit 1 was examined by a single project while Unit 2 was examined by a journal comprising site visits and laboratory exercises.

GENERAL COMMENTS

UNIT 1

There was an improvement in the number of candidates who demonstrated the breadth of knowledge necessary to perform well. There were still, however, a few candidates whose responses were inadequate, especially where they were required to infer relationships, read graphs, distinguish between terms and explain interactions and interrelationships. Greater attention to basic principles is still required.

Too many candidates struggled with questions requiring the use of higher-order cognitive skills. It is recommended that in preparing for the examination, greater emphasis be placed on providing guidance and practice in responding to these types of questions.

DETAILED COMMENTS

UNIT 1

Paper 01

Paper 01 consisted of forty-five multiple-choice items; fifteen items from each module. Candidates' performance in this paper was very good.

Paper 02

Candidates performed best in Module 3, followed by Module 1 and then Module 2.

Module 1 - Fundamental Ecological Principles

Question 1

In Part (a) of this question, candidates were required to explain what was meant by the term 'limiting factor' and provide THREE ways in which limiting factors operate.

In Part (b), candidates were required to use Figure 1, which was provided, to describe how the population size of the algal species changes with variation in nutrients.

In Part (c), candidates were required to use Figure 1 to explain how the variation in the population of algae impacts on the population of other species in the ecosystem.

Overall, candidates' performance in this question was satisfactory. A few candidates had difficulty explaining the concept of limiting factors. Most candidates were able to answer Part (b) and Part (c) satisfactorily.

Note:

A limiting factor can be any one of various factors that limit the distribution or numbers of an organism. Limiting factors can be density dependent or density independent. Density dependent factors are factors which lower the birth rate or increase the death rate as a population grows in size. Examples are the quantity and quality of food. Density independent factors are factors which affect population size irrespective of population density, for example abiotic factors, such as weather, climate and fire. Too much or too little of any abiotic factor can affect the growth of a population even if all other factors are at or near the optimum range of tolerance. Although organisms are affected by a variety of abiotic factors in their surroundings, one factor usually outweighs the others in determining the growth of the population. This factor is the limiting factor and it is the primary determinant of growth in an ecosystem. Limiting factors are important because they can easily be upset by human activities.

Question 2

This question dealt with primary and secondary ecological succession. A table was provided with the percentage forest cover for selected countries in the year 1996. Candidates were required to use a bar chart to illustrate the data provided in the table and then use the information provided in the table to identify the countries where secondary ecological succession is MOST likely and LEAST likely to occur. Candidates were also required to provide FIVE reasons to support their answer.
Candidates' performance in this question was not very good.

In Part (a) of this question, most candidates were able to distinguish between primary ecological succession and secondary ecological succession.

In Part (b) (i), most candidates were able to correctly illustrate the data using a bar chart. The more able candidates were able to:

- draw bar charts with appropriate and proper use of scales
- correctly label the axes
- plot all data points correctly
- provide an appropriate title for the bar chart.

Part (b) (ii) was challenging for candidates. Many candidates incorrectly identified Haiti as the country MOST likely to have secondary ecological succession and Belize as the country LEAST likely to have secondary ecological succession.

Note:

- From the data provided, Belize had most of its forest intact (96 per cent) and so was most likely to have disturbed areas which would have been in rather close proximity to undisturbed areas
- In secondary ecological succession, colonization of the area occurs by species that are usually in the surrounding area.
- In the case of Belize, there will therefore be good opportunity for species to migrate from the closely surrounding areas and become re-established in the disturbed area.
- It will be possible and easy for tree seeds to be dispersed and transferred from forested areas to the cut disturbed areas.
- This would most likely increase recolonization with previous species, leading to secondary ecological succession.
- In the case of Haiti all of the forest cover is lost and while there may be undisturbed areas, there will be few species in the surrounding areas. This reduces the likelihood of recolonization and secondary ecological succession taking place.

Question 3

Figure 2 represented a simplified predator-prey relationship between snail kites and freshwater snails and showed the variation in population numbers of both snails and snail kites in an ecosystem for the first eight months, January to August, of one year.

In Part (a) of this question, candidates were required to make reference to Figure 2 and describe the variation in the population size of BOTH organisms over the eight-month period.

In Part (b), candidates were required to outline how predation may be of benefit to the prey population.

Note:

- Predation provides a basis for population control in the prey population.
- The predator selectively removes very young, very old or sick prey/individuals (since they are easier to catch).
- This helps to prevent the population from exceeding the carrying capacity.
- This prevents any ensuing population crash since there will be adequate resources for the surviving members of the prey population.

