

CARIBBEAN EXAMINATIONS COUNCIL

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

**ENVIRONMENTAL SCIENCE
(REGION EXCLUDING TRINIDAD AND TOBAGO)**

ENVIRONMENTAL SCIENCE
CARIBBEAN ADVANCED PROFICIENCY EXAMINATION

MAY/JUNE 2008

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.

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. 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. This paper contributes 40 percent 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 II is examined by a journal comprising site visits and laboratory exercises.

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 dealt with the carbon cycle and 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 carbon cycle. In Part (c), most candidates were able to name two reservoirs of carbon in the carbon 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 weaker 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) 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 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 presented with Table 1 that showed 'per capita CO₂ emissions'. In Part (a), candidates were required to define 'per capita CO₂ emission'. In Part (b), candidates were expected to suggest a reason for the difference in per capita CO₂ 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 a justification for the answer provided.

In Part (a), candidates had difficulty defining 'per capita CO₂ emissions'. Parts (b) and (c) of this question were also poorly done. 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 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 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. .

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 presented 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 candidates’ 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 expectations. 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), 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 a correct reason to support their answer.

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 (LDCs) 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 Question 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 the (six) reasons required 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, and in Part (c) 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 very well done 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 a justification for their response.

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 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, bioprospecting does not prevent the natural replenishment of the resources and is considered a non-consumptive use.

Overall candidates' performance was below expectation.

Question 9

Candidates' knowledge and understanding of protected areas and of 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.

Candidates were required to state the purpose and main feature of each category identified and to explain how protected areas promote natural resource conservation. Both of these parts were done satisfactorily.

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 features 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 (IA) are summarised in the paragraph below.

“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) 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 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 such candidates to improve their writing and expression skills. 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 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 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.
- 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 and demonstrated an understanding of drawing graphs and reading information from graphs.

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 data that was presented. Candidates were expected to:

- (a) State why the mark-release-recapture method was suitable for population monitoring of lizard populations.
- (b) Outline the procedure for undertaking the mark-release-recapture method.
- (c) State two assumptions that must be made when using the mark-release-recapture method for when estimating population size.
- (d) Describe four steps of a monitoring plan to track lizard population. Candidates were asked to state one objective for each step of the monitoring plan.

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 result from forest operations.

UNIT 2**DETAILED COMMENTS****PAPER 01****Module 1: Sustainable Agriculture**Question 1

Candidates were required to define the term 'agriculture' and compare commercial farming with subsistence farming. In Part (c), candidates were required to demonstrate their understanding of the factors that have contributed to sugar cane being a major crop in the Caribbean.

This question was done well by the majority of candidates.

Question 2

This question assessed candidates' knowledge of environmental issues associated with the practice of monoculture cropping in the Caribbean. Candidates were required to recommend alternative sustainable practices to address environmental concerns associated with monoculture.

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

Question 3

This question examined candidates' understanding of the features of environmentally sustainable practices. Candidates were asked to outline one reason why certain specified agricultural practices were considered to be environmentally sustainable.

Candidates' responses to this question were satisfactory.

Question 4

Candidates were asked to outline the role of agriculture in the Caribbean in the production of food and non-food materials, employment generation and foreign exchange earnings.

Candidates demonstrated a good understanding of the role of agriculture in the Caribbean. 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

Candidates were required to define the unit 'kilowatt-hour' in Part (a). In Part (b), candidates were expected to use the information presented in Table 3 to state which energy source is most efficient for generating electricity. Candidates were required to identify costs to society associated with the use of the fuel source identified in Part (b) and explain how the cost to society occurs.

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:

A kilowatt-hour is the amount of energy consumed in one hour if the rate of energy used is 1000 watt per second.

Question 6

Part (a) required candidates to distinguish between 'kinetic energy' and 'potential energy'.

Part (b) tested candidates' understanding of how kinetic energy and potential energy are utilised in the generation of electrical energy in a tidal power plant.

In Part (c), candidates were asked to state one environmental advantage of the energy conversion occurring in a tidal power plant.

Candidates' performance in this question was good.

Most candidates were able to distinguish between 'kinetic energy' and 'potential energy' and describe how each type of energy is utilised in the generation of electrical energy in the tidal power plant. Candidates were also knowledgeable of the environmental advantages of energy conversion occurring in a tidal power plant.

