CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE CARIBBEAN ADVANCED PROFICIENCY EXAMINATION MAY/JUNE 2008

ENVIRONMENTAL SCIENCE (TRINIDAD AND TOBAGO)

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CARIBBEAN ADVANCED PROFICIENCY EXAMINATION

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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 2 – Sustainable Agriculture, Sustainable Energy Use, and Pollution of the Environment. Both Units are examined by three papers. Papers 01 and 02 are external examinations, while Paper 03 is the Internal Assessment and is examined internally by the teacher and moderated by CXC.

Paper 01 consists of 12 compulsory, short-response questions with four questions based on the contents of each Module. Each Module contributes 30 marks to the total 90 marks for the paper. This paper contributes 30 per cent to the Unit.

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

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

This report addresses Unit 2 Paper 01, Paper 02 and Paper 03 written by candidates from Trinidad and Tobago.

GENERAL COMMENTS

UNIT 1

Only a few candidates demonstrated the breadth of knowledge necessary to perform well. There were many candidates whose responses were inadequate especially where they were required to infer relationships, distinguish between terms and explain interactions and interrelationships. In some instances candidates were unable to define terms correctly. Greater attention to basic principles is required.

DETAILED COMMENTS

PAPER 01

Module 1: Fundamental Ecological Principles

Question 1

In Part (a) of this question, candidates were required to define 'biotic community', 'population' and 'species'. In Part (b), candidates were required to outline one type of interaction that occurs among members of the fish population in a lake.

Candidates' performance in this question was satisfactory. A few candidates had difficulty defining the terms. Most candidates were able to identify and outline one type of interaction that occurs among members of the fish population. More than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks.

Note:
A biotic community refers to populations of plants, animals and micro-organisms living and interacting in a given area, at a given time.

A population refers to a group of organisms of the same species living and interacting in a given area.

A species refers to a set of organisms with similar genetic characteristics which can interbreed and produce living, viable, fertile offspring.

Question 2

This question tested candidates' understanding of the processes occurring in the carbon cycle, the biological importance of the carbon cycle and reservoirs of carbon in the carbon cycle.

Candidates' performance in this question was good.

In Part (a), most candidates were able to identify the processes occurring in the carbon cycle correctly but in Part (b), most candidates had difficulty stating the biological importance of the cycle. In Part (c), most candidates were able to name two reservoirs of carbon in the cycle.

More than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks.

Question 3

Figure 2 represented a simplified food chain in a flooded rice field. In Part (a), candidates were required to state the initial source of energy for this food chain, name the process by which energy is incorporated into this food chain and state two reasons why only a small percentage of the energy absorbed by Species A is incorporated into the tissues of Species C. Candidates were also required to state one implication of the inefficient transfer of energy. In Part (b), candidates were required to state two ways in which the energy flow in the rice field is similar to those of a natural forest ecosystem.

Candidates' performance was less than expected. Less than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks.

Candidates struggled to state two reasons why only a small percentage of the energy absorbed by Species A is incorporated into the tissues of Species B. Candidates also had difficulty in outlining one implication of the inefficient transfer of energy.

Note that a small percentage of the energy absorbed is incorporated because:

- *Energy is lost through metabolic processes.*
- *Not all organisms at a trophic level are eaten.*
- *Not all of the material that is eaten is digested.*

As a result, the number and biomass of organisms will decrease at each trophic level because there is less energy available to support greater numbers and biomass.

Question 4

Figure 3 in this question showed the growth curve of a population of yeast cells in a laboratory culture.

Part (a) of this question required candidates to identify the type of population growth curve that was represented in Figure 3. In Part (b), candidates were required to state two conditions under which a population exhibits the type of growth illustrated in Figure 3. In Part (c), candidates were required to explain how population will change if the carrying capacity is exceeded.

Candidates' performance was poor. Less than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks.

Candidates did very well on Part (a) and Part (b). Most candidates had difficulty with Part (c) when they attempted to explain how the population will change if the carrying capacity is exceeded.