In Part (c), candidates were required to explain how ONE density independent factor may impact the size of the snail population. The difficulty here for some candidates was their inability to identify density independent factors.

Note:

Density independent factors are factors that are not dependent upon the density of the population in question. Some examples of density independent factors are weather, climate, and natural disasters, seasonal changes, hurricanes, and fires. These factors are unrelated to population size and affect everyone in the population regardless of population size.

In Part (d), candidates were required to assess TWO possible impacts on the ecosystem if the population of snails was significantly reduced by draining the waterway. Candidates did not pay attention to the fact that this part of the question asked for impact on the ecosystem and not only on the snail population. As such, many answers stated what would happen to the snails but failed to consider the impact on the ecosystem.

Overall, candidates' performance in this question was satisfactory.

Module 2 - People and the Environment

Question 4

Figure 3 in this question showed the total fertility rate versus per capita GDP.

Part (a) of this question required candidates to describe the relationship between per capita GDP and the level of poverty existing in countries. While some candidates correctly described the relationship, many were unable to do so.

Note:

- Poverty is the inability of individuals to meet their basic needs for, among other things, food, shelter and clothing.

- Gross Domestic Product (GDP) is the total annual output of a country's economy divided by the population of the country for that year.

- GDP per capita is an estimate of the amount of resources in terms of dollars that is available to each individual in that country.
- The greater the per capita GDP of a country the greater will be the resources available to individuals and the probability of them meeting their needs.

- As the GDP of a country increases, the level of poverty usually decreases.

In Part (b), candidates were required to outline the relationship between total fertility rate and per capita GDP based on the graph in Figure 3.

In Part (c), candidates were required to explain how the level of poverty in countries accounts for the relationship outlined in Part (b) (i).

Candidates did very well on Part (b) (ii) of this question. Most candidates had difficulty with Part (c) when they were required to explain how the level of poverty in countries accounts for the relationship outlined in Part (b) (i). Many candidates had difficulty when asked to interpret information from the graph and in describing the relationship between the two variables.

Candidates' performance in this question was very good. More than half of the candidates who attempted this question scored greater than 50 per cent of the available marks.

Question 5

Figure 4 in this question showed the death rate (DR) and birth rate (BR) of a developing country from the year 1900 to 2000.

In Part (a), candidates were required to describe how the growth rate of the population changed between 1908 and 2000.

In Part (b), candidates were required to calculate the doubling time of the population if its rate of growth remains constant beyond 2000.

In Part (c) of this question, candidates were required to outline TWO factors that may be responsible for the changes in the growth rate of the population since 1928.

In Part (d), candidates were required to assess the role of government policies in controlling population growth rate.

Candidates did very well on Part (d) of this question. However, Part (a), Part (b) and Part (c) posed difficulties for many candidates. Most candidates were unable to interpret the graph. Candidates failed to follow the instruction to begin at 1908. Many candidates also failed to discuss growth rate but focused instead on birth rate in isolation.

Candidates had difficulty with the calculation of 'doubling time' in Part (b).

Note:

Growth Rate = Birth Rate – Death Rate
Growth Rate in 2000 = 28 per thousand – 8 per thousand = 20 per thousand

Doubling time of population = $\frac{\mathbf{70}}{\%\text{ annual growth rate}}$

In 200, the growth rate was 20 per 1000 or 2 per 100 or 2 per cent

Doubling time of population = $\frac{\mathbf{70}}{2 \text{ per year}}$

Doubling time = 35 years

This was the most popular question in Module 2. Candidates' performance in this question was very satisfactory. More than half of the candidates who attempted this question scored greater than 50 per cent of the available marks.

Question 6

In this question Table 2 presented data for water consumption per capita for developing and developed countries.

In Part (a), candidates were required to calculate the percentage difference in the per capita water consumption between developing and developed countries. This part of the question was poorly done.

In Part (b), candidates were required to describe an environmental impact associated with high per capita water consumption. This part of the question was poorly done. Candidates did not appear to understand what an environmental impact was. Most candidates who attempted this part of the question discussed environmental factors rather than environmental impacts.

Part (c) required candidates to account for the difference in per capita water consumption between developing and developed countries. Candidates performed satisfactorily on this part of the question.

Part (d) required candidates to assess the statement "The high consumption patterns of developed countries are responsible for the world's environmental degradation" in the light of current world population distribution. This part of the question was the most frequently attempted part.

This was the least popular question in Module 2 but candidates' performance in this question was satisfactory. More than half of the candidates who attempted this question scored greater than 50 per cent of the available marks.