Question 7

This question tested candidates' ability to interpret graphical data and outline consequences of the changes in oil prices to non-oil producing Caribbean countries. Part (c) of this question required candidates to describe one way in which non-oil producing Caribbean countries could respond to the high oil prices.

Candidates' performance in this question was satisfactory.

Question 8

This question tested candidates' understanding of the concept and features of energy-efficient buildings.

Candidates' performance on this question was satisfactory. Candidates demonstrated a good understanding of the concept of energy efficiency and energy-efficient buildings.

Module 3: Pollution of the EnvironmentQuestion 9

This question examined candidates' comprehension of how the characteristics of chemicals influence their environmental impact.

This question was done well by candidates.

Candidates demonstrated a very good understanding of the how the characteristics of chemicals 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 the causes of pollution. Candidates were required to complete the given table by stating a specific related activity, the name of the pollutant and the resulting environmental impact for each cause of pollution identified in the table. Candidates performed very well on this question.

Question 11

This item examined candidates' knowledge and understanding of the concepts of 'bioconcentration' and 'bioaccumulation'.

Candidates' performance on this item was below expectations. Few candidates were able to identify 'bioconcentration' and 'bioaccumulation' as the two processes that were responsible for the concentration of heavy metals at the trophic levels.

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

Question 12

This question tested candidates' ability to interpret graphical data, analyse the impact of changing concentrations of a particular pollutant (P) and describe steps to be taken to monitor the concentration of this pollutant.

Candidates performed poorly on this item. Too few candidates were able to identify the pollutant and explain how changes in the concentration of pollutant P result in the changes in the dissolved oxygen concentration of the water.

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

PAPER 02

Module 1: Sustainable Agriculture

Question 1

This question assessed candidates' understanding of the features of sustainable agriculture and the need to practise sustainable agriculture in a named Caribbean country.

Candidates' performance on this question was satisfactory.

Question 2

This question assessed candidates' knowledge of environmental concerns associated with the practice of monoculture cropping in the Caribbean. In Part (b), candidates were required to recommend and justify alternative sustainable agricultural practices to address environmental concerns associated with monoculture.

Candidates performed very well on this question. The more able candidates provided good recommendations and justifications. More than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks.

Question 3

This question tested candidates' ability to interpret graphical data and to describe trends in fish harvesting in Part (a). In Part (b), candidates were required to explain how two features of aquaculture may have contributed to the trend illustrated in Figure 1. In Part (c), candidates were required to discuss two environmental concerns associated with the practice of aquaculture.

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.

Module 2: Sustainable Energy Use

Question 4

This question tested candidates' knowledge of the conventional generation of electricity. This was not a popular question. In Part (a), most candidates correctly identified the type of energy represented by Q3 and correctly stated the relationship among the magnitudes of Q1, Q2 and Q3.

Responses to the other parts of this question were poor. In Part (b), candidates were unable to describe the essential feature of the conventional process of generating electricity. In Part (c), few candidates were able to explain how the efficiency of the energy conversion process in this system can be increased. In Part (d), most candidates did not provide reasons **for** and **against** the country investing further in this method of generating electricity, as was required.

This was the least popular question in the paper. Candidates' responses were poor.

Question 5

This question tested candidates' knowledge of renewable energy sources, non-renewable energy sources and sustainable energy sources in Parts (a), (b) and (c). In Part (d), candidates were required to assess the feasibility of an energy source in terms of technological limitations, geographical restrictions and environmental impacts.

Candidates' performance in this question was satisfactory. Most candidates were able to distinguish between 'renewable energy sources' and 'non-renewable energy sources' and were able to identify sustainable energy resources. Candidates provided satisfactory responses when assessing the feasibility of the energy sources that were identified.

Question 6

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

Candidates' performance in this question was below expectation.

Few candidates correctly interpreted the quantity '60W' with reference to Bulb A and the majority of candidates were unable to use the information given for the three bulbs to explain the term 'energy efficiency'. Candidates also had difficulty explaining ways in which the large-scale use of the 'more energy efficient bulbs' could impact positively on the environment.

Module 3: Pollution of the Environment

Question 7

This question tested candidates' knowledge of the environmental pathways of pollutants and their ability to interpret data and analyse impact of pollutants.