Note:
If the carrying capacity is exceeded

- *Limiting factors will begin to operate and influence the health and status of the population.*
- *The rate of population increase will be affected as population numbers will increase more slowly or even decrease.*
- *The population will experience a 'crash' or 'dieback'.*

Module 2: People and the Environment

Question 5

This question was designed to test candidates' ability to

(i) state the meaning of 'replacement level fertility rate' in Part (a)
(ii) calculate the percentage of the population in the pre-reproductive years in Part (b)
(iii) predict how the population is likely to grow over the next ten years in Part (c).

Candidates' performance in this question was below expectation. Less than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks.

For Part (a), the responses suggested that candidates did not understand the meaning of 'replacement level fertility rate'. For Parts (b) and (c), many candidates had difficulty calculating the percentage of population in the pre-reproductive years and predicting how the population is likely to grow over the next ten years.

Note:
The replacement level fertility rate refers to the number of children a couple must have to replace themselves.

Question 6

Candidates were presented with a graph that showed the percentage of urban population in relation to the total population in four Caribbean countries. Part (a) tested candidates' understanding of population distribution between urban and rural areas. In Part (b), candidates were asked to give three reasons why population growth results in the type of population distribution illustrated in the graph. In Part (c), candidates were expected to outline two environmental impacts associated with the type of population distribution that was illustrated.

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

Question 7

Candidates were provided with Table 1 that showed 'per capita CO_2 emissions'. In Part (a), candidates were required to define 'per capita CO_2 emission'. In Part (b), candidates were expected to suggest a reason for the difference in per capita CO_2 emission' of Country A and Country B. In Part (c), candidates were expected to use data from Table 1 to deduce for which country the population has a greater negative impact on the environment and provide justification for their answers..

In Part (a), candidates had difficulty defining 'per capita CO_2 emissions'. Parts (b) and (c) of this question were also poorly done by candidates. Overall, candidates' performance in this question was below expectation. Less than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks.

Note:
'*Per capita carbon dioxide emissions' refers to the quantity of released carbon dioxide that is attributable to each individual in a population.*

Question 8

Figure 6 showed infant mortality rates in 2002 for two groups of countries. In Part (a), candidates were required to define 'infant mortality rate'. In Part (b), candidates were asked to identify the group of countries in Figure 6 with the average lower population growth rate in 2002. In Part (c), candidates were required to give two reasons why the group of countries identified in Part (b) had the lower population growth rate.

Only a few candidates defined 'infant mortality rate' correctly. Overall, candidates' performance in this question was below expectation. Less than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks. .

Note:
Infant mortality rate is the number of infant deaths per 1000 live births in the population.

Module 3: Sustainable Use of Natural Resources

Question 9

In Part (a), candidates were required to name two major natural resources (except) forest found in Caribbean territories and give two reasons why the resources identified are considered natural

resources. In Part (b) candidates were required to state two ways in which the resources identified in Part (a) are important to Caribbean countries. Part (c) required candidates to state two environmental impacts that result from the extraction and use of forest resources.

Candidates' performance in this question was excellent. Candidates who correctly identified major natural resources in Caribbean territories were able to give correct reasons why they are considered natural resources and also were able to state reasons for their importance to Caribbean countries. Candidates were also able to state satisfactorily two environmental impacts resulting from the extraction and use of forest resources.

Question 10

Candidates were provided with Figure 7 that showed the effect on the daily fish catch of increased harvesting of flying fish stocks.

In Part (a), candidates were required to explain what is meant by the term 'Maximum Sustainable Yield (MSY) in relation to the harvesting of the stock of flying fish. Part (b) required candidates to suggest two reasons why it is best to harvest fish stocks at the Point A shown in
Figure 7. In Part (c), candidates were required to outline two environmental impacts of over-harvesting flying fish stocks.

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

Question 11

Part (a) of this question examined students' knowledge and understanding of what is meant by 'restoration of natural resources' and 'rehabilitation of natural resources'. In Part (b), candidates were required to outline one way in which demographic factors can influence the use of natural resources.

Candidates' performance on this item was below expectation. Candidates had difficulty distinguishing between 'restoration of natural resources' and 'rehabilitation of natural resources'. Few candidates were able to outline ONE way in which demographic factors can influence the use of natural resources.

Less than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks.

Note:
Restoration – is bringing back the natural resource to a former condition. It involves the active manipulation of nature to recreate species diversity and ecosystem processes as close as possible to the state that existed before human disturbance.