Module 3 - Sustainable Use of Natural Resources

Question 7

In this question candidates were presented with Figure 5 which emanated from research conducted to investigate the environmental impact of mining two natural resources, gold and gravel.

In Part (a), candidates were required to compare the environmental impact of extracting these two natural resources.

Part (b) required candidates to account for the difference in the level of noise pollution when these two resources are extracted.

Part (c) required candidates to discuss THREE factors (excluding environmental) that the Government should consider before permitting the extraction of these two resources.

Candidates' performance in this question was very satisfactory. Candidates did very well on Part (a) and Part (b). Some candidates failed to heed the caution in the question – 'excluding environmental factors' – and discussed environmental factors. As such, this caused candidates not to score more marks for this question.

Question 8

Table 3 in this question presented information regarding the impact on mangrove ecosystems of a restricted freshwater flow and the discharge of sewage at three locations identified as A, B and C.

In Part (a) of this question candidates were required to describe ONE function of mangrove ecosystems.

This part of the question was well known and was satisfactorily done by candidates.
In Part (b), candidates were required to analyse the information presented in Table 3 and make a logical deduction. Candidates were required to justify their response.

Part (c) required candidates to describe the effects that EACH of the following could have on mangrove ecosystems:

- Reduced freshwater flow through mangrove ecosystems
- Discharge of sewage in mangrove ecosystems.

This part of the question posed some difficulty for some candidates. Candidates failed to adequately describe the effects of each of the actions as stated in the question. Many candidates listed at least four points for each response.

This was the most popular question in the module and candidates' performance in this question was satisfactory.

Question 9

In this question candidates were presented with Figure 6 that showed the percentage of countries marketing both specific ecotourism destinations and traditional tourism destinations between 1985 and 2005.

In Part (a) of this question, candidates were required to comment on the trend in the tourism travel market from 1985 to 2005. This part of the question presented the greatest difficulty for candidates. Candidates had difficulty commenting on the trend shown in Figure 6.

Part (b) required candidates to state FOUR possible reasons for the trend shown in Figure 6. This part of the question was widely known by candidates.

In Part (c), candidates were required to discuss THREE ways in which ecotourism can be used as a tool for the conservation of natural resources.

This was the least popular question in the module. Candidates' performance in this question was very satisfactory.

The Internal Assessment

It is important to emphasise the paragraph below:

"The Internal Assessment is an integral part of student assessment and is intended to assist students in acquiring certain knowledge, skills and attitudes that are associated with the subject. The Internal Assessment must relate to at least **ONE** Specific Objective stated in the syllabus. The following must be assessed by the Internal Assessment for **each** Unit.

(i) the collection and collation of data;
(ii) the analysis, interpretation and presentation of such data;
(iii) the selection of techniques, designs, methodologies and instruments appropriate to different environmental situations;
(iv) the development of appropriate models as possible solutions to specific environmental problems.

In general, the required criteria were applied effectively.

There was a noticeable increase in the evidence of primary data collection and a reduction in the use of secondary data. Candidates are encouraged to continue to design projects that will encourage the collection, collation and use of primary data.

A reminder for teachers: The CXC criteria at the bottom of the Moderation Sheet **must** be applied **at all times** when recording and distributing marks to the three Modules. A remainder of one mark must be allocated to Module 3. For a remainder of two marks, one mark is allocated to Module 2 and one to Module 3. Care should be taken when compiling total scores. Moderators detected many errors in the total scores submitted for students.

The major areas of concern are the literature review and communication of information. While some candidates were able to communicate the information in a fairly logical manner with few grammatical errors, there were still too many candidates who presented information with several grammatical errors. This reduced the overall quality of the final report.

DETAILED COMMENTS

While the overall standard of the Internal Assessment submissions appears not to have improved greatly, it is heartening to note that there is a substantial number of candidates who submitted work that was of a very high standard. The overall quality and content can be improved by choosing topics that lend themselves to a more scientific and investigative approach.

In general, the required criteria for this component were effectively applied. 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 candidates to improve their writing and expression skills. Poor written expression severely affects the quality of the report and at times is not reflective of what is expected at the CAPE level.

One major concern was the way in which the titles of projects were written. Titles were frequently misleading and written in the form of an objective. The purpose of the project was also not "concise" and often did not have, or sometimes did not clearly state the variables and/or objectives of the research. Note that objectives should be **SMART**, that is, **S**pecific, **M**easurable, **A**ttainable, **R**elevant, and **T**ime-bound.

The literature review, in many instances, was merely a listing of the literature, without much discussion. Candidates also need to pay attention to the format used for citations.