Candidates' performance on this question was satisfactory. Most candidates who correctly identified the pollutants P and Q illustrated in the figure in Part (a) correctly stated the chemical formulae for the pollutants in Part (b); described the environmental impacts of acid rain in Part (c) and explained how one activity in a country could result in acid rain in Part (d).

Question 8

Part (a) of this question tested candidates' understanding of the terms water pollution and water pollutant. Part (b) tested candidates' knowledge of how the characteristics of a pollutant impacts on its concentration in a river system.

Candidates' performance on this question was poor.

Question 9

Part (a) of this question tested candidates' knowledge of the path of solar radiation through the atmosphere to the earth's surface. Most candidates correctly identified the layers **A** and **B** as the troposphere and stratosphere in the diagram. Part (b) examined candidates' comprehension of the chemical processes that occur during ozone destruction. Only a few able candidates correctly described the chemical processes occurring during ozone destruction in the stratosphere.

Part (c) tested candidates' knowledge of the effects of the destruction of the ozone layer on the health of humans. Part (d) required candidates to assess the risk that the populations of the Caribbean countries face as a result of the destruction of the ozone layer. The responses of many candidates suggest that there is confusion between the processes of global warming and ozone depletion. In Part (c), a few candidates correctly discussed the effect of the destruction of the ozone layer on the health of humans. In Part (d), candidates had difficulty assessing the risk that Caribbean countries face as a result of the destruction of the ozone layer.

Note:

The ozone layer is thinnest in areas over the Arctic and Antarctic regions. Countries at high latitudes such as Canada and Australia are at a greater risk of exposure to high levels of ozone. Caribbean countries are closer to the equator and are at low latitudes where the concentration of the ozone is normal and the risk of overexposure to UV radiation is low.

The release of chlorine and other halogen molecules that cause ozone destruction depends on the development of special types of polar clouds at very low temperatures. During the summer months in the presence of sunlight, the chemicals destroy the ozone. High temperature conditions in the Caribbean preclude the formation of free chlorine molecules.

Because Caribbean countries are located near the equator and receive high levels of incident solar radiation all year round, the risk of over-exposure to UV radiation is higher. Due to the higher melanin levels in most Caribbean populations, the risk for skin cancers is still lower than in other countries such as Australia and Canada.

Destruction of the ozone layer can cause terrestrial plants and marine photosynthetic organisms to be damaged and so reduce photosynthetic production. This may disrupt food webs and ecosystems and cause problems for Caribbean populations.

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 recommended that, where necessary, teachers and students access this document and familiarise themselves with the current 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 some not 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.

PAPER 03B

Generally, there was overall improvement in the depth and breadth of coverage with respect to certain areas of the syllabus. Greater effort must also be made to improve candidates' 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 annual production of Phillip's Farm from 1993 to 2007.

In Part (b), candidates were expected to discuss the trend in the

- (i) banana production between 1995 and 2007
- (ii) nitrate concentration from 1992 to 2007.

In Part (c), candidates were expected to discuss the evidence from the graph supporting the claim that the water quality of the Rio Minho has deteriorated.

Candidates performed very well in this question. Candidates demonstrated the ability to use information to plot graphs and then discuss trends shown by the graph. Most candidates possessed the depth of knowledge required to perform well on this question.

Question 2

In Part (a), candidates were required to identify the evidence from the graph indicating that the operations at Phillip's Farm were responsible for any deterioration in the water quality of the Rio Minho.

Part (b) required candidates to provide an explanation for the relationship between banana production and nitrate concentration in the river.

In Part (c), candidates were required to outline one possible environmental pathway of nitrates from the farm to the river and identify two other chemicals that were likely to travel the same pathway as nitrates.

Part (d) tested candidates' knowledge of changes that are expected in a river ecosystem due to changes in concentration of nitrates as illustrated in the given figure. They were expected to explain how the concentration of nitrates was responsible for the observed changes.

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

Question 3

In Part (a), candidates were required to outline five reasons why it was necessary to monitor the quality of water bodies.

In Part (b), candidates were asked to identify four parameters, excluding nitrates, which should be measured in a programme to monitor the water quality of the Rio Minho River and define any three of the parameters that were identified.

In Part (c), candidates were required to outline the procedure to test for ONE of the water quality parameters that were identified.

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 to test water quality parameters.