Rehabilitation – is the rebuilding of structure and function in an ecological system without achieving complete restoration to its original state. It is the reversal of the deterioration of a resource, even if it cannot be fully restored, and the bringing back of an area to a useful state for human purposes rather than a truly natural state.

Question 12

Candidates were required to outline how the economic instruments, user fees, greening of national budgets, incentives, and penalties and environmental taxes can be used as conservation tools.

Candidates' performance on this question was good.

PAPER 02

Module 1: Fundamental Ecological Principles

Question 1

This question tested candidates' understanding of non-native species and the impacts caused to ecosystems by the introduction of non-native species. Part (d) required candidates to explain the role of natural selection in the adaptation of species to their natural environment.

Most candidates correctly identified non-native species and were able to explain why non-native species may be successful in new environments. Candidates were able to outline impacts on the ecosystem that may result from the introduction of non-native species. However, they had difficulty in explaining the role of natural selection in the adaptation of species to their natural environment.

Overall, more than 50 per cent of candidates achieved a satisfactory score on this question.

Question 2

This question tested candidates' understanding of the relationship between ecosystem stability and species diversity. In Part (a) of this question, candidates were able to correctly define the term 'ecosystem' but most candidates had difficulty defining the terms 'ecosystem stability' and 'ecosystem diversity'.

Note:
Ecosystem stability refers to the

- *ability of biological communities to remain relatively stable and constant over time*
- *constancy or lack of fluctuations in composition or function of an ecosystem*
- *ability of an ecosystem to resist perturbations*
- *ability of an ecosystem to repair damage after disturbance.*

Ecosystem diversity refers to the number and relative abundance of a species in a community.

In Part (b), most candidates correctly stated which ecosystem had the greatest species diversity and gave correct reasons to support their answers.

Candidates had difficulty with Part (c) and most failed to explain correctly how species diversity can influence ecosystem stability.

Note:
Since ecosystem stability increases as species diversity increases, the highest Ecosystem Stability Index (ESI) would be associated with the greatest species diversity.

Overall candidates' performance on this question was poor.

Question 3

This question tested candidates' understanding of the process of cycling of matter through an ecosystem. In Part (a), candidates were required to name two decomposers and state one source of energy for each and explain the importance of the decomposer food chain in the cycling of matter. In Part (b), candidates were asked to state two benefits of natural ecosystems to humans and describe two ways in which humans can disrupt the integrity of natural ecosystems.

Candidates exhibited satisfactory performance in all parts of this question.

Module 2: People and the Environment

Question 4

This question focused on sustainable development and the impact of fertility rates.

Most candidates demonstrated satisfactory understanding of the concept of sustainable development but had difficulty explaining how high fertility rates impact on a country's ability to achieve sustainable development.

Candidates demonstrated good knowledge of measures of population control and were able to respond satisfactorily.

Question 5

Candidates were presented with a Table with data on world population numbers in 1990 and the estimated numbers in 2020.

Part (a) of this question required candidates to calculate the percentage growth in world population attributable to Less Developed Countries between 1990 and 2020. Most candidates did not calculate this correctly.

Part (b) required candidates to explain why this estimated growth in the population of Less Developed Countries should be a cause for concern. This part of the question was done poorly as most candidates either did not understand or failed to grasp why the estimated growth in LDCs should be a cause for concern.

In Part (c), candidates were required to describe one environmental impact associated with the trend in world population growth calculated in 5 (a). Part (d) was designed to allow candidates to suggest an approach to mitigate the environmental impact described in Part (c).

Part (c) and Part (d) were done in a satisfactory manner. Candidates were able to describe an environmental impact associated with the trend of population growth and suggest an approach to mitigate the environmental impact.

Question 6

Part (a) of this question was designed to test candidates' understanding of how culture and religion impact on the rate of growth of a population. Most candidates were knowledgeable about this topic.

Candidates were required, in Part (b), to use the information on Human Development Index (HDI) presented in Table 3 to make three deductions regarding the relative achievement of both countries.

In Part (c), candidates were required to evaluate the statement "the education of women is critical to lowering the population growth rate of Less Developed Countries". They were required to include at least six points in their response.