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

Some of the work submitted for Internal Assessment did not demonstrate adequate field investigation and did not demonstrate much creativity and skills in presentation of data; often the presentation was limited to a number of graphs of similar type, graphs that were inappropriate, and photographs without titles. Candidates are encouraged to use the other available formats for presentation of data such as tabulation, cross-section, field sketch, and line transect.

The analysis was fairly adequate, based on the presented data. However, the analysis could have benefited from more variation in techniques (other than percentages).

The discussion of findings in some instances lacked depth of interpretation, and very few showed validity and reliability. Often they were not 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.

The conclusion often revisited the purpose. However, as was true of the discussion of findings, the conclusion was often based on generalized information on the topic but not the 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 on limitations. This category of recommendations is more appropriate to be addressed in the methodology. In general, similar to discussion of findings, recommendations were not 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.

Communication of information was satisfactory in some instances. However, it would be helpful to use the jargon/terminology of Environmental Science in order to improve the overall quality of the Internal Assessment projects. It is noted, however, that there are still many instances where candidates demonstrated a very poor standard of writing and communication skills for the CAPE level.
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.

Some areas in which projects in Unit 1 may be improved are:

- Each activity of the Internal Assessment should relate to at least ONE specific objective.
- Research title should be more concise and focused.
- The purpose of the project should be clearly outlined and the variables should be clearly defined.
- Data collection in some instances was inadequate and should be addressed.
- Diagrams and illustrations need to be more appropriate and well integrated in the text to increase their effectiveness.
- Comprehensive data analysis is required and this should make use of appropriate statistical tools to improve the results.
- 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 in the discussions.
- Greater attention should be paid to the literature review. This is still one of the weak areas in Internal Assessment pieces submitted for moderation.
- Conclusions must be clear, based on findings, valid and related to the purpose of the project. In addition, recommendations must be based on findings and must be fully derived from findings.
- Bibliographic references should be written using a consistent convention. In addition, there should be at least four up-to-date references.

Paper 03/2

There was a general improvement in candidates' responses to questions in this Paper. There was greater depth and breadth of coverage with respect to certain areas of the syllabus. However, greater effort must be made by candidates to improve their ability to organise, apply and communicate information.

Question 1

In Part (a), candidates were expected to use the information provided to plot a bar chart to show the population size of different species at each site.

In Part (b), candidates were asked to calculate the species diversity for EACH site and indicate which of the two sites has the GREATER species diversity.

In Part (c), candidates were required to differentiate between 'species abundance' and 'species diversity'.

Candidates performed very well in this question. They demonstrated an understanding of drawing graphs and reading information from graphs. Most candidates appeared to possess the depth of knowledge required to perform well on this question.

Question 2

This question was designed to test candidates' understanding of methods available for estimating population sizes of moving and non-moving organisms. Candidates were required in Part (b) of this question to outline the limitations of EACH technique identified in Part (a).

Overall candidates performed very well on this question. Most candidates demonstrated knowledge of sampling techniques for mobile populations.

Question 3

In Part (a) of this question, candidates were required to describe TWO measures that can be implemented to protect and conserve the Red Siskin (*Carduelis cucullatus*).

In Part (b), candidates were asked to design a plan to monitor the population of Red Siskin (*Carduelis cucullatus*).

In Part (c), candidates were required to explain why Site B may have been recommended by the EPA as the preferred site for developing the resort.

Candidates' performance on this question was satisfactory. Most candidates demonstrated knowledge of conservation strategies and the environmental impacts that can be the result of forest operations.

UNIT 2

GENERAL COMMENTS

There was an improvement in the number of candidates who demonstrated the breadth of knowledge necessary to perform well as was the case for Unit 1, however, there were still a few candidates whose responses were inadequate, especially where they were required to infer relationships, read graphs, distinguish between terms and explain interactions and interrelationships. Greater attention to basic principles is still required.

Too many candidates continue to struggle with questions requiring the use of higher-order cognitive skills. It is recommended that in preparing for the examination, greater emphasis be placed on providing guidance and practice in responding to these types of questions.

DETAILED COMMENTS

Paper 01

Paper 01 consisted of forty-five multiple-choice items; fifteen items from each module. Candidates' performance in this paper was very good.

Paper 02

Candidates performed better in Module 1 than in Module 2 or Module 3. Performance on Module 2 was superior to performance on Module 3.

Module 1 - Sustainable Agriculture

Question 1

This question presented some challenges to candidates. For Part (a), most candidates were unable to identify the differences between 'intensive aquaculture' and 'extensive aquaculture'. Responses such as the following were expected:

Aquaculture is the cultivation of the natural produce of water (fish, shellfish, algae, seaweed and other aquatic organisms). There are two kinds of aquaculture: extensive aquaculture based on local photosynthetic production and intensive aquaculture, in which the fish are fed with an external food supply. The management of these two kinds of aquaculture systems is completely different.

- Intensive aquaculture
  Intensive Aquaculture can often involve tanks or other highly controlled systems which are designed to boost production for the available volume or area of water resource. Essentially fish densities are high.

- Extensive aquaculture

  The available food supply by natural sources, commonly zooplankton feeding on pelagic algae or benthic animals, such as crustaceans and molluscs. Because most fish are carnivorous, they occupy a higher place in the trophic chain and therefore only a tiny fraction of primary photosynthetic production (typically 1 per cent) will be converted into harvestable fish. As a result, without additional feeding the fish harvest will not exceed 200 kilograms of fish per hectare per year, equivalent to 1 per cent of the gross photosynthetic production.

In Part (b), most candidates were able to satisfactorily describe the trends among intensive aquaculture, extensive aquaculture and marine fisheries. However in Part (c), when asked to select which *aquaculture* practice was most harmful to the environment and why, candidates encountered difficulties, at times describing the problems with marine fisheries.

Part (c) of the question was generally well done, although few candidates recognized that this part required an elaboration of the general impact of aquaculture. Responses such as the following were expected:

Aquaculture can be more environmentally damaging than exploiting wild fisheries. Some heavily-farmed species of fish, such as salmon, are maintained in net-contained environments. Unused feed and waste products can contaminate the sea floor and cultured fish can escape from these pens. Escapees can out-compete wild fish for food and spread disease, as well as dilute wild genetic stocks through interbreeding. Farming carnivorous fish like salmon may actually increase the pressure on wild fish, as for farming one kilo of farmed fish up to six kilo of wild fish are used for feeding. The concentrated nature of aquaculture often leads to higher than normal levels of fish waste in the water. Fish waste is organic and composed of nutrients necessary in all components of aquatic food webs. In some instances such as nearshore, high-intensity operations, increased waste can adversely affect the environment by decreasing dissolved oxygen levels in the water column. Onshore recirculating aquaculture systems, facilities using polyculture techniques, and properly-sited facilities (e.g. offshore or areas with strong currents) are examples of ways to reduce or eliminate the negative environmental effects of fish waste.

Question 2

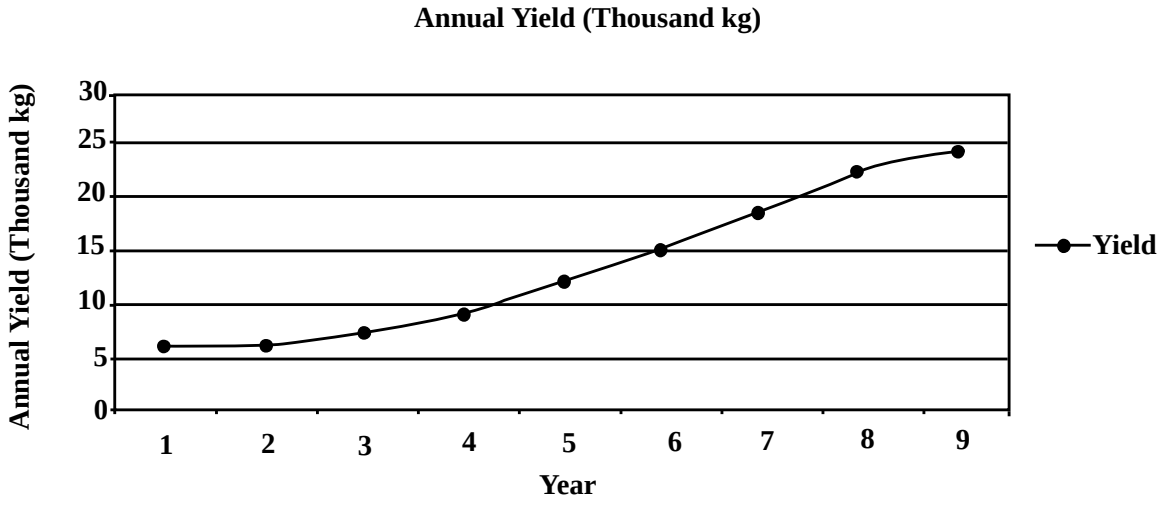
This question was fairly well done. In Part (a), most candidates were able to identify the method they would recommend to the farmer, as well as another environmentally sustainable method of pest control. However, many candidates were unable to give an adequate justification in Part (a) (i).

Part (b) was done better by the candidates, with most candidates identifying environmentally sustainable practices in agriculture systems and adequately explaining their reasons for their choice.