Part (b) and Part (c) posed a greater challenge to candidates. Candidates did not demonstrate adequate knowledge and understanding of the Human Development Index and so had difficulty deducing relevant information from the Table. Candidates also experienced difficulties in evaluating the statement that was given and in many instances candidates failed to present enough (six) reasons to support the position taken.

Overall, candidates' performance on this question was below expectation and less than 50% of candidates achieved a satisfactory score on this question.

Module 3: Sustainable Use of Natural Resources

Question 7

Candidates' knowledge and understanding of the functions and importance of coral reefs in the Caribbean was tested in this question. In Part (a), candidates were required to describe two functions of coral reef ecosystems in the Caribbean.

In Part (b), candidates were required to explain how any two human activities impact on coral reef ecosystems in the Caribbean.

Part (c) of this question required candidates to describe two methods for conserving coral reef ecosystems in the Caribbean.

Candidates' demonstrated very good knowledge and understanding of the issues related to coral reefs and human impacts in the Caribbean. This question was done very well by candidates. Overall, more than 50% of candidates achieved a satisfactory score.

Question 8

Candidates were tested on their understanding of the concepts of 'consumptive use', 'non-consumptive use' and 'bioprospecting' regarding natural resources.

In Part (a), candidates were required to use the data showing how quantities of two natural resources, A and B, changed over a ten-year period, to identify the resource which is non-renewable and provide justification for their responses.

In Part (b) candidates were required to use suitable examples to distinguish between 'consumptive' and 'non-consumptive' use of natural resources. In Part (c) candidates were required to explain why bioprospecting is considered a non-consumptive use of natural resources.

Candidates demonstrated limited understanding of the concepts tested. Most candidates were unable to interpret the graphical data in order to identify the non-renewable resource and provide a justification for their response. Candidates also found it challenging to explain why bioprospecting is considered a non-consumptive use of natural resources.

Note:
Consumptive use of natural resources refers to use of natural resources in which these resources are utilised and removed from their natural environment. Once used, they are no longer available for use by another person, for example, catching fish for food, limestone for construction and timber harvested for construction.

Non-consumptive use refers to the type of use of natural resources which does not require that the resources be removed from their natural environment or location. These resources are not consumed and so are available for use by another person. For example, use of forest resources for ecotourism, use of coral reefs for snorkelling and diving recreation activities and use of aquatic environments for swimming.

'Bioprospecting' is the use of natural biological resources to extract beneficial chemicals for use in medical and other industries. In bioprospecting only small quantities of the resource is extracted

from the natural environment. Since only small quantities are extracted this does not adversely affect the ability of the resource to replenish itself. Enough quantities of the resource are left for other uses. Hence since bioprospecting does not prevent the natural replenishment of the resource it is considered a non-consumptive use.

Overall candidates' performance was below expectation.

Question 9

Candidates' knowledge and understanding of protected areas and the International Union for the Conservation of Nature (IUCN) classification of protected areas was tested.

In Part (a), candidates were required to identify TWO categories of protected areas as classified by the IUCN.

In Part (b) candidates were required to state the purpose and main feature of each category identified and Part (c) to explain how protected areas promote natural resource conservation.

In Part (d), candidates were required to assess the effectiveness of protected areas in conserving natural resources in the Caribbean. They were required to include three issues associated with the implementation and operation of protected areas.

Candidates' performance on this question was satisfactory. While most candidates were aware of Protected Areas in a general sense, they were unable to identify the specific feature and purpose for the different categories. Candidates did not demonstrate adequate knowledge and understanding to explain how Protected Areas promote natural resource conservation and therefore had difficulty in assessing the effectiveness in conserving natural resources in the Caribbean.

THE INTERNAL ASSESSMENT

Some important features of the Internal Assessment are summarised in 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 are assessed for the Internal Assessment for **each** Unit:

(i) Collection and collation of data;
(ii) Analysis, interpretation and presentation of such data;
(iii) Selection of techniques, designs, methodologies and instruments appropriate to different environmental situations;
(iv) Development of appropriate models as possible solutions to specific environmental problems."

In general, the required criteria were applied effectively.