Question 3

This question was generally well done, with most candidates being able to identify hydroponics as the practice being demonstrated in the diagram. However in Part (a) (ii) they encountered some difficulties when asked to outline the features of hydroponics.

Part (b) required students to plot a graph of the data provided. Candidates were generally able to plot a graph, but had difficulties with the finer details, such as labelling the graph and axes, neatly sketching the curve and choosing an appropriate scale. An example of an acceptable graph is given below.



Candidates should note the following when drawing graphs:

- All graphs must have an appropriate title.
- The axes must be labelled appropriately.
- There must be correct point placement.
- The drawing of the curve must be appropriate, smooth and neat.

Candidates were generally able to identify the reasons for the trend in Part (c), as well as reasons why hydroponics is sustainable. Some candidates, however, were unsure about what was required for this answer and simply stated the features of sustainable agriculture.

Module 2 - Sustainable Energy

Question 4

This question was fairly well done, but Part (a) presented some challenges for candidates , since they had difficulty calculating the quantity of fossil fuel utilised by each country, and consequently determining which country used the larger percentage of its fossil fuel for electricity generation. Candidates, however, excelled in listing uses that could be included in the "other" category, identifying a broad range of responses.

For Part (b), candidates generally identified factors affecting the supply of energy to the new industrial estate, but many failed to adequately elaborate on these factors. **This was a general trend with questions that asked candidates to discuss, justify, analyse, and evaluate**. Candidates need to practise answering questions that require higher-order skills.

Question 5

This question presented some challenges to candidates, primarily since many had difficulties reading and interpreting the graph. In Part (a) (i), candidates generally had difficulties calculating the environmental cost of using natural gas as a source of energy:

9 – 6 = 3 US cents/kWH

In Part (a) (ii), candidates at times ignored the fact that their choice and identification should be based SOLELY on the data in the figure, and that the justification should include specific values from the figure.

Recommended form of energy: ***geothermal***

- *geothermal (7.5 cents/kWh) is overall cheaper than solar cells (19.7 cents /kWh)*
- *environmental cost of geothermal (1 cent/kWh) is about the same as solar cells (0.7 cents/kWh*
- *so geothermal is recommended as its cheaper than the other alternative, and has about the same environmental costs. This is in comparison to coal, which although fairly cheap, has very high environmental costs (9.6 cents/kWh)*

Nevertheless, in Part (b), candidates were generally able to posit factors EXCEPT cost that should be considered in implementing the switch from coal. However, some candidates missed the fact these reasons had to be **based on the form of renewable energy identified in (a) (ii).**

In Part (c), most candidates were able to identify relevant countries where geothermal energy would be a viable alternative (e.g. Grenada, St. Lucia, Dominica, St. Vincent and St. Kitts). Few were however able to adequately justify their choice, while some candidates actually performed an analysis of the options for replacing coal with geothermal energy as it pertained to other factors occurring in the country (e.g. utilizing the volcanic resource for ecotourism, accessibility of the resource, ability of the resource in the country to satisfy demand). This was exemplary and showed that some analysis went into the answer.

Question 6

Part (a) of this question was poorly done by the majority of the candidates. This was primarily because students had difficulty reading values correctly off the graph, and therefore the calculations derived from the graph were incorrect. **Candidates are asked to and should ensure that they equip themselves with rulers and other instruments when entering the examination room.**

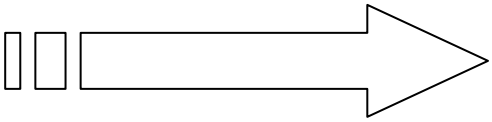
For Part (b), most candidates were able to identify positive and negative impacts of the use of nuclear power on the environment. However, many failed to develop and discuss these impacts.

Module 3 - Polution and the Environment

Question 7

This question was well done by the majority of the candidates. In Part (a) (i), however, many candidates were unable to rank the different waste types in INCREASING daily mass:

Textile; metal; other/glass; plastic; paper products; wood; yard and food waste



In Part (a) (ii), most candidates were able to identify and calculate the percentage waste type with the SMALLEST daily mass. However, there were candidates who had difficulty identifying the SMALLEST daily mass, and some merely identified the entity with the smallest mass but neglected to calculate the percentage.

Part (a) (iii) was generally well done, with most candidates being able to calculate the length of time required to dispose of 28 tonnes of waste. For Part a (iv), candidates suggested a diversity of reasons for the amount of metal being disposed being low. An example of an expected response is:

Metal is a valuable commodity that is recycled. It is sought extensively by landfill scavengers. Therefore metal would be low in waste in a landfill.

Generally, candidates were able to give an adequate definition for “lechate”, such as:

Leachate is the contaminated liquid formed by percolation of rainwater through the stored landfill waste.

They were also able to identify four pollutants EXCEPT leachate.

Part (c) of the question was exceedingly well done with the majority of candidates identifying the well that was MOST contaminated, and an explanation of how a pollutant can contaminate drinking water in that well. They were also able to explain why the other well was not contaminated.

Question 8

Candidates did fairly well on this question. For Part (a), most candidates were able to define the term "noise pollution". However, for Part (b) candidates had some difficulty in explaining why noise is considered a pollutant.

In Part (c) (i), most candidates could not identify what distance a homeowner had to be located from the fete, to ensure that he/she was not disturbed by the noise.

Based on the World Health Organisation (WHO) standard of 40 dBA for residential areas, the distance would be ***0.64 ± 0.01 km***

Most candidates were however able to identify ***0.24 ± 0.01 km*** as the distance a party-goer would have to walk before he began to experience a harmful noise level of 84 dBA

In Part (d), candidates readily identified measures to reduce noise pollution, but often had difficulty outlining how these measures could be used.

Question 9

This question tested the candidates' knowledge of the ozone layer, ozone depletion and the international legal regime pertaining to ozone depletion.

For Part (a), most candidates were able to identify at least two layers of the atmosphere, but had difficulty identifying the ozone layer on the diagram.

The ozone layer is between 17 to 26 km on the graph. **A single line or arrow is not enough, since the layer has a thickness. As such, candidates were expected to show this by using two lines to reflect the thickness of the layer and the region where the layer could be found.**

Most candidates could not identify 80 km as the altitude at which ozone concentration is lowest nor describe the relationship between 'ozone concentration' and 'altitude' in terms such as:

> *As altitude increases from 0 km to 10 km, ozone concentration decreases to a minimum at 10 km. From 10 km to 22 km, ozone concentration increases to a maximum at 22 km. After this, the ozone concentration decreases again with increasing height in the atmosphere to 80 km.*

In Part (b), most candidates could identify discussion points, but few were able to elaborate sufficiently on these points. As noted above, *one general point of note was that candidates had difficulty with questions that required some degree of explanation, that is, questions that asked the candidate to 'describe', 'explain', 'discuss', 'justify', 'evaluate', 'assess' and 'distinguish'.*

In Part (c), most candidates could identify the Montreal Protocol as the international treaty to protect the ozone layer and reduce ozone depletion, while only a few could comprehensively explain how the treaty worked.

The Internal Assessment

It is necessary to draw attention again to the fact that for Unit 2 there was a change in the requirements. This change is set out in the **AMENDMENT TO THE SYLLABUS IN ENVIRONMENTAL SCIENCE Effective for Examinations from May/June 2006, on the CXC website (www.cxc.org).** It is advisable that teachers and students access this document and familiarise themselves with the requirements.

The overall quality of the submissions for this Unit was good. In most instances an introduction to the journal was included. This was very useful in indicating the scope and purpose of the entries to the reader. This also helped to focus the candidate in making appropriate observations and interpretative comments. There was evidence of improvement in candidates' analysis and interpretation of results.

For the moderation process, it is important that teachers submit the mark schemes used for the laboratory exercises. These were missing in some instances.

The topics chosen for the journal were generally appropriate to the subject area and level of examination, but the topics were rarely stated. While there were some reports that were grossly simplistic, others displayed superficial treatment of the topic, whether stated or implied.

It was often difficult to determine how many of the journals and laboratory exercises were organized. Justification for site selection was rarely stated. In too many instances, the laboratory exercises were not related to the site visits, and, in some instances, the site visits were not related to each other; it is clear in the syllabus guidelines that these should be interrelated.

Interpretative comments in the journals needed more depth; this can be achieved by using the laboratory results to help explain field observations.

In general, scores in Unit 2 were higher than scores in Unit 1, perhaps because Unit 2 is more structured in terms of journal entries and laboratory exercises.

Laboratory Exercises

There was some overall improvement noted in the quality and relevance of laboratory exercises. In general, most candidates submitted an adequate number of laboratory exercises with satisfactory coverage of the criteria to be moderated. Only in a few instances were the spread of the laboratory exercises too narrow and the laboratory exercises chosen too simple for the level of examination.

While most candidates' work demonstrated adequate coverage of the skills to be assessed there is still room for improvement in the areas of manipulation and measurement and to a lesser extent analysis and interpretation.

The laboratory exercises were mostly well done, although many were not related to the site visits. One area that needs improvement in the laboratory exercises is observation and recording. While in most cases, results were recorded, very few had descriptions of the actual laboratory observations.