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

A reminder for teachers: The criteria at the bottom of the Moderation Sheet **must** be applied when recording and distributing marks to the three Modules. When there is a remainder of one, the mark must be allocated to Module 3. A remainder of two marks, one mark must be 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

Improvement was noted in the quality of the assignments submitted. In general, the required criteria for this component were effectively applied. Literature review is still an area of concern in many of the pieces submitted. In these cases, the literature review is either irrelevant or inadequate. There is an immediate need for candidates to improve their writing. This severely affects the quality of the report and at times is not indicative of the CAPE level.

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.
- Projects chosen should be relevant to Unit 1. This was not so in a few cases.
- The purpose of the project should be clearly outlined and the variables should be clearly defined.
- Data collection is 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 result.
- 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 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 03B

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 and apply knowledge.

Question 1

In Part (a), candidates were expected to use the information provided to plot an appropriate graph to show the variation in the lizard population from 1996 to 2005.

In Part (b), candidates were asked to describe how the lizard population varied over the ten-year period.

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

Question 2

This question was designed to test candidates' understanding of the mark-release-recapture method of population sampling that was used to collect the date that was presented.

Parts (a), (b) and (c) related to the actual procedure for the mark-release recapture method and the assumptions made in estimating population size.

Part (d) focused on a monitoring plan for tracking a lizard population

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

Question 3

In Part (a), candidates were required to discuss three conservation strategies that could be implemented to ensure the viability of the lizard population. Candidates were expected to indicate why the strategies chosen were appropriate.

In Part (b), candidates were asked to outline two environmental impacts caused by the operation of the forest concession that would need to be addressed in a rehabilitation programme.

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

DETAILED COMMENTS

PAPER 01

Module 1: Sustainable Agriculture

Question 1

Candidates were required to define the term 'agriculture' and to list three characteristics of commercial farming.

This question was done very well by the majority of candidates.

Question 2

Part (a) of this question assessed candidates' knowledge of the features of agroforestry and Part (b) assessed candidates' knowledge of the reasons why agroforestry is considered a feasible and sustainable agricultural practice.

Candidates' performance on this question was satisfactory. More than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks.

Note:
Agroforestry is a farming system that integrates crops and/or livestock with trees and shrubs. It provides numerous benefits such as increased biological production, better water quality and improved habitat for both humans and wildlife. It provides increased economic stability to farmers by diversifying their income sources. It integrates crops, trees and livestock which results in biological interactions that provide multiple benefits and prevents soil erosion.

Question 3

This question examined candidates' understanding of environmentally sustainable agricultural practices. In Part (a), candidates were asked to study the figure presented and identify the sustainable agricultural practice that was shown. Candidates were asked to outline two steps involved in the sustainable practice and state two reasons why this agriculture practice is considered to be environmentally sustainable.

In Part (b), candidates were asked to complete a table showing some post-harvest management practices in agricultural systems and the associated benefits of these practices.

Candidates' responses to Part (a) of this question were satisfactory. However, too few candidates demonstrated satisfactory knowledge of post-harvest management practices and benefits.

Question 4

This question examined candidates' understanding of the ways in which agriculture contributes to the economy of Caribbean countries.

Candidates demonstrated a good understanding of this topic.

More than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks.

Module 2: Sustainable Energy Use

Question 5

This question examined candidates' knowledge and understanding of the environmental costs associated with the use of fossil fuels to generate electricity. Candidates were required to identify and outline two ecological costs and one social cost.

Candidates' performance in this question was below expectation. Less than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks.

Note:
In examining the environmental costs, it is necessary to consider the environmental impacts associated with the exploration of fossils fuels and also the use of fossils in the electricity generation process.

Question 6

Part (a) tested candidates' knowledge of energy conversion occurring at different stages of the generation of electricity.

Part (b) required candidates to explain why energy conversion processes have low efficiencies.

Candidates' performance in this question was good.

For Part (a), most candidates were able to distinguish between the type of energy conversion occurring. For Part (b), most candidates were able to explain why energy conversion processes have low efficiencies.

Note:
In all energy conversion processes, some amount of the energy is converted into heat which is generally lost to the environment if steps are not taken to capture it. This is usually a substantial proportion of the energy hence the efficiency of conversion is substantially less than 100 per cent.

Question 7

In Part (a), candidates were asked to distinguish between a 'nuclear fission reaction' and a 'nuclear fusion reaction'. In Part (b), candidates were tested on their knowledge of the structure and functions of the parts of a nuclear reactor. In Part (c), candidates were asked to outline on advantage and one disadvantage of nuclear power plants over conventional power plants.