For Unit 2, it is important to note that laboratory exercises should relate to each or any of the series of site visits.

Journal

There was an overall improvement in the quality of journals submitted. The area of greatest improvement was reflected in candidates providing the required number of journal and laboratory entries. There were some candidates who were unable to link journal entries and laboratory exercises to specific objectives and conduct appropriate, complementary and supporting activities. Candidates should be reminded that the laboratory activities should be associated with the site visit and not treated as independent activities that are not related.

Candidates' inability to link objectives of site visits to the specific objectives in the syllabus resulted in many journals and laboratory activities reflecting objectives and activities related more to Unit 1 than to Unit 2. Candidates should always state and be guided by the specific objectives of the syllabus and the objectives for their journal activity. Candidates should always choose appropriate and adequate follow-up activities, present laboratory activities and journal entries in sequence and pay attention when writing chemical formulae for elements, compounds and ions.

There was improvement in the area of interpretative comments. This may be further improved if candidates develop the "habit of keen observation, relevant and precise reporting, concise recording and the ability for critical thinking, problem solving and decision making".

It cannot be overemphasised that the syllabus requires that journal entries should be based on either field visits to **one** site where changes over time are observed **OR** on visits to different sites to "compare and contrast similar processes or occurrences". In a few of the submissions, candidates visited different sites and so could not make valid comparisons since they examined different processes and occurrences and thus there was no basis for comparisons.

Paper 03/2

Generally, there was overall improvement in the depth and breadth of coverage with respect to certain areas of the syllabus. However, greater effort must be made by candidates to improve their ability to organise, apply and communicate information.

Question 1

Candidates were provided with some information and were asked to study the information and answer a number of questions which followed.

In Part (a), candidates were asked to state the name of the group of chemical pollutants that Guy could expect to find on his property.

In Part (b), candidates were asked to describe TWO environmental impacts that this group of chemical pollutants can cause.

In Part (c), candidates were provided with some additional information about results of the analyses of soil from Guy's gas station. Candidates were asked to make a conclusion about the level of contamination at Guy's Gas Station.

In Part (d), candidates were required to discuss whether the sampling scheme in Figure 1 would provide appropriate data for a conclusion to be made about the environmental quality of the site.

In Part (e), candidates were asked to design an alternative sampling scheme to determine the environmental quality of the soil at Guy's Gas Station. Candidates performed poorly on this part of the question. Most candidates were unable to present alternative sampling schemes that addressed all of the flaws identified in Part (d).

In Part (f), candidates were asked to explain how the new scheme they designed in Part (e) was better than the previous sampling scheme. The difficulty for most candidates was that they were unable to explain or show that the new scheme was better because it addressed all of the flaws in the previous scheme and showed how the new scheme provided enough data to make a decision on the environmental quality of the site.

Overall candidates' performance on this question was satisfactory.

Question 2

In Part (a) of this question, candidates were required to use the information provided for Question 2 to plot a suitable graph to display the data in Table 2. Candidates were then required to use the graph to determine what MAXIMUM concentration is observed at Sample Point 4 and to state at what depth the contaminant concentration first dropped to zero.

Part (b) required candidates to describe the trend shown in the graph while Part (c) required candidates to explain the trend observed in the data.

Part (d) required candidates to state THREE possible receptors for the contamination observed at Sample Point 4.

Overall candidates performed well on Part (a) and Part (b) of this question. Most candidates had difficulty with Part (d) of this question. Candidates did not outline adequately how the concentration of nitrates was responsible for the observed changes.

Question 3

Figure 2 presented the results of depth analyses of two other points on the site. In Part (a) of this question candidates were required to examine Figure 2 and determine how the MAXIMUM concentration levels varied among Sample Points 4, A and B. Candidates were required to say how the depths at which the MAXIMUM concentration levels occur varied among all THREE sample points.

In Part (b), candidates were required to use the data provided by all three depth analyses to determine the average depth of the excavation and estimate the volume of earth to be excavated in the remediation project.

In Part (c), candidates were required to suggest a strategy for disposal of the material excavated from Guy's Gas Station.

In Part (d) (i), candidates were required to suggest an alternative remediation strategy that could be used to clean up Guy's Gas Station. In Part (ii) candidates were required to compare excavation and soil replacement with the alternative remediation strategy that was proposed by the candidate in Part (d) (i).

Candidates performed well on Part (a) and Part (b) of this question. Candidates' performance was below expectation on Part (c), since most candidates did not demonstrate adequate knowledge of procedures and strategies for the disposal of materials which were excavated from the gas station.