Candidates' performance in this question was satisfactory.

Question 8

Part (a) of this question tested candidates' understanding of 'active use of solar energy' and 'passive use of solar energy'. Candidates' performance on this part was below expectation. Part (b) of this question required candidates to outline two disadvantages of using solar energy. Candidates' performance on this part of the question was satisfactory.

Note:
Active solar energy systems use solar collectors and additional electricity to power pumps or fans to distribute the sun's energy. In passive solar energy systems, no additional mechanical equipment is used to utilize the suns' energy.

Passive solar heating is a system of putting the sun's energy to use without requiring mechanical devices to distribute the collected heat.

Active solar heating is a system of putting the sun's energy to use in which a series of collectors absorb the solar energy, and pumps or fans distribute the collected heat.

Module 3: Pollution of the Environment

Question 9

Candidates were required to define pollution in Part (a) of this question. In Part (b), candidates were presented with data showing some characteristics of three pesticides. Candidates were required to study the data and identify, with reasons, which of the pesticides would most likely continue to pollute groundwater supplies up to a year after the application.

This question was done satisfactorily by candidates. In Part (a), most candidates defined 'pollutant' rather than 'pollution'.

Note:
Pollution is any chemical or physical change in the environment that is harmful to the environment, humans or other organisms.

Candidates demonstrated satisfactory understanding of how the characteristics of pesticides influence their environmental impact. More than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks.

Question 10

This question tested candidates' knowledge of primary air pollutants and greenhouse gases in Part (a). Part (b) tested candidates' understanding of global warming. Part (c) required candidates to suggest a reason why a device for monitoring background levels of air pollutants is located in a rural, undeveloped area. Many candidates had difficulty distinguishing between global warming and ozone depletion.

Candidates performed poorly on Part (c) of this question.

Note:
There are no major sources of air pollutants in rural areas because of little traffic and/or the absence of factories and industries. Hence the level of pollution will be minimal in these rural areas.

Question 11

Candidates were required to identify two sources of land pollution in Part (a). In Part (b), candidates were required to describe the environmental impact of pollution from one of the sources identified in Part (a). In Part (c), candidates were asked to consider the statement "the Kyoto Protocol will fail to make a significant impact on future global warming". Too few candidates demonstrated any significant knowledge of the Kyoto Protocol and so many candidates were unable to effectively suggest a reason for the belief expressed in the statement.

Less than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks.

Question 12

Part (a) of this question required candidates to draw a fully labelled diagram of a landfill for storing hazardous waste.

Candidates performed poorly on Part (b). Too few candidates were able to draw the required diagram and fewer still were able to describe two pathways whereby hazardous material from a landfill can be transported and the impact on receptors in the environment.

Less than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks.

Note:
The diagram drawn should have included the following components:

- *Heavy clay geology*
- *Waterproof liner*
- *Leachate control system*
- *Gas emission control system*

Note:
There are abiotic and biotic pathways.
Leaks and leachate from the landfill's contents could percolate downwards through the soil. Contaminant can then get into aquifers and hence into drinking water wells, rivers and the sea.

Gaseous emissions from volatile components or biological decay components can escape to landfill and be carried in the air. Organisms would then be exposed to gaseous contaminants or they may dissolve in rain and fall back to the earth.

UNIT 2

PAPER 02

Generally the performance of candidates was less than satisfactory and only a few candidates demonstrated the breadth of knowledge necessary to perform well. There were many candidates whose responses were inadequate. In too many cases, candidates were unable to define terms, distinguish between terms, explain and infer relationships. Greater attention to basic principles is also required. Too few candidates have demonstrated the higher order cognitive skills.

Module I: Sustainable Agriculture

Question 1

This question tested candidates' ability to interpret graphical data and analyse the impact of using inorganic and organic fertilisers.

Part (a) was well done with the majority of candidates stating the required four deductions that could be made about the agricultural yield from the farm. Part (b) was also well done with the majority of candidates being able to distinguish between 'organic' and 'inorganic' fertilisers.

Similarly, many candidates adequately discussed why in-spite of the trend shown by the graph, farmers are still being encouraged to increase their use of organic fertilisers in preference to inorganic fertilisers. Candidates who did not include six points in their response were not awarded full marks for Part (c) of this question. Candidates' performance in this question was satisfactory. More than 50 per cent of candidates scored 50 per cent or more of the available marks.

Question 2

This question tested candidates' ability to interpret graphical data and analyse the contributions made by subsistence and commercial agriculture to the gross domestic product (GDP), employment and foreign exchange earnings in Country A.

Part (a) was well done with the majority of candidates adequately commenting on the contributions of subsistence and commercial agriculture to the gross domestic product (GDP), employment and foreign exchange earnings in Country A. Part (b) was done satisfactorily with most candidates being able to describe how mechanization accounts for the differences in the contributions as shown in the figure presented.

Candidates were able to describe satisfactorily one feature of sustainable agriculture in Part (c). Overall candidates' performance in this question was good.

The more able candidates scored more than 50 per cent of the available marks.

Question 3

In Part (a), candidates were required to explain, using six points, why the officer told residents that their farming practices were responsible for the increased cases of soil erosion and water quality degradation.

In Part (b), candidates were required to justify, using six points, why farmers were advised to practise crop rotation in an effort to improve yields and reduce the problems caused by pest infestation.

In Part (c), candidates were able to name one soil conservation method that is appropriate for the farmers of Toco Village to describe the method while stating the role it plays in soil conservation and in Part (d), to outline two features of no-tillage farming and the reason why no-tillage farming is effective in reducing soil erosion.

Candidates' performance on this question was satisfactory. More than 50 per cent of candidates who attempted this question earned a score greater than 50 per cent of the available marks.

Module 2: Sustainable Energy Use

Question 4

This question tested candidates' ability to interpret graphical data.

In Part (a), candidates were asked to list the types of fossil fuels and outline the formation of fossil fuels.

Part (b) required candidates to compare the annual consumption of fossil fuel in 1990 with consumption in 2000 and consumption in 2000 with that in 2003.

In Part (c), candidates were required to use an appropriate example and outline the meaning of 'demand management' in relation to energy use and explain how demand management can mitigate the impacts of fossil fuel consumption.

Candidates' performance on this question was below expectation. Less than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks.

Question 5

This question tested candidates' knowledge of the generation of electricity from hydroelectric sources.

In Part (a), candidates were required to describe the energy conversion process occurring in the hydroelectric power plant, and to make clear the meaning of the terms 'potential energy' and 'kinetic energy'.

Part (b) required candidates to state two advantages and two disadvantages of hydroelectric power generation. Candidates answered this part of the question satisfactorily.

Few candidates were able to assess the suitability of hydroelectricity and solar energy to meet adequately the energy needs of developing countries in Part (c). Candidates' responses were poor.

Question 6

This question assessed candidates' understanding and knowledge of 'energy efficiency' and 'energy conservation'.

Candidates' performance in this question was below expectations.

Few candidates correctly interpreted what is meant by 'power rating of 60W' and 'efficiency of 5 per cent'.

In Part (b), candidates were required to outline two advantages of energy conservation.

Part (c) of this question tested candidates' understanding and knowledge of the concept of 'cogeneration'. Too few candidates were able to say what is meant by cogeneration, outline how it is achieved and to comment on the appropriateness of cogeneration systems for use in Caribbean countries.

Candidates were expected to explain how improving energy efficiency mitigates (reduces) environmental impacts resulting from energy use.

The majority of candidates were unable to correctly state the meaning of the terms.

Candidates' performance on this question was less than expected.

Module 3: Pollution of the Environment

Question 7

This question tested candidates' ability to interpret data presented in tabular form. Candidates were also tested on their knowledge of the environmental pathways of pollutants.

Candidates' performance on this question was poor. In Part (a) most candidates correctly stated four inferences from the data given.

In Part (b), there were many candidates who could not correctly outline two environmental pathways of the pesticide.

In Part (c), few candidates were able to account for the difference in dieldrin concentration in the organisms indicated in the Table. Candidates were required to include three points in their responses. Most candidates provided less than three points.

In Part (d), candidates were required to describe two characteristics of pesticides that account for their environmental impact.

Candidates' performance on this question was poor.

Question 8

This question tested candidates' ability to interpret graphical data.

In Part (a), candidates were required to study the diagram and state two major changes in the composition of solid waste between 1998 and 2007 and state the environmental significance of one of the changes.

Part (b) required candidates to suggest two reasons for the change in the composition of solid waste between 1998 and 2007 and Part (c) to explain why it is necessary to minimise the amount of solid waste produced in Caribbean countries.

Part (d) tested candidates' understanding of recycling and the effectiveness of recycling programmes for the Caribbean.

Candidates performed very well on this question.

Question 9

This question tested candidates' ability to interpret graphical data showing the variation in biological oxygen demand (BOD and dissolved oxygen (DO) concentration with distance from a reference point established to monitor the water quality of a river.

Most candidates correctly stated what information is provided by the BOD of a water sample and identified the type of water pollution source impacting on the river.

Few candidates were able to outline the laboratory process for determining BOD and to account for the change in the DO concentration along the river.

Too few candidates identified and justified their choice of distance from the reference point where it is likely that dead fish will be found floating in the river.

Overall, this question was done poorly by those candidates who attempted it.

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 outlined in an **AMMENDMENT TO THE SYLLABUS IN ENVIRONMENTAL SCIENCE Effective for Examinations from May/June 2006, on the CXC website (www.cxc.org).** It is recommendable that, where necessary, teachers and students access this document and familiarise themselves with the new 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.

It was apparent in some cases that there was some difficulty in finding appropriate tasks for the laboratory exercises. This was reflected in some activities being too simple and a few reflecting the standard and level of advanced proficiency.

There was significant improvement in candidates' analysis and interpretation of results.

Very few candidates failed to submit the required minimum number of pieces for the laboratory report and the journal entries.
For the moderation process, it is important that teachers submit mark schemes used for the laboratory exercises. These were missing in many instances. In some instances the total scores provided on the moderation sheet were inaccurate and not distributed according to the syllabus guidelines.

LABORATORY EXERCISES

Significant improvement was noted in the overall 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 the work of most candidates 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.

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

Journal

Overall, there was 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 able to link journal entries and laboratory exercises to specific objectives and conduct appropriate, complementary and supporting activities. Teachers and candidates are reminded that the laboratory activities should be associated with the site visits and not treated as independent activities that are not related.

As a result of objectives of site visits not being linked to the specific objectives in the syllabus, some journals and laboratory activities reflected objectives and activities that 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, pay attention when writing accurately chemical formulae for elements, compounds and ions.

There was improvement in the area of interpretative comments. However, there is room for further improvement. 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.

UNIT 2

PAPER 03B

Generally candidates' performance on this paper was below expectation. Again the number of entries was exceptionally small. There was not much overall improvement in the depth and breadth of coverage with respect to certain areas of the syllabus. Greater effort must be by candidates to improve their ability to organise and apply knowledge.

<u>Question 1</u>

Candidates were expected to use the information provided to plot an appropriate graph to show the annual cabbage yield and the quantity of fertiliser applied annually; to outline the relationship between annual cabbage yield and annual fertiliser input in Part (b); to calculate the mean annual nitrate concentration of the Mango River for the years 1995 to 2004 in Part (c); and to make inference regarding the impact of the activities of Green Thumb Farms on the Mango River.

Candidates performed satisfactorily on this question. Candidates demonstrated the ability to use information to plot graphs and then discuss trends shown by the graph.

Question 2

Candidates were required to explain why it is important for the investigation that nitrate concentration data for the river before 1994 be examined; to explain how the changing nitrate concentration impacts on the river ecosystem and the community of Carlings Town and to say how the clarity of the water of the Mangro River is expected to change between 1990 and 2004. Candidates were required to identify the parameter that is used to measure the clarity of the water, explain how the parameter affects the clarity of water and state a unit used to measure the clarity of water.

Overall, candidates performed poorly on this question.

Question 3

In this question, the management of Green Thumb Farms insisted that, based on its location, the activities at the farm are unlikely to cause pollution of the Mango River.

Candidates were asked to state whether or not they agreed with the position of the farm's management and to suggest a reason for the change in the fertility of the farm lands from 1994 to 2004.

Candidates were required to recommend to the management of Green Thumb Farms one method of improving the fertility of the farm while decreasing the impact of farming activities on the river.

Their performance was below expectation on all parts of this question.